PURDUE UNIVERSITY

Department of Mathematics Special Colloquium

Speaker: Dr. Young–Ju Lee, University of California, Los Angeles
Title: "New Numerical Techniques for Non–Newtonian Fluid Models and Thin Film Heteroepitaxial Growth"
Date: Wednesday, February 14, 2007
Time: 4:30 P.M.
Place: BRNG 1230

Abstract

In this talk, we shall discuss the construction of discrete analogues of continuous theories and their vital roles in two research areas, fluid dynamics and material sciences.

For the simulation of rate–type non–Newtonian fluid flows, we present new numerical discretization techniques obtained from the observation that the constitutive equations can be recast into the well–known symmetric matrix Riccati differential equations. Our discretization schemes are then shown to preserve some important physical characteristics that have been believed to be crucial for the numerical stability of any discretization scheme. The confirmation of such a belief shall be clearly demonstrated by providing the discrete analogue of the energy estimate for the continuous models and its consequences.

A discrete strain model is essential for understanding the strain effects in the thin film heteroepitaxial growth (one atomic species grows on a substrate of another material). New techniques are necessary to impose certain artificial boundary condition for the solution of the model, since the thickness of the substrate is considered to be infinite compared to the film thickness. We develop the discrete analogue of the conditions that ensure the existence of the exact artificial boundary condition, whose validation leads to the reduction of the computational domain significantly with no loss of accuracy.

Some illustrative but nontrivial applications of our methodologies shall be provided.