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THE HONG KONG UNIVERSITY OF SCIENCE & TECHNOLOGY

Department of Mathematics

SEMINAR ON SCIENTIFIC COMPUTATION

Well-balanced Kinetic Methods for Two-phase Flows

by

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Abstract

At equilibrium state of a two-phase fluid system, the chemical potential is constant and the velocity vanishes. However, such equilibrium state usually cannot be captured by the standard two-phase lattice Boltzmann equation (LBE) method due to discretization errors. Consequently, inconsistent thermodynamic interfacial properties due to non-constant chemical potential, and spurious velocities due to discrete force imbalance, are frequently encountered in LBE simulations. This talk first makes a rigorous analysis of the discrete balance property of LBE to identify the structure of force imbalance. Then, a well-balanced LBE (WB-LBE) model which has the same algorithm structure as the standard one is proposed. The WB-LBE is theoretically shown to be able to achieve the discrete equilibrium state, and the well-balance properties are confirmed by simulating a flat interface problem and a droplet system. The idea is also employed to design well-balanced discrete unified gas-kinetic scheme (DUGKS), which can use non-uniform meshes and exhibits better numerical stability for large density ratio systems. Some numerical tests are provided to validate the performance of the two kinetic schemes.

Date : 22 May 2023 (Monday)
Time : 10:30am – 11:30am
Venue : Room 4472 (Lifts 25-26)

All are Welcome!