

DEPARTMENT OF MECHANICAL ENGINEERING

WILLIAM MAXWELL REED SEMINAR SERIES

“Hypersonics and Scramjet Research in Small-Scale ArcJet Facilities using Laser Diagnostics”

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Abstract: Hypersonic vehicles are a key technology for the future of civil transportation, access to space and military defense. However, hypersonics still poses a series of formidable challenges for today’s aerodynamicists and designers. The development of effective and reliable experimental techniques is of fundamental importance to advance our knowledge of the complex phenomena occurring in hypersonic flight. The first part of the presentation introduces a novel class of small-scale arcjet facilities and advanced laser diagnostic tools that can be used to attack complex aerothermodynamics problems. The main advantages and limitations of this approach are discussed. The second part shows a practical application of the above techniques to study choking, shock propagation and unstart in an ethylene fueled axisymmetric scramjet model tested at Mach 4.5. Inlet unstart is a critical problem affecting supersonic air-breathing propulsion systems, consisting in the disorging of the inlet-isolator shock train outside of the engine, with detrimental effects on the engine thrust. In particular, the physical mechanisms responsible for combustion-induced choking and the isolator-combustor interactions occurring during unstart are investigated. The talk is concluded by a summary of the main findings and plans for future research.

Bio: Damiano Baccarella, PhD is a postdoctoral research associate in the Center for Exascale Simulation of Plasma-Coupled Combustion of the University of Illinois at Urbana-Champaign, where is currently investigating plasma-assisted ignition and combustion techniques applied to high-speed air breathing propulsion systems. Dr. Baccarella earned a Master Degree in Aerospace Engineering at the University of Pisa (Italy) in 2006 and a Ph.D in Mechanical Engineering at the University of Illinois in 2018. Between 2006 and 2013 Dr. Baccarella was a research engineer in the aerospace company Alta, where he collaborated to several international programs, coordinated by the European Space Agency (ESA), concerning atmospheric re-entry and high-speed flight. Dr. Baccarella’s research interests include experimental hypersonic aerothermodynamics, aerospace propulsion, plasma-assisted combustion and laser diagnostics applied to reacting flows.

Date: Tuesday, Feb. 12th
Place: CB 118

Time: 3PM
Contact: Dr. Alexandre Martin 257-4462

Meet the speaker and have refreshments
Attendance open to all interested persons