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An arbitrary Lagrangian Eulerian approach with exact mass conservation for the numerical simulation of a Taylor bubble problem[1]
MEHMET SAHIN, CAGATAY GUVENTURK, Istanbul Tech Univ — An arbitrary Lagrangian Eulerian approach is developed for incompressible multiphase fluid flows with exact mass conservation. The incompressible Navier-Stokes equations are discretized over unstructured moving quadrilateral/hexahedral meshes using the div-stable side-centered finite volume formulation. The pressure field is treated to be discontinuous across the interface. The surface tension term is considered as a force tangent to the interface. Interface kinematic boundary condition in normal direction is applied by satisfying both local and global discrete geometric conservation law [Guventurk and M. Sahin, 2017]. The resulting algebraic equations are solved in a fully coupled manner and preconditioning is performed by using a new matrix factorization proposed by Cetin and Sahin [2019]. The numerical algorithm is validated by simulating a rising Taylor bubble in a tube in two- and three dimensions. The numerical results are consistent with the results of an experimental work of Bugg and Saad [2017].

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Mehmet Sahin
Istanbul Tech Univ

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