

BREAKUP MODELING FOR ATOMIZATION SIMULATIONS

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Keywords: Atomization, Volume-of-Fluid (VOF), Subgrid structures, Fragmentation model

Abstract. In Volume-of-Fluid (VOF) atomization simulations, subgrid liquid structures pose a critical challenge: when interfacial features become thinner than the mesh resolution, curvature calculations generate high-frequency numerical oscillations that trigger non-physical fragmentation of liquid sheets and bias the droplet size distribution toward cell-scale fragments. To address this issue, we apply a fragmentation model, manifold death, to detect weak spots and perforate thin sheets once they reach a predefined critical thickness that can be resolved with the local grid size. This controlled removal of subgrid structures prevents curvature-driven numerical noise and improves the convergence of droplet population statistics above a critical diameter, yielding a coherent distribution for the analyzed benchmark case. By tuning the critical thickness threshold and the number of perforations, practitioners can balance simulation accuracy with computational cost. The manifold death model ensures that the key physical processes of ligament fragmentation and droplet formation are represented without artifacts, preserving the statistical validity of atomization metrics while maintaining manageable mesh requirements.