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THE HONG KONG UNIVERSITY OF SCIENCE & TECHNOLOGY

Department of Mathematics

SEMINAR ON APPLIED MATHEMATICS

Unified Properties of the Discrete Unified Gas Kinetic Scheme

By

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Abstract

The discrete unified gas-kinetic scheme (DUGKS) is a numerical method developed for multiscale flows based on the gas kinetic model equation. With the coupling of the collision and transport dynamics in the flux reconstruction, DUGKS can effectively simulate gas flows in all flow regimes, particularly continuum flows without resolving the kinetic scale. In this talk, a rigorous theoretical analysis of the asymptotic properties of DUGKS within the unified preserving (UP) framework is presented, which provides the asymptotic degree of the scheme. It is shown that the DUGKS is the second-order Lax-Wendroff scheme for the collision-less kinetic equation as the Knudsen number (ϵ) approaches to infinity; while in the continuum limit, DUGKS is consistent with the Navier-Stokes equations as the mesh size $\Delta x=o(\sqrt{\epsilon})$ and time step $\Delta t=o(\sqrt{\epsilon})$. Several related kinetic schemes are also analyzed for comparison. The analysis reveals that the space-time coupling is important in developing UP kinetic schemes. Numerical test of the Taylor vortex in a periodic domain confirms the theoretical analysis.

Date : 29 May 2023 (Monday)
Time : 11:00am – 12:00nn
Venue : Room 1410 (Lifts 25/26)

All are Welcome!