

XX International Symposium on Air Breathing Engines 2011

(ISABE 2011)

**Gothenburg, Sweden
12-16 September 2011**

Volume 1 of 3

ISBN: 978-1-61839-180-3

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 1801 Alexander Bell Drive, Reston, VA 20191, USA.

TABLE OF CONTENTS

Volume 1

Numerical Simulations of Unsteady, Multi-Phase Flows in Aero-Engine like Combustors	1
<i>Massimiliano Di Domenico, Patrick Le Clercq, Michael Rachner</i>	
Effect of Internal Two-Phase Flow on Effervescent Sprays	11
<i>Hrishikesh Gadgil, B. N. Raghunandan</i>	
Effect of Combustor Geometry on the Performance of an Airblast Atomizer under Sub-Atmospheric Conditions	19
<i>Ahad Mehdi, Vassilios Pachidis, Riti Singh, Pavlos Zachos, N. Grech</i>	
Numerical Investigation of Reacting Spray in a Lean Direct Injection Combustor	26
<i>Dipanjay Dewanji, Mathieu Pourquie, Arvind G. Rao, J. P. Van Buitenen</i>	
Investigations of a Combustor Using a 9-Point Swirl-Venturi Fuel Injector: Recent Experimental Results	38
<i>Robert C. Anderson, Christopher M. Heath, Yolanda R. Hicks, Kathleen M. Tacina</i>	
Development of a Lean Direct Injection Fuel Nozzle for Small Aircraft Engines	48
<i>Atsushi Horikawa, Masayoshi Kobayashi, Takeo Oda, Hideki Ogata</i>	
Assessment and Improvement of Engineering Simulation for Multiphase Turbulent Combustion in a Lean Direct Injection Combustor	55
<i>Nan-Suey Liu</i>	
Numerical Simulation and Validation of a Spray Combustion Field in a Scaled Sector Model for a Jet Engine Combustor	66
<i>Fumiteru Akamatsu, Satoru Komori, Ryoichi Kurose, Hideki Moriai</i>	
V-Gutter Stabilized Turbulent Premixed Flame and Lean Blowout	71
<i>Alejandro Briones, Balu Sekar, Hugh Thornburg, K. Granlund</i>	
Modeling of a Premixed Propane Flame behind a Triangular Bluff Body Using SAS-SST Model and an Optimized Two-Step Global Reaction Mechanism	83
<i>Lars-Erik Eriksson, Bernhard Gustafsson, Erik R. Johansson</i>	
Time Domain Modeling of Screech-Damping Liners in Combustors and Afterburners	93
<i>Lars-Erik Eriksson, Guillaume Jourdain</i>	
Effects of Mixing Section Geometry on the Combustion Instability Characteristics in a Dump Shape Combustor	104
<i>Min-Ki Kim, Seongsoon Park, Jisu Yoon, Youngbin Yoon</i>	
Flame Stabilization Studies in a Three Backward Facing Step Configuration Based Microcombustor with Premixed Methane-Air Mixtures	116
<i>Bhupendra Khandelwal, Karamveer S. Kumar, Anil A. Deshpande, Sudarshan Kumar</i>	
Influence of Flow Behavior in the Combustor on Combustion Instabilities Performance Operating on Homogeneous Fuel-Air Mixtures	123
<i>A. N. Doubovitsky, E. D. Sverdlov, Georgy K. Vedeshkin</i>	
Hydrogen Premix Combustion: Numerical and Experimental Analysis	129
<i>Jarno Brunetti, Alessandro Cappelletti, Francesco Martelli, Giovanni Riccio</i>	
Numerical Investigations of Thermoacoustic Instability in Gas Turbine Combustion Chambers Hydrogen Fired	139
<i>Alessandro Marini, Francesco Martelli, Giovanni Riccio</i>	
Single Annular comBustor for Emissions Reduction: Technology Development for Small Engines	150
<i>Rudy Dudebout, Sunil James</i>	
CFD Investigation of Swirl-stabilized Flexi-fuel Burner Using Methane-air Mixture for Gas Turbines	160
<i>Abdallah Abou-Taouk, Lars-Erik Eriksson, Ivan R. Sigfrid, Ronald Whiddon</i>	
Reacting Flow Simulation of a Small Gas Turbine Engine with Various Injecting Conditions	173
<i>Inseuck Jeung, Seihwan Kim</i>	
Development of Rich-Lean Type Full Annular Combustor for Small Aircraft Jet Engine in JAXA TechCLEAN Project Through Both Experimental and Analytical Researches	181
<i>Yoji Kurosawa, Mitsumasa Makida, Kazuo Shimodaira, Hideshi Yamada</i>	
Combustion and Thermo-fluid Characteristics of Hydrogen Fueled and Propane Fueled Ultramicro Combustors for UMGТ	191
<i>Takeshi Fueda, Yohei Ono, Takashi Sakurai, Saburo Yuasa</i>	
Transpiration Cooling Modelling for Ceramic Combustion Chambers	198
<i>F. Cheuret, T. Langener, Johan Steelant, J. V. Wolfsdorf</i>	

Colorless Distributed Combustion for Ultra Low Emission Gas Turbine Applications	208
<i>Ashwani K. Gupta, Ahmed E. E. Khalil</i>	
Ignition Performance Improvement in a Modern Gas Turbine Combustor	217
<i>Oleskiy Antoshkiv, Imon Bagchi, Sebastian Bake, Heinz-Peter Berg</i>	
Experimental Results Showing the Internal Three-component Velocity Field and Outlet Temperature Contours for a Model Gas Turbine Combustor	226
<i>G. I. Mahmood, J. P. Meyer, Bronwyn Meyers, T. H. Roos, G. C. Snedden</i>	
A Numerical Study of Flame Dynamics in an Annular Combustor with Multiple Swirl Injectors	241
<i>Jong-Chan Kim, Hong-Gye Sung, Vigor Yang, Kwang-Hee Yoo, Li Na Kim</i>	
Numerical and Experimental Investigation of Swirling Flows and Flames Generated Through a Multi-swirl Fuel Injector	251
<i>P. Iudiciani, C. Duwig, R. Z. Szasz, L. Fuchs, S. M. Hosseini, E. J. Gutmark</i>	
Lowering Low NO_x Combustor Stability Limits by Radicals Injection	261
<i>Yeshayahou Levy, Vladimir Erenburg, Valery Sherbaum, Vitaly Ovcharenko, Leonid Rosentsvit, Boris Chudnovsky, Amiel Herszage, Alexander Talanker</i>	
The Numerical Generation of an Ignition Map by Means of a Turbulent Flame Speed Closure Approach for the Configuration of a Jet Flame	269
<i>J. M. Boyde, M. Van Hove, M. Di Domenico, M. Aigner</i>	
A Design Methodology of a High Hub-to-Tip Ratio Compressor for Low Speed Research Using CFD Analysis	282
<i>Uttam Keripale, Snehal Nimje, A. M. Pradeep, Bhaskar Roy</i>	
An In-Depth Flow Measurement in a Four-Stage Large Scale Low-Speed Research Compressor	293
<i>Jun Hu, Liqun Ruan, Yingfeng Wang, Zhiqiang Wang</i>	
A Method to Determine the Effectiveness of Detergents for Gas Turbine On-line Compressor Washing	302
<i>Dimitrios Fouflias, Paul Lambart, Pericles Pilidis, Uyioghosa Igie, Ken Ramaden</i>	
Numerical Investigation of Effects of an Airfoil-Probe on the Flow Field in an Axial Compressor Stator Cascade	315
<i>Xiang He, Hongwei Ma, Minglin Ren, Honghui Xiang</i>	
Stability Enhancement of a Low Speed Axial Compressor with Tip Injection	324
<i>Shin-Hyoung Kang, Hyung-Soo Lim, Seung-Jin Song, Soo-Seok Yang</i>	
Experimental Investigation of Advanced Multistage Casing Treatments in a 2.5 Stage High Pressure Compressor Test Rig	334
<i>Sven-Jürgen Hiller, Peter Jeschke, Tobias Kroekel</i>	
Influence of Inlet Guide Vane Wakes on Performance and Stability of a Transonic Compressor	344
<i>Christoph Biela, Christoph Brandstetter, Felix Holzinger, Heinz-Peter Schiffer</i>	
FRAP Measurements in a Stability Enhanced High Pressure Compressor	355
<i>Jürgen Gründmayer, Sven-Jürgen Hiller, Martin Stadlbauer</i>	
Prediction of Boundary Layer Transition in a High Turning Cascade at Supercritical Flow Conditions	364
<i>Heinz Hoheisel, Dragan Kozulovic, Udo Stark</i>	
Design of Integrated Turning Vanes for a Compressor Transition Duct	379
<i>Peter Johansson, Thomas Robertsson, Fredrik Wallin</i>	
Numerical Investigation of the Effect of Part-span Sweep and Dihedral on the Performance of a Low-speed, High Hub-tip Ratio Axial Compressor Blade	387
<i>A. M. Pradeep, C. Rohan, R. Roy</i>	
Flow Behaviors in Vaneless Diffuser under Rotating Stall	397
<i>Kyung Jun Kang, You Hwan Shin, Yoon Pyo Lee</i>	
Effect of Inlet Distortion on Forward Swept Fan Rotors	403
<i>Aspi R. Wadia</i>	
Increased Capacity Fan Demonstrator for a Volvo RM12 Upgrade	415
<i>Hans Mårtensson, Torbjörn Salomonson, Pieter Groth, Gunnar Högström</i>	
Study of Near-Stall Flow Behavior in a Modern Transonic Fan with Composite Sweep	425
<i>Chunill Hah, Hyun-Woo Shin</i>	
Proof of Concept of a Mechanical Active Clearance Control System	436
<i>Wolfgang Horn, Michael Kern, B. Loy, Stephan Staudacher</i>	
PIV-Measurements in a Transonic Compressor Test Rig with Variable Inlet Guide Vanes	448
<i>Christoph Biela, Christoph Brandstetter, Martin Kegalj, Heinz-Peter Schiffer</i>	
Back to Back Comparison of a Casing Treatment in a High Speed Multi-Stage Compressor Rig Test	459
<i>Frank Heinichen, Erik Johann</i>	
A New Aerodynamic Design Concept for Transonic Swept Fan Outlet Guide Vanes	470
<i>Toshiyuki Arima, Markus Olhofer, Giles Endicott, Toyotaka Sonoda</i>	

Aerodynamic Analysis of Rotor/Stator Interaction Based on Immersed Boundary Method	478
<i>Lin Du, Xiaofeng Sun</i>	
CFD Validation of a High Speed Transonic 3.5 Stage Axial Compressor	486
<i>Lars Ellbrant, Lars-Erik Eriksson, Hans Mårtensson</i>	
Multifrequent Harmonic Balance Computations for a Multistage Compressor	499
<i>Guillaume Dufour, Thomas Guédene, Frédéric Sicot</i>	
An Unsteady Overset Grid Method for the Simulation of Compressors with Non-Circumferential Casing Treatments	510
<i>Lionne Castillon, Guillaume Legras</i>	
Comparison of Chimera and Sliding Mesh Techniques for Unsteady Simulations of Counter Rotating Open-Rotors	520
<i>Benjamin Francois, Michel Costes, Guillaume Dufour</i>	
Optimization and Examination of a Counter Rotating Fan Stage - The Possible Improvement of the Efficiency Compared with a Single Rotating Fan	530
<i>Timea Lengyel, Eberhard Nicke, Klaus-Peter Rüd, Reinhold Schaber</i>	
Development Study on Counter Rotating Fan Jet Engine for Supersonic Flight	541
<i>Kazuyuki Higashino, Daiki Kato, Ryojiro Minato, Nobuhiro Tanatsugu</i>	
Investigation of the Unsteady Flow in an Counter-Rotating Compressor Using the Nonlinear Harmonic Method	548
<i>Bo Liu, Lei Wang, Qingwei Wang, Xiaorong Xiang</i>	
Stall Development in a Centrifugal Compressor: Computational and Experimental Investigation	559
<i>Mohamed Ashraf, L. Fuchs, Ephraim Gutmark, Fredrik Hellstrom, Matthieu Gancedo, Erwann Guillou</i>	
Numerical Studies on the Effect of Impeller Cone Angle on Aerodynamic Performance of Mixed Flow Compressors	569
<i>Md. Musheer Basha, Q. H. Nagpurwala, C. S. Bhaskar Dixit, Ananthesha, S. Ramamurthy</i>	
Modeling and Optimization of the Impeller Fillet in Centrifugal Compressor	579
<i>Kun He, Zhirong Lin, Xin Yuan</i>	
Optimization of High Speed Centrifugal Compressor for the 100kW Micro Gas Turbine	587
<i>Hongliang Wang, Guang Xi, Zhiheng Wang</i>	
Comparison of Different Numerical Approaches at the Centrifugal Compressor RADIVER	595
<i>Oliver Borm, Hans-Peter Kau, Balint Balassa</i>	
Comparison of Coupling Analysis of Fluid-Structure Interaction with Engineering Empirical Formula on Typical Stages of a Compressor	606
<i>Peng Sun, Yang Yu, Xiaohui Zhang, Jingjun Zhong</i>	
TurboVib - A Swedish Research Initiative Addressing Turbomachinery Vibratory Phenomena	615
<i>Ronnie Bladh, Hans Mårtensson, Damian Vogt</i>	
IBR Resonant Response by Vane Clocking	627
<i>Sanford Fleeter, Yoon S. Choi</i>	
Numerical Analyses of Flutter Characteristics of Titanium and Composite Fan Rotor Blade	637
<i>Daisaku Masaki, Junichi Kazawa, Toshio Nishizawa</i>	
Use of Fluid-Structure Interaction to Estimate Fatigue Life of Gas Turbine Compressor Blades	647
<i>Priyanka Dhopade, Andrew Neely, Krishnakumar Shankar, John Young</i>	
Multicriteria Optimization of Conceptual Compressor Aerodynamic Design	655
<i>Tomas Grönstedt, Egill Thorbergsson</i>	
Euler-Lagrange Method for Numerical Simulation of Water Droplet-Laden Compressor Flow	662
<i>Franz Joos, Catharina Storm</i>	
Gas Turbine Engine Elements Systematic Improvement on the Base of Inverse Problem Concept by Stochastic Optimization Methods	673
<i>Victoria Afanasjevska, Andrij Myenyaylov, Aleksej Tronchuk, Mykhaylo L. Uglyumov</i>	
Aerodynamic Design of the Core Duct System for an Intercooled Aero Engine	682
<i>Jonathon F. Carrotte, Gavitha S. Regunath, Andrew M. Rolt, Duncan Walker, Paul A. Denman</i>	
Aerodynamic Design of the Cooling Flow Duct System for an Intercooled Aero Engine	691
<i>Chris A'Barrow, Jonathon F. Carrotte, Andrew M. Rolt, Duncan Walker</i>	
Rim-Rotor Rotary Ramjet Engine (R4E): Design and Experimental Validation of a Proof-of-Concept Prototype	699
<i>Mathieu Picard, Jean-Sébastien Plante, David Rancourt</i>	
Numerical Research of the Ram-rotor with Tip Clearance	710
<i>Ji'Ang Han, Ling Yang, Jingjun Zhong</i>	
Project SAGE3: Towards Cleaner Quieter Turbofans	717
<i>Mark N. Pacey, Antonia Peace</i>	
SAGE 4 Geared Turbofan Demonstrator	727
<i>Klaus Stegmaier, Edurne Carpintero Rogero, Patrick Yves Wackers</i>	

SAGE 5 Cleansky's Approach to Greener Helicopter Turboshafts	736
<i>E. Bouty, B. Chefel-Py, G. Paty</i>	
PROJECT SAGE2: Enabling Open Rotor Technologies	742
<i>Brigitte Bittar, Denis Bocquet, Michel Desaulty, Marc Doussinault</i>	

Volume 2

SAGE1 Demonstrator: Enabling Open Rotor Technologies.....	752
<i>Uwe Füß, A. B. Parry</i>	
Installation Effects of a CROR Propulsion System on a Modified DLR-F6 Aircraft Configuration	764
<i>Carsten Clemen, Carlos O. Márquez, Arne Stürmer</i>	
Application of the Open Rotor in a Box Wing Aircraft: A Feasibility Study	775
<i>R. F. C. Quintero, Howard Smith, Ravinka Seresinhe</i>	
An Open Rotor Test Case: F31/A31 Historical Baseline Blade Set	786
<i>David Elliott, John Gazzaniga, Dale E. Van Zante, Richard Woodward</i>	
Conceptual Design Study of an Advanced Technology Open-Rotor Propulsion System.....	797
<i>Douglas R. Thurman, Michael T. Tong, Mark D. Guynn</i>	
Design of the New Variable Cycle Engine Based on CFM56-5C2 with Reduced Environmental Effects	806
<i>S. A. Ciepanove, Amirreza Sheikh Movaghah</i>	
Advanced 3-shaft Turbofan Concepts and Technology: The Trent XWB and Beyond.....	815
<i>Ian Rainbow, John Whurr</i>	
Mission Optimisation of the Geared Turbofan Engine	831
<i>Richard Avellán, Tomas Grönstedt, Linda Larsson</i>	
Advanced Propulsion Systems for Next Generation Commercial Aircraft	838
<i>Frank Noppel</i>	
Mission Analysis of an Inter-turbine Burning Turbofan Engine.....	846
<i>Richard Avellán, Tomas Grönstedt</i>	
Analysis of an Intercooled Recuperated Aero-engine.....	857
<i>Tomas Grönstedt, Konstantinos Kyprianidis, Lei Xu</i>	
Feasibility Study on Intercooled Turbofan Engines	866
<i>Toshio Nagashima, Koji Okamoto, Tetsuya Shinmyo, Susumu Teramoto</i>	
Thrust Increase for the RM12 Engine	875
<i>Roger Hillerbo, Torbjörn Salomonson</i>	
Transient Simulations During Preliminary Conceptual Engine Design.....	884
<i>Joachim Kurzke</i>	
Advanced Numerical Modeling and Simulation of Secondary Air Systems	894
<i>Jean Francois Caron, Charles Faubert</i>	
Steady-state and Transient Performances Simulation of Large Civil Aircraft Auxiliary Power Unit	911
<i>Juanjuan Cheng, Jun Hu, Tieying Wu, Yunsheng Zhao</i>	
Development of a Micro Turboprop for High Altitude UAV Propulsion	921
<i>Steve Armfield, Jack Ling, D. Verstraete, K. C. Wong</i>	
Control System Modifications and their Effects on the Operation of a Hydrogen-Fueled Auxiliary Power Unit.....	929
<i>Sebastian Börner, Fabian Falk, Harald Funke, Patrick Hendrick</i>	
Advanced Aero Engine Families in the Power Range of 30 kW - 500 kW	939
<i>Heinz Peter Berg, Thanapol Poojitanont, Yves Reichel, Axel Himmelberg</i>	
Hydrogen Fueled Precooled Airbreathing Engines for Hypersonic Aircraft and Spaceplanes	948
<i>P. Hendrick, D. Verstraete</i>	
Improved Performance Assessment of a Precooled Turbofan for Hypersonic Vehicle Acceleration.....	955
<i>P. Hendrick, D. Verstraete</i>	
Variable Bypass Ratio Engine Cycle Using Small Fan Devices	963
<i>Hisao Futamura, Takuya Mizuno, Takeshi Tagashira</i>	
Research on Ejector-Jet Mode of Rocket-Ramjet Combined-Cycle Engine.....	970
<i>Susumu Hasegawa, Tetsuo Hiraiwa, Kouichiro Tani, Shuichi Ueda</i>	
Air Turbo Rocket Turbomachinery Design	980
<i>Michael Joly, Guillermo Paniagua, Tom Verstraete, R. Maffulli, V. Fernandez-Villace</i>	
Current Status of Researches of the Combined Cycle Engine at JAXA	988
<i>Tetsuo Hiraiwa, Kamenori Kato, Kouichiro Tani, Sadatake Tomioka</i>	
Conceptual Design Study on Rocket Based Combined Cycle Engine	996
<i>Sang-Hun Kang, Yang-Ji Lee, Daesung Lee, Soo-Seok Yang</i>	

Closed System of Thermodynamic Coordinated Conservation Laws in Working Process Theory of High Temperature Turbojet Engines.....	1003
<i>M. Ja. Ivanov</i>	
Integrated Propulsion and Airframe System Modeling and Analysis for a Truss-Braced Wing Configuration.....	1012
<i>Kyungsoon Lee, Dimitri N. Mavris, Taewoo Nam, Christopher Perullo, Joseph A. Schetz</i>	
In Flight Thrust Estimation for Future Fighter Engines.....	1022
<i>Mattias Henriksson</i>	
Turboelectric Distributed Propulsion in a Hybrid Wing Body Aircraft.....	1029
<i>Gerald V. Brown, Julio Chu, James L. Felder, Hyun Dae Kim</i>	
A Novel Hybrid Engine Concept for Aircraft Propulsion.....	1049
<i>Arvind G. Rao, J. P. Van Buitenen, Feijia Yin</i>	
Countering the Environmental Penalties of Increasing Air Traffic by Means of Active Core Technologies.....	1059
<i>Wolfgang Sturm</i>	
A New Method for Measuring Energy Intensity during Commercial Flight Missions.....	1069
<i>Deborah Mitchell, Henrik Ekstrand, Ulrika Ziverts</i>	
Sustainability-Driven Product Development - Some Challenges and Opportunities for Aero Industry.....	1079
<i>Sophie Hallstedt, Anthony W. Thompson</i>	
Particulate Size Distribution of Exhaust Gases for a Micro Gas Turbine Jet Engine	1089
<i>Hu Li</i>	
Perspectives of Application of the Solid Oxide Fuel Cells in Jet Engines for Civil Aircrafts	1097
<i>A. V. Baykov, V. V. Raznoschikov, L. S. Yanovskiy</i>	
ELECTERA - A Step towards the Development of a Techno Economic Risk Analysis Scheme for Future Electric Aircraft	1107
<i>Georgios Doulgeris, Huw Edwards, Amir S. Gohardani, Riti Singh</i>	
SWAFEA: A European Study the Feasibility and Impact of the Introduction of Alternative Fuel in Aviation	1116
<i>Philippe Novelli</i>	
Aerodynamic and Aeroacoustic Performance of Ultra Low Count Fan Outlet Guide Vanes.....	1127
<i>Mattias Billson, Sofia Ore, David Carlsson</i>	
Higher Order Moment Analysis of Jet Noise	1135
<i>Duck Joo Lee, T. J. Sarvothama Johti, K. Srinivasan</i>	
Active Control of Fan Noise at Various Rotational Speeds.....	1141
<i>Nobuhiko Yamasaki, Yutaro Suzuki, Takeshi Nakagawa, Yuzo Inokuchi</i>	
Prediction of Fan Tonal Noise at Far-field with Rotor-Stator Interaction Effect	1152
<i>Hidekazu Kodama, Shinya Kusuda, Masanobu Namba, Naoki Tsuchiya</i>	
A Blended Length Scale for Fine-Scale Turbulence Jet Noise Prediction.....	1162
<i>Xiadong D. Li, X. H. Xu, W. R. Shao</i>	
Jet Noise Scaling of a Precooled Turbojet Engine Utilizing a Hydrogen Rich Combustion Afterburner	1169
<i>Mikiya Araki, Takauki Kojima, Takayuki Sano, Hideyuki Taguchi</i>	
Computational and Experimental Study of Supersonic Turbojet Noise Reduction.....	1179
<i>Markus Burak, Lars-Erik Eriksson, Ephraim Gutmark, Erik Prisell, David Munday, Dan Cappoletti, Michael Perrino</i>	
Aero-Engine Volcanic Ash Related Research: An Overview of Work Carried Out in The Newac Work Package.....	1191
<i>Salvatore Colantuoni, John Nicholls, Paul A. Sellers</i>	
Limitations on Tube Filling in a Pulse Detonation Engines	1200
<i>Lars-Erik Eriksson, Tomas Grönstedt, Mohammad Irannejad</i>	
Investigation of Gasdynamic Flow Structure in Pulse Detonation Tube with External Co-flow	1211
<i>D. I. Babushenko, A. A. Evstigneev, V. I. Kopchenov, P. S. Kuleshov, A. M. Starik, N. S. Titova</i>	
On Plasma Dynamic Aspects of Detonation and Burning Processes Simulation.....	1222
<i>M. Ja. Ivanov, A. V. Malinin, Yu. L. Serov, L. V. Terentieva</i>	
R&T Effort on Continuous Detonation Wave Concept at MBDA	1230
<i>Francois Falempin, Bruno Le Naour, Flore Miquel</i>	
Development of a Lab-Scale Gel Fuel Ramjet Combustor.....	1237
<i>Doron Har-Lev, Alexander Kuznetsov, Benveniste Natan, Yair Solomon</i>	
Experimental Study of Subsonic and Supersonic Combustion Modes in Aluminized Solid Fuel Ramjet.....	1247
<i>Alon Gan, Shimon Saraf</i>	
Experimental Study on Combustion Characteristics in a Kerosene Fueled Scramjet.....	1255
<i>Meng Ding, Weidong Liu, Jianguo Tan, Yi Wang, Zhenguo Wang</i>	

Ignition and Agglomeration Characteristics of Porous Aluminum Powders	1262
<i>Alon Gany, Valery Rosenband, Yaron Yavor</i>	
Research on Ignition Process of Ramjet with Cavity-based Flameholder	1268
<i>Qing Li, Yu Pan, Jianguo Tan, Zhenguo Wang</i>	
Recent Training Group GRK 1095/2: Aero-Thermodynamic Design of a Scramjet Propulsion System.....	1274
<i>Uwe Gaisbauer, Bernhard Weigand</i>	
Multi-objective Design Optimisation of Axisymmetric Scramjet Nozzle and External Components Considering Static Stability by Using Surrogate-assisted Evolutionary Algorithms	1286
<i>Russell R. Boyce, Laurie Brown, Hideaki Ogawa, Tapabrata Ray</i>	
French Contribution to the Development of High-Speed Airbreathing Propulsion Technology	1300
<i>François Falempin</i>	
Experimental Investigation of an Axisymmetric Scramjet at Various Dynamic Pressures and Angles of Attack	1312
<i>Russell R. Boyce, Dillon Hunt, A. Paull</i>	
Pressure-Scaling of Inlet-Injection Radical - Farming Scramjets	1322
<i>Russell R. Boyce, Tim McIntyre, Fabric Schloegel, Sandy C. Tirtey</i>	
Effect of Cavity Width on Supersonic Flow Over Three Dimensional Cavities	1333
<i>Rajarshi Das, Jop Kurian</i>	
The Study on Coolant Flow and Heat Transfer along the Cooling Channels in Scramjet	1343
<i>Jin Jiang, Jialing Le, Ruoling Zhang, Guozhu Zhao, Weixiong Liu, Yang Yang</i>	
Comparison of Effectiveness in Ignition Enhancement in Air-breathing Engine between Thermal and Non-thermal Plasma	1351
<i>Pierre-Edouard A. A. Bossard, Yoshinori Matsubara, Kenichi Takita, Takamasa Yamamoto</i>	
Experimental Investigations of the Scramjet Combustor Performance at Various Equivalence Ratios.....	1359
<i>K. Vijayanand, A. Rolex Ranjith, Vikrant Satya, C. Chandrasekhar, V. Ramanujachari</i>	
Ignition Enhancement by Using Nonequilibrium Plasma in Supersonic Flow	1363
<i>Yoshinori Matsubara, Megumu Okazaki, Kenichi Takita, Takamasa Yamamoto</i>	
Multidisciplinary Design and Optimization of Hypersonic Glider with Scramjet Propulsion.....	1368
<i>Meng Ding, Liang Jin, Shinbin Luo, Xianyu Wu</i>	
Numerical Investigations of Unsteady Spray Combustion in a Liquid Kerosene Fueled Scramjet.....	1375
<i>Jialing Le, Xiyao Wang, Shunhua Yang</i>	
Turbulence Induced by Transvers Injection and Pseudo-Shock Wave in Supersonic Flow	1384
<i>Byonil Choi, Toshinori Kouchi, Goro Masuya, Koichi Takae</i>	
Detached-Eddy Simulation of Cavity Flame-holding in Supersonic	1391
<i>Shuaishuai Guo, Tian Wan, Lihong Chen, Xinyu Chang</i>	
Experimentally Investigation on the Combustion Oscillation in a Model Scramjet Engine	1401
<i>Jianhan Liang, Weidong Liu, Jianguo Tan, Zhenguo Wang, Pan Yu, Jing Lei</i>	
Experimental Investigation of Liquid Fuel Injection and Mixing in Supersonic Flow	1410
<i>Linfeng Liu, Xuesong Ma, Riheng Zheng</i>	
Spray Structure and Primary Atomization Characteristics of Liquid Jets in Supersonic Crossflows.....	1420
<i>Liang Chen, Jialing Le, Shunhua Yang, Wei He</i>	
Vitiation Effects on Performances of Hydrocarbon-Fueled Supersonic Combustor	1428
<i>Lingyun Hou, Xuesong Ma, Jin Yang, Wei Liu</i>	
Numerical and Theoretical Study of Supersonic Turbulent Non-Premixed Flames.....	1434
<i>Claudio Bruno, Donato Cecere, Eugenio Giacomazzi, Antonella Ingenito, L. Romagnosi</i>	
Flow Features of Dual-hole Injection in Supersonic Flow	1442
<i>Lihong Chen, Hongbin Gu, Tian Wan, Zhe Wei</i>	
Design and Development of Kerosene Heating System for Supersonic Combustion Studies	1447
<i>V. Ramanujachari, V. Satya, A. Singh</i>	
A New Ignition System for SCRAM Jet Engine	1455
<i>Shigeo Obata</i>	
Development and Testing of Advanced Surface Coolers for Aero Engines	1465
<i>Denis Bajusz, Jacques Charlier, Nicolas Heintz, Patrick Hendrick, N. Rainackers</i>	
Design, Development, Fabrication and Testing of a Microchannel Heat Exchanger for Aircraft Thermal Management Systems	1476
<i>Zia Mirza, Andrew Pineda, Hal Strumpf</i>	
Compact Heat Exchangers for Intercooled Turbofan Engines	1485
<i>Kenichiro Fukui, Yoshifumi Kawakami, Koji Okamoto, Tetsuya Shinmyo</i>	
Flow and Heat Transfer Characteristics Past Multiple Tube Banks: A Numerical Investigation.....	1491
<i>M. Abdel-Raouf, Mahmoud Galal, Essam E. Khalil</i>	
The Lightweight Integration of Intercoolers to the Turbofan Engine.....	1498
<i>Dennis Jacobsson, Anders Lundbladh, Martin Nilsson, Sofia Ore, Andrew Rolt</i>	

LCF Analysis of Welds	1507
<i>Tomas Måansson</i>	

Volume 3

Predicting Creep and Stress Rupture Failures in Aircraft Turbine Components Using 3D FEA	1513
<i>Viswa Bhattachar</i>	
3D Fatigue Crack Growth Prediction of Web Forging Flaws of a Turbine Disc	1523
<i>Jian Hou, Ron Westcott</i>	
Impact Analysis on Aero-Engine Performance Parameter Variation on Hot Section's Creep Life Using and Creep Factor Approach	1532
<i>M. F. Abdul Ghafir, Y. G. Li, L. Wang, W. Zhang</i>	
Structural Optimization Approach for Complex Turbofan Structures with Simultaneous Requirement Fulfilment	1545
<i>Daniel Borovic, Lars-Olof Hellgren</i>	
Temperature Effect on Fracture Toughness of Atmospheric Ice Accreted on a Typical Fan Blade Material	1554
<i>David Hammond, Marie-Laure Pervier, Alexandros Terzis</i>	
Light Weight Design of Composite Fan Guide Vanes with Hail Impact Threats	1563
<i>Niklas Jansson, Rickard Juntikka, Erik Olsson</i>	
Aircraft Turbine Engines and Helicopter Gearboxes Wear Debris Morphology via Analytical Ferrograph	1570
<i>Stanislav Slacik</i>	
Enabling Technologies for Fabricated Turbofan Engine Structures	1579
<i>Kent Holmedahl, Fredrik Kullenberg, Anders Sjunnesson</i>	
Automated Design of Aero Engine Structural Components: A Modular Approach that Enables Re-Use of Generative Engineering Methods	1588
<i>Ola Isaksson, Peter Thor</i>	
Separation of Geometrical and Defect Information in Digital Radiograms Using Wavelet Filter Techniques	1594
<i>Erik Lindgren, Håkan Wirdelius</i>	
Constitutive Modelling of Plastic and Creep Behaviour of the Nickel Base Superalloy Allvac® 718Plus® under Heat Treatment Conditions	1603
<i>Thomas Giersch, Arnold Kühhorn, Georg Rauer, Marcel Springmann</i>	
Visual Production - Strategic Manufacturing System Development Tools for Aerospace Industry	1613
<i>Björn Johansson, Johan Stahre, Johan Vallhagen</i>	
New Manufacturing Techniques for New Engine Component Designs	1623
<i>Erwin Bayer, Martin Bussmann, Klaus-Peter Rüd</i>	
Simulating a Chain of Manufacturing Processes for Prediction of Component Properties	1632
<i>Bijish Babu, Corinne Charles, Lars-Erik Lindgren, Andreas Lundback</i>	
Manufacturing of a Highly Twisted (Axial) Fan Rotor Blade Using a 3 Axes CNC Milling Machine	1644
<i>B. B. C. Kumar, K. Sampath, T. Samson Prabu, M. N. Varadarajan</i>	
Robustness in Aerospace Components Manufacturing and Fabrication - A Case Study	1651
<i>Johan Lööf, Rikard Söderberg, Johan Vallhagen, Kristina Wärmefford</i>	
Multidisciplinary Robustness Evaluations of Aero Engine Structures	1657
<i>Anders Forslund, Ola Isaksson, Johan Lööf, Rikard Söderberg</i>	
Geometry Control of Laser Metal Deposition for the Manufacture of Complex Structures in the Aero Industry	1666
<i>Anna-Karin Christiansson, Almir Heralic, Torbjörn Norlander, Mattias Ottosson</i>	
Active Vibration Damping of Engine Rotor Considering Piezo Electric Self Heating Effects	1675
<i>Christian Kaletsch, Robert Köhler, Markus Marszolek, Stephan Rinderknecht</i>	
Prediction and Measurements of Structural Damping of Compressor Blades Treated by Hard Coating	1686
<i>Leif Kari, Jia Sun</i>	
An Advanced Heat Analysis of Turbine Blades with Transition Modeling	1695
<i>L. Yu Gomzikov, V. G. Latyshev, Aleksey M. Sipatov</i>	
Assessment of Uncertainties in Modeling the Laminar to Turbulent Transition for Predicting the Heat Transfer Distribution on a Turbine Guide Vane	1710
<i>Rene Pecnik, Jeroen A. S. Witteveen</i>	
Numerical Investigation of Diffused Double-Jet Film-Cooling Geometry	1720
<i>Fei Tang, Wensan Wang, Jianzhong Xu</i>	

Turbine Shroud Durability Analysis Using Time Unsteady CFD and Si-C Testing	1731
<i>Jong Liu, Malak Malak, Jorge L. Rosales, Ed Zurnehly</i>	
Investigation of High Pressure Turbine End-Wall Film Cooling Performances under Realistic Inlet Conditions	1740
<i>Magnus Jonsson, Francesco Martelli, Luca Ottanelli, Simone Salvadori, Peter Ott</i>	
Effect of Blowing Ratio on Film Cooling Effectiveness of Cylindrical and Shaped Holes.....	1751
<i>Ahmed S. Al-Adawy, Essam E. Khalil, Samy M. Morcos</i>	
Experimental Investigation of Turning Mid Turbine Frame Designs.....	1763
<i>Emil Göttlich, Martin Hoeger, Cornelia Santner, Fredrik Wallin</i>	
Effects of Inlet Flow Conditions on the Flow Development in an S-shaped Inter-Turbine Duct.....	1774
<i>Shuzhen Hu, Edward Vlasic, Xue Feng Zhang, Yanfeng Zhang</i>	
Aero-design and Validation of a Turning Mid Turbine Frame	1786
<i>Emil Göttlich, Sofia Ore, Cornelia Santner, Fredrik Wallin</i>	
Improvement of the Flow Characteristics by Optimizing the Leading-Edge and the Junction Region Shape around Airfoil/Flat-Plate	1800
<i>Jongjae Cho, Jinhan Kim, Kuisoon Kim, Jaye Koo</i>	
Numerical Investigation into the Unsteady Effects of Non-Axisymmetric Turbine Endwall Contouring on Secondary Flows	1810
<i>Dwain Dunn, Glen Snedden, Theodor W. Von Backstrom</i>	
Influence of the Root Fillet on the Aerodynamic Performance and Flow Pattern of An Axial Turbine Rotor	1818
<i>Meining Chen, Ying Piao, Dalei Wang</i>	
Low-Pressure Turbine End Wall Design Optimisation and Experimental Verification in the Presence of Purge Flow	1825
<i>Reza S. Abhari, Markus Brettschneider, Philipp Jenny, Martin G. Rose, J. Gier, K. Engel</i>	
Aerodynamic Design of a Vaneless Counter-Rotating Turbine with Low Load-Coefficient.....	1836
<i>Jiafei Qiao, Jianzhong Xu, Qingjun Zhao</i>	
Measurements of Rim Seal Mixing Processes in an Axial Two Stage Turbine.....	1843
<i>Alexander Krichbaum, Claudius Linker, Heinz-Peter Schiffer, Sebastian Schrewe</i>	
Integrated Design of Rotor Leading Edge and Cavity Flows in an Axial Shrouded Turbine	1852
<i>Konstantinos G. Bampalias, Reza S. Abhari, Anestis I. Kalfas, Naoki Shibukawa, Takashi Sasaki</i>	
Experimental and Numerical Investigation of Blade Row Spacing Effects in a 1.5 Stage Turbine Rig under Off-Design Operating Conditions.....	1862
<i>Mirko Restemeier, Jens Niewoehner, Peter Jeschke, Yavuz Guendogdu, Karl Engel</i>	
Application of Transition Modelling in CFD for Use with Turbine Blades.....	1873
<i>Dwain Dunn, Thomas Hildebrandt, Thomas Roos, Glen Snedden</i>	
Small Aeroengine Turbine Design Concept and Problems	1880
<i>A. Karpenko, S. Khomlyev, S. B. Riznyk</i>	
Numerical Simulation for Gas Turbine Cascade with Jet Vortex Generators	1890
<i>Piotr Doerffer, Pawel Flaszynski</i>	
Pulsating Trailing Edge Coolant Blowing in a High-Pressure Supersonic Turbine to Control Shock Waves.....	1895
<i>B. Saracoglu, G. Paniagua, T. Yasa, S. Duni, S. Salvadori, F. Martelli</i>	
Investigation of Real Gas Effects on Hydrogen Underexpanded Jets	1903
<i>Vinicio Magi, Antonella Perrone, Anarita Viggiano</i>	
Active Flow Control Using Plasma Actuators in Gas Turbine Engine.....	1913
<i>Maria Grazia De Giorgi, Antonio Ficarella, Stefania Traficante</i>	
Numerical and Experimental Investigations of Boundary Layer Separation Control by Means of Synthetic Jets in Low Pressure Turbine Adverse Pressure Gradient Conditions	1927
<i>Chiara Bernardini, Mauro Carnevale, Daniele Simoni</i>	
Effect of Flow Control by Fluidic Jets on Heat Transfer of Cooled Turbine Blades	1937
<i>Piotr Doerffer, Pawel Flaszynski, Ryszard Szwaba</i>	
Non-Linear Multiple Point Adaptive Simulation Approach Using Aero-Engine Test-Bed Data	1943
<i>Y. G. Li, M. F. Abdul Ghafir, L. Wang, R. Singh, K. Huang, W. Zhang</i>	
Life Tracking System (LTS) for RM12.....	1957
<i>Magnus Andersson</i>	
Structure of a Complex Diagnosis System for Aviation Engines	1966
<i>Arif M. Pashayev, Ramiz A. Sadigov, Parviz Sh. Abdullayev, Azer J. Mirzoyev</i>	
Low-Cost Embedded Scouts for Engine Health Monitoring.....	1978
<i>D. Mylaraswamy, G. Parthasarathy, K. Kim, O. Uluyol</i>	

Study on A GUI-based Condition Monitoring Program for a Turboprop Engine Using Inverse Performance Model and Nero-Fuzzy Algorithms	1987
<i>Keonwoo Kim, Changduk Kong, Semyung Lim</i>	
Model-Based Gas Turbine Diagnostics at KLM Engine Services.....	2002
<i>Rob Duivis, J. P. Van Buitenen, Michel L. Verbist, Wilfried P. J. Visser</i>	
A Study on Defect Diagnosis of Gas Turbine Engine Using SVM and RCGA-based ANN in Off-Design Region.....	2010
<i>Wanjo Kim, Tae-Seong Roh</i>	
Tunable Diode Laser Absorption Sensors for Aeropropulsion.....	2020
<i>R. K. Hanson, J. B. Jeffries</i>	
The Effect of Sidewall Geometry on Starting Characteristics of Two-dimensional Hypersonic Inlet.....	2031
<i>Xiao-Qiang Fan, Wei-Dong Liu, Yi Wang, Zhen-Guo Wang</i>	
Turbulence Measurements in a High Subsonic Non-isothermal Flow Field (Turbine Engines Inlet Conditions Analysis).....	2037
<i>Francesco Baldani, Walter Bosschaerts</i>	
Bleed Rate Model Based on Prandtl-Meyer Expansion for a Bleed Hole Normal to a Supersonic Freestream.....	2046
<i>Shane Burnag</i>	
Dynamic Simulation of Foreign Object Trajectory into Aircraft Engine Inlet	2096
<i>Baily Vittal, Masayoshi Shimo</i>	
Parametric Study of DBD Plasma Actuators on Turbulent Boundary Layer Separation Control	2105
<i>Njuki Mureithi, Huu Duc Vo, Xiaofei Xu, Xue Feng Zhang</i>	
Numerical Investigations of Intake Starting Characteristics of a Hypersonic Vehicle	2116
<i>B. Rajinikanth, T. K. Ganesh Anavaradham, V. Thiagarajan, V. Ramanujachari</i>	
Flow Control for Shock Wave Turbulent Boundary Layer Interactions Using "Fail Safe" Hybrid Micro-Actuator	2124
<i>Bernhard H. Anderson</i>	
Fluidic Control of Nozzle Thrust.....	2132
<i>Ashraf Ali, Andrew Neely, John Young, Carlos Rodriguez</i>	
Numerical and Experimental Investigation of Highly Swirling Flows in a Model Turbofan Lobed Mixer.....	2142
<i>Mark Cunningham, Zhijun Lei, Ali Mahallati, Hong Yang, Patrick Germain</i>	
Study of Air-Oil Separation and Pumping Devices for Gas Turbine Engines.....	2155
<i>François Gruselle, Patrick Hendrick, Amélie Ruelle, Johan Steimes</i>	
Dynamic Testing of Fuel Control System for Gas Turbine Engine	2166
<i>B. A. Manjunatha, Y. Radhakrishna, P. N. Srinivasmurthy, T. Uppal</i>	
Numerical Investigations on the Leakage Flow and Pressure Distribution of the Conventional and Low-Hysteresis Brush Seals with Four Clearances.....	2176
<i>Zhenping Feng, Yangzi Huang, Jun Li, Bo Qiu</i>	
Influence of Honeycomb Facings on the Through Flow and the Temperature Distribution of Labyrinth Seals	2184
<i>Hans-Jörg Bauer, Klaus Dullenkopf, Tina Weimberger</i>	
The Impact of Geometry Variations on the Two-Phase Flows in Aero-Engine Bearing Chambers.....	2194
<i>Hans-Jörg Bauer, Klaus Dullenkopf, Wolfram Kurz</i>	
Static Metallic Feather Seals for Turbine Structures: Analysis and Evaluation of Sealing Performance	2202
<i>Andreas Borg, Dimitrios Kiousis, Mats Nilsson</i>	
Mathematical Model of Brush Seal - A Nonlinear Analytical Solution.....	2212
<i>Amin Changizi, Ion Stiharu, Patrick Hendrick</i>	
Effects of Bristle Lay Angle, Bristle Diameter and Length on the Hysteresis Characteristics of Brush Seals	2222
<i>Jun Li, Chunxin Chen, Bo Qiu, Zhenping Feng</i>	
An Investigation of Turbine Rim Seal Flow Interactions with a Transonic Hot Gas Path.....	2229
<i>R. S. Bunker, G. Laskowski, G. Ledezma</i>	
Testing of Carbon Brush Seals Tribological and Mechanical Performance and Definition of a Physical Model	2241
<i>Patrick Hendrick, Adrien Magnée, M. Paulus, M. Yacoubi</i>	
Prediction of Rim Seal Ingestion	2250
<i>Julie Lefrancois, Guillaume Boutet-Blais, Guy Dumas, Viswanathan Krishnamoorthy, Rinaz Mohammed, Giridhar Babu Yeruri, Jesuraj Felix, Jean-François Caron, Remo Marini</i>	
Bump Foil Bearings as a Suitable Candidate for Low Load-High Speed Turbomachinery Applications	2262
<i>V. A. Kumar, K. N. Shashidhara</i>	
Author Index	