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Constrained Large-eddy Simulation of Supersonic Turbulent Boundary Layer over a Compression Ramp LIANG CHEN, ZUOLI XIAO, YIPENG SHI, SHIYI CHEN, Peking University — The mean and statistical quantities as well as the flow patterns of a supersonic turbulent boundary layer over a compression ramp are numerically investigated using the constrained large-eddy simulation (CLES) method. The compression ramp is characterized by a deflection angle of 24. The free-stream Mach number is Ma=2.9, and the Reynolds number based on the inlet boundary layer thickness is Reθ =2300, in accordance with the reference experiment. A rescaling recycling technique is utilized for imposing the inflow boundary. Both the spatial average and the time average methods are employed in the constraint conditions for the Reynolds stresses and heat flux in the near-wall region. The results from CLES are well compared with those from detached-eddy simulation (DES), Reynolds-averaged Navier-Stokes (RANS) simulation, traditional large-eddy simulation (TLES), the experimental and DNS data. It is found that the wall-friction distribution, the wall-pressure distribution, the size of separation bubble, etc., predicted by CLES are in good agreement with the experimental and/or DNS data. Meanwhile, CLES proves to be able to predict the locations of separation and reattachment more accurately than DES, RANS and TLES.

Shiyi Chen
Peking University

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