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Droplet Dynamics in Rotating Flows

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Abstract

This paper deals with investigations of droplet dynamics in rotating flows. In many previous studies droplet dynamics was analysed in simple unidirectional flows. To fill this gap, the focus of this study is an overview on investigations of droplet dynamics in a complex rotating flow. A Lattice Boltzmann method with high potential in simulation of two-phase unsteady flows is applied to simulate the physics of the problem in a lid-driven cavity. In spite of its simple geometry, there is a complex rotating flow field containing different vortices and shear regions. The Reynolds number based on the cavity length scale and the upper wall velocity, Re_L , is considered to be 1000. We discuss here effects of different parameters such as: density ratios (1, 5, 10, 100, and 1000), droplet sizes ($D/L = 0.097, 0.114, 0.131$ and 0.2), and droplet initial positions ($1/8, 2/8$, and $3/8$ of the cavity length, L , out of center). The results are discussed in terms of global flow physics and its interaction with the droplet, drop deformation during its motion along with the main flow, and droplet trajectories. It is shown that there are strong interactions between the droplet and the main carrying flow. During motion, the droplets pass through different flow regions containing acceleration/deceleration zones. Consequently, the droplets experience different shear forces resulting in stretching, shrinking, rotating and dilatation which all contribute to the dynamics of the droplet.

Keywords: Two-Phase Flow, Droplet Dynamics, Rotating Flow, Lattice Boltzmann Method.

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