UNIVERSIDADE FEDERAL FLUMINENSE
INSTITUTO DE MATEMÁTICA E ESTATÍSTICA

Workshop On Control Theory and Partial Differential Equations

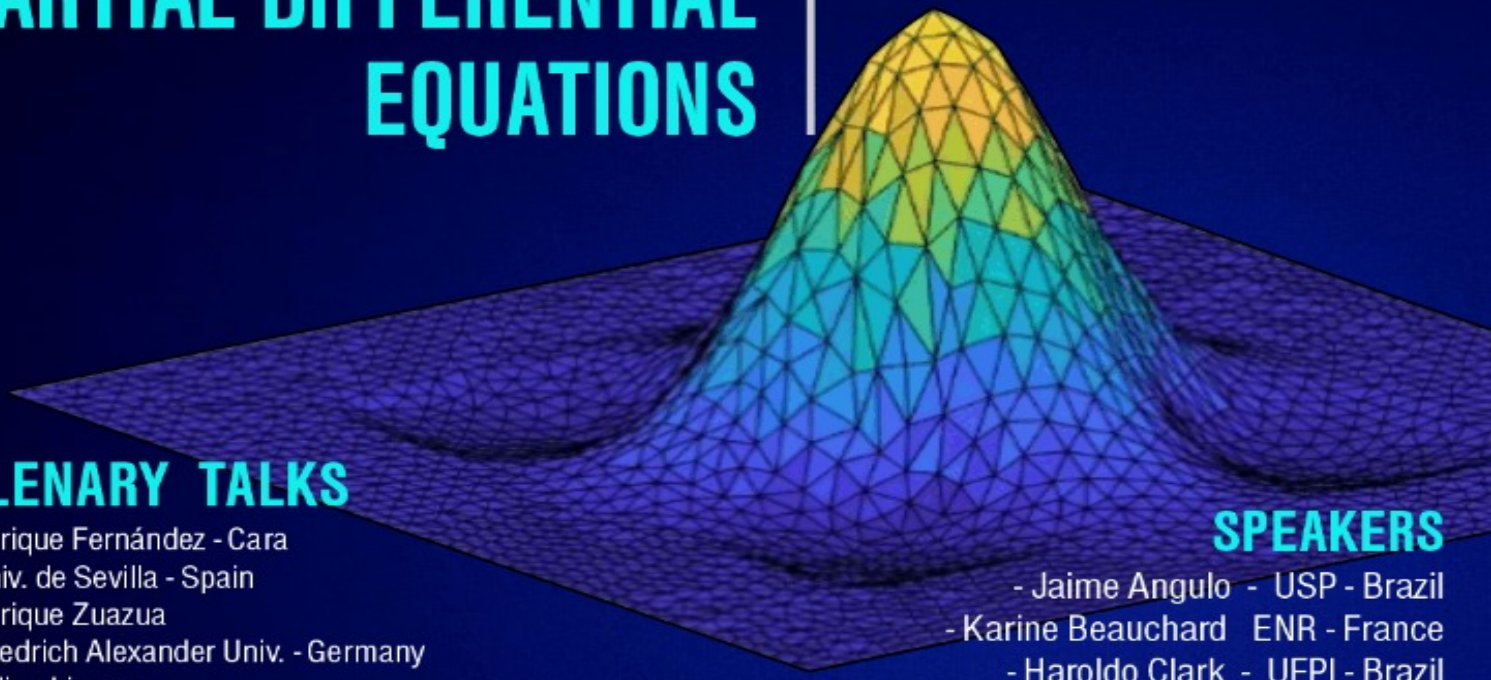
May 24th to 28th, 2021

Book of Abstracts

Niterói - RJ

WORKSHOP ON CONTROL THEORY AND PARTIAL DIFFERENTIAL EQUATIONS

MAY 24 to 28 2021



PLENARY TALKS

- Enrique Fernández - Cara
  Univ. de Sevilla - Spain
- Enrique Zuazua
  Friedrich Alexander Univ. - Germany
- Felipe Linares
  IMPA - Brazil
- Luz de Teresa
  UNAM / UFPB - Mexico
- Vilmos Komornik
  Strasbourg Univ. - France
- Gustavo Ponce
  Univ. of California, Santa Barbara - USA

SCIENTIFIC COMMITTEE

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- Enrique Zuazua - Spain.
- Fágner Araruna UFPB - Brazil
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- Carlos Guzmán - UFF

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- Jaime Angulo - USP - Brazil
- Karine Beauchard ENR - France
- Haroldo Clark - UFPI - Brazil
- Marcelo Cavalcanti - UEM - Brazil
- Valeria Calvancanti - UEM - Brazil
- Carlos Castro - Univ. Politecnica de Madrid Spain
- Liliane De Almeida Maia - UNB - Brazil
- Sylvain Ervedoza - Université de Bordeaux - France
- Luiz Farah - UFMG - Brazil
- Genni Fragnelli - Univ. di Bari Aldo Moro - Italy
- Francisco Guillen - Universidad de Sevilla - Spain
- Olimpo Hiroshi Miyagaki - UFSCAR - Brazil
- Irena Lasiecka - University of Memphis - USA
- André Nachbin - IMPA - Brazil
- Wladimir Neves - UFRJ - Brazil
- Edgar Pimentel - PUC - Brazil
- Gabriela Planas - UNICAMP - Brazil
- Mauro Rincon - UFRJ - Brazil
- Marko Rojas - Universidad de Tarapacá - Chile
- Lionel Rosier - Univ. du Litoral Côte d´Opale - France
- Boyan Sirakov - PUC - Brazil
- Eduardo Teixeira - University of Central Florida - USA

http://grupoedp.uff.br/wctpde

FAPERJ

General Information

The Fluminense Federal University, in partnership with UFF's graduate program in mathematics, will promote a workshop on EDP and Control Theory, entitled Workshop on Control Theory and Partial Differential Equations, which will take place from may 24^{th} to 28^{th}, 2021 and will be carried out virtually. This workshop will be a scientific meeting with the purpose of creating a discussion forum between students, teachers and researchers from educational and research institutions, having as areas of interest: Partial Differential Equations and Control Theory for system governed by EDPs. In addition to the presentation of recent works by researchers, the event also features the promotion of plenary lectures with internationally renowned researchers.

Coordinator

Juan Límaco (Univesidade Federal Fluminense - Brazil)

Scientific Committee

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Organizing Committee

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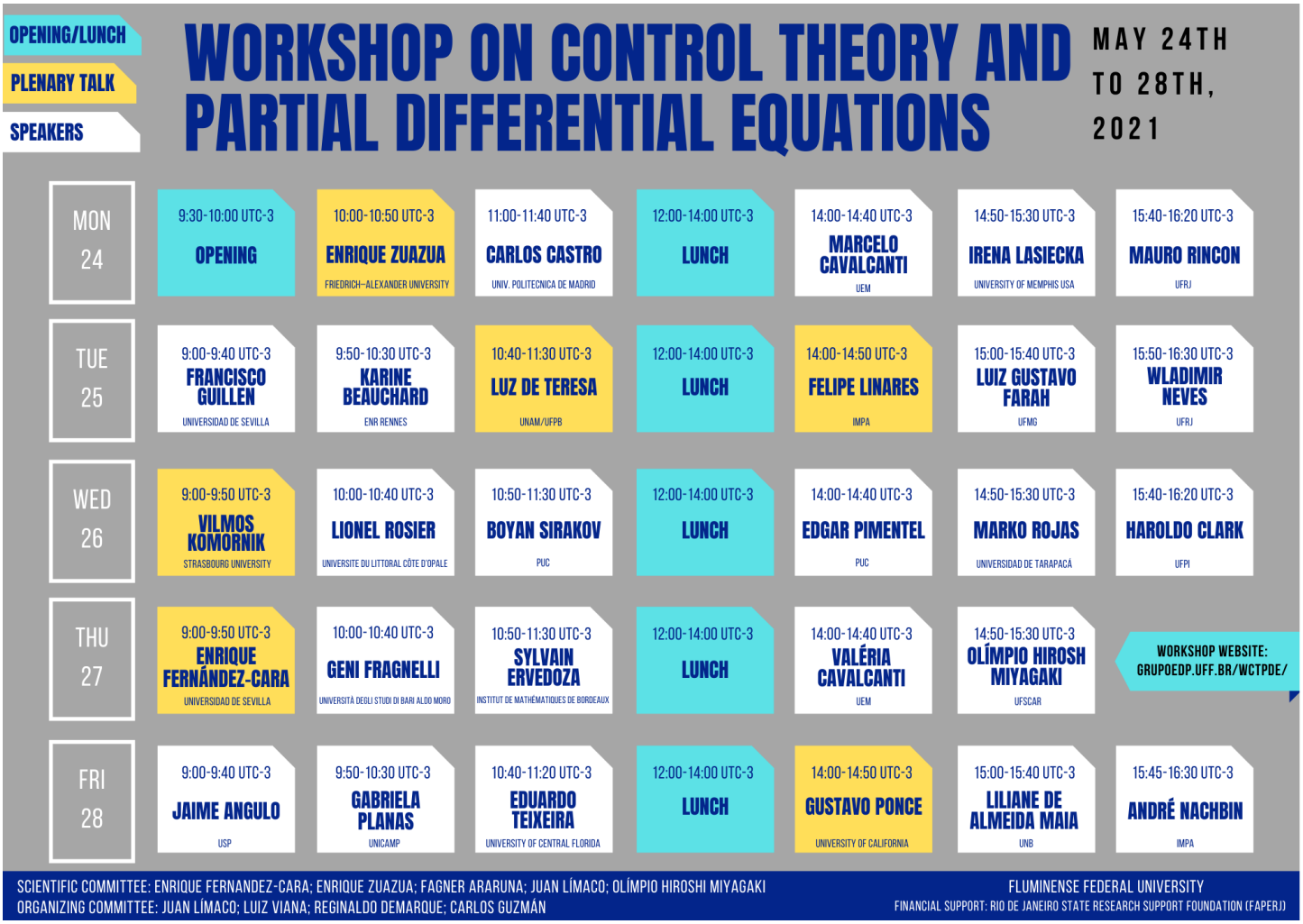
Finacial Support

Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ).

Schedule



Opening Ceremony

Prof. Max Souza - Coordinator of Graduate Program of IME-UFF.

Prof. Andrea Brito Latge - Dean of Research of UFF.

Prof. Juan Límaco - Coordinator of Event.

Contents

Plenary Talks

Recalling some local and global controllability results for nonlinear PDEs

May 27 - Thur. 9:00 - 9:50am UTC-3

Enrique Fernández-Cara
Universidad de Sevilla

The purpose of this talk is to review some techniques that have been used recently to prove local and global controllability results and then compute accurate numerical approximations of the controls. I will recall some theoretical and numerical achievements for quasi-linear parabolic equations and systems, Navier-Stokes equations and variants, etc. I will also mention some related open problems.

Neural Differential Equations, Control and Machine Learning

May 24 - Mon. 10:00 - 10:50am UTC-3

Enrique Zuazua
Friedrich–Alexander University

We analyze Neural Ordinary Differential Equations (NODEs) from a control theoretical perspective to address some of the main challenges in Machine Learning and, in particular, data classification and Universal Approximation. More precisely, we adopt the perspective of the simultaneous control of systems of NODEs. For instance, in the context of classification, each item to be classified corresponds to a different initial datum for the Cauchy problem of the NODE. And all the solutions corresponding the data under consideration need to be driven to the corresponding target by means of the same control. We present a genuinely nonlinear and constructive method, allowing to estimate the complexity of the control strategies we develop. The very nonlinear nature of the activation functions governing the nonlinear dynamics of NODEs under consideration plays a key role. It allows deforming half of the phase space while the other half remains invariant, a property that classical models in mechanics do not fulfill. This very property allows to build elementary controls inducing specific dynamics and transformations whose concatenation, along with properly chosen hyperplanes, allows achieving our goals in finitely many steps. We also present the counterparts in the context of the control of neural transport equations, establishing a link between optimal transport and deep neural networks.

The Cauchy problem for the L^2-critical generalized Zakharov-Kuznetsov equation in dimension 3

May 25 - Tue. 2:00 - 2:50pm UTC-3

Felipe Linares
Instituto de Matemática Pura e Aplicada (IMPA)

In this lecture I will present a recent result regarding local well-posedness for the L^2 critical generalized Zakharov-Kuznetsov equation in H^s, $s \in (3/4, 1)$. I will also discuss an "almost well-posedness" for initial data $u_0 \in H^s$, $s \in [1, 2)$, in the sense that the solution belongs to a certain intersection $C([0,T]\colon H^s(\mathbb{R}^3)) \cap X_T^s$ and is unique within that class, where we can ensure continuity of the data-to-solution map in an only slightly larger space. We will see that solutions satisfy the expected conservation of L^2-mass for the whole $s \in (3/4, 2)$ range, and energy for $s \in (1, 2)$. By a limiting argument, this implies, in particular, global existence for small initial data in H^1. If time allows I will also mention some results concerning almost everywhere (a.e.) convergence of solutions of the initial value problem to initial data.

Unique Continuation for some Nonlinear Dispersive Models

May 28 - Fri. 2:00 - 2:50pm UTC-3

Gustavo Ponce
University of California

We shall study unique continuation properties (UCP) of solutions to some time evolution eq's. We are interested in the following two questions:

(1) local: if u_1, u_2 are solution of the eq. which agree in an open set Ω, do they agree in the whole domain?

(2) asymptotic at infinity: if u_1, u_2 are solution of the eq. such taht at two different times t_1, t_2

$$|||u_1(\cdot, t_j) - u_2(\cdot, t_j)||| < \infty, j = 1, 2,$$

do they are equal in the whole domain? ($|||\cdot|||$ represents an approprieate "norm")

We shall concentrate on these questions for solutions of (i) the Korteweg-de-Vries eq., (ii) Benjamin-Ono eq. and (v) related models. These are integrable models and the last three are non-local.

Null controllability of coupled Stokes equations

May 25 - Tue. 10:40 - 11:30am UTC-3

Luz de Teresa
Universidad Autónoma de México (UNAM)
Universidade Federal da Paraíba (UFPB)

In this talk we present some new results on the null controllability of m-coupled Stokes equations. We will consider the situation in which we act only in the first N-dimensional Stokes system and we act only in $N-1$ components of this system. The work is in collaboration with Takéo Takahashi and Yingying Wu.

Simultaneous observability of infinitely many strings and beams

May 26 - Wed. 9:00 - 9:50am UTC-3

Vilmos Kormonik

University

We report on a joint work with A. C. Lai and P. Loreti. We investigate the simultaneous observability of infinite systems of vibrating strings or beams having a common endpoint where the observation is taking place. Our results are new even for finite systems because we allow the vibrations to take place in independent directions. Our main tool is a vectorial generalization of some classical theorems of Ingham, Beurling and Kahane in nonharmonic analysis.

Speakers

Wave-mediated Kuramoto-like synchronization of bouncing droplets

May 28 - Fri. 3:50 - 4:30pm UTC-3

André Nachbin

Instituto de Matemática Pura e Aplicada (IMPA)

Couder and Fort (PRL 2006) discovered that a fluid droplet bouncing on the surface of a vertically vibrating silicon oil bath, forms a wave-particle system referred to as a hydrodynamic pilot-wave system. Much research has been done since this discovery and many problems emerged with uncertainty related issues. The main focus of this talk is on the nonlinear dynamics of oscillators, which are coupled by the underlying Faraday wavefield. We will very briefly outline our PDE/fluid dynamic modeling [A], as well as the numerical scheme, where both use a Dirichlet-to-Neumann operator [B]. We capture regimes where two oscillating droplets, confined to separate cavities (potential wells), exhibit correlated features even when separated by a large distance. Two mass-spring-type ODEs, for the oscillators/droplets, are implicitly coupled by an underlying time-dependent potential governed by a PDE system [B]. The particles' phase space dynamics is described in a holistic fashion and may not be decomposed into separate subsystems. We detect "coherence" when the bouncing droplets spontaneously synchronize, as in the celebrated Kuramoto model for phase oscillators [C]. The droplet coupling is wave-mediated, dynamic, and more general than in the Kuramoto model where phase-coupling is explicit and pre-defined. We also discover a new regime [C] where "coherence" emerges in a statistical fashion. References: [A] Galeano, Milewski, Nachbin & Bush (JFM 2015), [B] Nachbin, Milewski & Bush (Phys. Rev. Fluids 2017), [C] Nachbin (Chaos 2018).of stochastic deformations, namely stochastic perturbation of the identity.

The Vazquez maximum principle and the Landis conjecture for elliptic PDE with unbounded coefficients

May 26 - Wed. 10:50 - 11:30am UTC-3

Boyan Sirakov

Pontífica Universidade Católica do Rio (PUC-Rio)

We develop a new, unified approach to the following two classical questions on elliptic PDE: (i) the strong maximum principle for equations with non-Lipschitz nonlinearities; and (ii) the at most exponential decay of solutions in the whole space or exterior domains. Our results apply to divergence and nondivergence operators with locally unbounded lower-order coefficients, in a number of situations where all previous results required bounded ingredients. Our approach, which allows for relatively simple and short proofs, is based on a (weak) Harnack inequality with optimal dependence of the constants in the lower-order terms of the equation and the size of the domain, which we establish.

Singular asymptotic expansion of the exact control for a perturbed wave equation

May 24 - Mon. 11:00 - 11:40am UTC-3

Carlos Castro

Universidad Politecnica de Madrid

In this work we deal with the asymptotic expansion of the null boundary control for the wave equation with a fourth order singular perturbation. The convergence and limit characterization of the controls are known. Here we focus on the characterization of the higher order terms in the asymptotic expansion. One of the main difficulties is the presence of a boundary layer, where the control acts. This produces a singular behavior of the control. The asymptotic expansion provides a simple and efficient approach to approximate numerically the controls. This is a joint work with A. Munch.

Nonconvex Hamilton-Jacobi equations with gradient constraints

May 26 - Wed. 2:00 - 2:40pm UTC-3

Edgard Pimentel

Pontifícia Universidade Católica do Rio de Janeiro (PUC - Rio)

We examine non-convex Hamilton–Jacobi equations in the presence of gradient constraints and produce new, optimal, regularity results for the solutions. An important aspect of this class of equations is the existence of a lower bound for the norm of the gradient; it competes with the elliptic operator governing the problem, and affects the regularity of the solutions. This class of models relates to a wide range of paramount questions, with applications in various fields; of particular interest is the modeling of optimal dividends problems for multiple insurance companies in risk theory and singular stochastic control in reversible investment models. We close the talk with a number of open problems, respecting the regularity of the solutions and the associated free boundary. This is joint work with Héctor Chang-Lara (CIMAT-GTO, Mexico).

On the critical point regularity for quasilinear problems

May 28 - Fri. 10:40 - 11:20am UTC-3

Eduardo Teixeira
University of Central Florida

I will discuss regularity estimates at interior critical points of solutions to p-degenerate elliptic equations in heterogeneous medium. The problem is connected to the $C^{p'}$ regularity conjecture. Indeed the fact that the sharp estimate from such a conjecture is attained by a naive looking, radially symmetric example whose p-laplacian is actually constant, begs the question: is there any further regularity left for non-homogeneous problems driven by the p-laplacian? In this talk I shall discuss this question through a new prism.

Optimal Control for some Chemotaxis PDE models

May 25 - Tue. 9:00 - 9:40pm UTC-3

Francisco Guillén-González
Universidad de Sevilla

When a bilinear control is considered for chemotaxis PDE problems, a non-regular term is added. In particular, classical solutions (using Amann's argument) cannot be obtained for the controlled problem. In this framework, we have considered a regularization and compactness argument, deriving existence of weak solutions of the controlled problem. In 1D or 2D domains, any weak solution with regular data is the unique strong solution of the problem, but a regularity criterium must be deduced implying strong regularity (and continuous dependence) for 3D domains. We will show three main results: existence of global optimal solution (via minimizing sequence and convexity), existence of (very weak) Lagrange Multipliers and regularity of the Lagrange Multiplier problem applying a very-weak vs strong uniqueness result. These results have been obtained with some collaborators: M.A. Rodríguez-Bellido (Universidad de Sevilla, Spain), E. Mallea Zepeda (Universidad Tarapacá, Chile) y E.J Villamizar Roa (Universidad Industrial de Santander, Colombia).

Analysis of some models of incompressible fluids for sprays

May 28 9:50 - 10:30am UTC-3

Gabriela Planas
Universidade Estadual de Campinas (UNICAMP)

We consider the α-Navier-Stokes equations coupled with a Vlasov type equation to model the flow of an incompressible fluid containing small particles. We prove the existence of global weak solutions to the coupled system subject to periodic boundary conditions. Moreover, we investigate the regularity of weak solutions and the uniqueness of regular solutions. The convergence of its solutions to that of the Navier-Stokes-Vlasov equations when α tends to zero is also established. Results are extended to the model with the diffusion of spray, i.e., to the α-Navier-Stokes-Vlasov-Fokker-Planck equations.

Controllability for degenerate and singular parabolic equations with a nonlocal space term

May 27 - Thur. 10:00 - 10:40pm UTC-3

Genni Fragnelli
Università degli Studi di Bari Aldo Moro

In this talk we will present new controllability results for degenerate and singular integro-differential equations. Such problems have recently attracted the attention of many mathematicians, since they describe a variety of physical phenomena. Due to the presence of the nonlocal terms, the usual technique to prove null controllability do not seem to work directly. To overcome this difficulty and establish the desired controllability results for the studied nonlocal problems, we use the following arguments: first, we establish null controllability properties for appropriating nonhomogeneous systems without nonlocal term, via new Carleman estimates with time weight functions that do no blow up at t = 0. Then, as consequence of the previous step, we obtain the controllability for the nonlocal problems by means of a fixed point argument.

Remark on second-grade fluids.

May 26 - Wed. 3:40 - 4:20pm UTC-3

Haroldo Clark
Universidade Federal do Piauí (UFPI)

This paper deals with a problem of incompressible non-Newtonian fluid of grade two in three dimensional space and is shown that such problem is well-posedness in the Hadamard sense. As a by-product of our analysis, an decay rate for energy is also established.

Long time behavior in flow-structure interactions

May 24 - Mon. 2:50 - 3:30pm UTC-3

Irena Lasiecka
University of Memphis

Flow-structure interactions are ubiquitous in nature. Problems such as attenuation of turbulence or flutter in an oscillating structure [Tacoma bridge], flutter in tall buildings, fluid flows in flexible pipes, in nuclear engineering flows about fuel elements and heat exchanger vanes -are prime examples of relevant applications. Mathematically, the models are represented by a 3D compressible, irrotational Euler Equation coupled to a nonlinear dynamic elasticity on a 2 D manifold. Strong boundary-type coupling at the interface between the two media is at the center of the analysis. This provides for a rich mathematical structure, opening the door to several unresolved problems in the area of nonlinear PDE's, dynamical systems and related harmonic analysis and differential geometry. This talk aims at providing a brief overview of recent developments in the area along with a presentation of some recent advances addressing the issues of control and long time behavior [partial structural attractors] subject to mixed boundary conditions arising in modeling

of the interface between the two environments. Part of this talk is based on recent work with D. Bonheur, F.Gazzola and J. Webster: Annales de L'Institute Henri Poincare Analyse, 2021 and also work completed while the author was a member of the MSRI program "Mathematical problem in fluid dynamics" at the University of California Berkeley during the Spring 2021 semester (NSF DMS -1928930).

Unstable kink profiles for the sine-Gordon equation on Josephson junctions

May 28 - Fri. 9:00 - 9:40am UTC-3

Jaime Angulo Pava

Department of Mathematics - IME
Universidade de São Paulo (USP)

In this talk we shed new light on the mathematical studies of nonlinear dispersive evolution equations on metric graphs. This trend has been mainly motivated by the demand of reliable mathematical models for different phenomena in branched systems which, in meso- or nano-scales, resemble a thin neighborhood of a graph, such as Josephson junction networks, electric circuits, blood pressure waves in large arteries, or nerve impulses in complex arrays of neurons, just to mention a few examples. Our dynamic problems here will be essentially related to the sine-Gordon model on a Y- junction graph type. We establish a general linear instability criterium for solitons profiles. In particular, we see that some kink or kink/anti-kink soliton profiles for the sine-Gordon model are linearly (and nonlinearly) unstable.

The arguments presented in this talk have prospects for the study of the instability of soliton-profiles solutions of other nonlinear evolution equations on branched systems.

On expansions for nonlinear systems, error estimates and convergence issues

May 25 - Tue. 9:50 - 10:30am UTC-3

Karine Beauchard

ENR Rennes

Explicit formulas expressing the solution to non-autonomous differential equations are of great importance in many application domains such as control theory or numerical operator splitting. In particular, intrinsic formulas allowing to decouple time-dependent features from geometry-dependent features of the solution have been extensively studied. First, we give a didactic review of classical expansions for formal linear differential equations, including the celebrated Magnus expansion (associated with coordinates of the first kind) and Sussmann's infinite product expansion (associated with coordinates of the second kind). Inspired by quantum mechanics, we introduce a new mixed expansion, designed to isolate the role of a time-invariant drift from the role of a time-varying perturbation. Second, in the context of nonlinear ordinary differential equations driven by regular vector fields, we

give rigorous proofs of error estimates between the exact solution and finite approximations of the formal expansions. In particular, we derive new estimates focusing on the role of time-varying perturbations. For scalar-input systems, we derive new estimates involving only a weak Sobolev norm of the input. Third, we investigate the local convergence of these expansions. We recall known positive results for nilpotent dynamics and for linear dynamics. Nevertheless, we also exhibit arbitrarily small analytic vector fields for which the convergence of the Magnus expansion fails, even in very weak senses. We state an open problem concerning the convergence of Sussmann's infinite product expansion. Eventually, we derive approximate direct intrinsic representations for the state and discuss their link with the choice of an appropriate change of coordinates.

A dynamical system approach for problems involving Pucci extremal operators

May 28 - Fri. 3:00 - 3:40pm UTC-3

Liliane A. Maia
University of Brasília (UNB)

We will present some recent results obtained on the existence, nonexistence and classification of radial positive solutions of some weighted fully nonlinear equations involving Pucci extremal operators. Our study is entirely based on the analysis of the dynamics induced by an autonomous quadratic system which is obtained after a suitable transformation. This method allows to treat both regular and singular solutions in a unified way, without using energy arguments. This is a work in collaboration with Gabrielle Nornberg (ICMC/USP, Brazil) and Filomena Pacella (Sapienza Università di Roma, Italy).

Exact controllability results of anisotropic 1D equations in spaces of analytic functions

May 26 - Wed. 10:00 - 10:40am UTC-3

Lionel Rosier
Universite Du Littoral Côte D'opale (ULCO)

Carleman estimates are a very efficient tool to establish the null controllability of parabolic equations, but they are not helpful to decide whether a given state is indeed reachable for such equations. Recently, the determination of the reachable space for the boundary control of the heat equation has attracted the attention of many researchers. In this talk, we shall review some recent results in the linear case (heat equation, KdV equation) and in the semilinear case (semilinear heat equation, anisotropic 1D PDE).

Global well-posedness and scattering for the inhomogeneous nonlinear Schrodinger equation

May 25 - Tue. 3:00 - 3:40pm UTC-3

Luiz Gustavo Farah
Universidade Federal de Minas Gerais (UFMG)

We consider the inhomogeneous nonlinear Schrödinger (INLS) equation

$$iu_t + \Delta u + |x|^{-b}|u|^{\alpha}u = 0, \;\; x \in \mathbb{R}^N, \tag{1}$$

in the intercritical regime $\frac{4-2b}{N} < \alpha < \frac{4-2b}{N-2}$, with $0 < b < \min\{N/2, 2\}$.

In this talk we discuss global well-posedness and scattering results for the INLS equation in the radial and non-radial settings. These results were obtained in collaboration with Mykael Cardoso (UFPI), Carlos Guzmán (UFF) and Jason Murphy (Missouri S&T).

Uniform decay rate estimates for the wave equation with subcritical semilinearities and locally distributed nonlinear dissipation

May 24 - Mon. 2:00 - 2:40pm UTC-3

Marcelo M. Cavalcanti
Universidade Estadual de Maringá (UEM)

We study the stabilization and the wellposedness of solutions of the wave equation with subcritical semilinearities and locally distributed nonlinear dissipation. The novelty of this talk is that we deal with the difficulty that the main equation does not have good nonlinear structure amenable to a direct proof of a priori bounds and a desirable observability inequality. It is well known that observability inequalities play a critical role in characterizing the long time behaviour of solutions of evolution equations, which is the main goal of this study. In order to address this, we truncate the nonlinearities, and thereby construct approximate solutions for which it is possible to obtain a priori bounds and prove the essential observability inequality. The treatment of these approximate solutions is still a challenging task and requires the use of Strichartz estimates and some microlocal analysis tools such as microlocal defect measures. Once we establish essential observability properties for the approximate solutions, it is not difficult to prove that the solution of the original problem also possesses a similar feature via a delicate passage to limit. In the last part of the talk, we establish various decay rate estimates for different growth conditions on the nonlinear dissipative effect. We in particular generalize the known results on the subject to a considerably larger class of dissipative effects.

Some ways to address non-regular problems

May 26 - Wed. 2:50 - 3:30pm UTC-3

Marko A. Rojas-Medar
Universidad de Tarapacá

There are some essential results to study optimization problems, in particular those where the dynamics of the system is given by differential equations. Most of the existing results in the literature are obtained under regularity conditions, which are required for the correct application of fundamental theorems of mathematical analysis (implicit function theorem, inverse function theorem, Lyusternik's theorem), for example, to obtain Pontryagin's maximum principle (both in EDO and EDP), requires that a certain associated linear problem admit existence and uniqueness of solutions (at least local), that is, that the system is completely controllable, what to do in this case if these hypotheses fail? In this talk we will give some possible ways to overcome these inconveniences. We will give some concrete examples where the previous theorems fail, for which a theory has been developed that allows them to be answered adequately.

Theoretical And Numerical Analysis For A Wave Equation With Dynamical Boundary Control

May 24 - Mon. 3:40 - 4:20pm UTC-3

Mauro Antônio Rincon
Universidade Federal do Rio de Janeiro (UFRJ)

We study the 2D linear wave equation with dynamical control on the boundary. New mathematical difficulties appear due to the boundary conditions. By adding some artificial viscosity term, we introduce a penalized problem, and we show the well posedness by using the Faedo-Galerkin method. We propose a numerical scheme and we prove that the associated discrete energy decays to zero. At the end, an a priori error estimate is obtained and some numerical results are presented.

Fractional elliptic systems with critical nonlinearities

May 27 - Thur. 2:50 - 3:30pm UTC-3

Olimpio H. Miyagaki
Universidade Federal de São Carlos (UFSCAR)

This paper deals with existence, uniqueness/multiplicity of positive solutions to the following nonlocal system of equations:

$$\begin{cases} (-\Delta)^s u = \dfrac{\alpha}{2_s^*}|u|^{\alpha-2}u|v|^{\beta} + f(x) \ \text{ in } \mathbb{R}^N, \\ (-\Delta)^s v = \dfrac{\beta}{2_s^*}|v|^{\beta-2}v|u|^{\alpha} + g(x) \ \text{ in } \mathbb{R}^N, \\ u,\, v > 0 \ \text{ in } \ \mathbb{R}^N, \end{cases} \tag{$\mathcal{S}$}$$

where $N > 2s$, $\alpha,\ \beta > 1$, $\alpha+\beta = 2N/(N-2s)$, $f,\ g$ are nonnegative functionals in the dual space of $\dot{H}^s(\mathbb{R}^N)$, i.e., ${}_{(\dot{H}^s)'}\langle f, u\rangle_{\dot{H}^s} \geq 0$, whenever u is a nonnegative function

in $\dot{H}^s(\mathbb{R}^N)$. When $f = 0 = g$, we show that the ground state solution of $(\mathcal{S})$ is *unique*. On the other hand, when f and g are nontrivial nonnegative functionals with $\ker(f)=\ker(g)$ then we establish the existence of at least two different positive solutions of $(\mathcal{S})$ provided $\|f\|_{(\dot{H}^s)'}$ and $\|g\|_{(\dot{H}^s)'}$ are small enough. Moreover, we also provide a global compactness result, which gives a complete description of the Palais-Smale sequences of the above system.

Insensitizing controls for the heat equation with respect to boundary variations

May 27 - Thur. 10:50 - 11:30am UTC-3

Sylvain Ervedoza

Institut de Mathématiques de Bordeaux

The goal of this talk is to present the question of insensitization for a quadratic functional involving the solution of the linear heat equation with respect to variations. These variations can be in the initial datum as it is usually done, or with respect to boundary variations as it has been investigated recently in a work by Lissy, Privat and Simporé (ESAIM 2019). In this latter case, this question amounts to find controls such that a functional is not sensitive with respect to small variations of the boundary. We will further analyze this question, and distinguish between the following questions: epsilon-approximate insensitization, exact insensitization, epsilon-approximate insensitization and exact insensitization on a finite-dimensional space. We will present several results on these questions based on the approximate controllability of a suitable coupled system of parabolic equations, and a new strategy to achieve exact insensitization on finite dimensional spaces of boundary variations. This is a joint work with Pierre Lissy and Yannick Privat.

Asymptotic behaviour of the energy to the viscoelastic wave equation with localized memory

May 27 - Thur. 2:00 - 2:40pm UTC-3

Valéria N. Domingos Cavalcanti

Universidade Estadual de Maringá (UEM)

We are concerned with the well-posedness of solutions as well as the asymptotic behaviour of the energy related to the viscoelastic wave equation with localized memory with past history and supercritical source and damping terms, posed on a bounded domain in the three-dimensional euclidean space. This is a joint work with M. Cavalcanti, T. D. Marchiori and C. M. Webler.

Homogenization of Schrödinger equations

May 25 - Tue. 3:50 - 4:30am UTC-3

Wladimir Neves

Universidade Federal do Rio de Janeiro (UFRJ)

In this talk we are concerned with the homogenization of Schrödinger equations for non-crystalline matter, that is to say the coefficients are given by the composition of stationary functions with stochastic deformations. Two rigorous results of so-called effective mass theorems in solid state physics are obtained: a general abstract result (beyond the classical stationary ergodic setting), and one for quasi-perfect materials (i.e. the disorder in the non-crystalline matter is limited). The former relies on the double-scale limits and the wave function is spanned on the Bloch basis. Therefore, we have extended the Bloch Theory which was restricted until now to crystals (periodic setting). The second result relies on the Perturbation Theory and a special case of stochastic deformations, namely stochastic perturbation of the identity.

Author Index