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A balanced-force finite-element method for surface-tension-driven interfacial flows using interface-capturing approaches ZHIHUA XIE, DIMITRIOS PAVLIDIS, JAMES PERCIVAL, Imperial College London, JEFFERSON GOMES, University of Aberdeen, CHRISTOPHER PAIN, OMAR MATAR, Imperial College London — Interfacial flows with surface tension are often found in industrial and practical engineering applications, including bubbles, droplets, liquid film and jets. Accurate modelling of such flows is challenging due to their highly complex dynamics, which often involve changes of interfacial topology. We present a balanced-force finite-element method with adaptive unstructured meshes for interfacial flows. The method uses a mixed control-volume and finite element formulation, which ensures the surface tension forces, and the resulting pressure gradients, are exactly balanced, minimising the spurious velocities often found in numerical simulations of such flows. A volume-of-fluid-type method is employed for interface capturing based on a compressive control-volume advection method, and second-order finite element methods. A distance function is reconstructed from the volume fraction on the unstructured meshes, which provides accurate estimation of the curvature. Numerical examples of an equilibrium drop and dynamics of bubbles (droplets) are presented to demonstrate the capability of this method.

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