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Author: Prof. Shen Chibing
National University of Defense Technology, China

NUMERICAL SIMULATION RESEARCH FOR THE EFFECTS OF TRAILING EDGE STRUCTURE ON THE SUPERSONIC MIXING LAYER

Abstract

A turbulent supersonic mixing layer plays a very important role on combustion performance of a dual-combustor ramjet. Based on the study of fuel-rich gas and supersonic inlets inside DCR, the physical model of supersonic turbulent mixing layer is built to simulate specific engineering problems in this paper. Effects of different trailing edge structures on supersonic mixing layer are studied by using the technique of three-dimensional large eddy simulation (LES). Trailing edge structures are designed for research of the passive mixing enhancement technique. These structures have a thickness of 1mm, and the shape of sawtooth with different space width. The mixing enhancement mechanism of trailing edge structures with the shape of sawtooth is revealed by LES. Firstly, the vortex structure development law of the mixing layer with trailing edge structure having the shape of sawtooth is obtained. The thickness of the mixing layer becomes thicker along by the flow direction, and the regular spanwise vortex structure is formed on the spanwise direction. The vortex develops gradually along by the flow direction, and the all the vortex cores are located next to the tip of the sawtooth trailing edge structure with 10mm space width. Secondly, many small vortexes are formed next to the alveolus of the sawtooth trailing edge structure with 20mm space width. Finally, streamwise vortexs can be induced by sawtooth trailing edge structure, and a sine distribution of the vortex is presented in spanwise direction. The peak of the vortex sine distribution is located next to the the tip of the sawtooth trailing edge structure, and the valley of the vortex sine distribution is located next to the alveolus of the sawtooth trailing edge structure. The research results can provide reference for developing mixing enhancement techniques of supersonic mixing layer.