Multiscale simulations of primary atomization

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Abstract

Atomization of a liquid jet by a high speed air stream flowing over it is a phenomenon of paramount importance to industrial applications. The probability density function (PDF) of the droplet size distribution in atomization has been a subject of keen interest as it is a measure of atomization efficiency. Further, the trajectory of the droplets as they detach and disperse away from the jet is also important. Numerical simulations resolving the smallest droplets are exceedingly expensive computationally. We present here, a Lagrangian tracking algorithm coupled with a VOF algorithm to transform smallest droplets into particles to be modeled as Lagrangian particles. The influence of the droplets on the flow is accounted for by using a momentum source term in the Navier-Stokes equation. We show that the droplets maintain a near linear trajectory as they pass through the gas jet. A PDF of the droplet distribution in different regions suggests different mechanisms generating droplets at different scales and show the evolution of the PDF in space.

Key words: Multiscale simulations, Atomization, Lagrangian Particle Tracking, Volume-of-fluid.

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