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DNS of Supersonic Turbulent Flows in a DLR Scramjet Intake

XINLIANG LI, CHANGPING YU, LHD, Institute of Mechanics, Chinese Academy of Science (CAS) — Direct numerical simulation (DNS) of supersonic/hypersonic flow through a DLR scramjet intake GK01 is performed. The free stream Mach numbers are 3, 5 and 7, and the angle of attack is zero degree. The DNS cases are performed by using an optimized MP scheme with adaptive dissipation (OMP-AD) developed by the authors, and the blow-and-suction perturbations near the leading edge are used to trigger the transition. To stabilize the simulation, locally non-linear fluttering is used in high-Mach-number case. The transition, separation, and shock-turbulent boundary layer interaction are studied by using both flow visualization and statistical analysis. A new method, OMP-AD, is also addressed in this paper. The OMP-AD scheme is developed by using joint MP method and optimized technique, and the coefficients in the scheme are flexible to show low dissipation in the smoothing region, and to show high robust (but high dissipation) in the large gradient region. Numerical tests show that the OMP-AD is more robust than the original MP schemes, and the numerical dissipation of OMP-AD is very low.

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