ICMC Summer Meeting on Differential Equations

2016 Chapter

February 1-3, 2016
São Carlos SP, Brazil

List of sessions and their organizers

Computational Dynamics
Marcio F. Gameiro (USP)

Conservation Laws and Transport Equations
Wladimir A. Neves (UFRJ)

Dispersive Equations
Márcia A. G. Scialom (UNICAMP)

Elliptic Equations
Claudianor O. Alves (UFCG)

Fluid Dynamics
Anne C. Bronzi (UNICAMP)

Linear Equations
Adalberto P. Bergamasco (USP)

Nonlinear Dynamical Systems
Sergio M. Oliva Filho (USP)

Ordinary/Functional Differential Equations
Jaqueline G. Mesquita (UnB) & Bruno de Andrade (UFS)

Poster Session
Juliana F. S. Pimentel (USP)

Executive Committee:

Alexandre N. de Carvalho
USP / Brazil

Hildebrando M. Rodrigues
USP / Brazil

Márcia C. A. B. Federson
USP / Brazil

Ma To Fu
USP / Brazil

Sérgio H. Monari Soares
USP / Brazil

Organizing Committee:

Ederson M. dos Santos
USP / Brazil

Jaqueline G. Mesquita
UnB / Brazil

Juliana F. S. Pimentel
USP / Brazil

Marcio F. Gameiro
USP / Brazil

Matheus C. Bortolan
UFSC / Brazil

Paulo L. Dattori da Silva
USP / Brazil

Scientific Committee:

Djairo G. de Figueiredo
UNICAMP / Brazil

Eduardo V. O. Teixeira
UFC / Brazil

Jean L. Mawhin
Université Catholique de Louvain / Belgium

John Mallet-Paret
Brown University / USA

José M. Arrieta
Universidad Complutense de Madrid / Spain

Konstantin Michaikow
Rutgers University / USA

Michael Y. Li
University of Alberta / Canada

Shui-Nee Chow
GaTech / USA

Tomás Caraballo
Universidad de Sevilla / Spain

Yingfei Yi
University of Alberta / Canada and JLU / China

More information:
summer.icmc.usp.br

Realization and support

Welcome

It is a pleasure to welcome you to the *ICMC Summer Meeting on Differential Equations - 2016 Chapter* and to São Carlos. We wish you a pleasant stay and that you enjoy the meeting.

Executive committee

Alexandre N. de Carvalho (USP/Brazil)

Hildebrando M. Rodrigues (USP/Brazil)

Márcia C. A. B. Federson (USP/Brazil)

Ma To Fu (USP/Brazil)

Sérgio H. Monari Soares (USP/Brazil)

Organizing committee

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Tomás Caraballo (Universidad de Sevilla/Spain)

Yingfei Yi (University of Alberta/Canada and JLU/China)

Session Organizers

Wladimir Neves (UFRJ): Special Session on Conservation Laws and Transport Equations

Claudianor O. Alves (UFCG): Special Session on Elliptic Equations

Anne C. Bronzi (UNICAMP): Special Session on Fluid Dynamics

Adalberto P. Bergamasco (USP): Special Session on Linear Equations

Sergio M. Oliva Filho (USP): Special Session on Nonlinear Dynamical Systems

Bruno de Andrade (UFS) & Jaqueline Godoy Mesquita (UnB): Special Session on Ordinary and Functional Differential Equations

Juliana F. S. Pimentel (USP): Posters Session

Address

ICMC Summer Meeting on Differential Equations - 2016 Chapter
Instituto de Ciências Matemáticas e de Computação
Universidade de São Paulo
Avenida Trabalhador São-carlense, 400
CEP: 13566-590 - São Carlos - SP
FAX: +55 (16) 3371-2238
e-mail: summer@icmc.usp.br

ICMC Summer Meeting on Differential Equations

2016 Chapter

Maps

Nome/Name: _____

Hosted in São Sarlos at the hotel: _____

Address: _____

Phone number: _____

Contact: _____

Tipo sanguíneo / Blood type: _____

Tomando medicação/Taking medication: _____

Alérgico a medicamentos / Alergic to medication: _____

Doença crônica / Chronic disease: _____

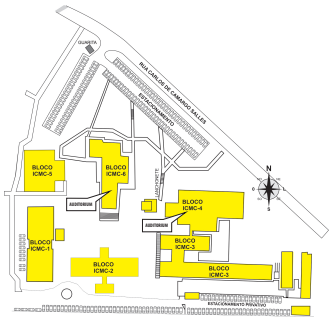
USEFUL NUMBERS

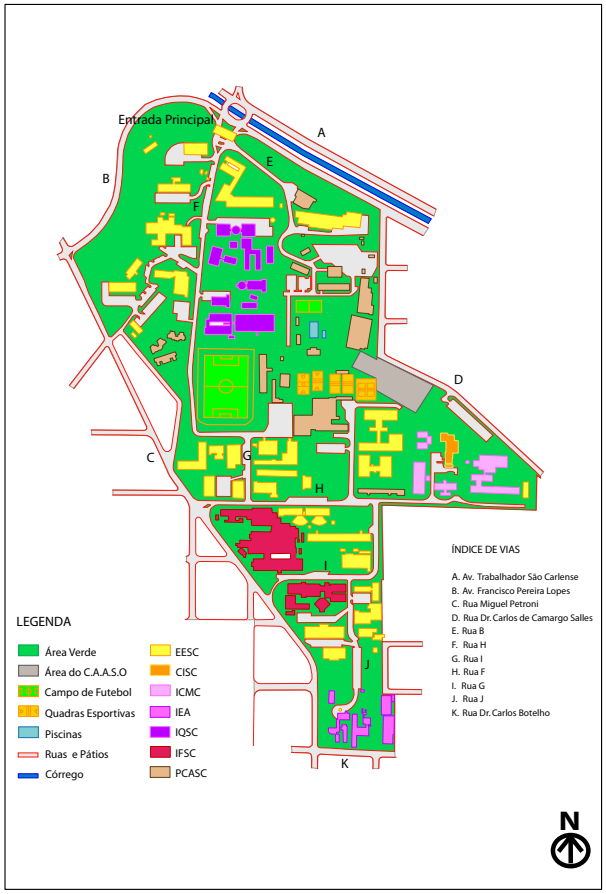
3373-9700	ICMC-USP
3373-9112	Campus Security Staff
190	Police Dept.
192	Medical Emergency
193	Fire Dept. and Rescue
0800-560159	National Courier Service
3371-2171	Local Post Office
3415-6005	Taxi-Cab Co.

www.visitesaocarlos.com.br/taxis.htm
(other Taxi-Cab Companies)

ENTRANCES AND EXITS OF THE CAMPUS

1. ICMC entrance
2. Main entrance
3. Observatory´s entrance
4. Physic´s institute entrance
5. Physic´s institute entrance





HOTÉIS - HOTELS

H1. Indaiá Hotel
R. Jacinto Favoreto, 351

H2. Atlantic Inn Residence
R. Salomão Dibbo, 321

H3. Indaiá Hotel Residence
R. Jacinto Favoretto, 782

H4. Parisi Hotel
Av. São Carlos, 3.163

H5. Hotel Anacã
Av. São Carlos, 2.690

H6. Hotel Ypê
Av. Dr. Carlos Botelho, 2.060

H7. San Ciro Apart Hotel
R. 28 de setembro, 2.222

H8. Central Park Apart Hotel
Av. Francisco Pereira Lopes, 2.600

H9. Hotel Acaccio
Av. São Carlos, 1.981

H10. Atlantic Inn Royale
R. Conde do Pinhal, 1.630

H11. Hotel Caiçara
R. Conde do Pinhal, 2.217

H12. Ibis Hotel
Av. Passeio dos Ipês, 140

BRAZILIAN SOUVENIRS

1. Papelaria CAASO (USP)
2. Praça XV de novembro (Sunday after 15h)
3. Duda Maria
   rua José Bonifácio, 1177 - 3307.2402

RECOMMENDED BAR, RESTAURANTS AND PIZZERIAS

R1. Restaurante Kallas
Av. São Carlos, 2784 - 3364.6362 - LUNCH/DINNER

R2. Quase 2 Restaurante e Hamburgueria
Av. São Carlos, 2796 - 3372.7240 - LUNCH and FAST FOOD at night

R3. Roda Chopp Restaurante
Av. São Carlos, 2603 - 3372.2343 - LUNCH ONLY

R4. Restaurante La Salute
R. Cons. João Alfredo, 47 - 3116.4939 - VEGETARIAN FOOD - LUNCH ONLY

R5. Casa do Café Restaurante
R. Riachuelo, 1201 - 3371.3033 - LUNCH/DINNER

R6. Cantina Ciao Bello
R. Riachuelo, 1.191 - 3371.4174 - LUNCH ONLY

R7. Restaurante Curinga
Av. Trabalhador Sãocarlense, 650 - 3413.3777 - LUNCH ONLY

R8. Barone Restaurante
Av. Dr. Carlos Botelho, 1.671 - 3412.8586 - LUNCH/DINNER

R9. Restaurante Mosaico
R. Aquidaban, 1.342 - 3371.4474 - LUNCH/DINNER

R10. Yo Konno
R. Aquidaban, 1368 - 3413.1666

R11. YouOki Culinária Asiática
R. Aquidaban, 1390 - 3415.2848 - ASIAN FOOD - LUNCH/DINNER

R12. Restaurante Paraíso
R. Dna. Maria Jacinta, 340 - 3376.6424 - LUNCH ONLY

R13. Habbib´s
Av. Trabalhador Sãocarlense, 620 - 3371.2223 - 24 hours

R14. Bom Pedaço Pizza & Bar
Av. Trabalhador Sãocarlense, 584 - 3371.3696 - DINNER ONLY

R15. La Villa Restaurante e Lanchonete
R. Quinze de Novembro, 1330 - 3376.2843 - LUNCH/DINNER
Tip: Special brazilian food (Feijoada) and music at Saturdays

R16. Amici Pizza & Cibo
R. Quinze de Novembro, 1289 - 3371.6463 - DINNER ONLY

R17. West Brothers Chopp & Culinária
Av. Trabalhador Sãocarlense, 671 - 3415.5717 - DINNER ONLY

R18. Yasan Restaurante/Bar
Av. Dr. Carlos Botelho, 1768 - 3307.1165 - LUNCH/DINNER

R19. King Fish Restaurante
Av. Trabalhador Sãocarlense, 25 - 3412.7400 - DINNER ONLY

R20. Restaurante Picanha na Tábua
Av. Francisco Pereira Lopes, 2520 - 3361.1453 - LUNCH/DINNER

R21. McDonald´s
Av. São Carlos, 3134 - 3374.7402 - 24 hours

R22. Seo Gera
R. Episcopal, 2442 - 3372.1051 - ONLY DINNER

R23. Trembão Burger & Grill
Av. São Carlos, 3055 - 3307.6189 - ONLY DINNER

R24. Restaurante Mamãe Natureza
R. Cap. Adão Pereira Cabral, 457 - 3374.2653 - VEGETARIAN FOOD - LUNCH ONLY

R25. China in Box
Av. São Carlos, 3030 - 3376.1221 - LUNCH/DINNER

R26. Restaurante Panela
R. Dr. Orlando Damiano, 2157 - 3371.4157 - LUNCH/DINNER

R27. Casa do Filé Restaurante
R. Nove de Julho, 1688 - 3307.2412 - ONLY DINNER

R28. Cabanha Steakhouse & Bar
R. Episcopal, 1661 - 3364.3067 - LUNCH/DINNER

R29. Restaurante Frei Damião
R. Nove de Julho, 1606 - 3416.8133 - ONLY LUNCH

R30. Cachaçaria Água Doce
R. Nove de Julho, 1625 - 3376.2077 - ONLY DINNER

R31. Donna Léo Chopperia & Happy Hour
R. Nove de Julho, 1643 - 3415.4560 - ONLY DINNER

R32. Don Raffaele Pizze & Ristorante
R. Marechal Deodoro, 1758 - 3371.1478 - ONLY DINNER

R33. Subway
Av. São Carlos, 2911 - 3416.4000 - 24 hours

R34. Kalil Cozinha Árabe
R. Dr. Carlos Botelho, 1737 - 3372.1696
ARABIC AND VEGETARIAN FOOD - LUNCH/DINNER

R35. Café Sete - Café Gastrobar
R. Sete de Setembro, 1447 - 3415.1026 - DINNER ONLY

R36. Churrascaria Tabajara
Av. São Carlos, 3677 - 3361.4282 - STEAKHOUSE - LUNCH/DINNER

R37. Churrascaria Trevo
Av. Prof. Luis Augusto de Oliveira, 385
(extension of the Av. São Carlos) - 3361.3052 - STEAKHOUSE - LUNCH/DINNER

R38. Restaurante e Buffet Cantos e Contos
Rua Major José Inácio, 2211 - 3372.6661

R39. Restaurante Sushi Ya-San
Rua Tiradentes, 128 - 3307.1165 - JAPANESE FOOD - LUNCH/DINNER

R40. Restaurante Zettai
Rua Marechal Deodoro, 1846 - 3416.5140 - JAPANESE FOOD - DINNER ONLY

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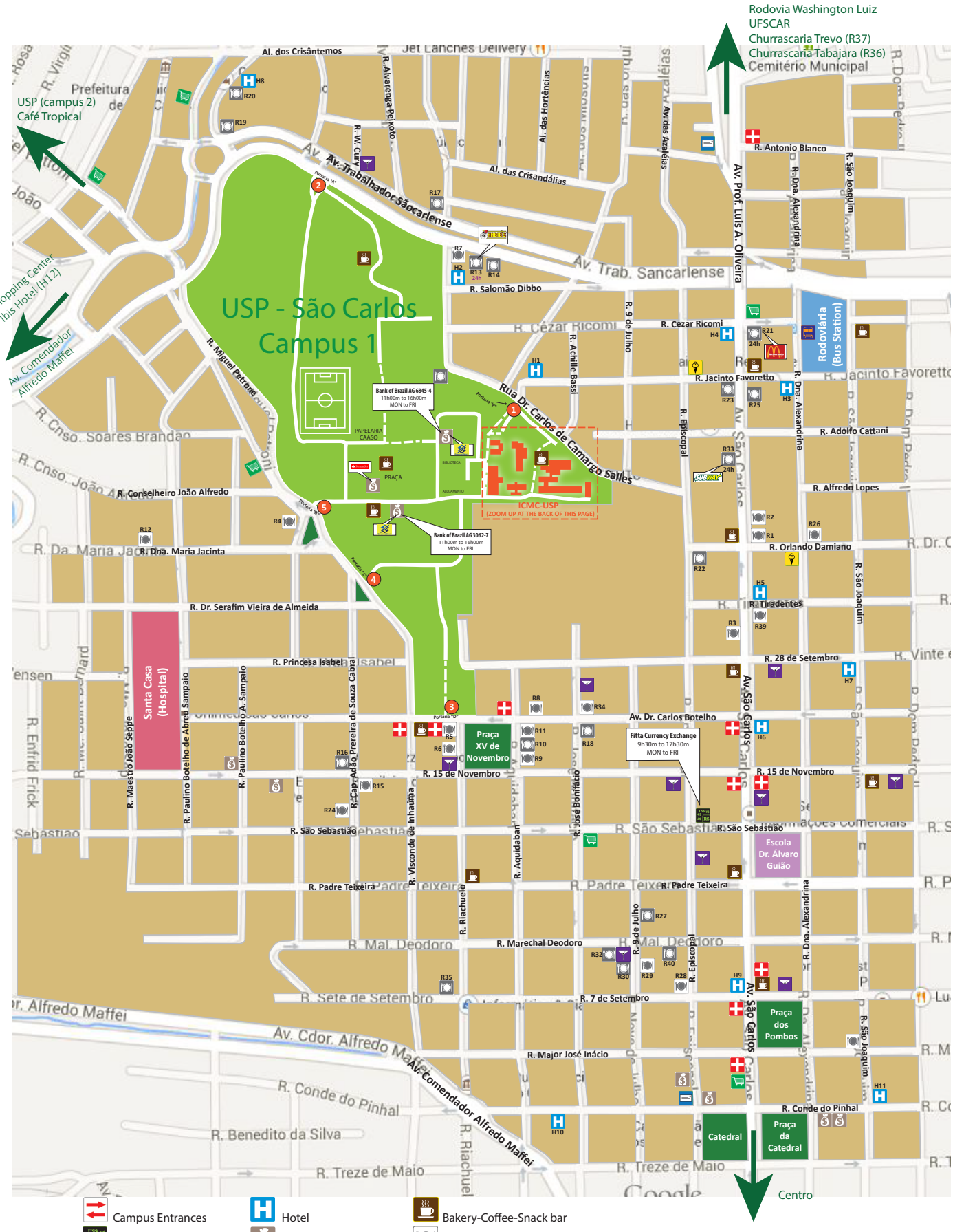
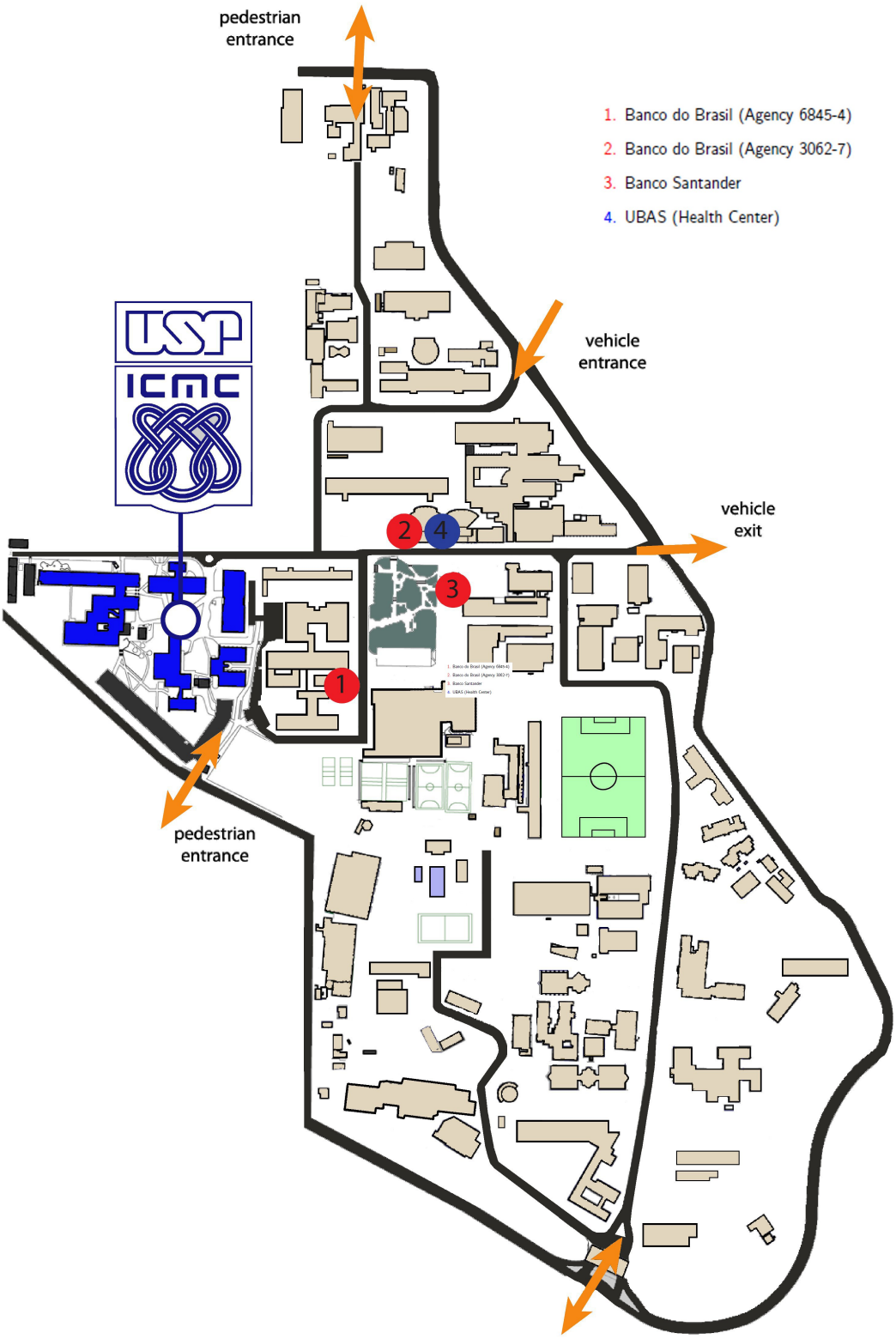
ICMC USP SÃO CARLOS


Rodovia Washington Luiz
UFSCAR
Churrascaria Trevo (R37)
Churrascaria Tabajara (R36)
Cemitério Municipal
USP (campus 2)
Café Tropical
Shopping Center
Ibis Hotel (H12)
Av. Comendador Alfredo Maffei
USP - São Carlos
Campus 1
Rua Dr. Carlos de Camargo Salles
ICMC-USP
(ZOOM UP AT THE BACK OF THIS PAGE)
Bank of Brazil AG 6845-4
11h00m to 16h00m
MON to FRI
Bank of Brazil AG 3062-7
11h00m to 16h00m
MON to FRI
PAPELARIA
CAASO
PRAÇA
Rodoviária
(Bus Station)
Santa Casa
(Hospital)
Praça
XV de
Novembro
Fitta Currency Exchange
9h30m to 17h30m
MON to FRI
Escola
Dr. Álvaro
Guião
Praça
dos
Pombos
Catedral
Praça
da
Catedral
Centro
Al. dos Crisântemos
Av. Trabalhador Sãocarlense
Al. das Crisandálias
Av. Trab. Sancarlense
R. Salomão Dibbo
R. Cezar Ricomi
R. Jacinto Favoretto
R. Adolfo Cattani
R. Alfredo Lopes
R. Orlando Damiano
R. Tiradentes
R. 28 de Setembro
R. 15 de Novembro
R. São Sebastião
R. Padre Teixeira
R. Marechal Deodoro
R. 7 de Setembro
R. Major José Inácio
R. Conde do Pinhal
R. Benedito da Silva
R. Treze de Maio
R. Sete de Setembro
R. Princesa Isabel
R. Dr. Serafim Vieira de Almeida
R. Conselheiro João Alfredo
R. Dra. Maria Jacinta
R. Cnso. Soares Brandão
R. Cnso. João Alfredo
R. Miguel Petroni
R. Alvarenga Peixoto
R. W. Cury
R. das Hortências
Av. das Azaléias
R. Antonio Blanco
R. São Joaquim
Av. Prof. Luis A. Oliveira
R. 9 de Julho
R. Achile Bassi
R. Episcopal
R. Dna. Alexandrina
R. Visconde de Inhaúma
R. Aquidaban
R. Riachuelo
R. Bonifácio
R. Carr. Adão Pereira de Souza Cabral
R. Paulino Botelho de Abreu Sampaio
R. Maestro João Seppe
Av. São Carlos
Av. Dr. Carlos Botelho
Portaria "A"
Portaria "B"
Portaria "C"
Portaria "D"
Campus Entrances
Money Exchange
Hotel
ATM
Drugstore
Supermarket-Grocery
Post Office
Bus Station
Bakery-Coffee-Snack bar
Restaurant
Other restaurant or Pizzeria
Açaí (Brazilian Ice Cream)
Bar Restaurant


pedestrian entrance
1. Banco do Brasil (Agency 6845-4)
2. Banco do Brasil (Agency 3062-7)
3. Banco Santander
4. UBAS (Health Center)
vehicle entrance
vehicle exit
pedestrian entrance
USP
ICMC
1
2
3
4


pedestrian
entrance
1. Library
2. Coffee Room
3. Events office
4. Financial office
5. Building 5
6. Building 6 (Auditorium)
7. Canteen
WC. Toilets
WC
WC
WC
WC
1
2
3
4
5
6
7

Contents

ICMC Summer Meeting on Differential Equations

2016 Chapter

General Information

Conference site

The meeting will take place at Buildings 5 and 6, and also in the Coffee Area. All these buildings are indicated in the map on page 11.

Plenary talks will take place at the Auditorium (Building 6)

Special session on Conservation Laws and Transport Equations in room 5-002 (Building 5)

Special session on Elliptic Equations in room 5-001 (Building 5)

Special session on Fluid Dynamics in room 5-004 (Building 5)

Special session on Linear Equations in room 5-002 (Building 5)

Special session on Nonlinear Dynamical Systems at the Auditorium (Building 6)

Special session on Ordinary and Functional Differential Equations in room 5-003 (Building 5)

Poster session in Coffee Room (ground floor of the Library)

Registration

The registrations will be made in the following schedule:

Sunday, January 31^{st}: From 18:00hs to 19:00hs in the lobby of Anacã Hotel.

Monday, February 1^{st}: From 8:00hs to 9:25hs in the entrance of the Auditorium (Building 6).

We will provide you a badge at registration. Please wear your badge at the event.

The Events Office (3, map at page 11) will be at your disposal for any questions and information, also the Events Office will set up a help desk with all the necessary information at the entrance of the Auditorium.

Financial support

The financial support from the local organizing committee will be available on Tuesday, February 2^{nd}, at the Financial Office (4, map of page 11). In order to receive your support, it is mandatory to completely fill out the on-line registration form available at `summer.icmc.usp.br/user_summer/` .

Meals and refreshments

There are several restaurants near the campus. You can find them by looking at the city map located on page 5. There are also choices of pizzerias. At night, there are many bars around the city.

There is also a canteen on the campus (7, map at page 11) where you can have either snacks or lunch.

Social events

Monday, February 1^{st}*:* Cocktail at 17:30hs in Coffee Room (ground floor of the Library).

Tuesday, February 2^{nd}*:* Photo of the meeting at 12:50hs at ICMC.

Tuesday, February 2^{nd}*:* Conference Banquet at 20:00hs at Café Sete.

Health emergencies

In case of accidents or health emergencies call 192 (SAMU).

Money exchanges

In case you need to exchange your money, we recommend Fitta Câmbio, located in Rua Episcopal, 1931. The working hours are from 9:00 to 17:30. You can locate it at the map in page 7. Another option, at Shopping Center Iguatemi, is Confidence Câmbio.

Smoking

Smoking is prohibited inside any of the ICMC buildings also in the canteen and on the ground floor of the library.

Computer and wireless LAN use

There will be available computers and a printer for use at the lobby of the Auditorium.

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

1. Enable wireless on your device.
2. Join the ICMC-GUEST wireless network.
3. Open a browser and try to visit any website.
4. You will be redirected to a login page. Enter the login and password as follows:

   User Name: *summer*

   Password: smode16!
5. You may freely browse the internet after logging in. You may occasionally need to re-authenticate using the above procedure.

ICMC Summer Meeting on Differential Equations

2016 Chapter

Plenary Talks

Plenary Speaker

Continuity of attractors for a family of $\mathcal{C}^1$ perturbations of the unit square

Antonio L. Pereira, Marcone C. Pereira, Pricila S. Barbosa
Universidade de São Paulo

We consider the family of semilinear parabolic problems

$$\begin{cases} u_t(x,t) &= \Delta u(x,t) - au(x,t) + f(u(x,t)), \quad x \in \Omega_\epsilon \text{ e } t > 0\,, \\ \dfrac{\partial u}{\partial N}(x,t) &= g(u(x,t)), \ x \in \partial\Omega_\epsilon \text{ e } t > 0\,, \end{cases}$$

where Ω_0 is the unit square, $\Omega_\epsilon = h_\epsilon(\Omega_0)$ and h_ϵ is a family of diffeomorphisms converging to the identity in the C^1-norm. We show that the problem is well posed for $\epsilon > 0$ sufficiently small in a suitable phase space, the associated semigroup has a global attractor $\mathcal{A}_\epsilon$ and the family $\{\mathcal{A}_\epsilon\}$ is continuous at $\epsilon = 0$.

Existence and multiplicity of solutions for a class of quasilinear elliptic field equation on $\mathbb{R}^N$

Claudianor O. Alves, Alan C.B. dos Santos
Universidade Federal de Campina Grande

In this paper, we establish existence and multiplicity of solutions for the following class of quasilinear field equation

$$-\Delta u + V(x)u - \Delta_p u + W'(u) = 0, \ \text{ in } \mathbb{R}^N, \tag{P}$$

where $u = (u_1, u_2, ..., u_{N+1})$, W is a singular function and V is a positive continuous function.

Ground state solutions of hamiltonian system in dimension two

Djairo G. de Figueiredo, João Marcos do Ó, Zhang Jianjun
Universidade Estadual de Campinas

We consider the Hamiltonian system in a bounded domain $\Omega \subset \mathbb{R}^2$

$$\begin{cases} -\Delta u = g(v) & \text{in } \Omega, \\ -\Delta v = f(u) & \text{in } \Omega, \\ u = 0, v = 0 & \text{on } \partial\Omega, \end{cases} \tag{1}$$

as well in the whole of $\mathbb{R}^2$, f, g have the Trudinger-Moser type of critical growth. By using a generalized Nehari Manifold, we obtain the existence of ground state solutions of the system.

Geometric regularity theory in diffusive models

Eduardo Teixeira
Universidade Federal do Ceará

I will discuss new geometric approaches for studying regularity issues in nonlinear elliptic PDE theory. In particular, I will highlight the connections these novel ideas have with the theory of free boundary problems. A number of applications will be discussed.

Semiflows for delay differential equations on Fréchet manifolds

Hans-Otto Walther

Giessen

Differential equations with variable time lags, state- or time-dependent, which are not necessarily bounded require initial data on $(-\infty, 0]$. Banach spaces of such data would exclude certain solutions with rapid growth at $-\infty$. This suggests to try Fréchet spaces, with the topology given by uniform convergence on compact sets.

It is shown that equations $x'(t) = f(x_t)$ with $f : U \to \mathbb{R}^n$, U an open subset of the Fréchet space $C^1 = C^1((-\infty, 0], \mathbb{R}^n)$, define a semiflow of solution operators which are continuously differentiable (in the sense of Michel and Bastiani, which is appropriate in Fréchet spaces), under a mild hypothesis on f which is slightly stronger than continuous differentiability, and which is taylored for the application to examples with state-dependent delay. The smoothness hypothesis allows for examples which involve unbounded delay - but implies that f is of *locally bounded delay* in an abstract sense, which of course comes down to $d : \mathbb{R} \to [0, \infty)$ being locally bounded in case of examples like $x'(t) = g(x(t-d(x(t)))$.

The semiflow lives on the set $X_f = \{\phi \in U : \phi'(0) = f(\phi)\}$ which is a submanifold of codimension n in C^1. We also have continuously differentiable local invariant manifolds at stationary points. The stable manifold results from the application of a transversality theorem to a stable manifold in the Banach space $C^1([-r, 0], \mathbb{R}^n)$ for equations with bounded delay [1], the unstable manifold comes from embedding an unstable manifold in a Banach space $B^1_a \subset C^1$ for equations with locally bounded delay [2], and the center manifold arises from modifying Krisztin's Lyapunov-Perron-type construction of a center manifold in $C^1([-r, 0], \mathbb{R}^n)$ for the bounded delay case [1].

[1] F. Hartung, T. Krisztin, H.O. Walther, and J. Wu, *Functional differential equations with state-dependent delays: Theory and applications.* In: A. Canada, P. Drabek, A. Fonda (Eds), HANDBOOK OF DIFFERENTIAL EQUATIONS, Ordinary Differential Equations, vol. 3, Elsevier Science B. V., North Holland, Amsterdam, 2006, pp. 435-545.

[2] H.O. Walther, *Differential equations with locally bounded delay.* J. Diff. Eqs. 252 (2012), 3001-3039.

[3] H. O. Walther, *Semiflows for differential equations with locally bounded delay on solution manifolds in the space* $C^1((-\infty, 0], \mathbb{R}^n)$. Topological Methods in Nonlinear Analysis, to appear.

[4] H.O. Walther, *Local invariant manifolds for delay differential equations with state space in* $C^1((-\infty, 0], \mathbb{R}^n)$. In preparation.

Semilinear control systems with impulses, delays and nonlocal conditions

Hugo Leiva

Louisiana State University

Mathematical control theory is the area of applied mathematics dealing with the analysis and synthesis of control systems. To control a system means to influence its behavior so as to achieve a desired goal such as stability, tracking, disturbance rejection or optimality with respect to some performance criterion. For many control systems in real life, impulses and delays are intrinsic phenomena that do not modify their controllability. So we conjecture that, under certain conditions, perturbations

of the system caused by abrupt changes and delays do not affect certain properties such as controllability. In this investigation we apply Fixed Point Theorems to prove the controllability of Semilinear Systems of Differential Equations with Impulses, delays and Nolocal Conditions. Specifically, Under additional conditions we prove the following statement: If the linear $\acute{z}(t) = A(t)z(t) + B(t)u(t)$ is controllable on $[0, \tau]$, then the semilinear system $z'(t) = A(t)z(t) + B(t)u(t) + f(t, z(t), u(t))$ with impulses, delays, and nonlocal conditions is also controllable on $[0, \tau]$. Moreover, we could exhibit a control steering the semilinear system from an initial state z_0 to a final state z_1 at time $\tau > 0$. This is a recent research work with many questions and open problems.

Boundary value problems with impulses at state-dependent moments

Irena Rachunkova
Palacky University Olomouc

We investigate the solvability of the impulsive problem

$$x'(t) = f(t, x(t)), \text{ a.e. } t \in [a, b], \quad \ell(x) = c \in R^n, \tag{2}$$

$$x(t+) - x(t) = J(t, x(t)) \text{ for } g(t, x(t)) = 0. \tag{3}$$

The impulse instants $t \in (a, b)$ in (3) are not known before and they are determined as solutions of the equation $g(t, x(t)) = 0$. The operator ℓ is an arbitrary linear and bounded operator. We provide conditions which allow to realize a construction of a solution of problem (2)–(3).

[1] I. Rachunková and J. Tomeček, Existence principle for BVPs with state-dependent impulses, *Topol. Methods in Nonlin. Analysis* 44 (2014) 349-368.

[2] I. Rachunková, L. Rachunek, A. Rontó, M. Rontó: A constructive approach to boundary value problems with state-dependent impulses, *Applied Mathematics and Computation*, 274 (2016) 726-744.

Tensor products, positive operators, and delay-differential equations

John Mallet-Paret, Roger D. Nussbaum
Brown University

We study linear nonautonomous delay-differential equations, such as

$$\dot{x}(t) = -a(t)x(t) - b(t)x(t-1). \tag{$*$}$$

Such equations can occur as the linearization of a nonlinear delay equation

$$\dot{x}(t) = -f(x(t), x(t-1))$$

around a given solution (often around a periodic solution), and they are crucial in understanding the stability of such solutions. We develop an associated linear theory to equation $(*)$ by taking the m-fold wedge product (in the infinite-dimensional sense of tensor products) of the dynamical system generated by $(*)$. Remarkably, in the case of a "signed feedback," namely where $(-1)^m b(t) > 0$ for some integer m, the associated linear system is given by an operator which is positive with respect to a certain cone in a Banach space. This leads to detailed information about stability properties of $(*)$, and in particular, information about its characteristic multipliers.

On solutions of the Dickman equation

Josef Diblík
Brno University of Technology

AMS Subject Classification: 34K06, 34K25, 11N25, 11A51.
Keywords and Phrases: Dickman equation, positive solution, dominant solution, subdominant solution, large time behavior, asymptotic representation, delayed differential equation.

The Dickman equation

$$\dot{x}(t) = -\frac{1}{t}\, x(t-1),$$

for $t \to \infty$ is considered. The number theory uses what is called a Dickman (or Dickman - de Bruin) function, which is the solution to this equation defined by an initial function $x(t) = 1$ if $0 \leq t \leq 1$. The Dickman equation has two classes of asymptotically different positive solutions. We investigate their asymptotic behaviors in detail. A structure formula describing the asymptotic behavior of all solutions to the Dickman equation is given, an improvement of the well-known asymptotic behavior of the Dickman function, important in number theory, is derived and the problem of whether a given initial function defines dominant or subdominant solution is dealt with.

Periodic oscillations related to the valveless pumping Lieabu phenomena

Milan Tvrdý, José Angel Cid, Gennaro Infante, Miroslawa Zima
Institute of Mathematics, Academy of Sciences of Czech Republic

The contribution is based on the recent joint research with J. Á. Cid, G. Infante, G. Propst and M. Zima (cf. [1] and [2]). We will present results on the existence and asymptotic stability of positive T-periodic solutions to singular differential equations of the form $u'' + a\,u' = \frac{1}{u}\,(e(t) - f(u')) - c$, where $a \geq 0$, $c > 0$, e is T-periodic and $f(x)$ behaves like x^2. The studied problem is related to the valveless pumping Liebau phenomena.

[1] J. Á. Cid, G. Propst and M. Tvrdý: On the pumping effect in a pipe/tank flow configuration with friction. *Phys. D* **273-274** (2014) 28–33.

[2] J. Á. Cid, G. Infante, M. Tvrdý and M. Zima: Topological approach to periodic oscillations related to the Liebau phenomenon. *J. Math. Anal. Appl.* **423** (2015), 1546-1556.

Concentration phenomena for fractional elliptic equation involving exponential growth in $\mathbb{R}$

Olimpio Hiroshi Miyagaki, Claudianor O. Alves, João Marcos do Ó
Universidade Federal de Juiz de Fora

We study the existence of positive solution, u_ϵ, for the following class of fractional elliptic equation

$$\epsilon(-\Delta)^{1/2}u + V(z)u = f(u) \text{ in } \mathbb{R},$$

where ϵ is small positive parameter, $(-\Delta)^{\frac{1}{2}}u$ is the fractional Laplacian, V is a bounded away from zero potential, and f has exponential growth. The solutions u_ϵ concentrate around a local minima of V, as ϵ goes to 0. The result is proved by using variational techniques combined with Del Pino and Felmer truncation argument.

Optimal transport and convergence results on finite graphs

Shui-Nee Chow, Wilfrid Gangbo, Wuchen Li, Haomin Zhou
Georgia Institute of Technology

In recent years, optimal transport has been considered by many authors and is essential in geometry and partial differential equations. It is also important in applications such as game theory. We consider a similar setting for finite discrete states which are on a finite but arbitrary graph. By defining a "discrete" 2-Wasserstein metric, we derive Fokker-Planck equations on finite graphs as gradient flows of free energies. We note that these Fokker-Planck equations are ordinary differential equations. Our derivation provides tools for many problems, including functional inequalities, numerics for nonlinear partial differential equations and evolutionary games on finite graphs. This is joint work with my colleagues Wilfrid Gangbo, Wuchen Li and Haomin Zhou at Georgia Institute of Technology.

Random dynamical systems generated by lattices perturbed by additive or multiplicative noise

Tomás Caraballo
Universidad de Sevilla

The objective of this talk is to report on recent advances in the topic of random dynamical systems generated by stochastic lattice differential systems. We will focus on problems containing additive and multiplicative noise and will emphasize the differences when considering a finite number of noisy terms at each node (essentially the same noise in each node) or a different noisy perturbation at each one. We will show how these systems generate a random dynamical system possessing a random attractor.

Reducibility of a Quasi-Periodic Linear KdV Equation

Yingfei Yi
University of Alberta & Jilin University

We consider the following linear, one-dimensional, quasi-periodic forced KdV equations

$$u_t + (1 + a_1(\omega t, x))u_{xxx} + a_2(\omega t, x)u_{xx} + a_3(\omega t, x)u_x + a_4(\omega t, x)u = 0$$

under periodic boundary condition $u(t, x + 2\pi) = u(t, x)$, where $a_i : \mathbb{T}^b \times T^1 \to \mathbb{R}$, $i = 1, \cdots, 4$, are small amplitude, real analytic functions. Under some reversibility conditions of the coefficients, we show that there exists a Cantor set of $\omega \in [0, 1]^b$ of full Lebesgue measure for which the equation is reducible to a constant-coefficients one. This problem is closely related to the existence and linear stability of quasi-periodic solutions in a nonlinear Schrödinger equation.

ICMC Summer Meeting on Differential Equations

2016 Chapter

Special Sessions

Conservation Laws and Transport Equations

Organizer: Wladimir A. Neves

Existence of strong trace for quasi-solution of conservation laws: Non-homogeneous case

Jean Silva, Wladimir Neves, E. Yu. Panov
Universidade Federal do Rio de Janeiro

In this talk, we consider a non-homogeneous conservation laws in a domain with smooth boundary and we stablish conditions in order to obtain the existence of strong trace for the normal components. Non-degeneracy conditions on the flux are required.

The global in time solvability the boundary value problem to nondiagonal parabolic systems with conservation law

Mikhail Vishnevski, Wladimir Neves
Universidade Estadual do Norte Fluminense

The main purpose of this communication is to present some technique and result of global existence of classical solutions of nondiagonal reaction-diffusion system with conservation law.

Nelson's conjecture revisited

Olivier Kneuss, Wladimir Neves
Universidade Federal do Rio de Janeiro

In this talk I will prove the existence of a bounded piecewise smooth divergence free vector field $a : \mathbb{R}^3 \to \mathbb{R}^3$ with compact support generating two distinct Lebesgue measure preserving flows in $\mathbb{R}^3$, hence disproving Nelson's conjecture. Note that none of the previously known such vector fields belongs to $L^p(\mathbb{R}^3)$ for $p < \infty$. As a byproduct I will also establish a non-uniqueness result for the linear transport equation. This is a joint work with Wladimir Neves.

Ant foraging dynamics: Reaction diffusion model and beyond.

Paulo Amorim, Ricardo Alonso, Thierry Goudon
Universidade Federal do Rio de Janeiro

I will present a reaction-diffusion system modeling ant foraging behaviour. The model is a system of parabolic PDEs of chemotaxis type and includes trail-laying and trail-following behaviour. I will present numerical simulations and also well-posedness results obtained with R. Alonso and T. Goudon. Finally, I will address some limitations of the model and discuss some new approaches.

An Itô-Ventzel formula for Holder paths

Pedro Catuogno, Rafael Castrequini
Universidade Estadual de Campinas

We obtain an Itô-Ventzel formula for Holder paths with exponent greater than $\frac{1}{3}$. Some applications to partial differential equations driven by a rough path are given.

The IBVP for a fractional degenerated heat equation

Wladimir Neves, Gerardo Huaroto
Universidade Federal do Rio de Janeiro

In this talk, we discuss the fractional Laplacian, in particular defined in bounded domains, and study the existence of solutions to a fractional and degenerated heat type equation posed in bounded domains.

Elliptic Equations

Organizer: Claudianor O. Alves

Boundary value problems for hypoelliptic evolution equations: Perron-Wiener solution and a cone-type criterion

Alessia E. Kogoj
Università degli Studi di Salerno

We show how to apply Harmonic Spaces Potential Theory in studying Dirichlet problem for a general class of evolution hypoelliptic PDEs of second order. We construct Perron-Wiener solution and we show a new regularity criterion for the boundary points. Our criterion extends and generalizes the classical parabolic-cone criterion for the Heat equation due to Effros and Kazdan. The class of operator to which our results apply contains the Heat operators on stratified Lie groups and the prototypes of the Kolmogorov operators.

Quasi-Linear corrections of the Schrodinger equations and critical points for non-differentiable functionals

Benedetta Pellacci, Lucio Boccardo
Università Parthenope di Napoli

We will prove the existence of a Mountain Pass solution of a quasi-linear Schrödinger equation in a bounded domain via variational methods. In order to do this we will have to study non-differentiable, and possibly unbounded functionals.

Sharp hessian integrability estimates for nonlinear elliptic equations

Edgard A. Pimentel, Eduardo V. Teixeira
Universidade Federal de São Carlos

In this talk, we present sharp $W^{2,p}$ regularity estimates for viscosity solutions of fully nonlinear elliptic equations under minimal, asymptotic assumptions on the governing operator F. By means of geometric tangential methods, we show that if the *recession* of the operator F – formally given by $F^*(M) := \infty^{-1}F(\infty M)$ – is convex, then any viscosity solution to the original equation $F(D^2u) = f(x)$ is locally of class $W^{2,p}$, provided $f \in L^p$, $p > d$, with appropriate universal estimates. Our result extends to operators with variable coefficients and, in this setting, they are new even under convexity of the frozen coefficient operator, $M \mapsto F(x_0, M)$, as oscillation is measured only at the recession level. Our methods further yield BMO regularity of the hessian, provided the source lies in that space. As a final application, we establish the density of $W^{2,p}$ solutions within the class of all continuous viscosity solutions, for generic fully nonlinear operators F. This result gives an alternative tool for treating common issues often faced in the theory of viscosity solutions. This is joint work with Eduardo V. Teixeira.

Fourth-order Schrödinger type operator with singular potentials

Federica Gregorio

Università di Salerno

In this paper we study the biharmonic operator perturbed by an inverse fourth-order potential. In particular, we consider the operator $A = \Delta^2 - V = \Delta^2 - \frac{c}{|x|^4}$ where c is any constant such that $c < C^*$, $C^* = \left(\frac{N(N-4)}{4}\right)^2$. The semigroup generated by $-A$ in $L^2(\mathbb{R}^N)$, $N \geq 5$, extrapolates to a bounded holomorphic C_0-semigroup on $L^p(\mathbb{R}^N)$ for $p \in [p_0', p_0]$ where $p_0 = \frac{2N}{N-4}$ and p_0' is its dual exponent. Furthermore, we study the boundedness of the Riesz transforms $\Delta A^{-1/2}$ on $L^p(\mathbb{R}^N)$ for all $p \in (p_0', 2]$.

The second CR Yamabe Invariant

Flávio Almeida Lemos, Ezequiel Barbosa

Universidade Federal de Ouro Preto

Let (M, θ) be a compact, connected, strictly pseudoconvex CR manifold with dimension $2n+1 \geq 3$. We define the second CR Yamabe invariant in terms of the second eigenvalue of the Yamabe operator and the volume of M over the pseudo-convex pseudo-hermitian structures $\widetilde{\theta}$ conformal to θ. Then we study when it is attained and classify the CR-sphere by its second CR Yamabe invariant.

Ground states of elliptic problems involving non homogeneous operators

Giovany M. Figueiredo, Humberto Ramos Quoirin

Universidade Federal do Pará

We investigate the existence of ground states for functionals with nonhomogenous principal part. Roughly speaking, we show that the Nehari manifold method requires no homogeinity on the principal part of a functional. This result is motivated by some elliptic problems involving nonhomogeneous operators. As an application, we prove the existence of a ground state and infinitely many solutions for three classes of boundary value problems.

Generalized spectrum for the (p,2)-Laplacian under parametric boundary conditions

Gustavo F. Madeira

Universidade Federal de São Carlos

In this lecture we consider the generalized spectrum of the (p,2)-Laplace operator under boundary conditions of Neumann or Steklov type. We show that the generalized spectrum consists of a point plus an unbounded interval. Moreover, the bottom of the interval is a bifurcation point for nonconstant solutions of the problem. Joint work with Jamil Abreu, from UFSCar.

Multivalued elliptic equation with exponential critical growth in $\mathbb{R}^2$

Jefferson A. Santos, Claudianor O. Alves

Universidade Federal de Campina Grande

In this work we study the existence of nontrivial solution for the following class of multivalued elliptic problems

$$-\Delta u + V(x)u - \epsilon h(x) \in \partial_t F(x,u) \quad \text{in} \quad \mathbb{R}^2, \tag{4}$$

where $\epsilon > 0$, V is a continuous function verifying some conditions, $h \in (H^1(\mathbb{R}^2))^*$ and $\partial_t F(x,u)$ is a generalized gradient of $F(x,t)$ with respect to t and $F(x,t) = \int_0^t f(x,s)\,ds$. Assuming that f has an exponential critical growth and a discontinuity point, we have applied Variational Methods for Locally Lipschitz Functional to get two solution for the above inclusion for ϵ small enough.

Schrödinger-Kirchhoff-Poisson type systems

João R. Santos Júnior, Cyril Joel Batkam

Universidade Federal do Pará

In this article we study the existence of solutions to the system

$$\begin{cases} -\left(a + b\int_\Omega |\nabla u|^2\right)\Delta u + \phi u = f(x,u) & \text{in } \Omega \\ -\Delta\phi = u^2 & \text{in } \Omega \\ u = \phi = 0 & \text{on } \partial\Omega, \end{cases}$$

where Ω is a bounded smooth domain of $\mathbb{R}^N$ ($N = 1, 2$ or 3), $a > 0$, $b \geq 0$, and $f : \overline{\Omega} \times \mathbb{R} \to \mathbb{R}$ is a continuous function which is 3-superlinear. By using some variants of the mountain pass theorem established in this paper, we show the existence of three solutions: one positive, one negative, and one which changes its sign. Furthermore, in case f is odd with respect to u we obtain an unbounded sequence of sign-changing solutions.

Regularity results for almost minimizers of a elliptic free boundary problem

Leandro da Silva Tavares

Universidade Estadual de Campinas

In this work we study the regularity of almost minimizers of the classical functional

$$J_\gamma(v) = \int_\Omega \langle A\nabla v, \nabla v\rangle + (v^+)^\gamma + (v^-)^\gamma dx,$$

where Ω is a bounded domain in R^n ($n \geq 2$) , $A = (a_{ij}), i, j = 1, ..., n$ is an elliptic matrix with Holder continuous coefficients with the functional considered in $H^1(\Omega) \cap L^\infty(\Omega)$, if $\gamma \in (0, 1]$ and in $H^1(\Omega)$ in the other case. This work was done in collaboration with Olivâine Queiroz from Unicamp.

A positive bound state for an asymptotically linear or superlinear Schrödinger equation

Liliane A Maia, Mónica Clapp
Universidade de Brasília

We will present some recent results on the existence of a positive solution to the stationary nonlinear Schrödinger equation

$$-\Delta u + V(x)u = f(u), \qquad u \in H^1(\mathbb{R}^N),$$

in situations where this problem does not have a ground state. We consider general superlinear nonlinearities and asymptotically linear ones, as well. This is a work in collaboration with Mónica Clapp from Universidad Nacional Autónoma de México.

Lotka-Volterra models with fractional diffusion

Marcos T. O. Pimenta, Antonio Suarez, Michelle O. Alves
Universidade Estadual Paulista

In this work we study the Lotka-Volterra models with fractional Laplacian. For that, we study in details the logistic problem with fractional diffusion and show that the sub-supersolution method works for the scalar problem and in case of systems as well. We apply this method to show existence and non-existence of positive solutions in terms of the system parameters.

Weighted Trudinger-Moser inequalities and applications

Marta Calanchi, Bernhard Ruf
Università degli Studi di Milano

Trudinger Moser inequalities provide continuous embeddings in the borderline cases of the standard Sobolev embeddings, in which the embeddings into Lebesgue L^p spaces break down. One is led to consider their natural generalization, which are embeddings into Orlicz spaces with corresponding maximal growth functions which are of exponential type. Some parameters come up in the description of these growth functions. The parameter ranges for which embeddings exist increase by the use of weights in the Sobolev norm, and one is led to consider weighted TM inequalities. Some interesting cases are presented for special weights in dimension two, with applications to mean field equations of Liouville type.

The p-laplacian on thin domains: Dirichlet vs Neumann boundary condition

Ricardo P. Silva, Marcone C. Pereira
Universidade de Brasília

We investigate the limiting behavior of solutions of quasilinear elliptic equations on thin domains. As we will see the boundary conditions play an important role. If one considers homogeneous Dirichlet boundary conditions the sequence of solutions will converges to the null function, whereas, if one considers Neumann boundary conditions there is a non trivial equation which determines the limiting behavior.

A new result about uniqueness of radial nodal solution for nonhomogeneous semilinear Dirichlet problems

Sigifredo Herrón Osorio, Hugo Aduén Muskus
Universidad Nacional de Colombia Sede Medellín

In this talk we present a brief review about uniqueness of radial solution for certain semilinear elliptic problems with a prescribed number of zeros. Then we address our lecture in a new uniqueness result for a superlinear Dirichlet problem. More exactly we present a uniqueness result to the problem

$$\begin{cases} \Delta u + f(|x|,u) = q(|x|), \quad \Omega := \{x \in \mathbb{R}^N : a < |x| < b\}, \\ u = 0, \text{ on } \partial\Omega, \\ u \text{ has exactly } k \text{ nodal region in } \Omega, \end{cases} \tag{P_k}$$

where

$$f(|x|,u) := K(|x|)|u|^{p-1}u, K \in C^2(\Omega), K > 0 \text{ in } \Omega \text{ and,}$$
$$q(|x|) := C \cdot K(|x|)|x|^{-p(N-2)},$$

for some adequate positive constant C.

Keywords: Prescribed number of zeros, elliptic problems, uniqueness of nonhomogeneous problems.

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[2] W. Dambrosio, *On the multiplicity of radial solutions to superlinear Dirichlet problems in bounded domains*. Journal of Differential Equations Volume 196 **1** (2004):91-118.

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Neumann problems with resonance in the first eingevalue

Wallisom da Silva Rosa, Francisco Odair Vieira de Paiva
Universidade Federal de Uberlândia

The aim of this work is to present results of existence of solutions for a class of superlinear asymmetric elliptic systems with resonance in the first eigenvalue. The asymmetry that we consider has linear behavior on $-\infty$ and superlinear on $+\infty$. To obtain these results we apply topological degree theory.

Fluid Dynamics

Organizer: Anne C. Bronzi

Mixed-hybrid finite element method for continuous flows in porous media

César Guilherme de Almeida, Eduard Rojas Castillo
Universidade Federal de Uberlândia

In this work, we are going to present some approximation techniques based on mixed-hybrid finite element method for both elliptic and convection-dominated parabolic equations corresponding to the model of the incompressible miscible displacement of the mixture of a solvent, with concentration c, and oil, in a mean free of gravitational effects. The system of governing equations is given by

$$\operatorname{div}(u) = q, \qquad u = \frac{-\mathcal{K}}{\mu(c)}\nabla p, \tag{5}$$

$$\phi\frac{\partial c}{\partial t} + \operatorname{div}(uc - D(u)\nabla c) = \widetilde{c}q, \tag{6}$$

where u is the Darcy's velocity; $\mathcal{K} = \mathcal{K}(\mathbf{x})$ is the absolute permeability of the rock at $\mathbf{x} = (x, y) \in \mathbb{R}^2$; $\mu = \mu(c)$ is the viscosity of the fluid, which depends on the solvent concentration, $c = c(\mathbf{x}, t)$; the pressure gradient is given by $\nabla p = \nabla p(\mathbf{x})$; the porosity of the medium is ϕ, which we consider as a positive constant; $q = q(\mathbf{x}, t)$ is the total volumetric flow rate at the well; $\widetilde{c}$ is the specified concentration at an injection well and the resident concentration at a producer; D is the diffusion-dispersion tensor given by:

$$D = D(u) = \phi d_m I + \frac{d_\ell}{|u|}\begin{pmatrix} u_1^2 & u_1u_2 \\ u_1u_2 & u_2^2 \end{pmatrix} + \frac{d_t}{|u|}\begin{pmatrix} u_2^2 & -u_1u_2 \\ -u_1u_2 & u_1^2 \end{pmatrix}.$$

In this tensor, $d_\ell \gg d_t$ and $d_t \geq 0$ are longitudinal and transverse dispersion coefficients, respectively, and $d_m > 0$ is the molecular diffusion coefficient.

Ackowledgment. The authors would like to thank the FAPEMIG.
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Energy decay characterization for solutions to some equations in fluid dynamics

César J. Niche, María E. Schonbek
Universidade Federal do Rio de Janeiro

Solutions to many dissipative equations in Fluid Mechanics, like the Navier-Stokes, quasi-geostrophic and Navier-Stokes-Voigt equations, obey energy inequalities that imply that their L^2 or Sobolev norms decay in time. In the late 80's M.E. Schonbek developed the Fourier Splitting method, which has been widely used to establish decay rates for these and many other systems of equations.

The Fourier Splitting method is based on the idea that "long time behavior of solutions is determined by small frequencies" and for it to provide uniform decay rates, it is necessary to restrict initial data to subsets of L^2 having some properties (say, $L^p \cap L^2, 1 \leq p < 2$, or data for which the linear part of the equations has certain decay rate). The question that then naturally arises is whether it is possible to establish decay for *any* initial data in L^2.

In this talk we will describe recent work (some of it in collaboration with M.E. Schonbek) in which we characterize the decay, for any initial data, of solutions to many families of dissipative equations. This description is based on the *decay character* $r^* = r^*(u_0)$ associated to any initial datum u_0. This number is, roughly speaking, the order of u_0 at the origin in frequency space and can be used to give explicit upper (and sometimes lower) bounds for the decay rates. As a consequence of this, we show how the same initial datum can produce quantitatively and qualitatively different behavior for solutions to very similar equations.

Friction coefficient for shear-thinning fluid flows

Fabio Ramos

Universidade Federal do Rio de Janeiro

We propose a new friction formula for turbulent power-law fluid flows, a class of purely viscous Non-Newtonian fluids commonly found in applications. Our model is derived through a friction factor analysis based on Kolmogorov's phenomenology. Tests against classical empirical data show excellent agreement over a significant range of Reynolds number. Limits of the model are also discussed.

Regularity results and solidifications processes

Luís de Miranda

Universidade de Brasília

In this talk, we address the analysis of the irreversible solidification process for certain materials, such as polymers. Essentially, the differential equations involved consist of a nonlinear system, accounting for the fluid flow in molten regions, coupled to a differential inclusion which is responsible for the solidification itself. We will focus at the mathematical difficulties for a proper analysis of the phenomenon. It turns out that there is a sutle relation between the existence of weak/strong solutions for this sort of model and regularity results for Quasilinear degenerate equations in the so-called Sobolev Spaces of fractional order.

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On a bilinear estimate in weak-Morrey spaces and uniqueness for Navier-Stokes equations

Lucas C. F. Ferreira

Universidade Estadual de Campinas

This talk is concerned with the continuity of the bilinear term B associated with the mild formulation of the Navier-Stokes equations. We provide a new proof for the continuity of B in critical weak-Morrey spaces without using auxiliary norms of Besov type neither Kato time-weighted norms. As a byproduct, we reobtain the uniqueness of mild solutions in the class of continuous functions from $[0,T)$ to critical Morrey spaces. Our proof consists in estimates in block spaces (based on Lorentz spaces) that are preduals of Morrey-Lorentz spaces. For that, we need to obtain properties like interpolation of operators, duality, Hölder and Young type inequalities in such block spaces.

Uniform global well-posedness of the Navier-Stokes-Coriolis system in a new critical space

Marcelo Fernandes de Almeida, Lidiane S. M. Lima, Lucas C. F. Ferreira

Universidade Federal de Sergipe

We prove global well-posedness for the Navier-Stokes-Coriolis system (NSC) in a critical space whose definition is based on Fourier transform, namely the Fourier-Besov-Morrey space $\mathcal{FN}^{\mu-1}_{1,\mu,\infty}$ with $0 < \mu < 3$. The smallness condition on the initial data is uniform with respect to the angular velocity ω. Our result provides a new class for the uniform global solvability of (NSC) and covers some previous ones. For $\mu = 0$, (NSC) is ill-posedness in $\mathcal{FN}^{\mu-1}_{1,\mu,\infty}$ which shows the optimality of the results with respect to the space parameter $\mu > 0$. The lack of Hausdorff-Young inequality in Morrey spaces suggests that there are no inclusion relations between $\mathcal{FN}^{\mu-1}_{1,\mu,\infty}$ and the largest previously known classes of Kozono-Yamazaki (Besov-Morrey space) and Koch-Tataru (BMO^{-1}). So, taking in particular $\omega = 0$, we obtain a critical initial data class that seems to be new for global existence of solutions of the Navier-Stokes equations (3DNS).

Steady flow for incompressible fluids in domains with unbounded curved channels

Marcelo Santos

Universidade Estadual de Campinas

We give an overview on the solution of the stationary Navier-Stokes equations for non newtonian incompressible fluids established by G. Dias and M.M. Santos (*Steady flow for shear thickening fluids with arbitrary fluxes*, J. Differential Equations **252** (2012), no. 6, 3873-3898)[1], propose a definition for domains with unbounded curved channels which encompasses domains with an unbounded boundary, domains with nozzles, and domains with a boundary being a punctured surface, and argue on the existence of steady flow for incompressible fluids with arbitrary fluxes in such domains. The slides I shall use for this talk are available at http://www.ime.unicamp.br/~msantos/ICMC2016.pdf.

[1] Cf. ArXiv: 1108.3595.

Boundary controllability of incompressible Euler fluids with Boussinesq heat effects

Maurício C. Santos, Enrique Fernández-Cara, Diego A. Souza
Universidade Federal de Pernambuco

We deal with the boundary controllability of inviscid incompressible fluids for which thermal effects are important. They will be modeled through the so-called Boussinesq approximation. In the zero heat diffusion case, by adapting and extending some ideas from J.-M. Coron and O. Glass, we establish the simultaneous global exact controllability of the velocity field and the temperature for 2D and 3D flows. When the heat diffusion coefficient is positive, we present some additional results concerning exact controllability for the velocity field and local null controllability of the temperature.

A Novel regularity to the Stoke's operator

Paulo M. Carvalho Neto, G. Planas
Universidade Estadual de Campinas

In the recent literature Carvalho-Neto and Planas proved that the mild solution to the Navier–Stokes equations with time fractional derivative of order $\alpha \in (0,1)$ belongs to the Banach space $L^r(0,\infty;L^q_\sigma(\mathbb{R}^N))$, where the parameters r and q satisfies $1/r = \alpha[1-(N/q)]/2$ and $N < q < \alpha N^2/(\alpha N - 2)$. In particular, if $N = 3$ it is deduced that the solution belongs to $L^{3/\alpha}(0,\infty;L^9_\sigma(\mathbb{R}^3))$ for any $\alpha \in (2/3, 1)$.

The aim of this lecture, supported by the last conclusion, is to prove that a certain regularity can be inherited to the Stokes operator through the application of a limit argument. Indeed, it is proved that the Stokes operator belongs to the space $L^{3+\epsilon}(\delta,\infty;L^9_\sigma(\mathbb{R}^3))$ for any $\delta, \epsilon > 0$.

Decay estimates in real Hardy spaces for dissipative evolution equations

Tiago Picon
Universidade de São Paulo

In this lecture we present asymptotic-in-time linear estimates in Hardy spaces $H^p(\mathbb{R}^n)$ for the Cauchy problem for evolution operators with structural dissipation. The obtained estimates are a natural extension of the known $L^p - L^q$ estimates, $1 \le p \le q \le \infty$, for these models. Different, standard, tools to work in Hardy spaces are used to derive optimal estimates.

This is joint work with Marcelo Ebert and Marcello D'Abbicco from FFCLRP.

Linear Equations

Organizer: Adalberto P. Bergamasco

Global solvability of involutive systems

Giuliano Zugliani, Jorge Hounie
Universidade Federal de São Carlos

We are interested in studying a linear operator associated with a closed non-exact real analytic 1-form b defined on a compact real analytic manifold M. Locally, we have an overdetermined system of first order linear partial differential equations, which generate a tube structure.

In order to find a global and smooth solution to the system, we require that, in a special covering space, the superlevel and sublevel sets of a primitive of b there defined are connected. If Σ denotes the set $\{t \in M : b(t) = 0\}$, this property implies that, for every connected component Σ_0 of Σ, there exists $p^* \in \Sigma_0$ such that the local primitives of b are open at p^*.

This is a joint work with Jorge G. Hounie from UFSCar. We thank FAPESP for the financial support.

A representation result and Gevrey solvability.

Luis Fernando Ragognette
Universidade de São Paulo

In the article "Gevrey solvability and Gevrey regularity in differential complexes associated to locally integrable structures", P.A.S. Caetano and P.D. Cordaro proved that given T' a Gevrey locally integrable structure of order s such that the differential complex associated to T' is locally solvable in the C^∞ sense at the origin in degree q then we have that it is also locally solvable in the G^s sense at the origin in degree q.

The key component to prove this result is a representation theorem that assures that every C^∞ function in a hypo-analytic chart has a representation usying an operator of infinite order(we call it an ultradifferential operator) applied to a Gevrey function of order s.

On the other hand, H. Komatsu proved in "Ultradistributions I" that every ultradistribution can be represented by an ultradifferential operator applied to a continuous function.

In this work we prove that every ultradistribution of order s in a hypo-analytic chart can be represented usying ultradifferential operators and Gevrey functions of order s and this allow us to relate different concepts of local solvability in the Gevrey sense.

Reconstruction of pde coefficients with overprescripton of Cauchy data at the boundary

Nilson Costa Roberty
Universidade Federal do Rio de Janeiro

Frequently incomplete information about coefficients in partial differential equations is compensated by an overprescription of Cauchy data at the boundary. We analyses this kind of boundary value problems in an elliptic system posed in Lipschitz domains. The main techniques are variational formulation, boundary integral equations and Calderon projector. To estimate those coefficients we

propose a variational formulation based on internal discrepancy observed in mixed boundary value problem obtaining by splitting the overprescrited Cauchy data. The question of existence of solution will be discussed.

Spectral invariance of elliptic boundary value problems with conical singularities

Pedro Tavares Paes Lopes

Universidade de São Paulo

Suppose we have an algebra A that contains a subalgebra B. We say that B has the spectral invariance property with respect to A if, whenever an element of B has an inverse in A, the inverse of this element also belongs to B.

This property was shown to hold on several pseudodifferential algebras. In this case, B is the an algebra of zero order pseudodifferential operators and A is the space of bounded operators in a Banach space, where the pseudos act continuously.

In this talk I will describe the algebra of pseudodifferential operators used to study boundary value problems with conical singularities and how to prove spectral invariance of this algebra.

Existence of solutions for certain non-globally hypoelliptic vector fields

Rafael Borro Gonzalez

Universidade de São Paulo

We study the range of a class of non-globally hypoelliptic vector fields on a torus of dimension higher than two, for instance, $L = \partial_t + (a + ib)(x)\partial_x + \lambda\partial_y$ on $\mathbb{T}^3$. Concerning the finiteness of range's codimension, the number of times that b changes sign is crucial. This condition is related to the Nirenberg-Treves condition (P).

Nonlinear Dynamical Systems

Organizer: Sergio M. Oliva Filho

On impulsive semidynamical systems: asymptotic almost periodic motion and Zhukovkij stabiliy

Ginnara Mexia Souto, Everaldo de Mello Bonotto, Luciene Perron Gimenes
Universidade de São Paulo

In this work we deals with recursive properties and stability on impulsive semidynamical systems. We shall give sufficient conditions to obtain the existence of asymptotic almost periodic motions in impulsive semidynamical systems and we also investigate the concept of quasi stability of Zhukovskij for impulsive systems to get asymptotic properties.

On the continuity of attractors for a Chafee-Infante equation in $\mathbb{R}$

Henrique Barbosa da Costa, Alexandre Nolasco de Carvalho, Pedro Marín-Rubio
Universidade de São Paulo

We will discuss continuity of attractors for a Chafee-Infante equation on the one-dimensional space $\mathbb{R}$ and look for clues of asymptotic stability when we approximate the unbounded domain by a family of bounded ones. We may discuss some topics on generation of semigroups on the space of locally uniform Lebesgue integrable functions, upper semicontinuity of global attractors and some words on lower semicontinuity of equilibria and/or attractors.

Stabilizing effect of large average initial velocity in forced dissipative PDEs invariant with respect to Galilean transformations

Jacek Cyranka, Piotr Zgliczyński
Rutgers - The State University of New Jersey

We present a topological method to study the dynamics of dissipative PDEs on a torus with rapidly oscillating forcing terms from [1]. We show that a dissipative PDE, which is invariant with respect to Galilean transformations, with a large average initial velocity can be reduced to a problem with rapidly oscillating forcing terms. We apply the technique to the Burgers equation, and the incompressible 2D Navier-Stokes equations with a time-dependent forcing. We prove that for a large initial average speed the equation admits a bounded eternal solution, which attracts all other solutions forward in time.

We briefly present a related result obtained using different techniques of classical PDEs analysis for more general forcings from [2], and we provide some illustrative numerical examples derived using the 2D Kolgomorov turbulence model.

[1] J. Cyranka, P. Zgliczyński, Stabilizing effect of large average initial velocity in forced dissipative PDEs invariant with respect to Galilean transformations, 2015, arXiv:1407.1712.

[2] J. Cyranka, P. Mucha, E. Titi, P. Zgliczyński, Stabilizing the Long-time Behavior of the Navier-Stokes Equations, 2016, preprint.

Non-autonomous parabolic equations with unbounded pullback attractors

Juliana F. S. Pimentel, Alexandre N. Carvalho
Universidade de São Paulo

We consider non-dissipative semilinear parabolic equations on a bounded interval. We review the recently developed theory for the autonomous version of this class of problems and present a characterization for the associated noncompact global attractor. We also examine a non-autonomous variation and take into account distinct regimes for the non-autonomous linear term; in this setting we investigate the dynamics on the related unbounded pullback attractor.

Asymptotic behaviour of non-autonomous equations - Part II: A nonclassical parabolic equation

Felipe Rivero, Matheus C. Bortolan
Universidade Federal Fluminense

In this talk I will show our study of the existence and continuity of four different notions of *non-autonomous attractors* for a family of non-autonomous non-classical parabolic equations given by

$$\begin{cases} u_t - \gamma(t)\Delta u_t - \Delta u = g_\epsilon(t,u), \text{ in } \Omega \\ u = 0, \text{ on } \partial\Omega. \end{cases}$$

in a smooth bounded domain $\Omega \subset \mathbb{R}^n$, $n \geqslant 3$, where the terms g_ϵ are a small perturbation, in some sense, of a function f that depends only on u.

Well-posedness for multicomponent Schrödinger-gKdV systems and stability of solitary waves with prescribed mass

Mahendra Panthee, Santosh Bhattarai, Adan Corcho
Universidade Estadual de Campinas

In this talk we present the well-posedness issues of the associated initial value problem, the existence of nontrivial solutions with prescribed L^2-norm, and the stability of associated solitary waves for two classes of coupled nonlinear dispersive equations. The first model here describes the nonlinear interaction between two Schrödinger type short waves and a generalized Korteweg-de Vries type long wave and the second model describes the nonlinear interaction of two generalized Korteweg-de Vries type long waves with a common Schrödinger type short wave. The results here extend many of the previously obtained results for two-component coupled Schrödinger-Korteweg-de Vries systems.

Semilinear elliptic problems in oscillating thin domains

Marcone C. Pereira
Universidade de São Paulo

In this talk we present some results from [1,2] about the asymptotic behavior of the family of solutions of a semilinear elliptic problem with homogeneous Neumann boundary condition posed on two dimensional thin domains with locally periodic structure on the boundary. First we discuss the limit problem assuming the thin domain degenerates to the unit interval also analyzing its dependence with respect to the geometry of the thin channel. Next we study its convergence investigating upper and lower semicontinuity of this family of solutions.

[1] Pereira M. C., *Parabolic problems in highly oscillating thin domains*, Ann. Mat. Pura Appl. (4) 194 (2015) 1203-1244.

[2] Pereira M. C., *Asymptotic analysis of a semilinear elliptic equation in highly oscillating thin domains*, Submitted.

Asymptotic behaviour of non-autonomous equations - Part I

Matheus C. Bortolan, Felipe Rivero

Universidade Federal de Santa Catarina

This is the first of a two-part talk about asymptotic behaviour of non-autonomous equations. The second part will be delivered by Felipe Rivero.

In this first part, we will discuss the abstract theory of asymptotic behaviour of non-autonomous equations: its different frameworks and approaches, where we will present the relationships among them all, to provide a full description of the long time behaviour of solutions.

Towards using TDA for building early warning systems

Miroslav Kramar, Konstantin Mischaikow, Lou Kondic, Michael Schatz, Claudia Colonnello

AIMR Tohoku University

In the first part of the talk we will introduce the methods of the topological data analysis. Namely, the persistence diagrams which are a relatively new topological tool for describing and quantifying complicated patterns in a simple but meaningful way. We will demonstrate this technique on patterns appearing in Rayleigh-Benard convection and dense granular media. This procedure allows us to transform experimental or numerical data from experiment or simulation into a point cloud in the space of persistence diagrams. There are a variety of metrics that can be imposed on the space of persistence diagrams. By choosing different metrics one can interrogate the pattern locally or globally, which provides deeper insight into the dynamics of the process of pattern formation.

In the second part of the talk we will discuss the deformation patterns of silo walls during gravity-driven granular discharges. Depending on the initial filing hight and/or protocol the silos might undergo serious deformations leading to a potential collapse. We will show that our methods can clearly distinguish the collapsing silos during the early stages of the discharge.

Nonlocal reaction-diffusion equations without uniqueness

Pedro Marín-Rubio, Tomás Caraballo, Marta Herrera-Cobos

Universidad de Sevilla

In this talk we will discuss on the existence of weak solutions to a reaction-diffusion problem with nonlocal viscosity term for which uniqueness of solution is not guaranteed. Then, some continuity properties and the long-time behavior of the solutions are analyzed.

This is a joint work with T. Caraballo and Marta Herrera-Cobos, from Universidad de Sevilla (SPAIN). It has been partially supported by FEDER and Ministerio de Economía y Competitividad (Spain) Grant MTM2011-22411 and by Junta de AndalucÃŋa Grant P12-FQM- 1492. M.H.-C. is a fellow of Programa de FPI del Ministerio de Economía y Competitividad, reference BES-2012-053398.

Humman mobility in epidemious models and non-local diffusions

Sergio Oliva
Universidade de São Paulo

We follow the modelling ideas of Brockmann where, from a simple epidemiologial SIR model where human mobility is introduced, we get a Reaction Diffusion equation with fractional power diffusion.

The first interested mathematical and epidemiological question is how to characterized the existence of positive equilibrium (the so called endemic) to this equations.

Pullback dynamics of non-autonomous wave equations with acoustic boundary condition

Thales Maier de Souza, To Fu Ma
Universidade de São Paulo

This work is concerned with a class of wave equations with acoustic boundary condition subject to non-autonomous external forces. Under some general assumptions, the problem generates a well-posed evolution process. Then we establish the existence of a unique pullback attractor within a universe of tempered sets defined by the forcing terms. We also study the upper semicontinuity of attractors as the non-autonomous perturbation tends to zero. Our results allow unbounded external forces and nonlinearities with critical growth.

Pullback dynamics of a Bresse-Timoshenko system

To Fu Ma, Ana Claudia Pereira, Julio Santiago Prates Filho
Universidade de São Paulo

The Timoshenko system, also called Bresse-Timoshenko, is a pair of wave equations with a distinguished coupling arising in the study of vibrations of elastic beams. Here we discuss the existence of pullback exponential attractors for a semilinear system with non-autonomous external perturbations.

On a fourth order nonlocal model for a prestressed plate

Vanderley A Ferreira Junior
Universidade de São Paulo

A nonlocal model for a vibrating narrow plate under prestressing is considered. Analysis of simple modes of oscillations indicates how longitudinal movement may give rise to torsional deformations in an ellastic plate under equilibrium.

Pullback attractors for 2D Navier-Stokes equations with inhomogeneous boundary conditions or delay on lipschitz domain

Xinguang Yang, Yuming Qin, To Fu Ma
Henan Normal University & Universidade de São Paulo

The Navier-Stokes equations give the essential law of the fluid flow. Based on the global well-posedness, we derive the pullback attractors for incompressible 2D Navier-Stokes equations with nonhomogeneous boundary conditions or multi-delays on Lipschitz domain.

Ordinary-Functional Differential Equations

Organizers: Bruno de Andrade & Jaqueline G. Mesquita

Exact solutions for some kind of periodic sytems

Antonio Acosta, Alexander López

Yachay Tech University

We consider a system of the type $\dot{x} = A(t)x$, where $A(t)$ is a periodic antisymmetric matrix. We obtain, under suitable conditions of the parameters appearing in $A(t)$, exact periodic solutions. In addition, we study the existence of periodic solutions for a perturbed system. Our problem is related with an equation of the type $i\frac{\partial U}{\partial t} = H(t)U$ which is important in physical problems associated, for instance, to nuclear magnetic resonance and photon assisted transport in nano structure.

Local well-posedness for a plate equation with memory via an abstract approach

Arlucio Viana, Bruno de Andrade

Universidade Federal de Sergipe

By means of an abstract approach, we seek to study local existence, uniqueness and continuous dependence of mild solutions of the following strongly damped plate equation:

$$u_{tt} = -\Delta^2 u + \mu\Delta u_t + \int_0^t a(t-s,(-\Delta)^\beta u(x,s))ds + |u|^{\rho-1}u,\ t>0,\ x\in\Omega; \quad (7)$$

$$u(0,x) = u_0(x),\ u_t(0,x) = u_1(x),\ x\in\Omega; \quad (8)$$

$$u(t,x) = \Delta u(t,x) = 0,\ t\geq 0,\ x\in\partial\Omega; \quad (9)$$

where $\mu > 0$, Ω is a sufficiently smooth bounded domain in $\mathbb{R}^N$, Δ^2 is the biharmonic with hinged boundary conditions and Δ is the Laplacian with Dirichlet boundary conditions in $L^2(\Omega)$.

The Grünwald-Letnikov derivative and the probabilistic weights for the values of a function and its derivative

Berenice C. Damasceno, Luciano Barbanti

Universidade Estadual Paulista

The Grünwald-Letnikov derivative at a point p provides for us a probabilistic structure in such way we are able in to do predictions on the hereditary points of p for a function and its derivative.

Existence and uniqueness of regular solutions to fractional integrodifferential equations

Bruno de Andrade
Universidade Federal de Sergipe

This talk is dedicated to the study of Fractional Integrodifferential equations. We analyze the existence of local mild solutions to the problem and their possible continuation to a maximal interval of existence. We also consider the problem of continuous dependence with respect to initial data. As application we consider a family of nonlinear Volterra equations coming from the theory of viscoelasticity.

A Massera's Theorem for functions defined on time scales

Eduard Toon, Hernan Henríquez, Jaqueline G. Mesquita
Universidade Federal de Juiz de Fora

We prove Massera's type result to establish the existence of periodic solutions of a dynamic equation on time scales defined on infinite dimensional Banach space and also, we prove Massera's type result to establish the existence of periodic solutions of a dynamic equation on time scales defined on $\mathbb{R}^n$. Finally, we prove that any almost periodic solution of dynamic equation on time scales is a p-periodic solution.

Maximal ℓ^p-regularity versus ℓ^p-boundedness of powerbounded operators

Filipe Dantas
Universidade Federal de Sergipe

We give the notion of ℓ^p-boundedness of powerbounded operators - which is more regular than concept of maximal ℓ^p-regularity proposed by Sönke Blunck - and we obtain a characterization theorem involving spectral properties, p-independence and stability. In addition, roughness-type theorems for ℓ^p-boundedness and maximal ℓ^p-regularity are given.

Stable integration of stochastic differential equations driven by general multiplicative noise

Hugo de la Cruz
Fundação Getúlio Vargas - Escola de Matemática Aplicada

This work develops a new approach for constructing strong local linearization-based methods for the approximation of multidimensional non-autonomous stochastic differential equations (SDEs). Using this approach, we construct new integrators for highly stiff stochastic equations and consequently suitable for the analysis and integration of important types of systems that function in the presence of random perturbations. We analyze the mean square stability property and the rate of convergence of the proposed methods. A comparative study with other methods in the literature is presented, showing the benefits of the proposed schemes in the integration of SDEs driven, in general, by multiplicative noise.

Keywords: stochastic differential equations, stability, local linearization method, multiplicative noise, approximation methods.

Bubble-type solutions of second order singular nonlinear ODE

Jana Burkotova
Palacky University Olomouc

We investigate the singular nonlinear second order ordinary differential equation

$$(p(t)u'(t))' + q(t)f(u(t)) = 0, \tag{10}$$

on unbounded domain $[0, \infty)$. Our aim is to prove the existence of a monotonously increasing solution satisfying the boundary conditions

$$u'(0) = 0, \quad \lim_{t\to\infty} u(t) = L. \tag{11}$$

This solution is called the bubble–type solution. In special cases, equation (10) together with the boundary conditions (11) describes formation of microscopic bubbles in a nonhomogeneous fluid.
In order to obtain existence results for bubble-type solutions, we study equation (10) subject to initial conditions

$$u(0) = u_0 \in [L_0, L], \quad u'(0) = 0, \tag{12}$$

where function f is continuous, has three zeros $f(L_0) = f(0) = f(L) = 0$, $L_0 < 0 < L$ and the sign conditions $xf(x) > 0$ for $x \in (L_0, 0) \cup (0, L)$ hold. Further, $p, q \in C[0, \infty)$ are positive on $(0, \infty)$ and $p(0) = 0$. The integral $\int_0^1 \frac{\mathrm{d}s}{p(s)}$ may be divergent which yields the time singularity at $t = 0$. By means of the existence and properties of different types of solutions of problem (10), (12) we prove the existence of a bubble-type solution of (10).

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Periodic averaging principle in quantum calculus

Jaqueline G. Mesquita, Martin Bohner
Universidade de Brasília

This is a joint work with Prof. Martin Bohner. The theory of averaging plays an important role for applications, since it can be used to study perturbation theory, control theory, stability of solutions, bifurcation, among others. In this work, we prove a periodic averaging principle for q-difference equations and present some examples to illustrate our result

Some remarks on forward Euler solutions, generalized solutions to discontinuous differential equations

Khalid Abdulaziz Alshammari
King Fahad University of Petroleum and Minerals

In this paper, we study the properties of one of the generalized solutions for ordinary differential equations with discontinuous right hand side, namely, the Forward-Euler Solution, which is simply the uniform limit of some Euler polygonal arcs x_{π_j}. We showed also by non-trivial examples that this solution is completely Independent from the other generalized solutions.

Almost automorphic solutions to second order abstract differential equations

Laura Gambera, Andrea Prokopczyk
Universidade Estadual Paulista

In this work we shall study the existence of an almost automorphic mild solution to the equation

$$x''(t) = Ax(t) + f(t, x(t)), \quad t \geq 0,$$

where X is a Banach space, $x(t) \in X$ for all $t \geq 0$, $A : \mathcal{D}(A) \subset X \to X$ is the infinitesimal generator of a strongly continuous cosine family $(C(t))_{t\in\mathbb{R}}$ of bounded linear operators on X and $f : [0, \infty) \to X$ is an appropriate function. This research was supported by FAPESP 2013/22813-3.

Every real function is the delta derivative of another on a computable time scale

Luciano Barbanti, Berenice C. Damasceno
Universidade Estadual Paulista

This work will be providing results about the fact that every real function can be the delta derivative of another any function on a computable time scale. Further we will be considering the fact that for every fixed time scale we can synthetize a class of pairs of functions in such a way the first is the delta derivate of the second one.

Asymptotic analysis for Volterra difference equations

Mario Choquehuanca, Claudio Cuevas, Herme Soto
Universidad De la Frontera

Let $\mathbb{X}$ be an arbitrary Banach space. This work will deals with some qualitative properties of solutions of the non-linear Volterra difference equation in $\mathbb{X}$ described by

$$u(n+1) = \lambda \sum_{j=-\infty}^{n} a(n-j)u(j) + f(n, u(n)), \quad n \in \mathbb{Z},$$

for λ in a distinguished subset of the complex plane, where $a(n)$ is a complex summable sequence and the perturbation f is a non-Lipschitz nonlinearity. Also we show a very interesting application.

Periodic averaging theorem for measure neutral FDEs

Patricia H. Tacuri, Jaqueline G. Mesquita
Universidade Estadual Paulista

In this work we prove a periodic averaging theorem for measure neutral functional differential equations. These class of equation are of type

$$\mathrm{D}[N(x_t, t)] = f(x_t, t)\mathrm{D}g(t)$$

and these equations can be regarded as generalized ordinary differential equations (we write generalized ODEs). By means of the correspondence between measure neutral functional differential equations and generalized ODEs, it is possible to state results on the existence, uniqueness and continuous dependence of solutions for our equation of neutral type.

Stabilization of a damped oscillatory differential equations with delayed control

Samuel Castillo
Universidad del Bío-Bío

Consider the dumped oscillatory differential equation with delayed control

$$m\ddot{x}(t) + \gamma\dot{x}(t) + \mu\dot{x}(t-r) + kx(t) = F(t),\ t \geq 0, \tag{13}$$

where m, γ, k are non negative constants such that $\gamma^2 < 4mk$, $\mu, r > 0$ are positive constants which represent control and delay respectively and $F(t)$ is an almost automorphic function. *How large μ need to be and how small r and $\sup|F(t)|$ need to be, to obtain stability for equation (13)?*

The characteristic quasi-polynomial of (13) is $P(\lambda) = m\lambda^2 + \gamma\lambda + \mu e^{-\lambda r}\lambda + k$. Its roots form a numerable set $\{\lambda_n(\mu, r)\}_{n\in\mathbb{N}} \subseteq \mathbb{C}$ such that $Re(\lambda_n(\mu, r)) \geq Re(\lambda_{n+1}(\mu, r))$ for all $n \in \mathbb{N}$, $\lambda_n(\mu, r) \to -\infty$ as $n \to +\infty$ y $\#\{\lambda \in \mathbb{C} : P(\lambda) = 0 \text{ e } Im(\lambda) = \beta\} < +\infty$, for all $\beta \in \mathbb{R}$. *To study the stability of (13) with $F(t) = 0$, a estimate of $Re(\lambda_1(\mu, r))$, in terms of μ and r will be given. This estimation is motivated by the study made in [4, section 2]. To estimate the necessary smallness of $F(t)$, methods used in [2] will be adapted.*

Comparisons with the example dealt in [3] will be given.

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Dynamics of nonautonomous chemostat models

Xiaoying Han, Tomas Caraballo, Peter Kloeden
Auburn University

Chemostat models have a long history in the biological sciences as well as in biomathematics. Hitherto most investigations have focused on autonomous systems, that is, with constant parameters, inputs and outputs. In many realistic situations these quantities can vary in time, either deterministically (e.g., periodically) or randomly. They are then non-autonomous dynamical systems for which the usual concepts of autonomous systems do not apply or are too restrictive. The newly developing theory of non-autonomous dynamical systems provides the necessary concepts, in particular that of a non-autonomous pullback attractor. These will be used here to analyze the dynamical behavior of non-autonomous chemostat models with or without wall growth, time dependent delays, variable inputs and outputs. The possibility of over-yielding in non-autonomous chemostats will also be discussed.

Poster Session

Organizer: Juliana F. S. Pimentel

Multiplicity and concentration behavior of solutions for a quasilinear problem involving N-functions via penalization method

Ailton Rodrigues da Silva, Claudianor O. Alves
Universidade Federal de Campina Grande

In this work, we study the existence, multiplicity and concentration of positive solutions for the following class of quasilinear problems

$$-\mathrm{div}\big(\epsilon^2\phi(\epsilon|\nabla u|)\nabla u\big) + V(x)\phi(|u|)u = f(u) \quad \text{in} \quad \mathbb{R}^N,$$

where, ϵ is a positive parameter, $N \geq 2$, V, f are continuous functions satisfying some technical conditions and $\phi : [0, +\infty) \to [0, +\infty)$ is a C^1-function.

Nodal ground state solution to a biharmonic equation via dual method

Alânnio Barbosa Nóbrega, Claudianor Oliveira Alves
Universidade Federal de Campina Grande

Using dual method we establish the existence of nodal ground state solution for the following class of problems

$$\begin{cases} \Delta^2 u = f(u), & \text{in} \quad \Omega, \\ u = Bu = 0, & \text{on} \quad \partial\Omega \end{cases}$$

where Δ^2 is the biharmonic operator, $B = \Delta$ or $B = \dfrac{\partial}{\partial\nu}$ and f is a C^1- function having subcritical growth.

Fractional semilinear heat equation

Daniel Vieira da Rocha, German Jesus Lozada Cruz
Universidade Estadual Paulista

Our goal in this work is to collect and to compare various definitions of the fractional powers for $-\Delta$ that can be found in the literature. We will discuss an equivalence of some of these definitions that coincide, in certain sense, with that given by Balakrishnan and compare properties of that notions in different approaches. We will use next this knowledge to the studies of the semilinear Cauchy problem in $\mathbb{R}^N$ with fractional Laplacian (see (14)).

$$\begin{cases} u_t & = -(-\Delta)^\alpha u + f(x,u),\ t > 0, x \in \mathbb{R}^N, \\ u(0,x) & = u_0(x),\ x \in \mathbb{R}^N. \end{cases} \tag{14}$$

One of the natural origin for equations including fractional-order derivative is the stochastic analysis; if the driven process is a jumps process (Lévy process), then the corresponding Fokker-Planck equation will contain a fractional Laplacian. In this last years, in the study of fluid mechanics, finances,

molecular biology and many other fields, it was discovered that the indraught of random factors can bring many new phenomena and features which are more realistic than the deterministic approach alone. Hence, it is natural to include stochastic terms, in particular fractional-order operators, when we establish the mathematical models. Moreover, the problems containing such fractional-order derivative terms becomes more challenging and many classical PDEs methods are hardly applicable directly to them, so that new ideas and theories are required.

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Uniqueness for the stochastic transport equations with bounded drift

David Alexander Chipana Mollinedo
Universidade Tecnológica Federal do Paraná

The linear transport equation, that is

$$\partial_t u(t,x) + b(t,x) \cdot \nabla u(t,x) = 0\,, \tag{15}$$

has several and diverse physical applications, for instance, to fluid dynamics. In the seminal work "Ordinary Differential Equations, Transport Theory and Sobolev Spaces" R.J. Di Perna and P. L. Lions proved uniqueness under the assumption that b is in the Sobolev class (locally in space), and later L. Ambrosio in your work "Transport Equations and Cauchy Problem for BV Vector Fiel" extended this result to vector field b in the class BV (locally in space). Under conditions weaker on the vector field b of the equation (15) there are examples of non uniqueness (see e.g. [3]). So, recently has been much attention devoted to extensions of this theory under random perturbations of the drift vector field, namely considering the stochastic linear transport equation:

$$\begin{cases} \partial_t u(t,x) + b(t,x) \cdot \nabla u(t,x) + \dfrac{dB_t}{dt} \cdot \nabla u(t,x) = 0\,, \\ u|_{t=0} = u_0\,, \end{cases} \tag{16}$$

where, $(t,x) \in [0,T] \times I\!R^d$, $b : I\!R_+ \times I\!R^d \to I\!R^d$ is a given vector field and $B_t = (B_t^1, ..., B_t^d)$ is a standard Brownian motion in $\mathbb{R}^d$, u_0 is the initial condition and the stochastic integration is to be understood in the Stratonovich sense.

The concern more important of this work is to prove existence and mainly uniqueness of L^2 - weak solutions for bounded vector fields for any initial data $u_0 \in L^2(\mathbb{R}^d)$ to the stochastic transport equation (16). The method applied here is via duality for parabolic equations (to see e.g. [1]).

[1] Doyoom Kim, N. V. Krylov, *Parabolic Equations with Measurable Coefficients*, Potential Anal, 26: 345-361, 2007.

[2] E. Fedrizzi, W. Neves and C. Olivera, *On a class of stochastic transport equation for L^2_{loc} vector fields*, Preprint available on Arxiv: 1410.6631, 2014.

[3] F. Flandoli, M. Gubinelli, E. Priola, *Well-posedness of the transport equation by stochastic perturbation*, Invent. Math., 180, 1-53, 2010.

Minimal, recurrent and almost periodic motions in impulsive semidynamical systems

Manuel Francisco Zuloeta Jimenez, Everaldo de Mello Bonotto
Universidade Tecnológica Federal do Paraná

This work concerns results about minimal, recurrent and almost periodic motions in impulsive semidynamical systems. First, we investigate general properties of minimal sets. In the sequel, we study some relations among minimal, recurrent and almost periodic motions. Some important results from the classical dynamical systems theory are generalized to the impulsive case, as Birkhoff's theorem for instance.

Domains of fractional powers of matrix-valued differential operators arising in heat-structure interaction models, with highly coupled boundary conditions at the interface

Marcelo Bongarti, Roberto Triggiani, Irena Lasiecka

Universidade Estadual Paulista

We consider a 3d-system consisting of two partial differential equations: a heat equation defined on an external domain and a wave equation with strong damping defined on contiguous internal domain. The two components are strongly coupled at the interface between the two domains. A recent paper shows that the overall system defines a strongly continuous contraction semigroup which moreover is both analytic and uniformly stable in the natural energy space. The same properties hold for the adjoint system. Accordingly, it is relevant to identify domains of fractional power of both the original generator $(-A)$ and its adjoint $(-A^*)$. Here is a sample result. It is shown that the domains of the square roots of these two operators coincide and are explicitly expressed in terms of appropriate boundary conditions of the original operators A or A^*. Thus the Kato problem has a positive answer for this physical system with highly coupled boundary (at the interface) conditions. This result is critical to solve the following subsequent problem. Assume that a control function (square integrable in both time and space) is applied on the Neumann boundary (interface) conditions). Then find the optimal regularity of the resulting boundary non-homogeneous problem.

Radial symmetry of solutions to p-Laplace equations on Riemannian models

Ricardo Pinheiro da Costa, João Marcos Bezerra do Ó

Universidade Federal de Sergipe

We are interested in studying radial symmetry and monotonicity properties for positive solution of elliptic equations involving the p-Laplace-Beltrami operator, $1 < p < \infty$ in a Riemaniann manifold $\mathcal{M}^n$, $n \geq 2$, with constant sectional curvature $K \neq 0$. Our first goal is to prove monotonicity and radial symmetry for positive solutions of the following class of quasilinear equations:

$$\begin{cases} -\Delta_p u = f(u), & \text{in } B \\ u \in W_0^{1,p}(B), \end{cases} \tag{17}$$

where B is a geodesic ball in $\mathcal{M}^n$ and f is a locally Lipschitz continuous function.

In the second place, for $K < 0$, we consider the scalar equation in the entire space $\mathcal{M}^n$. Precisely, for $x_0 \in \mathbb{H}^n$ fixed, we prove radial symmetry for positive solutions of the following class of p-Laplace-Betrami equations:

$$\begin{cases} -\Delta_p u = f(u) & \text{in} \quad \mathbb{H}^n \\ u(x) \to 0 & \text{as} \quad d(x, x_0) \to \infty \\ u \in W^{1,p}(\mathbb{H}^n) \cap L^\infty(\mathbb{H}^n). \end{cases} \tag{18}$$

Our third goal is to prove monotonicity and symmetry proprieties for solutions of the cooperative system

$$\begin{cases} -\Delta_{p_k} u_k = f_k(U), \quad u_k > 0 \quad \text{in} \quad B, \\ u_i \in W_0^{1,p}(B) \quad \text{for} \quad 1 \leq k \leq n, \end{cases} \tag{19}$$

where $1 < p_k < \infty$ and $U = (u_1, \ldots, u_n)$ B is a geodesic ball in $\mathcal{M}^n$ and f is C^1 function.

The main tools used to prove we results is the maximum and comparison principles, and a version of method of moving planes for the manifolds $\mathcal{M}^n$. If the sectional curvature K is nonzero we will use closed and totally geodesic hypersurfaces instead of planes to apply the method of moving planes.

Inverse source reconstruction and identification problem in elliptic equations

Roberto Mamud Guedes da Silva, Nilson Costa Roberty, Carlos Jose Santos Alves
Universidade Federal do Rio de Janeiro

In this work, we are interested in study the inverse source problem for Helmholtz Equations. Supposing that the source term is given by a characteristic function, we present a new result about the center of gravity (centroid) of the source support from boundary measurements. Beside this, questions related to the uniqueness and conditional stability are also discussed. Numerical experiments related to centroid and boundary reconstruction and stability of source reconstruction is presented.

Existence of solution for a nonlocal problem in $\mathbb{R}^N$ via bifurcation theory

Romildo N. de Lima, Claudianor O. Alves, Marco A. S. Souto
Universidade Federal de Campina Grande

We study the existence of solution for the following class of nonlocal problem,

$$\begin{cases} -\Delta u = \left(\lambda f(x) - \int_{\mathbb{R}^N} K(x,y)|u(y)|^\gamma dy\right) u, & \text{in} \quad \mathbb{R}^N, \\ \lim\limits_{|x|\to+\infty} u(x) = 0, \quad u > 0 & \text{in} \quad \mathbb{R}^N, \end{cases} \tag{P}$$

where $N \geq 3$, $\lambda > 0, \gamma \in [1,2)$, $f : \mathbb{R} \to \mathbb{R}$ is a positive continuous function and $K : \mathbb{R}^N \times \mathbb{R}^N \to \mathbb{R}$ is a nonnegative function. The functions f and K satisfy some conditions, which permit to use Bifurcation Theory to prove the existence of solution for problem (P).

ICMC Summer Meeting on Differential Equations

2016 Chapter

Programme

Sunday 31 from 18:00 to 19:00, Registration at Anacã Hotel

Auditorium	MONDAY 1	TUESDAY 2	WEDNESDAY 3
08:00 - 09:25	**Registration**		
09:25 - 09:40	**Opening**		

Auditorium	Plenary Talks		
Chairman	*Hildebrando M. Rodrigues*	*Shui-Nee Chow*	*John Mallet-Paret*
09:00 - 09:40	Registration/Opening	John Mallet-Paret	Djairo G. de Figueiredo
09:40 - 10:20	Shui-Nee Chow	Tomás Caraballo	Hans-Otto Walther
10:20 - 10:50	Coffee Break	Coffee Break & Poster Session	Coffee Break
Chairman	*Yingfei Yi*	*Hans-Otto Walther*	*Tomás Caraballo*
10:50 - 11:30	Josef Diblik	Irena Rachunkova	Claudianor O. Alves
11:30 - 12:10	Olimpio H. Miyagaki	Yingfei Yi	Milan Tvrdy
12:10 - 12:50	Eduardo Teixeira	Antonio L. Pereira	
12:50 - 14:30		Lunch	

Auditorium	Special Session on Nonlinear Dynamical Systems		
Chairman	*Pedro Marín Rubio*	*Ma To Fu*	*Sergio Muniz Oliva Filho*
14:30 - 15:00	Ma To Fu	Pedro Marín Rubio	Mahendra Panthee
15:00 - 15:30	Sergio Muniz Oliva Filho	Marcone Correa Pereira	Luis Felipe Rivero
15:30 - 16:00	Coffee Break	Coffee Break & Poster Session	Coffee Break
16:00 - 16:30	Matheus Cheque Bortolan	Xinguang Yang	Ginnara Mexia Souto
16:30 - 17:00	Juliana F. S. Pimentel	Henrique B. da Costa	Miroslav Kramar
17:00 - 17:30	Vanderley A. Ferreira Junior	Thales Maier de Souza	Jacek Cyranka

Room 5-001	**Special Session on Elliptic Equations**		
Chairman	*Claudianor O. Alves*	*Liliane A. Maia*	*Ricardo P. Silva*
14:30 - 15:00	Benedetta Pellacci	João R. Santos Júnior	Alessia E. Kogoj
15:00 - 15:30	Marta Calanchi	Marcos T. O. Pimenta	Edgard Almeida Pimentel
15:30 - 16:00	Coffee Break	Coffee Break & Poster Session	Coffee Break
16:00 - 16:30	Liliane A. Maia	Ricardo P. Silva	Flávio Almeida Lemos
16:30 - 17:00	Giovany M. Figueiredo	Sigifredo J. Herrón	Gustavo Madeira
17:00 - 17:30	Jefferson A. Santos	Wallisom da Silva Rosa	Leandro da Silva Tavares
17:30 - 18:00		Federica Gregorio	

Room 5-002	**Special Session on Linear Partial Differential Equations**
Chairman	*Paulo L. Dattori da Silva*
14:30 - 15:00	Pedro Tavares Paes Lopes
15:00 - 15:30	Giuliano Angelo Zugliani
15:30 - 16:00	Coffee Break
16:00 - 16:30	Rafael Borro Gonzalez
16:30 - 17:00	Luis Fernando Ragognette
17:00 - 17:30	Nilson Costa Roberty

Room 5-002	**Session on Conservation Laws and Transport Equations**
Chairman	*Wladimir Neves*
14:30 - 15:00	Olivier Kneuss
15:00 - 15:30	Paulo Amorim
15:30 - 16:00	Coffee Break & Poster Session
Chairman	*Paulo Amorim*
16:00 - 16:30	Wladimir Neves
16:30 - 17:00	Jean Silva
17:00 - 17:30	Pedro José Catuogno
17:30 - 18:00	Mikhail Vishnevski

Room 5-003	**Special Session on Ordinary and Functional Differential Equations**		
Chairman	*Milan Tvrdy*	*Samuel Castillo*	*Irena Rachunkova*
14:30 - 15:00	Jana Burkotova	Bruno de Andrade	Patrícia H. Tacuri
15:00 - 15:30	Khalid Alshammari	Filipe Dantas	Jaqueline Mesquita
15:30 - 16:00	Coffee Break	Coffee Break & Poster Session	Coffee Break
16:00 - 16:30	Samuel Castillo	Arlúcio Viana	Eduard Toon
16:30 - 17:00	Berenice C. Damasceno	Mario Choquehuanca	Luciano Barbanti
17:00 - 17:30	Laura Gambera	Hugo de La Cruz	Antonio Acosta

Room 5-004	**Special Session on Fluid Dynamics**	
Chairman	*Anne Caroline Bronzi*	*Fabio Tavares Ramos*
14:30 - 15:00	Marcelo Martins dos Santos	Mauricio Cardoso Santos
15:00 - 15:30	Fabio Tavares Ramos	Lucas C. F. Ferreira
15:30 - 16:00	Coffee Break	Coffee Break & Poster Session
16:00 - 16:30	Tiago Henrique Picon	Luís Henrique de Miranda
16:30 - 17:00	César Guilherme Almeida	Cesar J. Niche
17:00 - 17:30	Marcelo F. de Almeida	Paulo Mendes Carvalho

Coffee Area	**Poster Sessions**
10:20 - 10:50	Ailton Rodrigues da Silva
	Alânnio Barbosa Nóbrega
	Ricardo Pinheiro da Costa
	Roberto M. Guedes da Silva
	Romildo N. de Lima
15:30 - 16:00	Daniel Vieira da Rocha
	Manuel F. Zuloeta Jimenez
	Marcelo Santos Bongarti
	David A. Chipana Mollinedo

Social Events		
17:30	**Cocktail** (Coffee Area)	
12:50		**Photo** (ICMC)
20:00		**Conference Banquet** (Café Sete)

ICMC Summer Meeting on Differential Equations

2016 Chapter

List of Speakers

List of speakers **(ordered by last name)**

ICMC Summer Meeting on Differential Equations

2016 Chapter

Sponsors

The ICMC Summer Meeting on Differential Equations - 2016 Chapter is grateful to the following organizations for providing the financial support.

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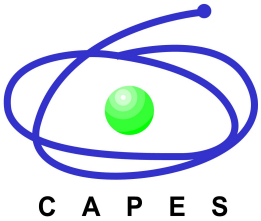

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