MS20: Accurate and Efficient Time Integration Methods for Unsteady PDEs III

Some Energy Stable Schemes for Phase Field Model With Moving Contact Lines

Xiaofeng Yang, *University of South Carolina*

We present some efficient energy stable schemes to solve a phase field model incorporating moving contact line. The model is a coupled system that consists of incom- pressible NavierStokes equations with a generalized Navier boundary condition and Cahn Hilliard equation in conserved form. By some subtle explicit-implicit treatments, we obtain a linear coupled energy stable scheme for systems with dynamic contact line conditions and a linear decoupled energy stable scheme for systems with static contact line conditions. The energy stability is obtained by rigorous proof and numerical results also show that the proposed schemes are very efficient and accurate.

Split-Step Method for Nonlinear Schr̈odinger Equations

Yanzhi Zhang, *Missouri University of Science and Technology*

Split-step methods have been widely used in solving time-dependent PDEs. In this talk, we discuss the numerical stability of the split-step method for solving the (fractional) nonlinear Schrodinger (NLS) equation. The stable conditions are analyzed for the plane wave solutions, and numerical experiments are provided to verify our analytical results. In addition, the performance of the split-step method is studied and compared in solving the standard and fractional NLS.

Discontinuous Galerkin Methods for the Shallow Water Equations with ADER-DT Time Stepping

Yulong Xing, *University of Tennessee*

Shallow water equations with a non-flat bottom topography have been widely used to model flows in rivers and coastal areas. In this presentation, we will talk about high-order discontinuous Galerkin methods with ADER-DT temporal discretizations for this system. We will show that the proposed methods are well-balanced and preserve the still water steady state exactly. Local time stepping of the ADER methods will also be studied to allows elements of different sizes to use different time steps. Some numerical tests are performed to verify the well-balanced property, high-order accuracy, and good resolution for general solutions.

Fast Operator Splitting Algorithms for Biomolecular Solvation Analysis

Shan Zhao, *University of Alabama, Tuscaloosa*

Recently, we have developed several operator splitting methods to efficiently and stably solve the nonlinear Poisson-Boltzmann (PB) equation for the electrostatics analysis of solvated biomolecules. The operator splitting framework enables an analytical integration of the nonlinear term that suppresses the instability. Both fully implicit alternating direction implicit (ADI) schemes and unconditionally stable locally one-dimensional (LOD) schemes are constructed, which provide fast PB solvers in electrostatic free energy analysis.