Temple University Mathematics Colloquium

Mark Alber

University of Notre Dame

will speak on

Multiscale approaches to biological modeling

ABSTRACT: A multiscale model will be described for studying formation of a clot (thrombus) in a blood vessel consisting of components for modeling viscous, incompressible blood plasma; non-activated and activated platelets; blood cells; activating chemicals; fibrinogen; vessel walls and their interactions. The macroscale dynamics of the blood flow is described by the continuum Navier Stokes equations. The microscale interactions are described through an extended stochastic discrete cellular Potts model (CPM). Simulation results demonstrate development of an inhomogeneous internal structure of the clot, which is confirmed by the preliminary experimental data [1].

In the second half of the talk a continuous limit of a discrete CPM for describing cells moving in a medium and reacting to each other through direct contact, cell-cell adhesion, and chemotaxis will be derived in the form of an integro-differential equation for the evolution of the cell probability density function. A very good agreement will be demonstrated between CPM Monte Carlo simulations and a numerical solution of the macroscopic model. A general multiscale approach will be applied to simulating spongy bone formation, suggesting that self-organizing physical mechanisms can account for this developmental process [2].

[1]. Xu, Z., Chen, N., , Kamocka, M.M., Rosen, E.D., and M.S. Alber, Multiscale Model of Thrombus Development, *Journal of the Royal Society Interface* (in press).

[2]. Alber, M., Chen, N., Lushnikov, P., and S. Newman, Continuous Macroscopic Limit of a Discrete Stochastic Model for Interaction of Living Cells, *Physical Review Letters* 99, 168102 (2007).

Monday, 3 March 2008
Lecture at 4:00 pm
Coffee, tea, and refreshments from 3-5 pm
Room 617, Wachman Building
Department of Mathematics