UNIVERSITY of HOUSTON

Department of Mathematics

Scientific Computing Seminar

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How can algebraic topology, differential geometry, and artificial intelligence help numerical PDEs on moving domains?

Thursday, February 6, 2025
1 PM- 2 PM
Room 646   PGH

Abstract: This talk is an overview of the framework of MARS (mapping and adjusting regular semi-analytic sets) for numerically solving the incompressible Navier-Stokes equations (INSE) on moving domains with fourth-order accuracy. We propose GePUP-ES, a fourth-order energy-stable adaptive projection method for solving INSE on a square box. To augment GePUP-ES to irregular and moving domains with arbitrarily complex topology and geometry, we have employed tools from algebraic topology, differential geometry, and artificial intelligence. Different from current methods that avoid topology and geometry by converting them into numerical ODEs/PDEs, we tackle topological and geometric problems with tools in topology and geometry. We show that the coupling of numerical analysis with (even elementary) concepts in topology and geometry could be powerful for realworld applications.

Speaker Bio:
Qinghai Zhang got his bachelor and master degrees at Tsinghua University and received 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. 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.

This seminar is easily accessible to persons with disabilities. For more information or for assistance, please contact the Mathematics Department at 743-3500.