

Proyectos MATH AmSud – convocatoria 2020

AGSAFE - Arithmetic Geometry: Shimura varieties, Automorphic Forms and Elliptic curves

Abstract

This project concerns mainly algebraic number theory, that is the study of fundamental problems about the integers using algebraic tools. To be more precise, we are interested in aspects related to the Langlands program, which conjecturally relates arithmetic objects, like Galois representations, with their analytic avatar, automorphic forms. It can be considered as a generalization of Wiles' proof of Fermat's last theorem.

One direction of research that we will develop in this project treats p-adic aspects of the Langlands program, like the study of p-adic L-functions, p-adic variation and p-adic comparison theorems in families. For example using methods introduced by Peter Scholze to prove new cases of the Eichler-Shimura isomorphisms.

These themes are related to modularity results, a central and extremely active area of research in modern number theory. For example, we recently have seen spectacular results like the proof of potential modularity of elliptic curve over totally real or CM fields. Another direction of research is precisely related to the study of Elliptic curves connected to modularity problems and arithmetic consequences. In this second direction the computational aspect will have a great importance.

We plan to reach the goals of the project through international collaborations between the participants of the project and other researchers in south America and France. Moreover, workshops for Students will be organized in Chile and Uruguay. Finally, this project will help in the organization of a summer school followed by a research conference, that will be organized in Chile.

Institutions and scientific coordinators:

Daniel Roberto Barrera Salazar, Universidad de Santiago de Chile, Chile

Gonzalo Tornara, Universidad de la Republica, Montevideo, Uruguay

Riccardo Brasca, Universite de Paris, France

ALGEO - Algebraic and geometric aspects of varieties and manifolds

Abstract

Geometry is one of the oldest branches of Mathematics, evolved from the axiomatic approach of Euclid to the study of complex and real spaces and its several applications.

This project is aimed to promote new mathematical networks, strengthen collaboration and create new research in geometry by means of international schools, missions and meetings in Argentina, Brazil, Chile and France.

This project has a special emphasis in supporting young researchers and students.

The scientific goal is the understanding of the geometry of manifolds and varieties, in its many guises.

We propose four scientific activities: two schools for students in Argentina and Brazil, a research workshop in France and a final conference in Chile.

Institutions and scientific coordinators:

Cecilia Salgado, Universidade Federal do Rio de Janeiro, Brasil

Angel Carocca, Universidad de La Frontera, Chile

Samuel Boissière, Université de Poitiers, France

CTMicrAAPDEs - Control Theory and Microlocal Analysis with Applications in Partial Differential Equations

Abstract

We aim to the analysis of diverse aspects in the study of dispersive equations under the scrutiny of microlocal analysis and other techniques, including some applications. As some partial differential equations appearing in models for several physical phenomena, we plan to study well-posedness, control and stabilization properties for Benney-Luke, Boussinesq KdV-KdV type systems which describes the propagation of bidirectional water waves, for Schrödinger on exterior domains which is a model of wave propagation in fiber optics and for biharmonic Schrödinger equation (or fourth order Schrödinger equation) on different domains which physically represents the propagation of intense laser beams.

Institutions and scientific coordinators:

Jose Raul Quintero, Universidad del Valle, Colombia

Roberto de Almeida Capistrano- Filho, Universidade Federal de Pernambuco, Brasil

Mauricio Sepúlveda, Universidad de Concepción, Chile

David Dos Santos Ferreira, Université de Lorraine, France

EOLIS - Efficient Off-Line numerical Strategies for multi-query problems

Abstract

This work proposes to design, implement and analyze novel preprocessing and postprocessing strategies for solving multi-query partial differential equation problems with finite element methods. By multi-query, we mean applications, such as inverse problems, optimal design or uncertainty quantification, that require a set of solution to the related PDE problems with different parameters. Instead of focusing on one particular PDE solve, we strive to reduce the computational cost for the whole set of PDE problems and focus on three main strategies: hp-adaptivity, multiscale modelling, and preconditioning. The design of nanostructures for light manipulation and the quantification of uncertainties associated with media fields on fluid flows will be the main benchmarks we consider.

Institutions and scientific coordinators:

Frédéric Valentin, LNCC - National Laboratory for Scientific Computing, Brasil

Manuel Solano, UDEC – Universidad de Concepcion, Chile

Abner Poza - USCS - Universidad Católica de la Santísima Concepción, Chile

Théophile Chaumont-Frelet, Inria - Institut national de recherche en sciences et technologies du numérique, France

FLN – CheGraTA - Franco - Latin Network on Chemical Graph Theory and its Applications.

Abstract

The present project proposes the establishment of a network of collaboration among Argentina, Bolivia, Brazil, Chile and France. The research topic of the proposal is Chemical Graph Theory, an important and modern area of discrete mathematics and chemical science. The proposal is structured in such a way that the training of highly qualified human resources and research activities are intertwined, this will ensure the generation of new knowledge in a relevant scientific area and will leave permanent ties of collaboration between the different research groups beyond the completion of the project.

Institutions and scientific coordinators:

Daniel Alejandro Jaume, Universidad Nacional de San Luis, Argentina

Jonnathan Rodríguez Zambrano, Universidad de Antofagasta, Chile

Leslie Karina Tejada Pérez, Universidad Mayor de San Andrés, Bolivia

Paul Rochet, Université de Nantes, France

GS&MS - Geometric Structures and Moduli Spaces

Abstract

This project proposes to advance in the research of several topics within the areas of differential and algebraic geometry and topology. The main objectives are (i) to understand special geometric structures on Riemannian manifolds, through their interplay with geometric flows and with complex algebraic geometry; and (ii) to focus on classical problems in algebraic geometry having moduli spaces as background.

This proposal has both theoretical and example-oriented objectives, with, on the one hand, qualitative results and, on the other, the construction of explicit geometric structures.

Institutions and scientific coordinators:

Henrique N. Sa Earp, Instituto de Matematica, Estatistica e Computacao Cientifica (IMECC), Universidade Estadual de Campinas (UNICAMP), Brazil

Adrian Andrada, Universidad Nacional de Cordoba, Argentina

Elizabeth Terezinha Gasparim, Universidad Catolica del Norte (UCN), Chile

Viviana del Barco, Laboratoire de Mathématiques d'Orsay, Université Paris-Saclay, France

Eric Loubeau, Laboratoire de Mathématiques de Bretagne Atlantique, Université de Brest (UBO), France

Latitude - Crossroad between dynamical systems and groups actions

Abstract

The goal of this project is to create a synergy between researchers from Chile, Uruguay and France on precise subjects like dynamics of flows in negatively curved manifolds, unipotent actions, billiards, counting problems, entropy, lyapounov exponents, growth of discrete isometry groups. Latitude's activities contemplate two workshops (one each year) and eight research stays (four each year).

Institutions and scientific coordinators:

Felipe Riquelme, Pontificia Universidad Católica de Valparaiso, Chile

Ángel Pardo, Universidad de Chile, Chile

Rafael Potrie, Universidad de la República, Uruguay

Françoise Dal'Bo, Université Rennes 1, France

Erwan Lanneau, Université Grenoble Alpes, France

François Ledrappier, Université Paris 6, France

Olivier Glorieux, Université Paris-Saclay Institut des Hautes Etudes Scientifiques, France

TOMENADE - Topological Methods and Non Autonomous Dynamics for Delay Differential Equations

Abstract

This project addresses open problems about non autonomous systems of Delay Differential Equations modeling some phenomena from life sciences, namely, a metapopulations version of the Nicholson equations and models of competition in a stirred chemostat. Nevertheless, the ideas and methods could be certainly extended in several ways, and we also expect to make progress in topics as the (non autonomous) topological linearization problem and the possibility of converse results for persistence.

Institutions and scientific coordinators:

Daniel Sepúlveda, Universidad Tecnológica Metropolitana, Chile

Pierluigi Benevieri, Universidade de São Paulo, Brasil

Frédéric Mazenc, Laboratoire des Signaux et Systèmes (L2S) – CNRS – CentraleSupélec, France

Mostafa Adimy, INRIA Rhone-Alpes, France

