Mechanical Engineering Thesis Defense

Detailed Analysis of Liquid Ligament Breakup

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Abstract

Multiphase flows are relevant to various industrial processes and is also a ubiquitous feature of nature. Atomization involves multiphase flow and the fragmentation of the liquid bulk emerging from it is one of the most researched aspect. The final drop size distribution of fragmenting liquids is important and is crucial to quantifying the performance of atomizers. The tracking of the interface of this liquid bulk is accurately done using popular techniques like Volume of Fluid and Level Set Methods but is computationally very expensive. This thesis deals with implementing methods to determine this drop size distribution by observing the changes in the ligament geometry with an aim to reduce computational cost. The first of the two methods implemented in this thesis involves fitting the geometry of the ligament with blobs (spheres) at different instants before the complete fragmentation of the liquid ligament and observing the evolution of their size distribution as it ultimately rules the final drop size distribution .The drop sizes from the Direct Numerical Simulations (DNS) runs in which the liquid ligament is provided with different sinusoidal surface perturbation is compared with the theoretical drop size probability distribution functions (pdf). The results show that the pdf of the blobs can predict the actual final drop size distribution. The second method utilizes the Rayleigh-Plateau Instability with an aim to determine the relation between fluid properties like density, viscosity, velocity, Stretching of ligament, Aspect ratio and dimensionless fluid properties like Ohnesorge and Weber number through DNS of ligaments with an initial surface perturbation of small amplitude. The drop sizes from Rayleigh-Plateau Instability are compared with the drops from the DNS runs.

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Zoom Link: https://asu.zoom.us/j/2852822859