For favour of Posting

THE HONG KONG UNIVERSITY OF SCIENCE & TECHNOLOGY

Department of Mathematics

PHD STUDENT SEMINAR

Onsager Principle-Based Physics-Informed Neural Network for Conserved Interfacial Dynamics

By

Miss Wenlin ZHANG

Abstract

Onsager's variational principle (OVP) provides a thermodynamically consistent foundation for the Cahn-Hilliard equation, where the dissipative dynamics is described by the phase field c, chemical potential μ, and flux J through a conservation law and a linear constitutive relation. To overcome the neural network training difficulty caused by fourth-order spatial derivatives, we propose an energy splitting architecture in which the free energy is decomposed into a convex and a concave components, which further lead to the corresponding splitting of μ and J under independent supervision. This allows the network to learn the dominant linear (concave) part and the nonlinear residual (convex) part separately. Numerical experiments show that the proposed method can successfully capture the full coalescence process of twin elliptic droplets – being rounded, approaching each other, merging, and coarsening. In comparison, the standard PINN will be trapped in a state in which the two ellipses remain separated. Such a state is approximately metastable, and the system cannot escape from that state by the standard PINN. This work provides a variational framework for systematic deep learning simulation of interfacial dynamics with conservation law.

Date : 14 May 2026 (Thursday)

Time : 4:00pm

Venue : Room 5508 (near Lifts 25/26)

All are Welcome!