

Kyle M. Hanquist

Education

- 2012–2017 **Ph.D., Aerospace Engineering**, *University of Michigan*, Ann Arbor, MI.
Areas of Study: Nonequilibrium Flows/Computational Fluid and Plasma Dynamics/Hypersonic Vehicles
- 2012–2015 **M.S.E., Aerospace Engineering**, *University of Michigan*, Ann Arbor, MI.
Area of Study: Fluid Dynamics
Relevant Coursework: Compressible Flow, Computational Fluid Dynamics, Turbulent Flow, Molecular Gas Dynamics, Viscous Flow, Plasma Physics, Teaching Engineering, Advanced Aerodynamics
- 2008–2012 **B.S.E., Mechanical Engineering**, *University of Nebraska*, Lincoln, NE.
Distinction and Honors
Relevant Coursework: Computational Heat Transfer, Thermal Fluids Lab, Dynamics and Control, Heat Transfer, MATLAB, CAD, Thermal Systems and Design, Fluid Mechanics, Thermodynamics, Materials Science
Certifications: Passed Fundamentals of Engineering Exam

Professional and Research Experience

- 2019-Present **Assistant Professor**, *Department of Aerospace & Mechanical Engineering*, University of Arizona, Tucson, AZ.
- Principal Investigator of the *Computational Hypersonics and Nonequilibrium Laboratory*, which is active in development and application of physical models and numerical methods for simulation of complex gas and plasma flows.
 - Founding investigator of Arizona Research Center for Hypersonics (<https://hypersonics.arizona.edu>).
- 2017-2019 **Research Fellow**, *Department of Aerospace Engineering*, University of Michigan, Ann Arbor, MI.
- Developed and validated models for computational fluid and plasma dynamics and material response to study the hypersonic flight aerothermodynamic environment.
 - Developed high-order aerothermochemistry models for air (e.g. oxygen) including state-to-state, electronic master equation, and nonequilibrium modeling and collaborated with Stanford University to compare to experimental data.
 - Developed optimization scheme for aerothermal design of hypersonic vehicles.
 - Mentored undergraduate and master students in areas of computational modeling of nonequilibrium gas and plasma dynamic systems in aerospace engineering.

2013-2017 **Graduate Research Assistant**, *Department of Aerospace Engineering*, University of Michigan, Ann Arbor, MI.

- Research assistant in Nonequilibrium Gas and Plasma Dynamics Laboratory directed by Prof. Iain Boyd.

2013 **Research Associate**, *USRA/NASA Ames*, Moffett Field, CA.

- Investigated a high-fidelity material response code, *PATO*, using data from ground testing (PICA Iso-Q samples in the Arc-Jet) and flight data (NASA's Stardust and Mars Science Laboratory missions).
- Mentors: Nagi Mansour, Ioana Cozmuta, David Hash, and Ryan McDaniel.

2011-2012 **Research Assistant**, *University of Nebraska*, Lincoln, NE.

- Researched fluid diodes as an infant heart-valve replacement experimentally and computationally using ANSYS Fluent
- Worked in collaboration with Prof. Kevin Cole and a pediatric heart surgeon at the University of Nebraska Medical Center
- *Honors Thesis*: Fluid Diodes for Treatment of Infant Heart-Valve Defects

Ph.D. Thesis

Title *Modeling of Electron Transpiration Cooling for Hypersonic Vehicles*

Advisor Iain D. Boyd

Committee Mark J. Kushner (cognate), Kenneth G. Powell, Philip L. Roe

Topic Using computational fluid and plasma dynamics to model thermionic emission from leading edges of hypersonic vehicles to investigate the effect of electron transpiration cooling. Thesis is available online at <http://ngpdlab.engin.umich.edu/files/papers/Hanquist.pdf>
Requirements met for Ph.D.: May 21, 2017.

Teaching and Mentoring Experience

2019-Present **Assistant Professor**, *University of Arizona*, Tucson, AZ.

- Core instructor for Introduction to Fluid Mechanics (AME 331), which is a core undergraduate course.
- Core instructor for Numerical Methods in Fluid Mechanics and Heat Transfer (AME 431-531), which is a joint senior and graduate level course.

2018-2019 **Lecturer**, *University of Michigan*, Ann Arbor, MI.

- Taught Molecular Gas Dynamics (AEROSP 532) for two consecutive winter semesters within the Aerospace Engineering department. This is a core graduate course that focuses on gas properties at the molecular level using kinetic theory, quantum mechanics, statistical mechanics, and chemical processes.

- 2017-2019 **Mentor**, *Nonequilibrium Gas and Plasma Dynamics Laboratory*, Ann Arbor, MI.
- *Effect of thermochemistry modeling on hypersonic flows*. Doctoral student: Michael Holloway (mhollo@umich.edu).
 - *High temperature shock analysis of pure oxygen*. Masters student: Kevin Viveros (kovivero@umich.edu)
 - *Shock tube analysis of pure oxygen using 2T and STS approaches*. Doctoral student: Pawel Sawicki (psawicki@umich.edu)
 - *Utilizing CFD to model rocket plumes in space*. Undergraduate student: Kathryn Henry (kvhenry@umich.edu)
 - *Master equation and shock tube analysis of vibrational relaxation times of oxygen*. Doctoral student: Michael Holloway (mhollo@umich.edu).
 - *Plume modeling*. Doctoral student: Austin Brenner (aubr@umich.edu)
 - *Assessment of open-source CFD software in accounting for real-gas effects*. Undergraduate student: Andry-Tohy Rakotovololona (rakoati@umich.edu)

2015 **Graduate Student Instructor**, *University of Michigan*, Ann Arbor, MI.

Aero 225: Introduction to Gas Dynamics (60 students)

- Lectured when professor was absent (14 lectures), held office hours and review sessions, and answered questions via email and the course website.

2014-2016 **Mentor**, *Michigan Mentorship Program*, Ann Arbor, MI.

- Mentored area high school students interested in engineering and computer science.

2011 **Teaching Assistant**, *University of Nebraska*, Lincoln, NE.

Mech 420: Heat Transfer

- Graded homework for a senior/graduate class of 35 students
- Co-wrote course notes

2010-2011 **Tutor**, *University of Nebraska*, Lincoln, NE.

- Tutored students in the Student Support Services (students with academic need, low income, first generation, or a documented disability) in areas of math, science, and engineering

Relevant Experience

2010 **Intern**, *United States Senate*, Washington, DC.

- Worked in the office of Nebraska Senator Benjamin Nelson (retired)
- Answered phone calls and mail from constituents
- Gave tours of U.S. Capitol building
- Received guests to the Senator's office

Activities, Affiliations, and Training

2020-Present AIAA Thermophysics Technical Committee (Member)

2020 NSF Engineering Directorate CAREER Proposal Workshop

- Attended this workshop designed to introduce junior faculty in submitting NSF CAREER proposals.

2018 NextProf - Michigan Engineering Workshop

- Attended this workshop designed to train participants for future academic success.

- 2018 Physics World
- Quoted in Physics World publication: <https://physicsworld.com/a/top-tips-from-tree-tops>
- 2018 Undergraduate Research Opportunity Program's Research Symposium (Judge)
- Judge posters and presentations presented by undergraduate researchers at the University of Michigan.
- 2018 NIH Proposal Workshop - University of Michigan
- Attended this workshop designed to train participants in proposals to funding agencies.
- 2017 Engineering Graduate Symposium (Judge)
- Judge the University of Michigan's College of Engineering Engineering Graduate Symposium, which included poster presentations of doctoral and master's students research.
- 2016 Golf Channel's Driver vs. Driver (Finalist)
- Finalist on nationally televised design competition where contestants compete to design Wilson-Staff's next golf driver.
 - Presented televised lecture on how aerodynamics are important in golf.
- 2016-2017 Aerospace Engineering Student Advisory Board (Member)
- Identified and planned activities for graduate students, as well as address areas of concern.
 - Organized department lecture and discussion on inclusion: *Growing together as Colleagues and Friends: Engaging in Sensitive Subjects and Difficult Conversations*.
- 2015 NSF I-Corps (Principal Investigator)
- Received a \$10,000 grant to identify commercial and product opportunities that can emerge from PhD research.
 - Focuses were on modeling cardiovascular system and glass manufacturing process.
- 2011-2012 Nebraska Pi Tau Sigma (President)
- Brought chapter into "good standing"
 - Best chapter report (national award)
 - Organized first annual College of Engineering Blood Drive
- 2011-2012 Tau Beta Pi Nebraska Alpha
- Most active member award.
- 2010-Present American Institute of Aeronautics and Astronautics (member)
- 2010-2012 AIAA Design-Build-Fly competition (co-leader)
- 2010-2012 Engineering Student Advisory Board (representative)

Journal Reviewing

Complete and updated list at [Publons.com](https://publons.com).

- 2017-2019 Journal of Thermophysics and Heat Transfer (7)
- 2017-2019 Nonlinear Dynamics (3)
- 2018-2019 Energies (17)
 - 2018 Applied Sciences (4)
 - 2019 Acta Astronautica
- 2017 International Journal of Heat and Mass Transfer (5)

Publications and Presentations

Journal

- 1 Jesse W. Streicher, Ajay Krish, Ronald K. Hanson, Kyle M. Hanquist, Ross S. Chaudhry, and Iain D. Boyd. Shock-tube measurements of coupled vibration-dissociation time-histories and rate parameters in oxygen and argon mixtures from 5,000-10,000 k. *Journal of Chemical Physics*, 2020 (submitted).
- 2 Michael E. Holloway, Kyle M. Hanquist, and Iain D. Boyd. Assessment of thermochemistry modeling for hypersonic flow over a double cone. *Journal of Thermophysics and Heat Transfer*, 2020.
- 3 Sinan Eyi, Kyle M. Hanquist, and Iain D. Boyd. Shape optimization of reentry vehicles to minimize heat loading. *Journal of Thermophysics and Heat Transfer*, 33(3):785–796, 2019.
- 4 Kyle M. Hanquist and Iain D. Boyd. Plasma assisted cooling of hot surfaces on hypersonic vehicles. *Frontiers in Physics: Plasma for Aerospace*, 7(9), 2019.
- 5 Sinan Eyi, Kyle M. Hanquist, and Iain D. Boyd. Aerothermodynamic design optimization of hypersonic vehicles. *Journal of Thermophysics and Heat Transfer*, 33(2):392–406, 2019.
- 6 Kentaro Hara and Kyle M. Hanquist. Test cases for grid-based direct kinetic modeling of plasma flows. *Plasma Sources Science and Technology*, 27(6), 2018.
- 7 Kyle M. Hanquist, Kentaro Hara, and Iain D. Boyd. Detailed modeling of electron emission for transpiration cooling of hypersonic vehicles. *Journal of Applied Physics*, 121(5), 2017.
- 8 Kyle M. Hanquist, Hicham Alkandry, and Iain D. Boyd. Evaluation of computational modeling of electron transpiration cooling at high enthalpies. *Journal of Thermophysics and Heat Transfer*, 31(2):283–293, 2017.

Conference

- 1 Aravinth Sadagopan, Daning Huang, and Kyle M. Hanquist. Impact of high-temperature effects on the aerothermoelastic behavior of composite skin panels in hypersonic flow. AIAA Paper 2020-0937, AIAA Science and Technology Forum and Exposition, 2020.
- 2 Kyle M. Hanquist and Iain D. Boyd. Modeling of electronically excited oxygen in O₂-Ar shock tube studies. AIAA Paper 2019-3567, AIAA Aviation and Aeronautics Forum and Exposition, 2019.

- 3 Sinan Eyi, Kyle M. Hanquist, and Iain D. Boyd. Shape optimization of reentry vehicles to minimize heat loading. AIAA Paper 2019-0973, AIAA Science and Technology Forum and Exposition, 2019.
- 4 Michael Holloway, Kyle M. Hanquist, and Iain D. Boyd. Effect of thermochemistry modeling on hypersonic flow over a double cone. AIAA Paper 2019-2281, AIAA Science and Technology Forum and Exposition, 2019.
- 5 Kyle M. Hanquist and Iain D. Boyd. Modeling of excited oxygen in post normal shock waves. AIAA Paper 2018-1714, AIAA Aviation and Aeronautics Forum and Exposition, 2018.
- 6 Sinan Eyi, Kyle M. Hanquist, and Iain D. Boyd. Aerothermodynamic design optimization of hypersonic vehicles. AIAA Paper 2018-3108, AIAA Aviation and Aeronautics Forum and Exposition, 2018.
- 7 Kyle M. Hanquist and Iain D. Boyd. Effectiveness of thermionic emission for cooling hypersonic vehicle surfaces. AIAA Paper AIAA Paper 2018-1714, AIAA Science and Technology Forum and Exposition, 2018.
- 8 Kyle M. Hanquist and Kevin J. Neitzel. Aerodynamic optimization of a golf driver using computational fluid dynamics. AIAA Paper AIAA 2017-0724, AIAA Science and Technology Forum and Exposition, 2017.
- 9 Kyle M. Hanquist and Iain D. Boyd. Computational analysis of electron transpiration cooling for hypersonic vehicles. AIAA Paper AIAA Paper 2017-0900, AIAA Science and Technology Forum and Exposition, 2017.
- 10 Kyle M. Hanquist, Kentaro Hara, and Iain D. Boyd. Modeling of electron transpiration cooling for hypersonic vehicles. AIAA Paper 2016-4433, AIAA Aviation and Aeronautics Forum and Exposition, 2016.
- 11 Kyle M. Hanquist and Iain D. Boyd. Emission limits for thermionic emission from leading edges of hypersonic vehicles. AIAA Paper 2016-0507, AIAA Science and Technology Forum and Exposition, 2016.
- 12 Kyle M. Hanquist and Iain D. Boyd. Comparisons of computations with experiments for electron transpiration cooling at high enthalpies. AIAA Paper 2015-2351, AIAA Aviation and Aeronautics Forum and Exposition, 2015.
- 13 Hicham Alkandry, Kyle M. Hanquist, and Iain D. Boyd. Conceptual analysis of electron transpiration cooling for the leading edges of hypersonic vehicles. AIAA Paper 2014-2674, AIAA Aviation and Aeronautics Forum and Exposition, 2014.

Current Contract/Grant Activities

N/A Currently under faculty start-up package.

References

Iain Boyd, *H. T. Sears Memorial Professor - National Security Faculty Director*, (PhD advisor).

- Ann and H.J. Smead Aerospace Engineering Sciences
- University of Colorado - Boulder
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Peiwen "Perry" Li, *Professor*, (department chair).

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Kentaro Hara, *Assistant Professor*, (research collaborator).

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- Stanford University
- 496 Lomita Mall
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Dwight Viehland, *Jack E. Cowling Professor*, (research collaborator).

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- Virginia Polytechnic Institute and State University
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David Hash, *Chief*, (mentor).

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- NASA Ames Research Center
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