# Proyectos MATH AmSud - convocatoria 2016

## DCS - Dynamics of Cantor systems: computability, combinatorial and geometric aspects

Abstract

The field of symbolic dynamics has its origins in the work of Hadamard from the late 1800’s, and has connections to many areas of mathematics, such as combinatorics, dynamical systems, ergodic theory, information theory, geometry and number theory. In the past ten years symbolic dynamics has seen a surge of activity, with the development of new techniques and the discovery of new connections with the related areas. This project will include (but will not be restricted to) topics on this recent activity, from which we mention the following: symbolic dynamics in one and more dimensions and the thermodynamical formalism of such systems, extensions to tiling systems and more general group actions, the study of many open problems concerning Cantor minimal systems and properties of its associated Bratteli-Vershik diagrams, the study of the symbolic dynamics of some interval maps and more general translation surfaces, the study of subshifts of finite type and link computational properties with dynamical ones. This enables to gain in the understanding of the computational complexity of symbolic systems among other topics.

Thus we want to bring together leading researchers from Brazil, Chile and France, working in the distinct subareas, to jointly tackle open problems concerning the afore mentioned topics. Extending already established fruitful collaborations between Chile and France, Brazil and France as well as between Brazil and Chile and founding new ones we are looking forward to a productive scientific cooperation leading to new important results in those theories, giving international visibility to our work. The project will also include training of doctoral students in ‘co-direction’ among the partners and other kinds of exchange of students and postdocs between France and the participating

South American institutions, which has already proved to be a successful approach for interchanging knowledge and stating good scientific collaborations in the past.

Institutions and scientific coordinators:

Centro de Modelamiento Matemático, Universidad de Chile (CMM-UCH), Chile / Alejandro Maass

Universidade Estatual de Campinas (Unicamp), Instituto de Matemática, Estatística e Computação Científica (IMECCUNICAMP) Departamento de Matemática, Brazil / Eduardo Garibaldi  
Université de Picardie Jules Verne (UPJV), France / Samuel Petite

CGHF - Complex Geometry and Holomofphic Foliations

Abstract

The project consists in doing scientific research about theory of complex foliations. More precisely,results are expected in the next main topics:

1. Holomorphic structure of the neighborhood of a curve embedded in a complex surface.

2. Moduli spaces of connections.

3. Singular projective structures on curves.

4. Foliations and webs on projective varieties.

5. Groups of local holomorphic diffeomorphisms and dynamics.

The project foresees the cooperation among researchers in the form of missions. Missions foryoung doctorate students from Brazil and France are also planned. Also, a Workshop with members of the three countries in Niterói in August 2018 is planned.

Institutions and scientific coordinators:

Universidade Federal Fluminense (UFF), Brazil / Thiago Fassarella do Amaral

Pontificia Universidad Católica del Perú (PUCP), Peru / Rudy Rosas

Université de Rennes 1, France / Frédéric Touzet

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## GDAR - Geometry, Dynamics and Asanov Representations

Abstract

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| In the last decade, Anosov representations appeared to be an important tool in the study of several geometric notions. This project will allow the collaboration between the scientific teams of the various partners, particularly for their young members, assisted by several international experts in other places in France or Brazil. A central idea will be to apply the notion of Anosov representations in the following area:   * Conformally flat lorentzian geometry, * Complex geometry.   More precisely, the main goal will be:   * To establish a correspondence between Anosov representations into SO(2,n+1) and conformally flat globally hyperbolic spacetimes of dimension n+1, * To study the dynamics of Anosov representations of surface groups into SL(3,₵ ) or PU(1,2), * To study the connection between the group of piecewise projective transformation groups of the circle and singular space-times.   Institutions and scientific coordinators:  Universidade Federal de Minas Gerais, Brazil / Mario Jorge Dias Carneiro  Universidad de Santiago de Chile, Chile / Andres Navas Flores  Avignon University, France / Thierry Barbot |
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## ICoPS - Inverse and control problems for physical systems

Abstract

We propose to study well-posedness, control properties, and coefficient inverse problems for partial differential equations appearing in models for several phenomena. We plan to study the well posedness of nonlinear reaction-diffusion equations modeling enzymatic reactions, as well as some Boussinesq type systems describing the propagation of bidirectional water waves. Also, we intend to study the inverse problems of recovering some coefficients in the previously mentioned equations, and also in nonlinear dispersive waves on trees, which appears in model for the cardiovascular system. We intend to study numerical approximations, using numerical schemes like Galerkin, colocation, finite difference, among others. Finally, this proposal includes study the controllability of the wave equation with a Kelvin-Voigt damping as a model of viscoelasticity, ant the determination of the reachable states in a control problem of KdV equation, using the flatness approach.

Institutions and scientific coordinators:

Instituto de Matemática, Universidade Federal do Rio de Janeiro, Brazil / Daniel Alfaro  
Departamento de Matemática Universidad Técnica Federico Santa María, Chile / Alberto Mercado

Departamento de Matemáticas Universidad del Valle, Colombia / Ivonne Rivas  
Laboratoire de Mathématiques de Versailles, France / Emmanuelle Crépeau

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## LIETS - Lie-type structures

Abstract

The proposal deals with different aspects of Lie algebras. The problems considered in the proposal are:

a) The study of higher cup products in cohomology. Our main example is the brace structure which determines the Lie structure of Hochschild cohomology, brace algebras are described by certain non-cocommutative Hopf algebras, called dendriform bialgebras. Our goal is to find a notion of higher dendriform bialgebras whose subspace of primitive elements are determined by McClureSmith operad, whose binary operations are precisely the higher cup products.

b) The description of the dendriform and brace structure on the

c) The classification of involutive set-theoretical solutions of the Yang-Baxter equation, via the description of the cohomology groups of left braces and linear cycles.

d) To extend the Lifshitz-Cardy formula in higher dimension to provide a microscopic account of the entropy of Lifshitz black holes.

Institutions and scientific coordinators:

Instituto de Matemáticas y Física, Universidad de Talca, Chile / María Ronco

Departamento de Matemáticas. Universidad de Buenos Aires, Argentina / Leandro Vendramin

Université Paris Diderot, France / Muriel Livernet

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## MODYNE - From monotonicity to dynamic and equilibrium: structures and applications

Abstract

The concept of monotonicity is at the heart of this research project, and will serve us as the guiding line of this proposal. Throughout this work, the monotonicity property will manifest in different forms: - as a convexity property, through the study of convex optimization problems as well as convex Bolza problems in the calculus of variations. These problems involves convex functions either in the objective or in the constraints parts; - as a convexity property, through the study of bilevel/ multilevel optimization problems; - as a hidden convexity, through the study of quadratic optimization problems and the use of Frank-Wolfe's or Dines' like-theorems which assert the convexity of the image of quadratic functions. Such a phenomenon will also be studied when we will deal with non-convex functional integrals--in this case, Lyapunov's convexity-like theorem would be the key tool to go back to the convex framework, - as a useful property of operators defined on Banach spaces; in this case, we will study many nice consequences of the monotonicity regarding the representability by a Fitzpatrick functions of a given operator, the maximality, and the validity of Minty's surjectivity theorem in reflexive and non-reflexive Banach spaces, - as a consistent tool for the study of proximal algorithms for general equations/inclusions governed by monotone operators, as well as for the study of (continuous) dynamics.

Institutions and scientific coordinators:

Federal University of Santa Catarina, Brazil / Maicon Marques Alves

Universidade Federal de Goiás, Brazil / Jefferson Divino Goncalves de Melo

Universidade Federal do Ceará, Brazil / Lev Birbrair   
University of Concepción, Chile / Fabian Flores Bazán   
Centro de Modelamiento Matemático, Universidad de Chile, Chile / Abderrahim Hantoute

Universidad del Pacifíco, Peru / Yboon García Ramos

Université de Perpigan, France / Didier Aussel

Université des Antilles, France / Marc Lassonde   
INRIA Rhône-Alpes, France / Malick Jérôme   
Université Aix-Marseille, France / Soubeyran Antoine

Université de Pau et de Pays de l’Adour, France / Luc Barbet

Université de Bourgogne, France / Abderrahim Jourani

## SIDIHAM - Hamiltonian Dynamical Systems, Celestial Mechanics, Weak KAM Theory

Abstract

This project aims at the establishment of an investigation network between Brazil, Chile, France and Uruguay to promote the development of Mathematics in the areas of Hamiltonian Systems and Celestial Mechanics in these countries of South America.

The main research topics are: central configuration in the N-body problem, integral manifolds in the gravitational N-body problem, central configurations, the stability of equilibrium solutions in Hamiltonian Systems, the existence and stability of periodic and quasi periodic solutions in Hamiltonian Systems and in particular to those derived from

Celestial Mechanics, Non-integrability in Celestial Mechanics, Weak KAM solutions in the N-body problem, C⁰ and Lipschitz integrability for Tonelli Hamiltonians.

It is worthwhile mentioning that this proposed scientific network involves a large number of young doctors as well as Master and PhD students in Mathematics. This project would facilitate the mobility of young doctors to make post-doctoral visits at the countries which are members of the network; also, Master students could eventually proceed to their doctoral studies in one of these countries.

We intend to organize a one-week meeting in Uruguay, at the end of the 2017, and another one-week meeting in Recife, at the end of 2018. The goal is to promote discussions between the members of the cooperation network. These meeting are meant to stimulate the development of these emergent research centers as regards these topics of Mathematics.

Institutions and scientific coordinators:

Universidad de la Republica, Uruguay / Ezequiel Maderna

Universidad del Bio-Bio, Chile / Claudio Vidal Diaz

Universidade Federal Rural de Pernambuco, Brazil / Anete Soares Cavalcanti

Universite d'Avignon, France / Andrea Venturelli