The Hong Kong Polytechnic University
Department of Applied Mathematics

Colloquium

Exponential Time Differencing Gauge Method for Incompressible Viscous Flow

by

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Abstract

To design efficient and accurate time integration schemes for numerically simulating incompressible viscous flows, such as those governed by Stokes or Navier-Stokes equations, the discretization and coupling of velocity and pressure needs to be treated carefully for stability and consistency. The gauge formulation introduces a gauge variable and an auxiliary field for the fluids equations, and the resulting system contains a coupled momentum equation and a kinematic equation with certain consistent boundary conditions. In this talk, we present an exponential time differencing multistep method for solving the gauge system with high-order temporal accuracy. In particular, the momentum equation is completely decoupled from the kinematic equation in the discrete level at each time step and is solved by explicit exponential time stepping schemes. We analyze the stability of the proposed method and rigorously prove that the first order exponential time differencing scheme is unconditionally stable for the Stokes flows. We also discuss compact representation of the method for problems on rectangular domains, which make FFT-based fast solvers available for the resulting fully discrete problem. Various numerical experiments are carried out to demonstrate the accuracy and stability of the proposed method.

Date : 3 June, 2016 (Friday)
Time : 3p.m. – 4p.m.
Venue : TU801, The Hong Kong Polytechnic University

*** * * ALL ARE WELCOME * * ***