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Dependence of surface tension on curvature obtained from a diffuse-interface approach ARNOLDO BADILLO, Imperial College London, NATHAN LAFFERTY, ETH Zurich, OMAR K. MATAR, Imperial College London

— From a sharp-interface viewpoint, the surface tension force is $\mathbf{f} = \sigma\kappa\delta(\mathbf{x} - \mathbf{x_i})\mathbf{n}$, where σ is the surface tension, κ the local interface curvature, δ the delta function, and $\mathbf{n}$ the unit normal vector. The numerical implementation of this force on discrete domains poses challenges that arise from the calculation of the curvature. The continuous surface tension force model, proposed by Brackbill *et al.* (1992), is an alternative, used commonly in two-phase computational models. In this model, δ is replaced by the gradient of a phase indicator field, whose integral across a diffuse-interface equals unity. An alternative to the Brackbill model are Phase-Field models, which do not require an explicit calculation of the curvature. However, and just as in Brackbill's approach, there are numerical errors that depend on the thickness of the diffuse interface, the grid spacing, and the curvature. We use differential geometry to calculate the leading errors in this force when obtained from a diffuse-interface approach, and outline possible routes to eliminate them. Our results also provide a simple geometrical explanation to the dependence of surface tension on curvature, and to the problem of line tension.

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