

Thermophysics

Papers Presented at the AIAA SciTech Forum and Exposition
2021

Online
11 - 15 & 19 - 21 January 2021

ISBN: 978-1-7138-2646-0

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

RADIATION MODELING AND EXPERIMENTS I

CHARACTERIZATION OF RADIATIVE HEATING ANOMALY IN HIGH ENTHALPY SHOCK TUNNELS	1
<i>Brett A. Cruden, Chun Y. Tang, Joseph Olejniczak, Adam J. Amar, Hideyuki Tanno</i>	
INFRARED RADIATION MEASUREMENTS OF A RECOMBINING CO ₂ PLASMA AT ATMOSPHERIC PRESSURE	13
<i>Corentin Grimaldi, Sean McGuire, Augustin C. Tibère-Inglesse, Christophe O. Laux</i>	
MODELING OF NO EMISSIONS FROM A HYPERSONIC GROUND-BASED FACILITY	27
<i>Ozgur Tumuklu, Matthew Jouffray, Deborah A. Levin</i>	

RADIATION MODELING AND EXPERIMENTS II

MODELING OF TURBULENT-RADIATION INTERACTION IN TURBULENT COMBUSTION FLOWS USING THE VELOCITY-FREQUENCY-COMPOSITION JOINT PDF METHOD	85
<i>Masoud Darbandi, Mohamad B. Barezban, G E. Schneider</i>	
NUMERICAL ANALYSIS OF FLOW AND RADIATIVE TRANSFER WITH EXCITATION NONEQUILIBRIUM IN AN ARC-JET FACILITY	94
<i>Kazuyuki Sunabe, Yousuke Ogino, Takeharu Sakai</i>	
ELECTRON NUMBER DENSITY MEASUREMENTS IN A SATURN ENTRY CONDITION	104
<i>Yu Liu, Christopher M. James, Richard G. Morgan, Peter Jacobs, Rowan Gollan, Timothy McIntyre</i>	

NON-EQUILIBRIUM FLOWS I

A METHOD OF CHARACTERISTICS SOLVER FOR UNSTEADY QUASI-ONE-DIMENSIONAL CHEMICALLY REACTING GAS FLOWS	122
<i>Ananthkumar Jayamani, Frank K. Lu</i>	
A STATE-TO-STATE AND MULTI-TEMPERATURE STUDY OF AIR THERMOCHEMISTRY	135
<i>Alexander J. Fangman, Daniil Andrienko</i>	
DETAILED COMPARISON OF DIFFUSIVE TRANSPORT PHENOMENA BETWEEN CFD AND DSMC ON A TWO-DIMENSIONAL CYLINDER	148
<i>Chiara Amato, Michael D. Kroells, Thomas E. Schwartzentruber, Graham V. Candler</i>	
DIRECT MOLECULAR SIMULATION OF DISSOCIATING OXYGEN UNDER ADIABATIC AND NORMAL SHOCK WAVE CONDITIONS	163
<i>Erik Torres, Thomas E. Schwartzentruber</i>	

NON-EQUILIBRIUM FLOWS II

ELECTRONIC-SPECIFIC MODELING OF NITRIC OXIDE IN A RECOMBINING AIR PLASMA.....	176
<i>Ulysse Dubuet, Pierre Mariotto, Marie-Yvonne Perrin, Christophe O. Laux</i>	
EXPERIMENTAL METHODS FOR STUDYING POST SHOCK RELAXATION.....	199
<i>Steve F. Apirana, Christopher M. James, Steven Lewis, Richard G. Morgan</i>	
FIRST-PRINCIPLE SIMULATION OF VIBRATIONAL ACTIVATION AND DISSOCIATION IN OXYGEN SHOCK FLOWS	211
<i>Varishth T. Baluckram, Daniil Andrienko</i>	
SIMULTANEOUS VIBRATIONAL, ROTATIONAL, AND TRANSLATIONAL THERMOMETRY BASED ON LASER ABSORPTION OF CO IN SHOCK-INDUCED NON-EQUILIBRIUM.....	233
<i>Christopher Jelloian, Fabio A. Bendana, Chuyu Wei, Raymond M. Spearrin, Megan E. Macdonald</i>	

NON-EQUILIBRIUM FLOWS III

MODELING OF IONIZED GAS FLOWS WITH A VELOCITY-SPACE HYBRID BOLTZMANN SOLVER	248
<i>Georgii Oblapenko, David B. Goldstein, Philip Varghese, Christopher Moore</i>	
ANALYSIS OF CHEMICAL KINETIC PARAMETERS FOR HYDROGEN ATMOSPHERES.....	259
<i>Kaelan Hansson, Alex T. Carroll, Savio J. Poovathingal, Iain D. Boyd</i>	
OBJECTIVE MOLECULAR DYNAMICS OF DISSOCIATING NITROGEN UNDER HIGH TEMPERATURE CONDITIONS.....	275
<i>Gunjan Pahlani, Erik Torres, Thomas E. Schwartzentruber, Richard D. James</i>	

NON-EQUILIBRIUM FLOWS IV

QUASI-NEUTRALITY IN HYPERSONIC IONIZING REENTRY FLOWS.....	285
<i>Carolyn R. Kaplan, Elaine S. Oran</i>	
THREE-BODY COLLISION BASED RECOMBINATION RATE CONSTANTS FROM QUASI CLASSICAL TRAJECTORY CALCULATIONS	293
<i>Eric C. Geistfeld, Thomas E. Schwartzentruber</i>	

ABLATION MODELING AND EXPERIMENTS I

A COUPLED ABLATION APPROACH USING ICARUS AND US3D	315
<i>Olivia M. Schroeder, Joseph Brock, Eric Stern, Graham V. Candler</i>	
AIR-CARBON ABLATION MODEL FOR HYPERSONIC FLIGHT FROM MOLECULAR BEAM DATA	329
<i>Krishna Sandeep Prata, Timothy K. Minton, Thomas E. Schwartzentruber</i>	
AN IMMERSSED BOUNDARY METHOD FOR HYPERSONIC VISCOUS FLOWS.....	353
<i>Joel A. McQuaid, Aleksander L. Zibitsker, Bijaylaxhmi Saikia, Alexandre Martin, Christoph Brehm</i>	

MACHINE LEARNING IN THERMOPHYSICS I

A CRITICAL ASSESSMENT OF ADAPTIVE TABULATION FOR FLUID PROPERTIES USING NEURAL NETWORKS.....	369
<i>Daniel T. Banuti</i>	
ARTIFICIAL INTELLIGENCE APPLICATION IN COMBUSTION MODELING.....	383
<i>Luke N. Dillard, Vishal Nandigana, Jay P. Gore</i>	

ABLATION MODELING AND EXPERIMENTS II

CRACK MODELING IN CHARRING ABLATION MATERIALS	395
<i>Rui Fu, Sean McDaniel, Matthew Beck, Alexandre Martin</i>	
DEVELOPMENT OF KINETIC-BASED ABLATIVE REACTION MODELS IN THERMAL ANALYSIS OF SUPER/HYPERSONIC VEHICLES.....	410
<i>Sean M. Babiniec, Joel Seibert, Matthew Musselman</i>	
DSMC SIMULATION OF ABLATING MICROSTRUCTURES AT FLIGHT RELEVANT CONDITIONS.....	423
<i>Sahadeo Ramjatan, Michael D. Kroells, Thomas E. Schwartzentruber</i>	

HEAT TRANSFER ENHANCEMENT AND ENERGY HARVESTING AND THERMAL MANAGEMENT AND CONTROL IN AIRCRAFT AND SPACECRAFT: DEVICES AND APPLICATIONS

ENERGY HARVESTING MECHANISMS FOR A SOLAR PHOTOVOLTAIC PLANT MONITORING DRONE: THERMAL SOARING AND BIOINSPIRATION	448
<i>Mariah Gammill, Michelle Sherman, Ali Raissi, Mostafa Hassanalian</i>	
EXPERIMENTAL DEMONSTRATION OF HIGH-AMPLITUDE THERMOACOUSTIC INSTABILITIES UNDER TRANSCRITICAL TEMPERATURE CONDITIONS IN A STANDING-WAVE DEVICE.....	456
<i>Ariana G. Martinez, Benjamin Kuras, Mario Tindaro Migliorino, Carlo Scalo, Stephen D. Heister</i>	

ABLATION MODELING AND EXPERIMENTS III

NUMERICAL RECONSTRUCTION OF SPALLED PARTICLE TRAJECTORIES IN AN ARC-JET ENVIRONMENT	469
<i>Raghava Davuluri, Sean Bailey, Kaveh Tagavi, Alexandre Martin</i>	
SURFACE OXIDATION OF CARBON/CARBON COMPOSITES IN HYPERSONIC ENVIRONMENTS	481
<i>Ares Barrios-Lobelle, Raghava Davuluri, Rui Fu, Alexandre Martin, Savio J. Poovathingal</i>	
NONINTRUSIVE MANUFACTURED SOLUTIONS FOR ABLATION	492
<i>Brian A. Freno, Brian Carnes, Neil R. Matula</i>	

THEORETICAL, EXPERIMENTAL AND COMPUTATIONAL HEAT TRANSFER I

EQUIVALENT GIBBS FUNCTION CONTINUATION FOR MULTI-TEMPERATURE PLASMAS IN CHEMICAL EQUILIBRIUM	505
<i>Pedro Dinis Caseiro Jorge, James B. Scoggins, Thierry E. Magin, Nagi N. Mansour</i>	
ELECTROHYDRODYNAMIC GAS PUMP IN A SQUARE CHANNEL WITH ELECTRODES MOUNTED ON TWO PARALLEL WALLS	519
<i>Sheam-Chyun Lin, Y. J. Chang, C. Y. Wu, Feng C. Lai</i>	
MODELING OF THE SUPERCRITICAL BOILING CURVE BY FORCED CONVECTION FOR SUPERCRITICAL FLUIDS IN RELATION TO REGENERATIVE COOLING	529
<i>Nelson P. Longmire, Daniel T. Banuti</i>	

AEROTHERMODYNAMICS AND THERMAL PROTECTION SYSTEMS I

ON THE ENERGY TRANSFER MECHANISMS FOR THE SUPERSONIC MODE	539
<i>Bijaylakshmi Saikia, Sayed Mohammad Abdullah Al Hasnine, Leonard Dueñas, Christoph Brehm</i>	
DISCONTINUOUS GALERKIN SIMULATIONS OF DUSTY FLOWS OVER A FULL-SCALE CAPSULE DURING MARS ATMOSPHERIC ENTRY	565
<i>Eric J. Ching, Matthias Ihme</i>	
GEOMETRY DEPENDENCE OF TRANSPIRATION COOLING FOR HYPERSONIC SYSTEMS	585
<i>Jason Connolly</i>	

AEROTHERMODYNAMICS AND THERMAL PROTECTION SYSTEMS II

HIGH-FIDELITY SIMULATIONS OF HYMETTS ARC-JET FLOWS FOR PICA-N MODELING	598
<i>Patricia Ventura Diaz, Jeremie B. Meurisse, Aaron M. Brandis, Brody K. Bessire, Michael Barnhardt, Steven Yoon</i>	
INSTRUMENTED HYPERVELOCITY TESTING USING ADDITIVE MANUFACTURING	618
<i>Robert W. Eldridge, Tan Phan, Christopher M. James, Steve F. Apirana</i>	
INVESTIGATION OF IN-DEPTH PENETRATION OF RADIATIVE HEATING IN THERMAL PROTECTION SYSTEM (TPS)	636
<i>Ayan Banerjee, Savio J. Poovathingal</i>	
MULTI-FIDELITY HEATING PREDICTION OF ADAPTABLE, DEPLOYABLE ENTRY PLACEMENT TECHNOLOGY VEHICLES	651
<i>Mario Santos, Serhat Hosder, Thomas K. West</i>	

AEROTHERMODYNAMICS AND THERMAL PROTECTION SYSTEMS III

PARAMETRIC ASSESSMENT OF EFFECT OF DESIGNED-IN FEATURES ON THERMAL RESPONSE OF TPS FOR SELF-HEALING APPLICATIONS	669
<i>Nathaniel Skolnik, Zachary R. Putnam</i>	

PROJECTION-BASED MODEL REDUCTION FOR FINITE-ELEMENT SIMULATIONS OF
THERMAL PROTECTION SYSTEMS 684
Marco Arienti, Patrick J. Blonigan, Francesco Rizzi, John Tencer, Micah Howard

STRAIN-DEPENDENCE OF THERMAL CONDUCTIVITY IN FLEXIBLE FIBROUS
INSULATION MATERIALS 700
Christopher Barrow, John F. Maddox, Kaveh Tagavi

Author Index