THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學

DEPARTMENT OF APPLIED MATHEMATICS
應 用 數 學 系

PolyU Numerical PDEs Seminar

Fourth-order, Energy-stable, Cartesian-grid-based, Sharp-interface, Cut-cell Projection Methods for Simulating Density-stratified Incompressible Flows on Domains with Irregular and Moving Boundaries

By

Prof. Qinghai Zhang

Zhejiang University

Abstract

I will start with various examples of moving boundary problems such as Saint Andrew's Cross (SAC) in density-stratified flows to motivate the need of high-order efficient numerical solvers for the incompressible Navier-Stokes equations (INSE) and Boussinesq equations. Then I will briefly review the MARS framework for theoretically describing and numerically simulating moving boundary problems. As for the main-flow solver, I will present GePUP-ES, a fourth-order energy-stable projection method for solving the INSE with no-slip conditions. Under the MARS framework, we have generalized GePUP-ES to irregular domains via an Boolean algebra for physically meaningful regions and an AI-aided algorithm for generating poised lattices in multivariate polynomial interpolation. We further augment the solver to domains with moving boundaries via Reynolds transport theorem and a volume-merging strategy. Results of numerical experiments for SAC and a few other problems confirm the high fidelity of our solver.

Biography

Qinghai Zhang got his bachelor and master degrees both at Tsinghua University and obtained his Ph.D. at Cornell University. He did his postdocs at Lawrence Berkeley National Lab and University of Utah. He is now a distinguished professor of mathematics at Zhejiang University, where he also serves as the department chair of computational mathematics. His work focuses on numerical algorithms of multiphase flows and one of his main research themes is to tackle geometrical and topological problems with tools in geometry and topology. He has published papers in prestigeous journals such as SIAM Review, PNAS, Math. Comput., SIAM J. Numer. Anal., SIAM J. Sci. Comput., CMAME, J. Comput. Phys., and Coastal Engr.

Date: 3 June 2024 (Monday)
Time: 10:30-11:15 (Beijing Time)
Venue: TU817

ALL ARE WELCOME