FLACAM 2019

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5 - 8 November, Santiago - Chile

Speaker: Gabriel Haeser (University of São Paulo)

Title: Optimality conditions for nonlinear symmetric cone programming

Authors: Ellen Hidemi Fukuda (U. of Kyoto), Gabriel Haeser (U. of São Paulo), Daiana S. Viana (Federal U. of Acre)

Abstract: Nonlinear symmetric cone programming (NSCP) generalizes important optimization problems such as nonlinear programming (NLP), nonlinear semidefinite programming (NSDP) and nonlinear second-order cone programming (NSOCP). In this work, we present two new optimality conditions for NSCP without constraint qualifications, which implies the Karush-Kuhn-Tucker (KKT) conditions under a condition weaker than Robinson's constraint qualification. In addition, we prove that an augmented Lagrangian method proposed for NSOCPs satisfies our optimality conditions, which gives better global convergence results.

Reference and acknowledgements:

François Murat
Laboratoire Jacques-Louis Lions, Sorbonne Université and CNRS, Paris

Homogenization of the Neumann's brush problem

In this lecture, I will describe joint work with Antonio Gaudiello (Naples, Italy) and Olivier Guibé (Rouen, France).

We consider a sequence of domains Ω^ε which have the form of brushes (in dimension $N = 3$) or of combs (in dimension $N = 2$). Each domain Ω^ε is an open subset of $\mathbf{R}^N$ with $N \geq 2$ which is made of teeth distributed over a basis. When ε tends to zero, the basis remains fixed, while the teeth vary in size, forms and distributions. No periodicity is assumed on the distributions of the teeth, which are assumed to be vertical, cylindrical, and of fixed height, and do vary with ε. For each domain Ω^ε, the diameter of every tooth is assumed to be less than or equal to ε ; the cross sections of the teeth, which are open, can vary from one tooth to another one; they are not assumed to be smooth, and the teeth can be adjacent, i.e. they can share parts of their boundaries. Finally the sequence of the characteristic functions of the cross sections of the teeth is assumed to have, as ε tends to zero, an $L^\infty(\mathbf{R}^{N-1})$ weak-star limit $\theta = \theta(x')$ (this latest assumption is an innocuous one).

For this sequence of domains we study the asymptotic behavior, as ε tends to zero, of the solution of a linear second order elliptic equation with a zeroth order term which is bounded from below away from zero, and with a source term in L^2, when the homogeneous Neumann boundary condition is imposed on the boundaries of the domains Ω^ε.

This is a classical homogenization problem since the pioneering work presented by R. Brizzi and J.-P. Chalot in their Ph.D. Thesis in 1978, but our work takes place in a geometry which is much more general that the ones which have been considered since that time. In our paper A. Gaudiello, O. Guibé & F. Murat, Homogenization of the brush problem with a source term in L^1, published in Archive for Rational Mechanics and Analysis, volume 225, (2017), pp. 1-64, we have treated the case where $\theta_0 \leq \theta(x') \leq 1$ for some $\theta_0 > 0$ and given for the first time a corrector result. I will state and prove these homogenization and corrector results.

If time permits, I will also describe a very recent work in which we treat the case where $\theta_0 = 0$, namely the case where one can have a cylindrical measurable subset of the zone of the teeth where there is no matter remaining at the limit.

Speaker: Kolja Knauer (Université Aix-Marseille)

Title: Complete acyclic colorings

Authors: Kolja Knauer (U. Aix-Marseille, France)

Abstract: The "a-vertex arboricity" of a graph is the largest number of colors that can be used such that every color induces a forest but merging any two colors yields a monochromatic cycle. Similarly, the "adichromatic number" of a digraph is the largest number of colors its vertices can be colored with such that every color induces an acyclic subdigraph but merging any two yields a monochromatic directed cycle. Both concepts are natural generalizations of the achromatic number. We study the relation of these parameters with others such as the "diachromatic number" of Araujo-Pardo, Montellano-Ballesteros, Olsen, and Rubio-Montiel and most importantly with feedback vertex sets, where a strengthening of the Erdös-Pósa property arises.

Reference and acknowledgements:

Speaker: Fábio Botler (Universidade Federal do Rio de Janeiro, Brazil)

Title: Further on Gallai's path decomposition conjecture

Authors: Fábio Botler (UFRJ, Brazil)

Abstract: A path decomposition of a graph G is a collection of edge-disjoint paths of G that covers the edge set of G. Gallai (1968) conjectured that every connected graph on n vertices admits a path decomposition of cardinality at most n/2. Seminal results towards its verification consider the graph obtained from G by removing its vertices of odd degree, which is called the E-subgraph of G. Lovász (1968) verified Gallai's Conjecture for graphs whose E-subgraphs consist of at most one vertex, and Pyber (1996) verified it for graphs whose E-subgraphs are forests. In 2005, Fan verified Gallai's Conjecture for graphs in which each block of their E-subgraph is triangle-free and has maximum degree 3. Since then, no result was obtained regarding E-subgraphs. In this paper, we verify Gallai's Conjecture for graphs whose E-subgraphs have maximum degree at most 3. As a corollary, we extend Fan's result by relaxing the triangle-free condition on at most one block of each component of the E-subgraph. More specifically, we verify Gallai's Conjecture for graphs in which each block of their E-subgraph has maximum degree at most 3 and, for each component of their E-subgraph, all but at most one block is triangle-free.

Reference and acknowledgements:

Speaker: Olga Vasilieva (Universidad del Valle, Colombia)

Title: Optimal control approach for implementation of sterile insect techniques

Authors: Pierre-Alexandre Bliman (Sorbonne Universite, Universite Paris-Diderot SPC, Inria, CNRS & Laboratoire Jacques-Louis Lions, equipe Mamba, Paris, France; pierre-alexandre.bliman@inria.fr), Daiver Cardona-Salgado (Universidad Autónoma de Occidente, Cali, Colombia; dcardona@uao.edu.co), Yves Dumont (AMAP, Universite Montpellier, CIRAD, CNRS, INRA, IRD, Montpellier, France; yves.dumont@cirad.fr), Olga Vasilieva (U. del Valle, Colombia)

Abstract: Vector or pest control is essential to reduce the risk of vector-borne diseases or crop losses. Among the available biological control tools, the Sterile Insect Technique (SIT) is one of the most promising. However, SIT-control campaigns must be carefully planned in advance in order to render desirable outcomes.

In this presentation, we design SIT-control intervention programs that can avoid the real-time monitoring of the wild insect population and require to mass-rear a minimal overall number of sterile insects, in order to induce a local elimination of the wild insects in the shortest time. Continuous-time release programs are obtained by applying an optimal control approach, and they further form the basis of more practical SIT-control programs consisting of periodic impulsive releases.

Reference and acknowledgements:

Speaker: Roberto Andreani (U. Campinas, Brazil)

Title: Sequential conditions of optimality theoretical and practical importance

Authors: Roberto Andreani (U. Campinas, Brazil)

Abstract: Every local minimizer of a smooth constrained optimization problem satisfies the sequential approximate Karush–Kuhn–Tucker (AKKT) condition. This optimality condition is used to define the stopping criteria of many practical nonlinear programming algorithms.

In this presentation we present the theoretical and practical importance of these conditions, to generalize the convergence of algorithms and the development of new algorithms with desirable conditions. We will also show other sequential conditions of optimality

We also present minimum constraint qualifications under which the algorithms converge. These conditions will be called strict constraint qualifications (SCQs).

Reference and acknowledgements:

Speaker: Paulo J. S. Silva (U. Campinas, Brazil)

Title: Robust nonlinear support vector machine based on difference of convex functions

Authors: Raquel Serna (U. Campinas, Brazil), Paulo J. S. Silva (U. Campinas, Brazil)

Abstract: The training data of some classification problems can present systematic errors, or outliers, that limit the learning process. In this case it might be desirable to derive variations of usual classification models that can deal with the errors. One example is the robust support vector machines introduced by Xu, Crammer and Schuurmans. It is based on the idea of ignoring the samples with the largest errors. There is also another model suggested by Tsyurmasto, Zabarankin, and Uryasev, that uses ideas of value-at-risk. Both models, however, could only be used in the case of linear separation as they lack a strong duality theory that allows for the use of the kernel trick.

In this work we present a variation of the robust support vector machine that can be recast as a difference of convex optimization with linear constraints. Such problems that have a rich strong duality theory. We then succeed to build a dual problem whose data depend only on inner products of the original sample vectors, opening the path to use kernels for nonlinear separation. We also show how the nonlinear classifiers can be obtained from dual solutions and present some preliminary numerical results that exemplify the theory.

Reference and acknowledgements:

Speaker: Antoine Rousseau (INRIA, France)

Title: Bioremediation of natural resources: how modeling and optimization can help?

Authors: Antoine Rousseau (INRIA, France)

Abstract: In this talk I will introduce biological models in large water ressources, with the objective to model contamination and/or decontamination processes. Starting from complex coupled PDE systems, we will see how simplified models may both help to minimize the numerical cost of numerical simulations, and to implement optimization tools in order to accelerate the decontamination of polluted water systems. This is a joint work with colleagues form INRA Montpellier and Universidad de Chile.

References and acknowledgements:

Speaker: Ignacio Muga (Pontificia Universidad Católica de Valparaíso, Chile)

Title: A DG-based stabilized residual minimization technique

Authors: Victor Calo (School of Earth and Planetary Sciences, Curtin University, Australia), Alexandre Ern (U. Paris-Est, France), Ignacio Muga (PUCV) & Sergio Rojas (School of Earth and Planetary Sciences , Curtin University, Australia)

Abstract: Starting from a stabilized DG method for approaching the solution of a given PDE, we devise and analyze a residual minimization method by restricting the trial space to be globally continuous (while keeping the discontinuous test space of the original DG formulation). The residual is minimized in the sense of a discrete dual norm.

This residual minimization leads to a guaranteed stable saddle-point problem which delivers a (continuous) discrete solution as well as an error representation function that can be used to perform adaptive refinements.

In this talk, I will show in detail the proofs of well-posedness of the underlying residual minimization problem, together with the a priori and a posteriori error analysis. The performance of the method will be illustrated on the advection-reaction problem.

References and acknowledgements:

Speaker: Flavia Bonomo (Universidad de Buenos Aires, Argentina)

Title: On the thinness and proper thinness of a graph

Authors: Flavia Bonomo (U. de Buenos Aires, Argentina)

Abstract: The thinness of a graph is a with parameter introduced by Mannino, Oriolo, Ricci, and Chandran in 2007 as a generalization of interval graphs, which are exactly the 1-thin graphs. When a representation of the graph as a k-thin graph is given, for a constant value k, some NP-complete problems as maximum weighted independent set and bounded coloring with fixed number of colors can be solved in polynomial time [Mannino, Oriolo, Ricci, and Chandran (2007); Bonomo, Mattia and Oriolo (2011)]. These algorithms were respectively applied for improving heuristics of two real-world problems: the Frequency Assignment Problem in GSM networks, and the Double Traveling Salesman Problem with Multiple Stacks, respectively.

In this talk we introduce the concept of proper thinness, such that graphs with bounded proper thinness generalize proper interval graphs. We present the complexity of problems related to the computation of thinness and proper thinness, describe the behavior of the thinness and proper thinness under some graph operations, and relate thinness and proper thinness to other graph invariants in the literature. We will describe also a wide family of problems that can be solved in polynomial time for graphs with bounded thinness, when the k-thin representation of the graph is given, generalizing for example list matrix partition problems with bounded size matrix, and enlarge this family of problems for graphs with bounded proper thinness, including domination problems, when the k-proper-thin representation of the graph is given.

Reference and acknowledgements:

Speaker: Gonzalo Muñoz (Universidad de O'Higgins, Chile)

Title: Intersection cuts for polynomial optimization

Authors: Gonzalo Muñoz (U. de O'Higgins, Chile)

Abstract: We consider dynamically generating linear constraints (cutting planes) to tighten relaxations for polynomial optimization problems. Let S be a closed set and P a polyhedron. It is well known from integer programming that for feasible sets obtained from intersecting P and S one can construct cutting planes using convex "forbidden'' regions, or S-free sets. Here, we observe that polynomial optimization problems can be represented as a problem with linear objective function over such a feasible set, where S is the set of real, symmetric matrices representable as outer-products. Accordingly, we study outer-product-free sets and develop a thorough characterization of several (inclusion-wise) maximal families. In addition, we present a cutting plane approach that guarantees polynomial-time separation of an extreme point in P\S using our outer-product-free sets. Computational experiments demonstrate the promise of our approach from the point of view of strength and speed.

Reference and acknowledgements:

Speaker: César Hernández-Cruz (Centro de Investigación y de Estudios Avanzados, Mexico)

Title: Strongly chordal digraphs

Authors: César Hernández-Cruz (CINVESTAV, Mexico)

Abstract: Haskins and Rose introduced perfect elimination digraphs in 1976. In 2012, Meister and Telle re-considered this family, presenting it as a directed analogue of chordal graphs. Although there is good evidence to support the idea of viewing perfect elimination digraphs as a natural directed analogue of chordal graphs, the family is to large, and general theorems analogous to the undirected case (e.g., induced subgraph characterization) have not been obtained yet.

Reference and acknowledgements:

Speaker: Justina Gianatti (Centro Internacional Franco-Argentino de Ciencias de la Información y de Sistemas, Argentina)

Title: Optimal Control of An Age-Structured System With State Constraint

Authors: Justina Gianatti (CIFASIS, Argentina)

Abstract: The aim of this work is to address an optimal control problem of partial differential equations, where the state equation is age-structured, and is driven by a general abstract parabolic operator. In addition, we consider a finite number of linear state constraints. We start by proving the existence and uniqueness of solution for the state equation and we give first and second parabolic estimates. We provide a first order optimality condition and analyze the regularity of the costate. Finally, we present an illustrative example of a pregnancy model, where two coupled age-structured equation are involved.

Reference and acknowledgements:

Speaker: Pierre Monmarché (Sorbonne Université, France)

Title: Coupling for velocity jump processes

Authors: Pierre Monmarché (Sorbonne U., France)

Abstract: A velocity jump process is a Markov process moving in straight lines between random switching times. This class of piecewise deterministic processes models for instance motion of bacteria and are used in MCMC algorithms (Zig-zag process, Bouncy particle sampler...). I will present some coupling arguments for the study of such processes, in particular their long-time convergence and non-linear perturbations.

Reference and acknowledgements:

Speaker: Mauricio Sepúlveda (Universidad de Concepción, Chile)

Title: Stability analysis of the numerical method for damping dispersive equations

Authors: Mauricio Sepúlveda (U. de Concepción, Chile)

Abstract: This presentation deals with the numerical method for damping dispersive equations. These numerical methods are based on conservative finite differences in order to ensure the conservation of mass and energy, and thus achieve stable numerical schemes. Damping terms are added to these models, and the stability and exponential decay of energy are studied.

The first part of the talk deals with the stability of the solutions of the critical generalized Korteweg-de Vries equation (GKdV-4) with an extra drift term and a localized damping term. An initial two-point boundary value problem is stated in a bounded domain with homogeneous Dirichlet boundary conditions. We show that the proposed first-order implicit discretization converges strongly in L4 and the scheme is chosen to preserve similar stability properties as in the continuous problem, showing an exponential decay rate independently of the spatial mesh size and the time step. In addition, a second-order scheme is stated, but the strong L4 convergence and the uniform exponential decay are only ensured if a numerical viscosity term of fourth order is included in the scheme.

The second part of the talk deals with the study of the numerical method for a high-order Schrodinger equation with a localized dissipative term. This equation models the propagation of femtosecond optical pulses in a monomode optical fiber, accounting for additional effects such as third order dispersion, self-steeping of the pulse, and self-frequency shift.

Reference and acknowledgements:

Speaker: Oscar Jarrín (Universidad Técnica de Ambato, Ecuador)

Title: On decay properties and asymptotic behavior of solutions to a non-local perturbed KdV equation.

Authors: Oscar Jarrín (U. Técnica de Ambato, Ecuador)

Abstract: In this talk, we consider the KdV equation with an additional non-local perturbation term defined through the Hilbert transform, also known as the OST-equation. We prove that the solution has a precise pointwise decay in spatial variable, provided that the initial data has the same decaying and moreover we find the asymptotic profile of the solution.

Next, we show that decay rate given above is optimal when the initial data is not a zero-mean function and in this case we derive an estimate from below. In the case when the initial datum is a zero-mean function, we prove that the decay rate above can be improved.

Finally, we study the local-well posedness of the OST-equation in the framework of Lebesgue spaces.

This is a joint work with Fernando Cortez (EPN, Ecuador).

Reference and acknowledgements:

Speaker: Simona Rota Nodari (Université de Bourgogne, France)

Title: Uniqueness and non-degeneracy for a class of semilinear elliptic equations

Authors: Simona Rota Nodari (U. de Bourgogne, France)

Abstract: In this talk, I will present a result on the uniqueness and the non-degeneracy of positive radial solutions for a class of semilinear elliptic equations. Next, I will illustrate this result with two examples: a nonlinear Schrödinger equation for a nucleon and a Schrödinger equation with a double power non-linearity. This talk is based on joint works with Mathieu Lewin.

Reference and acknowledgements:

Speaker: Juan José Montellano-Ballesteros (Instituto de Matemáticas, UNAM, México)

Title: On the vertex-monochromatic connectivity of strong digraphs

Authors: Diego González-Moreno (UAM- Cuajimalpa, México), Mucuy-kak Guevara (Facultad de Ciencias, UNAM, México), Juan José Montellano-Ballesteros (Instituto de Matemáticas, UNAM, México)

Abstract: In 2008 Chartrand, Johns, McKeon and Zhang introduced the concept of “rainbow connectivity of an edge colored graph’’.

Several variations of this concept has been presented since then (for instance, for vertex colorings, or not rainbow but monochromatic connectivity, or for colorings on digraphs).

A vertex coloring of a strong digraph D is a “strong vertex-monochromatic connection coloring’’ (SVMC-coloring) if for every pair {u, v} of vertices in D there exists a directed (u, v)-path having all its internal vertices of the same color. Let smcv(D) denote the maximum number of colors used in an SVMC-coloring of a digraph D.

In this talk we will see some results related to the SVMC-colorings. In particular the value of smcv(D), whenever D is the line digraph of a digraph, is determined. Also, if D is a tournament, some conditions to find the exact value of smcv(D) will be presented.

Reference and acknowledgements:

Speaker: Gerard Olivar-Tost (Universidad de Aysén, Coyhaique, Chile)

Title: Convenient growth of renewable resources for stability of sustainable development

Authors: Gerard Olivar-Tost (U. de Aysén, Coyhaique, Chile)

Abstract: In this work, we determine the convenient values of birth and death rates and natural growth of renewable resources. This study will allow keeping sustainable development in a community based on primary economic activities. A 3-dimensional mathematical model is considered to describe this society, which models resources, population, and financial capital. Besides, an economic reactivation factor is included that represents the influence of economic growth on population growth. To analyze the importance of the parameters of effective rate of population growth and natural resource growth, a bifurcation diagram of codimension-2 is computed, where a Bogdanov-Takens (BT) point appears. Three scenarios are presented in the model, depending on the parameter values. In the first scenario, the variables of resource, population, and capital tend to balance through small crisis scenarios. In a second scenario, the variables show periods of scarcity, followed by periods of abundance. And finally, a third scenario is possible, where extinction cannot be avoided. We conclude that control actions on the net growth of the population must be guaranteed to favor long-term sustainability. Also, non-sustainability scenarios can be avoided by implementing crop policies that modify the intrinsic growth rate of the renewable resource.

Reference and acknowledgements:

Speaker: David Mora (Universidad del Bío-Bío, Chile)

Title: Virtual Element for the Vibration Problem of Kirchhoff Plates

Authors: David Mora (U. del Bío-Bío, Chile)

Abstract: In this talk, we develop a virtual element method (VEM) for the vibration problem of thin plates on polygonal meshes. We consider a variational formulation relying only on the transverse displacement of the plate and propose an H^2 conforming discretization by means of the VEM which is simple in terms of degrees of freedom and coding aspects. Under standard assumptions on the computational domain, we establish that the resulting scheme provides a correct approximation of the spectrum and prove optimal order error estimates for the eigenfunctions and a double order for the eigenvalues. Finally, we report several numerical experiments illustrating the behavior of the proposed scheme and confirming our theoretical results on different families of meshes

Reference and acknowledgements:

Speaker: Karina Vilches (Universidad Católica del Maule, Chile)

Title: Emergent behaviors in multi-cellular tumor progression including micro-environmental interactions

Authors: Karina Vilches (U. Católica del Maule, Chile)

Abstract: We present a mathematical approach that captures and explores a wide range of mechanisms and biological variability in tumor progression to better understand the orchestrate multiple phenomena in cancer dynamics. In this respect, Mathematical Biology is needed to promote the realization of modeling platforms that facilitate the discovery of novel biological phenomena, rules, and theories. Therefore, the main goal of this presentation corresponds to discuss the analysis of a mathematical model that represents a multi-cellular chemotaxis-haptotaxis interaction in Cancer progression. The main novelty consists in to apply the non-linear analysis of parabolic-elliptic system and numerical approximation to describe the micro-environment effects over tumor progression.

Reference and acknowledgements:

Speaker: Pablo Venegas (Universidad del Bío-Bío, Chile)

Title: Numerical analysis of a time-domain elastoacoustic problem

Authors: Pablo Venegas (U. del Bío-Bío, Chile)

Abstract: This work deals with the numerical analysis of a system of second-order in time partial differential equations modeling the vibrations of a coupled system that consists of an elastic solid in contact with an inviscid compressible fluid. We analyze a weak formulation with the unknowns in both media being the respective displacement fields. For its numerical approximation, we propose first a semi-discrete in space discretization based on standard Lagrangian elements in the solid and Raviart-Thomas elements in the fluid. We establish its wellposedness and derive error estimates in appropriate norms for the proposed scheme. In particular, we obtain optimal rate of convergence under minimal regularity assumptions of the solution, which are proved to hold for appropriate data of the problem. Then, we consider a fully discrete approximation based on a family of implicit finite difference schemes in time, from which we obtain optimal error estimates for sufficiently smooth solutions. Finally, we report some numerical results, which allow us to assess the performance of the method. These results also show that the numerical solution is not polluted by spurious modes as is the case with other alternative approaches.

Reference and acknowledgements:

Speaker: Olivier Goubet (Université Picardie Jules Verne, France)

Title: Mathematical modelling for complex forest ecosystems

Authors: Olivier Goubet (U. Picardie Jules Verne, France)

Abstract: the mathematical modelling of plant species in a forest environment require tools from PDEs at a continuous scale and from Markov chains at a discrete scale. We discuss here the link between these models for a plant metacommunity and we show that taking into account the exchange between forest patches improves the biodiversity, for a simple neutral model. This work is supported by CNRS with a Prime80 grant.

Reference and acknowledgements:

Speaker: Alain Rapaport (MISTEA, Montpellier, France)

Title: Weak resilience to invasion in the chemostat model and asymptotically periodic controls

Authors: Alain Rapaport (MISTEA, Montpellier, France)

Abstract: We consider the chemostat model with the constraint to maintain the bacterial species density above a given threshold, playing with the removal rate as a control variable. We consider species invasions that make the system not resilent, in the sense that it is not longer possible to satisy the constraint for the resident species at any time. We propose a definition of "weak resilience", as the possibility for the time spent satisfying the constraint to be of infinite measure. Under certain characteristics of the invasive species, we give a construction of a family of open-loop controls for the system to be weakly resilient. Then, we show that this control makes the system asymptotically periodic, under suitable assumptions. Finally, we show that this control can be, alternatively, synthetized by a simple hybrid feedback controller.

Reference and acknowledgements:

Speaker: Maria Soledad Aronna (Fundacao Getúlio Vargas, Brazil)

Title: Optimality Conditions for the Control of Fokker-Planck Equations

Authors: Maria Soledad Aronna (F. Getulio Vargas, Brazil).

Joint work with Fredi Tröltzsch (TU Berlin, Germany)

Abstract: For a Fokker-Planck equation with bilinear coupling of the state and control, the latter being time-dependent, we obtain first and second order optimality conditions.

Reference and acknowledgements:

Speaker: Chulkwang Kwak (Pontificia Universidad Católica de Chile, Chile)

Title: Ill-posedness issue of the abcd boussinesq system

Authors: Chulkwang Kwak (PUC, Chile)

Abstract: The "abcd" Boussinesq system (shortly, abcd system) is a frst order approximation to the Euler equations, initially introduced by Bona-Chen-Saut (one dimensional case) and Bona-Colin-Lannes (two dimensional case). This system asymptotically (up to suitable time scales) describes water waves of small amplitude in the shallow water wave regime or Boussinesq regime. In this talk, we are going to visit the initial value problem of abcd system, which is a fundamental problem in the theory of PDEs. In particular, we are going to discuss the ill-posedness of strongly dispersive abcd system in low regularity Sobolev space, which extends the work by Chen-Liu (ill-posedness of weakly dispersive abcd system). Moreover, some interesting related open problems will be addressed.

This is joint work with Christopher Maulen.

Reference and acknowledgements:

Speaker: Hanne Van Den Bosch (Universidad de Chile - CMM & UMI - CNRS 2807)

Title: Optimizers for a Poincaré-Sobolev inequality

Authors: Hanne Van Den Bosch (U. de Chile - CMM & UMI - CNRS 2807)

Abstract: We study a specific Poincaré-Sobolev inequality in bounded domains, that has recently been used to prove a semi-classical bound on the kinetic energy of fermionic many-body states. The corresponding inequality in the entire space is precisely scale invariant and this gives rise to an interesting phenomenon. Optimizers exist for some (most ?) domains and do not exist for some other domains, at least for the isosceles triangle in two dimensions. In this talk, I will discuss bounds on the constant in the inequality and the proofs of existence and non-existence.

This is joint work with Rafael Benguria and Cristóbal Vallejos (PUC, Chile).

Reference and acknowledgements:

Speaker: Andreas Wiese (Universidad de Chile-DII, Chile)

Title: Fully Dynamic Approximate Maximum Independent Set in Interval and Geometric Intersection Graphs

Authors: Andreas Wiese (U. Chile-DII, Chile)

Joint work with Monika Henzinger and Stefan Neumann.

Abstract: Independent set is a fundamental problem in combinatorial optimization. While in general graphs the problem is essentially inapproximable, for many important graph classes there are approximation algorithms known in the offline setting. These graph classes include interval graphs and geometric intersection graphs, where vertices correspond to intervals/geometric objects and an edge indicates that the two corresponding objects intersect. We present the first dynamic approximation algorithms for independent set of intervals and geometric objects. They work in the fully dynamic model where in each update an interval/geometric object is inserted or deleted.
Our algorithms are deterministic and have worst-case update times that are polylogarithmic for constant d and epsilon. We achieve the following approximation ratios:
- For independent set of intervals, we maintain (1+epsilon)-approximate solutions for the unweighted and the weighted case.
- For independent set of d-dimensional hypercubes we maintain (1+epsilon)2^d-approximate solutions in the unweighted case and O(2^d)-approximate solutions in the weighted case. Also, we show that for maintaining unweighted (1+epsilon)-approximate solutions one needs polynomial update time for d>=2 if the ETH holds.
- For weighted d-dimensional hyperrectangles we present a dynamic algorithm with approximation ratio (1+epsilon)log^(d-1)N, assuming that the coordinates of all input hyperrectangles are in [0,N]^d and each of their edges has length at least 1.

Reference and acknowledgements:

Speaker: Sigifredo Laengle (FEN – Universidad de Chile, Chile)

Title: Learning in the Viability Theory

Authors: Sigifredo Laengle (FEN – U. de Chile, Chile)

Abstract: The Theory (Mathematical) of Viability (TMV) is a theory proposed by J.P.Aubin (1990) to understand and regulate complex dynamic systems. It is a mathematical theory that has been formulated independently of the General System Theory, although they share, in large part, the same intuitions. In particular, the Stafford Beer Viable System Model (VSM, 1972) richly describes concepts of hierarchy and uncertainty, among other fundamental notions. On the one hand, mathematicians TMV researchers have focused on solving several problems related to determining viable sets or minimizing crisis times, both problems had also been introduced in the VSM. Despite the surprising conceptual coincidences, in our opinion, TMV has not sufficiently studied the problem of uncertainty and learning. In fact, a closed system is essentially a self-learning system. A fundamental notion in the General System Theory. Therefore, in this paper, we propose a relatively simple model of the problem of information and uncertainty and review how the learning capacity of the system affects characteristics of viable solutions. It is a dynamic stochastic model in discrete time that presents a series of mathematical challenges. Performing our work, we found a monotonous relationship between learning capacity and viable set size. We also propose a calculation method that can solve problems of larger dimensions. We believe that this work leads to an important line of research that approaches both theories and advances in the design and control of viable systems in a richer and more unified way.

Reference and acknowledgements:

Speaker: Diego Morán (Universidad Adolfo Ibañez, Chile)

Title: Subadditive Duality for Conic Mixed-Integer Programs

Authors: Diego Morán (U. Adolfo Ibañez, Chile)

Abstract: In this talk, we show that the subadditive dual of a feasible conic mixed-integer program (MIP) is a strong dual whenever it is feasible. Moreover, we show that this dual feasibility condition is equivalent to feasibility of the conic dual of the continuous relaxation of the conic MIP. In addition, we prove that all known conditions and other `natural' conditions for strong duality, such as strict mixed-integer feasibility, boundedness of the feasible set or essentially strict feasibility, imply that the subadditive dual is feasible. As an intermediate result, we extend the so-called `finiteness property' from full-dimensional convex sets to intersections of full-dimensional convex sets and Dirichlet convex sets. This is joint work with Burak Kocuk (Sabanci University).

Reference and acknowledgements:

Speaker: Anton Svensson (DIM – Universidad de Chile, Chile)

Title: Towards Tractable Constraint Qualifications for Parametrized Optimization Problems and Applications to Multi-Leader-Follower Games

Authors: Anton Svensson (DIM – U. de Chile, Chile) and Didier Aussel (U. of Perpignan, France)

Abstract: Parametric optimization problems are very important in applications, for instance, to define non-cooperative games such as Nash games or Bilevel programs, which are particular cases of the class of multi-leader-follower games. To ensure that a parametrized convex optimization problem is equivalent to its parametrized KKT conditions, one could verify that a constraint qualification is satisfied for each parameter. We show a simple way for doing so by assuming joint convexity of the parametrized optimization problem. We show how this applied for comparing solutions of a Generalized Nash Equilibrium Problem (GNEP) with the concatenation of KKT conditions of all players, and the solutions of a multi-leader-follower game and its MPCC reformulation, obtained by replacing the lower level GNEP by its concatenated KKT conditions.

Reference and acknowledgements:

Speaker: Paulina E. Sepúlveda (Pontificia Universidad Católica de Valparaíso, Chile)

Title: Two adaptive discontinuous space-time methods for the wave equation

Authors: Paulina E. Sepúlveda (PUCV, Chile)

Abstract: When solving a large time-dependent problem, adaptive mesh refinement schemes become an important tool to obtain efficient numerical simulations. This talk will address the features and limitations of adaptive strategies using two Petrov-Galerkin spacetime methods. We will first present a space-time discontinuous Petrov-Galerkin (DPG) method for the linear wave equation and show adaptive numerical results based on its built-in error estimator [1]. The second method to be presented is a Discontinuous-in-time Petrov-Galerkin formulation that employs explicit-in-time finite elements, using explicit-in-time basis functions [2]. Maintaining the explicit in-time method while designing a space-time adaptive mesh refinement scheme still remains a difficult task partially due to strong stability constraints that arise from time-stepping methods. We propose a new space-time adaptive mesh refinement technique for an explicit-in-time finite element method.

Reference:

[1] J. Gopalakrishnan, and P. Sepúlveda. A space-time DPG method for the wave equation in multiple dimensions. To appear in the book: Space-Time Methods. Applications to Partial Differential Equations. Berlin, Boston: De Gruyter. 2019.

[2] J. Muñoz-Matute, D. Pardo, V. M. Calo, E. Alberdi., Time-domain goal-oriented adaptivity using pseudo-dual error representations. Computer Methods in Applied Mechanics and Engineering. Vol 325 (1), pp 395-415, (2017).

Acknowledgements:

Speaker: Didier Aussel (University of Perpignan, France)

Title: Mutli-Leader-Disjoint follower game: genericity and electricity contract problem

Authors: Didier Aussel (U. of Perpignan, France), Gemayqzel Bouza (U. la Havana, Cuba), Stephan Dempe (Technical U. Freiberg, Germany)

Abstract: We introduce the concept of Multi-Leader-Disjoint-Follower games (MLDF). It corresponds to a particular case of Multi-Leader-Follower games in which each leader has a dedicated set of followers. For this specific class of problem, we show that, generically, good properties such as constraint qualification and non degeneracy of the solutions, are satisfied at each bilevel problem. In particular, given a problem, we obtain that except for a zero-Lebesgue measure set, with at most quadratic perturbations of the involved functions, these properties are satisfied. We also prove that these properties will remain stable under small perturbations of the involved functions. We discuss the consequences of this result for the particular (MLDF) model that appears when agents have to design the contracts they will propose to their clients, knowing that the clients will choose the best option.

Reference and acknowledgements:

Speaker: Adrián Carrillo-Gálvez (Universidad de Concepción, Chile)

Title: The Environmental/Economic Dispatch Problem based on Duality Theory

Authors: Adrián Carrillo-Galvez (U. de Concepción, Chile)

Abstract: In this investigation a duality theory approach is proposed for solving the Environmental/Economic Dispatch problem. The scalarization weighted sum method for the multiobjective optimization problem is used, and the associated dual problem is solved using a quadratic programming algorithm. This strategy is tested on three systems with different number of generators and characteristics. The obtained results are compared with other previously reported elsewhere, showing some advantages of our proposal.

Joint work with: Fabián Flores-Bazán (DIM-UdeC) and Enrique López Parra (DIE-UdeC).

Reference and acknowledgements:

Speaker: Sylvain Sorin (Sorbonne University, France)

Title: No-regret criteria in learning, games and convex optimization

Authors: Sylvain Sorin (Sorbonne U., France)

Abstract: The purpose of this talk is to underline links between no-regret algorithms used in learning, games and convex optimization. In particular we will present continuous and discrete time versions and their connections.

We will comment on recent advances ion:

- Euclidean and non-euclidean approaches
- link with variational inequalities
- extension to infinite dimensional set up
- speed of convergence of the evaluation
- convergence of the trajectories

Reference and acknowledgements:

Speaker: Diego Chamorro (University Paris-Évry, France)

Title: Hölder regularity for transport-diffusion equations

Authors: Diego Chamorro (U. Paris-Évry, France)

Abstract: We study the Hölder regularity of the solutions of general linear transport-diffusion equations where the transport is bounded in suitable Morrey-Campanato spaces and where the diffusion is given in terms of Lévy-type operators. Morrey-Campanato spaces give a general framework to study singular and regular functions while Lévy-type operators are interesting generalization for the fractional Laplacian with several applications in probability. Using classical tools from harmonic analysis we will see how it is possible to obtain a gain of regularity for the solutions of this type of PDE. This is a joint work with S. Menozzi (Evry).

Reference and acknowledgements:

Speaker: Ramteen Sioshansi (The Ohio State University, USA)

Title: Can We Get Market and Regulatory Designs 'Right' for Energy Storage?

Authors: Ramteen Sioshansi (The Ohio State U., USA)

Abstract: Energy storage is a unique power system asset, in that it can provide services that are functionally similar to those provided by generation, transmission, and distribution assets and act as a load. Most of our market designs and regulatory constructs assume that assets primarily fall into one of these categories. This talk will introduce the challenges that are raised by this dichotomy between the capabilities of energy storage and the regulatory and market treatment of power system assets. It will discuss also the potential use of storage-capacity rights as a way of overcoming these challenges.

Reference and acknowledgements:

Speaker: Anna Désilles (ENSTA, France)

Title: Sensitivity relations for some classes of optimal multi-processes

Authors: Anna Désilles (ENSTA, France)

Abstract: This talk will focus on some recent results about HJB approach to solve some classes of optimal control problems governed by a hybrid differential system with a finite number of switching times. It is assumed that the switching times can be unknown and optimized together with the optimal control low.

The main result that will be presented is the proof of the sensitivity relationships for such problems i.e. the link between the adjoint state from the Maximum principle and the subdifferential of some value function that can be associated with the problem. The proposed approach extends the results from [1, 2, 3] to a class of optimal control problems for multi processes with free switching times. Some extensions of the main result to free end-time problems with endpoint constraints will be also discussed.

An numerical approach to the optimal trajectory computation based on the sensitivity relations will be presented and illustrated by an example.

Reference:

[1] Vinter, R. B. New results on the relationship between dynamic programming and the maximum principle, Math. Control Signals Systems 1, 1, pp. 97-105 (1988).

[2] Clarke, Frank H. and Vinter, Richard B., The relationship between the maximum principle and dynamic programming, SIAM J. Control Optim. 25, 5, pp. 1291-1311 (1987).

[3] Bettiol, Piernicola and Frankowska, Helene and Vinter, Richard B. Improved sensitivity relations in state constrained optimal control, Appl. Math. Optim.71, 2, pp. 353-377 (2015).

Acknowledgements:

Speaker: Alexandre Ern (Université Paris-Est, France)

Title: A Hybrid High-Order discretization combined with Nitsche's method for contact and Tresca friction in small strain elasticity

Authors: F. Chouly (1), A. Ern (2), N. Pignet (2,3)

(1) Université Bourgogne Franche-Comté, Dijon, France
(2) Université Paris-Est, ENPC and INRIA, Paris, France
(3) EDF R&D / ERMES and IMSIA, UMR EDF/CNRS/CEA/ENSTA 9219, Palaiseau, France

Abstract: We devise and analyze a Hybrid high-order (HHO) method to discretize unilateral and bilateral contact problems with Tresca friction in small strain elasticity. The nonlinear frictional contact conditions are enforced weakly by means of a consistent Nitsche's technique with symmetric, incomplete, and skew-symmetric variants. The present HHO-Nitsche method supports polyhedral meshes and delivers optimal energy-error estimates for smooth solutions under some minimal thresholds on the penalty parameters for all the symmetry variants. An explicit tracking of the dependency of the penalty parameters on the material coefficients is carried out to identify the robustness of the method in the incompressible limit, showing the more advantageous properties of the skew-symmetric variant. 2D and 3D numerical results including comparisons to benchmarks from the literature and to solutions obtained with an industrial software, as well as a prototype for an industrial application, illustrate the theoretical results and reveal that in practice the method behaves in a robust manner for all the symmetry variants in Nitsche's formulation.

Reference and acknowledgements:

Speaker: Rodolfo Rodríguez (Universidad de Concepción - CMM, Chile)

Title: Dissipative acoustics vibration problems

Authors: Rodolfo Rodríguez (U. de Concepción - CMM, Chile)

Abstract: Computing the vibration modes of an acoustic fluid in presence of dissipation leads to solving quadratic eigenvalue problems; namely, problems in which the (complex) vibration frequencies are the roots of a complete quadratic operators equation. These problems turn out to be equivalent to the eigenvalue problem for a non compact and non selfadjoint operator. In this talk, we will consider inner dissipation sources (viscous fluids). We will introduce a model based on a formulation in terms of fluid displacements, which are assumed to be irrotational, and will provide a full spectral characterization of the derived problem. Then, we will introduce a discretization of the problem by means of Raviart-Thomas finite elements. We will prove that the resulting numerical method converges with optimal order and is free of spurious modes. Finally, we will report a numerical test which will allow us to assess the performance of the method.

Reference and acknowledgements:

Speaker: Vicente Acuña (Universidad de Chile-CMM, Chile)

Title: Bubble generators in directed graphs for the analysis of DNA and RNA data

Authors: Vicente Acuña (U. Chile-CMM, Chile)

Abstract: Bubbles are pairs of internally vertex-disjoint (s, t)-paths in a directed graph, which have many applications in the processing of DNA and RNA data. Listing and analysing all bubbles in a given graph is usually unfeasible in practice, due to the exponential number of bubbles present in real data graphs. In this work, we propose a notion of bubble generator set, i.e., a polynomial-sized subset of bubbles from which all the other bubbles can be obtained through a suitable application of a specific symmetric difference operator. This set provides a compact representation of the bubble space of a graph. A bubble generator can be useful in practice, since some pertinent information about all the bubbles can be more conveniently extracted from this compact set. We also provide a polynomial-time algorithm to decompose any bubble of a graph into the bubbles of such a generator and we present some applications of the bubble generator on a real RNA-seq dataset.

Reference and acknowledgements:

Speaker: Marco Antonio López (University of Alicante, España)

Title: Four alternative approaches to optimality theory in convex semi-infinite optimization

Authors: Marco Antonio Lopez (U. of Alicante, España)

Abstract: In this talk we present four alternative ways to derive Fritz-John and KKT optimality conditions in convex semi-infinite optimization. They are developed in frameworks which rely on different constraint qualifications, from the most restrictive to the most general. For the last one, the standard compactnes assumptions on the index set and (upper)semi-continuity of the constraint functionsn are dropped out. This is a joint work with Rafael Correa (Universidad de O'Higgins) and Abderrahim Hantoute (CMM, Universidad de Chile).

Reference and acknowledgements:

Speaker: Hiep Han (Universidad de Santiago de Chile, Chile)

Title: Quasi-random words and limits of word sequences

Authors: Hiep Han (USACH, Chile)

Abstract: Words are finite sequences of letters over a finite alphabet and in this talk we address two intimately related topics for this object: quasi-randomness and limit theory. With respect to the first topic we study the notion of uniform distribution of letters over intervals, and in the spirit of the famous Chung-Graham-Wilson theorem we provide a list of word properties which are equivalent to uniform distribution.

This investigation naturally gives rise to a notion of convergent word sequences, and in the second part of our work we develop a limit theory for such sequences. Via this theory we address several problems such as property testing and finite forcibility. Further, as a byproduct we obtain new models of random word sequences and limits of higher dimensional combinatorial objects such as permutations.

Joint work with Marcos Kiwi and Matias Pavez-Signe.

Reference and acknowledgements:

Speaker: Alexandre Street (PUC-Rio, Brazil)

Title: Distributionally Robust Transmission Expansion Planning: a Multi-scale Uncertainty Approach

Authors: Alexandre Street (PUC-Rio, Brazil)

Abstract: We present a distributionally robust optimization (DRO) approach for the transmission expansion planning problem, considering both long- and short-term uncertainties on the system demand and renewable generation. On the long-term level, as it is customary in industry applications, the deep uncertainties arising from social and economic transformations, political and environmental issues, and technology disruptions are addressed by long-term scenarios devised by experts. The system planner is then allowed to consider exogenous long-term scenarios containing partial information about the random parameters, namely, the average and the support set. For each constructed long-term scenario, a conditional ambiguity set is used to model the incomplete knowledge about the probability distribution of the uncertain parameters in the short-term. Consequently, the mathematical problem is formulated as a DRO model with multiple conditional ambiguity sets. The resulting infinite-dimensional problem is recast as an exact, although very large, finite-deterministic mixed-integer linear programming problem. To circumvent scalability issues, we propose a new enhanced-column-and-constraint-generation (ECCG) decomposition approach with an additional Dantzig–Wolfe procedure. In comparison to existing methods, ECCG leads to a better representation of the recourse function and, consequently, tighter bounds. Numerical experiments based on the benchmark IEEE 118-bus system are reported to corroborate the effectiveness of the method.

Reference and acknowledgements:

Speaker: Héctor Olivero (Universidad de Valparaíso, Chile)

Title: Synchronization and propagation of chaos for mean field networks of Hodgkin-Huxley neurons with noisy channels

Authors: Héctor Olivero (U. de Valparaíso, Chile)

Abstract: In this work we are interested in the behavior of a fully connected network of neurons either when the number of neurons or the time go to infinity. We assume that every neuron follow a stochastic version of the Hodgkin-Huxley dynamic and that the interactions between neurons, which take into account electrical and chemical synapses, are of mean field type. Our main results are the propagation of chaos property for the system for any set of parameters, and a synchronization result, which is uniform in the size of the system, when the interaction is strong enough. Combining these two result we conclude that the nonlinear PDE describing the infinite network concentrates around the solution of the ODE describing a single neuron. We complement our theoretical analysis with some numerical simulations.

A joint work with Mireille Bossy (INRIA-France) and Joaquín Fontbona (DIM-U.Chile, Chile)

Reference and acknowledgements:

Speaker: Patrick Gerard (Patrick Gérard, Université Paris-Saclay, France)

Title: The wellposedness threshold of the Benjamin-Ono equation with periodic boundary conditions

Authors: Patrick Gerard (Patrick Gérard, U. Paris-Saclay, France)

Abstract: I will report on a recent jointwork in collaboration with T. Kappeler and P. Topalov, where we use the integrable structure of the Benjamin-Ono equation with periodic boundary conditions to prove that the corresponding initial value problem is wellposed down to the scaling regularity.

Reference and acknowledgements:

Speaker: Carlos Román (Pontificia Universidad Católica de Chile, Chile)

Title: On the 3D Ginzburg-Landau model of superconductivity

Authors: Carlos Román (PUC, Chile)

Abstract: The Ginzburg-Landau model is a phenomenological description of superconductivity. A crucial feature is the occurrence of vortices (similar to those in fluid mechanics, but quantized), which appear above a certain value of the strength of the applied magnetic field called the first critical field. In this talk I will present a sharp estimate of this value and describe the behavior of global minimizers for the 3D Ginzburg-Landau functional below and near it. This is partially joint work with Etienne Sandier and Sylvia Serfaty.

Reference and acknowledgements:

Speaker: Norbert Heuer (Pontificia Universidad Católica de Chile, Chile)

Title: On the DPG method for the Reissner-Mindlin plate model

Authors: Norbert Heuer (PUC, Chile)

Abstract: We will report on recent advances of the DPG method for plate bending problems. Special focus is on the Reissner-Mindlin model and its limit case, the Kirchhoff-Love model. Considering ultraweak variational formulations, the analysis boils down to considering corresponding trace operators. Since plate bending models are of fourth order (summing up the orders of the system), several trace components appear which are, unfortunately, not robustly independent. The lack of independence stems from a lack of regularity of field variables (in the Kirchhoff-Love case) or the fact the we are dealing with a singularly perturbed problem (in the Reissner-Mindlin case).

We will discuss these problems in some detail and illustrate our findings with numerical experiments.

Parts of this research are based on collaborations with Antti Niemi, University of Oulu, Finland; Francisco-Javier Saya, University of Delaware, USA; Alexander Haberl, Technical University of Vienna, Austria.

Reference and acknowledgements:

Speaker: Roberto Morales (Universidad de Chile, Chile)

Title: On the controllability of some PDE's with dynamic boundary conditions

Authors: Roberto Morales (U. de Chile, Chile)

Abstract: While controllability of PDE's with Dirichlet, Neumann and Fourier boundary conditions have been intensely studied in the past years, the same question for this kind of models with dynamic boundary conditions remains open. The aim of this talk is to present some recent results on the null controllability of parabolic and Schroödinger equations with boundary conditions of Wentzell type. Following the well-known duality between controllability and observability, these results can be obtained by a suitable observability inequality associated to the adjoint system of these models. In the same spirit of the classical ideas of A. Fursikov and O. Imanuvilov, the proof of these inequalities is based on suitable Carleman estimates for some PDE's with Wentzell boundary conditions by using appropriate weight functions.

Reference and acknowledgements:

Speaker: Exequiel Mallea (Universidad de Tarapacá, Arica, Chile)

Title: A regularity criterion for a 3D chemo-repulsion system and its application to a bilinear optimal control problem

Authors: Exequiel Mallea (U. de Tarapacá, Arica, Chile)

Abstract: A bilinear optimal control problem associated to a 3D chemo-repulsion model with linear production term is studied. The existence of weak solution is proved and a regularity criterion to get global in time strong solutions is established. As a consequence, the existence of a global optimal solution with bilinear control is deduced and, using a Lagrange multipliers theorem, first-order optimality conditions for local optimal solutions are derived.

Reference and acknowledgements:

Speaker: Sebastián Zamorano (Universidad de Santiago de Chile, Chile)

Title: Null controllability from the exterior of a one-dimensional nonlocal heat equation

Authors : Sebastián Zamorano (USACH, Chile)

Abstract: In this talk we discuss the null controllability problem for the one dimensional heat equation associated to the fractional Laplace operator of order s\in (0,1). We will show that there exists a control function, which is localized in a nonempty open set at the exterior of the domain, such that the system is null controllable at any positive time if and only if s\in (1/2, 1).

This is a joint work with Mahamadi Warma from University of Puerto Rico.

Reference and acknowledgements:

Speaker: Cristhian Montoya (Universidad Técnica Federico Santa María, Chile)

Title: Simultaneous robust control and hierarchic control in some PDEs

Authors: Cristhian Montoya (UTFSM, Chile)

Abstract: In recent works, the notion of searching for a robust control system is developed simultaneously with a strategy on hierarchic control. From a mathematical point of view, the robustness of a system is equivalent to find a saddle point because we are looking for maximizing the perturbation and simultaneously minimizing the control that stabilizes the system. In addition to the above, a hierarchic control strategy appears at the system. The scheme is based in considering a robust control problem for the follower control and its associated disturbance function. Afterwards, we consider the notion of Stackelberg optimization (which is associated to the leader control) in order to deduce a controllability result for nonlinear systems

Reference and acknowledgements:

Speaker: Nicolás Carreño (Universidad Técnica Federico Santa María, Chile)

Title: Boundary null-controllability of a system coupling fourth- and second-order parabolic equations

Authors: Nicolás Carreño (UTFSM, Chile)

Abstract: In this talk we will consider a control system coupling fourth- and second-order parabolic equations. We begin with a brief overview of the moment method and then we show some control properties of this system when we only control the second-order partial differential equation through a boundary condition. Actually, depending on the choice of the diffusion coefficients, we obtain positive and negative results for approximate- and null-controllability. In particular, we prove that for any given positive time T_0, we can find some diffusion coefficients such that the system is null-controllable in time T if $T > T_0$ and is not null-controllable if $T < T_0$.

This is a joint work with Eduardo Cerpa and Alberto Mercado.

Reference and acknowledgements:

Speaker: Diego Vicencio (Universidad Técnica Federico Santa María, Chile)

Title: Comparison of Viability Kernels for Generalized Monotone Controlled Systems and Applications to Biological Control

Authors: Diego Vicencio (UTFSM, Chile)

Abstract: This work consists in a study of viability kernels for monotone controlled dynamical systems. In a controlled dynamical system, viability kernels are the set of initial conditions for which the trajectories of the flows associated with such system, remain in a given desirable set, with a predetermined set of available control inputs. Viability kernels are useful to predict the behaviour and to determine input conditions for ecological systems, in which desirable sets often can represent population levels which are intenteded to be managed or protected by application of control policies.

In our work, first we present a result concerning comparison of trajectories of flows derived from controlled dynamical systems, which are monotone for a given pre-order induced by a closed convex cone. Then, we introduce a viability kernel, which we are trying to determine, in terms of a set of available control inputs, and a given desirable set. From these last two sets, defining a new desirable set and using information from the closed convex cone, we can define a new viability kernel which we prove that is equal to the initial viability kernel we are trying to determine.

Finally, we present an ecological application of this result with a model for Dengue control. This model consists in the dynamic of mosquito populations, in which the control policy is the introduction of Wolbachia virus in the mosquito population, which is an inhibitor of the capacity of mosquitoes to spread diseases such as Dengue. We setup the problem of estimating a viability kernel for this problem, in particular, for a given set of control inputs, and the desirable set in which the Wolbachia-infested mosquito population remains above a certain level, and the uninfested mosquito population remains below a certain level. Using the previous result, we show that the problem can be reduced to a determine another viability kernel, which is simpler and easier to address.

Reference and acknowledgements:

Speaker: Matteo Rizzi (Universidad de Chile - CMM - UMI 2807 CNRS, Chile)

Title: Some solutions to the Cahn-Hilliard equation and constant mean curvature surfaces

Authors: Matteo Rizzi (U. de Chile - CMM - UMI 2807 CNRS, Chile)

Abstract: In the talk I will present the construction of a family of solutions to the Cahn-Hilliard equation whose zero level set is prescribed and approaches a given complete, embedded, k-ended constant mean curvature surface. It is a joint work with Michal Kowalczyk. Moreover, I will present some classification results, dealing with properties such as boundedness, monotonicity and radial symmetry.

Reference and acknowledgements:

Speaker: Daniel Quiroz (Universidad de Chile - CMM, Chile)

Title: Clique immersions and independence number

Authors: Daniel Quiroz (U. de Chile - CMM, Chile)

Abstract: The analogue of Hadwiger's conjecture for the immersion order states that every graph with chromatic number t contains an immersion of a clique on t vertices. If true, it would imply that every graph with n vertices and independence number alpha contains an immersion of a clique on at least n/alpha vertices.

We shall sketch the story of this conjecture, focusing on recent efforts to prove its above mentioned corollary.

Reference and acknowledgements:

Speaker: Carlos Hoppen (Universidade Federal do Rio Grande do Sul, Brazil)

Title: The Erdös-Rothschild problem and generalizations

Authors: Carlos Hoppen (UFRGS, Brazil)

Abstract: There has been a lot of recent progress on variations of an edge-coloring problem proposed by Erdös and Rothschild in the 1970s. Given a graph with a coloring pattern and a fixed number of colorings, the goal is to find the maximum number of edge-colorings avoiding copies of this pattern among all host graphs with a fixed number of vertices. Moreover, one aims to characterize the graphs that achieve this number of colorings. In this talk, I shall survey recent results and open problems in this direction.

Reference and acknowledgements:

Speaker: Frederic Valentin (Laboratório Nacional de Computação Científica, Brazil)

Title: The MHM Method for Elasticity on Polytopal Meshes

Authors: Frederic Valentin (LNCC, Brazil)

Abstract: This work revisits the general form of the Multiscale Hybrid-Mixed (MHM) method for the second-order linear elasticity equation under the perspective of non-convex non-conforming polytopal meshes. In this context, we propose new stable multiscale finite elements such that they preserve the well-posedness, super-convergence, and local conservation properties of the original MHM method under mild regularity conditions. Precisely, we show that piecewise polynomial of degree l bigger than 1 for the Lagrange multipliers (traction) along with continuous piecewise polynomial interpolations of degree l + d, where d is the dimension of the domain, posed on second-level sub-meshes are stable. Such one- and two-level discretization impact the error in a way that the discrete primal (displacement) and the dual (traction) variables achieve super-convergence in the natural norms under additional local regularity only. Numerical tests assess theoretical results and validate the new method on highly heterogeneous media.

Reference and acknowledgements:

Speaker: Guilherme Mota (Universidade Federal do ABC, Brazil)

Title: The size-Ramsey number of 3-uniform tight paths

Authors: Guilherme Mota (UFABC, Brazil)

Abstract: Given a hypergraph H, the size-Ramsey number r_2(H) is the smallest integer m such that there exists a graph G with m edges with the property that in any colouring of the edges of G with two colours there is a monochromatic copy of H. We prove that the size Ramsey number of the 3-uniform tight path on n vertices P_n is linear in n, i.e., r_2(P_n) = O(n). This answers a question by Dudek, Fleur, Mubayi, and Rödl for 3-uniform hypergraphs, who proved r_2(P_n) = O(n^{3/2} \log^{3/2} n).

This is a joint work with Jie Han, Yoshi Kohayakawa and Olaf Parczyk

Reference and acknowledgements:

Speaker: Rodolfo Araya (Universidad de Concepción - CMM, Chile)

Title: An a posteriori error estimator for the MHM method

Authors: Rodolfo Araya (U.de Concepción-CMM, Chile)

Abstract: In this work, we introduce and analyze an a posteriori error estimator for the MHM method, which takes care of the multiscale nature of the method. This error estimator is decomposed into two parts: one related to the lack of continuity of the discrete solution, and the other one related to the local multiscale solver used to solve the local problems. We conclude with some numerical experiments to prove the quality of the adapted scheme based on our estimator.

Reference and acknowledgements:

Speaker: Jacek Jendrej (Université Paris-Nord, France)

Title: Dynamics of bubbling wave maps with prescribed radiation

Authors: Jacek Jendrej (U. Paris-Nord, France)

Abstract: We consider wave maps from the (1+2)-dimensional Minkowski plane to the two-sphere. It is known that any finite-energy wave map that develops a singularity does so through bubbling, that is concentrating (possibly) several copies of a harmonic map at the origin. If only a single bubble is concentrated, the solution decomposes into a rescaled harmonic map (the bubble) and a regular part. We ask the following question: is a blow-up solution completely determined by the regular part (or, equivalently, by the data outside of the light cone emanating from the singularity)? With Andrew Lawrie and Casey Rodriguez we gave a partial positive answer by proving that, in some cases, for a given regular part there is only one possible blow-up rate. I will present this result and explain the link with the problem of continuing the solution after the singularity.

Reference and acknowledgements:

Speaker: Julio Rossi (Universidad de Buenos Aires, Argentina)

Title: The evolution problem associated with eigenvalues of the Hessian

Authors: Julio Rossi (U. de Buenos Aires, Argentina)

Abstract: Equations involving the eigenvalues of the Hessian matrix include some famous examples, like the Laplacian, Monge-Ampere, and the equation for the convex envelope.

In this talk we deal with the evolution problem associated with a single eigenvalue of the Hessian.

We show that the (unique) solution to this evolution problem exists in the viscosity sense and can be approximated by the value function of a two-player zero-sum game as the parameter measuring the size of the step that we move in each round of the game goes to zero.

In addition, when the boundary datum is independent of time, we show that viscosity solutions to this evolution problem stabilize and converge exponentially fast to the unique stationary solution. We obtain this result with two different techniques: with PDE tools and and with game theoretical arguments. Moreover, in some special cases (for affine boundary data) we can show that solutions coincide with the stationary solution in finite time.

Joint work with P. Blanc and C. Esteve.

Reference and acknowledgements:

Speaker: Thomas Führer (Pontificia Universidad Católica de Chile, Chile)

Title: A least-squares finite element method for the obstacle problem

Authors: Thomas Führer (PUC, Chile)

Abstract: In this talk we present recent results on a least-squares finite element method for a first order reformulation of the obstacle problem.

A priori error estimates including the case of non-conforming convex sets are given and optimal convergence rates are shown for the lowest-order case.

We provide a posteriori bounds that can be used as error indicators in an adaptive algorithm. Numerical studies are presented.

Reference and acknowledgements:

Speaker: Manuel Solano (Universidad de Concepción, Chile)

Title: A priori and a posteriori error analyses of an unfitted HDG method for semi-linear elliptic problems

Authors: Manuel Solano (U. de Concepción, Chile)

Abstract: We present a priori and a posteriori error analyses of a Hybridizable discontinuous Galerkin (HDG) method applied to a semi-linear elliptic problem posed on a non polygonal domain. The motivation to study these types of problems comes from an application to plasma physics, where the magnetic equilibrium in axisymmetric fusion reactors can be described in terms of the solution to an equation of this type---the Grad-Shafranov equation---posed on a curved, piecewise smooth domain. We approximate this domain by a polygonal subdomain and propose an HDG discretization, which is shown to be optimal under mild assumptions related to the distance between the boundaries of the polygonal subdomain and the true domain. Moreover, we provide an a posteriori estimator that takes into account the curved geometry. Numerical experiments validate the theory.

Reference and acknowledgements:

Speaker: Rodolfo Viera (Universidad de Santiago de Chile, Chile)

Title: On an equation involving the Jacobian and Delone sets

Authors: Rodolfo Viera (USACH, Chile)

Abstract: In 1994 Gromov posed the following question : Is there a separated net in the euclidean space which cannot be mapped to the standard lattice by a bi-Lipschitz map? Later in 1998, Burago & Kleiner and, independently, McMullen, answered this question in the affirmative by showing that there exists a real-valued continuous map from the square, bounded away from zero, which cannot be realized as the Jacobian of a bi-Lipschitz map. In this talk we will see the Burago-Kleiner construction and that not only non-realizable (as the Jacobian of BL maps) functions exist, but are also generic.

Reference and acknowledgements:

Speaker: Juan Carlos Pozo (Universidad de La Frontera, Chile)

Title: A non-local in time telegraph equation

Authors: Juan Carlos Pozo (UFRO, Chile)

Abstract: In this talk we present a non-local in time telegraph equation, which includes as particular cases the classical telegraph equation and the fractional in time telegraph equation. We prove that the fundamental solution of this problem can be interpreted as a probability density function, and we analyze the temporal behavior of the corresponding variance. Further, we find a generalization of the D'Alembert formula for wave equation

Reference and acknowledgements:

Speaker: Julian Fernandez (Universidad de Buenos Aires, Argentina)

Title: Gamma convergence and asymptotic behavior for eigenvalues of nonlocal problems

Authors: Julian Fernandez (U. de Buenos Aires, Argentina)

Abstract: In this talk I will discuss how the asymptotic analysis of several different eigenvalue problems arising in nonlocal models can be treated by the same common framework of gamma convergence. In this way, we can recover the asymptotic behavior for the eigenvalues of the p-fractional laplacian as s goes to 1 (recovering recent results of Brasco-Parini-Squassina) and as p goes to infinity (extending some results of Lindgren-Lindqvist). Other examples will also be discussed.

Reference and acknowledgements:

Speaker: Michael Karkulik (Universidad Técnica Federico Santa María, Chile)

Title: Space-time least squares finite elements for parabolic equations and applications

Authors: Thomas Führer (Facultad de Matemáticas, Pontificia Universidad Católica de Chile, Chile), Michael Karkulik (Departamento de Matemática, UTFSM, Chile)

Abstract: In the last couple of years, different space-time discretizations for parabolic problems have been proposed in the literature. In our talk, we present a space-time least squares finite element method for the heat equation.

The advantages of our method over current space-time approaches is that we do not make any assumption on the space-time mesh (apart from the usual assumptions on spatial meshes), that our formulation is of Galerkin-type (which means that we do not have to worry about discrete inf-sup conditions), and that we have an a-posteriori error estimator for free. In particular, our approach features full space-time adaptivity. We will present theory and numerical results.

Reference and acknowledgements:

Speaker: Elsa Cazelles (Universidad de Chile-CMM, Chile)

Title: The Wasserstein-Fourier Distance for Stationary Time Series

Authors: Elsa Cazelles (U. de Chile-CMM, Chile)

Abstract: We introduce a novel framework for analysing stationary time series based on optimal transport distances and spectral embeddings. First, we represent time series by their power spectral density (PSD), which summarises the signal energy spread across the Fourier spectrum. Second, we endow the space of PSDs with the Wasserstein distance, thus exploiting the unique ability of this distance to convey geometric information and location of distributions (of energy in this case) and their support. These two steps enable us to define the Wasserstein-Fourier (WF) distance directly on the space of stationary time series, that is also expandable to Gaussian process. A key feature of the so-defined WF distance is its ability to compare time series even when they differ in sampling rate, length, magnitude and phase. We validate the WF distance experimentally through synthetic signal generation, interpolation and, more critically, as the distance within a logistic regression framework applied to real-world audio and body-motion data.

Reference and acknowledgements:

Speaker: Gabriela Araujo-Pardo (Mathematic Institute, Universidad Nacional Autónoma de México, Mexico)

Title: Circulant graphs and digraphs: Achromatic and diachromatic numbers and achromatic index

Authors: Gabriela Araujo-Pardo (UNAM, Mexico), Juan José Montellano-Ballesteros (Inst. de Mat., UNAM, Mexico) , Mika Olsen (Depto. de Matemáticas Aplicadas y Sistemas, Universidad Autónoma Metropolitana, Cuajimalpa, México) and Christian Rubio-Montiel (FES Acatlán, UNAM, México)

Abstract: A complete k-vertex-coloring of a graph G is a vertex-coloring of G using k colors such that for every pair of colors there is at least two incident vertices in G colored with this pair of colors. The chromatic and achromatic numbers of G are the smallest and the largest number of colors in a complete proper k-vertex-coloring of G.

The dichromatic number and the diachromatic number, generalice the concepts of chromatic number and achromatic number. An acyclic k-vertex-coloring of a digraph D is vertex coloring using k colors such that D has no monochromatic cycles and a complete k-vertex-coloring of a digraph D is a vertex coloring using k colors, such that for every ordered pair (i,j) of different colors, there is at least one arc (u,v), such that u has color i and v has color j. The dichromatic number and diachromatic number of D are the smallest and the largest number of colors in a complete proper k-vertex-coloring of D.

We determine the achromatic and diachromatic numbers of some specific circulant graphs and digraphs and give general bounds for these two parameters on these graphs and digraphs. Also, we determine the achromatic index for circulant graphs using projective planes.

Reference and acknowledgements:

Speaker: Gelásio Salazar (Universidad Autónoma San Luis de Potosí, México)

Title: Knots and shadows: applications of graph theory to knot theory

Authors: (U. Autónoma San Luis de Potosí, México)

Abstract: A diagram of a knot is a projection of the knot with the over/under information at each crossing. If we omit the over/under information, we instead obtain a shadow of the knot, which is a 4-regular plane graph. Motivated by applications to molecular biology, we have investigated the following basic question. Given a knot K and a knot shadow S, is S a shadow of K? That is, is it possible to lay out the knot K in 3-space and project it onto a plane to obtain the shadow S? We will give an overview of recent results around this question, emphasizing the algorithmical issues involved. We use classical results from knot theory and tools from topological and extremal graph theory.

Reference and acknowledgements:

Speaker: Mario Valencia-Pabón (LIPN - University Paris-Nord, France)

Title: Hom-idempotent graphs, normal Cayley graphs and k-tuple coloring of graphs

Authors: Mario Valencia-Pabón (LIPN – U. Paris-Nord, France)

Abstract: In this talk, we will discuss the notion of hom-idempotence on graphs: A graph G is said to be hom-idempotent if there is a homomorphism from the Cartesian product G \Box G to G. This notion is strong related to a special family of Cayley graphs: the normal Cayley graphs. We will mention some results concerning hom-idempotence of Kneser graphs and s-stables Kneser graphs. We will also show some applications of hom-idempotence of graphs to k-tuple colorings of graphs.

Reference:

[1] Flavia Bonomo, Ivo Koch, Pablo Torres, Mario Valencia-Pabon, k-tuple colorings of the cartesian product of graphs, Discrete Applied Mathematics, Vol. 245, pp. 177-182, 2018.

[2] Pablo Torres, Mario Valencia-Pabon, Shifts of the Stable Kneser Graphs and Hom-Idempotence, European Journal of Combinatorics, Vol. 62, pp. 50-57, 2017.

Acknowledgements:

Speaker: Jessika Camaño (Universidad Católica de la Santísima Concepción, Chile)

Title: A new mixed FEM for the stationary incompressible magneto-hydrodynamics

Authors: Jessika Camaño (U.C. de la Santísima Concepción, Chile)

Abstract: In this work we propose and analyze a new mixed finite element method for the stationary incompressible magneto-hydrodynamics. The method is based on the introduction of a pseudostress tensor relating the velocity gradient with the convective term, leading to a mixed formulation where the aforementioned pseudostress tensor and the velocity are the main hydrodynamic unknowns, while the magnetic field and a Lagrange multiplier are the magnetic unknowns. Then the associated Galerkin scheme can be defined by employing Raviart-Thomas elements of degree k for the pseudostress tensor, discontinuous piecewise polynomial elements of degree k for the velocity, Nédélec elements of degree k for the magnetic field and Lagrange elements of degree k for the respective Lagrange multiplier. The analysis of the continuous and discrete problems are carried out by means of the Lax-Milgram lemma, the Banach-Nečas-Babuška theorem and the Banach fixed-point theorem, under a sufficiently small data assumption. We also develop an a priori error analysis and show that the proposed finite element approximation leads to optimal order of convergence.

Reference and acknowledgements:

Speaker: Ricardo Oyarzúa (Universidad del Bío-Bío, Chile)

Title: A new mixed-FEM for steady-state natural convection models allowing conservation of momentum and thermal energy

Authors: Ricardo Oyarzúa (U. del Bío-Bío, Chile)

Abstract: In this work we present a new mixed finite element method for a class of natural convection models describing the behavior of non-isothermal incompressible fluids subject to a heat source. More precisely, we consider a system based on the coupling of the steady-state equations of momentum (Navier-Stokes) and thermal energy by means of the Boussinesq approximation. Our approach is based on the introduction of a modified pseudostress tensor depending on the pressure, and the diffusive and convective terms of the Navier-Stokes equations for the fluid and a vector unknown involving the temperature, its gradient and the velocity for the heat equation. The introduction of these further unknowns lead to a mixed formulation where the aforementioned pseudostress tensor and vector unknown, together with the velocity and the temperature, are the main unknowns of the system. Then the associated Galerkin scheme can be defined by employing Raviart-Thomas elements of degree k for the pseudostress tensor and the vector unknown, and discontinuous piece-wise polynomial elements of degree k for the velocity and temperature. With this choice of spaces, both, momentum and thermal energy, are conserved if the external forces belong to the velocity and temperature discrete spaces, respectively, which constitutes one of the main feature of our approach. We employ the Banach-Necas-Babuska and Banach's fixed point theorems to prove unique solvability for both, the continuous and discrete problems. We provide the convergence analysis and particularly prove that the error decay with optimal rate of convergence. Further variables of interest, such as the fluid pressure, the fluid vorticity and the fluid velocity gradient, can be easily approximated as a simple postprocess of the finite element solutions with the same rate of convergence. Finally, several numerical results illustrating the performance of the method are provided.

Reference and acknowledgements:

Speaker: Manuel Sánchez (Pontificia Universidad Católica de Chile, Chile)

Title: Symplectic Hybridizable discontinuous Galerkin methods for wave propagation problems

Authors: Manuel Sánchez (PUC, Chile)

Abstract: We devise Hybridizable discontinuous Galerkin methods, Mixed methods, and Discontinuous Galerkin methods for wave propagation problems written in Hamiltonian form. The main objective of the space discretizations is to preserve the Hamiltonian structure for a slightly modified discrete Hamiltonian defined for each method. We then discretize in time using symplectic time integrators, specifically, partitioned Runge-Kutta and diagonally implicit Runge-Kutta methods. The fundamental feature of the fully discrete schemes is that the conservation of the energy, the discrete Hamiltonian, is guaranteed. We present numerical examples that suggest optimal convergence of the errors and long-time simulations experiments that confirm the energy-conserving properties of the numerical schemes.

Reference and acknowledgements:

Speaker: Sergio Gutiérrez (Pontificia Universidad Católica de Chile, Chile)

Title: Optimal design under uncertainty using Small Amplitude Homogenization

Authors: Sergio Gutiérrez (PUC, Chile)

Abstract: In many optimal design problems there is a certain degree of uncertainty, for example, in the source terms, the material properties, etc. We apply the small amplitude homogenization idea to solve the worst case scenario, which becomes explicit and then allows us to derive efficient numerical algorithms. The method, which is quite general, is presented together with numerical examples, including some standard cases like compliance minimization and the torsion problem.

Reference and acknowledgements:

Speaker: Dieter Mitsche (Inst. Camille Jordan, France)

Title: k-regular subgraphs near the k-core threshold of a random graph

Authors: Dieter Mitsche (Inst. Camille Jordan, France)

Abstract: We prove that G(n,p) with p=c/n has a k-regular subgraph if c is at least exp(-Theta(k)) above the threshold for the appearance of a subgraph with minimum degree at least k, i.e. a non-empty k-core. In particular, this pins down the threshold for the appearance of a k-regular subgraph to a window of size exp(-Theta(k)).

(Joint work with M. Molloy and P. Pralat)

Reference and acknowledgements:

Speaker: Rodolfo Gutiérrez-Romo (Universi dad de Chile-CMM, Chile)

Title: Coding the Teichmüller flow by veering triangulations

Authors: Rodolfo Gutiérrez-Romo (U. de Chile-CMM, Chile)

Abstract: A half-translation surface is a collection of polygons whose sides are identified in pairs by translations and half-turns in such a way that the resulting topological surface is orientable. We consider two such collections to define the same half-translation surface if it is possible to cut the former along straight lines and reglue the pieces using the identifications to obtain the latter.

The Teichmüller flow is a geodesic flow on the space of half-translation surfaces. It can be defined directly on a polygon by stretching the horizontal direction and shrinking the vertical direction by the same factor. By a seminal result—independently by Masur and Veech in the early 1980s—the Teichmüller flow is known to be ergodic for the (unique) Lebesgue-class measure (nowadays it is even known to be exponentially mixing).

Since the work of Rauzy and Veech, a great deal of effort has been directed at finding suitable combinatorial schemes (or "codings") to study the Teichmüller flow. In this talk, I will present a new coding leveraging the theory of veering triangulations. This is joint work with Mark Bell, Vincent Delecroix, Vaibhav Gadre and Saul Schleimer.

Reference and acknowledgements:

Speaker: Alexander Quaas (Universidad Técnica Federico Santa María, Chile)

Title: The sharp exponent in the study of the nonlocal Hénon equation in Rn. a Liouville theorem and an existence result

Authors: B. Barrios (U. de La Laguna, España) y Alexander Quaas (UTFSM, Chile)

Abstract: We consider the nonlocal Hénon equation. We prove a nonexistence result for positive solutions in the optimal range of the nonlinearity. Moreover, we prove that a bubble solution, that is a fast decay positive radially symmetric solutions, exists at the critical exponent.

Reference and acknowledgements:

Speaker: Claire Delplancke (Universidad de Chile-CMM, Chile)

Title: A scalable stochastic algorithm for passive seismic tomography

Authors: Claire Delplancke (U. de Chile-CMM, Chile)

Abstract: Seismic tomography consists in reconstructing the velocity field of seismic waves in a geological medium from their first-arrival times registered at an array of sensors. We address this problem in the case of an underground mine, where data consists in noisy first-arrival times of millions of mining-induced microseisms, passively registered over years. The problem mathematically translates into a Bayesian inverse problem, with latent variables corresponding to the unknown hypocenters of each of the seismic events, a non-linear and evaluation-costly forward function, and a possibly high-dimensional set of parameters encoding the velocity field. Our main contribution is to develop and implement an online scalable algorithm, based on a novel Stochastic Gradient Descent method for a latent variable model, able to take full advantage of the large available dataset and carry out a fast and dynamic estimation of the non-homogeneous velocity field. Joint work with J. Fontbona and J. Prado.

Reference and acknowledgements:

Speaker: Carlos Pérez Arancibia (Pontificia Universidad Católica de Chile, Chile)

Title: Density interpolation methods

Authors: Carlos Pérez Arancibia (PUC, Chile)

Abstract: This talk presents ongoing work on a class of effective and simple-to-implement methods for the numerical evaluation of boundary integral operators and layer potentials in two and three spatial dimensions. These methods rely on the use of Green's third identity and local Taylor-like interpolations of density functions in terms of homogeneous solutions of the underlaying PDE. The proposed technique effectively regularizes the singularities present in boundary integral operators and layer potentials, and recasts the former in terms of integrands that are bounded or even more regular, depending on the order of the density interpolation. The resulting boundary integrals can be easily, accurately, and inexpensively evaluated by means of standard quadrature rules. A variety of numerical examples demonstrate the effectiveness of the technique in the context of Nyström and boundary element methods for the Laplace, Helmholtz, and Maxwell equations.

This is joint work with Catalin Turc (Department of Mathematical Sciences, NJIT) and Luiz Faria (Laboratorie POEMS, INRIA).

Reference and acknowledgements:

Speaker: Noureddine Igbida (Université de Limoges, France)

Title: Augmented Lagrangian method for Hamilton Jacobi equation

Authors: Noureddine Igbida (U. de Limoges, France)

Abstract: The aim of This talk is to show how one can use the Augmented Lagrangian method as an alternative to the commonly used methods to solve the Hamilton-Jacobi equation (HJ). Using the intrinsic metric associated with HJ equation we'll show how one can link the problem with Monge-Kantorovich problem and use duality method to characterize the maximal sub-solution. Then, using the augmented Lagrangian method to solve numerically the problem, we will see in some examples that we can deal with very meaningful cases, particularly the cases of degenerate HJ equation.

Reference and acknowledgements:

Speaker: Afaf Bouharguane (Université de Bordeaux, France)

Title: Numerical methods for optimal mass transportation problem and application

Authors: Afaf Bouharguane (U. de Bordeaux, France)

Abstract: We present an iterative method to numerical solve the L^2 Monge-Kantorovich problem. The method is based on a continuation approach where we iteratively solve the linearized mass conservation equation, progressively decreasing a constant lift-up to map compact support densities in the limit. A Lagrangian as well as en Eulerian integration scheme are proposed. Several examples show that the present methods can significantly reduce the computational effort.

We finally use these numerical schemes to improve the numerical simulations of the kinematic of the zebrafish larvae.

Reference and acknowledgements:

Speaker: Thierry Huillet (Université de Cergy-Pontoise, France)

Title: Scaling features of two Markov chains with total disasters

Authors: Thierry Huillet (U. de Cergy-Pontoise)

Joint work with Branda Goncalves (LPTM).

Abstract: Catastrophe Markov chain population models have received a lot of attention in the recent past. We will consider two special cases of such models involving total disasters, both in discrete and in continuous-time. Depending on the parameters range, the two models can show up a recurrence/transience transition and, in the critical case, a positive/null recurrence transition. The collapse transition probabilities are chosen in such a way that the models are exactly solvable and, in case of positive recurrence, intimately related to the extended Sibuya and Pareto-Zipf distributions whose divisibility and self-decomposability properties are shown relevant. The study includes: existence and shape of the invariant measure, time-reversal, return time to the origin, contact probability at the origin, extinction probability, height and length of the excursions, a renewal approach to the fraction of time spent in the catastrophic state, scale function, first time to collapse and first-passage times, divisibility properties.

Reference and acknowledgements:

Speaker: Sebastián Donoso (Universidad de Chile-CMM, Chile)

Title: Characteristic factors and joint ergodicity for commuting transformations and polynomial iterates

Authors: Sebastián Donoso (U. de Chile-CMM, Chile)

Abstract: In this talk I will review the notion of joint ergodicity in the context of multiple ergodic averages. Essentially, this property says that a multiple average converges to the ‘‘correct’’ limit, namely a product of integrals. This property was discovered by Furstenberg for linear iterates in weakly mixing systems and extended for polynomials (also in weakly mixing systems) by Bergelson. When considering several commuting transformations results are more scarce, mainly because there is no a well understood notion of ''characteristic factor''. By exploiting a recent work by Tao and Ziegler, I will present some developments on the understanding of characteristic factors for multiple averages for commuting transformations, and show some applications of this to the joint ergodicity property in the context of several commuting transformations. This is joint work with Andreas Koutsogiannis and Wenbo Sun.

Reference and acknowledgements:

Speaker: Enrique Otárola (Universidad Técnica Federico Santa María, Chile)

Title: Numerical methods for fractional diffusion

Authors: Enrique Otárola (UTFSM, Chile)

Abstract: We consider the spectral fractional Laplacian in bounded domains \Omega and present solution techniques for the nonuniformly elliptic problem, posed on \Omega \times (0,\infty), that localizes it. We establish regularity estimates for the solution of this problem; in particular, the analytic regularity with respect to the extended variable. We present a first-degree tensor product FEM and the tensorization of a first-degree FEM in \Omega with a suitable hp-FEM in the extended variable.

Reference and acknowledgements:

Speaker: Daniel Remenik (Universidad de Chile-CMM, Chile)

Title: Survival and coexistence for a spatial population model with forest fire epidemics

Authors: Daniel Remenik (U. de Chile-CMM, Chile)

Abstract: We consider a spatial model where population spreads through a network in discrete time while being attacked by forest-fire type epidemics that wipe out large clusters of individuals. In earlier work with Rick Durrett we showed that, for a specific version of the model, the population density in this model converges to the trajectory of an explicit deterministic dynamical system which turns out to be chaotic. In this talk we will consider a multitype version of the model and consider the problem of understanding the effect that the introduction of forest-fire epidemics can have on coexistence. We will see that the multitype model also converges to a chaotic dynamical system, and that knowledge about the behavior of this dynamical system can be used to prove coexistence for the original spatial population model, in contrast with the behavior of the model without epidemics, where the fitter species always dominates. This is joint work with Luis Fredes and Amitai Linker.

Reference and acknowledgements:

Speaker: María Isabel Cortez (Universidad de Santiago de Chile, Chile)

Title: Minimal aperiodic group actions on the Cantor set

Authors: María Isabel Cortez (USACH, Chile)

Abstract: We will explain the concept of orbit equivalence of minimal aperiodic Cantor systems. We will show some classification problems related with orbit equivalence and some connections with Group Theory.

Reference and acknowledgements:

Speaker: Alejandro Jofré (Universidad de Chile, DIM -CMM, Chile)

Title: Strategic behavior and risk analysis for network electricity markets under massive entry of renewal energies, stochastic optimization and game theory tools

Authors: Alejandro Jofré (U. Chile, DIM-CMM, Chile)

Abstract: In this talk we describe some of the key issues in the operational and strategic decisions when an energy system or market is stressed by a massive entry of nonconventional renewal energy production (NREP), such as the case of the Independent System Operator (ISO), the producer reactions, trade-off between cheap and uncertain generation sources and the risk analysis of producers versus generators and consumers. We use a combination of game theory, stochastic optimization and risk analysis techniques for modeling and trying to understand some of the behaviors and perturbations induced by the entry of NREP.

Reference and acknowledgements:

Speaker: Tertuliano Franco (Universidad Federal de Bahia, Brazil)

Title: The Directed Edge Reinforced Random Walk: Ant Mill Phenomena

Authors: Tertuliano Franco (U. Federal de Bahia, Brazil)

Abstract: We define here the directed edge reinforced random walk on any locally finite connected graph G. As the name suggests, this walk keeps track of its past, giving more probability to choose a (directed) edge already crossed before. We prove that if the graph G is finite and is not a tree, or if G=Z^d with d\geq 2, then the walk will be trapped forever in some oriented cycle, which has a connection with a biological phenomena known as
Ant Mill.

Talk based in a joint work with D. Erhard (UFBA) and G. Reis (UFBA).

Reference and acknowledgements:

Speaker: Jean-Stéphane Dhersin (CNRS, France)

Title: Cost functionals for large random trees

Authors: Jean-Stéphane Dhersin (CNRS, France)

Joint work with Jean-François Delmas and Marion Sciauveau.

Abstract: Additive tree functionals allow to represent the cost of many divide-and-conquer algorithms. We give an invariance principle for such tree functionals for the Catalan model and for simply generated trees . In the Catalan model, this relies on the natural embedding into the Brownian excursion.

Reference and acknowledgements:

Speaker: Jairo Bochi (Pontificia Universidad Católica de Chile, Chile)

Title: Emergences in Ergodic Theory

Authors: Jairo Bochi (PUC, Chile)

Abstract: This talk is based on joint work with Pierre Berger (U. Paris 13, CNRS). In the first part, I will present new ways of quantifying dynamical complexity. The first one is called topological emergence, and essentially measures how many distinguishable statistics the orbits of a dynamical system may have. The second one is called metric emergence, and depends on a reference probability measure: here we disregard those statistics that have small probability. Metric emergence is always bounded by topological emergence, which in turn can be bounded in terms of the box dimension of the ambient space.

In the second part, I will concentrate on the case of area-preserving dynamics. KAM theory reveals that Lebesgue measure is typically NOT ergodic, unless the system is in some sense hyperbolic. In particular, metric emergence is typically non-trivial in this region. It turns out that metric emergence is as high as it can be for C-infinity generic dynamics in the non-hyperbolic region. So the KAM picture looks more and more complex as we zoom in.

Reference and acknowledgements:

Speaker: Pablo Groisman (Universidad de Buenos Aires, Argentina)

Title: Nonhomogeneous First Passage Percolation and Manifold Leraning

Authors: Pablo Groisman (U. de Buenos Aires, Argentina)

Abstract: We will consider the following problem. Let Q = {q_1, ..., q_n} be independent random points with common density supported on a Riemannian manifold. Define a distance in Q that captures both the intrinsic structure of the manifold and the density. We will propose such a distance and show its asymptotic behavior as the number of points goes to infinity. This is important in several learning tasks like clustering, classification, dimensionality reduction, non parametric regression, etc. The proofs involve the study of geodesics in non homogeneous Euclidean First Passage Percolation on manifolds. The talk will be based on joint work with Matthieu Jonckheere and Facundo Sapienza.

Reference and acknowledgements:

Speaker: Diego Paredes (Universidad de Concepción, Chile)

Title: New advances on multiscale hybrid-mixed methods

Authors: Diego Paredes (U. de Concepción, Chile)

Abstract: The Multiscale Hybrid-Mixed method (or MHM for short), a finite element method, was presented in 2013 for solving the Laplace equation with a highly oscillatory permeability coefficient. This method appears as an attractive “divide-and-conquer” option to handle multiscale problems by naturally merging the effects of multiple scales to provide solutions with high-order precision on coarse meshes. The underlying upscaling procedure transfers to a set of basis functions the responsibility of achieving high orders of accuracy at scales smaller than the coarse mesh. The upscaling is built inside the general framework of hybridization, in which the continuity of the solution is relaxed a priori and imposed weakly through the action of Lagrange multipliers. This procedure characterizes the unknowns as the solutions to local problems with boundary conditions driven by the multipliers. The computation of local problems is embedded in the upscaling procedure, with local computations being completely independent and thus fitting naturally with parallel computation facilities. Since our first work, this methodology was extended for several problems, and new theoretical and computational features have been developed as a consequence. In this talk, we discuss some of these advances focusing on new discretization strategies its accuracy and computational performance.

Reference and acknowledgements:

Speaker: Paul Pegon (Université Paris-Dauphine, France)

Title: Some fractal shapes in branched transport

Authors: Paul Pegon (U. Paris-Dauphine, France)

Abstract: In branched transport, particles travel along a 1-dimensional structure with a cost proportional to l m^s if a collection of particles of total mass m moves over a distance l, where s is an exponent strictly between 0 and 1. The strict subadditivity of the cost favours joint transportation and is responsible for the presence of branching points. In this talk, after briefly introducing the theory, I will present some results and conjectures on fractal sets related to branched transport, and describe in particular a shape optimization problem whose optimizers play the role of ``unit balls'' in branched transport, which should have a boundary of non-integer dimension.

Reference and acknowledgements:

Speaker: Frédéric Havet (CNRS – INRIA Nice, France)

Title: Trees in graphs and digraphs

Authors: Frédéric Havet (CNRS – INRIA Nice, France)

Abstract: It is folklore that every graph of minimum degree k-1 contains all tree of order k. Similarly every digraph with minimum in- and out-degree k-1 contains all oriented trees of order k.

In this talk, we survey some strengthenings on those two statements. A special attention will be devoted to the celebrated conjecture of Erdös-Sós that every graph with average degree exceeding k-2 contains every tree of order k, and its variants and directed analogue, as well as the conjecture of Burr that every digraph with chromatic number 2k-2 contains every oriented tree of order k.

Reference and acknowledgements:

Speaker: Léonard von Niederhäusern (Universidad de O'Higgins, Chile)

Title: A Trilevel Energy Market Model for Demand-Side Management

Authors: Léonard von Niederhäusern (UOH, Chile)

Abstract: Among other concerns, the constantly increasing consumption of energy, the breakthrough of renewable energies in the production mix, and the need to be economically viable constitute tremendous challenges for energy companies nowadays. At the center of the preoccupations, the supply-demand balance in the grid has to be ensured at all times. Whereas the old paradigm consisted in adapting the production to the demand, the converse method has been on the rise for the past thirty years: adapting the demand to the production is one of the aims of demand-side management (DSM). To implement DSM, several techniques are available: the approach presented in this talk is load shifting, achieved through time-of-use pricing.

More precisely, a set of suppliers aims to sell energy to a set of clients of various types (so-called aggregators and local agents). The suppliers offer prices, to which the clients react in an optimal way, adapting their demand in order to minimize their purchase costs and their inconvenience.

Mathematically, this takes the form of a bilevel problem. Such problems model the hierarchical interaction between two actors: a leader takes decision, explicitly taking into account the optimal reaction of a follower. Bilevel problems are known to be NP-hard, even in their simplest form. However, through a thorough theoretical study of our problem, we manage to present various solution methods, and prove their efficiency with numerical results.

This is a joint work with Didier Aussel (PROMES-CNRS/UPVD), Luce Brotcorne (Inria Lille) and Sébastien Lepaul (EDF R&D).

Reference and acknowledgements:

Speaker: Vincent Rivoirard (U. Dauphine, France)

Title: Frequentist and Nonparametric inference for Hawkes processes. Applications for estimating functional connectivity graphs of neurons

Authors: Vincent Rivoirard (U. Dauphine, France)

Abstract: Functional connectivity in neuroscience is considered as one of the main features of the neural code. It is nowadays possible to obtain the spike activities of tens to hundreds of neurons simultaneously and the issue is then to infer the functional connectivity thanks to those complex data. To deal with this problem, we consider estimation of sparse local independence graphs by using models based on multivariate Hawkes processes. Such counting processes have become very popular since they are, in particular, very useful to model occurrences of a process when it is affected by its past occurrences. Hawkes processes depend on an unknown functional parameter to be estimated, for instance, by linear combinations of a fixed dictionary. To select coefficients, we propose a Lasso-type procedure, where the penalty is derived from Bernstein inequalities. Our tuning procedure is proven to be robust with respect to all the parameters of the problem, revealing its potential for concrete purposes and in particular in neuroscience. Finally, some extensions in the nonparametric Bayesian setting will be presented.

Reference and acknowledgements:

Speaker: Paulina Cecchi (Universidad de Santiago de Chile, Chile)

Title: Balance in symbolic systems

Authors: Paulina Cecchi, USACH, Chile

Abstract: Given a finite alphabet A and a finite word v belonging to A*, an infinite word x with symbols in A having v as a subword is said to be balanced on v if the difference between the number of occurrences of v in two factors of x of the same length is bounded. The problem of knowing whether an infinite word is balanced in some subword is related to the unique ergodicity of the subshift generated by this word, and to the speed of convergence of some specific Birkhoff sums.

We will explain the problem of balance both from the word combinatorics and dynamical point of view, see its connections with weak-mixing properties and review some known examples of balanced and non-balanced subshifts.

Reference and acknowledgements:

Speaker: Antoine Brault (Universidad de Chile - CMM, Chile)

Title: Young and rough differential inclusions

Authors: Antoine Brault (Universidad de Chile - CMM, Chile)

Abstract: The notions of solutions for differential inclusions driven by irregular noise are defined using the rough path theory. Results of the existence of solutions are then proven, with different hypotheses on the set-valued map.

Reference and acknowledgements:

Speaker: Cristina Fernandes (University of São Paulo, Brazil)

Title: A new approximation for Maximum Leaf Spanning Arborescence on directed acyclic graphs

Authors: Cristina Fernandes (U. of São Paulo, Brazil)

Abstract: Consider the problem of, given a digraph D, finding a spanning arborescence of D, if one exists, with the maximum number of leaves. We consider the case in which D is restricted to be a rooted directed acyclic graph. This case is known to be MaxSNP-hard and there is a 2-approximation for it. We improve on this result, presenting a 3/2-approximation for this case.

Reference and acknowledgements:

Speaker: Jaime San Martín (Universidad de Chile - CMM, Chile)

Title: Powers of Green Potentials

Authors: Jaime San Martín (U. Chile-CMM, Chile)

Abstract: In this talk we shall discuss some stability properties of the Green kernel for regular domains in dimension d larger or equal to 3. In particular we shall study such stabilities for powers.

Reference and acknowledgements:

Speaker: Hagop Tossounian (Universidad de Chile - CMM, Chile)

Title: Kac's Model with thermostats and Rescaling

Authors: Hagop Tossounian (U. de Chile - CMM, Chile). Joint work with Roberto Cortez.

Abstract: In 1956 Mark Kac introduced a probabilistic model and used it to derive a simple Boltzmann-type equation, now known as the Kac-Boltzmann equation that governs the velocity distribution of the particles. The mechanism used to derive the Kac-Boltzmann equation is now known as ''propagation of chaos''. Thermostats were introduced in Kac's model in 2014 to speed up approach to equilibrium. In this talk, I will introduce Kac's model, propagation of chaos, and a new model where in addition to the thermostats, there is a global rescaling action on the velocities of the particles that aims at keeping the total energy of the system close to a predetermined value. A propagation of chaos result for this model will be presented.

Reference and acknowledgements:

Speaker: Gregorio Moreno (Pontificia Universidad Católica de Chile, Chile)

Title: Convergence to the Burgers equation: two examples

Authors: Gregorio Moreno (PUC, Chile)

Abstract: We report on two works showing convergence to the Burgers equation. In the first one, we consider the Sasamoto-Spohn model, a natural discretization of Burgers equation. In the second one, we study the partition function of the semi-discrete directed polymer in a Brownian environment.

We briefly review the theory of energy solutions of Burgers equation and show how it is suitable to show scaling limits for discrete models.

This is a joint work with Milton Jara (IMPA).

Reference and acknowledgements:

Speaker: Avelio Sepúlveda (Université Lyon 1, France)

Title: A survey on level sets of the two-dimensional Gaussian free field

Authors: Avelio Sepúlveda (U. Lyon 1, France)

Abstract: The study of the geometry of the two-dimensional Gaussian free field (GFF) has been an active area of research in the last decade. In this talk, I will summarize the main results in the study of the level set of the GFF, namely: existence, uniqueness, monotonicity, connectivity and percolative properties, relationship with other conformal invariant objects and fractal dimension.

Reference and acknowledgements:

Speaker: Yuri Lima (Universidade Federal do Ceará, Brazil)

Title: Markov partitions and adapted measures

Authors: Yuri Lima (U. Federal do Ceará, Brazil)

Abstract: Markov partitions provide an efficient way of understanding various statistical properties of dynamical systems. For systems with singularities, a class of interesting measures in given by the adapted ones: a measure is adapted if the hyperbolicity overrules the proximity to the singular set. In this talk, we will discuss the existence of Markov partitions for adapted measures in two contexts: two dimensional billiards and one dimensional maps.

Reference and acknowledgements:

Speaker: Jean Dolbeault (U. Paris-Dauphine, France)

Title: Hypocoercivity and functional inequalities

Authors: Jean Dolbeault (U. Paris-Dauphine, France)

Abstract: The purpose of the L^2 hypocoercivity method is to obtain rates for solutions of linear kinetic equations without regularizing effects, in asymptotic regimes. Initially intended for systems with compactness or confinement in position space and simple local equilibria, the method has been extended to various local equilibria in velocities and non-compact situations in positions. It is also flexible enough to include non-local transport terms associated with Poisson coupling. The lecture will be devoted to a review of some recent results which rely on various functional inequalities. An application to the linearized Vlasov-Poisson-Fokker-Planck system will also be presented.

Reference and acknowledgements:

Speaker:

Title:

Authors:

Abstract:

Reference and acknowledgements: