THE UNIVERSITY OF HONG KONG

Institute of Mathematical Research
Department of Mathematics

COLLOQUIUM

Stability of time discretizations for semi-discrete high order schemes for time-dependent PDEs

Professor Chi-Wang Shu

Theodore B. Stowell University Professor
of Applied Mathematics
Division of Applied Mathematics
Brown University, USA

Date:	April 24, 2024 (Wednesday)
Time:	4:00 – 5:00pm
Venue:	Room 210, Run Run Shaw Bldg., HKU

Abstract

In scientific and engineering computing, we encounter time-dependent partial differential equations (PDEs) frequently. When designing high order schemes for solving these time-dependent PDEs, we often first develop semi-discrete schemes paying attention only to spatial discretizations and leaving time t continuous. It is then important to have a high order time discretization to maintain the stability properties of the semi-discrete schemes. In this talk we discuss several classes of high order time discretization, including the strong stability preserving (SSP) time discretization, which preserves strong stability from a stable spatial discretization with Euler forward, the implicit-explicit (IMEX) Runge-Kutta or multi-step time marching, which treats the more stiff term (e.g. diffusion term in a convection-diffusion equation) implicitly and the less stiff term (e.g. the convection term in such an equation) explicitly, for which strong stability can be proved under the condition that the time step is upper-bounded by a constant under suitable conditions, the explicit-implicit-null (EIN) time marching, which adds a linear highest derivative term to both sides of the PDE and then uses IMEX time marching, and is particularly suitable for high order PDEs with leading nonlinear terms, and the explicit Runge-Kutta methods, for which strong stability can be proved in many cases for semi-negative linear semi-discrete schemes. Numerical examples will be given to demonstrate the performance of these schemes.

All are welcome