Drop Coalescence Simulations Using Level Sets Coupled with Boundary Integral Methods

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ABSTRACT

The study of singularities in free surface flows remains a subject of considerably interest. Regarding droplet dynamics the pinch-off events and merging of droplets have been extensively studied due its enormous interest in industrial applications. The level set techniques allows to embed the partial differential equations posed on a free boundary into one higher dimension equations posed on a fixed domain, in such a way that the classical potential flow model can be re-formulated in a complete Eulerian frame work, with the advantage that free boundary topological changes are automatically included. The Laplace equation for the velocity potential is solved via its integral formulation and a boundary element approximation, whereas the evolution of the level set function and extended velocity potential function is approximated using first order finite differences schemes. Merging and splitting events are therefore computationally possible. In the case of two equal drops coalescing, initial instants are very difficult to compute and also to see experimentally. After initial contact a liquid bridge connecting the two drops grows on time and a capillary wave, generated at the point of contact, propagates towards the drop end points. Numerical results regarding two droplet coalescence are presented and a detail discussion of the main flow characteristics is addressed. Comparison with previous computations and laboratory experiments will be also included.

REFERENCES

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