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Large eddy simulation of intersection shock-wave/ turbulent boundary layer interactions in hypersonic flow regimes[1] LIN FU, Center for Turbulence Research, Stanford University, SANJEEB BOSE, Cascade Technologies, PARVIZ MOIN, Center for Turbulence Research, Stanford University — For high-speed vehicles, accurate surface heat flux prediction is paramount for designing effective thermal protection systems. In this work, hypersonic flow over the double-fin geometry (Kussoy and Horstman, 1992) characterized by three-dimensional intersecting shock-waves/turbulent boundary-layer interaction at Mach 8.3 is numerically simulated using wall modeled large eddy simulation (WMLES) in the charLES code. This geometry is meant to be representative of an inlet for a hypersonic, air-breathing flight vehicle. The flow is characterized by aggressive pressure gradients, intersecting shock waves and strong separation. We use a standard equilibrium eddy viscosity wall model modified with semi-local scaling (Huang, JFM 305), which we demonstrate to yield more accurate comparisons with the experimental measurements. Both wall pressure and heat flux profiles have strong non-monotonic behaviors that challenge RANS turbulence models. However, the agreement of WMLES with the experimental data is remarkably good quantitatively, and qualitatively in terms of mean flow structures.

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