Wetting boundaries for high density ratio ternary Lattice Boltzmann

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Abstract:

The physics and dynamics of a ternary fluid system are of special interests for a variety of practical applications, including combustion engines, ink-jet printing, and oil recovery. We recently developed a novel lattice Boltzmann method based on the free energy approach, which combines multiphase and multicomponent terms. The model is able to simulate two liquid phases and one gas phase having a density contrast of the order of 1000. By employing the Entropic collision operator we are able to simulate the impact of immiscible drops at large Weber and Reynolds numbers.

In this contribution, I will present a thorough validation of the allowed combinations of surface tensions, in order to precisely match realistic ternary systems. I will also present three alternative implementations of wetting boundaries, based either on force or geometric criteria. All three methods allow to accurately reproduce a wide range of equilibrium contact angles. We also validated the dynamic properties by simulating the motion of a train of drops in a channel, driven by an imbalance of capillary forces.

In the future, we plan to employ this method to investigate the mechanics of drops impacting on a liquid bath and on Lubricant-Infused Substrates (LIS).