

Hypersonics

Papers Presented at the AIAA SciTech Forum and Exposition
2025

Orlando, Florida, USA
6-10 January 2025

Volume 1 of 2

ISBN: 979-8-3313-1822-2

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 12700 Sunrise Valley Drive, Suite 200, Reston, VA 20191, USA.

TABLE OF CONTENTS

VOLUME 1

HYPERSONIC FUNDAMENTALS

Investigation on Spectral Signature of an Isolated Roughness Induced Transitional Boundary Layer on a Sharp Tip Cone in Hypersonic Flow	1
<i>Ankit Bajpai, Gopalan Jagadeesh</i>	
Fluid-Structure Interactions of a Thin Flexible Panel in Hypersonic Flow	11
<i>Himakar Ganti, Luis G. Bravo, Anindya Ghoshal, Prashant Khare</i>	
Efficient Transport Property Formulation for Scale-Resolved Hypersonic Flow Simulations	25
<i>Ali Musawi, Neil D. Sandham</i>	
High-Fidelity Simulations of Reacting Supersonic Jet in Hypersonic Cross Flow	51
<i>Alberto Garcia-Arroba Velasco, Pino Martin, Swapnil Desai, Jackie Chen</i>	

HYPERSONIC MISSIONS AND VEHICLES

The Common Front End: A Testbed Concept for High-Speed Technology Maturation	62
<i>Nicholas F. Giannelis, Joseph Luppino, Samuel Cousens, Mark Eldridge, Jason Smith, Hilbert Van Pelt, Graham Wild, Andrew J. Neely, Scott K. Beinke, Scott Gorin</i>	
Conceptual Design of a Mach 5, Horizontal Takeoff, Commercial Passenger Aircraft.....	78
<i>Trenton Abraham, Christine Case, Troy Abraham, Joshua J. Hurwitz, Nathan H. Hoch, Benjamin M. Ford, Zander T. Johnson, Bryan Gricius, Clayton Spencer, Zachary N. Foster, Andrew Crook, Adam S. Weaver, Jorge Hernandez</i>	
Rapid Evaluation and Optimization of Very Low Earth Orbit Systems Using Multidisciplinary Design Optimization.....	127
<i>Sean Gauntt, Matthew T. Walsh, Jereme Chien</i>	
Numerical Investigation of SF6 Injection Into Supersonic Reacting Flow for Reentry Communications Blackout Alleviation.....	144
<i>Léon Lüer, Kevin Sabo, Rui Xu, Wesley Harris</i>	

THERMAL MANAGEMENT IN HYPERSONICS

Increasing Sonic Ring Standoff Distance Reduces Aerodynamic Heating With High Heat Capacity Fluid Injection	171
<i>Dekkala Vinay, Raunak Sharma, Yash Raj, Narender Singh, Vr Sanal Kumar</i>	
Circuit Analysis of an Electron Transpiration Cooling System for Hypersonic Leading Edges	179
<i>Kal Monroe, Iain D. Boyd</i>	
Arc-Jet and Free-Flight Evaluation of Laminar and Turbulent Diffusion Models on Ablation.....	199
<i>Kyle J. Worden, Andrew Heider, Serhat Hosder</i>	
Experimental Visualization of Hypersonic Boundary Layer Transition	229
<i>Duk-Min Kim, Hyoung Jin Lee</i>	

COMPUTATIONAL METHODS IN HYPERSONICS I

Sensitivity Analysis and Uncertainty Quantification of Plasma Formation in Nonequilibrium Hypersonic Airflows.....	234
<i>Nicholas Carter, Timothy T. Aiken, Iain D. Boyd</i>	
Verification of a Modular DSMC-CFD Simulation Method Implementation for Expanding Rarefied Flows	275
<i>Ioannis Nompelis, Michael D. Kroells, Thomas Schwartzentruber, Graham V. Candler</i>	
Approximate Surface Pressures and Heat Load Gradients for the Optimisation of Hypersonic Vehicles	291
<i>Ingo H. Jahn</i>	
A Deep Operator Network Based Surrogate Model for Non-Equilibrium Chemistry in Hypersonic Flows	303
<i>Liang Wei, Joseph Abraham</i>	
Symmetrized Generalized and Simplified Bernoulli-Trials Collision Schemes in DSMC.....	312
<i>Maryam Javani, Ehsan Roohi Golkhatmi, Stefan Stefanov</i>	
Multi-Mission Codesign of a Hypersonic Vehicle Leading Edge With Heat Flux Constraints	317
<i>Chris Van Der Heide, Andrew Lock, Viv Bone, Kieran Mackle, Ingo H. Jahn, Peter M. Dower, Chris Manzie</i>	

HYPERSONIC PROPULSION COMPONENTS

Experimental Study of Mode Transition in a Cavity-Based Dual-Mode Scramjet Combustor	331
<i>Alexander Dolnik, Dan Michaels</i>	
Conceptual Study on a Scramjet External Nozzle in a Rocket-Based Combined Cycle Engine	343
<i>Tatsushi Isono, Takahiro Fujikawa</i>	
Intake Design for Air-Breathing Electric Propulsion: A Framework.....	358
<i>Astrid Raisanen, Adriane Faust, Jeff Taylor, Josh Higginson, Matthew E. Zuber</i>	

COMPUTATIONAL METHODS IN HYPERSONICS II

Reduced-Order Modeling of Resolved Turbulent Flows for High-Speed Fluid-Structure Interaction Analysis	377
<i>Elliot Kimmel, Daning Huang, Vansh Sharma, Jagmohan Singh, Venkatramanan Raman, Peretz P. Friedmann</i>	
Hybridizable Discontinuous Galerkin Methods for Input/Output Analysis of Complex Hypersonic Boundary Layers	401
<i>Charles Kiefer, David Cook, Joseph W. Nichols</i>	
Numerical Study of Hypersonic Fluid-Structure Interaction on Cantilever Plate with Oscillating Shock Impingement.....	414
<i>Prabin Paudel, Sanskar C. Shahi, Sarthak Pandey, Sashakta Kharel, Nishchal Poudel, Sudip Bhattarai, Krishna M. Talluru</i>	

An Automated Framework for High Fidelity Modeling of Hypersonic Flows Over Mesoscale Roughness Features	439
<i>Hannah R. Stroud, Cory M. Stack, Lincoln Collins, Scott Roberts</i>	

Multifidelity Dust Erosion Analysis of Mars Entry Vehicles	449
<i>Adam J. Boland, Dominic Zanti, Serhat Hosder, Andrew Hinkle</i>	

HYPERSONIC PROPULSION SYSTEMS

Optimizing Hypersonic Propulsion: Analysis of Angled Fuel Injection and Strut Geometries in Scramjet Combustors.....	473
<i>Vedika Garg, Loukik S. Deshpande, Tanishka Verma, Swaraj Patil, Vinay Dekkala, Yash Raj, Neeraj Kumar Gahlot, Nidhi Sharma, Vr Sanal Kumar</i>	

Tandem Injection Effects in Scramjet Engines: A Numerical Study	487
<i>Manoj Prabakar Sargunraj, Ramprakash Ananthapadmanaban</i>	

Rocket Based Combined Cycle Using a Rotating Detonation Rocket Engine and Ramjet.....	494
<i>Andrew Duggleby, Sibylle Walter, Ben Saletta, Josh Camp, Bill Ross, Joel Darin</i>	

Ramjet Experiments on Sustainable Supersonic Flight	512
<i>Friedolin T. Strauss, Konstantin Manassis, Luca Bauer, Christoph U. Kirchberger</i>	

COMPUTATIONAL METHODS IN HYPERSONICS III

Experimental and Numerical Studies of Shock Wave -- Boundary-Layer Interactions Over a Cone-Cylinder-Flare in Hypersonic Flows	522
<i>Benjamin W. Arfi, Erwan A. Corcoral, Simon A. Prince, Zeeshan A. Rana, Spyros Tsentis</i>	

Comparison of Numerical Results With Wind Tunnel Aerodynamic Data of Flight Vehicle for Hypersonic Flight	544
<i>Susumu Hasegawa</i>	

Optimal Receptivity of Hypersonic Boundary Layers with Wall-Cooling	555
<i>Omar Kamal, Matthew T. Lakebrink, Tim Colonius</i>	

VOLUME 2

Hypersonic Glide Vehicle Shape and Trajectory Co-Design	578
<i>Andrew Lock, Glen Oberman, Ingo H. Jahn, Chris Van Der Heide, Viv Bone, Peter M. Dower, Chris Manzie</i>	

Multidisciplinary Design and Analysis of a Hypersonic Glide Vehicle With Trimmed Aerodynamics.....	592
<i>Emily G. Herrmann, Adam Cox, Dimitri Mavris</i>	

HYPERSONICS TEST AND EVALUATION I

Initial Results of the BOLT-1B Flight Experiment	610
<i>Gregory McKiernan, Cameron Butler, Thomas Wolf, Parth Kathrotiya, Prasad Kutty, John Melcher, Bradley M. Wheaton, David W. Adamczak</i>	

Flush Air-Data Sensing System for Hypersonic Flight Experimental Vehicle With Ogive-Shaped Nose.....	634
<i>Hideki Takahashi, Tomonari Hirotsu, Hideyuki Taguchi</i>	
Shock Perturbations in Attached Turbulent Shock-Wave/Boundary-Layer Interactions at Mach 6	671
<i>Grant W. Duemmel, Stuart Laurence</i>	
STORT Hypersonic Flight Experiment Forebody Temperature Results.....	684
<i>Thomas Reimer, Giuseppe Di Martino, Lucas Dauth, Luis Baier, Ali Gülhan, Florian Klingenberg, Dorian Hergarten</i>	

COMPUTATIONAL METHODS IN HYPERSONICS IV

Constrained Turbulent Boundary Layer Generation Using Scale-Resolving Methods	699
<i>Luis Villalobos, Jack R. Edwards, Pedro Paredes</i>	
Comet-3D: GPU-Accelerated Three-Dimensional Direct Simulation Monte Carlo Code Using Unstructured Mesh	715
<i>Chonglin Zhang</i>	
Modeling Freestream Noise Radiation From Hypersonic Tunnel Wall Turbulent Boundary Layers	734
<i>Gregory Stroot, Dhiman Roy, Anagha Madhusudanan, Lian Duan, Beverley J. McKeon</i>	
Influence of Aerothermoelasticity on Performance of Oblique Detonation Wave Engines.....	750
<i>Sandip Gewali, Anup Pandey, Nishchal Poudel, Sanjeev Adhikari, Sudip Bhattra</i>	
Assessment of Radiation Scattering by Dust in Mars Entry	777
<i>Andrew Hinkle, Christopher O. Johnston, Kyle B. Thompson, Serhat Hosder</i>	

HYPERSONICS TEST AND EVALUATION II

Experimental Characterization of a Hypersonic Nozzle Flow Field	793
<i>Lukas Jakobs, Jan-Erik Brune, Christian Mundt</i>	
Development of an Inductively Coupled Plasma Wind Tunnel Facility for Hypersonics and Magnetoaerodynamics.....	801
<i>Hisham K. Ali</i>	
Reusable Aircraft for Routine, Reliable Access to Hypersonic Flight.....	816
<i>Joshua Stults, Adam Peters, Zachariah Swetky, Col (R) Michael Hopkins</i>	

COMPUTATIONAL METHODS IN HYPERSONICS V

Bow Shockwave Instabilities of the Mars Science Laboratory Using Wall-Modeled Large Eddy Simulation	824
<i>Adrian Anton Alvarez, Adrian Lozano-Duran</i>	
Transforming Hypersonic Waveriders with Sonic Ring Optimization: Advancing Thermal Management and Aerodynamic Efficiency through Nose Cavity Design	846
<i>Shivansh Rana, Vinay Dekkula, V. R. Sanal Kumar</i>	
Comparison of the Lockheed Martin Falcon CFD Solver to Test Data on a Mach 4 Waverider Model	857
<i>Dennis B. Finley, Alex Bryant, Alex Bosco</i>	

Modeling and Simulation of Interactions Between a Hypersonic Flow and an Ablatable Wall During an Atmospheric Reentry: Focus on Surface Chemical Reactions.....	882
<i>Guillaume Coria, Jean-Denis Parisse</i>	

Theory and Implementation of a Rapid Hypersonic Impact Method (HI-Mach) Part I: Aerodynamics.....	900
<i>Jeremiah K. Goates, Logan B. Freeman, Douglas F. Hunsaker</i>	

Theory and Implementation of a Rapid Hypersonic Impact Method (HI-Mach) Part II: Convective Heating	920
<i>Logan B. Freeman, Jeremiah K. Goates, Douglas F. Hunsaker</i>	

GUIDANCE AND CONTROL SYSTEMS IN HYPERSONICS

An Iterative Control Allocation Algorithm for Hypersonic Glide Vehicles with Asymmetric Magnitude and Rate Limits	942
<i>Johannes Autenrieb, Patrick Gruhn</i>	

Robust Multi-Objective H_∞ Control of GHAME Hypersonic Vehicle in Subsonic Flight	964
<i>Egor Goz, Spilios Theodoulis</i>	

Unscented Hypersonic Trajectory Optimization With a Heating-Rate Chance Constraint.....	996
<i>Elliot Schwartz, Mark Karpenko, Isaac M. Ross</i>	

Longitudinal Dynamics of a Nonlinear Model of Air-Breathing Hypersonic Vehicle.....	1015
<i>Kavita Shekhawat, Nandan K. Sinha</i>	

Observability-Based Sensor Selection and Dimensionality Reduction of Pressure Distribution for a Vehicle-as-a-Sensor Concept.....	1028
<i>Ana Cristine Meinicke, Carlos Cesnik</i>	

Assessment of Externally Applied Magnetohydrodynamic Effects on the Boundary Layer in Shock- Dominated Hypersonic Flows	1040
<i>Joseph D. Franciamore, Ozgur Tumuklu</i>	

OTHER TOPICS IN HYPERSONICS I

Variable Acceleration Shock-Driven Droplet Breakup.....	1057
<i>Jacob M. Keltz, Vasco O. Duke, Praveen Ramaprabhu, Jacob A. McFarland</i>	

Aerothermoelastic Response of a Radiatively Heated Compliant Panel in Mach 6 Flow	1063
<i>Zacharia Tuten, Dylan D. Dooner, Andrew J. Neely, David Buttsworth</i>	

Laser-Driven Microparticle Impact Experiments on Reinforced Carbon-Carbon, Graphite, and Silicon Carbide	1079
<i>Jamshid Ochilov, Peter Yip, Frederick N. Shireman, Savio J. Poovathingal, Thomas Schwartzentruber, Suraj Ravindran</i>	

OTHER TOPICS IN HYPERSONICS II

A Step Towards the Full-Integrated Aero-Thermo-Chemo-Mechanics Simulation of Hypersonic Systems.....	1089
<i>James Crouse, Summer A. Hoss, Christopher T. Quinn, Raul Radovitzky, Matthew McLaughlin, Nathan J. Falkiewicz</i>	

Application of PID Control to Hypersonic Vehicle Control Surfaces	1105
<i>Dominique J. Djanal-Mann, Muthuvel Murugan</i>	
Fuel Pump Power and Thermal Conceptual Design Investigation for a High Speed Vehicle	1115
<i>Jacob H. Jadischke, Jose A. Camberos, Ramana Grandhi, Danielle Hollon, Mitch Wolff</i>	
Hypersonic Heat Flux Prediction and Validation.....	1135
<i>Cristina Gonzalez, Jesus Castillo, Afroza Shirin</i>	
Evaluation of Morphing Inward-Turning Inlets for Improved Performance at Off-Design Angles of Attack	1140
<i>Shreyas Madhvaraju, William Engblom, Jacob Snider</i>	

Author Index