



Computer-Assisted Research Mathematics and its Applications

**Workshop on Experimental and
Analytical Mathematics marking
the occasion of Jonathan
Borwein's 60th birthday**

29 Nov – 1 Dec 2011

Abstracts

Alejandro Jofre
Center for Mathematical Modelling and Dept. of Mathematical
Engineering University of Chile

TITLE: ROBUSTNESS OF WALRASIAN TATONNEMENT IN LOCALLY IDENTIFYING AN EQUILIBRIUM

Abstract: It is widely believed that classical schemes of tatonnement, in which prices are systematically lowered for goods in excess supply but raised for goods in excess demand, are inadequate for achieving equilibrium in basic models of exchange with a satisfying degree of generality. Well known examples reveal a lack of convergence even if the process is initiated with prices arbitrarily near to equilibrium prices. However, the examples involve initial supplies and demands that are seriously out-of-kilter, and they do not answer the question of what might be expected if such were not the case. Here it is shown, under relatively mild economic assumptions, that tatonnement is certain to work when goods as well as prices start out close enough to an equilibrium configuration. The developments lead beyond tatonnement to the formulation of dynamical equations which capture how equilibrium prices should evolve in response to incremental additions to, or subtractions from, the agents equilibrium holdings. Key Words. General equilibrium, exchange, price adjustment, Walrasian tatonnement, evolution of equilibrium

Aidan Sims
University of Wollongong

TITLE: COHOMOLOGY AND TWISTED C^* -ALGEBRAS FOR k -GRAPHS

Abstract: Given a higher-rank graph Γ , there is an associated cohomology theory. I will describe how to twist the C^* -algebra of a k -graph by a circle-valued 2-cocycle and indicate some interesting C^* -algebraic examples that arise. I will then discuss work in progress on adapting George Elliott's clever computation of the K -theory of the irrational rotation algebras to understand K -theory for twisted K -graph algebras. This is joint work with Alex Kumjian and David Pask.

Walter Kozłowski
University of NSW

TITLE: CONVERGENCE OF ITERATION FIXED POINT PROCESS FOR POINTWISE LIPSCHITZIAN MAPPINGS IN BANACH SPACES

Abstract: We present recent results on the strong and weak convergence of generalized Mann-Krasnosel'skii and Ishikawa algorithms. We discuss conditions sufficient for such iteration processes to converge to common fixed points of semigroups of pointwise Lipschitzian mappings. The discussion will focus on demonstrating how various techniques like uniform convexity, approximate fixed points, quasi-periodicity and others, can be combined to obtain convergence results. We will also touch upon some open questions and possible further research directions.

Jeff Hogan
The University of Newcastle

TITLE: SINGULAR INTEGRALS AND WAVELET BI-FRAMES

Abstract: Most wavelet constructions – performed via representation theory, frame theory or multiresolution analysis -- require the wavelet(s) ψ to have at least one vanishing moment, i.e., $\int \psi = 0$. This condition is, after all, the reason they're called wavelets as it imposes oscillations. In this talk we show how an approach to wavelet construction that uses the modern theory of singular integrals can remove the vanishing moment condition on the synthesising wavelet at the cost of the imposition of extra oscillation conditions on the analysing wavelet. Our path will lead us through function spaces such as BMO and Hardy spaces as well as classical results on lacunary Fourier series. This is joint work with John Gilbert (University of Texas, Austin) and Joe Lakey (New Mexico State University, Las Cruces).

Brailey Sims
The University of Newcastle

TITLE: C_0 AND THE NEXT 30 YEARS

Ilias Kotsireas
Wilfrid Laurier University

TITLE: NEW RESULTS ON D-OPTIMAL MATRICES

Abstract: D-optimal matrices are $2v \times 2v$ $(-1,+1)$ -matrices that have maximal determinant among all $2v \times 2v$ $(-1,+1)$ -matrices, where v is an odd positive integer. The value of the maximal determinant is given by Ehlich's bound. We present new theoretical and computational results on D-optimal matrices of circulant type. Such D-optimal matrices are constructed via two circulant submatrices of orders v each. In particular, we construct new D-optimal matrices of orders 206, 242, 262, 482. Joint work with D. Z. Djokovic.

Ian Doust
University of NSW

TITLE: HOW ROUND ARE METRIC TREES?

Abstract: Generalized roundness is an important notion in the setting of metric spaces that originally arose in the study of embedding questions. Given a metric space (X,d) , it will have generalized roundness p for all real numbers p in some closed interval of the form $[0,p_X]$ where $0 \leq p_X \leq \infty$. The definition of the statement (X,d) has generalized roundness p is not too difficult, but actually finding the maximum value p_X for any given metric space is very challenging. It is known that if (X,d) is a metric tree then $p_X \geq 1$. A few years ago Anthony Weston and I showed that if (X,d) is a finite metric tree then $p_X > 1$. It is expected that except in a some special cases $p_X = 1$ for any infinite metric tree. In this talk I shall describe some recent work with Caffarelli and Weston towards clarifying the infinite tree case.

David Yost
University of Ballarat

TITLE: CONTRACTIVE PROJECTIONS ON BANACH SPACES

Abstract: On all of the familiar Banach spaces, it is very easy to write down a formula which defines a norm one projection. This is not true for arbitrary Banach spaces. The following rough trichotomy indicates the range of behaviour.

A) Most finite dimensional Banach spaces admit no norm one projections at all (except those with rank one). Such examples may be smooth, strictly convex, or polyhedral.

B) Some separable Banach spaces admit no continuous projections at all (except those with finite rank or co-rank).

C) Many non-separable Banach spaces admit many nontrivial norm one projections, even under every equivalent norm.

Jon Borwein
The University of Newcastle

TITLE: MEETINGS WITH COMPUTER ALGEBRA AND SPECIAL FUNCTIONS: A RAMANUJAN-STYLE TALK

Abstract: I intend to display roughly a dozen examples where computational experimentation, computer algebra and special function theory have lead to pleasing or surprising results. In the style of Ramanujan, very few proofs are given but may be found in the references. Much of this work requires extensive symbolic and numeric computations. It makes frequent use of the new NIST Handbook of Mathematical Functions and related tools such as gfun.

Rob Corless
University of Western Ontario in London

TITLE: MANDELBROT POLYNOMIALS AND MATRICES

Abstract: In this talk, we explore a family of polynomials whose roots are related to the Mandelbrot set. These roots correspond to the k -periodic points of the iteration defining the Mandelbrot set. We explore a variety of approaches to compute the roots of these polynomials; classical iterative schemes, eigenvalues of companion matrices and a novel family of recursively defined matrices.

Joint work with Piers W. Lawrence and David J. Jeffrey.

Warren Moors
The University of Auckland

TITLE: WHEN IS THE LINEAR IMAGE OF A CLOSED CONVEX CONE CLOSED ?

Wadim Zudilin
The University of Newcastle

TITLE (COMPLICATED): FACTORIAL RATIOS

Abstract: We outline techniques and results as well as pose some problems about deciding whether a ratio of products of factorials is integral.

<http://carma.newcastle.edu.au/>

Regina Burachik
University of South Australia

TITLE: ASYMPTOTIC STRONG DUALITY

Abstract. Given a nonconvex and nonsmooth optimization problem, we define a family of "perturbed" Lagrangians, which induce well-behaved approximations of the dual problem. Our family of approximated problems is said to verify strong asymptotic duality when the optimal dual values of the perturbed problems approach the primal optimal value. Our perturbed Lagrangians can have the same order of smoothness as the functions of the original problem, a property not shared by the classical (unperturbed) augmented Lagrangian. Therefore our proposed scheme allows the use of efficient numerical methods for solving the perturbed dual problems. We establish general conditions under which strong asymptotic duality holds, and we relate the latter with both strong duality and lower semicontinuity of the perturbation function. We illustrate our perturbed duality scheme with two important examples: Constrained Nonsmooth optimization and Nonlinear Semidefinite programming.

Fran Aragon
The University of Newcastle

TITLE: IMPLICIT MULTIFUNCTION THEOREMS AND METRIC REGULARITY

Abstract: In this talk we will focus on implicit generalized equations defined by the sum of a function and a multifunction (set-valued map) acting between some Banach spaces. Focusing on the fundamental properties of metric regularity and Lipschitzian stability, we will see some qualitative and quantitative relationships between these properties for the multivalued parts and the corresponding solution map (the implicit multifunction).

Alex Kruger
University of Ballarat

TITLE: STATIONARITY AND REGULARITY OF INFINITE COLLECTIONS OF SETS

Abstract: The talk is about a possible way of extending the *extremal principle* from finite to infinite collections of sets. Stationarity and regularity properties of (finite and infinite) collections will also be discussed. Primal and dual space definitions of these concepts will be compared. All the properties mentioned above can be characterized in terms of certain primal and dual (subdifferential) *regularity moduli*. As an application of stationarity conditions, an *intersection rule* for Fréchet normals will be considered.

Julian Revalski
Bulgarian Academy of Sciences

TITLE: Geometry of Banach spaces and best approximation problems

Abstract: It is known that, in certain cases, uniform convexity of the norm assures the existence, uniqueness and stability of the best approximations to a nonempty closed set in a given Banach space. However, often the uniqueness of the best approximation is not guaranteed but the stability of the solution set remains of substantial interest. We will present properties of the norm which are needed in order to have the required stability of the set of best approximations. It turns out that these are uniform type conditions of the norm which are more general than the uniform convexity. The case of local uniform convexity will be discussed as well, and the descriptive properties of the set of best approximations to a closed set in a Banach space with such norms will be presented.