Simulation des écoulements diphasiques en présence d'effets thermiques

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Abstract

The development of accurate numerical approaches is required to study flows driven by surface tension gradients induced by temperature variations. Previous studies have employed various methods, including Smoothed Particle Hydrodynamics, Volume-of-fluid, levelset, and front tracking. These approaches have been demonstrated to be adopted for this kind of flow. The present study proposes an implementation on ARCHER, the in-house code solver for Navier-Stokes equations, based on the coupled levelset and Volume-of-fluid method. The impact of fluctuations in surface tension in response to temperature gradients is incorporated. Furthermore, the Boussinesq approximation is introduced to account for the buoyancy effect. Two canonical cases were subject to examination to validate this novel implementation. The first case study considers a flat interface between two fluids with a temperature gradient aligned with the interface. This results in generating a flow that can be analytically described for a range of scenarii, which was then reproduced through numerical simulation. The second case considers a spherical or circular bubble subjected to a temperature gradient. This results in the migration of the dispersed phase. Once more, the analytical solution is employed to address this case. Finally, the impact of temperature gradients is studied by considering the Rayleigh-Bénard-Marangoni instability at two limits: when driven by buoyancy and when driven by Marangoni stress. The observation of instability cells and the deformation of the interface were also noted