Contributed Papers
Communications libres
(Org: **Jamie Foster** (McMaster))

LUCAS CALIXTO, University of Ottawa (Canada) and Unicamp (Brazil)
Equivariant Map Queer Lie Superalgebras

Map Lie (super)algebras are a large class of Lie (super)algebras that generalize the well-known loop and current Lie (super)algebras. More precisely, the map Lie superalgebra $M(X, \mathfrak{g})$ is the Lie superalgebra whose elements are regular maps from the algebraic variety X to the Lie superalgebra $\mathfrak{g}$. More generally, if Γ is a group acting on both X and $\mathfrak{g}$, then the *equivariant* map Lie superalgebra $M(X, \mathfrak{g})^\Gamma$ consists of the elements of $M(X, \mathfrak{g})$ that are Γ-equivariant. Our goal in this talk is to present a classification of all irreducible finite-dimensional representations of $M(X, \mathfrak{g})^\Gamma$ in the case that $\mathfrak{g}$ is the queer Lie superalgebra. In particular, this yields a classification of the irreducible finite-dimensional modules for twisted loop queer superalgebras. This is joint work with Adriano Moura and Alistair Savage.

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MICHAEL CAVERS, University of Calgary
Rewiring dynamics on directed graphs

Brain function can be modeled as a network, or graph, of interacting neurons. Most graph theoretic approaches use undirected graphs by assuming such interactions are symmetric. We consider asymmetric interactions to construct directed graphs derived from functional Magnetic Resonance Imaging (fMRI) data. The aim is to better understand the relationship between structural properties of these directed graphs and the dynamics of neural networks. Since functional connectivity (the interaction between brain regions sharing functional properties) is a dynamic process, this gives rise to evolving networks. For this reason, we apply spectral graph theory techniques to study the effect that rewiring arcs in directed graphs has on the dynamics of the network.

This is joint work with Kris Vasudevan (University of Calgary).

GREG DOYLE, Carleton University
Explicit Evaluation of Double Gauss Sums

Let n be a positive integer, p a prime, s an integer coprime to p and $Q = ax^2 + bxy + cy^2$ is an integral binary quadratic form. For any rational number α, we set $e(\alpha) := e^{2\pi\imath\alpha}$.

Consider the exponential sum given by $G(Q; s; p^n) := \sum_{x,y=0}^{p^n-1} e\left(\frac{Q \cdot s}{p^n}\right)$. We call this a double Gauss sum.

Using elementary methods, we give an explicit evaluation of these double Gauss sums, and show where we may apply this result. With time remaining, we will discuss how to expand these methods to deal with a general case.

DOUGLAS HENRICH, Iroquois Ridge High School
Mathematical Ethics: Values, Valences and Virtues

In this paper I will review the themes of: gender differentiation and engagement in mathematics, ethics and separated values within mathematics, and proven teaching strategies that promote mathematical learning engagement. These themes will be unified by anecdotal success strategies that show how emphasis on the connected values of mathematics engages both male and female students.

MOHAMMAD ALAMGIR HOSSAIN, Memorial University of Newfoundland
Numerical modelling of the nonhydrostatic mesoscale stratified flows

In this research, the evolution of dry thermals in a stratified atmosphere has been investigated to study the development of a nonhydrostatic atmospheric model. In designing such models, one needs to minimize artificial energy dissipation at the resolved scale, and parameterize the effect of unresolved turbulent mixing. First, we have adopted the standard mesoscale filtering of conservation laws (mass, momentum, and energy) assuming that the characteristic scale of circulation is much less than the density scale hight of the atmosphere. Second, we have filtered the mesoscale equations with a Deslauriers–Dubuc (DD) wavelet system along with a Smagorinsky type eddy viscosity model. The DD wavelet results in a non-dissipative advection scheme. The time integration is performed by projecting the solution onto a Krylov subspace, and by solving the system with the GMRES (generalized minimal residual) algorithm. In this talk, I will present numerical simulation of internal wave generated penetrative convection in a stratified environment.

This is a joint work with Dr. Jahrul Alam (Memorial University of Newfoundland)

REESE JOHNSTON, University of Wisconsin - Madison
Complexity of binary trees of uncountable height

In the context of ω_1-computability, we investigate the complexity of paths through computable binary trees of height ω_1. In particular, I will present a computable binary tree of countable width in which the unique path is not computable.

ETHAN MCCARTHY, University of Wisconsin—Madison
Counting periodic billiard paths on some tessellating polygons

Imagine standing at a frictionless billiard table with polygonal boundary π. Given a natural number n, how many ways can you roll a billiard ball so that it bounces around the table exactly n times, returns to its initial position, and repeats? This poster-presentation will present answers for π given by a rectangle, an equilateral triangle, an isosceles-right triangle, and a 30-60-90 triangle. Joint work with Andrew Baxter and Jonathan Eskreis-Winkler, at the DIMACS Institute Summer REU.

FARZAD POURBABAEE, McMaster University
Assortative Configuration Graphs

Assortative configuration model as a generalization to the conventional configuration random graphs is introduced, in which the distribution of half-edge attachments is no longer uniform and could be of any arbitrarily type, which satisfies some regularity conditions. A wiring process is developed, so as the limiting ratio of edges with out-degree k and in-degree j converges in probability to Q_{kj}. This model could be exploited as a better realization of real-world random networks, where the connections are assortative.

S.M. ASHRAFUR RAHMAN, Western University
Modelling the impact of early versus late antiretroviral treatment on HIV epidemics

In absence of effective vaccines pre-exposure prophylaxis (PrEP) and post-exposure prophylaxis (PEP) demonstrate substantial impact on HIV epidemics. Antiretroviral treatment (ART) has the potential to reduce mortality and disease progression among HIV infected individual. ART can reduce the viral load to an undetected level help preventing new infections. Whether the treatment should begin early or delayed is still an unanswered question. This study consider the impact of early versus delay ART on the HIV epidemic and demonstrate the optimum timing of ART initiation. Our results highlights the long-term consequences of early treatment in the subjects of reduction of new infection, treatment, disease death and adult prevalence.

SCHEHRAZAD SELMANE, Liforce. Faculty of Mathematics. University of Science and Technology Houari Boumediene. Algeria

Forecast of Cutaneous Leishmaniasis Incidence using Temperature

Cutaneous leishmaniasis (CL) represents a serious public health problem in Algeria. A total number of 149,706 of CL were diagnosed between 2000 and 2011. The number of cases peaked in 2005 and 2010 with 25,511 and 21,049 cases respectively. Biskra ranks first among the endemic provinces of the country and records every year a high incidence of CL with 3,5149 cases diagnosed between 2000 and 2011 with peaks in 2005 and 2010; 8594 and 6169 cases respectively.

As leishmaniasis is a climate-sensitive disease, we therefore undertook this study in the aim to assess the impact of climate variables on leishmaniasis and to test applicability of a built model in the control and prevention of the disease in Biskra province. The modeling was performed through time series analysis and regression analysis. The study period consisted of a twelve year period from January 2000 to December 2011 with two different monthly data sets: epidemiological and meteorological. We performed a statistical model based on a generalized linear model with Poisson regression considering the number of CL cases as dependent variable and climatic conditions of temperature, relative humidity, evaporation, and rainfall as independent variables. It has been shown that the temperature and temporal effect are the main factors that determine the number of CL cases. The forecasting model can be used to predict CL cases, given appropriate climatological information. An increase of one Celsius degree in the temperature will lead to an increase of 18 percent in the number of CL cases.

ROBERT STREHL, Ryerson University, Toronto

Efficient stochastic simulation of multiscale reaction-diffusion models

Recently, computational and experimental tools for investigating biochemical reactions experienced a rapid development. Therefore a precise numerical analysis of modelling approaches on a micro- or mesoscopic scale is now possible. This has a huge potential of leading to new insights into key cellular processes such as intracellular signalling pathways or cell divisions on an unprecedented level of detail.

I present a new hybrid numerical method for stochastic discrete models of heterogeneous biochemical reaction networks, that combines exact and approximate simulation strategies. The idea is it to efficiently cope with a variety of event rates (diffusion and reaction) to reduce the significant computational cost of exact inhomogeneous stochastic simulation algorithms, given high event rates. This is joint work with Silvana Ilie and Katrin Rohlf.

XIAOYING WANG, University of Western Ontario

A two-patch predator-prey model with adaptive habitancy of predators

A two-patch predator-prey model with the Holling type II functional response is studied, in which predators are assumed to adopt adaptive dispersal to inhabit the better patch in order to gain more fitness. Analytical conditions for the persistence and extinction of predators are obtained under different scenarios of the model. Numerical simulations are conducted which show that adaptive dispersal can stabilize the system with either weak or strong adaptation, when prey and predators tend to a globally stable equilibrium in one isolated patch and tend to limit cycles in the other. Furthermore, it is observed that the adaptive dispersal may cause torus bifurcation for the model when the prey and predators population tend to limit cycles in each isolated patch.