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THE HONG KONG UNIVERSITY OF SCIENCE & TECHNOLOGY

Department of Mathematics

SEMINAR ON APPLIED MATHEMATICS

Adaptive high-order BDF methods: analysis and applications

By

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Abstract

In this talk, we introduce a framework for the stability and convergence of third-order backward differentiation formula (BDF3) with variable time steps applied to nonlinear parabolic problems. Under a relaxed constraint on the adjacent step-size ratio, we develop a novel discrete energy method to prove the robust stability and optimal error estimate in an abstract functional setting. The main techniques are the gradient decomposition and reformulation of the multi-step scheme via the orthogonal convolution kernels. The proposed framework is applicable to a wide range of evolution PDEs. As a typical application, we show an energy stable BDF3 method with efficient adaptive time-stepping algorithm for the square phase field crystal model. The unconditional energy dissipation law and error estimate are proved. Moreover, we extend this framework to the adaptive IMEX BDF method for hyperbolic systems with stiff relaxation. Ample numerical results are provided to confirm the theoretical analysis and efficiency of the adaptive BDF methods.

Date : 2 April 2026 (Thursday)
Time : 10:30a.m. - 11:30a.m.
Venue : Room 4472 (Lift 25/26)

All are Welcome!