



The Hong Kong University of Science and Technology

Department of Mathematics

Seminar on PDE

**Asymptotic Analysis of Implicit Time
Stepping for Allen Cahn Dynamics**

By

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Abstract

There is a growing awareness that fully implicit time stepping methods are needed to accurately compute phase field models with metastable dynamics, such as energy gradient flows of Allen-Cahn and Cahn-Hilliard. The superior accuracy of fully implicit time stepping compared to energy stable schemes is shown in a number of ways. The criticisms of fully implicit time stepping in the literature have been that the resulting nonlinear system has multiple solutions; that even when there is a correct local solution the system is difficult to solve numerically; and that this solution may not decrease the energy. Using the asymptotic structure of metastable solutions, it is shown that when time steps are chosen appropriately to the dynamics, locally unique solutions to the fully implicit problem exist that decrease energy. In addition, there is a simple preconditioner that gives a condition number independent of spatial resolution and order parameter for a conjugate gradient solve for Newton iterates for the nonlinear system. The asymptotic results are confirmed in numerical experiments, part of a larger computational benchmark project. This is joint work with Xinyu Cheng, Dong Li, and Keith Promislow. Some recent, related work by Jinchao Xu will also be discussed.

Date : : Thursday, 14 June 2018

Time: : 1:30 p.m. – 2:30 p.m.

**Venue: : Room 4475, Academic Building,
(Lifts 25, 26)**

All are welcome!