Phase field lattice Boltzmann method for multiphase flows

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Abstract

In this talk, we will introduce our recent advances on the phase field lattice Boltzmann (LB) method for multiphase flows. The method takes advantage of two standard LB equations, one of which is used to solve the conservative Allen-Cahn equation for interface capturing, and another is adopted to solve the incompressible Navier-Stokes equations for hydrodynamics. The appropriate equilibrium distribution functions and the simplified forcing distribution function are elegantly incorporated in the LB equations. The feature of the method is that it enables to handle multiphase flows with high density ratios, up to the order of $O(10^3)$. Besides, in order to simulate the multiphase flows involving wetting solid, two popular contact angle models including the cubic surface-energy model and the geometrical model are also implemented in the method, and their numerical performances are also evaluated. Finally, we also conveniently introduce the contact angle hysteresis effect into the present LB method by considering the prescription of a receding contact angle and an advancing contact angle. The method is validated by simulating many steady and unsteady problems without or with the contact angle hysteresis, and the satisfactory numerical results are obtained, which indicates that the present method is a promising candidate for simulating practical multiphase flow problems.