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THE HONG KONG UNIVERSITY OF SCIENCE & TECHNOLOGY

Department of Mathematics

SEMINAR ON SCIENTIFIC COMPUTATION

Towards the high-fidelity computation and modeling of compressible turbulent flows

by

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Abstract

In this talk, we will focus on the high-fidelity computations of turbulence from the perspective of modeling and numeric. Firstly, the interaction of an incident shock wave with a Mach-6 laminar boundary layer is addressed using DNS and equilibrium wall-modeled LES (WMLES). The consequences of the interaction are that the boundary layer transitions to turbulence, and that transition causes a localized significant increase in the Stanton number and skin-friction coefficient. WMLES provides predictions of DNS peak loads within 10% at 150 times lower computational cost. In the fully-turbulent boundary layer, WMLES agrees well with DNS for the Reynolds-analogy factor, the mean velocity and temperature profiles, and the temperature/velocity correlations. Secondly, we will introduce the recently proposed high-order shock-capturing TENO schemes. For TENO, arbitrarily high-order, i.e. both even and odd order, scheme can be constructed in a unified framework. The novel ENO-type stencil selection strategy guarantees that the spectral properties of the counterpart linear scheme can be preserved up to intermediate wavenumbers. The core idea is that one candidate stencil is either abandoned when crossed by discontinuities or applied for the final reconstruction with the optimal weight. TENO schemes are demonstrated to be robust for shock capturing and perform better than classical WENO schemes in resolving small-scale structures.

Biography: *Dr. Lin Fu is a postdoctoral fellow of CTR (Center for Turbulence Research) working with Prof. Parviz Moin at Stanford University. Before he joined CTR, he did postdoctoral research with Prof. Nikolaus Adams in Technical University of Munich. In the same institute, he obtained his Ph.D. degree with a grade of Summa Cum Laude. His research involves fundamental study of flow physics including turbulence, transitional flows, multi-phase flows, and etc. His research dedicates to an improved theoretical understanding of these complex fluids and contributes to optimizing the engineering quantities of interest, e.g. drag, heat transfer, mixing ratio, etc. In the perspective of scientific computation, he develops novel numerical methods including the high-order TENO (targeted ENO) schemes for hyperbolic conservation laws, the CVP (Centroidal Voronoi Particle) and SPH (Smoothed-particle hydrodynamics) based domain decomposition method, SPH method and mesh generation method. Recently, he focuses on hypersonic flows by Direct Numerical Simulation (DNS) and Large Eddy Simulation (LES) approach. He is the reviewer of about 16 journals and has authored more than 25 publications on prestigious journals.*

Date : 11 September 2020 (Friday)
Time : 10:00am – 11:00am
Zoom Meeting : https://hkust.zoom.us/j/93559765024 (Passcode: 518056)

All are Welcome!