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A Novel Numerical Solver for Incompressible Two-Fluid Flows at High Reynolds Numbers ZIXUAN YANG, SHIZHAO WANG, GUOWEI HE, Institute of Mechanics, Chinese Academy of Sciences — We present a proposed novel numerical method for robust simulations of two-fluid flows at high Reynolds numbers. The conservative form of the momentum equation is solved, and the convection equation of density is evolved together with the momentum equation at all cell faces. Consistent schemes are used to calculate the density and momentum fluxes. The interface between the two fluid phases is captured using the coupled level-set and volume-of-fluid method. The interface is kept sharp without any diffusion of the density or viscosity around the interface. The performance of the new algorithm is tested using two canonical cases: the convection of a high-density droplet and the collapse of a 2D water column. The results of the proposed method are in excellent agreement with analytical solutions and the results of laboratory experiments. The proposed method is also used to simulation two 3D cases with complex interface geometries: a plunging wave at a high Reynolds number and a collapsing water column impinging onto a fixed object. The test results show that if the interface is kept sharp and if the mass of each fluid phase is effectively conserved, the dynamics of the interface can be predicted accurately at a relatively low grid resolution.

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