Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Periodic Loading of a Mach 4 Boundary Layer over a Compliant Surface by an Oscillating Shock Generator[1] MALLORY NEET[2], JOANNA AUSTIN[3], California Institute of Technology — A significant challenge in designing hypersonic vehicles is developing predictive models for aerodynamic loads associated with turbulent boundary layers and shock boundary layer interactions on compliant surfaces. Shock-boundary layer interactions on high-speed vehicles can lead to pressure fluctuations which can couple to structural modes and lead to premature high-cycle fatigue and ultimately component failure. In collaboration with simulations, experimental studies can give insight into the degree of fluid-structure coupling under prescribed load conditions. In this presentation, the flow response over a 0.2 mm thick compliant steel panel under dynamic loading from an oscillating shock generator is investigated in the Caltech Mach 4 Ludwieg tube. Euler simulations were performed to design the geometry and location of the shock generator, predict the amplitude of the oscillation required to drive the pressure wave across the compliant surface, and to calculate the pressure rise on the compliant surface. The flow response is characterized using fast-acting pressure transducers, high-speed schlieren images, and porous fast-response pressure sensitive paint and the panel response using laser doppler vibrometry.

[1]Work sponsored by AFOSR (FA9550-17-1-0106) with Dr. Ivett Leyva as Program Officer
[2]PhD Candidate, Graduate Aerospace Laboratories
[3]Professor of Aerospace, Graduate Aerospace Laboratories

Mallory Neet
California Institute of Technology

Date submitted: 26 Jul 2019 Electronic form version 1.4