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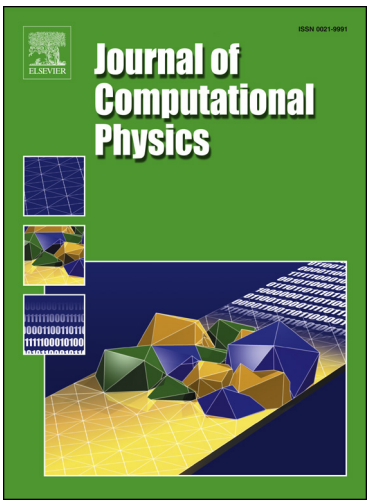

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Diffuse interface modeling of three-phase contact line dynamics on curved boundaries: A lattice Boltzmann model for large density and viscosity ratios

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Abstract

We introduce a simple and efficient lattice Boltzmann method for immiscible multiphase flows, capable of handling large density and viscosity contrasts. The model is based on a diffuse-interface phase-field approach. Within this context we propose a new algorithm for specifying the three-phase contact angle on curved boundaries within the framework of structured Cartesian grids. The proposed method has superior computational accuracy compared with the common approach of approximating curved boundaries with stair cases. We test the model by applying it to four benchmark problems: (i) wetting and dewetting of a droplet on a flat surface and (ii) on a cylindrical surface, (iii) multiphase flow past a circular cylinder at an intermediate Reynolds number, and (iv) a droplet falling on hydrophilic and superhydrophobic circular cylinders under differing conditions. Where available, our results show good agreement with analytical solutions and/or existing experimental data, highlighting strengths of this new approach.

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