

DEPARTMENT OF MECHANICAL ENGINEERING

WILLIAM MAXWELL REED SEMINAR SERIES

“Thermal Management of Hot Aerospace Surfaces using Plasma Assisted Cooling”

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University of Arizona

Abstract: The development of aeronautics has been largely driven by the passion to fly faster. From the flight of the Wright Flyer that flew 48 km/hr to the recent advances in hypersonic flight, most notably NASA’s X-43A that flew over 3 km/s, the velocity of flight has steadily increased. As these hypersonic speeds are reached and increased, contradicting aerothermodynamic design requirements present themselves. For example, a hypersonic cruise vehicle requires sharp leading edges to decrease the drag in order to maximize the range. However, the aerodynamic performance gains obtained by having a sharp leading edge come at the cost of very high, localized heating rates. There is currently no ideal way to manage these heating loads for sustained hypersonic flight. An approach that has been recently proposed involves using thermo-electric materials on these sharp leading edges to manage the heating loads. When exposed to high convective heating rates, these materials emit a current of electrons that leads to a cooling effect of the surface of the vehicle called electron transpiration cooling (ETC). A recent numerical study was completed and showed that ETC can reduce the stagnation point surface temperature by 11% and 50% for 6 km/s and 8 km/s test cases, respectively. In this seminar, Dr. Hanquist will present the challenges of modeling ETC and the results of recent investigations.

Bio: Dr. Kyle Hanquist is an Assistant Professor of Aerospace and Mechanical Engineering at the University of Arizona, where he is the Director of the Computational Hypersonics and Nonequilibrium Laboratory (chanl.arizona.edu) and a founding faculty member of the Arizona Research Center for Hypersonics (hypersonics.arizona.edu). His research group is active in the development and application of physical models and computational methods for the simulation of complex phenomena such as nonequilibrium and reactive flows experienced during hypersonic flight. Previously to joining the department, Prof. Hanquist was a Postdoctoral Research Fellow and Lecturer in the Department of Aerospace Engineering at the University of Michigan. He has research experiences at NASA Ames Research Center in the area of aerothermodynamics and heat shield design and has teaching interests in the area of fluid mechanics and computational methods. He earned his Ph.D. (2017) and M.S.E. (2015) in Aerospace Engineering from the University of Michigan and a B.S.E. (2012) in Mechanical Engineering from the University of Nebraska. Dr. Hanquist is a member of the American Institute of Aeronautics and Astronautics (AIAA), the AIAA Thermophysics Technical Committee, and the American Physical Society (APS).

Date: Friday, Feb. 26th

Place: <https://uky.zoom.us/j/92940732923>

Time: 3:00PM EST

Contact: Dr. Alexandre Martin 257-4462

Attendance open to all interested persons