

Pressure Gain Combustion

Papers Presented at the AIAA SciTech Forum and Exposition
2025

Orlando, Florida, USA
6-10 January 2025

Volume 1 of 2

ISBN: 979-8-3313-1810-9

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

DETONATION FUNDAMENTALS

High Speed Imaging of Gaseous Detonations in Rectangular Curved Channels with Representative Widths for RDEs	1
<i>Regan Hencel, Steven Abbate, Matthew Longer, Kevin Y. Cho</i>	
Design and Analysis of a Dump Tank Release System for Detonation Tube Facility	18
<i>Bryan Suarez, Nicolas Berube, Daniel R. Dyson, Anthony J. Aguilera, Hamil Patel, Subith Vasu</i>	
Interstitial Impacts on Shock-Driven Fuel Droplet Atomization	23
<i>Miguel L. Moran, Steven A. Schroeder, Sheikh Salauddin, Rachel Hytovick, Anthony J. Morales, Kareem A. Ahmed</i>	
Design Considerations in Aluminum Powder Introduction for Detonation Tube Applications	27
<i>Rodrigo I. Yuraszeck, Daniel R. Dyson, Hamil Patel, Alejandro J. Puerta-Alvarado, Subith Vasu, Ryan W. Houim</i>	

LIQUID FUELED ROTATING DETONATION ENGINES

Flight Demonstration of Detonation Engine System Using Sounding Rocket S-520-34: Performance of Rotating Detonation Engine Using Liquid Propellants	33
<i>Tomoki Sato, Ken Matsuoka, Noboru Itouyama, Masaaki Yasui, Koichi Matsuyama, Yuichiro Ide, Kotaro Nakata, Yamato Suzuki, Ryoto Ishibashi, Sota Suzuki, Jiro Kasahara, Akira Kawasaki, Hidetoshi Hirashima, Daisuke Nakata, Hikaru Eguchi, Tomoyuki Takano, Masaharu Uchiumi, Akiko Matsuo, Ikkoh Funaki, Hiroto Habu, Satoshi Arakawa, Junichi Masuda, Kousuke Kawahara, Tomoaki Usuki, Kenji Maehara, Maki Shida, Tatsuro Nakao, Kazuhiko Yamada, Takehiro Himeno, Yusei Yahata</i>	
Impact of Liquid Fuel Droplet Size on Detonation Dynamics	51
<i>Stephan Agee, Calvin Young, Vasco Duke-Walker, Manoj Paudel, Jacob A. McFarland</i>	
Multiphase Detonations with Spatially Inhomogeneous Equivalence Ratio Distribution	59
<i>Manoj Paudel, Praveen Ramaprabhu, Jacob McFarland</i>	
Liquid Fuel Injection Dynamics and Wave Behavior of a Kerosene - Oxygen RDRE	70
<i>Charlie H. Black, Mark Frederick, Calle W. Junker, Thomas E. Neafus, Rohan Gejji, Carson D. Slabaugh</i>	
A Numerical Investigation of Liquid Fuel Powered Rotating Detonation Engines	96
<i>Madhav Nagori, Prashant Tarey, John Boles, Tanner Nielsen, Matthew Goodson, Jacob McFarland, Mesbah Uddin, Praveen Ramaprabhu</i>	

FUNDAMENTAL INVESTIGATION OF PGC CONCEPTS I

Asymptotic Dynamics of Rotating Detonation Engines	107
<i>Trevor Kickliter, Vishal S. Acharya, Tim Lieuwen, Eli Young</i>	

Capturing Rotating Detonation Flame Interaction Through Chemiluminescence of Dissimilar Fuels	120
<i>Tyler C. Pritschau, Rachel Wiggins, Nolan Bellenoue, Ephraim Gutmark</i>	
Characterization of Secondary Wave Dynamics in an RDC Using Complementary High-Speed Pressure Measurements and Chemiluminescence Imaging	132
<i>Rugved Dikay, Ethan P. Wissmann, Terrence R. Meyer, Austin M. Webb, Christopher Fugger</i>	
Dynamically Dominant Flow Features During Wave Mode Transition in a Rotating Detonation Engine Combustor	151
<i>Veeraraghava Raju Hasti, Jacob Pratt, Reetesh Ranjan</i>	
Numerical Investigation on the Development of the Rotating Detonative Instability in a Rocket Combustor	169
<i>Bukyeng Sung, Jeongyeol Choi</i>	

FUNDAMENTAL INVESTIGATION OF PGC CONCEPTS II

Conservative Shock-Fitting Approach for Modeling Detonations	177
<i>Oliver Gibson, Caleb Van Beck, Venkatramanan Raman</i>	
Numerical Study on Operability and Design Characteristics of a Small-Scale Hydrogen-Air Rotating Detonation Engine	192
<i>Yunus E. Karasu, Scott Jackson, Paul Cizmas</i>	
Assessment of a Diode Turbine to Prevent Backflow	206
<i>Lakshya Bhatnagar, Guillermo Paniagua</i>	
Non-Reacting VOF CFD Methodology for Single Liquid RDRE Injector	214
<i>Devin Johnson, Kayla Gatsonis, William Stigliano, Christopher A. Fugger, Venkat Athmanathan, Terrence R. Meyer, James Braun</i>	
Validated Reduced Methods for Realistic RDC Injection Modeling Without Chemistry	238
<i>Liam Stumbar, William Stigliano, John A. Grunenwald, Peter Salek, Venkat Athmanathan, Terrence R. Meyer, Christopher A. Fugger, Kenji Miki, Hugh D. Perkins, James Braun</i>	
Investigation of the Fuel Injector Design Effects on Mixing and Performance of a Hydrogen Fueled Rotating Detonation Engine	260
<i>Tom Giribone, Bayindir H. Saracoglu</i>	

RDE MEASUREMENT AND DIAGNOSTICS I

Synthetic LAS Measurements of Combustion Efficiency in a Rotating Detonation Engine Using 3D-DNS Data	289
<i>Jose Guerrero, Mirko Gamba</i>	
Combustion Efficiency Measurements in a Rotating Detonation Engine Using Scanned-Wavelength-Modulation Spectroscopy	309
<i>Jose Guerrero, Mirko Gamba</i>	
High-Speed Visualization of Spray Breakup and Velocity Estimation in a Rotating Detonation Combustor Using Laser Induced Fluorescence	320
<i>Matthew Hooper, Robert B. Wang, Peter Salek, Zoe Brand, Austin M. Webb, Venkat Athmanathan, Terrence R. Meyer, Christopher Fugger, Hugh D. Perkins</i>	

Experimental Validation of a Robust Laser Spectroscopic Instrument in a Detonation Environment.....	335
<i>Andrew M. Derusha, Nishan Khanal, Marc B. Etienne, Daniel R. Dyson, Justin Urso, Subith Vasu</i>	

PGC OPERABILITY AND PERFORMANCE I

Feasibility Study of Small-Scale RDREs in Space Propulsion Applications	342
<i>Kofi Abusah, Taha Rezzag, Kareem A. Ahmed</i>	
Experimental Testing of a 25 mm Rotating Detonation Rocket Engine with Methane and Hydrogen	350
<i>Raj Dave, Kaito J. Durkee, Garrett R. Cobb, Matthew Maybee, Jason R. Burr, John W. Bennewitz</i>	
Performance Comparison of Variable Center Body Configurations for a 25 mm Rotating Detonation Rocket Engine.....	364
<i>Kaito J. Durkee, Raj T. Dave, Matthew Maybee, Garrett R. Cobb, Jason R. Burr, John W. Bennewitz</i>	
Comparative Analysis of Exit Geometries in Small-Scale Rotating Detonation Rocket Engines.....	379
<i>Luis Longas, Gabriel Shamam, Gerardo A. Rodriguez, Egan J. Rigney, Aref Abdala, Taha Rezzag, Kareem A. Ahmed</i>	
Additively Manufactured Inconel 718 in Small-Scale Rotating Detonation Rocket Engines	388
<i>Aref Abdala, Gabriel Shamam, Emil Alunno, Taha Rezzag, David S. Hanon, Kareem A. Ahmed</i>	

RDE MEASUREMENT AND DIAGNOSTICS II

Experimental Study of Ion Probe Configuration for Detonation Wave Speed Measurements in a Linear Detonation Tube.....	396
<i>Olivia Decaro, Ruthie Hill, Kunning G. Xu</i>	
Spatially and Temporally Synchronous OH* and CH* Chemiluminescence Imaging in the Exhaust of a Rotating Detonation Engine	412
<i>Ashley James, Dalton G. Langner, Apurav Gupta, Ajay K. Agrawal</i>	
Regression Analysis of Detonation Wave Speed in a Flow-Through Rotating Detonation Combustor	424
<i>Peter H. Glaubitz, Anthony J. Centofanti, Tyler C. Pritschau, Ephraim Gutmark</i>	

COMPUTATIONAL MODELING, SIMULATION, AND VALIDATION I

RDRE Simulation Using Chemistry Models Updated for Undiluted Conditions.....	430
<i>Mathias Ross, Matthew E. Harvazinski, Armani Batista, Matthew Billingsley, Jason R. Burr, Zachary Labry, Liam Mackin</i>	
Characterization of Re-Ignition Events in Constant Volume Combustion	442
<i>Choomanee Runnoo, Bastien Boust, Marc Bellenoue, Quentin Michalski</i>	
Numerical Investigation of Detonation Re-Initiation Mechanism by Shock Reflection	452
<i>Sagar K. S, Pathasarathy Vasanthakumar</i>	
Computational Study of Chemical Timescales in an Ethylene-Oxygen Non-Premixed RDE.....	463
<i>Mohammed N. Nejaamtheen, Jeongyeol Choi</i>	

PGC OPERABILITY AND PERFORMANCE II

Experimental Study of Rotating Detonation Engine Operated on Binary Gaseous Fuel Mixtures	473
<i>Scott L. Chriss, John Hoke, Matthew Fotia, Adam T. Holley</i>	
Investigation of Limit Cycle Oscillation Persistence Within Rotating Detonation Engines.....	491
<i>Kristyn Johnson, Justin Weber, Donald H. Ferguson, Andrew C. Nix, Todd Sidwell</i>	
Investigation of the Potential Scaling Effects of Rotating Detonation Rocket Engines	507
<i>Gabriel Shamam, Luis Longas, Gerardo A. Rodriguez, Subhan Wade, Egan J. Rigney, Nathaniel S. Michnoff, Aref Abdala, Taha Rezzag, Kareem A. Ahmed</i>	
Detonation Wave Velocity Error Across Multiple Methodologies in a 6 Inch Rotating Detonation Engine.....	522
<i>Mason Stocke, Regan Hencel, John Hoke, Matthew Fotia</i>	
Improved Injection Scheme Yielding Robust Operation of a Radial Rotating Detonation Engine with an Aerospike	535
<i>Dalton G. Langner, Apurav Gupta, Ashley James, Ajay K. Agrawal</i>	

VOLUME 2

Global Evaluation of Process Conditions and Corresponding Wave Modes in a Rotating Detonation Engine.....	548
<i>Justin Weber, Kristyn Johnson, Wesley R. Boyette, Donald H. Ferguson</i>	

COMPUTATIONAL MODELING, SIMULATION, AND VALIDATION II

Reduced-Fidelity Models for Rotating Detonation Combustors for Use in Flowpath Analysis.....	560
<i>Yusuf S. Keskinöz, Shuzhi Zhang, Ral Bielawski, Venkatramanan Raman</i>	
Numerical Evaluation of Methods to Quantify Combustion Efficiency of Rotating Detonation Engines	570
<i>Joshua Sykes, Adam L. Comer, Brent A. Rankin</i>	
A High-Order Discontinuous Galerkin Spectral Element Method for Compressible Reacting Flows	587
<i>Benjamin W. Keeton, Muhsin Ameen, Pinaki Pal, Peter Strakey</i>	
Component Based Reduced Order Modelling of Two Dimensional Rotating Detonation Engine with Non-Uniform Injection.....	606
<i>Ryan G. Camacho, Cheng Huang</i>	
Difference Between 2D and 3D NS Calculations for RDE Pressure Gain	623
<i>A Koichi Hayashi, Takumi Ito, Nobuyuki Tsuboi, Kohei Ozawa, Yuta Otsuka, Kazuhiro Ishii</i>	

COMPUTATIONAL MODELING, SIMULATION, AND VALIDATION III

Computational Optimization of a Rotary Valved Pulse Combustor Concept	632
<i>Daniel E. Paxson, Hugh D. Perkins, Shaye Yungster</i>	
Comprehensive Numerical Procedure of the THOR Non-Premixed Hydrogen-Air RDE	645
<i>John A. Grunenwald, Sebastian Perna, Peter Salek, Venkat Athmanathan, Terrence R. Meyer, Austin M. Webb, Christopher A. Fugger, Kenji Miki, Hugh D. Perkins, James Braun</i>	

Characterization of RDC Interaction with a Core Flow	667
<i>John A. Grunenwald, Edward Wang, Austin M. Webb, Christopher A. Fugger, Terrence R. Meyer, James Braun</i>	

Pressure Gain Estimations in a Laboratory Scale RDE	676
<i>Venkat E. Tangirala, Craig Nordeen, Anthony Dean, Chris M. Brophy</i>	

DETONATION COMBUSTION SYSTEMS

Design Changes and Initial Results from a New Detonation Wave Imaging Facility	694
<i>Nicolas Berube, Daniel R. Dyson, Hamil Patel, Anthony Aguilera, Sydney M. Briggs, Nathaniel Root, Rodrigo Yuraszeck, Subith Vasu</i>	

Experiments and Large Eddy Simulation of Supersonic Combustion in the Small-Scale Flight Experiment	704
<i>Christer Fureby, Jan Martinez Schramm</i>	

Interaction of Detonation Wave with Flush-Mounted Injector	720
<i>Jayson C. Small, Liwei Zhang</i>	

Ignition of a Liquid-Fueled Scramjet Using a Pulse Detonation Ignitor	733
<i>Yuval Aldema-Tshuva, Hertzal Kadosh, Joel Van Der Lee, Rudy Kaner, Dan Michaels</i>	

Performance Analysis of New Modular Turbulator for Improved Detonation Tube Performance	760
<i>Nathaniel Root, Nicolas Berube, Hamil Patel, Anthony Aguilera, Subith Vasu</i>	

Spray-Shock Interactions Downstream of a Converging-Diverging Nozzle	766
<i>Christopher B. Reuter, Douglas A. Schwer</i>	

PGC OPERABILITY AND PERFORMANCE III

Effect of Geometric and Flow Parameters on a Hydrogen-Air Rotating Detonation Combustor Operability and Performance	774
<i>Andrea Ruan, Rohan Geji, Eric Bach, Carson D. Slabaugh, Guillermo Paniagua</i>	

Experimental Investigation of Stable Performance in a H ₂ /Air RDC for Hydrogen-Based Power Generation	793
<i>Joachim Grune, Karsten Sempert, Daniel T. Banuti</i>	

Dynamic Flow Field Measurement Inside an RDC and Its Interactions with a Turbine Proxy	806
<i>Hongyi Wei, Eric Bach, Oliver Paschereit, Myles Bohon</i>	

Propagation Analysis of Detonation Waves Inside (95/115) RDE with H ₂ /Air	823
<i>Toshiharu Mizukaki, Faming Wang, Ibuki Nagayama, Ryota Ozawa, Rintaro Suzuki, Shinji Mabuchi, Yuki Iwaki, Mitsunori Itoh</i>	

PGC OPERABILITY AND PERFORMANCE IV

Thermochemical Equilibrium Analysis and Detailed Simulation of Conical Detonation Waves	830
<i>Sebastian Abisleiman, Vansh Sharma, Ral Bielawski, Venkatramanan Raman</i>	

Improved Incidence Loss Model for Wave Rotor Turbine with Non-Axial Channels at Off-Design Conditions	841
<i>Nirmala P. Manthripragada, M Razi Nalim</i>	

3D Numerical Simulation on Disk Type RDE Used Hydrogen-Air Premixed Gas and Non-Premixed Gas with Multi-Ports Injection 856
Takumi Ito, Nobuyuki Tsuboi, Kohei Ozawa, A Koichi Hayashi

Complex Continuous Detonation Wave Behaviors in a Disk Combustor 867
Xin Huang, Po-Hsiung Chang, Zhen Wei Teo, Jiun-Ming Li, Chiang Juay Teo, Boo Cheong Khoo

PGC THERMAL MANAGEMENT I

Heat Transfer Measurements of NASA Liquid Kerosene/Oxygen Rotating Detonation Rocket Engine..... 883
Thomas W. Teasley, Dillon M. Petty, Michaela R. Hemming, David Scarborough, Stephen D. Heister

Structural Life Characterization of a Rotating Detonation Rocket Engine (RDRE) 899
John S. Smallwood, Stephen D. Heister, Michael Sangid

Average Heat Flux Measurements in a Gaseous Detonation-Based Rocket Engine 919
Matthew Maybee, Michaela R. Hemming, Kaito J. Durkee, Justin Byers, Joseph Hernandez-McCloskey, Kunning G. Xu, John W. Bennowitz, Thomas W. Teasley

Calorimeter Heat Flux Trends in NASA's Subscale Rotating Detonation Rocket Engine 931
Joseph Hernandez-McCloskey, Thomas W. Teasley, Dillon M. Petty, Seth A. Reutlinger, Daniel I. Pineda

Finite-Life Design of a Radiatively Cooled Rotating Detonation Rocket Engine 951
Matthew J. Shorter, Yuval Harduf, Zachary C. Cordero

PGC THERMAL MANAGEMENT II

MHz Rate In-Situ Direct Surface Heat-Flux Measurements in a Rotating-Detonation Engine 972
Venkat Athmanathan, Robert B. Wang, Austin M. Webb, Konstantin Huber, Tim Rödiger, James Braun, Sukesh Roy, Christopher A. Fugger, Terrence R. Meyer

The Use of Thin Filament Pyrometry to Measure Temperature in a Rotating Detonation Engine 979
Theodore B. Guetig, Marc D. Polanka, Larry P. Goss, Brian Sell

Novel Design and Fabrication of a High Frequency Transient Heat Flux Sensor for Use in a RDE 991
Zachary T. Tallman, Andrew C. Nix, Donald H. Ferguson, Kristyn Johnson, Edward Sabolsky

Experimental Investigation of Gaseous Film Cooling for Cylindrical Rotating Detonation Engines 1008
Allen Chan, Kotaro Nakata, Noboru Itouyama, Ken Matsuoka, Jiro Kasahara, Akira Kawasaki, Akiko Matsuo, Ikkoh Funaki, Kazuyuki Higashino

Parameterized Study of Heat Load Trends in a Subscale Rotating Detonation Rocket Engine 1023
Dillon M. Petty, Thomas W. Teasley, Joseph Hernandez-McCloskey, Ari D. Goldman

PGC THERMAL MANAGEMENT III

Characterization of Bladeless Power Extraction from a Rotating Detonation Rocket Combustor 1036
Benjamin L. Delgado, Eduardo Leite De Moraes, Franklin Rice, John Grunenwald, Venkat Athmanathan, James Braun

Thermodynamic Power Cycle Analysis in Actively Cooled Rotating Detonation Rocket Engines	1051
<i>Garrett R. Cobb, Kaito J. Durkee, Jason R. Burr, John W. Bennowitz</i>	
Impact of Multiple Detonation Waves on Heat Flux in Rotating Detonation Engines	1072
<i>Hyejin Oh, Wenhai Li, Foluso Ladeinde</i>	
Performance Estimations of an RDE with Exit Nozzles	1082
<i>Venkat E. Tangirala, Anthony Dean</i>	

Author Index