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THE HONG KONG UNIVERSITY OF SCIENCE & TECHNOLOGY

Department of Mathematics

SEMINAR ON APPLIED MATHEMATICS

Addressing two fundamental problems in lattice Boltzmann method for two-phase flows

By

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Abstract

This talk focuses on two fundamental problems in two-phase lattice Boltzmann equation (LBE) methods: (i) spurious velocities in the vicinity of the phase interface, and (ii) the disappearance of small droplets or bubbles.

For the first issue, we provide a rigorous analysis of the discrete balance property of the LBE to identify the structure of force imbalance. A well-balanced LBE (WB-LBE) model is then proposed, which retains the same algorithmic structure as the standard LBE. The WB-LBE is theoretically shown to achieve a discrete equilibrium state, and its well-balance properties are confirmed through simulations of a flat interface problem and droplet system.

For the second issue, we construct an LBE model based on the Cahn–Hilliard phase-field theory, where the Cahn–Hilliard equation employs a singular mobility that acts only near the interface. The equilibrium distribution function includes a free parameter to enable variable (and even zero) mobility. Meanwhile, the equilibrium distribution function for the Navier–Stokes equations is modified to include another free parameter to achieve a large viscosity ratio. Numerical results demonstrate that the singular LBE model reduces numerical dissipation and yields physically acceptable results over large time scales.

Date : 30 April 2026 (Thursday)
Time : 11:00a.m.-12:00noon
Venue : Room 3598 (Lift 27/28)

All are Welcome!