DEPARTMENT OF MECHANICAL & AEROSPACE ENGINEERING
WILLIAM MAXWELL REED SEMINAR SERIES

"Inductively Coupled Plasma Flows: Experiments, Model Validation, and Application to Material Testing for Hypersonics"

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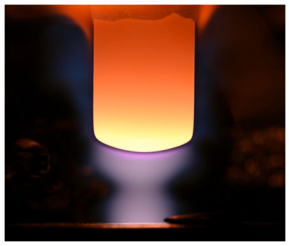
Abstract:
The behavior of plasmas is often complex and governed by the interaction of multiple physical processes: fluid mechanics, chemistry, thermodynamics, interface effects and electromagnetic fields. Modern and future engineered systems crucially rely on plasma flows, e.g. whether during atmospheric re-entry, hypersonic flight, plasma fuel synthesis, advanced manufacturing, electric propulsion, or plasma-assisted combustion. To advance technology in these domains, it is necessary to study fundamental questions in relevant environments and to develop predictive models. However, comprehensive experimental studies are challenging due to the extreme flow conditions, strong background radiation, electromagnetic fields, and multiphysics nature of the problems at hand. In this seminar, I will detail experimental and modeling efforts for the development of predictive capabilities regarding a 50 kW atmospheric pressure inductively coupled plasma torch and material tests representative of atmospheric hypersonic flight. Results from magnetic flux probes, coherent anti-Stokes Raman scattering, and emission spectroscopy are used to elucidate torch operation and plasma properties. Additionally, data from a capacitive glow discharge are employed to study plasma kinetic processes on a more fundamental level and to develop reduced order models at different pressures. Finally, measurements on graphite samples elucidate gas-surface chemistry processes controlling ablation in high-enthalpy flow environments. Through these endeavors, I will highlight how experimental measurements contribute to the development of new models and how these efforts motivate innovative diagnostic capabilities.



Speaker Bio:

Dan Fries is a research associate at the University of Texas at Austin in the Department of Aerospace Engineering and Engineering Mechanics. He holds a Ph.D. in Aerospace Engineering from the Georgia Institute of Technology, where his research focused on turbulent mixing, ignition, and combustion in subsonic and supersonic flows. Prior to his Ph.D., he obtained Master's degrees from the University of Stuttgart (Germany) and Georgia Tech. Currently, Dan is engaged in research on an inductively coupled plasma torch, high-enthalpy material tests, and plasma kinetics in a capacitive glow discharge. He collaborates closely with researchers at Sandia National Labs and the UT Oden Institute for Computational Engineering and Sciences. His research interests include high-enthalpy and high-speed flows, plasma and combustion chemistry, aerothermodynamics, laser diagnostics and spectroscopy, and the inversion of measurement models. Dan has published ten peer-reviewed articles in journals such as the Journal of Fluid Mechanics, Combustion & Flame, and Applied Optics. He has a Fulbright scholarship to his name, has filed a patent for an emergency ventilator, and has received awards at the Spaceport America Cup. His work is driven by a commitment to advancing space access, enabling exploration, and addressing environmental pollution through the study of important fundamental research questions.

Date: Tuesday, February 6, 2024
Time: 3:00 PM EST
Place: Whitehall Classroom Building 118
Contact: Dr. Jonathan Wenk

Attendance open to all interested persons

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