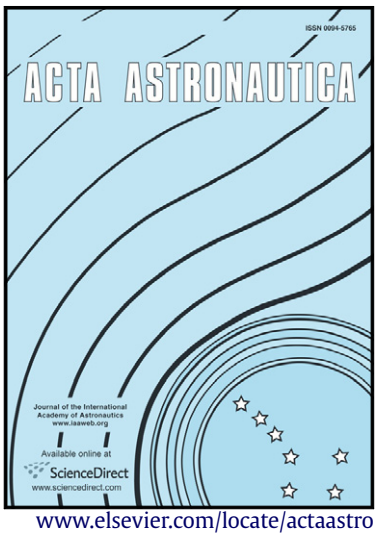

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Effects of oblique and transverse injection on the characteristics of jet in supersonic crossflow

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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^{o} jet are smaller and shorter than that of 90^{o} jet, respectively. Compared with the 45^{o} jet, the stronger shear between injectant and crossflow leads to the early breakup of CVPs in 90^{o} jet, so the length of CVPs in 90^{o} jet is shorter than that of 45^{o} jet in time-averaged results. The simulation also shows that the rotating number of CVPs in 45^{o} jet is more than in 90^{o} jet, but the mixing of 45^{o} jet is worse than that of 90^{o} jet, which indicates that the large-scale structures in the shear layer between the crossflow and injectant make more contribution to the mixing process.

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