Numerical Modeling of Surfactant Effects in Interfacial Fluid Dynamics
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Surfactants are substances that preferentially accumulate at interfaces between two fluids, altering the local surface tension. An imposed flow can produce a non-uniform distribution of surfactant. In regions of high surfactant concentration the surface tension is low, so the interface offers less resistance to deformation and can become highly curved, allowing very small droplets or bubbles to pinch off. A numerical method to simulate interfacial surfactant mechanics within a volume of fluid method has been developed. To conserve surfactant, the surfactant mass and the interfacial surface area are tracked as the interface evolves, and then the surfactant concentration is reconstructed. The algorithm is coupled to an incompressible flow solver that uses a continuum method to incorporate both the normal and tangential components of the surface tension force into the momentum equation.