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LES and DNS of Shock-Boundary Layer Interactions. AVINASH JAMMALAMADAKA, ZHAORUI LI, FARHAD JABERI — Large-eddy simulations (LES) of an incident oblique shock wave interacting with a flat-plate supersonic turbulent boundary layer at various flow/shock conditions are performed and the results are compared with the direct numerical simulation (DNS) data. The objectives are to evaluate the performance of compressible subgrid-scale (SGS) models in shock-turbulence flow regions and to study the effects of shock angle, Mach number and other parameters on the shock-boundary layer interactions. The filtered compressible Navier-Stokes equations are solved with a seventh-order Monotonicity-Preserving scheme for the Euler fluxes and a sixth-order compact scheme for the viscous terms. Comparison of DNS and LES results reveal the significance of the SGS model in supersonic boundary layer flow, particularly in the shock-turbulence regions. Due to its excessive dissipative nature, the standard Smagorinsky and gradient type models are found to predict a significantly larger mean separation bubble size when compared to the DNS data. In contrast, the predicted results by the scale-similarity, mixed or dynamic Smagorinsky models are found to be in reasonably good agreement with the DNS. Similar trends are observed for all the major flow variables. In general, the dynamic models, though computationally expensive, are found to generate better results when compared to other models.

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