7th IST-IME

A conference
in "Analysis and Applications"

ICM2018 Satellite Conference

in honour of Prof. Paulo Cordaro,
on the occasion of his 65th birthday

July 23rd
to 27th

University of São Paulo, BRASIL

2018

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Organizing Committee: Clodoaldo Grotta Ragazzo, Pedro A. S. Salomão, Paolo Piccione, Sergio M. Oliva, Gaetano Siciliano, Marcone Pereira, Orlando Lopes.

IME-USP ICM 2018 BIÊNIO DA MATEMÁTICA BRASIL CAMGSD INCTMat CAPES CNPq Conselho Nacional de Desenvolvimento Científico e Tecnológico FAPESP

7th IST-IME

A conference in Analysis and Applications

in honor to Prof. Paulo Cordaro on occasion of his 65th birthday

Instituto de Matemática e Estatística
Universidade de São Paulo

July 23-27, 2018

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Welcome to 7th IST-IME

Welcome to São Paulo.

It is a great pleasure to welcome you all to the 7th IST-IME `A conference in Analysis and Applications`. We hope you enjoy it and have a pleasant stay.

About the 7th IST-IME Conference

The IST-IME meetings are organized biennially by the Instituto Superior Técnico (IST-Lisbon) and the Instituto de Matemática e Estatística (IME) of the Universidade de São Paulo (USP). The broad purpose of the meetings is to promote the interaction of researchers from both institutes among themselves and with researchers from other institutions. Analysis and Applications will be the main topic of this edition which is also a Satellite Conference of ICM2018. Finally, it is worth mentioning that we will have the opportunity to honor *Prof. Paulo Cordaro* on occasion of his 65th birthday.

Venue

The Lectures will take place at Antonio Gilioli Auditorium - Building A 247/262 - Instituto de Matemática e Estatística da Universidade de São Paulo - Rua do Matão 1010, São Paulo, SP.

Organizing Committee

Clodoaldo Grotta-Ragazzo / Orlando Lopes / Sérgio M. Oliva / Marcone Pereira / Paolo Piccione / Pedro A. S. Salomão / Gaetano Siciliano

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Social Events

- Tuesday 24th Photo of the meeting at lounge of Building A at 11:30.

- Thursday 26th Conference dinner at Bovinu'S Restaurant at 1604, Rebouças Avenue, São Paulo.

Financial Support

We gratefully acknowledge financial support from FAPESP, CAPES and IME-USP.

Wireless Internet Connection

The University provides access to wireless internet connection via **eduroam**. If you do not possess an eduroam account you can access the following wireless connection:

Login: 7th IST-IME

Password: 7THISTIME2018

Transportation

- The suggested hotel for the conference is WZ Jardins Hotel, located at Av. Rebouças 955, very close to Paulista's avenue and the subway station Oscar Freire. It is one of the main spots of the city of São Paulo. The organizing committee will provide a shuttle service from WZ Jardins Hotel to IME. Please see the schedule of the event.

- Public transportation is available from Guarulhos International Airport to São Paulo city. Please take a look at the link `http://www.aeroportoguarulhos.net/en/guarulhos-airport-directions`. An option to get Paulista neighborhood by bus is the line São Paulo (Hotels circuit) of the Airport Bus Service – EMTU. In this case, a taxi to WZ Jardins Hotel may be necessary. The use of transport apps as Uber, Cabify and 99 is allowed and is a nice transport option in São Paulo.

- Any way, in order to go to the Conference from WZ Jardins Hotel, it is possible to take the following bus lines (public transportation):

  702U-10 Cid. Universitária (It returns as Term. Pq. D. Pedro II).

  7411/10 Cid. Universitária (It returns as Praça da Sé)

  The buses go inside the University and there is a bus stop very close to the Institute. The bus stop is called FAU II in Google Maps.

  There is also a bus stop very close to the hotel. You only need to turn left in the avenue. When you are leaving the hotel, the university is also in the left direction.

  We recommend leaving the hotel with one hour in advance to arrive at the University.

Schedule Overview

	Monday	Tuesday	Wednesday	Thursday	Friday
8:30	**Vans leave the hotel to campus**				
9:00-9:30	Registration				
9:30-10:30	Opening Lecture	Alex Himonas	Carlos Rocha	Bernold Fiedler	Miguel Abreu
10:30-11:30	J. Hounie	Friedrich Haslinger	Rui Loja Fernandes	Alexandre Carvalho	Jorge D. Silva
11:30-13:30	**Lunch**				
13:30-14:30	Gabriel Araújo	Bernhard Lamel	Julio Rossi	Diogo Gomes	G. Della Sala
14:30-15:30	Laurent Stolovitch	Juliana Fernandes	Ricardo P. Silva	*Short Talks*	*Short Talks*
15:30-16:00	**Coffee break**				
16:00-17:00	Alexandre Kawano	Márcia Federson	Hildebrando Rodrigues	Edgard Pimentel	Phillipo Lappicy
17:30	**Vans leave the campus to hotel**				

Social Events

	Monday	Tuesday	Wednesday	Thursday	Friday
11:30		Photo[1]			
20:00				Dinner[2]	

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[1] Photo of the meeting at lounge of Building A.
[2] Bovinu's Restaurant, 1604 Rebouças Avenue, São Paulo.

Short Talks

	Thursday	Friday
14:30-14:40	Abrãao Mendes	Antonio V. da Silva Junior Nicholas Braun Rodrigues
14:40-14:50	Javid Ali	Carlos Esteve
14:50-15:00	Priscilla da Silva Barbosa	Lucas Ruiz dos Santos
15:00-15:10	Jean Carlos Nakasato	Esenturk Emre
15:10-15:20	Gregorio Chinni	
15:20-15:30		

A message from Prof. François Treves

Dear friends and colleagues,

as many of you know, I have been the Ph. D. superviser of Paulo Cordaro, as well as of Antonio Gillioli and Jorge Hounie. I regard myself as very lucky to have had them as students and, later, as friends and collaborators. On a personal note, my work in the last ten years could not have been possible without the constant help, support and patience of Paulo. But beyond my personal feelings, I think it has been a very good thing that mathematical analysis of the highest quality has blossomed in the universities of São Paulo and San Carlos. To this I must add my admiration for the level of professional and ethical standards Paulo and Jorge were able to maintain. During many decades of contact I have witnessed the most exemplary behavior on their part and that of their entourage. I have seen Paulo react very strongly to the temptation that 'we do like everybody does' and that anybody 'in our team' ought to be accorded privileges, solely for being on our team. Many mathematical institutions and institutes, in all parts of the world, famous and less famous, are plagued by pervasive cronyism. This tendency must be resisted.

Mathematics in its totality is an awesome temple under construction. Every one of us in it, believe me - every one, feels very small. Outside the temple, people reluctantly share the awe, often resent it and some denigrate the relevance of mathematics - at the same time as it is impacting, in various guises and more than ever, many important aspects of life. We are not sure what kind of god inhabits the temple: a gigantic algorithm, or something more? That question is crucial, not only to the philosophy of science, but truly to the debate about what it is to be human. We do not know the answer. But for the time being we must do our daily job, try to add some bricks, however minor, to the building. In this, the life and the dedication of Paulo Cordaro to math is a model for all of us.

I wish you a happy and productive 7th IST-IME Meeting.

François Treves

Abstracts - Talks

Applications of symplectic/contact invariants to conservative dynamics

Miguel Tribolet de Abreu

Inst. Superior Técnico

I will report on joint work with Leonardo Macarini on applications of symplectic/contact invariants to multiplicity questions for periodic orbits in conservative dynamics.

Real-analytic solvability for differential complexes associated to locally integrable structures

Gabriel Araujo

Inst. Mat. e Estatística - USP

Inspired by the work of Suzuki (1972) on the concept of real-analytic solvability for first-order analytic linear partial differential operators we extend his results for the differential complexes associated to analytic locally integrable structures of corank one. We prove that such notion of solvability is related to the smooth solvability condition introduced by Treves (1983). In our arguments the natural extension to closed forms of the well-known Baouendi-Treves approximation formula, the so-called "Approximate Poincaré Lemma" plays a key role. Joint work with Paulo D. Cordaro.

Gradient Non-autonomous Chafee Infante Problems

Alexandre N. Carvalho

Inst. Ciências Mat. e de Computação - USP

In this work we prove that some non-autonomous scalar one dimensional semi-linear parabolic problems have an associated skew-product semiflow with gradient structure.

New paths of path integrals

Márcia Federson

Inst. Ciências Mat. e de Computação - USP

We retake some intricacies behind the Feynman path integral and the physics involved. Then we resume the main ideas of the non-absolute path integral defined by Ralph Henstock, which fixes the main deficiency of the Feynman integral, and consider applications to electrodynamics.

Integrability and Associativity

Rui Loja Fernandes

U. Illinois

A classical theorem by Mal'cev shows that the only obstruction to embed a local Lie group to a global Lie group is the failure of (higher) associativity. A theorem of Olver characterizes local Lie groups in terms of Lie groups. We show that both results can be generalized to the setting of local Lie groupoids. More important, we show that (the lack of) associativity is intimately connected to (the lack of) integrability.

Good to be late, precisely

Bernold Fiedler

Free University of Berlin

Delays are a nuisance in control. But, are delays all that bad? Following an idea of Pyragas, we attempt noninvasive and model- independent stabilization of unstable p-periodic phenomena $u(t)$ by a friendly delay τ. Our feedbacks are based on delayed differences like $u(t - \theta?\tau) - u(t - \theta)$. When the time delay τ is chosen to be an integer multiple np of the minimal period p, the difference and the feedback vanish: the control strategy becomes noninvasive on the target periodic orbit. We pursue this idea for an example: control of a delay equation by additional delays. Results include joint work with Alejandro Lopez, Sergio Oliva, Isabelle Schneider, and others. See also http://dynamics.mi.fu-berlin.de/

A mean-field game price formation model

Diogo Gomes

Inst. Superior Técnico

Here, we introduce a price-formation model for electricity markets where a large number of small players can store and trade electricity. Our model is a constrained mean-field game (MFG) where the price is a Lagrange multiplier for the supply vs. demand balance condition. Under mild conditions, we prove the uniqueness of the solution. Moreover, we establish several estimates for the solutions. Next, we examine model with finitely many agents and linear-quadratic models that have explicit solutions. Finally, we develop numerical methods and illustrate the behavior of the system numerically.

The $\overline{\partial}$-Neumann problem and Schrödinger operators

Friedrich Haslinger

Universität Wien

We apply methods from complex analysis, in particular the d-bar-Neumann operator, to investigate spectral properties of Schrödinger operators with magnetic field (Pauli operators). For this purpose we consider the weighted d-bar-complex on $\mathbb{C}^n$ with a plurisubharmonic weight function.

We derive a necessary condition for compactness of the corresponding d-bar-Neumann operator (the inverse of the complex Laplacian) and a sufficient condition, both are not sharp. So far, a characterization can only be given in the complex 1-dimensional case.

The Pauli operators appear at the beginning and at the end of the weighted d-bar-complex. It is also of importance to know whether a related Bergman space of entire functions is of infinite dimension.

In addition we consider the d-complex, where the underlying Hilbert space is the Fock space - the space of entire functions with the Gaussian weight.

Persistence of spatial analyticity for evolution equations

Alex Himonas

Notre Dame University

In this talk we will discuss the persistence of spatial analyticity for solutions of the Cauchy problem of two important integrable evolutions equations, namely, the Korteweg-de Vries and the Camassa-Holm equations. For a class of analytic initial data with a given uniform radius of analyticity, we shall present asymptotic lower bounds on the uniform radius of analyticity at time t, as t goes to infinity. The talk is based on recent work with Professors Petronilho, Barostichi and Kalisch, Selberg.

Semi-global solvability with loss of one derivative of partial differential operators on surfaces

Jorge Hounie

Univ. Federal de São Carlos

The local solvability theory of linear PDE's developed by Nirenberg and Treves and Beals and Fefferman, shows that if $P(x, D)$ is an operator of principal type of order m satisfying condition (P), the equation $P(x, D)u = f$ can be locally solved in the Sobolev space H^{s+m-1} when $f \in H^s$, $s \in R$. This is known as local solvability with loss of one derivative. Hormander's work on semi-global solvability addressed the problem of finding a solution on a neighborhood of a given compact set K (the case in which K is a point corresponds to local solvability) and his famous results states the existence of solutions with a loss slightly higher than one. In joint work with Paulo Cordaro, we show that in the case of two variables his result can be improved by showing that solutions can in fact be taken with a sharp loss of one derivative.

Uniqueness and non uniqueness for a class of almost periodic distributions and applications

Alexandre Kawano

Escola Politécnica - USP

We consisder distributions $u \in \mathcal{S}'(\mathbb{R})$ of the form $u(t) = \sum_{n \in \mathbb{N}} a_n e^{i\lambda_n t}$, where $(a_n)_{n \in \mathbb{N}} \subset \mathbb{C}$ and $\Lambda = (\lambda_n)_{n \in \mathbb{N}} \subset \mathbb{R}$ have the following properties: $(a_n)_{n \in \mathbb{N}} \in s'$, that is, there is $q \in \mathbb{N}$ such that $(n^{-q} a_n)_{n \in \mathbb{N}} \in \ell^1$; for the real sequence Λ, there is a $n_0 \in \mathbb{N}$, $C > 0$ and an $\alpha > 0$ such that $n \geq n_0 \Rightarrow |\lambda_n| \geq Cn^\alpha$. Let $I_\epsilon \subset \mathbb{R}$ be an interval of length ϵ. We prove that given Λ: (1) if $\Lambda = \mathrm{O}(n^\alpha)$ with $\alpha < 1$, then $\nexists \epsilon > 0$ such that $u|_{I_\epsilon} = 0 \Rightarrow u \equiv 0$; (2) if $\Lambda = \mathrm{O}(n)$ is uniformly discrete, then $\exists \epsilon > 0$ sucht that $u|_{I_\epsilon} = 0 \Rightarrow u \equiv 0$; (3) if $\alpha > 1$ and Λ is uniformly discrete, then for any $\epsilon > 0$, $u|_{I_\epsilon} = 0 \Rightarrow u \equiv 0$.

Since the distributions of the aforementioned form are common in Engineering, as in the case of wave modeling, signal processing, vibration of beams, plates and shells, the results of uniqueness and non-uniqueness have important consequences on identification problems in industry.

On regularity of CR mappings

Bernhard Lamel

University of Vienna

We will discuss a number of recent results in the regularity theory of CR mappings.

A Lyapunov function for fully nonlinear parabolic equations in one spatial variable

Phillipo Lappicy

Inst. de Ciências Mat. e de Computação - USP

Fri 16:00

Lyapunov functions are used to prove stability of equilibria, or to indicate a gradient-like structure of a dynamical system. Zelenyak (1968) and Matano (1988) constructed a Lyapunov function for quasilinear parabolic equations. We modify Matano's method to construct a Lyapunov function for fully nonlinear parabolic equations under Dirichlet and mixed nonlinear boundary conditions of Robin type. This is joint work with Bernold Fiedler.

Limiting grow-up behavior for a one-parameter family of dissipative PDEs

Juliana Fernandes S. Pimentel

Univ. Federal do ABC/Univ. Federal do Rio de Janeiro

Tue 14:30

We provide a relation between the well known class of dissipative equations and the recently introduced class of slowly non-dissipative equations, in the setting of scalar reaction-diffusion equations. The latter type of equations is characterized by the existence of grow-up (i.e., infinite time blow-up) with absence of finite time blow-up. A particular small perturbation of an unbounded non-dissipative global attractor is considered, in such a way that the perturbed attractor is dissipative. Although the continuity of the family of attractors is verified in compact sets, our choice of perturbation produces a great change on the dynamics close to the infinity of the phase space. In other words, we prove that the limit of the compact attractors is not the unbounded attractor of the limiting equation. This is based on joint work with S. Bruschi and A. N. Carvalho.

Geometric methods in regularity theory for (nonlinear) PDEs

Thu 16:00

Edgard Pimentel

Pont. Univ. Católica - RJ

In this talk we examine the regularity theory of the solutions to a few examples of (nonlinear) PDEs. Arguing through a genuinely geometrical method, we produce regularity results in Sobolev and Hölder spaces, including some borderline cases. Our techniques relate a problem of interest to another one - for which a richer theory is available - by means of a geometric structure, e.g., a path. Ideally, information is transported along such a path, giving access to finer properties of the original equation. Our examples include elliptic and parabolic fully nonlinear problems, the Isaacs equation, degenerate examples, a double divergence model and the porous medium equation. We close the talk with a discussion on open problems and further directions of work.

Global Attractors for Morse-Smale Processes

Carlos Rocha

Instituto Superior Técnico

We consider small non-autonomous perturbations of dynamical systems to discuss the resulting changes on the global attractors in the framework of an extension of the notion of Morse-Smale dynamical system to non-autonomous processes. This is based on a joint work with R. Czaja and W. Oliva.

Infinite dimensional Linearization

Hildebrando M. Rodrigues

Inst. de Ciências Mat. e de Computação - USP

Previous and New results.

Games for PDEs with eigenvalues of the Hessian

Julio Rossi

Univ. de Buenos Aires

For a function $u : \Omega \subset \mathbb{R}^N \mapsto \mathbb{R}$, we consider the Hessian, D^2u, and its ordered eigenvalues

$$\lambda_1(D^2u) \leq ... \leq \lambda_N(D^2u).$$

Here our main concern is the Dirichlet problems for the equations:

$$P_k^+(D^2u) := \sum_{i=N-k+1}^{N} \lambda_i(D^2u) = 0, \tag{1}$$

(note that P_k^+ is just the sum of the k largest eigenvalues)

$$P_k^-(D^2u) := \sum_{i=1}^{k} \lambda_i(D^2u) = 0, \tag{2}$$

(P_k^- is the sum of the k smallest eigenvalues) and, more generally, any sum of k different eigenvalues

$$P_{i_1,...,i_k}(D^2u) := \sum_{i_1,...,i_k} \lambda_{i_j}(D^2u) = 0. \tag{3}$$

These operators appear in connection with geometry but our goal is to provide a probabilistic interpretation.

We will describe games whose values approximate viscosity solutions to these equations in the same spirit as the random walk can be used to approximate harmonic functions.

Joint work with P. Blanc (U. Buenos Aires, Argentina).

The Borel property on certain algebras of functions

Giuseppe Della Sala

American University at Beirut

Let K be a compact set of C^n with a distinguished point p. We consider the algebra A(K) obtained by the closure of the algebra of restrictions of entire functions to K, with a suitable Fréchet topology, and the Borel map sending an element f of A(K) to its formal power series expansion at K. We study the link between the algebraic behavior of the Borel map and the geometry of K. Particularly interesting is the case of a compact set K coming from a locally integrable structure on a smooth manifold. (Joint work with P. Cordaro and B. Lamel)

Mass inflation and strong cosmic censorship for the spherically symmetric Einstein-Maxwell-scalar field system with a cosmological constant and an exponential Price law

Jorge D. Silva

Inst. Superior Técnico

In this talk, we will start by reviewing some basic notions of General Relativity, in particular the structure of black holes in spherical symmetry, leading to the formulation of the celebrated strong cosmic censorship conjecture, from a PDE perspective. We will then describe the characteristic initial value problem for the study of the Einstein-Maxwell-scalar field system inside a black hole, as a model for studying this conjecture, recalling some of the known results in this context.

We will finish by presenting recent work, where improvement is achieved by considering the presence of a cosmological constant and imposing more realistic initial data along the event horizon of the black hole, satisfying a Price law. The conclusions focus on the occurrence of mass inflation or the extendability of the corresponding maximal globally hyperbolic development.

This is joint work with João L. Costa, Pedro Girão and José Natário.

Parabolic Equations on Evolving Spaces

Ricardo P. Silva

Univ. de Brasília

We present an abstract framework for dealing with the well-posedness of solutions to parabolic equations on time dependent spaces. This theory is applicable to variational formulations of PDEs on evolving spatial domains including moving hyper-surfaces but not restricted to. Then we show the well-posedness for certain classes of parabolic equations.

Equivalence of Cauchy-Riemann manifolds and multisummability theory

Laurent Stolovitch

Université de Nice Sophia-Antipolis

We prove that if two real-analytic hypersurfaces in $\mathbb{C}^2$ are equivalent formally, then they are also C^∞ CR-equivalent at the respective point. As a corollary, we prove that all formal equivalences between real-algebraic Levi-nonflat hypersurfaces in $\mathbb{C}^2$ are algebraic (in particular are convergent). The result is obtained by using the recent *CR - DS technique*, connecting degenerate CR-manifolds and Dynamical Systems, and employing subsequently the *multisummability theory* of divergent power series used in the Dynamical Systems theory. This is a joint work with I. Kossovskiy and B. Lamel.

Abstracts - Short talks

Convergence and stability theorems for iterative schemes and applications

Thu 14:30

Javid Ali

Aligarh Muslim University

In this talk, first we recall some well kwon results in fixed point theory. We define new iterative algorithm to approximate fixed point of nonlinear mappings defined on a Banach space. We also discuss convergence and stability results of newly defined algorithm. Further, we show that our algorithm converge faster than previously known algorithms in the literature in the sense of Berinde. Finally, we discuss some applications of iterative algorithm to image recovery problem and approximate solution of integral equations.

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Continuity of attractors for a family of semi linear parabolic problems in Lipschitz domains

Pricila da Silva Barbosa

The study of existence and continuity of attractors for parabolic problems in relation to the perturbation of the domain is a subject much approached in the literature. In general, works that deals with perturbations of domain has as assumptions that the domain is smooth. In this talk we consider a family of semi-linear parabolic problems with non-linear Neumann boundary conditions, defined in Lipschitz domains. These domains are obtained considering a family of perturbations of the square that depend on a parameter ϵ, and converge to the identity in the norm C^1. Using tecniques of perturbations of the boundary and under appropriates assumptions on the problem addressed, we will prove that the associated semigroup has a global attractor and the family of attractors obtained is continuous at $\epsilon = 0$.

On the (semi-)global analytic hypoellipticity for some models of "sums of squares"

Gregorio Chinni

University of Vienna

We are concerned with the problem of the (semi-)global analytic hypoellipticity; more precisely, we focus on the real analytic regularity of the solutions of sums of squares with real analytic coefficients on the torus satisfying the Hörmander condition, [3]. In two recent papers, [1] and [2], Albano, Bove and Mughetti and Bove and Mughetti produced and studied the first models of sums of squares operators not consistent with the (micro-)local Treves conjecture, [4]. The global and semi-global, i.e. local in some variables and global in others, analytic hypoellipticity on the torus is showed for two classes of sums of squares operators which include the global version on the torus of the operators introduced in [1] and [2], which fail to be neither locally nor microlocally analytic hypoelliptic. This shows that the scenario can be very different moving from the local to the global case. Therefore, it seems natural to ask yourself the following question: taking inspiration from the models in [1] and [2], is it possible produce an operator which satisfies the conditions of the global Treves conjecture and at the same time fails to be globally analytic hypoelliptic? In order to try to answer to such question, we present and discuss a couple of models of sums of squares.

Mathematical theory of exchange-driven growth

Emre Esenturk

University of Warwick

Exchange-driven growth (EDG) is an non equilibrium mean field model of cluster growth which has become popular in the last two decades for its wide range of applicability from physics to social sciences (population dynamics, wealth exchange etc. EDG is a process in which pairs of clusters interact by exchanging single unit of mass at a time. The rate of exchange is given by an interaction kernel $K(j, k)$ which depends on the masses of the two interacting clusters. Despite its importance a rigorous mathematical analysis of the EDG has not been given to date. In this talk we present first rigorous results for the the fundamental mathematical properties of the mean field rate equations of this process. We show two different classes of behavior depending on whether $K(j, k)$ is symmetric or not. For the non-symmetric case, we show global existence and uniqueness of solutions for kernels satisfying $K(j, k) < Cjk$. This result is optimal in the sense that we show for a large class of initial conditions and kernels satisfying $K(j, k) > Cj^\beta (\beta > 1)$ the solutions cannot exist. On the other hand, for symmetric kernels solutions exist globally for $K(j, k) < C(j^\mu k^v + j^v k^\mu)(\mu, v \leq 2, \mu + v \leq 3)$, while existence is lost for $K(j, k) > Cj^\beta (\beta > 2)$. In the intermediate regime $3 < \mu + v < 4$, we can only show local existence.

Touchdown behavior for the MEMS problem with variable dielectric permittivity

Carlos Esteve

Université Paris 13

We consider a well-known model for micro-electromechanical systems (MEMS) with variable dielectric permittivity, based on the following parabolic equation with singular non- linearity

$$\begin{cases} u_t - \Delta u = f(x)(1-u)^{-p}, & x \in \Omega, \ t > 0, \\ u = 0, & x \in \partial\Omega, \ t > 0, \\ u(0, x) = 0, & x \in \Omega, \end{cases}$$

where Ω is a smooth bounded domain in $\mathbb{R}^n, n \geq 1, p \geq 0$ and $f \geq 0$ is a Hölder continuous function. We study the eventually apparition of singularities in the non-linear part of the equation. This phenomenon is known as quenching or touchdown. Recently, the question whether or not touchdown can occur at zero points of the permittivity profile f, which had long remained open, was answered negatively in [3] for the case of interior points. Our aim in [1] is to go further by considering the same question at points of positive but small permittivity. As one of our main results, in any space dimension, we show that touchdown cannot occur at an interior point where the permittivity profile is suitably small. We also obtain a similar result in the boundary case, under a smallness assumption of f in a neighborhood of the boundary. Moreover, in view of practical considerations of MEMS design, in

[2] we give special care to express our smallness conditions in a quantitative way, especially in one space dimension, where analytic computations can be made more precise. We also obtain another kind of results regarding further properties of the touchdown set, some of them locating it far away from the maximum points of f, which confirm the necessity of some kind of smallness condition on f if one wants to prevent touchdown in certain regions of the domain.

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On generic simplicity of the eigenvalues of the drifting Laplacian

Abraão Mendes

Univ. Federal Amazonas/Univ. Federal do ABC

In 1976, K. Uhlenbeck showed that for a class of second order elliptic operators Lb defined on a compact Riemannian manifold M, the following generic property holds: all eigenvalues are simple, that is, multiplicity 1. As an application, all eigenvalues of Δ_g are simple, for a generic metric g on M. In this poster, we want to show that this same generic property holds for the operator drifting Laplacian

$$\Delta + \langle \nabla \eta, \nabla \rangle$$

for a generic drifting function $\eta \in B = \{\eta : M \to \mathbb{R}, \eta > 0\} \subset C^\infty(M)$, that is, there exists a residual set $\Gamma \subset B$ such that for $\eta \in \Gamma$ the operator

$$L_\eta = \Delta + \langle \nabla \eta, \nabla \rangle$$

has all eigenvalues simple, that is, multiplicity equal to 1 also.

Monotone operators in thin domains with doubly oscillatory boundary

Jean Carlos Nakasato

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In this work we apply the unfolding operator method to analyze the asymptotic behavior of the solutions of a monotone operator equation with Neumann boundary condition set in bounded thin domains with doubly oscillating bounries of the type $R^\varepsilon = \{(x,y) \in \mathbb{R}^2 : x \in (0,1) \text{ and } -\varepsilon h(x/\varepsilon^\alpha) \le y \le \varepsilon g(x/\varepsilon^\beta)\}$. We take L_g-periodic and L_h-periodic functions $h, g : \mathbb{R} \to \mathbb{R}$ in $L^\infty(\mathbb{R})$. We assign $\alpha > 1$ to model the oscillatory behavior of the bottom boundary of R^ε and we consider three cases concerning to the order of oscillations of the upper boundary: weak, resonant and high, respectively set by $0 < \beta < 1, \beta = 1$ and $\beta > 1$. Joint work with Marcone Corrêa Pereira.

Approximate solutions of vector fields and an application to Denjoy-Carleman regularity of solutions of a nonlinear PDE

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Let $\mathcal{C}^\mathcal{M}$ be the Denjoy-Carleman class associated with the regular weight sequence $\mathcal{M} = \{M_k\}_{k=0}^{k=\infty}$ and let L be a $\mathcal{C}^\mathcal{M}$-vector field of the form

$$L = \frac{\partial}{\partial t} + \sum_{j=1}^{N} a_j(x,t)\partial_{x_j}.$$

We construct an approximate solution of L for any given $\mathcal{C}^\mathcal{M}$-initial datum, i.e. we construct a C^∞ function $u(x,t)$ such that

$$|Lu(x,t)| \le \frac{C^{k+1}M_k}{k!}|t|^k, \quad \forall k \in \mathbb{Z}_+.$$

We also give an application to the study of microlocal regularity of a $\mathcal{C}^2$-solution of the first order nonlinear equation

$$u_t = f(x,t,u,u_x),$$

where $f(x,t,\zeta_0,\zeta)$ is ultradifferentiable in the variables $(x,t) \in \mathbb{R}^N \times \mathbb{R}$ and holomorphic in the variables $(\zeta_0,\zeta) \in \mathbb{C} \times \mathbb{C}^N$. More precisely, we prove that if $\mathcal{C}^\mathcal{M}$ is a regular Denjoy-Carleman class (including the quasianalytic case) then:

$$WF_\mathcal{M}(u) \subset Char(L^u),$$

where $WF_\mathcal{M}(u)$ is the Denjoy-Carleman wave-front set of u and $Char(L^u)$ is the characteristic set of the linearized operator L^u:

$$Lu = \frac{\partial}{\partial t} - \sum_{j=1}^{N} \frac{\partial f}{\partial \zeta_j} f(x,t,u,u_x)\frac{\partial}{\partial x_j}.$$

Modelling of viscoelastic tides with the pseudo-rigid body theory

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In this work, we present ordinary differential equations for the motion of linear viscoelastic bodies interacting under gravity. The equations are fully three dimensional and allow for the integration of the spin, the orbit, and the deformation of each body. Using such a formulation, we can present good models for the tidal forces that take into account the possibly different rheology of each body. The equations are obtained within a finite dimension Lagrangian framework with dissipation function. The main contribution is a procedure to associate to each spring-dashpot model, which defines the rheology of a body, a potential and a dissipation function for the body deformation variables. The theory is applied to the Earth (solid part plus oceans) and a comparison between model and observation of the following quantities is made: norm of the Love numbers, rate of tidal energy dissipation, Chandler period, and Earth-Moon distance increase. Joint work with Ragazzo, C.

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