



Biomedical Engineering Seminar Series



Johns Hopkins School of Medicine and the Whiting School of Engineering

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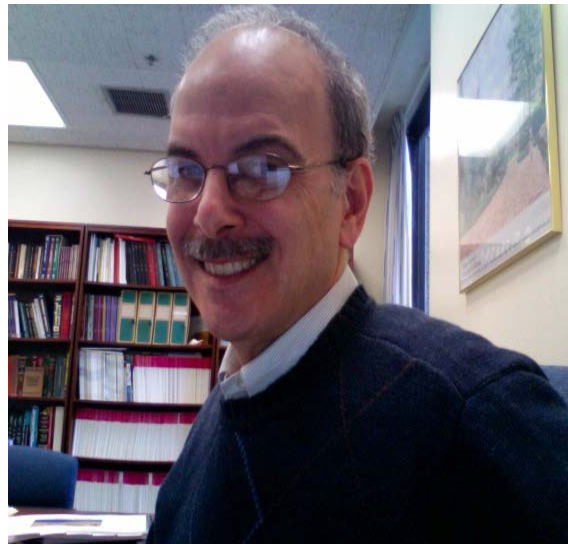
Monday, November 16, 2009 at 1:30

Rome Room, Clark 110

Host: Dr. Andre Levchenko

Light lunch will be provided in Clark 110

Video-Teleconferenced to Homewood Campus,
Talbot Room, Traylor 709



Modeling and Simulation of Actin Polymerization in Cells

We have built a quantitative model based on the dendritic nucleation scheme for actin assembly. The model explicitly incorporates the major mechanisms for actin polymerization starting with activation of Arp2/3 at the cell membrane by NWASP. We first used this model to establish the steady state properties of the actin system in the absence of nucleation by Arp2/3. The model reproduces all the experimental behaviors derived from in vitro studies of sub-systems of the component molecules. We then constructed 3D spatial models of cells with thin lamellipodia and thick cell bodies.

Activation of Arp2/3 in a small segment of lamellipodium membrane causes rapid localized actin nucleation and a buildup of F-actin to the 1mM level.

The model provides an explanation for speckle microscopy experiments showing a remarkably sharp transition from filament assembly at the leading edge of cells and filament disassembly just 1 μ m away from the leading edge. We also applied the model to experimental data on signaling aggregates propelled by actin comet tails. Simulation results are in quantitative agreement with the observed profiles of actin distribution in the comets. Because this model and the simulation results are "open source", in the sense that they are publicly available and editable through the Virtual Cell database (<http://vcell.org>), they can be accessed, analyzed, modified and extended.

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