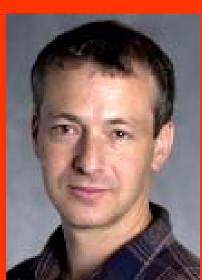
IAM – PIMS – MITACS
2005-2006 DISTINGUISHED COLLOQUIUM SERIES

The Institute of Applied Mathematics (IAM) and the Pacific Institute for the Mathematical Sciences (PIMS) at the University of British Columbia, with support from The Mathematics of Information Technology and Complex Systems (MITACS), are pleased to announce their 9th Annual Distinguished Colloquium Series. The talks are held in room 301 of the Leonard S. Klinck Building (6356 Agricultural Road, UBC) from 3:00 to 4:00 pm on Mondays, unless noted otherwise. Refreshments are served in room 306 (IAM Lounge), about 20 minutes before the talks. Everyone is welcome to attend.



Eli Tziperman

Monday, 26 September 2005, 3 pm

ELI TZIPERMAN – *Pamela and Vasco McCoy Jr Professor of Oceanography and Applied Physics, Department of Earth and Planetary Sciences, Division of Engineering and Applied Sciences, Harvard University*

Rapid Past Climate Change: It's the Sea Ice

Heinrich events are massive glacier discharges from the ice sheets around the North Atlantic Ocean which occurred every 7,000-10,000 years during the last glacial period (10-50 thousand years ago). Each of these events also triggered an abrupt atmospheric warming of some 10 degrees Celsius around the northern North Atlantic. The warming (Dansgaard-Oeschger event) occurred rapidly, in about twenty years, lasted a few hundred years, and terminated abruptly again, within a few decades. We suggest that such past rapid climate changes during the last glacial maximum have occurred due to rapid sea ice melting and formation. A specific mechanism is proposed for the climatic effects of Heinrich events. The synchronous iceberg discharges from several ice sheets around the North Atlantic are explained by a nonlinear phase locking between the different glaciers.

Eitan Tadmor

Monday, 17 October 2005, 3 pm

EITAN TADMOR – *Distinguished University Professor, Department of Mathematics, Institute for Physical Science & Technology, Director of the Center for Scientific Computation and Mathematical Modeling, University of Maryland*

Edge Detection, Hierarchical Decompositions and Velocity Averaging

I will discuss three separate problems which are dominated by the presence of different scales. The first problem deals with edge detection in noisy spectral data using *separation of scales*. The second problem originates with image processing: I will present a novel representation of texture which is decomposed into *hierarchical scales* of edges. I will conclude with velocity averaging of kinetic to macroscopic scales, deriving new regularizing effects in nonlinear second-order equations.

Gregory Kriegsmann

Monday, 07 November 2005, 3 pm

GREGORY KRIEGSMANN – *Foundation Chair of Applied Mathematics, Professor of Mathematics, Department of Mathematical Sciences, New Jersey Institute of Technology*

Microwave Heating of Materials: A Mathematical and Physical Overview

The use of microwaves to heat and dry materials is rapidly gaining acceptance in industry and, to some extent, in the field of biomedical engineering. The working engineering theories are based upon heuristically averaged, linear equations which adequately explain some processes, such as microwave cooking of foodstuffs, but not others. These include such phenomenon as thermal runaway and hot-spot formations which have important ramifications in both biomedical and industrial applications. They are caused by the temperature dependencies of the electrical and thermal properties of the irradiated material which make the basic underlying mathematical description highly nonlinear. We shall describe several microwave heating experiments and present models which have been used by researchers in this field. The strengths and shortcomings of these models will be discussed, and open questions of both mathematical and computational natures will be presented.

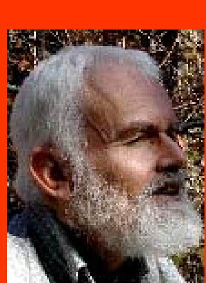
Lakshminarayanan Mahadevan

Monday, 16 January 2006, 3 pm

LAKSHMINARAYANAN MAHADEVAN – *Gordon McKay Professor of Applied Mathematics and Mechanics, Division of Engineering and Applied Sciences, Harvard University*

Geometry and Elasticity in Physical Packing Problems

Mathematical packing problems, which have a venerable history, typically deal with the arrangements of rigid spheres in unbounded domains. Physical packing (and unpacking) problems have a much shorter history and deal with the relatively large deformations of soft extended objects such as strings and membranes. Examples include the exquisitely orchestrated packing of a long thin strand of DNA into a cell nucleus or in a virus, the aesthetic drapes of a textile, the intricate folds in origami, the wrinkles in a drying raisin and the violent crumpling of a sheet of paper. I will discuss some of the general and specific features of the statics and dynamics of packing and their role in the evolution of structures on many different length scales in the material world.



Philip Holmes

Monday, 20 March 2006, 3 pm

PHILIP HOLMES – *Department of Mechanical and Aerospace Engineering, NIMH Silvio O. Conte Center for Neuroscience Research, Princeton University*

Optimal Decisions in the Brain: From Neural Oscillators to Stochastic Differential Equations

The sequential probability ratio test (SPRT) is optimal in that it allows one to accept or reject hypotheses, based on noisy incoming evidence, with the minimum number of observations for a given level of accuracy. There is increasing neural and behavioral evidence that primate and human brains employ a continuum analogue of SPRT: the drift-diffusion (DD) process. I will review this and descibe how a biophysical model of a pool of spiking neurons can be simplified to a phase oscillator and analysed to yield spike rates in response to stimuli. These spike rates tune DD parameters. This study is a small step toward the construction of a series of models, at different time and space scales, linking neural spikes to human decisions. This work provides a rich, if chaotic, example of applied mathematics in action, involving probability, stochastic differential equations, and nonlinear dynamical systems.

John Tyson

Monday, 27 March 2006, 3 pm

JOHN TYSON – *University Distinguished Professor, Department of Biology, Virginia Polytechnic Institute and State University*

Computational Cell Biology: From Molecular Networks to Cell Physiology

Cell physiology – how cells feed, move around, respond to stimuli – is a consequence of the dynamic properties of complex networks of interacting macromolecules (genes and proteins). Effective mathematical methods for deriving cell physiology from molecular interaction networks are crucial to future progress in understanding living cells and in modifying cell behavior for medical and technological purposes. Of particular interest is the network regulating cell reproduction (DNA synthesis and cell division). Too complex to be reliably understood by hand-waving arguments, the network can be described by nonlinear differential equations that accurately predict the observed properties of growing and dividing cells.

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