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Numerical Simulations of Complex Multiphase Flows

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Abstract

Direct numerical simulations of multiphase flows, where every continuum temporal and spatial scale are fully resolved, are now relatively routine, at least for relatively simple disperse flows of bubbles, drops and solid particles. The challenges now are twofold: How to use the results to increase our ability to predict industrial scale flows and how to conduct direct numerical simulations of much more complex systems. Routine predictions usually require course models where the large scales are evolved deterministically, and small scales are included statistically. We will discuss strategies to coarsen results of fully resolved simulations of multiphase flows in a systematic way, retaining sharp interfaces, as well as initial efforts to develop models to evolve the coarse flow. We also discuss efforts to simulate complex flows, including three-phase liquid-gas-solid disperse flows where the solid particles are either hydrophobic or hydrophilic.