IAM – PIMS – MITACS
2006-2007 DISTINGUISHED COLLOQUIUM SERIES

The Institute of Applied Mathematics and the Pacific Institute for the Mathematical Sciences at the University of British Columbia, with support from The Mathematics of Information Technology and Complex Systems, are pleased to announce their 10th Annual Distinguished Colloquium Series. The talks are held on Monday or Wednesday afternoons in room 301 of the Leonard S. Klinck Building (6356 Agricultural Road, UBC). Refreshments are served in room 306 (IAM Lounge), about 15 minutes before the talks. Everyone is welcome to attend.

Alex Mogilner

Wednesday, 06 September 2006, 4:00-5:00 pm

ALEX MOGILNER – ***Department of Mathematics and Center for Genetics and Development, University of California at Davis***

System Level Mathematical Analysis of Mitosis

Mitotic spindle goes through distinct morphological states characterized by increasing spindle length and distances between chromosomes. A complete picture of how the spindle assembles is still lacking. We performed an In Silico model screen to identify all potential mechanisms of spindle self-organization. We trained the computer to assemble a set of models and screened the models in a multi-dimensional parameter space. To identify models that fit experimental data we used stochastic optimization and genetic algorithms. We found multiple models quantitatively describing the spindle in which the timing of force activity must be fine tuned, in contrast to the kinetic and mechanical parameters that show robustness to change.

William L. Kath

Wednesday, 13 September 2006, 3:15-4:15 pm

WILLIAM L. KATH – ***Engineering Sciences and Applied Mathematics, Department of Neurobiology and Physiology, Northwestern University***

Models of Initiation and Propagation of Dendritic Spikes in Hippocampal CA1 Pyramidal Neurons

In computational models of hippocampal CA1 pyramidal neurons with active dendrites, distal synaptic inputs trigger dendritic spikes, but in many cases these spikes do not propagate reliably to the soma to produce output action potentials in the axon. The computational models show, moreover, that the probability of axonal action potential initiation increases dramatically if the distal dendritic inputs are accompanied by small amounts of more proximal synaptic input. In this case, the propagation of the dendritic spikes appears to be gated by the more proximal inputs. The mechanisms for this phenomenon, as well as experimental results designed to test the predictions of the computational models, will be discussed.

Peter A. Forsyth

Monday, 06 November 2006, 3:00-4:00 pm

PETER A. FORSYTH – ***David R. Cheriton School of Computer Science, University of Waterloo***

Hedging Under Jump Diffusion with Transaction Costs

In this talk, we consider the problem of hedging a contingent claim, where the underlying asset follows a jump diffusion process. The no-arbitrage value of the claim is given by the solution of a Partial Integro-Differential Equation (PIDE), which in general must be solved numerically. By constructing a portfolio consisting of the underlying asset and a number of liquidly traded options, we devise a dynamic hedging strategy. At each hedge rebalance time, we minimize both the jump risk and the cost of buying/selling due to bid-ask spreads. Simulations of this strategy show that the standard deviation of the profit and loss of the hedging portfolio is greatly reduced compared with the standard hedging strategy.

James R. Rice

Monday, 12 February 2007, 3:00-4:00 pm

JAMES R. RICE – ***Department of Earth and Planetary Sciences, Division of Engineering and Applied Sciences, Harvard University***

Episodic Slow Slipping of Seafloor Under Cascadia: What Physical Processes Cause Aseismic Deformation Transients?

In several shallow-dipping subduction zones, including Cascadia, the seafloor undergoes episodes of more rapid than usual creep-slippage under the overlying margin, but at rates vastly slower than usual earthquake slip. In some locations, also including Cascadia, non-volcanic seismic tremors occur during the slip episodes. Graduate student Yajing Liu and I have been trying to understand what physical processes underlie these phenomena. We have shown that transients, with features somewhat like the observations, are a natural outcome of modern "rate and state" formulations of fault zone friction, in a regime for which the ambient fluid pore pressure within the fault zone is very high and close to the compressive normal stress clamping the fault walls together. Evidence for such pressure conditions is provided by independent mechanical and petrological constraints.

Emmanuel Candes

Monday, 12 March 2007, 3:00-4:00 pm

EMMANUEL CANDES – ***Department of Applied Mathematics, California Institute of Technology***

Compressive Sampling

One of the central tenets of signal processing is the Shannon/ Nyquist sampling theory: the number of samples needed to reconstruct a signal without error is dictated by its bandwidth. Recently, an alternative sampling or sensing theory has emerged which allows the faithful recovery of signals and images from highly incomplete sets of data. Underlying this metholdology is a concrete protocol for sensing and compressing data simultaneously. This talk will present the key mathematical ideas underlying this new sampling or sensing theory, and will survey some of the most important results. An interesting aspect of this theory is that it has bearings on some fields in the applied sciences and engineering such as statistics, information theory, coding theory, theoretical computer science, and others as well.

Paul Bressloff

Monday, 19 March 2007, 3:00-4:00 pm

PAUL BRESSLOFF – ***Department of Mathematics, University of Utah***

Mathematical Models of Protein Receptor Trafficking and Its Role in Synaptic Plasticity

AMPA receptors mediate the majority of fast excitatory synaptic transmission in the central nervous system, and recent experimental evidence suggests that AMPA receptor trafficking regulates synaptic strength, a phenomenon implicated in learning and memory. There are two major mechanisms of AMPA receptor trafficking: exo/endocytic exchange of surface receptors with intracellular receptor pools, and lateral diffusion of surface receptors within the plasma membrane. In this talk we review some mathematical models of these trafficking mechanisms, and show how they can account for a variety of physiological data regarding plasticity at the single-synapse and multi-synapse levels.

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