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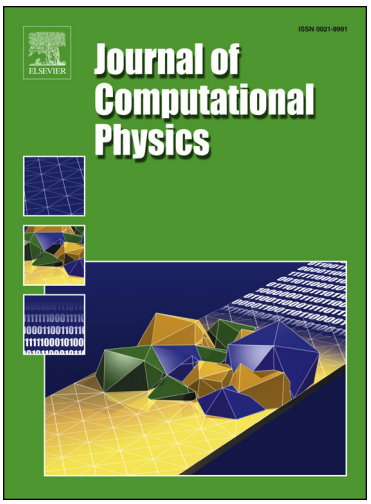

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A weighted multiple-relaxation-time lattice Boltzmann method for multiphase flows and its application to partial coalescence cascades

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Abstract

We present a lattice Boltzmann method (LBM) with a weighted multiple-relaxation-time (WMRT) collision model and an adaptive mesh refinement (AMR) algorithm for direct numerical simulation of two-phase flows in three dimensions. The proposed WMRT model enhances the numerical stability of the LBM for immiscible fluids at high density ratios, particularly on the D3Q27 lattice. The effectiveness and efficiency of the proposed WMRT-LBM-AMR is validated through simulations of (a) buoyancy-driven motion and deformation of a gas bubble rising in a viscous liquid; (b) the bag-breakup mechanism of a falling drop; (c) crown splashing of a droplet on a wet surface; and (d) the partial coalescence mechanism of a liquid drop at a liquid-liquid interface. The numerical simulations agree well with available experimental data and theoretical approximations where applicable.

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