CURRICULUM VITAE

IAIN D. BOYD

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BIRTH

7/10/64	Paisley, Scotland

EDUCATION

12/88	Ph. D. in Aeronautics and Astronautics, University of Southampton, England
7/85	B. Sc. (with honors) in Mathematics, University of Southampton, England

HONORS AND AWARDS

10/2014	APS Fellow
6/2012	AIAA Thermophysics Best Student Paper Award
6/2011	AIAA Thermophysics Best Paper Award
5/2011	AIAA Fellow
10/2009	James E. Knott Professor of Engineering
6/2009	Paper selected by *Physics of Plasmas* as one of its most significant publications in 50 years
3/2009	UM Monroe-Brown Foundation Research Excellence Award
9/2006	CTR Senior Fellow (Stanford University)
6/2005	AIAA Thermophysics Best Student Paper Award
3/2004	UM Aerospace Outstanding Achievement Award
1/1998	AIAA Lawrence Sperry Award
9/1997	Cornell Engineering College Teaching Award
7/1997	AIAA Electric Propulsion Best Paper Award

EMPLOYMENT HISTORY

10/10 – present	James E. Knott Professor of Aerospace Engineering, University of Michigan, Ann Arbor, Michigan
8/02 – 9/10	Professor of Aerospace Engineering, University of Michigan, Ann Arbor, Michigan
6/99 - 8/02	Associate Professor Aerospace Engineering, University of Michigan, Ann Arbor, Michigan
11/95 - 5/99	Associate Professor Mechanical and Aerospace Engineering, Cornell University, Ithaca, New York
1/93 - 10/95	Assistant Professor Mechanical and Aerospace Engineering, Cornell University, Ithaca, New York
1/89 - 12/92	Research Scientist Eloret Institute, NASA Ames Research Center, Moffett Field, California

ACADEMIC EXPERIENCE

A. Courses Taught

Hypersonic Aerothermodynamics	(graduate; 2003, 2004, 2007; Michigan)
Molecular Gas Dynamics	(graduate; 2003-2006, 2008-2016; Michigan)
Gas Kinetic Theory	(graduate; 2000, 2001; Michigan)
Introduction to Gas Dynamics	(undergraduate; 2000-2002,2005; 2009-2015; Michigan)
Spacecraft Engineering	(undergraduate; 1997, 1998; Cornell)
Compressible Fluid Flow	(graduate; 1996, 1997, 1998; Cornell)
Physics of Fluids	(graduate; 1994-1996, 1999; Cornell)
Introduction to Aeronautics	(undergraduate; 1993-1995; Cornell)
Computational Aerodynamics	(graduate; 1993; Cornell)

B. Graduate Students/Visitors

Current Students:	Sam Chen	(UM Fellowship)
	Peter Cross	(Navy Fellowship)
	David Dang	(NSTRF Fellowship)
	Horatiu Dragnea	(NSTRF Fellowship)
	Kyle Hanquist	(Lockheed-Martin)
	Kaelan Hansson	(DOE)

	Michael Holloway	(UM Fellowship)
	Candice Kaplan	(NSF fellowship)
	Lauren Mackey	(AFRL)
	Astrid Raisanen	(AFOSR)
	Alex Vaszonyi	(College Fellowship)
Graduated Students:	Kevin Neitzel	(PhD, Michigan, 2017)
	Smart Blue Innovations LLC	
	Maria Choi	(PhD, Michigan, 2016)
	NASA Glenn Research Center	
	Brandon Smith	(PhD, Michigan, 2015)
	University of Michigan	
	Kentaro Hara	(PhD, Michigan, 2015)
	Texas A & M University	
	Ashley Verhoff	(PhD, Michigan, 2015)
	Blue Origin	
	Jon Wiebenga	(PhD, Michigan, 2014)
	Williams International	
	Cyril Galitzine	(PhD, Michigan, 2014)
	Northeastern University	
	Anna Abhilasha	(PhD, Michigan, 2013)
	CD-adapco	
	Andrew Crow	(PhD, Michigan, 2013)
	Lockheed-Martin	
	Adam Irvine	(PhD, Michigan, 2013)
	Onyx Aerospace	
	Paul Giuliano	(PhD, Michigan, 2013)
	Boeing	
	Eunji Jun	(PhD, Michigan, 2012)
	DLR, Germany	
	Hicham Alkandry	(PhD, Michigan, 2012)
	Applied Physics Laboratory	
	Tyler Huismann	(PhD, Michigan, 2011)

University of Colorado

Tim Deschenes (PhD, Michigan, 2011)
Spectral Sciences, Inc.

Erin Farbar (PhD, Michigan, 2010)
Chrysler

Tim Holman (PhD, Michigan, 2010)
Naval Research Laboratory

Nick Bisek (PhD, Michigan, 2010)
Air Force Research Laboratory

Minkwan Kim (PhD, Michigan, 2009)
University of Adelaide, Australia

Andrew Porwitzky (PhD, Michigan, 2008)
Sandia National Laboratory

Jeremy Boerner (PhD, Michigan, 2008)
Sandia National Laboratory

Yongjun Choi (PhD, Michigan, 2008)
Michigan State University

John Yim (PhD, Michigan, 2008)
NASA Glenn Research Center

Jose Padilla (PhD, Michigan, 2007)
NASA Langley Research Center

Andrew Lofthouse (PhD, Michigan, 2007)
United States Air Force Academy

Leonardo Scalabrin (PhD, Michigan, 2007)
Embraer, Brazil

Tom Schwartzentruber (PhD, Michigan, 2007)
University of Minnesota

Matt McNenly (PhD, Michigan, 2006)
Lawrence Livermore National Laboratory

Michael Martin (PhD, Michigan, 2006)
Louisiana State University

Jon Burt (PhD, Michigan, 2006)
NASA Glenn Research Center

Anton VanderWyst (PhD, Michigan, 2006)
Northrop-Grumman Corporation

Chunpei Cai (PhD, Michigan, 2005)
Michigan Technical University

Jerry Emhoff (PhD, Michigan, 2005)
Applied Physics Laboratory

Justin Koo (PhD, Michigan, 2005)
Air Force Research Laboratory

Wen-Lan Wang (PhD, Michigan, 2004)
Foxconn Technology Group

Quanhua Sun (PhD, Michigan, 2003)
Chinese Academy of Sciences

Jitendra Balakrishnan (PhD, Cornell, 2001)
Corning

Jyothish George (PhD, Cornell, 2000)

Douglas VanGilder (PhD, Cornell, 2000)
CRAFT Technology

Daniel Karipides (PhD, Cornell, 1999)
Tech-X Corporation

Gang Chen (PhD, Cornell, 1998)
Brion Technologies

Keith Kannenberg (PhD, Cornell, 1998)
Lockheed-Martin

Research Visitors:

Brandon Smith (postdoc: 2015 – present)
Daniil Andrienko (postdoc: 2014 – present)
Andrew Weaver (postdoc: 2015 – 2017)
Michael Logue (postdoc: 2015 – 2016)
Anna Abhilasha (postdoc: 2013 – 2015)
Kelly Stephani (postdoc: 2012-2014)
Hicham Alkandry (postdoc: 2011-2014)

Erin Farbar (research investigator: 2010-2016)
Jaegang Kim (postdoc: 2010-2014)
Tom Scanlon (visitor from Strathclyde: 2012)
Alexandre Martin (postdoc: 2007-2010)
Minkwan Kim (postdoc: 2009-2010)
Jon Burt (postdoc: 2006-2010)
Michael Keidar (research investigator: 1998-2005)
Quanhua Sun (postdoc: 2003-2005)
Andrew Christlieb (post-doc: 2001-2002)
Jing Fan (post-doc: 1998-2000)
Koffi Kossi (post-doc: 1996-1998)
Gabriel Font (post-doc: 1995-1997)
Stefan Dietrich (post-doc: 1993-1995)
Laurent Garrigues (post-doc: 2000)
Sergey Gimelshein (post-doc: 1998)
Savino Longo (visitor from Bari, Italy: 1997-1998)
Stefan Stefanov (visitor from Sofia, Bulgaria: 1997)

C. University of Michigan Service

Member, Executive Committee, Michigan Institute for Plasma Science & Engineering (2012-present)
Member, Aerospace Engineering Internal Review Committee (2013)
Member, Executive Committee, Michigan Institute for Computational & Discovery Engineering (2013-2014)
Chair, Aerospace Department Head Search Committee (2010-2011)
Chair, College of Engineering Honors & Awards Committee (2010)
Member, College of Engineering Research Computing Committee (2010-2011)
Member, College of Engineering Honors & Awards Committee (2009)
Member, Aerospace Engineering Graduate Committee (2008-present)
Member, Aerospace Engineering Undergraduate Committee (2000-2002)
Member, Aerospace Engineering Faculty Search Committee (2008-2009)
College of Engineering freshmen advisor (2007-2008)
Faculty Advisor, Michigan Rocket Engineering Association (2007-2012)
Chair, Aerospace Engineering Faculty Search Committee (2005-2006)
Member, Aerospace Department Head Search Committee (2004-2005)
Faculty Advisor, Student Chapter of AIAA (2002-2005)
Undergraduate Program Advisor in Aerospace Engineering (2000-2003)
Chair, Aerospace Engineering Curriculum Committee (2003-2005)
Member, College of Engineering Faculty Phase of the Anniversary Campaign (2002-2005)
Member, College of Engineering Nominating Committee (2002-2003)
Member, University of Michigan Senate Assembly (2002-2005)
Director, W.M. Keck Computational Fluid Dynamics Laboratory (2002-2011)

D. Software Licensing

MONACO:
- ESI Group (2011)
- Boeing Space & Intelligence Systems (2013)
- Space Exploration Company (2016)
- Blue Origin (2016)
- NASA Glenn Research Center (2017)
- Naval Research Laboratory (2017)

LeMANS:
- Virtual EM Inc., Ann Arbor, MI (2013)
- Corvid Technologies (2013)
- Active Cooling Technologies, Inc. (2015)
- Raytheon Missile Systems (2016)

MOPAR-MD:
- Southwest Research Institute (2016)
- Raytheon Missile Systems (2016)

EXTERNAL PROFESSIONAL ACTIVITIES

A. Journal Editorships and Reviewing

Editorial Board, *Physical Review Fluids*, (2016-present)
Associate Editor, *Journal of Thermophysics and Heat Transfer,* (2016-present)
Editorial Board, *Physics of Fluids*, (2014-2015)
Associate Editor, *Journal of Spacecraft and Rockets,* (1994-2015)
Editorial Board, *International Journal of Aerospace Engineering*, (2010-2013)
Editorial Advisory Board, *The Open Aerospace Engineering Journal*, (2009-2011)
Paper reviewer for *Journal of Fluid Mechanics*
Paper reviewer for *Journal of Applied Mechanics*
Paper reviewer for *Physics of Fluids*
Paper reviewer for *Physics of Plasmas*
Paper reviewer for *Journal of Computational Physics*
Paper reviewer for *AIAA Journal*
Paper reviewer for *Journal of Physics*
Paper reviewer for *Journal of Propulsion and Power*
Paper reviewer for *Journal of Thermophysics and Heat Transfer*
Paper reviewer for *Progress in Aerospace Sciences*
Paper reviewer for *Aerospace Science & Technology*
Paper reviewer for *Journal of Microelectromechanical Systems*
Paper reviewer for *International Journal of Heat and Mass Transfer*
Paper reviewer for *Journal of Vacuum Science and Technology A*

Paper reviewer for *Journal of Electrochemical Society*
Paper reviewer for *ASME Journal of Fluids Engineering*
Paper reviewer for *ASME Journal of Heat Transfer*
Paper reviewer for *Plasma Sources, Science & Technology*
Paper reviewer for *Review of Scientific Instruments*
Paper reviewer for *Journal of Micromechanics and Microengineering*
Paper reviewer for *Earth, Moon, and Planets*
Proposal reviewer for *NASA Office of Chief Technologist*
Proposal reviewer for *National Science Foundation*
Proposal reviewer for *Air Force Office of Scientific Research*
Proposal reviewer for *Army Research Office*
Proposal reviewer for *California Institute of Technology President's Fund*
External examiner for *Nanyang Technological University, Singapore.*
External examiner for *University of Queensland, Australia.*

B. Board and Committee Activities

Member, National Academies' Intelligence Science & Technology Experts Group (2016-present)
Member and Vice Chair, Air Force Scientific Advisory Board (2010-present)
Member, Review Board for DOE Exascale Computing Requirements (2016)
Member, Board of Directors, Space United (2013 – 2014)
Member, Panel on USAF R&D, AFA Symposium, Langley AFB (2015)
Member, Review Board for AFRL High Speed Strike Weapons Program (2015)
Member, Scientific Committee, 5th International Workshop, Radiation of High Temperature Gases in Atmospheric Entry, Barcelona, Spain (2012)
Member, NATO RTO-AVT, Catalytic Gas-Surface Interactions (2011-2012)
Member, NSF Proposal Review Panel on Combustion & Plasmas (2010)
Member, Scientific Committee, 4th International Workshop, Radiation of High Temperature Gases in Atmospheric Entry, Paris, France (2010)
Member, Defense Science Study Group (2008-2009)
Member, Board of Honor of Rarefied Gas Dynamics (2008 – present)
Member, NRC Panel on Assessment of NASA Aeronautics Program (2007-2008)
Member, Review Board on Aerothermodynamics for NASA Mars Science Laboratory (2007)
Co-Lead for Aerothermodynamics, Hypersonics Education Initiative (2007)
Member, AIAA Electric Propulsion & Power Technical Committee (1997-2007)
Member, NSF Proposal Review Panel on Plasma Science (2006)
Member, Organizing Committee of 2002 Rarefied Gas Dynamics Symposium
Member, Organizing Committee of 2001 AIAA Joint Propulsion Conference

C. Membership of Professional Societies

Fellow, American Institute of Aeronautics and Astronautics (AIAA), 2011

Fellow, American Physical Society (APS), 2014
Member, American Society of Mechanical Engineers (ASME)

D. Short Courses

"Introduction to Hypersonic Aerothermodynamics," National Institute of Aerospace, Hampton, VA, September 2007 (with G. V. Candler).

"Advanced Hypersonic Aerothermodynamics," National Institute of Aerospace, Hampton, VA, December 2007 (with G. V. Candler).

E. Consulting

SpaceX (2016)
IQM Research Institute (2015 – 2016)
Science & Technology Policy Institute (2015 – present)
Raytheon Missile Systems (2015)
Seneca Sciences (2014 – 2015)
The Aerospace Corporation (1997-98, 2001-2004, 2013 - present)
Ohio Aerospace Institute (2009 - present)
VirtualEM Inc (2013)
RockWest (2012-2013)
Cornell Technical Services (2012-2013)
CFDRC (2012)
Spectral Sciences (2012)
Ovshinsky Solar (2011-2012)
Raytheon (2010-2011)
CU Aerospace (2009)
ZONA Technology (2009-2010)
MilSys Technologies (2008)
Naval Research Laboratory (2008)
Mattson Technology, Inc. (2006-2007)
Aerospace Testing Alliance (2006)
Jet Propulsion Laboratory (2006)
ERC, Inc. (2000-2004, 2006)
Institute for Defense Analyses (2006, 2008-2009)
ElectroDynamic Applications (2005-2006)
QSS, Inc (2005)
Applied Physics Laboratory (2005)
Advatech Pacific (2005-2007)
Aerojet (2004-2005)
Clear Science, Inc. (2003-2004)
SAGE Systems (2003)
Tech-X Corporation (2002)

Sverdrup Technology, Inc. Corporation (2002)
Intelsat Global Service Corporation (2002)
NASA Marshall Space Flight Center (2000)
Epion Corporation (1999)
SETI Institute (1999, 2009, 2010)
Symyx, Inc. (1999)
Applied Pulsed Power (1999)
Eaton Corporation (1998)
Los Alamos National Laboratory (1998)
Quantum Materials Technology, Inc (1997-98)
Dutch High Energy Physics Institute (1994)

PRESENTATIONS AND PUBLICATIONS

A. Invited Talks at Conferences and Workshops

1. "Nonequilibrium Mechanisms in Rarefied Hypersonic Flow," AIAA Fluid Dynamics Conference, Washington, DC, June 2016.

2. "State Resolved Analyses of High Temperature Energy Transfer Processes in Oxygen," *52nd Society of Engineering Science Technical Meeting*, College Station, TX, October 2015.

3. "Parallel Computation of Nonequilibrium Gas Flows," *27th International Conference on Parallel Computational Fluid Dynamics*, Montreal, May 2015.

4. "Challenges for the Direct Simulation Monte Carlo Method," *Workshop on Moment Methods in Kinetic Theory II*, Fields Institute, University of Toronto, October 2014.

5. "Modeling of Radiation in Fluid Flow," *Center for Turbulence Research Summer Program*, Stanford University, July 2014.

6. "Computations of High-Enthalpy Laminar Air Flow Around Double Cone and Cylinder-Flare Geometries," *AIAA Thermophysics Conference*, Atlanta, GA, June 2014 (Alkandry, H., Anna, A., and Boyd, I. D.).

7. "Progress in Coupled Modeling of Flow, Surface Chemistry, and Material Response," *Radiation and Gas-Surface Interaction Phenomena in High-Speed Re-entry*, Urbana-Champaign, IL, April 2014.

8. "Detailed Analyses of Oxygen Thermochemistry Based on State-Resolved Kinetics," *AIAA SciTech Meeting*, National Harbor, MD, January 2014.

9. "Simulation of a Pulsed Atomic Oxygen Beam," *SPIE Optical Engineering &*

Applications Conference, San Diego, California, August 2013 (Carron, N., Boyd, I.D., et al.)

10. "Computation of Hypersonic Flow Using the Direct Simulation Monte Carlo Method," *21st AIAA CFD Conference*, San Diego, California, June 2013.

11. "Progress and Future Prospects for Particle-Based Simulation of Hypersonic Flow," *43rd AIAA Fluid Dynamics Conference*, San Diego, California, June 2013 (Schwartzentruber, T.E. and Boyd, I.D.).

12. "Approaches for Emulating the Boltzmann Equation When Particle Simulation Becomes Inefficient," *Workshop on Issue in Solving the Boltzmann Equation for Aerospace Applications*, Providence, Rhode Island, June 2013.

13. "Status and Challenges for Coupled Modeling of Flow, Surface Chemistry, and Material Response," *Gordon Conference on Atmospheric Re-entry Physics*, Ventura, California, February 2013.

14. "State-resolved Analysis of Thermochemical Nonequilibrium for H_2 and N_2," *1st International Symposium on Hypersonic Aerothermodynamics–Recent Advances*, Bangalore, India, December 2012 (Kim, J.G. and Boyd, I.D.).

15. "Hybrid Particle-Continuum Numerical Methods for Aerospace Applications," *Models and Computational Methods for Rarefied Flows*, Von Karman Institute for Fluid Mechanics, Brussels, Belgium, January 2011 (Boyd, I.D. and Deschenes, T.R.).

16. "Simulation of Electric Propulsion Thrusters," *Models and Computational Methods for Rarefied Flows*, Von Karman Institute for Fluid Mechanics, Brussels, Belgium, January 2011.

17. "Hybrid Particle-Continuum Methods for Nonequilibrium Gas and Plasma Flows," *27th International Symposium on Rarefied Gas Dynamics*, Asilomar, CA, July 2010.

18. "Development of Hybrid DSMC-Continuum Methods for Nonequilibrium Gas and Plasma Flows," *Direct Simulation Monte Carlo: Theory, Methods, and Applications*, Santa Fe, NM, September 2009.

19. "Strongly Coupled Computation of Material Response and Nonequilibrium Flow for Hypersonic Ablation," (with Alexandre Martin), *AFOSR/NASA/SNL Technical Interchange Meeting on Ablation Modeling*, Santa Fe, NM, April 2009.

20. "Simulation of Non-Continuum Hypersonic Flows," *NASA Fundamental Aeronautics Program Annual Meeting*, Atlanta, GA, October 2008.

21. "Direct Simulation Monte Carlo for Atmospheric Entry. 1. Theoretical Basis and Physical Models," *Nonequilibrium Hypersonic Flows*, Von Karman Institute for Fluid Mechanics, Brussels, Belgium, September 2008.

22. "Direct Simulation Monte Carlo for Atmospheric Entry. 2. Code Development and Application Results," *Nonequilibrium Hypersonic Flows*, Von Karman Institute for Fluid Mechanics, Brussels, Belgium, September 2008.

23. "Direct Simulation Monte Carlo for Atmospheric Entry," *Shortcourse on Hypersonic Entry and Cruise Vehicles*, Stanford University, CA, July 2008.

24. "Hybrid Computation of Nonequilibrium Gas and Plasma Flows," *3rd ASTRONUM Conference*, St. John, Virgin Islands, June 2008.

25. "Flow and Radiation Analyses of Stardust Entry," *3rd Reentry Emission Signatures Workshop*, NASA Ames Research Center, CA, May 2008.

26. "Monte Carlo Simulation of Particle Radiation in High Altitude Solid Rocket Plumes," *43rd AIAA Joint Propulsion Conference*, Cincinnati, OH, July 2007.

27. "Particle Simulation of Chemical Nonequilibrium in Hypersonic Gas Flows," *232nd Meeting of the American Chemical Society*, San Francisco, CA, September 2006.

28. "Multi-Scale Modeling of Hypersonic Flows," *Hypersonics Workshop*, Minneapolis, MN, October 2005.

29. "Lessons Learned from Modeling In-Space Hall Thruster Plume Experiments," *High-Power Electric Propulsion Test Platform User Workshop*, Houston, TX, May 2005.

30. "Numerical Simulation of Hall Thruster Plasma Plumes," *9th Space Charging Technology Conference*, Tokyo, Japan, April 2005.

31. "Sensitivity Analysis of Near Field Simulations of Plasma Plumes," *Mini Conference on Plasma Propulsion*, Division of Plasma Physics 46th Annual Meeting, Savannah, Georgia, November 2004.

32. "Review of Micro-Propulsion Ablative Devices," *International Symposium on Energy Conversion Fundamentals*, Istanbul, Turkey, June 2004.

33. "Hybrid Particle-Continuum Computation of Nonequilibrium Hypersonic Flows," *NASA Marshall Spring Fluids Workshop*, Huntsville, Alabama, April 2004.

34. “Hybrid Particle-Continuum Computation of Multi-Scale Nonequilibrium Gas Flows," *Particle-Based Mesoscale Simulation Techniques Symposium*, University of Minneapolis, Minnesota, April 2004.

35. "Direct Simulation Monte Carlo Method: A Particle Method for Nonequilibrium Gas Flows," *Particle-Based Mesoscale Simulation Techniques Symposium*, University of Minneapolis, Minnesota, March 2004.

36. "Hybrid Particle-Continuum Computation of Nonequilibrium Hypersonic Flows," *Workshop on Multi-Algorithm Methods for Multi-Scale Simulations*, Lawrence Livermore National Laboratory, California, January 2004.

37. "Hybrid Particle-Continuum Computation of Nonequilibrium Hypersonic Flows," *American Mathematical Society Southeastern Section Fall Meeting*, Chapel Hill, North Carolina, October 2003.

38. "The Information Preservation Method: A DSMC Variant With Reduced Statistical Fluctuations," *Workshop on "40 Years of the DSMC Method",* Milan, Italy, June 2003.

39. "Simulation of Micro-Scale Aerodynamics," *41st AIAA Aerospace Sciences Meeting*, Reno, Nevada, January 2003.

40. "Predicting Breakdown of the Continuum Equations Under Rarefied Flow Conditions," *23rd International Symposium on Rarefied Gas Dynamics*, Whistler, Canada, July 2002.

41. "Particle Methods for Micro-Scale Gas Flows," *32nd AIAA Fluid Dynamics Conference*, St. Louis, Missouri, June 2002.

42. "Present Status of Numerical Simulations in Electric Propulsion," *8th International Workshop on Combustion and Propulsion*, Pozzuoli, Italy, June 2002.

43. "Simulation of the Plasma Plume Generated by a Micro-Laser-Ablation Thruster," *SPIE High-Power Laser Ablation Conference*, Taos, New Mexico, April 2002.

44. "Hall Thruster Far Field Plume Modeling and Comparison to Express Flight Data," *AIAA 40th Aerospace Sciences Meeting*, Reno, Nevada, January 2002.

45. "Particle Simulation of Micro-Scale Gas Flows," *AIAA 39th Aerospace Sciences Meeting*, Reno, Nevada, January 2001.

46. "Modeling of Rarefied Flow Around a Meteoroid," *Leonid MAC Workshop*, Tel Aviv, Israel, April 2000.

47. "A Review of Hall Thruster Plume Modeling," *AIAA 38th Aerospace Sciences Meeting*, Reno, Nevada, January 2000.

48. "Particle Simulation of Gas Flows for MEMS Devices," *American Institute of Chemical Engineers Annual Meeting*, Dallas, Texas, November 1999.

49. "Numerical Modeling of Hall Thruster Plumes," *CNES Workshop on Plasma Propulsion Plumes*, Toulouse, France, September 1999.

50. "Nonequilibrium Chemistry Modeling in Rarefied Hypersonic Flows," *AIAA Thermophysics Conference*, Norfolk, Virginia, June 1999.

51. "Parallel Monte Carlo Modeling of a Plasma Etch Reactor," *50th Gaseous Electronics Conference*, Madison, Wisconsin, October 1997.

52. "Currents Strengths and Limitations of the Direct Simulation Monte Carlo Method," *Workshop on Mathematical Methods for Kinetics Problems*, Berlin, Germany, September 1997.

53. "Direct Simulation of Ultra-Violet Emission From the Hydroxyl Radical," *AIAA Thermophysics Conference*, Atlanta, Georgia, June 1997.

54. "Monte Carlo Simulation of Nonequilibrium Flow in Low Power Hydrogen Arcjets," *AIAA Fluid Dynamics Conference*, New Orleans, Louisiana, June 1996.

B. Book Contributions

1. Boyd, I.D. and Schwartzentruber, T.S., *Nonequilibrium Gas Dynamics and Molecular Simulation*, Cambridge University Press, March 2017.

2. Boyd, I.D., "Thrusters: Pulsed Plasmas," *Encyclopedia of Plasma Technology*, edited by J.L. Shohet, CRC Press, 2016, pp. 1484-1491.

3. Boyd, I.D., "Computation of Hypersonic Nonequilibrium Flows using the Direct Simulation Monte Carlo Method," *Hypersonic Nonequilibrium Flows: Fundamentals and Recent Advances*, edited by E. Josyula, AIAA, 2015, pp. 45-102.

4. Boyd, I.D. and Agarwal, R. K., "Computational Modeling of Rarefied Gas Flows," *Encyclopedia of Aerospace Engineering*, edited by R. Blockley and W. Shyy, Wiley, 2010.

5. Boyd, I.D., "Non-Continuum Hypersonic Flows," *Encyclopedia of Aerospace Engineering*, edited by R. Blockley and W. Shyy, Wiley, 2010.

6. Boyd, I.D., “Direct Simulation Monte Carlo for Atmospheric Entry. Part I: Theoretical Basis and Physical Models,” *Hypersonic Entry and Cruise Vehicles*, Edited by N.N. Mansour, T. Magin, P. Moin, and O. Chazot, Von Karman Institute for Fluid Dynamics, 2009.

7. Boyd, I.D., “Direct Simulation Monte Carlo for Atmospheric Entry. Part II: Code Development and Application Results,” *Hypersonic Entry and Cruise Vehicles*, Edited by N.N. Mansour, T. Magin, P. Moin, and O. Chazot, Von Karman Institute for Fluid Dynamics, 2009.

8. Boyd, I.D., "Multi-Scale Modeling of Hypersonic Gas Flows," *Handbook of Materials Modeling*, edited by S. Yip, Springer Press, Heidelburg, 2005, pp. 2811-2818.

9. Boyd, I.D., "Nonequilibrium Chemistry Modeling in Rarefied Hypersonic Flows," *Chemical Dynamics in Extreme Environments*, edited by R. A. Dressler, World Scientific Press, Singapore, 2001, pp. 81-137.

C. Refereed Articles Published in Archival Journals

1. Cross, P.G. and Boyd, I.D., “Two-Dimensional Modeling of Ablation and Pyrolysis With Application to Rocket Nozzles,” *Journal of Spacecraft and Rockets*, Vol. 54, 2017, pp. 212-224.

2. Hanquist, K.M., Hara, K., and Boyd, I.D., “Detailed Modeling of Electron Emission for Transpiration Cooling of Hypersonic Vehicles,” *Journal of Applied Physics*, Vol. 121, Article 053302, 2017.

3. Smith, B.D., and Boyd, I.D., “Molecular Dynamics Investigation of Hexagonal Boron Nitride Sputtering and Sputtered Particle Characteristics,” *Journal of Applied Physics*, Vol. 120, Article 053301, 2016.

4. Farbar, E.D., Boyd, I.D., and Esmaily-Moghadam, M., “Monte Carlo Modeling of Radiative Heat Transfer in Particle-Laden Flow,” *Journal of Quantitative Spectroscopy and Radiative Heat Transfer*, Vol. 184, 2016, pp. 146-160.

5. Irvine, A.G., Boyd, I.D., and Gentile, N.A., “Reducing the Spatial Discretization Error of Thermal Emission in Implicit Monte Carlo Simulations,” *Journal of Computational and Theoretical Transport*, Vol. 45, 2016, pp. 99-122.

6. Andrienko, D.A. and Boyd I.D., "Thermal Relaxation of Molecular Oxygen in

Collisions With Nitrogen Atoms," *Journal of Chemical Physics*, Vol. 145, Article 014309, 2016.

7. Andrienko, D.A. and Boyd, I.D., "Master Equation Study of Vibrational and Rotational Relaxations of Oxygen," *Journal of Thermophysics and Heat Transfer*, Vol. 30, 2016, pp. 533-552.

8. Ulusoy, I.S., Andrienko, D.A., Boyd I.D., and Hernandez, R., "Quantum and Quasi-Classical Collisional Dynamics of O2-Ar at High Temperatures," *Journal of Chemical Physics*, Vol. 144, Article 234311, 2016.

9. Andrienko, D.A. and Boyd I.D., "Rovibrational Energy Transfer and Dissociation in O2-O Collisions," *Journal of Chemical Physics*, Vol. 144, Article 104301, 2016.

10. Stephani, K.S. and Boyd, I.D., "Spacecraft Plume Interactions With the Magnetosphere Plasma Environment," *Journal of Geophysical Research – Space Physics*, Vol. 121, 2016, pp. 1402-1412.

11. Boyd, I.D. and Josyula, E., "Resolution of the Vibrational Energy Distribution Function Using a Direct Simulation Monte Carlo – Master Equation Approach," *Physics of Fluids*, Vol. 28, 2016, article 016102.

12. Anna, A. and Boyd, I.D., "Numerical Analysis of Surface Chemistry in High-Enthalpy Flows," *Journal of Thermophysics and Heat Transfer*, Vol. 29, 2015, pp. 653-670.

13. Stephani, K.S. and Boyd, I.D., "Molecular Dynamics Modeling of Defect Formation in Many-Layer Hexagonal Boron Nitride," *Nuclear Instruments & Methods in Physics Research B*, Vol. 365, 2015, pp. 235-239.

14. Scanlon, T.J., White, C., Borg, M.K., Palharini, R.C., Farbar, E.D., Boyd, I.D., Reese, J.M., and Brown, R.E., "Open Source Direct Simulation Monte Carlo Chemistry Modeling for Hypersonic Flows," *AIAA Journal*, Vol. 53, 2015, pp. 1670-1680.

15. Andrienko, D. A. and Boyd, I. D. "High Fidelity Modeling of Thermal Relaxation and Dissociation of Oxygen," *Physics of Fluids*, Vol. 27, 2015, Article 116101, 2015.

16. Andrienko, D. and Boyd, I.D., "Investigation of Oxygen Vibrational Relaxation by Quasi-Classical Trajectory Method," *Chemical Physics*, Vol. 459, 2015, pp. 1-13.

17. Martin, A. and Boyd, I.D., "Modeling of Heat Transfer Attenuation By Ablating Gases During Stardust Reentry," *Journal of Thermophysics and*

Heat Transfer, Vol. 29, 2015, pp. 450-466.

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301. Boyd, I.D., Beattie, D.R., and Cappelli, M.A., "Monte Carlo and Experimental Studies of Chamber Effects for a Low-Power Hydrogen Arcjet," International Electric Propulsion Conference, Seattle, WA, September 1993, .

302. Zelesnik, D., Penko, P.F., and Boyd, I.D., "Effects of Nozzle Geometry on Plume Expansion for Small Thrusters," International Electric Propulsion Conference, Seattle, WA, September 1993.

303. Boyd, I.D. and Gokçen, T., "Assessment of Thermochemical Models for Continuum and Particle Simulations of Hypersonic Flow," Paper 92-2954, AIAA Thermophysics Conference, Nashville, TN, July 1992.

304. Boyd, I.D. and Whiting, E.E., "Decoupled Predictions of Radiative Heating in Air Using a Particle Simulation Method," Paper 92-2971, AIAA Plasmadynamics Conference, Nashville, TN, July 1992.

305. Penko, P.F., Boyd, I.D., Meissner, D.L., and DeWitt, K.J., "Analysis and Measurement of a Small Nozzle Plume in Vacuum," Paper 92-3108, AIAA Joint Propulsion Conference, Nashville, TN, July 1992.

306. Jafry, Y.R., Vanden Beukel, J., Boyd, I.D., and DeBra D.B., "Impingement Calculations for Ultra-Low Density Helium Thrusters," 12th IFAC

Symposium on Automatic Control in Aerospace, Ottobrun, Germany, September 1992.

307. Haas, B.L. and Boyd, I.D., "Models for Vibrationally-Favored Dissociation Applicable to a Particle Simulation," Paper 91-0774, AIAA Aerospace Sciences Conference, Reno, NV, January 1991.

308. Boyd, I.D., Penko, P.F., and Meissner, D.L., "Numerical and Experimental Investigations of Rarefied Nozzle and Plume Flows of Nitrogen," Paper 91-1363, AIAA Thermophysics Conference, Honolulu, HI, June 1991.

309. Penko, P.F., Boyd, I.D., Meissner, D.L., and DeWitt, K.J., "Pressure Measurements in a Low-Density, Nozzle Plume for Code Verification," Paper 91-2110, AIAA Joint Propulsion Conference, Sacramento, CA, June 1991.

310. Boyd, I.D., "Assessment of Chemical Nonequilibrium in Rarefied Hypersonic Flow," Paper 90-0145, AIAA Aerospace Sciences Meeting, January 1990.

311. Boyd, I.D., Penko, P.F. and Carney, L.M., "Efficient Monte Carlo Simulation of Rarefied Flow in a Small Nozzle," Paper 90-1693, AIAA Thermophysics Conference, Seattle, WA, June 1990.

312. Boyd, I.D., "Direct Simulation of Rotational and Vibrational Nonequilibrium," Paper 89-1880, AIAA Thermophysics Conference, Buffalo, NY, June 1989.

313. Boyd, I.D. and Stark, J.P.W., "Modelling of a Small Hydrazine Thruster Plume in the Transition Flow Regime," Paper 88-2631, AIAA Thermophysics Conference, San Antonio, TX, June 1988.

F. Research Seminars

1. Aerospace Engineering, University of Colorado, Boulder, CO, April 2017.
2. Aerospace Corporation, El Segundo, CA, March 2014.
3. AFRL Propulsion Directorate, Wright-Patterson AFB, OH, May 2011.
4. Aerospace Engineering, University of Illinois-UC, IL, September 2010.
5. NASA Ames Research Center, Moffett Field, CA, July 2010.
6. AFRL Propulsion Directorate, Wright-Patterson AFB, OH, August 2009.
7. AFRL Air Vehicles Directorate, Wright-Patterson AFB, OH, May 2009.

8. Aerospace Engineering, Georgia Institute of Technology, Atlanta, GA, November 2008.
9. Aerospace Engineering, Ohio State University, Columbus, OH, November 2008.
10. Scientific Computing, Lawrence Berkeley National Laboratory, Berkeley, CA, May 2007.
11. NASA Ames Research Center, Moffett Field, CA, May 2007.
12. Mechanical & Aerospace Engineering, University of Virginia, Charlottesville, VA, March 2007.
13. Applied Scientific Computing, Lawrence Livermore National Laboratory, Livermore, CA, February 2007.
14. Mechanical & Aerospace Engineering, UCLA, Los Angeles, CA, February 2007.
15. Air Force Research Laboratory, Edwards Air Force Base, CA, December 2006.
16. NASA Ames Research Center, Moffett Field, CA, November 2006.
17. Mechanical Engineering, Stanford University, CA, October 2006.
18. Mechanical & Aerospace Engineering, Princeton University, Princeton, NJ, February 2006.
19. Mechanical Engineering, Michigan Technological University, Houghton, MI, Dec. 2005.
20. Department of Engineering, Queen Mary University of London, England, April 2005.
21. Aerospace Engineering, University of Michigan, Ann Arbor, MI, October 2004.
22. Aerospace & Oceanic Engineering, Virginia Tech, Blacksburg, VA, October 2004.
23. Aerospace Engineering, University of Glasgow, Scotland, July 2004.
24. NASA Marshall Space Flight Center, Huntsville, AL, April 2004.
25. Aerojet Corporation, Redmond, WA, January 2004.
26. Aerospace Engineering, University of Michigan, September 2003.
27. Applied Physics Laboratory, Johns Hopkins University, Laurel, MD, April 2003.

28. Aerospace Engineering, University of Maryland, College Park, MD, April 2003.
29. Mathematics, University of Michigan, Ann Arbor, MI, January 2003.
30. Air Force Research Laboratory, Edwards Air Force Base, CA, October 2002.
31. Applied CFD Branch, Wright-Patterson AFB, OH, April 2002.
32. Arnold Engineering and Development Center, Arnold AFB, TN, February 2002.
33. Mechanical Engineering, Vanderbilt University, Nashville, TN, September 2001.
34. Advanced Propulsion Center, NASA-MSFC, Huntsville, AL, April 2001.
35. Propulsion Division, TRW, Redondo Beach, CA, January 2001.
36. Aeronautics, California Institute of Technology, Pasadena, CA, October 2000.
37. Advanced Propulsion, Jet Propulsion Laboratory, Pasadena, CA, October 2000.
38. Aerospace Corporation, Los Angeles, CA, October 2000.
39. Mechanical Engineering, Ohio State University, Columbus, OH, April 2000.
40. Aerospace Engineering, University of Minnesota, Minneapolis, MN, April 1999.
41. Space Hazards Branch, Hanscom Air Force Base, Boston, MA, March 1999.
42. Plasma Physics, Universite Paul Sabatier, Toulouse, France, January 1999.
43. Aeronautics & Astronautics, University of Illinois-UC, IL, December 1998.
44. NASA Lewis Research Center, Cleveland, OH, November 1998.
45. Aerospace Engineering, University of Michigan, MI, October 1998.
46. Mechanical Engineering, Worcester Polytechnic Institute, MA, September 1998.
47. Applied Mathematics, Brown University, RI, September 1998.
48. CERCA, Montreal, Canada, May 1998.
49. Aerospace Engineering, Pennsylvania State University, State Park, PA, March 1997.

50. Applied Physics, Princeton University, Princeton, NJ, December 1996.
51. NASA Lewis Research Center, Cleveland, OH, September 1996.
52. Mechanical Engineering, Stanford University, CA, April 1996.
53. NASA Ames Research Center, Moffett Field, CA, April 1996.
54. Hanscom Air Force Base, Boston, MA, March 1996.
55. Mechanical Engineering, Ohio State University, Columbus, OH, October 1995.
56. NASA Lewis Research Center, Cleveland, OH, August 1995.
57. Physical Sciences Incorporated, Andover, MA, August 1995.
58. Aerospace Corporation, Los Angeles, CA, July 1995.
59. Phillips Laboratory, Edwards Air Force Base, CA, July 1995.
60. Space Propulsion Group, MIT, Cambridge, MA, April 1995.
61. Mechanical and Aerospace Engineering, Syracuse University, NY, December 1994.
62. Science Applications International Corporation, McLean, VA, August 1994.
63. Space Propulsion Group, MIT, Cambridge, MA, June 1994.
64. NASA Lewis Research Center, OH, May 1994.
65. NASA Ames Research Center, Moffett Field, CA, March 1994.
66. NASA Langley Research Center, Hampton, VA, January 1994.
67. NASA Lewis Research Center, Cleveland, OH, July 1993.
68. CALSPAN, Buffalo, NY, July 1993.
69. NASA Ames Research Center, CA, April 1993.
70. HTGL, Mechanical Engineering, Stanford University, CA, November 1992.
71. Aerospace Engineering, University of Southern California, CA, November 1992.
72. Aerospace Engineering, University of Virginia, Charlottesville, VA, April 1992.
73. Aeronautics and Astronautics, MIT, Cambridge, MA, April 1992.
74. Applied Mechanics and Engineering Science, UC San Diego, CA, March 1992.
75. NASA Lewis Research Center, Cleveland, OH, March 1992.

76. Aerospace Engineering, Pennsylvania State University, PA, March 1992.
77. Mechanical and Aerospace Engineering, Cornell University, NY, February 1992.
78. Aeronautics and Astronautics, Stanford University, CA, October 1991.
79. Laboratoire D'Aerothermique, CNRS, Meudon, France, April 1991.
80. NASA Lewis Research Center, Cleveland, OH, March 1991.
81. Aerospace Engineering, University of Southern California, CA, March 1990.
82. Mechanical Engineering, University of California, Berkeley, CA, August 1989.
83. Applied Mathematics, University of Kaiserslautern, Germany, September 1987.