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NUMERICAL INVESTIGATION ON THE MIXING CHARACTERISTICS OF SHEAR LAYERS IN SUPERSONIC-SUBSONIC FLOW

Abstract

Aiming at the mixing process between supersonic rocket wake flow and subsonic ramjet air in Rocket Based Combined Cycle engine, the mixing characteristics of shear layer in supersonic-subsonic flow has attracted more attention to research the primary influence factor, growth rate, vortex structures and enhancement measures. In this paper, Large Eddy Simulation (LES) has been conducted to investigate the mixing characteristics on the normalized growth rate, flow field structures and parameter influence rule of shear layers in a planar supersonic-subsonic flow. The simulation results have shown well agreement with the experimental data of streamwise schlieren photographs and velocity distribution using the laser Doppler velocimeter system, which indicating the LES method reasonable. The compressibility parameter c , a nonmalized parameter to indicate the compressibility of shear layer, ranges from 0.5 to 3 to analyse the parameter influence rule, and the pressure difference P at the exit of splitter plate changes from 0 to 6000Pa to discuss the variation of nonmalized growth rate, vortex structures and deflection angle of shear layer. The results show that, the nonmalized growth rate, a representational parameter to reflect the mixing strength, reduces with the c increasing, which accords well with the known conclusion, as a result, the LES method's reasonability has been validated more. Also, the growth rate and deflection angle of shear layer under diverse pressure difference can be obtained to direct the mixing enhancement. Meanwhile, the forms and development process of large scale vortex structures can be observed clearly at different dimension, from which the functions between c and the size of large scale eddy can be acquired to reveal the development character of shear layer. In addition, the shocklet structures, a particular flow field structures caught along with the streamwise eddy structures at larger c conditions ,can be found under different parameter of c to confirm the change boundary to c.