Pratibha Raghunandan
(Advisor: Prof. Stephen Ruffin)

“A Numerical Study on Non-Equilibrium Multi-Temperature Thermo-Chemistry”

Thursday, March 21 at 11 a.m.
Montgomery Knight Building 317

Abstract:
The accurate computation of hypersonic flowfields is an ongoing endeavor and is important for the accurate prediction of heat transfer and space vehicle design. Of the various models existing till date of varying levels of complexity, multi-temperature modeling continues to be the most widely implemented and computationally least expensive form of modeling hypersonic flows. This thesis explores the resulting physics from various forms of multi-temperature non-equilibrium models developed including: chemical, thermo-chemical with the typical two temperature formalism, and thermo-chemical with multiple vibrational temperatures used to represent the gas under consideration.

The simulations carried out using an adaptive Cartesian grid-based flow solver emphasize the temporal and spatial sensitivity of non-equilibrium energy modeling approaches for isochoric finite heat baths and two-dimensional flow fields. The results are used to investigate collision effects, equilibrium dependence on initial non-equilibrium characteristics, and variations in shock structure predictions. For the aerothermodynamics community, this work contributes to understanding the resultant thermo-chemical non-equilibrium rate effects for different forms of representing the effective temperature of a reaction within a multi-temperature modeling perspective, and the resultant intermediate non-equilibrium chemistry effects could be leveraged for controlled heat transfer applications.

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