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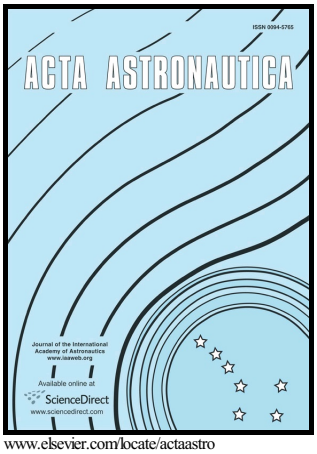

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Abstract: The gas-liquid interaction process of a liquid jet in supersonic crossflow with a Mach number of 1.94 was investigated numerically using the Eulerian-Lagrangian method. The KH (Kelvin-Helmholtz) breakup model was used to calculate the droplet stripping process, and the secondary breakup process was simulated by the competition of RT (Rayleigh-Taylor) breakup model and TAB (Taylor Analogy Breakup) model. A correction of drag coefficient was proposed by considering the compressible effects and the deformation of droplets. The location and velocity models of child droplets after breakup were improved according to droplet deformation. It was found that the calculated spray features, including spray penetration, droplet size distribution and droplet velocity profile agree reasonably well with the experiment. Numerical results revealed that the streamlines of air flow could intersect with the trajectory of droplets and are deflected towards the near-wall region after they enter into spray zone around the central plane. The analysis of gas-liquid relative velocity and droplet deformation suggested that the breakup of droplets mainly occurs around the front region of the spray where gathered a large number of droplets with different sizes. The liquid trailing phenomenon of jet spray which has been discovered by the previous experiment was successfully captured, and a reasonable explanation was given based on the analysis of gas-liquid interaction process.

Keywords: Large eddy simulation; Eulerian–Lagrangian; Supersonic crossflow; Liquid jet; Droplet breakup; Spray; Two-phase flow

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