FUDAN UNIVERSITY

Applied Math Ph.D. Seminar

A positivity-preserving, energy stable BDF2 scheme with variable steps for the Cahn-Hilliard equation with logarithmic potential.

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Time: 2022-10-13, 16:10 to 17:00

Location: Rm 1801, Guanghua East Tower

Advisor: Wenbin Chen (Fudan University)

Abstract: High-order numerical schemes and adaptive time strategies are widely used to solve PDEs. In this paper, a BDF2 scheme with variable time steps is proposed and analyzed for the Cahn-Hilliard equation with a logarithmic Flory-Huggins energy potential. To guarantee the unique solvability and positivity-preserving property, the lumped mass method is adopted in the finite element space discretization. For energy stability analysis, two modified energy dissipation laws are derived and compared if the maximum step ratio has a finite upper bound. To estimate the spatial and temporal errors separately, a spatially semi-discrete scheme is proposed, and a new elliptic projection is introduced, and the super-closeness between this projection and the Ritz projection of the exact solution is attained. Based on the strict separation property of the numerical solution obtained by using the technique of combining the rough and refined error estimates, the convergence analysis in $\ell^\infty(0,T;L_h^2(\Omega))$ norm is established when $\tau \leq Ch$ by using the technique of the DOC kernels. Finally, several numerical experiments are carried out to validate the theoretical results.