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Numerical simulation of evaporating liquid jet in crossflow MARIOS SOTERIOU, XIAOYI LI, United Technologies Research Center — Atomization of liquid fuel jets by cross-flowing air is critical to combustor performance. Ability to experimentally probe the fundamentals of this multiscale two phase flows has been hampered by limitations in experimental techniques and the challenges posed by operating conditions. Direct numerical simulation has recently emerged as a promising alternative due to advances in computer hardware and numerical methods. Using this approach, we recently demonstrated the ability to reproduce the physics of atomization of a liquid jet in cross-flow (LJIC) under ambient conditions. In this work we consider this flow in a high temperature environment. The inclusion of evaporation is the major new element. The numerical approach employs the CLSVOF method to capture the liquid-gas interface. Interface evaporation is solved directly with proper treatment of interface conditions and reproduces the relevant species/temperature fields there. A Lagrangian droplet tracking approach is used for the small droplets which are transferred from the Eulerian phase and evaporate using a traditional d^2 law model. Other key algorithms of the massively parallelized solver include a ghost fluid method, a multi-grid preconditioned conjugate gradient approach and an adaptive mesh refinement technique. The overall method is verified using canonical problems. Simulations of evaporating LJIC point to the significant effect that evaporation has on the evolution of this flow and elucidate the downstream fuel species patterns.

Marios Soteriou
United Technologies Research Center

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