A new lattice Boltzmann method to describe solid particles at fluid interfaces

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We suggest a new numerical method to describe particle dynamics at fluid interfaces. The presented method is established on combining a multi-phase lattice Boltzmann method with a numerical algorithm regarding solid particles in a fluid. To validate the present algorithm, we perform several simulation tests. As first, equilibrium contact angles of a single particle at the fluid interfaces is studied. With control of wettability of particles, the equilibrium position of particles is changed, and its values follow the known analytic solution. As the next step, we extend the test toward a more complicated system, such that two high-density particles are attached at fluid interfaces. In that system, the contact angle of particles and interfaces' curvature are determined by the balance between the buoyancy force and the interfacial tension of fluids. These characteristics are reflected well in the present simulation, and also the results correspond to the analytic solution based on the capillary charge theory. From these quantitative and qualitative analyses, we conclude that the capillary interactions on particles are correctly reproduced in the proposed method.