香港浸會大學
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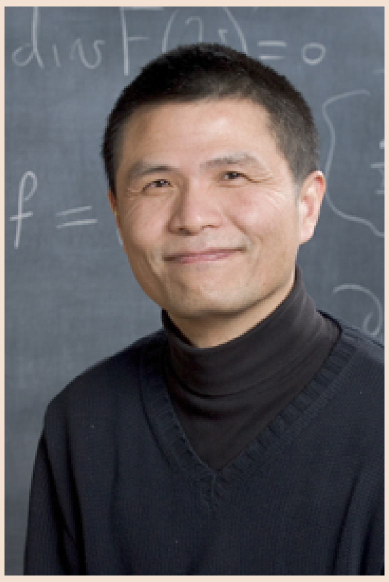
HKBU MATH SINCE 1970

HKBU MATH 45th Anniversary Distinguished Lecture

IMEX Time Marching for Discontinuous Galerkin Methods



Professor Chi-Wang Shu

Theodore B. Stowell University Professor of Applied Mathematics
NASA Public Service Group Achievement Award (1992)
Feng Kang Prize (1995)
ISI Highly Cited Author in Mathematics (2004)
SIAM/ACM Prize in Computational Science and Engineering (2007)
SIAM Fellow (2009)
AMS Fellow (2012)
ICM Invited Speaker (2014)

Date: 15 December 2015 (Tuesday)

Time: 4:30 pm - 5:30 pm (Preceded by Reception at 4:00 pm)

Venue: SCT909 Science Tower, Ho Sin Hang Campus,
Hong Kong Baptist University

Abstract

For discontinuous Galerkin methods approximating convection diffusion equations, explicit time marching is expensive since the time step is restricted by the square of the spatial mesh size. Implicit methods, however, would require the solution of non-symmetric, non-positive definite and nonlinear systems, which could be difficult. The high order accurate implicit-explicit (IMEX) Runge-Kutta or multi-step time marching, which treats the diffusion term implicitly (often linear, resulting in a linear positive-definite solver) and the convection term (often nonlinear) explicitly, can greatly improve computational efficiency. We prove that certain IMEX time discretizations, up to third order accuracy, coupled with local discontinuous Galerkin method for the diffusion term treated implicitly, and regular discontinuous Galerkin method for the convection term treated explicitly, are unconditionally stable (the time step is upper bounded only by a constant depending on the diffusion coefficient but not on the spatial mesh size) and optimally convergent. The results also hold for drift-diffusion model in semiconductor device simulations, where a convection diffusion equation is coupled with an electrical potential equation. Numerical experiments confirm the good performance of such schemes. This is a joint work with Haijin Wang, Qiang Zhang and Yunxian Liu.

✧ ✧ ✧ All are welcome ✧ ✧ ✧

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