Flacam 2019
Workshops (parallel sessions) overview

SPET — **Stochastic Processes and Ergodic Theory**
Chair: Joaquín Fontbona

OPT — **Optimization**
Chair: Héctor Ramírez

MMIP — **Mathematical Mechanics and Inverse Problems**
Chair: Axel Osses

PDE — **Partial Differential Equations**
Chairs: Claudio Muñoz & Michal Kowalczyk

A&C — **Algorithms and Combinatorics**
Chair: Maya Stein

NPDE — **Numerical Methods for Partial Differential Equations**
Chair: Mauricio Sepúlveda

BIO — **Biomathematics**
Chairs: Alejandro Maass & Héctor Ramírez

Parallel Sessions W1, 11:00-12:30

SPET	Scaling limits of random processes and structures / Organizer: Joaquín Fontbona	
	Thierry Huillet, Jean-Stephen Dhersin, Hagop Tossounian	Open Space
OPT	Energy markets / Organizers: Tito Homen-de-Mello & Héctor Ramírez	
	Alejandro Jofré, Didier Aussel, Alexandre Street	D'Etigny
MMIP	Control of PDEs I / Organizers: Eduardo Cerpa, Carlos Conca, Jaime Ortega	
	Sebastián Zamorano, Charles Dapogny, Cristhian Montoya	B04
PDE	PDE I / Organizers: Claudio Muñoz & Michal Kowalczyk	
	Van den Bosch, Carlos Román, Olivier Goubet	CMM 7th floor
A&C	Graph classes and algorithms / Organizer: Maya Stein	
	Gelasio Salazar, Cristina Fernandes, Mario Valencia-Pabón	DIM 5th floor
NPDE	Numerical Analysis I / Organizers: David Mora, Manuel Solano, Mauricio Sepúlveda	
	Pablo Venegas, Michael Karkulik, Rodolfo Araya	CMM 6th floor

Parallel Sessions W2, 14:00-16:00

SPET	Ergodic theory and dynamical system I / Organizers: Sebastián Donoso	
	Jairo Bochi, Yuri Lima, Rodolfo Gutiérrez	Open Space
OPT	Energy & optimal control / Organizers: Cristopher Hermosilla	
	Carrillo-Galvez, Anna Désilles, María Soledad Aronna	D'Etigny
MMIP	Control of PDEs II / Organizers: Eduardo Cerpa, Carlos Conca, Jaime Ortega	
	Exequiel Mallea, Roberto Morales, Nicolás Carreño	B04
PDE	PDE I / Organizers: Claudio Muñoz & Michal Kowalczyk	
	Matteo Rizzi, Jean Dolbeault, Oscar Jarrín	CMM 7th floor
A&C	Random graphs and limits / Organizer: Maya Stein	
	Dieter Mitsche, Hiêp Hàn	DIM 5th floor
NPDE	Numerical Analysis II / Organizers: David Mora, Manuel Solano, Mauricio Sepúlveda	
	Manuel Sanchéz, David Mora, Noureddine Igbida	CMM 6th floor

Parallel Sessions Th1, 11:00-12:30

SPET

Stochastic Modeling and Data Science / Organizers: Felipe Tobar & Joaquín Fontbona

Elsa Cazelles, Claire Delplancke, Pablo Groisman	Open Space

OPT

Controlled biological dynamical systems / Organizers: Pedro Gajardo & Héctor Ramírez

Alain Rapaport, Olga Vasilieva, Diego Vicencio	D'Etigny

MMIP

Inverse problems I / Organizers: Eduardo Cerpa, Carlos Conca, Jaime Ortega

François Murat, Sergio Gutiérrez, Nicolás Lebbe	B04

PDE

PDE II / Organizer: Mircea Petrache

Jacek Jendrej, Simona Rota-Nodari, Sergio Gutierrez,	CMM 7th floor

A&C

Structural graph theory / Organizer: Maya Stein

Fábio Botler, Daniel Quiroz, César Hernández-Cruz	DIM 5th floor

NPDE

Numerical Analysis III / Organizers: David Mora, Manuel Solano, Mauricio Sepúlveda

Ignacio Muga, Alexandre Ern, Thomas Führer	CMM 6th floor

BIO

Controlled biological dynamical systems / Organizers: Pedro Gajardo & Héctor Ramírez

Alain Rapaport, Olga Vasilieva, Diego Vicencio	D'Etigny

Parallel Sessions Th2, 14:00-16:00

SPET

Random models in mathematical physics / Organizer: Daniel Remenik

Gregorio Moreno, Tertuliano Franco, Avelio Sepulveda — Open Space

OPT

Combinatorial optimization / Organizer: José Verschae

Andreas Weise, Diego Morán, Gonzalo Muñoz — D'Etigny

MMIP

Inverse problems II / Organizers: Eduardo Cerpa, Carlos Conca, Jaime Ortega

Rodrigo Lecaros, Gino Montesinos, Joaquín Mura — B04

PDE

PDE II / Organizer: Mircea Petrache

Diego Paredes, Cristobal Guzmán, Rodolfo Viera — CMM 7th floor

A&C

Extremal graph theory and coloring / Organizer: Maya Stein

Carlos Hoppen, Guilherme Mota, Kolja Knauer — DIM 5th floor

NPDE

Numerical Analysis IV / Organizers: David Mora, Manuel Solano, Mauricio Sepúlveda

Carlos Pérez, Paulina Sepúlveda, Mauricio Sepúlveda — CMM 6th floor

BIO

Mathematical modeling for natural resources and cancer progression / Organizers: Alejandro Maass & Héctor Ramírez

Karina Vilchez, Héctor Oliveros, Gérard Olivar — DIM 4th floor

Parallel Sessions F1, 11:00-12:30

SPET

Stochastic analysis / Organizer: Joaquín Fontbona

Jaime San Martín, Victor Rivero, Antoine Brault — Open Space

OPT

New results on support vector machines and conic programming / Organizer: Héctor Ramírez

Paulo Silva, Julio López, Gabriel Haeser — D'Etigny

MMIP

No session

PDE

PDE III / Organizer: Erwin Topp

Juan Carlos Pozo, Alexander Quaas — CMM 7th floor

A&C

No session

NPDE

No session

Parallel Sessions F2, 14:00-16:00

SPET

Ergodic theory and dynamical systems II / Organizer: Alejandro Maass

Paulina Cecchi, Sebastián Donoso, María Isabel Cortez — Open Space

OPT

New trends in algorithmics and learning / Organizers: Mario Bravo & Héctor Ramírez

Mikhael Solodov, Roberto Andreani, Sylvain Sorin — D'Etigny

MMIP

No session

PDE

PDE III / Organizer: Erwin Topp

Gonzalo Dávila, Julián Fernández, Julio Rossi — CMM 7th floor

A&C

No session

NPDE

No session

Workshop optimization (OPT)

Wednesday, Nov 6th

Parallel session W1: Energy Markets
Organizers: Tito Homen-de-Mello & Héctor Ramírez
Chair: Tito Homen-de-Mello

11h00-11h30	Alejandro Jofré	UCH, Chile	Strategic behavior and risk analysis for network electricity markets under massive entry of renewal energies
11h30-12h00	Didier Aussel	U. Perpignan, France	Mutli-Leader-Disjoint follower game: genericity and electricity contract problem
12h00-12h30	Alexandre Street	PUC Rio, Brazil	Distributionally Robust Transmission Expansion Planning: a Multi-scale Uncertainty Approach

Parallel session W2: Energy and Optimal control
Organizers: Cristopher Hermosilla
Chair: Cristopher Hermosilla

14h00-14h30	Adrian Carrillo-Galvez	U. Concepción, Chile	The Environmental/Economic Dispatch Problem based on Duality Theory
14h30-15h00	Anna Désilles	Ensta Paris Tech, France	Sensitivity relations for some classes of optimal multi-processes
15h00-15h30	Maria Soledad Aronna	F. Getulio Vargas, Brazil	Optimality Conditions for the Control of Fokker-Planck Equations

Thursday, Nov 7th

Parallel session Th1: Optimization meets biomathematics - Controlled Biological Dynamical Systems
Organizers: Héctor Ramírez & Pedro Gajardo
Chair: Pedro Gajardo

11h00-11h30	Alain Rapaport	MISTEA, France	Weak resilience to invasion in the chemostat model and asymptotically periodic controls
11h30-12h00	Olga Vasilieva	U. del Valle, Colombia	Optimal control approach for implementation of sterile insect techniques
12h00-12h30	Diego Vicencio	USM, Chile	Comparison of viability kernels for generalized monotone controlled systems and applications to biological control

Parallel session Th2: Combinatorial Optimization
Organizers: José Verschae
Chair: José Verschae

14h00-14h30	Andreas Wiese	UCH, Chile	Fully Dynamic Approximate Maximum Independent Set in Interval and Geometric Intersection Graphs
14h30-15h00	Diego Morán	UAI, Chile	Subadditive Duality for Conic Mixed-Integer Programs
15h00-15h30	Gonzalo Muñoz	UOH, Chile	Intersection cuts for polynomial optimization

Friday, Nov 8th

Parallel session F1: New results on support vector machines and conic programming
Organizers: Héctor Ramírez
Chair: Héctor Ramírez

11h00-11h30	Paulo Silva	U. Campinas, Brazil	Robust nonlinear support vector machine based on difference of convex functions
11h30-12h00	Julio López	UDP, Chile	A New formulation for support vector regression based on second-order cone programming
12h00-12h30	Gabriel Haeser	U Sao Paulo, Brazil	Optimality conditions for nonlinear symmetric cone programming

Parallel session F2: New trends in algorithmics and learning
Organizers: Mario Bravo & Héctor Ramírez
Chair: Mario Bravo

14h00-14h30	Mikhael Solodov	IMPA, Brazil	Some news on the convergence and the cost of iterations of augmented Lagrangian methods
14h30-15h00	Roberto Andreani	U. Campinas, Brazil	Sequential conditions of optimality theoretical and practical importance
15h00-15h30	Sylvain Sorin	U. Sorbonne, France	No-regret criteria in learning, games and convex optimization

Workshop Biomathematics (BIO)

Thursday

Parallel session Th1: Optimization meets biomathematics - Controlled Biological Dynamical Systems

Organizers: Héctor Ramírez & Pedro Gajardo

Chair: Pedro Gajardo

Room: D'Etigny

11h00-11h30	Alain Rapaport	MISTEA, Montpellier, France	Weak resilience to invasion in the chemostat model and asymptotically periodic controls
11h30-12h00	Olga Vasilieva	U. del Valle, Colombia	Optimal control approach for implementation of sterile insect techniques
12h00-12h30	Diego Vicencio	USM, Chile	Viability Kernels in Monotone Controlled Dynamical Systems and Ecological Applications

Parallel session Th2: Mathematical modeling for natural resources and cancer progression

Organizers: Héctor Ramírez & Alejandro Maass

Chair: Alain Rapaport

Room: Seminar room 4th floor

14h00-14h30	Karina Vilchez	UC Maule, Chile	Emergent behaviors in multi-cellular tumor progression including micro-environmental interactions
14h30-15h00	Héctor Olivero	U. Valparaiso, Chile	Synchronization and propagation of chaos for mean field networks of Hodgkin-Huxley neurons with noisy channels
15h00-15h30	Gerard Olivar	U. Aysen, Chile	Convenient growth of renewable resources for stability of sustainable development

FLACAM 2019

French Latin - American Conference on New Trends in Applied Mathematics

5 - 8 November, Santiago - Chile

Workshop Optimization (OPT)

Session W1 (Wednesday 11h00-12h30):

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.

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.

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.

Session W2 (Wednesday 14h00-15h30):

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).

Speaker: Anna Désilles

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

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.

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

References:

[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).

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.

Session Th1 (Thursday 11h00-12h30):

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.

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.

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.

Session Th2 (Thursday 14h00-15h30):

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.

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).

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.

Session F1 (Friday 11h00-12h30):

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.

Speaker: Julio López (Unversidad Diego Portales, Chile)

Title: A New formulation for support vector regression based on second-order cone programming

Abstract: In this work, we propose a new formulation for Support Vector Regression (SVR) based on second-order cones. The proposed approaches define a robust worst-case framework for the conditional densities of the input data. Linear and kernel-based second-order cone programming formulations for SVR are proposed, while the duality theory allows us to derive interesting geometrical properties for this strategy: the method maximizes the margin between two ellipsoids obtained by shifting the response variable up and down by a fixed parameter. Experiments for regression on twelve well-known datasets confirm the superior performance of our proposal compared to alternative methods such as standard SVR and linear regression. Finally, we provide a new proposal for SVR based on nonparallel hyperplanes.

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.

Session F2 (Friday 14h00-15h30):

Speaker: Mikhael Solodov (IMPA, Brazil)

Title: Some news on the convergence and the cost of iterations of augmented Lagrangian methods

Abstract: We discuss some recent results on convergence and rate of convergence of the classical augmented Lagrangian algorithm. The local primal-dual linear/superlinear convergence is obtained under the sole assumption that the dual starting point is close to a multiplier satisfying the second-order sufficient optimality condition. In fact, in the equality-constrained case, even the weaker noncriticality assumption is enough. In particular, no constraint qualifications of any kind are needed. Previous literature on the subject required the linear independence constraint qualification (in addition to other things). Moreover, we show that to compute suitable approximate solutions of augmented Lagrangian subproblems which ensure the

superlinear convergence of the algorithm, it is enough to make just two Newtonian steps (i.e., solve two quadratic programs, or two linear systems in the equality-constrained case). The two quadratic programs are related to stabilized sequential quadratic programming, and to second-order corrections, respectively. Previously, nothing was known about the cost/complexity of solving the augmented Lagrangian subproblems, under any reasonable assumptions.

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).

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 on:

- 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

Workshop Biomathematics (BIO)

Session Th1 (Thursday 11h00-12h30):

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.

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.

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.

Session Th2 (Thursday 14h00-15h30):

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.

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 follows 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 results 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)

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.