About stability condition for bifluid flows with surface tension

Paul Vigneaux
Université Bordeaux I

We consider models for the simulation of curvature-driven incompressible bifluid flows, where the surface tension term is discretized explicitly. Since Brackbill, Kothe and Zemach (J. Comput. Phys. 100, pp 335-354, 1992) introduced the Continuum Surface Force (CSF) method, many methods involved in interface tracking or capturing are based on this reference work. Particularly, the surface tension term is discretized explicitly and therefore, a stability condition is induced on the computational time step. This constraint on the time step allows the containment of the amplification of capillary waves along the interface, which can be the source of parasitic currents on the interface. The derivation of this stability condition puts more emphasis on the terms linked with the density in the Navier-Stokes equation (i. e. unsteady and inertia terms) rather than on the viscous terms. Indeed, the viscosity does not appear, as a parameter, in this stability condition.

In this talk, we introduce a new stability condition for which we present a theoretical estimation for flows with low and medium Reynolds numbers. The analysis is based on a perturbation study with capillary wave. This stability condition involves the fluid viscosity, emphasizing the role of viscous terms for such flows. Numerical simulations of microflows, using a Level Set method, validate this analysis.