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Analysis and PDE Seminar

Professor Gung-Min Gie
Department of Mathematics,
University of Louisville

TITLE: Singular perturbations in fluid mechanics: Analysis and computations

Date : September 2nd, 2021 (Thursday)
Time : 10am-11am (Hong Kong time)
11am-12noon (Korea time)
Link to ZOOM : https://unist-kr.zoom.us/j/3170659442
Meeting ID : 317 065 9442
Password : APDE21

Abstract. Singular perturbations occur when a small coefficient affects the highest order derivatives in a system of partial differential equations. From the physical point of view, singular perturbations generate thin layers near the boundary of a domain, called boundary layers, where many important physical phenomena occur. In fluid mechanics, the Navier-Stokes equations, which describe the behavior of viscous flows, appear as a singular perturbation of the Euler equations for inviscid flows, where the small perturbation parameter is the viscosity. In general, verifying the convergence of the Navier-Stokes solutions to the Euler solution (known as the vanishing viscosity limit problem) remains an outstanding open question in mathematical physics. Up to now, it is not known if this vanishing viscosity limit holds true or not, even in 2D for which the existence, uniqueness, and regularity of solutions for all time are

known for both the Navier-Stokes and Euler. In this talk, we discuss a recent result on the boundary layer analysis for the Navier-Stokes equations under a certain symmetry where the complete structure of boundary layers, vanishing viscosity limit, and vorticity accumulation on the boundary are investigated by using the method of correctors. We also discuss how to implement effective numerical schemes for slightly viscous fluid equations where the boundary layer correctors play essential roles. This is a joint work in part with J. Kelliher, M. Lopes Filho, A. Mazzucato, and H. Nussenzveig Lopes, and with C.-Y. Jung and H. Lee.

All are welcome

This is a joint activity organized by Department of Mathematics, The Chinese University of Hong Kong, Hong Kong; Department of Mathematics, Institute of Mathematical Research, Research Division of Mathematical and Statistical Science, The University of Hong Kong, Hong Kong; and Department of Mathematical Sciences, Ulsan National Institute of Science and Technology, Korea. More details can be found in https://hkumath.hku.hk/~imr/event/CUHK_HKU_UNIST_Analysis_and_PDE/index.php.