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High Fidelity Simulation of Transcritical Liquid Jet in Crossflow

XIAOYI LI, MARIOS SOTERIOU, United Technologies Research Center — Transcritical injection of liquid fuel occurs in many practical applications such as diesel, rocket and gas turbine engines. In these applications, the liquid fuel, with a supercritical pressure and a subcritical temperature, is introduced into an environment where both the pressure and temperature exceeds the critical point of the fuel. The convoluted physics of the transition from subcritical to supercritical conditions poses great challenges for both experimental and numerical investigations. In this work, numerical simulation of a binary system of a subcritical liquid injecting into a supercritical gaseous crossflow is performed. The spatially varying fluid thermodynamic and transport properties are evaluated using established cubic equation of state and extended corresponding state principles with established mixing rules. To efficiently account for the large spatial gradients in property variations, an adaptive mesh refinement technique is employed. The transcritical simulation results are compared with the predictions from the traditional subcritical jet atomization simulations.

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