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A Particle-Based Method Coupled with Finite Volume Solver for Interfacial Flows

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Abstract

A hybrid Lagrangian-Eulerian (hLE) scheme, combining a particle-based, mesh-free technique with a finite-volume flow solver, is developed for direct simulations of two-phase flows. The approach uses marker points around the interface and advects the signed distance to the interface in a Lagrangian frame. The kernel–based derivative calculations typical of particle methods are used to extract the interface normal and curvature from unordered marker points. Connectivity between the marker points is not necessary. The fluid flow equations are solved on a background, fixed mesh using a co-located grid finite volume solver together with balanced force algorithm (Francois *et al.* JCP, 2006, Herrmann JCP, 2007) for surface tension force. The numerical scheme is applied to standard test cases to show promising results: (i) parasitic currents in a stationary spherical drop, (ii) small amplitude damped surface waves, (iii) capillary waves on droplet surface, (iv) Rayleigh-Taylor instability, and (v) gravity-driven bubble/droplet in a stationary fluid.

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