AARMS-CMS Student Poster Session
Présentations par affiches des étudiants - AARMS-SMC
(Org: **Aaron Berk** (UBC) and/et **Svenja Huntemann** (Dalhousie))

SALAM ALNABULSI, University of Calgary
Improved Downward wave-field with application to reverse time migration

We introduced a new technique in the Reverse Time Migration, it aims to decrease the negative effect of the multiples that generated during the forward wave-field propagation. Based on the approach of absorbing boundary conditions, we produced reflections free forward wave-field (RFFW) and used it in the imaging conditions (IC). The resulting images show a good agreement with the structure image of the true reflectivity model. We tested two types of velocity models, elastic and viscoelastic velocity model using two different numerical approximation techniques: finite difference method and finite element method.

CHELSEA BATTELL, University of Ottawa
A Higher-Order Logical Framework for Reasoning about Programming Languages

Logical frameworks implementing higher-order abstract syntax (HOAS) may be used to encode and prove properties of object logics while minimizing repetitive computations incidental to the idea of each encoding, such as managing free and bound variables, performing beta-reductions and checking alpha equivalence. This allows the user to concentrate on the essence of the proofs. A variety of logical frameworks based on the proof theory of higher-order logic include an intermediate layer called the specification logic. The object logic is then encoded in the specification logic rather than directly in the HOAS layer and this increases the variety of object logics and their judgments that can be reasoned about inductively. Hybrid is in this class of logical frameworks; it is implemented as a Coq library and so allows easy extensions by the addition of new specification logics. This work presents the progress of the implementation and integration of a new specification logic based on higher-order hereditary Harrop formulas. The addition of a higher-order specification logic further increases the class of object logics that can be reasoned about in Hybrid.

JOSÉ MANUEL RODRIGUEZ CABALLERO, Université du Québec à Montréal
La suite de Fibonacci et les idéaux de l'algèbre de Laurent des polynômes en deux variables sur un corps fini

On étudie le rapport entre les idéaux de codimension donnée en $F_q[x, x^{-1}, y, y^{-1}]$ et la suite de Fibonacci.

MIHAIL CALITOIU, Carleton University
Three problems in Geometric Probability related to Frank Hawthorne E1150 [Amer.Math.Monthly 62(1955), 40]

Geometric probability is the study of probabilities associated with the lengths, areas and volumes of randomly generated objects and configurations of elementary geometry. In 1955, Frank Hawthorne proposed the problem E1150 in American Mathematical Monthly: "If three points are selected at random in a rectangle AX2A, what is the probability that the triangle so determined is obtuse?". Roger Pinkham suggested in 60' a more general problem: "Let there be given three points at random in an arbitrary rectangle. What is the probability that the triangle thus formed is obtuse?". In this research, we study three problems derived from E1150. The method we used consists in performing independent trials of same chance processes and recording the number of trials until a particular outcome is obtained.

This is a joint work of Mihail Calitoiu, Ning Hu, Andrew Sun, Ryan Sun, and Louis Zhang

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KRIS CHAMBERS, University of Ottawa
Isotropy in the Category of Continuous G-sets

Recent work by Hofstra, Funk and Steinberg defined a new algebraic invariant of Grothendieck Topos called the isotropy group (2012). The isotropy group of a topos generalizes well known algebraic concepts like isotropy subgroups of groups acting on a set and vertex groups of groupoids. Additionally, there is a close connection to crossed modules. Joyal and Tierney showed that each Grothendieck topos is equivalent to a category of equivariant sheaves on some localic groupoid. For the case of a topological group G, we will present a topological group theoretic representation of the isotropy group in the category of continuous G-sets. The aim of this work is to build a bridge between ideas from topos theory on one hand and concepts in topological group theory on the other.

JORGE GONZALEZ, Florida Atlantic University

Parameterization Method for Stable/Unstable Manifolds of Periodic Points for Maps

The Parameterization Method is a general functional analytic framework for studying invariant manifolds of dynamical systems. We develop a version of the method for stable/unstable manifolds associated with periodic points of discrete time dynamical systems. The novelty of our approach is that by introducing new variables we are able to avoid computing compositions of the map. We describe the method in general and implement the method for some one and two dimensional manifolds in some two and three dimensional dynamical systems.

PAULINE HUBERT & NADIA LAFRENIÈRE, UQAM

From the Descent Algebra to the Peak Algebra on the Symmetric Group

Given a permutation σ in the symmetric group of order n, the descents are the positions $\{i \mid \sigma(i) > \sigma(i+1)\}$. This leads to an algebra whose elements are sums of permutations sharing the same descent set. This algebra has been widely studied for its connections with Coxeter groups and card shuffling. In a similar way, the peaks correspond to the set $\{i \mid \sigma(i-1) < \sigma(i) > \sigma(i+1)\}$. This allows us to define a subalgebra of the descent algebra, that is as well a left ideal of it. We extend results on the descent algebra to their equivalent in terms of peaks.

CHEIKH BÉCAYE NDONGO, Université Ottawa

Intermittency for the wave equation with Lévy white noise

We consider the stochastic wave equation in dimension 1 driven by the Lévy white noise introduced in Balan (2015). Using Rosenthal's inequality, we develop a maximal inequality for the moments of order $p \geq 2$ of the integral with respect to this noise. Based on this inequality, we show that this equation has a unique solution, which is weakly intermittent in the sense of Foondun and Khoshnevisan (2009) and Khoshnevisan (2014).

PIERRE-OLIVIER PARISÉ, Université du Québec à Trois-Rivières

The Generalized Mandelbrot Sets over the Tricomplex spaces

Résumé

Nous présentons l'espace des nombres *multicomplexes*. Cet espace est une généralisation des nombres complexes. Précisément, nous nous concentrons sur les espaces des nombres bicomplexes et tricomplexes. Nous montrons par la suite une application aux systèmes dynamiques. Pour ce faire, nous définissons, à l'aide de ces structures de nombres, les ensembles de Mandelbrot générés par les polynômes de la forme $z^p + c$.

Abstract

We present the *multicomplex* spaces. These spaces generalize the complex numbers. Precisely, we focus on the bicomplex and the tricomplex spaces. Then, we show an application to dynamical systems. We define, over the bicomplex and tricomplex spaces, the Mandelbrot sets generated by the polynomials of the form $z^p + c$.

YANN RICAUD, Laval University

Rigorous numerics for periodic orbits of piecewise-smooth systems: a functional analytic approach based on Chebyshev series

In this talk, we introduce a rigorous computational method for proving existence of periodic orbits of continuous and discontinuous (Filippov) piecewise-smooth differential equations. The computer-assisted proofs are obtained by combining a functional analytic approach based on Chebyshev series together with a Newton-Kantorovich type argument (the radii polynomial approach). Using this approach, we prove existence of crossing periodic orbits in a model nonlinear Filippov system and in the Chua's circuit system. This is joint work with Marcio Gameiro (USP, Brazil) and Jean-Philippe Lessard (Université Laval, Canada).

JENNIFER VAUGHAN, University of Toronto
Dynamical Invariance of a New Metaplectic-c Quantization Condition

Metaplectic-c quantization was developed by Robinson and Rawnsley as an alternative to the classical Kostant-Souriau quantization procedure with half-form correction. Given a metaplectic-c quantizable symplectic manifold (M, ω) and a real-valued function H on M, we propose a condition under which a regular value E of H is a quantized energy level for the system (M, ω, H). We show that the condition is dynamically invariant: if there are two functions on M that share a level set, then the quantization condition over that level set is identical for both functions. We then show that the quantized energy levels obtained for the harmonic oscillator and the hydrogen atom are consistent with the predictions of quantum mechanics.

NANCY WALLACE, UQAM
Constantes de structure liées à la nouvelle base dite immaculée, de l'algèbre des fonctions symétriques non commutative.

Introduite en 2013 par Chris Berg, Nantel Bergeron, Franco Saliola, Luis Serrano et Mike Zabrocki dans [BBSSZ] la base immaculée est la seule qui relève, pour toute composition, les fonctions symétriques Hall-Littlewood dans l'algèbre des fonctions symétriques non commutative. L'affiche que je propose donnera une définition des fonctions immaculées, une règle de Pieri à droite, les constantes de structure apparaissant lors de la décomposition des fonctions homogènes non commutative dans cette base et les constantes de structures de la décomposition des fonctions Schur ruban non commutatif dans cette nouvelle base. Ces deux dernières constantes de structure sont liées à des objets combinatoires qui seront brièvement abordés.

[BBSSZ] Chris Berg, Nantel Bergeron, Franco Saliola, Luis Serrano et Mike Zabrocki, *A lift of the Schur and Hall-Littlewood bases to non-commutative symetric functions* (2013)

JORDON YAN, University of Toronto
Goldbach's Conjecture Proof for integers 36,000 and above

We have the proof forGoldbach's conjecture for even integers above 36,000. The proof holds for any given even integer that is "big enough" (36,000 and greater). The proof will not only provide a solution to if every even integer greater than 36,000 can be expressed as the sum of two primes, but also how many 'pairs' of these expressions there are in total.

JONGUK YANG, University of Toronto
Matings with the Basilica

I will present an overview of the family of quadratic rational maps with a 2-periodic superattracting orbit. Many of these maps can be described as the mating of the basilica with a quadratic polynomial. For this reason, the family has attracted much recent attention, and the parameter space picture is now nearly completely understood. I will survey the known results, with particular emphasis on my own contribution to the topic: the mateability of Siegel quadratic polynomials of bounded type with the basilica polynomial.