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The Hong Kong University of Science & Technology

Department of Mathematics

PhD Student Seminar

High-order Gas-kinetic Scheme for Turbulence Simulation

by

Mr. Guiyu CAO

Abstract

High-order gas-kinetic scheme (HGKS) is developed and applied for turbulence simulation, including supersonic isotropic turbulence and high-Reynolds number engineering turbulent flows. Direct numerical simulation (DNS) of compressible isotropic turbulence up to the supersonic regime is implemented by the two-stage fourth-order (S2O4) GKS. With the higher initial turbulent Mach number, the stronger random shocklets and higher expansion regions are identified, as well as the wider range for probability density function (PDF) of local turbulence Mach number, which pose great challenge for high-order scheme. As the compressible isotropic turbulence from subsonic regime to supersonic one is simulated, the super robustness of S2O4 GKS is confirmed. Targeting on the high-Reynolds number engineering turbulent flows, an implicit HGKS (IHGKS) with Lower-Upper Symmetric Gauss-Seidel (LU-SGS) technique is developed under the S2O4 framework. Based on traditional turbulence model, a turbulent relaxation time is obtained and used for an enlarged particle collision time in the IHGKS for the high-Reynolds number turbulent flows. Numerical experiments confirm that the IHGKS has high accuracy in space and time, especially for smooth turbulent flows, obtaining more accurate turbulent flow fields on coarse grids compared with second-order GKS. In addition, significant acceleration on computational efficiency in simulating complex flows is confirmed for current IHGKS. It is concluded that the HGKS provides a solid tool for DNS of turbulence, as well as shows great advantages in practical engineering turbulent flows.

Date: ***Thursday, 25 April 2019***

Time: ***11:00 a.m. - 12:00 p.m.***

Venue: ***Room 5510, Academic Building (near Lifts 25-26), HKUST***

All are welcome!