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Supersonic Boundary-Layer Response to Freestream Disturbances

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The prediction of the location and extent of boundary layer transition is a major issue for the design and control of supersonic flight vehicles. Blunt bodies generate detached bow shocks thereby adding complexities to the flow field. The resulting high pressure gradient and entropy layer change the characteristics of the boundary layer and the dynamics of shock-boundary layer interactions. Our presentation consists of three parts: computation of steady base flow, linear stability analysis, and receptivity simulations. The steady viscous flow field around a blunt flat plate at $M_\infty = 2.5$ is numerically simulated by solving the full Navier–Stokes equations using a multi-domain spectral collocation method. Linear stability analysis is carried out on the steady base flow. Receptivity simulations are related to planar freestream fast acoustic disturbance waves, which are imposed on the steady base flow. The analysis covers the interaction of disturbances with the shock wave and the receptivity of the boundary layer.

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