International Workshop on Nonlinear Dynamical Systems and Functional Analysis

August 13-16, 2018
Universidade de Brasília
ICM 2018 Satellite Conference

Organizing Committee:

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Arte: Athos Bulcão, 1988. Painel em azulejos, Memorial da América Latina, São Paulo - SP (imagem gentilmente cedida pela Fundação Athos Bulcão).

Access homepage of the event using this QR code

International Workshop on Nonlinear Dynamical Systems and Functional Analysis

Book of Abstracts

Scientific Committee

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Difference Equations/Dynamic equations on time scales
Organizer: Eduard Toon (Universidade Federal de Juiz de Fora)

Elliptic Partial Differential Equations
Organizer: Edcarlos Domingos da Silva (Universidade Federal de Goiás)

Functional Analysis
Organizer: Geraldo de Azevedo Botelho (Universidade Federal de Uberlândia)

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Organizer: Juliana Pimentel (Universidade Federal do ABC)

Ordinary/Functional Differential Equations
Organizer: Pierluigi Benevieri (Universidade de São Paulo)

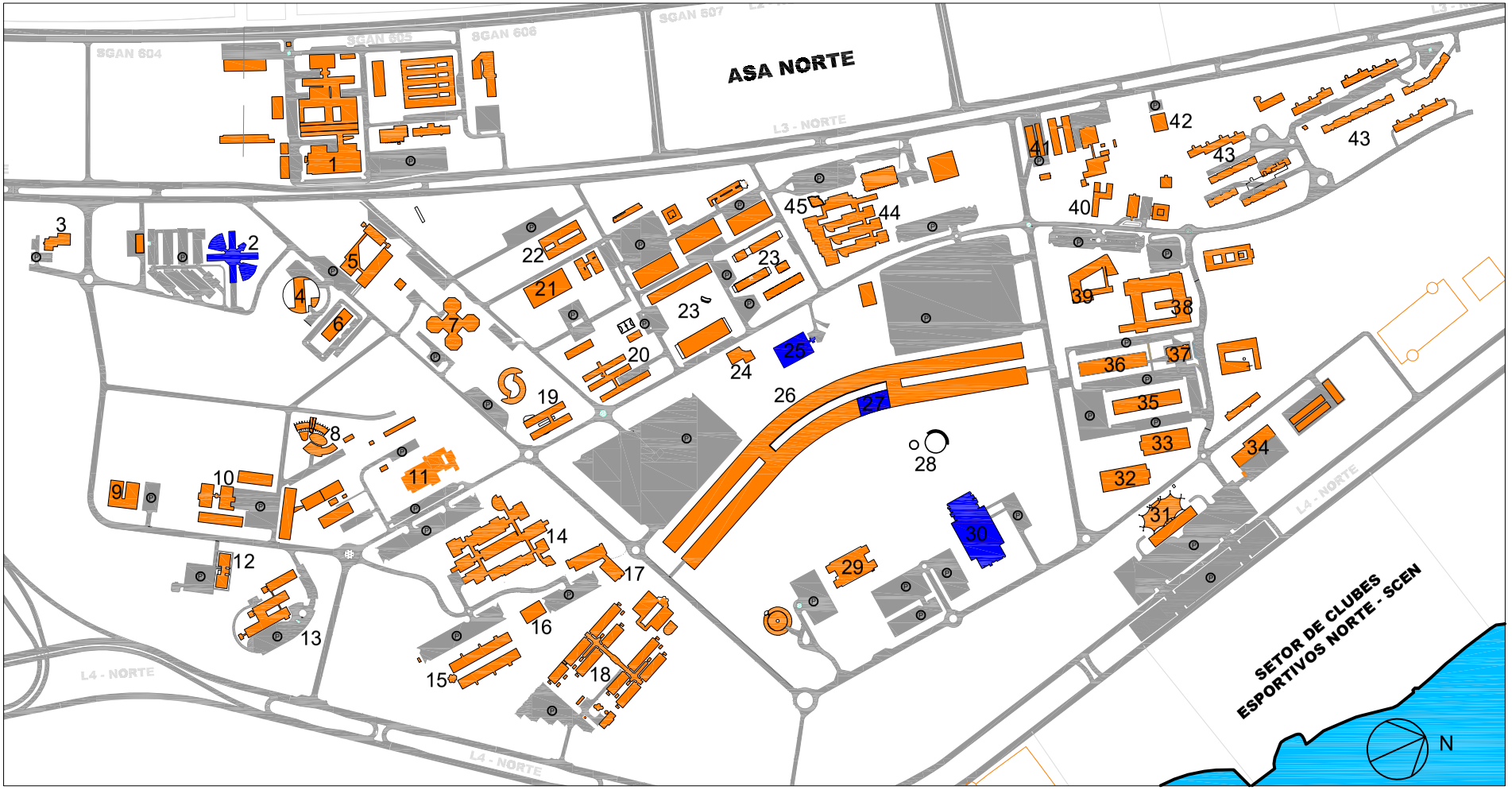
Parabolic Differential Equations
Organizer: Anderson Luis Albuquerque de Araújo (Universidade Federal de Viçosa)

Poster
Organizer: Willian Cintra (Universidade de Brasília)

Adress

Universidade de Brasília
Instituto de Ciências Exatas
Departamento de Matemática
Campus Universitário Darcy Ribeiro
70910-900 Brasília - DF

Map of the University of Brasília



1- HUB (Hospital Universitário) - University hospital	16- MASC	31- Centro Comunitário Athos Bulcão - Community Center
2- Finatec	17- BSA	32- CIC
3- FUBRA	18- Instituto de Biologia - Biology Institute	33- UED
4- AUTOTRAC	19- PMU II	34- Almoxarifado - Warehouse
5- FIO CRUZ	20- PMU II	35- PJC
6- CAEP	21- FE	36- PAT
7- CET	22- Casa do Professor	37- MASC
8- CRAD	23- SG 1 ao SG 12	38- FACE
9- CDT	24- Banco do Brasil - Bank	39- FA
10- CME	25- Restaurante Universitário - University Restaurant	40- ASFUB
11- NMT	26- ICC	41- Posto de Gasolina/Subway/Spoletto - Gas Station/Restaurant
12- CPD	27- Departamento de Matemática - Math departament	42- PMDF - Police
13- CESPE	28- Teatro de Arena Honestino Guimarães - Arena Theater	43- Colina
14- Faculdade de Saúde - Health College	29- Reitoria - Rectory	44- FT
15- Instituto de Química - Chemistry Institute	30- Biblioteca - Library	45- Auditório da FT

Contents

General Information

Location

The congress will take place in FINATEC at the University of Brasília. Also, the participant may want to know the departament of mathematics of the University of Brasília. Both places are indicated in blue in the map on page 5.

Useful Phone Numbers

In case of any health emergencies call 192 (SAMU).
Police number: 190.
Math department of the University of Brasília: (61) 3107 7236
Security of the University of Brasília: (61) 3107 6222

Meals and refreshments

There is a university restaurant indicated in the map of page 4 that serves breakfast (7:00hs - 9:00hs), lunch (11:00hs - 14:30hs) and dinner (17:00hs - 19:30hs). There are several restaurants nearby the in Asa Norte. We will present you a few options:
1. Feitiço Mineiro located at 306 Norte, bloco B - lojas 45/51, Asa Norte (lunch and dinner).
2. Restaurante e Bar Xique Xique located at 708 Norte Bloco E Loja 45, Asa Norte (lunch and dinner).
3. Subway/Spoleto at the University of Brasília, indicated in the map of page 4, number 41 (lunch and dinner).
4. Domino's Pizza located at 109 Norte Bloco B, Loja 1, Asa Norte (Dinner).
5. Crepe au Chocolat located at 109 Norte, Bloco C, Loja 5, Asa Norte (Launch and Dinner).
6. Restaurante El Negro located at 413 Norte Bloco C, Loja 21, Asa Norte.
There is also a supermarket (Pão de Açucar) at 404/405 Norte, Bloco A, Asa Norte opened from 7:00hs to 22:00hs.

Schedule

International Workshop on Nonlinear Dynamical Systems and Functional Analysis

Auditorium	Plenary Talks			
	Monday 13	**Tuesday 14**	**Wednesday 15**	**Thursday 16**
Chairman	*Jaqueline Mesquita*	*Juliana Pimentel*	*Giovany Figueiredo*	*Luis Miranda*
09:00 - 09:40		Bernold Fiedler	Tibor Krisztin	Gennaro Infante
09:40 - 10:20	Hans-Otto Walther	Carlos Rocha	Pedro Miana	Márcia Federson
10:20 - 11:00	Coffee Break/Posters	Coffee Break/Posters	Coffee Break/Posters	Coffee Break
11:00 - 11:40	Martin Bohner	Alexandre Nolasco	Gabriela Planas	Minbo Yang
11:40 - 12:20	Carlos Tomei	Photo	Oímpio Miyagaki	
12:20 - 14:30	Lunch	Barbecue (13:00-18:00)	Lunch	Lunch

T.B.A.	Special Session on Parabollic Differential Equations			
	Monday 13	**Tuesday 14**	**Wednesday 15**	**Thursday 16**
Chairman	*Luis Miranda*			
14:30 - 15:00	Adilson Presoto			
15:00 - 15:30	Anderson Araújo			
15:30 - 16:00	Jamil Abreu			
16:00 - 16:30	Coffee Break	Barbecue	Coffee Break	Coffee Break
Chairman	*Anderson Araújo*			
16:30 - 17:00	Arlúcio Viana			
17:00 - 17:30	Luis Miranda			
17:30 - 18:00	Rodrigo Monteiro			Closing

T.B.A.	Special Session on Functional Analysis			
	Monday 13	**Tuesday 14**	**Wednesday 15**	**Thursday 16**
Chairman	*Geraldo Botelho*		*Nilson Bernardes*	
14:30 - 15:00	Mary Lourenço		Khazhak Navoyan	
15:00 - 15:30	Nilson Bernardes		Santiago Muro	
15:30 - 16:00	Elisa Santos		Daniele Vieira	
16:00 - 16:30	Coffee Break	Barbecue	Coffee Break	Coffee Break
Chairman	*Pedro Miana*		*Mary Lourenço*	
16:30 - 17:00	Gustavo Araújo		Alex Pereira	
17:00 - 17:30	Cláudia Correa		Thiago Alves	
17:30 - 18:00	Geraldo Botelho		Jamilson Campos	Closing
18:00 - 18:30			Victor Barbosa	

T.B.A.	Special Session on Nonlinear Dynamical Systems			
	Monday 13	**Tuesday 14**	**Wednesday 15**	**Thursday 16**
Chairman			*Sergio Oliva*	*Everaldo Bonotto*
14:30 - 15:00			Everaldo Bonotto	Mauro Patrão
15:00 - 15:30			Juliana Pimentel	Philipo Lappicy
15:30 - 16:00			Jacson Simsen	Lucas Seco
16:00 - 16:30	Coffee Break	Barbecue	Coffee Break	Coffee Break
Chairman			*Mauro Patrão*	
16:30 - 17:00			Sergio Oliva	
17:00 - 17:30			Sabrina Carmargo	
17:30 - 18:00			Rodrigo Samprogna	

International Workshop on Nonlinear Dynamical Systems and Functional Analysis

T.B.A.	Special Session on Elliptic Partial Differential Equations			
	Monday 13	**Tuesday 14**	**Wednesday 15**	**Thursday 16**
Chairman	*Maxwell Silva*		*Edcarlos Domingos*	
14:30 - 15:00	Gaetano Siciliano		Damião Araújo	
15:00 - 15:30	Gustavo Madeira		Pawan Mishra	
15:30 - 16:00	Kaye Silva		José Francisco Alves	
16:00 - 16:30	Coffee Break	Barbecue	Coffee Break	Coffee Break
Chairman	*Kaye Silva*		*Damião Araújo*	
16:30 - 17:00	Eudes Barboza		Edcarlos Domingos	
17:00 - 17:30	Diego Moreira		Maxwell Silva	
17:30 - 18:00			Jorge Marques	Closing

T.B.A.	Special Session on Ordinary/Functional Differential Equations			
	Monday 13	**Tuesday 14**	**Wednesday 15**	**Thursday 16**
Chairman	*Pablo Amster*		*Pierluigi Benevieri*	
14:30 - 15:00	Marielle Silva		João Marcos do Ó	
15:00 - 15:30	Pierluigi Benevieri		Agnieszka Malinowska	
15:30 - 16:00	Maria Carolina Mesquita		Pablo Amster	
16:00 - 16:30	Coffee Break	Barbecue	Coffee Break	Coffee Break
Chairman	*Pablo Amster*			
16:30 - 17:00	Valeriano Antunes			
17:00 - 17:30	Joelma Azevedo			
17:30 - 18:00				Closing

T.B.A.	Special Session on Difference Equations/Dynamic Equations on Time Scales			
	Monday 13	**Tuesday 14**	**Wednesday 15**	**Thursday 16**
Chairman	*Eduard Toon*			
14:30 - 15:00	Geraldo Silva			
15:00 - 15:30	Fernanda Silva			
15:30 - 16:00	Tom Cuchta			
16:00 - 16:30	Coffee Break	Barbecue	Coffee Break	Coffee Break
Chairman	*Geraldo Silva*			
16:30 - 17:00	Eduard Toon			
17:00 - 17:30	Aldo Solis			
17:30 - 18:00	Sabrina Streipert			Closing

T.B.A.	Poster Session			
	Monday 13	**Tuesday 14**	**Wednesday 15**	**Thursday 16**
	Laís Santos	Cláudia Santana	Daniel Santiago	
	Angelina Faria	Claudiney Goulart	Fernando Carvalho	
	Felipe Federson	José Carlos Albuquerque	Ian Massa	
10:20 -11:00	Monisse Alves	Alfredo Pejerrey	Leonardo Galvão	
	Pedro Gabriel Colucci	Marcos Leandro Carvalho	Mateus Fleury	
	Sanjeev Kumar	Mayra Rodrigues	Paulo Huertas	
	Thiago Cavalcante	Ricardo Alves	Steffânio Sousa	
		Rodrigo Clemente		

Auditorium	Monday 13	Tuesday 14	Wednesday 15	Thursday 16
08:20 - 09:00	Registration			
09:00 - 09:40	Opening			
11:40		Photo (11h40)		
13:00 - 18:00		Barbecue		Closing (17h30)

Plenary Talks

Non-Autonomous Morse-Smale Dynamical Systems: Structural Stability under Non-Autonomous Perturbations

Alexandre Nolasco
Instituto de Ciências Matemáticas e de Computação
Universidade de São Paulo, São Carlos, Brazil

Abstract

In this lecture we present our recent results on structural stability of gradient Morse-Smale Dynamical Systems under non-autonomous perturbations. To that end we introduce the notion of lifted invariant sets and give a characterization of the uniform attractor in terms of dynamical structures of a family of pullback attractors. This is a joint work with G. Raugel (Paris XI), J. Langa (U. Sevilla) and M. Bortolan (UFSC-Brazil).

Design of dynamic complexes for Sturm global attractors

Carlos Rocha
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Center for Mathematical Analysis, Geometry and Dynamical Systems
Department of Mathematics
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Abstract

We use the geometric and combinatorial characterization of global Sturm attractors to discuss the Thom-Smale dynamic complexes consisting of a single 3D ball resulting from scalar semilinear parabolic differential equations with Neumann boundary conditions. This is a joint work with B. Fiedler.

References

[1] B. Fiedler and C. Rocha, Sturm 3-balls and global attractors 1: Thom-Smale complexes and meanders, to appear in *São Paulo J.Math. Sc.*, arXiv:1611.02003, 2016.

[2] B. Fiedler and C. Rocha, Sturm 3-balls and global attractors 2: Design of Thom-Smale complexes, to appear in *J. Dyn. Diff. Eqns.*, arXiv:1704.00344, 2017.

[3] B. Fiedler and C. Rocha, Sturm 3-balls and global attractors 3: Examples of Thom-Smale complexes, to appear in *Discr. Cont. Dyn. Sys.* , arXiv:1708.00690, 2018.

On the non-isothermal Navier-Stokes-Allen-Cahn equations for two-phase fluids

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Departamento de Matemática
IMECC - Unicamp
Campinas, Brazil

Juliana Honda Lopes
Departamento de Matemática
IMECC - Unicamp
Campinas, Brazil

Abstract

This talk is concerned with some non-isothermal diffuse-interface models which describe the motion of a mixture of two viscous incompressible fluids. These kind of models consist of modified Navier-Stokes equations coupled with a phase-field equation given by a convective Allen-Cahn equation, and energy transport equation for the temperature. It is discussed questions related to the well-posedness of the problem in the two and three dimensional cases. Moreover, regular and singular potentials for the phase-field equation are considered.

Positive solutions of nonlocal elliptic systems with functional BCs

Gennaro Infante
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Università della Calabria
Cosenza, Italy

Abstract

We discuss the existence of non-negative weak solutions for second order nonlocal elliptic systems subject to functional boundary conditions and depending on some parameters. This setting for the boundary conditions is fairly general and covers the case of multi-point, integral and nonlinear boundary conditions. Our approach is based on classical fixed point index theory and we make use of recent results contained in [1].

References

[1] G. Infante, Nonzero positive solutions of a multi-parameter elliptic system with functional BCs, *Topol. Methods Nonlinear Anal.*, to appear.

Differential Equations with State-Dependent Delay, Fréchet and other Derivatives, and Complicated Motion

Hans-Otto Walther
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Mathematisches Institut
Universität Gießen
Gießen, Germany

Abstract

The lecture presents (1) recent results about delay differential equations in the general form

$$x'(t) = f(x_t)$$

which are designed for the application to equations with state-dependent delay, which may be unbounded. The state space which carries a nice semiflow is a Fréchet manifold, and the (weak) assumptions on f which are required for the theory (well-posedness of initial value problem, linearization, local invariant manifolds) have implications on the nature of differentiability of f as well as on the type of delay (which can be formulated as a property of the functional f).

We also (2) report about work on complicated solution behaviour which seems to be specific for delay differential equations and which is less local than chaotic motion in a thin "Cantor-dust".

References

[1] H. O. Walther. *Semiflows for differential equations with locally bounded delay on solution manifolds in the space* $C^1((-\infty, 0], \mathbb{R}^n)$. DOI 10.12775/TMNA.2016.056, Topological Methods in Nonlinear Analysis, **48** (2016), 507-537.

[2] H. O. Walther.*Local invariant manifolds for delay differential equations with state space in* $C^1((-\infty, 0], \mathbb{R}^n)$. DOI 10.14232/ejqtde.2016.1.85, Electronic Journal of the Qualitative Theory of Differential Equations, **No. 85** (2016), 1-29.

[3] H. O. Walther. *Fréchet differentiability in Fréchet spaces, and differential equations with unbounded variable delay.* arXiv: 1801.09213, preprint, 2018, 45 pp.

[4] H. O. Walther. *A delay differential equation with a solution whose shortened segments are dense.* Preprint, 2017, submitted, 30 pp.

[5] H. O. Walther. *Maps which are continuously differentiable in the sense of Michal and Bastiani but not of Fréchet.* Preprint, 2017, submitted, 13 pp.

On the Schrödinger equation in the quantum case

Márcia Federson
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Universidade de São Paulo,
São Carlos, Brazil

Abstract

We address some issues within the Schrödinger equation in the quantum case and the Feynman path integral and we give a quick overhaul of the main contributions of the theory of non-absolute integration in the sense of Ralph Henstock.

References

[1] E.M. Bonotto; M. Federson; P. Muldowney, A Feynman-Kač solution to a random impulsive equation of Schrödinger type, *Real Anal. Exchange* 36(1), (2010/2011), 107-148.

[2] R.P. Feynman, Space-time approach to non-relativistic quantum mechanics, *Rev. Modern Phys.* 20(2), (1948), 367-387.

[3] R.P. Feynman; R.B. Leighton; M. Sands, *The Feynman Lectures on Physics*, Addison-Wesley, 1964.

[4] P. Muldowney, Feynman's path integrals and Henstock's non-absolute integration. *J. Appl. Anal.* 6(1), (2000), 1-24.

[5] P. Muldowney, *A Modern Theory of Random Variation - The Henstock Integral in Probability and Stochastic Calculus, with application to Option Pricing and Feynman Path Integrals*, John Wiley & Sons, Inc. 2012.

[6] E.S. Nathanson, *Path integration with non-positive distributions and applications to the Schrödinger equation*. PhD Thesis, The University of Iowa. 2014. 113 pp.

[7] E.S. Nathanson,; P.E.T. Jorgensen, A global solution to the Schrdinger equation: from Henstock to Feynman. *J. Math. Phys.* 56(9), (2015), 092102, 15 pp.

[8] E.S. Nathanson,; P.E.T. Jorgensen, Trotter's limit formula for the Schrdinger equation with singular potential. *J. Math. Phys.* 58(12) (2017), 122101, 13 pp.

Massera's Theorem in Quantum Calculus

Martin Bohner
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Departement of Mathematics and Statistics
Missouri S&T
Rolla, MO 65409-0020, USA

Abstract

In this talk, we present versions of Massera's theorem for linear and nonlinear q-difference equations and give some examples to illustrate our results. This is joint work with Jaqueline Mesquita (University of Brasília, Brazil) and will appear in the *Proceedings of the American Mathematical Society*.

References

[1] Martin Bohner and Rotchana Chieochan. Floquet theory for q-difference equations. *Sarajevo J. Math.*, 8(21)(2):1–12, 2012.

[2] Martin Bohner and Jaqueline Mesquita. Periodic averaging principle in quantum calculus. *J. Math. Anal. Appl.*, 435(2):1146–1159, 2016.

[3] Martin Bohner and Jaqueline Mesquita. Massera's theorem in quantum calculus. *Proc. Amer. Math. Soc.*, 2018. To appear.

[4] Martin Bohner and Sabrina Streipert. The second Cushing–Henson conjecture for the Beverton–Holt q-difference equation. *Opuscula Math.*, 37(6):795–819, 2017.

Hénon type problems: nonradial solutions, asymptotic behavior, compactness, etc.

O. H. Miyagaki
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Federal University of Juiz de Fora
Juiz de Fora, Brazil

Abstract

In this talk a Hénon type problem in a unit ball is discussed. By using minimization arguments on Nehari manifold is stablished that symmetry breaking appear when the problem is asymptotic to a some limit problem. Asymptotic behavior of the ground state solution is discussed, also, some compactness results are established.

The talk is related to the papers [1, 2, 3, 4, 5, 6].

References

[1] D. G. Costa, O. H. Miyagaki, M. Squassina, J. Yang, *Asymptotics of ground states for Henon type systems with fractional diffusion,* "Contributions to Nonlinear Elliptic Equations and Systems, Progress in Nonlinear Differential Equations and Their Applications 86, A Tribute to Djairo Guedes de Figueiredo on the Occasion of his 80th Birthday"(2015), 133-161.

[2] R. B. Assuno, O. H. Miyagaki, G. A. Pereira, B. M. Rodrigues, *On a class of nonhomogeneous equations of Hénon-type: Symmetry breaking and non radial solutions.* Nonlinear Anal., **165** (2017), 102–120.

[3] P.C. Carrião, D.G. de Figueiredo, O.H. Miyagaki, *Quasilinear elliptic equations of the Hénon-Type: Existence of non- radial solutions,* Comm.Contemporary Math. **5**(2009), 783–798.

[4] D. G. de Figueiredo, E. Moreira dos Santos, O. H. Miyagaki,*Critical Hyperbolas and multiple symmetric solutions to some strongly coupled elliptic systems,* Advanced Nonlinear Studies, **13**(2013), 359-371.

[5] D. G. de Figueiredo, E. Moreira dos Santos, O. H. Miyagaki,*Sobolev spaces of symmetric functions and applications,* Journal of Functional Analysis, **261**(2011), 3735-3770.

[6] D. G. Costa, D. G. de Figueiredo, E. Moreira dos Santos, O. H. Miyagaki,*in preparation*

Evolution C_0-semigroups and generalized Cesáro operators

Pedro J. Miana
Partially supported by Project MTM2016-77710-P, DGI-FEDER, of the MCYTS and Project E-64, D.G. Aragón, Universidad de Zaragoza, Spain
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Abstract

In this talk, we present a complete spectral research of generalized Cesàro operators on Sobolev-Lebesgue sequence spaces. The main idea is to subordinate such operators to suitable C_0-semigroups on these sequence spaces. We introduce that family of sequence spaces using the fractional finite differences and we prove some structural properties similar to classical Lebesgue sequence spaces. In order to show the main results about fractional finite differences, we state equalities involving sums of quotients of Euler's Gamma functions. Finally, we display some graphical representations of the spectra of generalized Cesàro operators. Main results of this talk are included in a joint paper with L. Abadias ([1]).

References

[1] L. Abadias and P.J. Miana. *Generalized Cesàro operators, fractional finite differences and Gamma functions.* J. Funct. Anal., **274**, (2018), 1424–1465.

A differential equation with a state-dependent queueing delay

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University of Szeged
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Abstract

We consider a differential equation with a state-dependent delay motivated by a queueing process. The time delay is determined by an algebraic equation involving the length of the queue. For the length of the queue a discontinuous differential equation holds. We formulate an appropriate framework to study the problem, and show that the solutions define a Lipschitz continuous semiflow. Then, in the developed framework, we show that the system has a slowly oscillating periodic solution.

This is a joint work with István Balázs (Szeged, Hungary).

Special Sessions

Difference Equations/Dynamic Equations on time scales

Organizer: Eduard Toon (UFJF)

Cosine and sine functions on time scales

Aldo Pereira
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University of Brasília
Brasília, Brazil

Abstract

Abstract cosine and sine functions defined on a Banach space are useful tools in the study of wide classes of abstract evolution equations. In this work, we introduce a definition of cosine and sine functions on time scales, which unify the continuous, discrete and cases which are between these ones. Our definition includes several types of time scales. For instance, real numbers set, integers numbers set, quantum scales, among others. We study the relationship between the cosine function on time scales and its infinitesimal generator, proving several properties concerning it. Also, we study the sine functions on time scales, presenting their main properties. Finally, we apply our theory to study the homogeneous and inhomogeneous abstract Cauchy problem on time scales in Banach spaces. Joint work with Jaqueline G. Mesquita (U. de Brasília) and Rodrigo Ponce (U. de Talca, Chile).

References

[1] M. Bohner, A. Peterson: *Dynamic Equations on Time Scales: An Introduction with Applications,* Birkhäuser, Boston, 2001.

[2] M. Bohner, A. Peterson: *Advances in Dynamic Equations on Time Scales,* Birkhäuser, Boston, 2003.

[3] H.R. Henríquez, C. Lizama, J.G. Mesquita: *Semigroups on time scales and applications to abstract Cauchy problems*, submitted.

Boundedness of solutions of dynamic equations on time scales

Eduard Toon
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Juiz de Fora, Brazil.

Abstract

This is a joint work with Márcia Federson, Rogélio Grau and Jaqueline G. Mesquita. We prove results concerning boundedness of solutions for dynamic equations on time scales. In order to prove our main results, we prove results about boundedness of solutions for generalized ordinary differential equations and boundedness of solutions for measure differential equations and we use the fact that dynamic equations on time scales represent a particular case of measure differential equations.

References

[1] M. Bohner and A. Peterson, *Dynamic Equations on Time Scales: An Introduction with Applications*, Birkhäuser, Boston, 2001.

[2] M. Federson, R. Grau, J. G. Mesquita and E. Toon, Boundedness of solutions of measure differential equations and dynamic equations on time scales *Journal of Differential Equations* 263 (1), 26-56, 2017

[3] Š. Schwabik, *Generalized Ordinary Differential Equations*, World Scientific, Series in Real Anal., vol. 5, 1992.

[4] A. Slavík, Dynamic equations on time scales and generalized ordinary differential equations, *Journal of Mathematical Analysis and Applications* 385, 534-550, 2012.

Controllability for dynamic systems on time scales

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Abstract

In the literature, we found results on controllability for the following dynamic equation on times scales

$$x^{\Delta}(t) = A(t)x(t) + B(t)u(t),$$

where $x(\cdot) \in \mathbb{R}^n$ is a state vector, $u(\cdot) \in \mathbb{R}^m$ is a piecewise rd-continuous control vector function, $A(\cdot) \in \mathbb{R}^{n\times n}$ and $B(\cdot) \in \mathbb{R}^{n\times m}$ are rd-continuous matrices. (See [3], [1] and [2], for example). In order to investigate more general conditions for the functions $A(\cdot), B(\cdot)$ and $u(\cdot)$, we consider a dynamic equation on times scales of the type

$$x^{\Delta}(t) = a(t)x(t) + b(t)u(t), \tag{1}$$

where $x(\cdot) \in X$ is a state vector, $a : [t_0, +\infty)_{\mathbb{T}} \to L(X)$ is Kurzweil-Henstock Δ-integrable (KH Δ-integrable), $u : [t_0, +\infty)_{\mathbb{T}} \to U$ and $b : [t_0, +\infty)_{\mathbb{T}} \to L(U, X)$ are such that $b(\cdot)u(\cdot)$ is KH Δ-integrable on $[t_0, +\infty)_{\mathbb{T}}$, and X, U, Y are Banach spaces. The goal of this work is to regard equation (1) as a generalized ordinary differential equation and to investigate necessary and sufficient conditions for the equation (1) to be controllable.

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Optimal Control on Time Scales: Necessary Optimality Conditions

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Abstract

We consider smooth optimal control problems on time scales and provide necessary optimality conditions in the form of the Maximum Principle. The result presented here are under the convexity assumption on the velocity set, besides the usual assumptions. Although the convexity is an assumption which is little bit restrictive we expect to remove it in forthcoming works.

Periodic functions on isolated Time Scales

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Abstract

In this work, we formulate the definition of periodicity for isolated time scales. This provides the base for future research regarding periodicity on time scales with a positive graininess. The introduced definition is consistent with the known formulations in the discrete and quantum calculus setting. Using the definition of periodicity, we discuss the existence and uniqueness of ω-periodic solutions to a family of linear dynamic equations on isolated time scales.

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Lambert W for time scales

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Abstract

The classic Lambert W function is a well-known special function that inverts the map $z \mapsto ze^z$. We investigate a time scales calculus generalization of the Lambert W function that inverts the map $z \mapsto ze_z(t, t_0)$, where $e_z(t, t_0)$ denotes the exponential function on a time scale. Special emphasis will be given to the time scale $\mathbb{T} = \mathbb{Z}$ (i.e. difference equations).

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Ordinary/Functional Differential Equations

Organizer: Pierluigi Benevieri (USP)

On systems of fractional differential equations with a general derivative

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Abstract

Fractional Differential Equations (FDE) are a generalization of ordinary differential equations, where integer-order derivatives are replaced by fractional derivatives. Over the last decades, those equations have attracted a lot of attention of researchers from different areas, since fractional derivatives provide an excellent tool for the description of memory and hereditary properties of various materials and processes. Several types of fractional derivatives have been suggested in order to describe more accurately the real world phenomena, each ones with their own advantages and disadvantages. A more general unifying perspective to the subject was proposed in [2], by considering fractional operators depending on general kernels. In this work, we follow the special case of this approach that was developed in [1]. This type of differentiation depends on a kernel ϕ, and for some particular choices of ϕ, we obtain the well known fractional derivatives like the Caputo or the Caputo–Hadamard fractional derivatives.

We present the results on the existence and uniqueness of solutions to systems of FDEs with a derivative that depends on a kernel ϕ. Then we address the leader-follower consensus tracking problem for multi-agent systems. The consensus algorithm is proposed and its convergence its proved based on the stability results for linear systems of FDEs with a general form of fractional derivative. The effectiveness of the theoretical results is demonstrated through numerical simulations.

The presented results are based on the joint works with R. Almeida and T. Odzijewicz.

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Beyond integrability: real life eigenvalue algorithms

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Abstract

In the eighties, the celebrated QR method, used to compute eigenvalues of matrices, has been shown to be interpolated by a flow in the integrable hierarchy of the Toda lattice. Shift techniques improve performance dramatically. We consider the dynamics of these algorithms. Joint work with Nicolau Saldanha (PUC-RIO) and Ricardo Leite (UFES).

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Elliptic equations and systems with critical Trudinger-Moser nonlinearities

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Abstract

Existence of solutions is established for a class of systems of coupled equations via variational methods. Typical features of this class of problems are the lack of compactness because the unboundedness of the domain and critical growth. Moreover, the associated functional is strongly indefinite. The main tool used is the Trudinger-Moser inequality combined with a linking theorem.

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Topological structure of solutions set of strongly damped wave equations

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Abstract

This is joint work with Claudio Cuevas (Federal University of Pernambuco - Brazil) and Herme Soto (University of La Frontera - Chile). In this presentation, we focus on the following Cauchy problem

$$\begin{cases} u_{tt} + 2\eta A^{\frac{1}{2}} u_t + Au = f(t, u, u_t),\ t > 0, \\ u(0) = u_0 \in X^{\frac{1}{2}},\ \ u_t(0) = v_0 \in X, \end{cases} \tag{2}$$

where X is a reflexive Banach space, $A : D(A) \subseteq X \to X$ is a closed densely defined operator, $X^{\frac{1}{2}}$ is the fractional power space associated with A and $\eta > 0$. Equations like (2) has a lot of non-trivial and interesting features and appear in the literature under the name of strongly damped wave equations. An example of mathematical model represented in the form (2) is the wave equation with structural damping (see [1, 2, 3, 4, 5]). Here we are concerned with the topological structure of solutions set of problem (2).

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Bifurcation theory for generalized ODE's

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Abstract

We establish conditions on the existence of bifurcation points of solutions of generalized ordinary differential equations via coincidence degree theory. We also present applications to ordinary differential equations.

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On oscillation of Functional Differential Equations with delay with values in $\mathbb{R}^n$

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Abstract

Consider the mesuare differential equation with impulses and delay

$$\begin{cases} (Dy_1(t), \ldots, Dy_n(t)) = -(p_1(t)y_1(t-\tau_1), \ldots, p_n(t)y_n(t-\tau_n))Dg \\ y_j(t_k^+) - y_j(t_k) = b_k y_j(t_k), \quad k \in \mathbb{N}, \quad j = 1, \ldots, n, \end{cases} \tag{3}$$

where $\tau_j > 0$ is a constant, $p_j : [t_0, \infty) \to \mathbb{R}$ are functions, $j = 1, \ldots n$, $g : [t_0, \infty) \to \mathbb{R}$ is a regulated function which is left-continuous and continuous at the points of impulses t_k and Dy_j and Dg stand for the distributional derivatives of the functions y_j and g in the sense of distributions of L. Schwartz and, moreover,

- $t_0 < t_1 < \ldots < t_k < \ldots$ are fixed points and $\lim_{k\to\infty} t_k = \infty$;
- for $k \in \mathbb{N}$, $b_k \in (-\infty, -1) \cup (-1, \infty)$ are constants;
- for each compact subset $[a, b]$ of $[t_0, \infty)$ and $j = 1, \ldots, n$, the Perron-Stieltjes integral $\int_a^b p_j(s)\, dg(s)$ exists.

The goal of this work is to present new criteria for the existence of oscillatory and nonoscillatory solutions of (1), that is, we propose oscillation and nonoscillation criteria for functional differential equations which the functions involved take values in $\mathbb{R}^n$.

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Uniform persistence and periodic solutions for some systems of delay differential equations

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Abstract

Simple criteria for persistence in some systems of delay differential equations shall be presented. Inspired by a classical population model, we shall introduce sufficient conditions for weak or strong persistence and uniform persistence. As a consequence, we shall deduce the existence of positive periodic solutions. Moreover, we shall prove, in some cases, that the conditions are also necessary; in particular, accurate assumptions will imply that 0 is a global attractor for all the positive solutions.

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Global persistence of nonlinear operators in Hilbert spaces

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Abstract

We study the nonlinear eigenvalue problem $Lx + \varepsilon N(x) = \lambda x$ in a finite-dimensional real Hilbert space H, where ε, λ are real parameters, $L\colon H \to H$ is linear, and $N\colon S \to H$ is a continuous map, S being the unit sphere in H. We prove a global continuation property of the set of the *solution triples* $(x, \varepsilon, \lambda) \in S \times \mathbb{R} \times \mathbb{R}$ of this problem. Namely, under the assumption that l_* is a simple eigenvalue of L with eigenvector $x_* \in S$, we show that, in the set of all the solution triples, the connected component containing $(x_*, 0, \lambda_*)$ is either unbounded or meets a solution triple $(x^*, 0, l^*)$ with $x^* \neq x_*$.

Our results are related to some papers by R. Chiappinelli, in which he studied a "local" persistence property of eigenvalues and eigenvectors of self-adjoint operators in real Hilbert spaces. This is a joint work with A. Calamai, M. Furi, M.P. Pera

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Optimality Conditions for Optimal Control Problems with Mixed Constraints

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Abstract

Necessary and sufficient optimality conditions are given for optimal control problems with mixed state-control constraints. The necessary conditions are given in the form of a weak maximum principle and are obtained under a constant rank type regularity condition. Such necessary conditions are shown to be also sufficient for optimality under generalized convexity assumptions. The concept of generalized convexity is the most general one.

Problem statement and optimality conditions

The optimal control problem with mixed constraints this work is concerned with is posed as follows:

$$\begin{array}{ll} \text{minimize} & l(x(0),x(1)) \\ \text{subject to} & \dot{x}(t)=f(t,x(t),u(t),v(t)) \text{ a.e. in } [0,1], \\ & h(t,x(t),u(t),v(t))=0 \text{ a.e. in } [0,1], \\ & g(t,x(t),u(t),v(t))\leq 0 \text{ a.e. in } [0,1], \\ & v(t)\in V(t) \text{ a.e. in } [0,1], \\ & (x(0),x(1))\in C, \end{array} \tag{P}$$

where $l:\mathbb{R}^n\times\mathbb{R}^n\to\mathbb{R}$, $(f,g,h):[0,1]\times\mathbb{R}^n\times\mathbb{R}^{k_u}\times\mathbb{R}^{k_v}\to\mathbb{R}^n\times\mathbb{R}^{m_g}\times\mathbb{R}^{m_h}$ are given functions, $V(t)\subset\mathbb{R}^{k_v}$ for all $t\in[0,1]$ and $C\subset\mathbb{R}^n\times\mathbb{R}^n$.

Let us denote the unmaximized Hamiltonian function as

$$H(t,x,p,q,r,u,v):=p\cdot f(t,x,u,v)+q\cdot h(t,x,u,v)+r\cdot g(t,x,u,v).$$

The weak maximum principle is said to be satisfied at a feasible process $(\bar{x},\bar{u},\bar{v})$ if there exist $p\in W^{1,1}([0,1];\mathbb{R}^n)$, $q\in L^1([0,1];\mathbb{R}^{m_h})$, $r\in L^1([0,1];\mathbb{R}^{m_g})$, $\zeta\in L^1([0,1];\mathbb{R}^{k_v})$, and $\lambda\geq 0$ such that

(i) $\|p\|_\infty+\lambda\neq 0$;

(ii) $(-\dot{p}(t),0,\zeta(t))=\nabla_{x,u,v}H(t,\bar{x}(t),p(t),q(t),r(t),\bar{u}(t),\bar{v}(t))$ a.e. in $[0,1]$;

(iii) $\zeta(t)\in \mathrm{co}N_{V(t)}(\bar{v}(t))$ a.e. in $[0,1]$;

(iv) $r(t)\cdot g(t,\bar{x}(t),\bar{u}(t),\bar{v}(t))=0$ and $r(t)\leq 0$ a.e. in $[0,1]$;

(v) $(p(0), -p(1)) \in N_C(\bar{x}(0), \bar{x}(1)) + \lambda \nabla l(\bar{x}(0), \bar{x}(1))$.

Furthermore, for some integrable function K_m, $|(q(t), r(t))| \leq K_m(t)|p(t)|$ a.e. in $[0, 1]$.

In this work, necessary optimality conditions are given for (P) in the form of the weak maximum principle stated above, where a regularity condition of constant rank type is imposed on the mixed constraints. This regularity condition is weaker than full rank assumptions found in the literature (see de Pinho [3] and references therein), and is an alternative regularity condition regarding Mangasarian-Fromovitz constraint qualification (see de Pinho and Rosenblueth [4]). Sufficient optimality conditions are obtained in terms of the so called maximum-principle-pseudo-invexity (MP-pseudo-invexity) (see de Oliveira and Silva [1, 2]). As expected, MP-pseudo-invex problems subsume convex problems. Moreover, it is shown that when all extremal control processes are optimal, the problem is, necessarily, MP-pseudo-invex. This means that the class of MP-pseudo-invex problems is the largest class of optimal control problems in which the optimality conditions of the maximum principle are both necessary and sufficient.

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Nonlinear Dynamical Systems

Organizer: Juliana Pimentel (UFABC)

The Variational Principle for Locally Compact Spaces

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Abstract

We have extended the *variational principle* for entropies to continuous transformations $T : X \to X$ defined over locally compact separable metrizable spaces. To each T-invariant Radon probability measure μ, there is an associated *Kolmogorov-Sinai* entropy, $h_\mu(T)$. The *Bowen entropy*, $h_d(T)$, is defined for each metric d compatible with the topology of X. And when X is compact, Adler, Konheim e McAndrew have defined the *topological entropy*, $h(T)$, in terms of open coverings. To deliver a theory similar to the compact case (Theorem 8.6 in [2]), we have extended in [1] the concept of *topological entropy* using open coverings such that at least one of its members has compact complement. Using this new definition, he have shown that

$$\sup_\mu h_\mu(T) = h(T) = \min_d h_d(T),$$

where the minimum of $h_d(T)$ is attained when d is the restriction to X of any metric defined over the *one point compactification* of X.

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Impulsive non-autonomous dynamical systems

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Abstract

In this talk, we present the theory of "impulsive non-autonomous dynamical systems". We establish conditions to ensure the existence of an impulsive cocycle attractor and we present some examples.

References

[1] E. M. Bonotto, M. C. Bortolan, T. Caraballo and R. Collegari, *Impulsive non-autonomous dynamical systems and impulsive cocycle attractors*, Math. Meth. Appl. Sci., **40**, 1095-1113, 2017.

Construction of a global solution for a process

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Abstract

Construction of bounded complete trajectories for semigroups (see [1, 2]) and bounded complete orbits for multivalued semiflows or generalized semiflows (see [3]) is an old subject of extreme importance for characterization of attractors . I will present in this talk a technique developed in [4] to construct a bounded global solution for a process in order to obtain upper semicontinuity of a family of pullback attractors.

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Combining random searches, individual's memory, and population dynamics: analysis of population redistribution patterns

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Abstract

The reaction-diffusion equation is one of the possible ways for modeling animal movement, where the reactive part stands for the population growth and the diffusive part for random dispersal of the population. Nevertheless, there are some mechanisms that affect the movement, such as resource depletion or individual's spatial memory of recently depleted patches, which results in a bias for one direction of dispersal and can be modeled by an advective term on a advection-reaction-diffusion equation. Therefore, our model is composed of a coupled nonlinear partial differential equation system with one equation for the population dynamics and other for the memory density distribution. For the population growth, we use either the exponential or logistic growth function. Analytic approach, shows that for the exponential and logistic growth the traveling wave speeds are the same with or without memory dynamics. From numerical analysis, we explore how the population redistribution is affected by different values of the parameters: memory, growth rate, and carrying capacity. Combining these parameters results on a redistribution pattern of the population associated to either normal or anomalous diffusion: subdiffusion and supperdiffusion.

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The minimal Morse components of translations in flag manifolds are normally hyperbolic

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Abstract

In the projective space, consider the iteration of an invertible matrix: are the minimal Morse components normally hyperbolic? An affirmative answer was only known in the case where the matrix is diagonalizable. Using Lie theory, we prove this to be true in the rather more general context of an arbitrary element of a semisimple Lie group acting on one of its flag varieties: the so-called translations in flag varieties. This context encompasses the iteration of invertible matrices not necessarily diagonalizable in the real or complex projective space, the classic flag varieties of real or complex nested spaces, and also the symplectic grassmanians. Without using the tools from Lie Theory we do not know a solution for this problem even in the simplest case of the projective space. In this lecture we will sketch how we solve this question for the projective space, presenting the necessary rudiments from Lie theory.

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The Topological Entropy of Endomorphisms of Lie Groups

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Abstract

In this talk, we determine the topological entropy $h(\phi)$ of a continuous endomorphism ϕ of a Lie group G. This computation is a classical topic in ergodic theory which seemed to have long been solved. But, when G is noncompact, the well known Bowen's formula for the entropy $h_d(\phi)$ associated to a left invariant distance d just provides an upper bound to $h(\phi)$, which is characterized by the so called variational principle. We prove that

$$h(\phi) = h\left(\phi|_{T(G_\phi)}\right)$$

where G_ϕ is the maximal connected subgroup of G such that $\phi(G_\phi) = G_\phi$, and $T(G_\phi)$ is the maximal torus in the center of G_ϕ. This result shows that the computation of the topological entropy of a continuous endomorphism of a Lie group reduces to the classical formula for the topological entropy of a continuous endomorphism of a torus. Our approach explores the relation between null topological entropy and the nonexistence of Li-Yorke pairs and also relies strongly on the structure theory of Lie groups.

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A nonlocal approach to spatial spread in thin structures

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Abstract

In this talk we discuss an approach to considerer spatial spread in N-dimensional thin structures. We introduce equations with nonlocal dispersal and defined in tight domains contrasting it with its corresponding local diffusion equation with Neumann and Dirichlet boundary conditions. Here the thin structure effect is modeled by an ϵ-parameter family of open sets which squeezes to a lower dimension open set as $\epsilon \to 0$. The asymptotic behavior of the solutions is analyzed and the results are compared with classical situations to elliptic equations in thin domains.

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Unbounded Sturm attractors for quasilinearparabolic equations

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Abstract

The goal of this paper is to construct explicitly the global attractors of quasi-linear parabolic equations when solution can also grow up, and hence the attractor is unbounded. In particular, we construct heteroclinic connections betweenbounded and/or unbounded hyperbolic equilibria. This is a joint work with Juliana Pimentel.

Rayleigh–Bénard problem for micropolar fluids

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Abstract

The talk will be devoted to the Rayleigh–Bénard convection of a micropolar fluid. Convective flows in such fluids are governed by the following system of equations

$$\begin{aligned}
&\frac{1}{\mathrm{Pr}}(u_t + (u\cdot\nabla)u) - (1+K)\Delta u + \frac{1}{\mathrm{Pr}}\nabla p = 2K\,\mathrm{rot}\,\omega + e_3\mathrm{Ra}T\\
&\mathrm{div}\,u = 0\\
&\frac{M}{\mathrm{Pr}}(\omega_t + (u\cdot\nabla)\omega) - L\Delta\omega - G\nabla\mathrm{div}\,\omega + 4K\omega = 2K\,\mathrm{rot}\,u\\
&T_t + u\cdot\nabla T - \Delta T = 0,
\end{aligned}$$

where, in contrast to Newtonian fluids, in order to close the system, one needs to consider the additional equation for the angular momentum ω. We will present the results on the existence and dimension of global attractor and compare them with the corresponding results for Newtonian fluids. In three-dimensional case we will show that the global attarctor exists for large Prandtl number Pr. We will also show the estimates for the Nusselt number obtained by the background flow method, for finite and infinite Prandtl number, and compare them with the known estimates for the Newtonian fluids. The estimates for micropolar fluids turn out to be sharper then the corresponding ones for Newtonian fluids, which reflects the fact that additional dissipation effects related with the rotational friction between fluid particles are present in the model.

Robustness with respect to exponents for non-autonomous reaction diffusion equations

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Abstract

In this work we establish upper semicontinuity of pullback attractors for a non-autonomous evolution equation of the form

$$\begin{cases} \frac{\partial u_\lambda}{\partial_t}(t) - \operatorname{div}\left(D(t)|\nabla u_\lambda(t)|^{p_\lambda(x)-2}\nabla u_\lambda(t)\right) + |u_\lambda(t)|^{p_\lambda(x)-2}u_\lambda(t) = B(t,u_\lambda(t)), \\ u_\lambda(\tau) = u_{0\lambda} \end{cases} \tag{P_λ}$$

with a homogeneous Neumann boundary condition, for $(t,x) \in (\tau,+\infty)\times\Omega$ where Ω is a bounded smooth domain in $\mathbb{R}^N$ for some $N \geq 1$ and the initial condition $u_\lambda(\tau) \in H := L^2(\Omega)$. The exponets functions $p_\lambda \in C(\overline{\Omega},\mathbb{R})$ satisfy some control assumptions and $p_\lambda \to p$ in $L^\infty(\Omega)$ for some p such that $p(\cdot) \in C(\overline{\Omega},\mathbb{R})$.

The terms B and D are assumed to satisfy:

Assumpition B The mapping $B : [\tau,T]\times H \to H$ is such that

(B1) there exist $L \geq 0$ such that

$$\|B(t,x_1) - B(t,x_2)\|_H \leq L\|x_1 - x_2\|_H$$

for all $t \in [\tau,T]$ and $x_1, x_2 \in H$;

(B2) for all $x \in H$ the mapping $t \to B(t,x)$ belongs to $L^2(\tau,T;H)$;

(B3) the function $t \to \|B(t,0)\|_H$ is nondecreasing, absolutely continuous and bounded on compact subsets of $\mathbb{R}$.

Assumpition D $D : [\tau,T]\times\Omega \to \mathbb{R}$ is a function in $L^\infty([\tau,T]\times\Omega)$ such that

(D1) there are positive constants, β and $\mathcal{M}$ such that $0 < \beta \leq D(t,x) \leq \mathcal{M}$ for almost all $(t,x) \in [\tau,T]\times\Omega$;

(D2) $D(t,x) \geq D(s,x)$ for each $x \in \Omega$ and $t \leq s$ in $[\tau,T]$.

The authors in [1] also considered the non-autonomous problem and proved the robustness with respect to the diffusion coefficient whereas in this work we study the robustness with respect to the exponents. The results of this research can be found in detail in [2].

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Intermingled basins in coupled Lorenz systems

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Abstract

Riddled basins occur in nonlinear systems whose phase space symmetry allows an invariant subspace with a chaotic attractor. This invariant subspace can either attract or repel orbits. As a consequence, for every point belonging to the basin of attraction, there is another point, arbitrarily close, that does not belong to the basin of attraction. The presence of riddled basins is verified by analyzing the maximal transversal Lyapunov exponent and the maximal transversal finite time Lyapunov exponent.

In this work, we consider a system of two identical linearly coupled Lorenz oscillators presenting synchronization of chaotic motion for a specified range of the coupling strength. We verify the existence of global synchronization and antisynchronization attractors with intermingled basins of attraction such that the basin of one attractor is riddled with holes belonging to the basin of the other attractor and vice versa. We investigated this phenomenon by verifying the fulfillment of the mathematical requirements for intermingled basins and obtained scaling laws that characterize quantitatively the riddling of both basins in this system.

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Functional Analysis

Organizer: Geraldo de Azevedo Botelho (UFU)

Duality in Spaces of Lorch Analytic Mappings

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Abstract

Let E be a complex Banach algebra. In this talk we study the strong dual of the Fréchet space $\mathcal{H}_L(E)$ of the mappings $f : E \to E$ that are analytic in the sense of Lorch. In fact we are going to present two descriptions of the dual of the space $\mathcal{H}_L(E)$ and some recent results on topological properties of the strong dual of the space $\mathcal{H}_L(E)$.

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Twisted sums of c_0 and $C(K)$

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Abstract

The purpose of this talk is to discuss a problem I have been working on for the last couple of years. This problem deals with the existence of nontrivial twisted sums of Banach spaces. It is an easy corollary of Sobczyk's Theorem that if X is a separable Banach space, then every twisted sum of c_0 and X is trivial. This naturally raises the question about the converse of this last implication, i.e., if X is a Banach space such that every twisted sum of c_0 and X is trivial, then X must be separable? This question is easily answered negatively. However it becomes quite interesting when we restrict ourselves to the subclass of Banach spaces of the form $C(K)$, i.e., the space of continuous real-valued functions defined on a compact Hausdorff space K, endowed with the supremum norm. Recall that a space $C(K)$ is separable if and only if K is metrizable. Therefore the question in this context can be rephrased as: Is there a nonmetrizable compact Hausdorff space K such that every twisted sum of c_0 and $C(K)$ is trivial? This question was proposed originally by Cabello, Castillo, Kalton and Yost in 2003 and it has not been solved yet. In this talk I will present the progress we have made towards the general solution of this problem as well as possible future developments.

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On the spectrum of the algebra of bounded type holomorphic functions on Banach spaces

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Abstract

We study the spectrum of the algebra of bounded type analytic functions on unit ball (or a complete Reinhardt domain in) in a Banac space E. We aim to describe $M_b(U)$ as analytic manifold. We show that whenever U is a complete Reinhardt domain in a reflexive space with 1-unconditional basis, each connected component of $M_b(U)$ is (identified with) a complete Reinhardt set. We also prove that, when U is the unit ball of ℓ_p, the connected components are identified with balls which, with the exception of the component formed by evaluations, have radius strictly smaller that 1. Moreover, there are connected components with arbitrary small radius. We also show that for other Banach sequence spaces, connected components do not necessarily identify with balls. Joint work with D. Carando and S. Muro, UBA, Argentina.

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Some stability properties of the polynomial daugavetian index

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Abstract

Let X be an infinite-dimensional complex Banach space and let P be a compact polynomial on X given by $P = P_0 + P_1 + \cdots + P_n$ where P_j is a j-homogeneous polynomial for $j = 0, \ldots, n$. From [1, Proposition 3.4], we have that P_1 is a compact linear operator. And it follows from the Cauchy Inequality that

$$\|Id + P_1\| \leq \|Id + P\|.$$

Since P_1 is compact and X has infinity dimension, $\|Id+P_1\| \geq 1$ and consequently $\|Id+P\| \geq 1$. This allow us to define the *polynomial daugavetian index* of X as

$$\operatorname{daug}_p(X) = \max\{m \geq 0 : \|Id + P\| \geq 1 + m\|P\| \text{ para todo } P \in \mathcal{P}_K(X)\},$$

generalizing the ideas of the daugavetian index defined by M. Martín [2]. Observe that $0 \leq \operatorname{daug}_p(X) \leq 1$. When $\operatorname{daug}_p(X) = 1$, the space X has the *polynomial Daugavet property*, that is, every weakly compact polynomial P on X satisfies the Daugavet equation:

$$\|Id + P\| = 1 + \|P\|.$$

The purpose of this talk is to present some stability properties of the daugavetian index for c_0-, $\ell_\infty-$ and ℓ_1-sums.

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Summability of multilinear operators: a unified theory and consequences

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Abstract

Results related to summability of multilinear operators date back, at least, to the 30's, when Littlewood proved his seminal 4/3 inequality. Since then, several different related results and approaches have appeared, as the Hardy–Littlewood inequalities (Quarterly J. Math., 1934), that can be considered a keystones to the theory of summability of multilinear operators. In this talk we present a new unifying approach to a series of results on summability of multilinear forms, that include the aforementioned inequalities.

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Jorge Mujica's last theorem and applications

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Abstract

Let U be a balanced open subset of the complex Banach space E. Shortly before passing away quite prematurely, Jorge Mujica proved that the sequence $(Q(^nE))_{n=0}^{\infty}$, where $Q(^nE)$ is the space of complex-valued continuous n-homoge-neous polynomials on E, is an $\mathcal{S}$-absolute Schauder decomposition for the predual $G_b(U)$ of the space $\mathcal{H}_b(U)$ of holomorphic functions of bounded type on U. In this talk we describe two applications of this result, concerning representations of linearizations of holomorphic functions of bounded type and closed ideals of linear operators between locally convex spaces. This is a joint work with Vinícius V. Fávaro and Jorge Mujica.

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mid (q,p)-summable sequences

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Abstract

The notion of mid p-summable sequences was introduced by Karn and Sinha in 2014 and recently explored by Botelho *et al.* in 2017. From this we design a theory of mid summable sequences in the anisotropic setting. As a particular case of our results, we prove that mid p-summable sequences are mid q-summable whenever $p \leq q$, an inclusion result that seems to have been yet not proven in the literature. We will also draw attention to a certain bilinear nature of operators that transform sequences from/into this kind of space.

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Complementation in Fremlin vector lattice symmetric tensor products

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Abstract

For a vector lattice E, let $\bar{\otimes}_{n,s}E$ denote the n-fold Fremlin vector lattice symmetric tensor product of E. For $m > n$, we prove that (i) if $\bar{\otimes}_{m,s}E$ is uniformly complete then $\bar{\otimes}_{n,s}E$ is positively isomorphic to a complemented subspace of $\bar{\otimes}_{m,s}E$, and (ii) if there exists $\phi \in E_+^{\sim}$ such that $ker(\phi)$ is a projection band in E then $\bar{\otimes}_{n,s}E$ is lattice isomorphic to a projection band of $\bar{\otimes}_{m,s}E$. We also obtain analogous results for the n-fold Fremlin Banach lattice symmetric tensor product $\hat{\otimes}_{n,s,|\pi|}E$ of E where E is a Banach lattice. This is a joint work with professors Dr. Qingying Bu and Dr. Donghai Ji.

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Biholomorphic Mappings on Banach Spaces

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Abstract

H. Cartan theorem stating that a holomorphic self-map of a bounded domain in $\mathbb{C}^n$ with a fixed point at which the derivative is the identity has to be the identity was widened by Cima et al. [2] to separable Hilbert spaces and then to separable dual Banach spaces in [1]. Now, we present an infinite-dimensional version of Cartan theorem concerning the existence of a holomorphic inverse of a given holomorphic self-map of a bounded convex open subset of a dual Banach space. The main assumption is that the derivative operator is power bounded that we, in turn, show to be diagonalizable in some cases, like the separable Hilbert space.

Joint work with H. Carrión and P. Galindo

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Mean Li-Yorke Chaotic Operators on Banach Spaces

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Abstract

We investigate the notion of mean Li-Yorke chaos for operators on Banach spaces. We show that it differs from the notion of distributional chaos of type 2, contrary to what happens in the context of topological dynamics on compact metric spaces. We prove that an operator is mean Li-Yorke chaotic if and only if it has an absolutely mean irregular vector. As a consequence, absolutely Cesàro bounded operators are never mean Li-Yorke chaotic. Dense mean Li-Yorke chaos is shown to be equivalent to the existence of a dense (or residual) set of absolutely mean irregular vectors. As a consequence, every mean Li-Yorke chaotic operator is densely mean Li-Yorke chaotic on some infinite-dimensional closed invariant subspace. A (Dense) Mean Li-Yorke Chaos Criterion and a sufficient condition for the existence of a dense absolutely mean irregular manifold are also obtained. Moreover, several examples and counterexamples are presented. Finally, mean Li-Yorke chaos is also investigated for C_0-semigroups of operators on Banach spaces.

Joint work with Antonio Bonilla and Alfredo Peris.

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Dynamics of homogeneous polynomials on Banach spaces

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Abstract

Let X be a Banach space. A function $F : X \to X$ is said to be hypercyclic if there exists $x \in X$ whose orbit $Orb_F(x) = \{F^n(x) : n \in \mathbb{N}_0\}$ is dense in X. It is a known fact that there exist hypercyclic linear operators in arbitrary separable infinite dimensional Banach spaces. The dynamical system induced by a (non linear) homogeneous polynomial is quite different. Associated to each homogeneous polynomial there is a ball, centered at zero, with the following property: orbits that meet this limit ball tend to zero. Therefore homogeneous polynomials on Banach spaces cannot be hypercyclic. However, the behavior of the orbits that never enter the limit ball can be non trivial. Indeed, in [1] Bernardes showed the existence of orbits oscillating between infinity and the limit ball. He also proved that there are supercyclic homogeneous polynomials in arbitrary separable infinite dimensional Banach spaces.

In this talk we will exhibit a simple and natural 2-homogeneous polynomial that is at the same time d-hypercyclic (the orbit meets every ball of radius d), weakly hypercyclic (the orbit is dense with to respect the weak topology) and Γ-supercyclic ($\Gamma \cdot Orb_P(x)$ is dense) for each subset $\Gamma \subseteq \mathbb{C}$ unbounded or not bounded away from zero. To prove this, the properties of its Julia set are studied. We will also generalize the construction to arbitrary infinite dimensional Fréchet spaces.

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Holomorphic functions with distinguished properties on infinite dimensional spaces

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Abstract

The study of algebras of holomorphic functions is a classical topic in function theory. When the subject comes to holomorphic functions of infinitely many variables, new phenomena occur, in the sense that functions enjoying properties that are forbidden in the case of finitely many variables might exist (see, e.g, [2]). A central question is the existence, or not, of such functions and, in the positive case, it is usually a very difficult task to construct such functions. A cornerstone in this study was the construction, by Aron, Cole and Gamelin [1], of a bounded holomorphic function on the open unit ball of an infinite dimensional complex Banach space that is continuously but not uniformly continuously extended to the closed unit ball (let us call such functions *Aron-Cole-Gamelin functions*). The main purpose of our talk is to present a method to construct holomorphic functions of infinitely many variables satisfying certain prescribed distinguished properties. For instance, we show how to construct, for the first time to the best of our knowledge, Aron-Cole-Gamelin functions on certain open sets not necessarily the open unit ball. The technique we develop is powerful enough to provide, in certain cases, large algebraic structures formed by such functions (up to the null function, of course).

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Positive definite kernels on two-point homogeneous spaces

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Abstract

In this work we study continuous kernels on compact two-point homogeneous spaces which are positive definite and zonal (isotropic). Such kernels were characterized by R. Gangolli some forty years ago and are very useful for solving scattered data interpolation problems on the spaces. In the case the space is the d-dimensional unit sphere, J. Ziegel showed in 2013 that the radial part of a continuous positive definite and zonal kernel is continuously differentiable up to order $\lfloor (d-1)/2 \rfloor$ in the interior of its domain. The main issue here is to obtain a similar result for all the other compact two-point homogeneous spaces.

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Elliptic Partial Differential Equations

Organizer: Edcarlos Domingos da Silva (UFG)

Sharp Regularity for the Inhomogenous Porous Medium Equation

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Abstract

In this talk we shall consider the inhomogeneous porous medium equation

$$\partial u_t - \Delta u^m = f \in L^{q,r} \quad m > 1.$$

Here we show that weak solutions are Hölder continuous, with the following sharp exponent

$$\min\left\{\frac{\alpha_0^-}{m}, \frac{[(2q-n)r-2q]}{q[mr-(m-1)]}\right\},$$

where α_0 denotes the optimal Hölder exponent for solutions of the Homogeneous equation. The method relies on an approximation lemma and geometric iteration with the appropriate intrinsic scaling. This talk is based on *joint* work with J. Miguel Urbano and A.F. Maia - University of Coimbra - Portugal.

Up to the boundary gradient estimates in free boundary problems

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Abstract

In this talk, we present some ingredients that lead to gradient estimates up to the boundary in nonlinear free boundary problems. As an application and main motivation, we apply these estimates for singular perturbation problems of flame propagation type.

On nonquadratic fractional coupled elliptic systems in unbounded domains

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Abstract

In this talk we establish existence of positive solutions for a class of nonlocal linearly coupled systems involving Schrödinger equations with fractional Laplacian operator given by

$$\begin{cases} (-\Delta)^{s_1} u + V_1(x)u = f_1(u) + \lambda(x)v, & x \in \mathbb{R}^N, \\ (-\Delta)^{s_2} v + V_2(x)v = f_2(v) + \lambda(x)u, & x \in \mathbb{R}^N, \end{cases}$$

where $(-\Delta)^s$ denotes de fractional Laplacian, $s_1, s_2 \in (0,1)$ and $N \geq 2$. The coupling function $\lambda : \mathbb{R}^N \to \mathbb{R}$ is a bounded and continuous function which is related with the potentials by $|\lambda(x)| \leq \delta\sqrt{V_1(x)V_2(x)}$, for some $\delta \in (0,1)$. We deal with periodic and asymptotically periodic bounded potentials $V_1(x)$ and $V_2(x)$. On the nonlinear terms f_1 and f_2, we assume "superlinear" at infinity and at the origin. Employing a variational approach we obtain existence of bound and ground states solutions without assuming the well known Ambrosetti-Rabinowitz condition on the nonlinear terms. Furthermore, we give a description of the ground states when the coupling function $\lambda(x)$ goes to zero in the L^∞ norm.

Joint work with João Marcos do Ó (Unb), José Carlos de Albuquerque (UFG).

Hénon Elliptic Equations in $\mathbb{R}^2$ with Subcritical and Critical Exponential Growth: Mountain–Pass case

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Abstract

We study the Dirichlet problem in the unit ball B_1 of $\mathbb{R}^2$ for the Hénon-type equation of the form

$$\begin{cases} -\Delta u &= \lambda u + |x|^\alpha f(u) \quad \text{in} \quad B_1, \\ u &= 0 \qquad\qquad\qquad\quad \text{on} \quad \partial B_1, \end{cases}$$

where $f(t)$ is a C^1-function in the critical growth range motivated by the celebrated Trudinger-Moser inequality. We consider $0 < \lambda < \lambda_1$ and under suitable hypotheses on constant and $f(t)$, by variational methods, we study the solvability of this problem in appropriate Sobolev Spaces.

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Infinitely many solutions for a class of degenerated or singular elliptic p-Kirchhoff equations

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Abstract

We are concerned in this lecture with existence of infinitely many solutions for a class of elliptic equations where Kirchhoff term may be degenerated, discontinuous or singular at origin. The source term in the equation may be nonlocal as well. In the final part of the lecture extension of the results to more general nonhomogeneous elliptic Kirchhoff equations will be also discussed.

Least energy nodal solution for the Schrödinger-Poisson system under an asymptotically cubic nonlinearity

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Abstract

In this talk we present a recent result concerning the existence of a least energy sign changing solution for a nonlinear Schrödinger-Poisson system in the whole space. The nonlinearity behaves asymptotically cubic at infinity then it is in strict competition with the nonlocal term appearing in the energy functional. To prove the existence of such a solution we work on the the "nodal Nehari set" on which we minimize the functional. One of the main difficulties is to show that this set is nonempty under the assumption made on the nonlinearity.

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Extremal for a k-Hessian inequality of Trudinger-Moser type

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Abstract

We consider k-Hessian operators $S_k[u]$ in bounded domains Ω in $\mathbb{R}^N$ such that $\partial\Omega$ is $(k-1)$-convex. For so-called k-admissible functions $u \in \Phi_0^k$ one has Sobolev type inequalities of the form

$$\|u\|_{L^p(\Omega)} \leq C \|u\|_{\Phi_0^k}$$

where $\|u\|_{\Phi_0^k}^{k+1} = \int_\Omega (-u) S_k[u] dx$, and $1 \leq p \leq k^* = \frac{N(k+1)}{N-2k}$. The case $N = 2k$ is a borderline case of Trudinger-Moser type, and it was recently shown by Tian-Wang that a corresponding inequality of exponential type holds

$$\sup_{\|u\|_{\Phi_0^k} \leq 1} \int_\Omega \left(\mathrm{e}^{\alpha |u|^{\frac{N+2}{N}}} - \sum_{j=0}^{k-1} \frac{\alpha^j |u|^{j\frac{N+2}{N}}}{j!} \right) \mathrm{d}x \leq C$$

for $\alpha \leq \alpha_N = N \left[\frac{\omega_{N-1}}{k} \binom{N-1}{k-1} \right]^{2/N}$. In this article we prove an analogue to the famous result of Carleson–Chang, namely that for $\Omega = B_R(0)$ the above supremum is attained also in the limiting case $\alpha = \alpha_N$.

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On the well-posedness of Goursat problems in Gevrey classes

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Abstract

Some authors, Nishitani [5], Hasegawa [3], Carvalho e Silva [4], have investigated the C^∞ well-posedness of Goursat problems for linear PDE's with constant coefficients. I am interested in trying to find necessary and sufficient conditions for the generalized Goursat problem to be well-posed in the Gevrey classes Γ^s with $s > 1$.

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The fibering method approach for a non-linear Schrödinger equation coupled with the electromagnetic field

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Abstract

We study, with respect to the parameter $q \neq 0$, the following Schrödinger-Bopp-Podolsky system in $\mathbb{R}^3$

$$\begin{cases} -\Delta u + \omega u + q^2 \phi u = |u|^{p-2} u, \\ -\Delta \phi + a^2 \Delta^2 \phi = 4\pi u^2, \end{cases}$$

where $p \in (2, 3], \omega > 0, a \geq 0$ are fixed. We prove, by means of the fibering approach, that the system has no solutions *at all* for large values of $q's$, and has two *radial* solutions for small $q's$ (see [1]). We give also qualitative properties about the energy level of the solutions and a variational characterization of these extremals values of q. Our results recover and improve some results in [2, 3].

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Ground states for quasilinear Schrödinger elliptic systems

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Abstract

In this work we are concerned with the existence and nonexistence of ground state solutions for the following class of quasilinear Schrödinger coupled systems

$$\begin{cases} -\Delta u + a(x)u - \Delta(u^2)u = g(u) + \theta\lambda(x)uv^2, & x \in \mathbb{R}^N, \\ -\Delta v + b(x)v - \Delta(v^2)v = h(v) + \theta\lambda(x)vu^2, & x \in \mathbb{R}^N, \end{cases}$$

where $N \geq 3$, $\theta \geq 0$, $a, b, \lambda : \mathbb{R}^N \to \mathbb{R}$ are periodic or asymptotically periodic functions. The nonlinear terms g, h are superlinear at infinity and at the origin. By using a change of variable, we turn the quasilinear system into a nonlinear system where we can establish a variational approach with a fine analysis on the Nehari method. For the nonexistence result we compare the potentials $a(x), b(x)$ with periodic potentials proving nonexistence of ground state solutions.

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On the Choquard equation with Hardy-Littlewood-Sobolev upper critical exponent

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Abstract

In this talk I am going to introduce some existence results for the Choquard equation

$$-\varepsilon^2\Delta u + V(x)u = \varepsilon^{\mu-3}\Big(\int_{R^N}\frac{Q(y)G(u(y))}{|x-y|^\mu}dy\Big)Q(x)g(u) \quad \text{in } R^N,$$

where $0<\mu<N$, ε is a positive parameter, V, Q are two continuous real function on R^N and G is the primitive of g which is of critical growth due to the Hardy-Littlewood-Sobolev inequality. under different assumptions on the nonlinearities and potentials, we proved the existence and multiplicity of solutions, including the Brezis-Nirenberg type results, for this nonlocal equation by variational methods.

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Super critical problems with concave and convex nonlinearities in $\mathbb{R}^N$

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Abstract

In this work, adopting a methodology based on variational principle on convex sets, we establish an existence and multiplicity result for a class of semilinear elliptic problems defined on whole $\mathbb{R}^N$ with nonlinearities involving sublinear and superlinear terms.

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Parabolic Differential Equations

Organizer: Anderson Luis Albuquerque de Araújo (UFV)

The number π and the nonexistence of solution for Chern-Simons equation

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Abstract

The Brezis and Benilan's seminal work [1] on Thomas-Fermi problem which leads with elliptic problems involving L^1 or measure data has guided us to a new class of fascinating problems. Here we are interesting in understand the phenomenon of breaking of existence solutions of

$$\begin{cases} -\Delta u + e^u(e^u + 1) = \mu, & \text{in } \Omega, \\ u = 0, & \text{on } \partial\Omega. \end{cases}$$

when the measure evaluated in singletons surpass $4\pi\mathcal{H}^{n-2}$. We approximate the datum by a suitable convergent sequence in the measure sense in order to obtain a convergent sequence of solutions. The limit will be determined in terms only of datum. We also discuss the unlike cases when the data has signal and the counterpart of system.

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A class of parabolic equations driven by the mean curvature flow

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Abstract

We study a class of parabolic equations which can be viewed as a generalized mean curvature flow acting on cilindrically symmetric surfaces with Dirichlet condition on the boundary. We prove existence of a unique solution by means of an approximation scheme. We also develop the theory of asymptotic stability for solutions of general parabolic problems.

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Global solutions for a fractional reaction–diffusion equation

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Abstract

We shall discuss the existence and nonexistence of global positive solutions for the semilinear fractional diffusion equation

$$u_t(t,x) = \int_0^t dg_\alpha(s)\Delta u(t-s,x) + |u(t,x)|^{\rho-1}u(t,x), \text{ in } (0,\infty)\times\mathbb{R}^N; \tag{4}$$

$$u(x,0) = u_0(x), \text{ in } \mathbb{R}^N, \tag{5}$$

where $\rho > 1$. Indeed, a combination of [1, Th. 1] and [2, Th. 5] provides the following result:

(i) If $1 < \rho < 1 + \frac{2}{\alpha N}$, there exists no nonnegative global solution of (4)-(5).

(ii) If $\rho \geq 1 + \frac{2}{\alpha N}$, there exists a global nonnegative solution of (4)-(5).

Eventually, we highlight some asymptotic properties of the existing global solution.

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On the Dirichlet-to-Neumann Semigroup: Recent Developments and Results

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Abstract

Let $\Omega \subset \mathbb{R}^N$ be an open set with Lipschitz boundary. The Dirichlet-to-Neumann operator, in its simplest version, is the operator D_0 acting on $L^2(\partial\Omega)$ with the property that $\varphi \in \mathcal{D}(D_0)$ and $D_0\varphi = h$ if, and only if there exists $u \in H^1(\Omega)$ with $\Delta u = 0$ on Ω, $u|_{\partial\Omega} = \varphi$ on $\partial\Omega$, and $\partial_\nu u = h$ in a weak sense. It turns out that D_0 is the associated operator to a j-elliptic form (following Arendt and ter Elst [2]), namely, the classical Dirichlet form

$$\mathfrak{a}(u, v) = \int_\Omega \nabla u \cdot \overline{\nabla v}\, dx,$$

where $j : H^1(\Omega) \to L^2(\partial\Omega)$ is the trace operator form $H^1(\Omega)$ to $L^2(\partial\Omega)$.

In this talk we comment on several results concerning some other versions of this operator, including the case of rough domains and more general dynamics such as $\mathcal{L}u = \lambda u$, where $\mathcal{L}$ is a general second order differential operator satisfying certain hypotheses.

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Fractional Regularity for Degenerate Equations

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Abstract

In this talk we are going to address the fractional regularity of solutions for Quasilinear degenerate equations of both parabolic and elliptic type. Our goal will be to link the interaction between the nonlinear character of p-Laplacian-like operators with certain spaces of fractional order of differentiability and its effects on the associated solutions. In turn, special attention will be delivered for the case of the parabolic p-Laplacian, cf. [1], and also to the (p, q)-Laplacian, cf. [2], where we are going to review or present some new and old results regarding the regularity of solutions to this sort of equations, as well as the related a priori estimates.

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Attractors for a vectorial von Karman system

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Abstract

This lecture is concerned with long-time dynamics of a full von Karman (vectorial) system subject to nonlinear thermal coupling and *free* boundary conditions. In contrast with *scalar* von Karman system, vectorial full von Karman system accounts for both vertical and in plane displacements. The corresponding PDE is of critical interest in flow structure interactions where nonlinear plate/shell dynamics interacts with perturbed flows [vicid or invicid]. It is shown that the system is quasi-stable and admits a global attractor which is also *smooth and of finite fractal dimension.* The above result is shown to hold for plates without regularizing effects of rotational inertia and without any mechanical dissipation imposed on vertical displacements.

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Poster Session

Organizer: Willian Cintra (UnB)

The Riemann hypothesis as a problem of functional analysis

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Abstract

J. Alcántara [1] has proved that the Riemann Hypothesis (RH) holds true if and only if a certain compact operator A_ρ on $L^2(0,1)$ is injective. In [2] and [3] has been establish several relations between the operators A_ρ and $A_\rho(\alpha)$. One of then helps us to establish, using Theorem 1 in [4], that RH holds true if and only if $Ran(V_\alpha) \subset \overline{Ran(A^*_\rho(\alpha))}$.

In [1] has been proven that A_ρ is non-nuclear Hilbert-Scmidt. Using the fact that if (λ_n) is the sequence of non-zero eigenvalues of A_ρ where the ordering is such that $|\lambda_n| \geq |\lambda_{n+1}|$ for all $n \in \mathbb{N}$ and each one of them being repeated according to its algebraic multiplicity, then the first eigenvalue λ_1 is positive and has algebraic multiplicity one, $|\lambda_n| \leq \frac{e}{n}$ for all $n \in \mathbb{N}$, we stablish, using the Ringrose decomposition [5] and the spectral theorem for compact normal operators, that the sum of A_ρ and a quasi-nilpotent operator belongs to Lorentz ideal of compact operators $M_{1,\infty}$.

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Relation between approximation tools in homogeneous compact spaces of rank 1

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Abstract

In constructive approximation theory there are a lot of tools measuring, some how, the smoothness of functions. In this work we are interested on finding relations between particular of these tools, namely, moduli of smoothness, K-functionals and the rate of approximation of average operators on homogeneous compact spaces of rank 1.

It is proved a generalization of a recent result obtained on the spherical setting. Specifically, we show that the rate of approximation of the shifting operator is equivalent (in the asymptotic meaning) to the classical K-functional defined on homogeneous compact spaces of rank 1, and given by Laplace-Beltrami operator.

Relations once established permit us to apply a very new technique in order to get sharp estimates for the decay rate of eigenvalue sequences of certain integral operators on homogeneous compact spaces of rank 1.

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Standing waves for a system of quasilinear schrödinger equations in $\mathbb{R}^N$

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Abstract

In this paper we study the existence of bound state solutions for stationary quasilinear Schrödinger systems of the form

$$\begin{cases} -\Delta u + V(x)u - [\Delta(u^2)]u = K(x)H_u(u,v) & \text{in} \quad \mathbb{R}^N, \\ -\Delta v + V(x)v - [\Delta(v^2)]v = K(x)H_v(u,v) & \text{in} \quad \mathbb{R}^N, \end{cases} \tag{S}$$

where $N \geq 3$, V and K are bounded continuous nonnegative functions, and, the primitive of nonlinearity, $H(u,v)$ is a p-homogeneous function of class C^1 with $4 < p < 22^*$. We give a special attention to the case when V may eventually vanishes. Our arguments are based on truncation methods, Moser iteration scheme and some variational arguments like as Mountain-Pass Theorem and changing of variable.

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Standing waves for weakly coupled nonlinear Schrodinger systems with critical growth in $\mathbb{R}^N$

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Abstract

In this work we apply variational methods to study the existence of positive solutions for the following nonlinear coupled Schrodinger system with critical growth in $\mathbb{R}^N$

$$\begin{cases} -\Delta u + \lambda_1 u &= |u|^{p-2}u + \frac{2\beta\alpha}{\alpha+\mu}|u|^{\alpha-2}u|v|^{\mu}, \qquad \text{in} \qquad \mathbb{R}^N, \\ -\Delta v + \lambda_2 v &= |v|^{q-2}v + \frac{2\beta\mu}{\alpha+\mu}|v|^{\mu-2}v|u|^{\alpha}, \qquad \text{in} \qquad \mathbb{R}^N, \end{cases} \tag{6}$$

with $N \geqslant 2$, $\beta > 0$, $\alpha, \mu > 1$, $\alpha + \mu = 2^*$, $2 < p, q < 2^*$ and $\lambda_1,\ \lambda_2 > 0$, where we define $2^* = \infty$ if $N = 2$ and $2^* = 2N/(N-2)$ if $N \geq 3$. Existence of positive least energy solution will also be established. For this, we consider the associated functional restricted to Nehari monifold and we apply local and global minimization arguments combined with minimax methods. We also establish appropriate estimates for the level determined by Mountain Pass Theorem and use arguments developed by Brezis and Nirenberg for the study of semilineares problems with critical growth.

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Mountain pass algorithm via Pohozaev manifold

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Abstract

A new numerical algorithm for solving asymptotically linear problems is presented. The ground state solution of the problem, which in general is obtained as a min-max of the associated functional, is obtained as a minimum of the functional constrained to the Pohozaev manifold instead. Examples are given of the use of this method for finding numerical solutions depending on various parameters.

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On retarded potentials and applications

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Abstract

When we take into account time-varying electric current or charge distributions in the past, it is reasonable to consider retarded potentials for the generated electromagnetic fields. The fields propagate at the speed of light, c, so the delay of the fields connecting cause and effect at earlier and later times is an important factor. We extend the notion of retarded potentials to paths so that we can employ the Henstock integral in order to obtain a Feynman-Kač-type formula to the wavefunction which is a solution of the Schrödinger equation with retarded potentials in quantum mechanics.

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Topological optimization in the kirchhoff plate bending model using topological derivative

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Abstract

The topological derivative is a scalar field that measures the sensitivity of a functional data to an infinitesimal perturbation in a $\Omega \subset \mathbb{R}^n$ domain. The topological derivative has been successfully used for topological optimization in a large class of engineering and physical problems. In this work, we use the topological derivative in the Kirchhoff plate bending model, which is modeled by a fourth-order differential operator, in order to maximize the first eigenvalue, which represents the first natural frequency of vibration.

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Solving D'Alambert problem using Perplex Numbers

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Abstract

We will present a particular solution to the following D'Alambert non homogeneous partial differential equation

$$\frac{\partial^2\psi(x,t)}{\partial x^2} - \frac{1}{v^2}\frac{\partial^2\psi(x,t)}{\partial t^2} = \frac{K}{x^2-(vt)^2},\ v \in \mathbb{R}^+$$

using a method based on complex analysis, adapted to another number set, the Perplex Numbers.

Positive ground states for a subcritical and critical coupled system involving Kirchhoff-Schrödinger equations

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Abstract

In this paper we prove the existence of positive ground state solution for a class of linearly coupled systems involving Kirchhoff-Schrödinger equations. We study the subcritical and critical case. Our approach is variational and based on minimization technique over the Nehari manifold. We also obtain a nonexistence result using a Pohozaev identity type.

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Continuums of positive solutions for classes of non-autonomous and non-local problems with strong singular term

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Abstract

In this work, we show existence of *continuums* of positive solutions for non-local quasilinear problems with strongly-singular reaction term on a bounded domain in $\mathbb{R}^N$, with $N \geq 2$. We approached non-autonomous and non-local equations by applying the Bifurcation Theory to the corresponding ϵ-perturbed problems and using a comparison principle for $W^{1,p}_{\rm loc}(\Omega)$-sub and supersolutions to obtain qualitative properties of the ϵ-*continuum* limit. Moreover, this technique empowers us to study a strongly-singular and non-homogeneous Kirchhoff problem to get the existence of a *continuum* of positive solutions.

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Singularity formation in toy models for incompressible flow

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Abstract

In this presentation, I will explore some toy models for the equations of incompressible fluid flow, in hopes of gaining insight on the possible devices for finite time singularity formation. This is achieved by examining geometric and/or analytic similarities between the models and the $3D$ Euler and Navier-Stokes equations. In doing so, I will survey through some of the classical techniques used in the theory of partial differential equations. More specifically, I deal with the well-understood CLM equation [2], alongside its proposed viscosity models [4, 3], in connection with the framework of $3D$ vortex stretching, and the equation discussed in [1], due to its similarities with the SQG equation, which itself can be viewed as a $2D$ model for the $3D$ Euler equations. These topics are part of my ongoing undergraduate research project funded by Fapesp, under the supervision of Prof. Anne Caroline Bronzi, in the process $2018/05899-5$.

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A Brézis-Oswald problem to $\Phi-$*Laplacian* operator with a gradient term

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Abstract

It is establish existence of minimal solution to the quasilinear elliptic problem

$$\begin{cases} -\Delta_\Phi u = \lambda f(x,u) + \mu g(x,u,\nabla u) \text{ in } \Omega, \\ u > 0 \text{ in } \Omega,\ u = 0 \text{ on } \partial\Omega, \end{cases}$$

where f, g have a sublinear growth, $\lambda > 0$, and $\mu \geq 0$ are real parameters. Our results are an improvement of the classical Brézis-Oswald result to Orlicz-Sobolev setting by including singular nonlinearity as well as a gradient term.

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Existence and uniqueness of solutions for RFDEs

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Abstract

In this work, we define a retarded functional differential equation (RFDE, for short) given by:

$$\begin{cases} \dot{x}(t) = f(t, x_t) \\ x_\sigma = \phi. \end{cases}$$

with $\phi \in C([-r, 0], \mathbb{R}^n)$ and $x_t : [-r, 0] \to \mathbb{R}^n$ is such that $x_t(\theta) = x(t + \theta)$. We consider $x \in C([\sigma - r, \sigma + A], \mathbb{R}^n)$, $t \in [\sigma, \sigma + A]$, $\theta \in [-r, 0]$ and $f : \mathbb{R} \times C([-r, 0], \mathbb{R}^n) \to \mathbb{R}^n$. Also, we prove some results for this type of equation such as the existence and uniqueness of solutions.

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Asymptotically Linear Indefinite Problems in $\mathbb{R}^N$ via an Abstract Linking Theorem

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Abstract

An abstract linking result for Cerami sequences is proved without assuming a compactness condition. It is applied directly in order to prove the existence of critical points for a class of indefinite problems in infinite dimensional Hilbert Spaces. The main applications are given to Hamiltonian systems and Schrödinger equations. Here spectral properties of the operators are exploited and hypotheses of monotonicity on the nonlinearities are discarded.

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Existence of solutions in Besov-Morrey spaces for chemotaxis Navier-Stokes fluid with chemical attractant

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Abstract

The goal of this project is to study the asymptotic behavior type to the Keller-Segel system coupled with Navier-Stokes fluid in $\mathbb{R}^N$ ($N \geq 2$). We will present the result about existence of global mild solutions to these equations by taking initial data belonging to homogeneus Besov-Morrey spaces. The mild solutions are obtained by means of a fixed point argument in a time-dependent space X, where the space X is constructed so that its norm is invariant by the intrinsic scaling of the equations in question. These results are part of my PhD thesis.

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Global well-posedness of weak solutions for the Vlasov-Fokker-Planck system

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Abstract

This paper is devoted to show the existence of weak solutions of the kinetic Vlasov-Fokker-Planck system in bounded domains with the self-consistent force field bounded at any time. The existence and uniqueness of weak solutions is proved as in Carrillo [1]. This fact is analysed using a variational technique and the theory of elliptic-parabolic equations of second order.

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On the Quantum Harmonic Oscillator Model applied to Spectroscopy

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Abstract

One of the systems with great occurrence in nature in the Harmonic Oscillator. When it does not appear explicitly, one can use it to make an approximate analysis of how the system would behave at a certain limit. Here we analyze two aspects:

- how the molecules behave in infrared spectroscopy using the Quantum Oscillator, where the vibrational energies of the molecules can be estimated by solving the Schrdinger equation;
- how the electric field is used to generate dipoles, thus varying the absorption or the scattering of the infrared beam.

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Existence of multiple positive solutions for Schrödinger equation with singular nonlinearities sign-changing

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Abstract

In this work, we study the Schrödinger equation

$$\begin{cases} -\Delta u + V(x)u = \lambda a(x)u^{-\gamma} + b(x)u^p \text{ in } \mathbb{R}^N \\ u > 0, \text{ in } \mathbb{R}^N, \end{cases}$$

where $\lambda > 0$ is a real parameter, $N \geq 3$, $0 < \gamma < 1 < p < 2^* - 1$, $a \in L^{\frac{2}{1+\gamma}}(\mathbb{R}^N), b \in L^\infty(\mathbb{R}^N)$ and V is a potential satisfying $X \hookrightarrow\hookrightarrow L^q(\mathbb{R}^N)$, where $2 \leq q < 2^*$ and $X = \left\{u \in H^1(\mathbb{R}^N); \int V(x)u^2(x)dx < \infty\right\}$. The main novelties in our result are obtaining multiplicity of positive solutions beyond of the extremal that is classical to apply Nehari's methods before it and allowing the potential b changing its signal.

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On Lane-Emden systems with singular nonlinearities

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Abstract

We are interested in regularity properties of semi-stable solutions for a class of singular semilinear elliptic problems with advection term defined on a smooth bounded domain of a complete Riemannian manifold with zero Dirichlet boundary condition. We prove uniform Lebesgue estimates and we determine the critical dimensions for these problems with nonlinearities of the type Gelfand, MEMS and power case. As an application, we show that extremal solutions are classical whenever the dimension of the manifold is below the critical dimension of the associated problem. Moreover, we analyze the branch of minimal solutions and we prove multiplicity results when the parameter is close to critical threshold and we obtain uniqueness on it. Furthermore, for the case of Riemannian models we study properties of radial symmetry and monotonicity for semi-stable solutions.

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A model for determining the concentration of urea in artificial kidney

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Abstract

In medicine, dialysis is primarily used to provide an artificial replacement for lost kidney function (renal replacement therapy) due to renal failure. Dialysis may be used for very sick patients, who have suddenly but temporarily lost their kidney function (acute renal failure) or for quite stable patients who have permanently lost their kidney function. We present a model, which consist of partial differential equation defining the process of diffusion in artificial kidney and finally get the solution of this equation in the form of concentration of urea in blood by using the finite difference approach. The graph drawn between concentration and radial distance shows the variation between these two quantities. Dialysis treatments replace some of these functions through diffusion (waste removal) and ultrafiltration (fluid removal).

Sistemas com Termo Cncavo-Convexo em Domnio No Limitado

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Abstract

Este trabalho estabelece a existncia de soluo para Sistemas com Termo Cncavo-Convexo em Domnio No-Limitado para o operador p-Laplaciano. Estendendo, de certa forma, o problema estudado no artigo [3]. A grande dificuldade que surge ao considerar um sistema, a troca de informao para mostrar a existncia de uma super-soluo para o mesmo.

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Fourth order elliptic problems with combined nonlinearities

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Abstract

It is establish existence and multiplicity of solutions for a class of superlinear elliptic involving a fourth order elliptic problem under Navier conditions on the boundary. Here we do not apply the well known Ambrosetti-Rabinowitz condition at infinity. Instead of we assume that the nonlinear term is a nonlinear function which is nonquadratic at infinity. The nonlinear term is a concave-superlinear function which is indefinite in sign. In order to apply variational methods we employ some fine arguments in order to recover the compactness

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