Single Droplet/Bubble and Its Stability: Kinetic Theory and Dynamical System Approaches

Shigeru Takata

Department of Aeronautics and Astronautics
Graduate School of Engineering
Kyoto University
Email: takata.shigeru.4a@kyoto-u.ac.jp

Abstract

Steady solutions of a single droplet or bubble in the van der Waals fluid are investigated on the basis of the kinetic model equation that has been recently proposed by Miyauchi et al. [Gas Dynamics with Applications in Industry and Life Sciences (Springer, Cham, 2023), pp. 19–39]. Under the thermal equilibrium condition and isotropic assumption with respect to the origin of the coordinates, the kinetic equation is reduced to an ordinary differential equation for the density, which can be regarded as a low-dimensional dynamical system. The possible density distribution is studied as a flow in the low-dimensional phase space. It is clarified that a single droplet or bubble can be understood as a flow that goes into a fixed point and that the flow is qualitatively different in the unstable and metastable parameter regions. The features of the obtained density distributions in individual regions are also clarified. Finally, the stability of those solutions is studied by direct numerical experiments of the kinetic equation. This is a joint work with Takumu Miyauchi published recently in Phys. Rev. E 110, 025102 (2024).