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Evaporation effect of liquid jet in supersonic crossflow SHUFAN ZOU, DEZHI ZHOU, SUO YANG, University of Minnesota,Twin Cities — Due to the longer auto-ignition time with liquid fuels compared with hydrogen, the understanding of interaction of shock wave with the spray and subsequent vapor mixing are significant to design ramjet/scramjet with liquid fuel spray. In this study, an Eulerian-Lagrangian framework with detailed transport models for the Eulerian gas-phase species properties and Lagrangian spray, atomization, evaporation and break-up is developed based on the OpenFOAM platform. In addition, an equilibrium wall function is added to model the near-wall properties. The newly developed solver is used to conduct wall-modeled large eddy simulations (WMLES) on a non-reactive liquid jet in supersonic crossflow (JISCF) with liquid water spray. The strong supersonic flow break up the transverse spray droplet and the droplet evaporation and fuel properties (e.g., heat capacity and enthalpy of evaporation) effects on liquid plume trajectory and penetration length are discussed in this study. It is shown that evaporation effect primarily happens in the temperature field. For n-heptane spray, such impact could be conducted to other properties of the flow field like spray plume size, particle size distribution and volumetric flux, which is caused by the difference in latent heat and heat capacity.

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