Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Aero-Optical Distortions by Supersonic Turbulent Boundary Layers[1] KAN WANG, MENG WANG, University of Notre Dame — Large-eddy simulations are performed to investigate the aero-optical distortions caused by Mach 2 flat-plate turbulent boundary layers at $Re_\theta = 2650$ with wall temperatures at 0.8, 1.0 and 1.2 times the adiabatic wall temperature. The optical distortions for the adiabatic wall temperature case are compared with those caused by a subsonic turbulent boundary layer at a similar Reynolds number. It is found that the distortion magnitude normalized by the product of free-stream density, square of Mach number and boundary-layer thickness is slightly lower in the supersonic boundary layer than that in the subsonic boundary layer. The relative contributions from different flow regions to the optical path difference and its two-point spatial correlations are similar for subsonic and supersonic boundary layers. The contribution of Mach waves generated in the supersonic boundary layer to optical distortions is found to be small. The wall temperature significantly affects optical distortions. The distortion magnitude decreases with decreasing wall temperature, which is consistent with experimental findings.

[1]Supported by HEL-JTO through AFOSR Grant FA9550-13-1-0001

Meng Wang
University of Notre Dame

Date submitted: 01 Aug 2014 Electronic form version 1.4