Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Aero-optical predictions using wall-modeled LES[1] MOHAMMED KAMEL, KAN WANG, MENG WANG, University of Notre Dame — The accuracy of LES with wall-modeling for predicting aero-optical distortions is evaluated in turbulent boundary layers and flow over a cylindrical turret by comparing results with those from previous wall-resolved LES and experiments. For turbulent boundary-layer flows at Mach 0.5 and momentum-thickness Reynolds numbers up to 31000, the velocity statistics in the majority of the logarithmic layer and the wake region are well predicted with an equilibrium stress-balance model, but the level of density fluctuations and hence optical wavefront distortions are over-predicted. The causes for the over-prediction and model improvement are investigated. When wall-modeled LES is applied to compute the turbulent flow over a cylindrical turret with a flat window at Mach 0.5 and the experimental Reynolds number of 5.6×10^5 based on the cylinder radius, both the flow statistics and optical distortions induced by the separated shear layer agree well with experimental measurements and previous wall-resolved LES results at a lower Reynolds number. The incorporation of the pressure gradient effect in wall-model equations is shown to improve the prediction of the fluctuating density field and optical distortions.

[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