UTEP

Department of Mathematical Sciences

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Colloquium Series

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Dr. Amanda Diegel

Mississippi State University

Finite Element Methods for Phase Field Models

In this talk, we investigate numerical methods relating to phase field models with a particular attention to two-phase flow models. Due to the vastness in applicability, two-phase flow models have drawn the attention of a number of researchers in recent years. One of the biggest challenges to modeling these systems lies in the difficulties regarding the moving interfaces (or boundaries) between the various phases. The traditional sharp interface models usually lead to almost unsolvable theoretical problems, not to mention the hardships found while attempting to derive stable and convergent computational schemes for these problems. To overcome these hardships, a phase field approach is taken such that the Cahn-Hilliard equation is coupled with fluid flow equations, thus creating a diffuse interface and eliminating the need to explicitly track a sharp interface. The numerical methods we discuss in this talk mimic the energy dissipation laws inherent to models using a phase field approach. Creating numerical methods in this way makes it possible to rigorously prove three key properties: unconditional stability, unconditional unique solvability, and optimal convergence. Convergence results provide valuable feedback concerning the approximation properties of a numerical scheme and unconditional stability leads to enhanced convergence estimations which leads to high confidence that the numerical schemes accurately estimate solutions to the equations upon which they are designed. If time allows, we will conclude the talk with an extension of the ideas presented to the development of a novel finite element method for a phase field model of nematic liquid crystal droplets.

For further information, please contact Drs. Emil Schwab or Xiaogang Su, eschwab@utep.edu or xsu@utep.edu