INFLUENCE OF MOBILITY AND INTERFACE THICKNESS IN NAVIER STOKES CAHN-HILLIARD PHASE FIELD MODEL

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ABSTRACT

Phase field (diffuse interface) model for two or higher phase systems have been sought as an alternative to conventional two-phase methods such as VoF, Level set etc. which are based on geometrical considerations. With its origin from thermodynamic principles, phase-field model has been largely investigated for compressible fluids using an equation of state with density as an order or phase-field parameter. This particular choice circumvents the need of additional equation for the order parameter. However, in case of incompressible immiscible fluid systems, the choice of a scalar variable (volume or mass fraction) necessitates to solve an additional equation known as the advected form of Cahn-Hilliard (CH) equation. The accuracy and consistency of the solution is largely governed by input model parameters, interface thickness and mobility. Unlike the interface thickness, which is a physically measurable variable, the mobility is primarily a numerical parameter in these systems though physical analogies have been drawn for it and which is analogous to diffusion coefficient for potential.

Despite several articles showing good agreement of their results with test cases given in the literature for incompressible immiscible fluids, the depiction of the pressure field across of the interface for cases presented therein has been scarcely addressed. While it may seem intuitive to expect a perfect pressure field whilst agreement for other parameters such as velocity field, an unusual behavior departing from smooth Laplace jump condition has been observed in our simulations. We investigate the effect of mobility and interface thickness on the pressure field for surface tension-oriented flows on trivial test cases (advection and bubble rise).