TEMPLE UNIVERSITY
Department of Mathematics

Applied Mathematics and Scientific Computing Seminar

Wednesday, 10 September 2014, 4:00 p.m.
Room 617 Wachman Hall

(refreshments and social at 3:45 p.m)

Discontinuous Galerkin Finite Element Methods for Cahn-Hilliard Type Models

by Andreas Aristotelous
Temple University

Abstract. A mixed formulation discontinuous Galerkin (DG) finite element method is devised and analyzed for a modified Cahn-Hilliard equation that models phase separation in diblock copolymer melts. The time discretization is based on a convex splitting of the energy of the equation. We prove that our scheme is unconditionally energy stable with respect to a spatially discrete analogue of the continuous free energy of the system, unconditionally uniquely solvable, and convergent in the natural energy norm with optimal rates.

Fully-discrete, discontinuous Galerkin schemes with time dynamic, locally refined meshes in space are developed for a fourth order Cahn-Hilliard equation with an added nonlinear reaction term, a phenomenological model that can describe cancerous tumor growth. The proposed schemes, which are both second-order in time, are based on a primitive variable DG spatial formulation. The schemes are proved to be convergent, with optimal order error bounds, even in the case where the mesh is changing with time.

Numerical tests are presented, in two dimensions, showing the convergence of the above schemes at the predicted rates and the flexibility of the methods for approximating complex solution dynamics efficiently.