Simulation of shock wave boundary layer interaction in flat channel with jet injection

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Abstract: The flow around jets has been comprehensively investigated experimentally [1] and simulated numerically. Nowadays the interactions between boundary layer and shock wave in the channel flow field with perpendicular jet injection aren't well understood. Due to complexity of these interactions, usually they are studied by parts. One part of these studies focuses on the properties of the shock wave structures in the region of the jet injection [2], other considers the zone of the shock wave boundary layer interaction [3]. In the present we simulate and study the shock wave structures in the supersonic channel flow with jet injection where both processes will be present. For describing the process of the multispecies supersonic gas flow in the flat channel with perpendicular jet injection, Favre-averaged Navier-Stokes equations coupled with $k-\omega$ turbulence model are applying. High order Weighted Essentially Non-Oscillatory (WENO) scheme is used to approximate convective terms. During the investigation of flow physics in detail, the three shock wave structures are observed: in the region of the jet (barrel, bow, oblique and closing shocks), on the upper boundary layer (reflection, transmitted and reattachment shocks), and new structures behind the jet on the lower boundary layer, which are analogous to the structures on the upper boundary layer.

Keywords: supersonic flow, SWBLI, flow control, separation, Navier-Stokes equations, WENO-scheme, shock wave

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