PURDUE UNIVERSITY

Department of Mathematics Special Colloquium

Speaker: Dr. Shuwang Li, University of California, Irvine
Title: "Interface Dynamics and the Control of Microstructure Morphologies"
Date: Tuesday, January 8, 2008
Time: 4:30 P.M.
Place: MATH 175

Abstract

Many multiphysics problems in fluids, materials and biosystems involve time-dependent free boundaries where the boundary motion is mediated by the competition among stabilizing microscopic forces (e.g. surface tension) and destabilizing macroscopic driving forces (e.g. undercooling in crystals, pumping rate in Hele-Shaw flows and external flow for multiphase fluids and biomembranes). In a variety of circumstances, the resulting instabilities that the boundaries experience can be controlled and redirected such that the shapes can be prescribed giving the potential to design materials uniquely targeted to specific technologically important applications.

In this talk, I will focus on the Mullins-Sekerka instability in crystal growth and the Saffman-Taylor instability in Hele-Shaw flows. I will demonstrate that there exist critical conditions such that these instabilities may be suppressed and instead yield attractive, compact self-similarly evolving shapes (universal shapes). We then design protocols by which compact growth with desired symmetries can be achieved. We present both 2D and 3D results using adaptive boundary integral methods. Preliminary experimental results are presented that suggest the confirmation of the theory.

Refreshments will be served in the Math Library Lounge, 4:00 P.M.