
Contributed Papers
Communications libres
(Org: **Bill Weiss** (Toronto))

BHAGWAN AGGARWALA, University of Calgary, Calgary, Canada

HIV: From Infection to AIDS

We present a model consisting of four first order ODE's to model the progression of HIV from infection to AIDS. The model clarifies the role of protease inhibitors and reverse transcriptase inhibitors in this progression. We also show that, depending upon the viral activity, the solution may exhibit progression to an endemic state, or what appears to be a limit cycle around this state. In this model, the disease may be eradicated by sufficiently strong doses of protease inhibitors or reverse transcriptase inhibitors or a combination thereof. An attempt is made to understand the phenomenon of HIV blips.

A. BASS BAGAYOGO, University College of Saint Boniface, 200 avenue de la Cathédrale, Winnipeg, MB, Canada

Hybrid Grid Generation: A Symbolic Programming Approach

Over the past 25 years, grid generation has been identified as one of the most challenging and key components in a variety of areas in Science and Engineering. We present a novel grid generation based on the octree technique suitable for the decomposition of the 3D geometries in order to generate the hybrid grids. This kind of grids are useful when we want to resolve viscous problems characterized by a high Reynolds number. In this study we will introduce new algorithms to:

- (1) perform a triangular faces recognition and triangular faces ordering, with a complexity of $O(N)$;
- (2) perform the projection of the nodes of the triangular faces on the object with a complexity of $O(N^2)$.

The emphasis is on the rapid production of the geometry with a minimum of the user input. We will also show the feasibility of combining Maple and C++ programming languages as a suitable tool for generating hybrid grids by using specially designed data structures.

ADAM COFFMAN, IU-Purdue Fort Wayne, Fort Wayne, IN 46805, USA

Unfolding CR singularities of real 4-manifolds in \mathbb{C}^5

A real 4-submanifold in \mathbb{C}^5 is "CR singular" at a point where the tangent space contains a complex line. The local extrinsic geometry of a real analytic embedding near a CR singularity is studied by finding a normal form for the defining equations under biholomorphic transformations. We also consider one-parameter families of embeddings, and find a normal form for a family exhibiting a cancellation of a pair of CR singularities.

MUHAMMAD DUR-E-AHMAD, Arizona State University

A model of activity-dependent changes in dendritic spine density and spine structure

Recent evidence indicates that the geometry of a dendritic spine influences the dynamics of calcium in the spine and is regulated during synaptic plasticity. For instance, a moderate rise in calcium can cause elongation, while a very large increase in calcium causes fast shrinkage and the eventual collapse of a spine. This expansion and shrinkage depends on the frequency of the synaptic input to a spine. Here, we extend previous modeling studies due to Verzi *et al.* (J. Neurophys., 2005) by combining

models for activity-dependent spine density and spine stem resistance with one for calcium-mediated spine-stem restructuring. The spine density model is based on the standard dimensionless cable equation, which is used to model the changes in trans-membrane potential in a passive dendrite. Additional equations represent the activity dependent changes in spine density along the dendrite, the current balance equation for the spine head, the calcium concentration in the spine head, and the spine stem resistance. For this continuum model, Hodgkin–Huxley type kinetics represent the changes in trans-membrane potential in the spine head. We are using computational studies to investigate the changes in spine density and structure for a variety of synaptic inputs of different frequencies. In particular, we are using the model to investigate the mechanisms underlying changes in spine density and morphology and the role of spine plasticity in long-term depression (LTD) and long-term potentiation (LTP), which are thought to contribute to learning and memory.

HADI JORATI, UBC

Mikhlin multiplier theorem for nonhomogeneous dilations

We seek an analogue of Mikhlin multiplier theorem for nonhomogeneous dilations by analyzing a specific family of curved flag kernels adapted to a parabola in the euclidean plane \mathbb{R}^2 .

ANH VINH LE, Harvard University, Mathematics Department, 1 Oxford St., MA 02138, US

Some colouring problems of unit-quadrance graphs

The quadrance between two points $A_1 = (x_1, y_1)$ and $A_2 = (x_2, y_2)$ is the number $Q(A_1, A_2) = (x_1 - x_2)^2 + (y_1 - y_2)^2$. Let q be an odd prime power and F_q be the finite field with q elements. The unit-quadrance graph D_q has the vertex set F_q^2 , and X, Y in F_q^2 are adjacent if and only if $Q(A_1, A_2) = 1$. In this talk, we will discuss various colouring problems for the unit-quadrance graph D_q .

JING LI, The University of Western Ontario, Middlesex College, 1151 Richmond St. N., London, ON, N6A 5B7

Modeling the Latency and Spatial Non-Locality in Susceptible-Infectious Epidemic Models

With the assumptions that the infectious disease has a fixed latent period, and the exposed individuals are capable of moving around, we reformulate the SI models under the discrete spatial space called patches. Some ordinary differential system models over patches with delay representing the latency of the diseases and the dispersion accounting for the mobility of the population between the patches are obtained. We will show how the disease latency and population mobility jointly affect the dynamical behaviour of the diseases by using mathematical analysis and computer simulations.

FRANKLIN MENDIVIL, Acadia Univesity

Fractal set-valued measures

In this talk we discuss set-valued measures and give two frameworks for constructing self-similar set-valued measures. We also discuss the general idea of self-similar measures and give several examples.

JIE XIAO, Memorial University

The sharp Sobolev and isoperimetric inequalities split twice

In this talk, we will show that each of the sharp (endpoint) Sobolev inequality and the isoperimetric inequality can be split into two sharp and stronger inequalities through either the 1-variational capacity or the 1-integral affine surface area. Furthermore, some related sharp analytic and geometric inequalities will be explored as well.

KATE (FANG) ZHANG, University of New Brunswick
Asymptotic Behavior of A Reaction-Diffusion Model With A Quiescent

This research is devoted to the investigation of the asymptotic behavior for a reaction-diffusion model with a quiescent stage. We first establish the existence of asymptotic speed of spread and show that it coincides with the minimal wave speed for monotone traveling waves. Then we obtain a threshold result on the global attractivity of either zero or positive steady state in the case where the spatial domain is bounded. The numerical simulations are also provided to illustrate these analytic results.