Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Large Eddy Simulation of Supersonic Cold Flow in Ramp-Cavity Combustor with Fuel Injector ZIA GHIASI, DONGRU LI, JONATHAN KOMPERDA, FARZAD MASHAYEK, University of Illinois at Chicago — Numerical simulation of supersonic flows is technologically important in efficient design and development of high-speed propulsion systems. The supersonic flow within the combustion chamber of scramjet is a prime example of multi-scale and multi-physics flow and is generally accompanied by concurrent presence of shock waves and turbulence. Developing a robust numerical method for such simulations leads to various technical challenges due to the presence of complex geometries, shocks, and turbulence, and normally requires massively parallel computation. In the present work, we employ the Discontinuous Spectral Element Method (DSEM) for high-fidelity simulation of supersonic and turbulent flows. The numerical code features an entropy-based artificial viscosity method for capturing shock waves and standard Smagorinsky-Lilly model for turbulence modeling. Two different turbulence sensors are also developed to improve the turbulent viscosity at the shocked areas and the inlet boundary layer. A supersonic cold flow within a ramp-cavity flame holder featuring a round fuel injector at the ramped side of the cavity is simulated. Results are provided and the physics of the flow is studied.

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Date submitted: 31 Jul 2015 Electronic form version 1.4