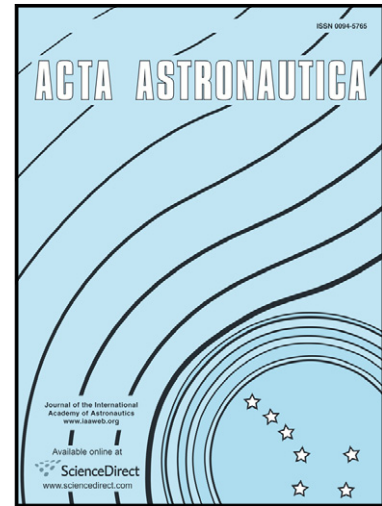


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Effects of oblique and transverse injection on the characteristics of jet in supersonic crossflow

Yujie Zhang^{1,2*}, Weidong Liu^{1,2}, Bo Wang^{1,2}

1. College of Aerospace Science and Engineering, National University of Defense Technology, Changsha, Hunan
410073, People's Republic of China

2. Science and Technology on Scramjet Laboratory, National University of Defense Technology, Changsha,
Hunan 410073, People's Republic of China

Abstract: The effect of oblique and transverse injection on the transverse jet was investigated by the hybrid RANS/LES simulation with recycling-rescaling procedure. The streamwise velocity distribution and instantaneous fine turbulent structures of transverse jet obtained by the particle image velocimetry (PIV) and nanoparticle-based planar laser-scattering (NPLS) are applied to validate the accuracy of simulation approach. Statistics obtained from the hybrid RANS/LES simulation with fine mesh shown good agreement with the experimental results. Four kinds of vortex structures are observed in the flow field, namely leading edge vortices, hanging vortices, counter-rotating vortex pairs (CVPs) and horseshoes vortex. The instantaneous results and spatial correlation analysis show that the size and interval of large-scale structures in windward shear layer of 45° jet are smaller and shorter than that of 90° jet, respectively. Compared with the 45° jet, the stronger shear between injectant and crossflow leads to the early breakup of CVPs in 90° jet, so the length of CVPs in 90° jet is shorter than that of 45° jet in time-averaged results. The simulation also shows that the rotating number of CVPs in 45° jet is more than in 90° jet, but the mixing of 45° jet is worse than that of 90° jet, which indicates that the large-scale structures in the shear layer between the crossflow and injectant make more contribution to the mixing process.

* corresponding author, E-mail: jamejie123@163.com, Phone: +86 731 84574756

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