MS1: Accurate and Efficient Time Integration Methods for Unsteady PDEs I

Fast and Accurate Algorithms for Simulating Coarsening Dynamics of Cahn-Hilliard Equations

Lili Ju, *University of South Carolina*

The coarsening dynamics in a binary mixture can be modeled by the celebrated Cahn-Hilliard equations. To perform efficient and accurate long time integration, we develop a fast and stable high-order numerical algorithm for solving Cahn-Hilliard equations. The spatial discretization is carried out by compact difference methods while the time integration is done through a high-order exponential time difference multistep approach. We demonstrate the effectiveness of the new algorithm by numerical experiments and study computationally the coarsening kinetics corresponding to different choices of the diffusion mobility.

Analysis of a Second-Order in Time Mixed Method for the Cahn-Hilliard Equation

Amanda Diegel, *University of Tennessee*

In this talk, I present the analysis of an unconditionally stable, second-order-in-time numerical scheme for the Cahn-Hilliard equation in two and three space dimensions. We prove that our two-step scheme is unconditionally energy stable and unconditionally uniquely solvable. Furthermore, we show that the discrete phase variable is bounded in $L^\infty(0,T;L^\infty)$ and the discrete chemical potential is bounded in $L^\infty\left(0,T;L^2\right)$, for any time and space step sizes, in two and three dimensions, and for any finite final time T. We subsequently prove that these variables converge with optimal rates in the appropriate energy norms in both two and three dimensions.

Time Domain Decomposition Methods for Forward-and-Backward PDEs

Zhu Wang, *University of South Carolina*

The forward-and-backward partial differential equation system always appears in the optimal control and optimization problems. It is appealing to solve such a system directly since a single solve suffices to determine the optimal states, adjoint states, and controls. However, this approach is computationally expensive. In this talk, we present several time domain decomposition methods, which are based on a decomposition of the time domain into smaller subdomains, and are suited for implementation on parallel computer architectures. The effectiveness of these algorithms are verified by numerical tests

Continuous Development of a Matched Alternative Direction Implicit (ADI) Method for Solving Parabolic Interface Problems

Chuan Li, *University of Alabama, Tuscaloosa*

A matched Alternate Direction Implicit method (ADI) was introduced by Dr. Shan Zhao recently aiming at delivering an efficient and stable method for solving parabolic interface problems with general physical interface conditions. This work continues the development of this scheme and improves it for handling more complex geometries and interface conditions. Numerical results obtained by the coupling of this matched ADI method and various time steppers are reported in this talk as well.