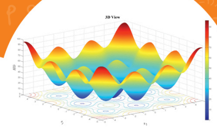
UNIVERSIDAD
DE SANTIAGO
DE CHILE

XII CONGRESS 2018

GAFEVOL

EVOLUTION EQUATIONS AND FUNCTIONAL ANALYSIS GROUP

NOVEMBER 14 / 15 / 16



ABSTRACTS DUE

August 31

ORGANIZING COMMITTEE

Carlos Lizama
Universidad de Santiago de Chile

Sebastián Zamorano
Universidad de Santiago de Chile

Hernán Henríquez
Universidad de Santiago de Chile

Rodrigo Ponce
Universidad de Talca

Edgardo Álvarez
Universidad del Norte, Colombia

VENUE

Auditorio Departamento de Matemática y Ciencia de la Computación

www.gafevol.usach.cl

carlos.lizama@usach.cl

sebastian.zamorano@usach.cl

SCIENTIFIC COMMITTEE

Manuel Pinto
Universidad de Chile

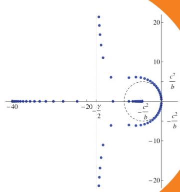
Carlos Conca
Universidad de Chile

Jaqueline Mesquita
Universidade de Brasilia

Mahamadi Warma
Universidad de Puerto Rico

Rolando Rebolledo
Universidad de Valparaíso

Luciano Abadías
Universidad de Zaragoza



$$\frac{\partial C}{\partial t} = D\frac{\partial^2 C}{\partial x^2}$$

$$\frac{\partial^\alpha C(x,t)}{\partial t^\alpha} = D_\alpha \frac{\partial^2 C(x,t)}{\partial x^2}$$

$$\nabla^2 = \frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2}$$

$$\frac{\partial c}{\partial t} = D\nabla^2 c - \vec{u}\cdot\nabla c$$

SUPPORT

VICERRECTORÍA DE
INVESTIGACIÓN
DESARROLLO E INNOVACIÓN
UNIVERSIDAD DE SANTIAGO DE CHILE

FACULTAD DE
CIENCIA
UNIVERSIDAD DE SANTIAGO DE CHILE

DEPARTAMENTO DE
MATEMÁTICA Y CIENCIA DE
LA COMPUTACIÓN
UNIVERSIDAD DE SANTIAGO DE CHILE

UNIVERSIDAD DE SANTIAGO DE CHILE

DEPARTAMENTO DE MATEMÁTICA Y CIENCIA DE LA COMPUTACIÓN
UNIVERSIDAD DE SANTIAGO DE CHILE

Welcome

Welcome to Santiago 2018!

We are delighted to welcome friends and colleagues to our home city of Santiago for the XII GAFEVOL Congress 2018.

Continuing the successful trend of past Congresses, the 2018 Congress in Santiago shows how important the GAFEVOL Congress has become as a regular platform accommodating the rapid pace of progress in the Evolution Equations and Functional Analysis field and for presenting the results of studies which have a direct impact on the applications.

GAFEVOL 2018 will provide a Scientific Programme that builds on the highly successful models from previous Congresses, while incorporating innovative suggestions from valuable stakeholders.

This Congress will feature presentations of some of the most recent research including controllability of systems, chaotic dynamics of non local models, advances on existence, periodicity, mild solutions, classical solutions, extensions, global bifurcation, and convergence of solutions for different classes of ODE's and PDE's. Also, applications in stochastic models in epidemiology and damage models will be treated.

We wish you a pleasant stay in Santiago. Enjoy the Congress!.

Organizing Committee

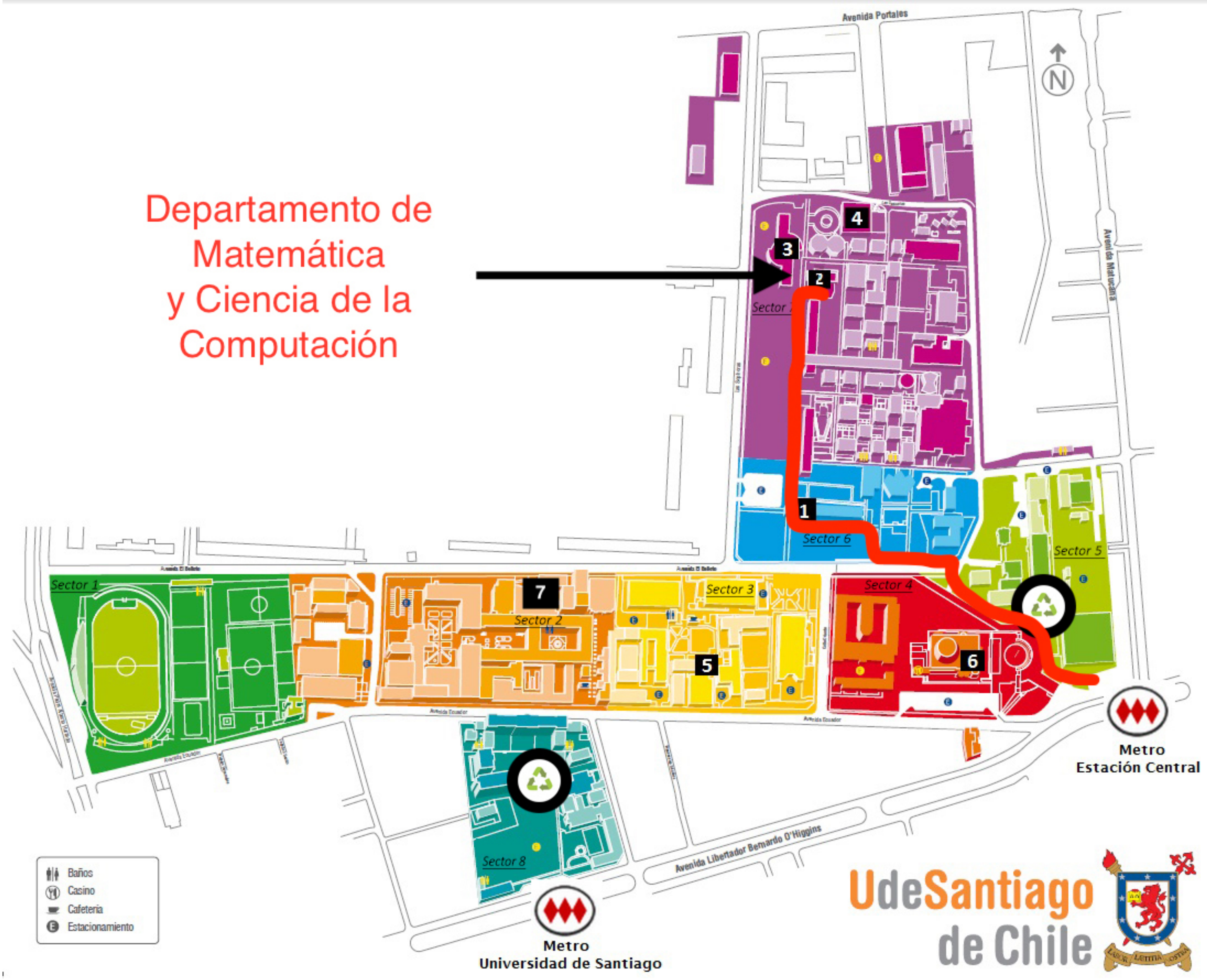
Carlos Lizama (U. de Santiago)
Hernán Henríquez (U. de Santiago)
Sebastián Zamorano (U. Santiago)
Edgardo Álvarez (U. del Norte)
Rodrigo Ponce (U. de Talca)

Scientific Committee

Manuel Pinto (U. de Chile)
Carlos Conca (U. de Chile)
Jaqueline Mesquita (U. de Brasília)
Mahamadi Warma (U. de Puerto Rico)
Rolando Rebolledo (U. de Valparaíso)
Luciano Abadías (U. de Zaragoza)

Address

XII Congress GAFEVOL
Universidad de Santiago de Chile
Facultad de Ciencia
Departamento de Matemática y Ciencia de la Computación
Las Sophoras N° 173, Estación Central, Santiago, Chile
Webpage: http://gafevol.usach.cl
Email: carlos.lizama@usach.cl, sebastian.zamorano@usach.cl


Avenida Portales
N
Departamento de Matemática y Ciencia de la Computación
4
3
2
1
Sector 6
Sector 5
Sector 1
7
Sector 2
Sector 3
5
Sector 4
6
Sector 8
Avenida Libertador Bernardo O'Higgins
Metro Estación Central
Metro Universidad de Santiago
Baños
Casino
Cafetería
Estacionamiento
UdeSantiago de Chile

Contents

General Information

Location

The congress will take place in Auditorio Departamento de Matemática y Ciencia de la Computación at the University of Santiago of Chile. The site is indicated with the number 2 in the map.

Useful Phone Numbers

In case of any health emergencies, please call 131 (SAMU)
Police number: 133
Math department of the University of Santiago of Chile: +(56)2 2 718 2033

Lunch

The lunch will take place in Casino de Autoridades–EAO at the University of Santiago of Chile. The site is indicated with the number 7 in the map.

The menu for each day will be the following*

WEDNESDAY 14
Appetizer – *Entrada* Hydroponic vegetables and egg with golf sauce – *Vegetales hidropónicos con huevo golf*
Main course – *Plato de fondo* Meat with a red wine sauce and poppy rice – *Carne al vino tinto con arroz de amapola*
Dessert – *Postre* Desserts of the day – *Postres del día* American coffee, herbs infusion and tea – *Café en grano Americano, agua de hierbas o té*

*Please inform us if you have gluten intolerance, allergy to any condiment or food, or if you are vegetarian.

THURSDAY 15
Appetizer – *Entrada* Fresh cheese marinated in green vegetables – *Queso fresco marinado sobre vegetales verdes*
Main course – *Plato de fondo* Chicken breast with lemon sauce and potatoes with parsley – *Pechuga de pollo al limón con papas al perejil*
Dessert – *Postre* Desserts of the day – *Postres del día* American coffee, herbs infusion and tea – *Café en grano Americano, agua de hierbas o té*

FRIDAY 16
Appetizer – *Entrada* Pumpkin cream with croutons – *Crema de zapallo con crutones*
Main course – *Plato de fondo* Meat with mushroom sauce and creamy mote – *Carne al champiñon con mote cremoso*
Dessert – *Postre* Desserts of the day – *Postres del día* American coffee, herbs infusion and tea – *Café en grano Americano, agua de hierbas o té*

Schedule

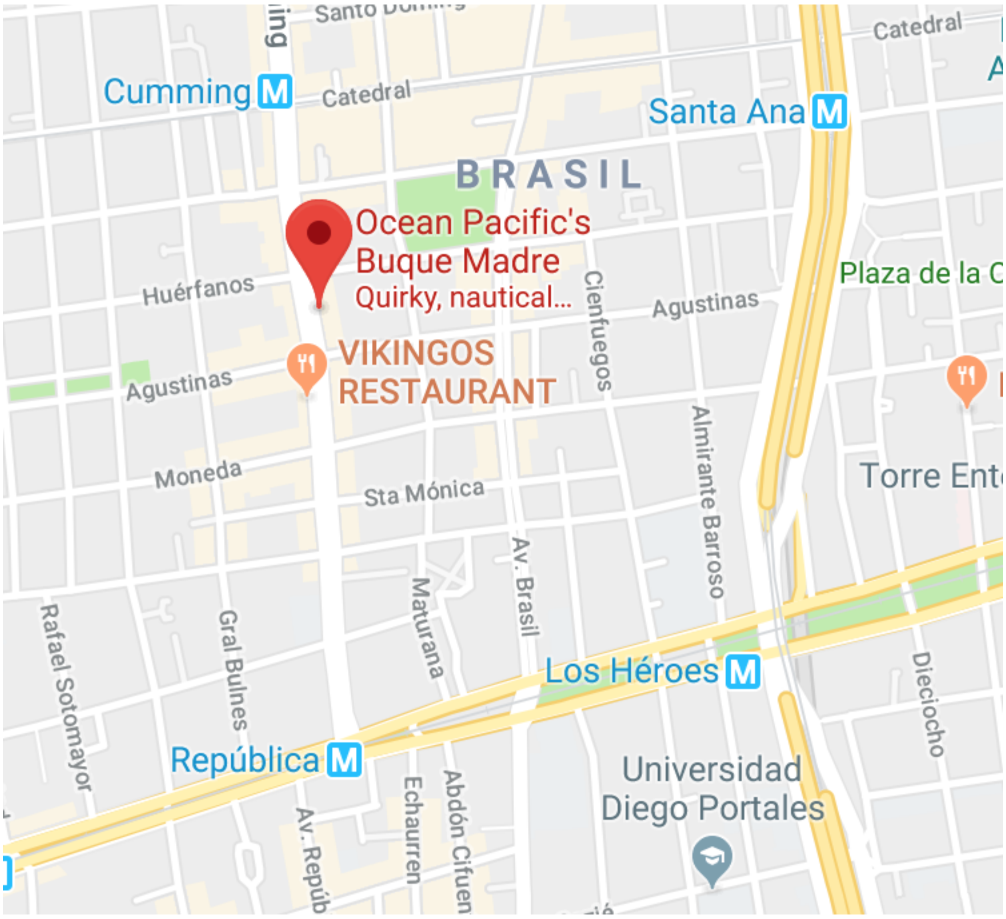
PROGRAM: XII CONGRESO GAFEVOL: November 14-16, 2018

Auditorio Departamento de Matemática y Ciencia de la Computación

	Wednesday 14	Thursday 15	Friday 16
9:00-9:45	Registration	Filipe Andrade	Joelma Azevedo
9:45-10:30	Registration	Humberto Prado	Samuel Castillo
10:30-11:00	Congress oppening	Coffee break	Coffee break
11:00-11:45	Tomás Caraballo	Alfred Peris	Marisela Domínguez
11:45-12:30	Sergei Trofimchuk	Pierluigi Benevieri	Alberto Mercado
12:30-14:30	Lunch (Casino Autoridades EAO)	Group photo and lunch (Casino Autoridades EAO)	Lunch (Casino Autoridades EAO)
14:30-15:15	Eduardo Cerpa	Poster Session	Jaime Ortega
15:15-16:00	Jaqueline Mesquita	Ricardo Torres	Edgardo Álvarez
16:00-16:30	Coffee break	Coffee break	Coffee break
16:30-17:15	Erwin Topp	Gonzalo Robledo	Closing Ceremony
17:15-18:00	Cocktail	Ruben Astudillo	
20:00-24:00			Dinner (Ocean Pacific)

Closing Dinner

The closing dinner will be on November 16th, 2018 at 8:00 PM in the restaurant *Ocean Pacific's*, which is located at Avenida Ricardo Cumming 221, Santiago.



The principal menu will be the following*

Aperitif – *Aperitivo* Fruit juice – *Jugo Natural* Pisco Sour Amaretto Sour Mango Sour Whisky Sour
Appetizer Ecuatorian shrimp ceviche cooked sous-vide in a homemade biscuit, accompanied by quinoa and a soft milk ***Entrada*** *Ceviche de camarón ecuatoriano cocinado sous-vide en un bísquet de la casa, acompañado de quı'noa y una suave leche de tigre*
First course Tuna tartare with sour cream, together with crab chupe bread in panko, on avocado mousse and passion fruit sauce, accompanied by sous-vide octopus in smoke oil, topped with Azapa olives sauce ***Primer plato*** *Tartar de atún montado en sour cream, junto con bolitas de chupe de jaiba apanadas en panko sobre mousse de palta y salsa de maracuyá, acompañado de pulpo sous-vide en aceite de humo, aderezado con salsa de aceitunas de Azapa*

*Please inform us if you have gluten intolerance, allergy to any condiment or fish or shellfish, if you are diabetic, or if you are vegetarian.

Second course

1. Mero fish in yellow pepper sauce, mounted on asparagus, accompanied by a crab chupe in squid ink and crispy
2. Sous-vide steak in a wine sauce accompanied by a gratan of finoise of apple in a beater sauce
3. Chicken breast stuffed with a mixture of asparagus and bacon, accompanied by three-cheese rustic mashed potatoes (parmesan, buttery and camembert)

Segundo plato

1. *Mero en salsa de ají amarillo, montado en espárragos, acompañado de un timbal de chupe de jaiba en tinta de calamar y crocante de hilo*
2. *Filete sous-vide en salsa de vino acompañado de un gratan de finoise de manzana en salsa de beterraga*
3. *Pechuga de pollo rellena con una mezcla de espárragos y tocino, acompañado de puré rústico de tres quesos (parmesano, mantecoso y camembert)*

Dessert

Delicate tropical fruit mousse (mango and passion fruit) with a soft mix of chocolate sauce and coconut cream, accompanied by a deconstruction of merengue and lucuma

Postre

Delicado mousse de frutas tropicales (mango y maracuyá) con una suave mezcla de salsa de chocolate y crema de coco, acompañado de una deconstrucción de merengue y lúcuma

Abstracts of Talks

Vector-valued (ω, c)-periodic functions and applications

Edgardo Álvarez
Departament of Mathematics
Universidad del Norte
Barranquilla, Colombia

Abstract

In this talk we introduce and study a new class of vector-valued functions, which we call (ω, c)-periodic functions ([1]). In the scalar-valued case, these functions are called periodic functions of the second kind and were introduced by Floquet in [2]. The collection of (ω, c)-periodic functions includes periodic, anti-periodic, Bloch and unbounded functions. We prove that the set conformed by the (ω, c)-periodic functions is a Banach space with a suitable norm. Furthermore, we show several properties of this class of functions as the convolution invariance. We present some examples and a composition result. As an application, we establish some sufficient conditions for the existence and uniqueness of (ω, c)-periodic mild solutions to a fractional evolution equation.

References

[1] E. Alvarez, A. Gómez and M. Pinto. *(ω, c)-periodic functions and mild solutions to abstract fractional integro-differential equations.* Electron. J. Qual. Theory Differ. Equ. **2018** (16) (2018) 1–8.

[2] G. Floquet. *Sur les équations différentielles linéaires à coefficients périodiques.* Ann. Sci. École Norm. Sup. (2) **12** (1883), 47–88.

The topological structure of solutions set for some classes of differential equations

Filipe Andrade da Costa*
Departament of Mathematics
University of Pernambuco
Nazaré da Mata, Brazil

Abstract

In this talk we discuss the topological structure of the set solutions of some abstract problems, more precisely we will present a new result about the Kneser property, and to this, we will talk about the history of the problem, some results that motivate this work ([1] and [2] for example) and some open problems related to such property.

References

[1] F. Andrade et al. *L^p-boundedness and topological structure of solutions for flexible structural systems*. Mathematical Methods in the Applied Sciences, v. 38, n. 18, p. 5139-5159, 2015.

[2] H. R. Henríquez , G. Castillo. *The Kneser property for the second order functional abstract Cauchy problem*. Integral Equations and Operator Theory, v. 52, n. 4, p. 505-525, 2005.

[3] H. Kneser. *Uber die Losungen eines systems gewohnlicher Differentialgleichungen das der Lipschitzschen Bedingung nichtgenugt*. S.-B. Preuss. Akad. Wiss. Phys.-Math. Kl. (1923), 171-174.

*e-mail: `filipe.andrade13@gmail.com`

On the convergence of solutions for second order systems of a cocoercive family of operators

Ruben Astudillo*
Departament of Mathematics
Universidad Técnica Federico Santa María
Valparaíso, Chile

Abstract

Let $\mathcal{H}$ be a *Hilbert* space. Given $A : \mathcal{H} \to 2^{\mathcal{H}}$ a maximally mototone operator, $\alpha(t) > 0 \in \mathcal{C}^1(\mathcal{H})$ a function and $\gamma \in \mathbb{R}$ a constant, we will study the second order differential systems

$$\ddot{u}(t) + \gamma\dot{u}(t) + \alpha(t)A_{\alpha(t)}u(t) = 0, \quad t > t_0 \tag{1}$$

where $A_{\alpha(t)}$ is the *Yosida* regularization of A with parameter $\alpha(t)$. We will prove that under certain conditions for $\alpha(t)$ and γ, the solutions $u(t)$ of these systems converge weakly to an element of the set

$$A^{-1}\{0\} = \bigcap_{t>t_0} \left(\alpha(t)A_{\alpha(t)}\right)^{-1}\{0\} \tag{2}$$

This result is similar to the one proved by *Álvarez* on [1]. Following this, we present a discrete formulation of the previous system given by

$$\frac{u_{k+1} - 2u_k + u_{k-1}}{s^2} + \gamma\frac{u_{k+1} - u_k}{s} + \alpha_k A_{\alpha_k} u_{k+1} = 0$$

where $\{\alpha_k\}$ is a positive sequence with related conditions as the continuous case. From here we propose the use of a RIPA[2] algorithm to obtain a minimizing sequence in a efficient way. Finally we will show some numerical experiments that motive the use of this formulations and algorithms.

References

[1] F. Alvarez. *On the minimizing property of a second order dissipative system in Hilbert spaces.* SIAM Journal on Control and Optimization 38.4 (2000): 1102-1119.

[2] H. Attouch, and J. Peypouquet. *Convergence of inertial dynamics and proximal algorithms governed by maximally monotone operators.* Mathematical Programming (2017): 1-42.

*e-mail: `ruben.astudillo@alumnos.usm.cl`

Classical solutions for strongly damped wave equations

Joelma Azevedo*
Departament of Mathematics
University of Pernambuco
Recife, Brazil

Claudio Cuevas†
Departament of Mathematics
Federal University of Pernambuco
Recife, Brazil

Herme Soto‡
Department of Mathematics and Statistics
University of La Frontera
Temuco, Chile

Abstract

In this presentation, we focus on the following Cauchy problem

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

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 (1) 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 (1) is the wave equation with structural damping (see [1, 2, 3, 4, 5]). These equations are also considered in physical areas, such a heat conduction, solid mechanics and so on. Here we are interested in studying the existence of classical solutions for the problem (1).

References

[1] A. N. Carvalho, J. W. Cholewa, Attractors for strongly damped wave equations with critical nonlinearities, *Pacific J. Math.,* **207** (2) (2002), 287-310.

[2] A. N. Carvalho, J. W. Cholewa, T. Dlotko, Strongly damped wave problems: boostrapping and regularity of solutions, *J. Differential Equations*, **244** (9) (2008), 2310-2333.

[3] S. Chen, R. Triggiani, Proof of extensions of two conjectures on structural damping for elastic systems: The case $\frac{1}{2} \leq \alpha \leq 1$, *Pacific J. Math.,* **136** (1) (1989), 15-55.

[4] S. Chen, R. Triggiani, Characterization of domains of fractional powers of certain operators arising in elastic systems and applications, *J. Differential Equations*, **88** (2) (1990), 279-293.

[5] S. Chen, R. Triggiani, Proof of two conjectures of G. Chen and D. L. Russell on structural damping for elastic systems: The case $\alpha = \frac{1}{2}$, in: *Lectures Notes in Math.*, vol. **1354**, Springer -Verlag, 1988, 234-256.

*e-mail: joelmamoura2009@hotmail.com
†e-mail: cch@dmat.ufpe.br
‡e-mail: herme.soto@ufrontera.cl

Global bifurcation for critical values of special maps in Banach and Hilbert spaces

Pierluigi Benevieri*
Instituto de Matemática e Estatística
Universidade de São Paulo
São Paulo, Brazil

Abstract

We present three global bifurcation results for critical values of C^1 maps in Banach spaces and of C^2 maps in Hilbert spaces. We proceed in the general spirit of the family of works that uses topological methods, whose origin can be found in the classical (local) results of Krasnoselskij of 1964 and in the (global) results of Rabinowitz of 1971, even though, we must emphasize, their results concern bifurcation of *solutions* of particular equations, while ours are related to bifurcation of *critical values*, that is, *target values* of a particular function.

Our approach makes use of the Morse index and the spectral flow and we compare these topological tools with methods based on degree theory.

This is a joint work with P. Amster (Universidad de Buenos Aires) e J. Haddad (Universidade Federal de Minas Gerais, Brasil).

*e-mail: `pluigi@ime.usp.br`

Random and stochastic models in Epidemiology

Tomás Caraballo*
Departamento de Ecuaciones Diferenciales y Análisis Numérico
Universidad de Sevilla
Sevilla, Spain

Abstract

Stochastic and random models are being used to model many realistic phenomena from the real world. In fact, every happening in our world is affected by some randomness or stochasticity. Therefore, it is very important to decide which kind of stochastic or random model is the most appropriate to describe the behavior of the real one in the best way. We will provide some features about this problem in this lecture. Instead of providing a general or abstract theory on this topic, we will consider a random and another stochastic version of an epidemic model previously introduced and analyzed by Kloeden and Kozyakin [2]. In particular, the existence of a random attractor is proved for the random model and the persistence of the disease is analyzed as well. In the stochastic case, we consider some environmental effect on the model, in fact, we assume that one of the coefficients of the system is affected by some stochastic perturbation, and analyze the asymptotic behavior of the solutions. We will emphasize on the comparison between the two different modeling strategies and the usefulness of the theory of random attractors to analyze this and other models from the applied sciences.

References

[1] T. Caraballo, R. Colucci. *A comparison between random and stochastic modelling for a SIR model*. Comm. Pure Appl. Anal. **16**(1) (2017), 151–162.

[2] P. E. Kloeden and V. S. Kozyakin. *The dynamics of epidemiological systems with nonautonomous and random coefficients*. MESA: Mathematics in Engineering, Science and Aerospace, vol. **2**, no. 2 (2011).

*Partially supported by FEDER and Ministerio de Economía y Competitividad under grant MTM2015-63723-P and Junta de Andalucía under Proyecto de Excelencia P12-FQM-1492, e-mail: caraball@us.es

Existence results for linearly abstract perturbed oscillator

Samuel Castillo*
Department of Mathematics
University of Bío-Bío
Concepción, Chile

Manuel Pinto†
Department of Matematics
University of Chile
Santiago, Chile

Abstract

$$x_1'(t) = \omega x_2(t) + R_{11}(t, x_1(t)) + R_{12}(t, x_2(t + \cdot)) + R_{13}(t, z(t)) \tag{1a}$$

$$x_2'(t) = -\omega x_1(t) + R_{21}(t, x_1(t)) + R_{22}(t, x_2(t)) + R_{23}(t, z(t)) \tag{1b}$$

$$z(t) = \int_0^{+\infty} G(t,s)[R_{31}(s, x_1(s)) + R_{32}(s, x_2(s)) + R_{33}(s, z(s))]ds, \tag{1c}$$

where X can be written as

$$X =< \hat{e}_2 > \oplus < \hat{e}_2 > \oplus \mathcal{E}$$

the solution of system (1) can be written as

$$x(t) = x_1(t)e_1 + x_2(t)e_2 + z(t),$$

$x_1(t), x_2(t) \in \mathbb{R}$ are real valued and $z(t) \in \mathcal{E}$ for all $t \geq 0$,
$R_{11}(t,\cdot), R_{12}(t,\cdot), R_{21}(t,\cdot), R_{22}(t,\cdot)$ are linear functions from $\mathbb{R}$ into itself,
$R_{31}(t,\cdot), R_{32}(t,\cdot)$ are linear functions from $\mathbb{R}$ into $\mathcal{E}$,
$R_{33}(t,\cdot)$ is a linear function from $\mathcal{E}$ into itself for $t \geq 0$
and the kernel $G(t,s)$ is a linear function from $\mathcal{E}$) into itself, for $t, s \geq 0$,

In this talk, we will show operator given by (1) as an integral formulation for the existence of weak solutions for differential equations with especial property: stability [1, 5], asymptotic integration[2, 3, 7] and almost periodicity [4].

$G(t,s)$ will be considered as a Green function with a expo-ordinary dichotomy.

$\int_0^t G(t,s)[\cdot]ds$ will be considered as a compact, contractive or a sum of a compact operator and a contractive operator.

$\{R_{ij}(t,\cdot)\}_{t\geq 0}$ are families of linear functions which are small in an integral sense.

Examples will be presented.

*Partially supported DIUBB 164408 3/R, e-mail: `scastill@ubiobio.cl`
†Partially supported by FONDECYT Grant 1170466, e-mail: pintoj@uchile.cl

References

[1] W. A. Coppel. *Dichotomies in Stability Theory.* Lecture Notes in Mathematics, **629**, Springer-Verlag Berlin Heidelberg, 1978.

[2] S. Castillo; M. Pinto. *Levinson theorem for functional differential systems.* Nonlinear Analysis TMA **47** (2001), 6, 3963–3975.

[3] S. Castillo; M. Pinto. *Asymptotics for second order delayed differential equations.* Proyecciones **26** (2007), 1, 91–103.

[4] S. Castillo; M. Pinto. Existence and stability of almost periodic solutions to differential equations with piecewise constant arguments. Electron. J. Differential Equations **2015** (2015) 58, 15 pp.

[5] J. L. Daleckii; M. G. Krein. *Stability of Solutions of Differential Equations in Banach Spaces*, Translations of mathematical monographs **43**, American Mathematical Society, 2002 (reprinted).

[6] K. Engel; R. Nagel. *One-Parameter Semigroups for Linear Evolution Equations.* Springer Science & Business Media, 2006 (reprinted).

[7] M. Pinto. *Asymptotic integration of second-order linear differential equations.* J. Math. Anal. Appl. **111** (1985), 2, 388–406.

[8] G. R. Sell; Y. You *Dynamics of Evolutionary Equations.* Springer Science & Business Media, 2013 (reprinted).

Stabilization of unstable wave equations with boundary feedback controls

Eduardo Cerpa*
Departamento de Matemática
Universidad Técnica Federico Santa María
Valparaíso, Chile

Abstract

In this talk some one-dimensional wave equations with reflecting boundary condition at $x = 1$ and unstable dynamic boundary condition at $x = 0$ are considered. Moreover, these equations present unstable internal velocity terms. The main goal of this talk is to show how we can add a boundary control acting at $x = 1$ forcing the system to be exponentially stable. A similar problem with no internal unstable term nor unstable dynamic boundary condition has been considered in [1], where the authors write the wave equation as two transport equations coupled through the boundary conditions and use Riemann variables. This talk is based on the article [2] and we use the backtepping method directly for the wave equation as in [3].

This is a joint work with Christophe Roman, Delphine Bresch-Pietri, Christophe Prieur, and Olivier Sename.

References

[1] D. Bresch-Pietri and M. Krstic. *Output-Feedback Adaptive Control of a Wave PDE With Boundary Anti-Damping*. Automatica, Vol. 50, pp. 1407-1415, 2014.

[2] C. Roman, D. Bresch-Pietri, E. Cerpa, C. Prieur, and O. Sename. *Backstepping control of a wave PDE with unstable source terms and dynamic boundary*. IEEE Control Systems Letters, Vol. 2, No. 3, 2018, pp. 459-464.

[3] A. Smyshlyaev, E. Cerpa, and M. Krstic. *Boundary stabilization of a 1-D wave equation with in-domain anti-damping*. SIAM J. Control Optim., Vol. 48, No. 6, pp. 4014-4031, 2010.

*Partially supported by Fondecyt 1180528, e-mail: `eduardo.cerpa@usm.cl`

On extensions of positive definite functions on groups

Marisela Domínguez*
Department of Matematics
Central University of Venezuela
Caracas, Venezuela

Ramon Bruzual†
Department of Matematics
Central University of Venezuela
Caracas, Venezuela

Abstract

We prove that an operator valued positive definite function defined on an interval of $\mathbb{Z}^2$ with the lexicographic order can be extended to a positive definite function on the whole discrete plane.

Let $\mathcal{H}$ be a Hilbert space with inner product $\langle \cdot, \cdot \rangle_{\mathcal{H}}$. Let $(G, \cdot)$ be an abelian group and let D be a subset of G.

A function $k : D - D \to \mathbb{C}$ is said to be *positive definite* on D if

$$\sum_{x,y \in D} \langle k(x-y)h(x), h(y) \rangle_{\mathcal{H}} \geq 0$$

for every function $h : D \to \mathcal{H}$ with finite support.

M. G. Krein proved that *if a is a positive real number and if $k : (-2a, 2a) \to \mathbb{C}$ is continuous and positive definite then there exists $K : (-\infty, +\infty) \to \mathbb{C}$ continuous and positive definite such that $K|_{(-2a,2a)} = k$.*

M. L. Gorbachuck extended the result of Krein for a general Hilbert space.

Z. Sasvári proved that a scalar valued positive definite function defined on an interval of an ordered group can be extended to a positive definite function on the whole group.

We will deal with operator valued positive definite functions on $\mathbb{Z}^2$.

Consider $\mathbb{Z}^2$ with the *lexicographic order*, that is: if $\vec{n} = (n_1, n_2)$, $\vec{m} = (m_1, m_2) \in \mathbb{Z}^2$ then: $\vec{n} < \vec{m}$ if and only if $n_2 < m_2$ or $n_2 = m_2$ and $n_1 < m_1$.

The following result is proved.

Let $\mathcal{H}$ be a Hilbert space, let $\vec{a} \in \mathbb{Z}^2$, $\vec{a} > 0$. Let $k : (-\vec{a}, \vec{a}) \to L(\mathcal{H})$ be a positive definite function. Then there exists a positive definite function $K : \mathbb{Z}^2 \to L(\mathcal{H})$ such that $K|_{(-\vec{a},\vec{a})} = k$.

In order to prove this result we associate to k, in a natural way, a multiplicative family of partial isometries $(S_{\vec{n}}, \mathcal{E}_{\vec{n}})_{\vec{n} \in [0,\vec{a})}$ on a Hilbert space $\mathcal{E}$ that can be extended to a strongly continuous group of unitary operators $U_{\vec{n}}$.

To obtain the unitary extension of the family the following result is given.

Let $\mathcal{L}$ be a Hilbert space, let $\mathcal{D}_A$, $\mathcal{D}_B$, be closed subspaces of $\mathcal{L}$, and let A and B be partial isometries with initial spaces $\mathcal{D}_A$ and $\mathcal{D}_B$. Suppose that:

(i) $\mathcal{D}_B \subset \mathcal{D}_{A^n}$ for $n = 0, 1, 2, \ldots$.

(ii) $\mathcal{R}_B \subset \mathcal{R}_{A^n}$ for $n = 0, 1, 2, \ldots$.

Then

$$\langle A^{-n}Bf, Bg \rangle_{\mathcal{L}} = \langle f, A^n g \rangle_{\mathcal{L}}$$

*Partially supported by Central University of Venezuela, e-mail: fc.2011.mdt@gmail.com
†Partially supported by Central University of Venezuela, e-mail: tramonbruzual@gmail.com

for all $f, g \in \mathcal{D}_B, n = 0, 1, 2, \ldots$ *is a necessary and sufficient condition for the existence of a Hilbert space* $\mathcal{F}$ *which contains* $\mathcal{L}$ *as a closed subspace and two commuting unitary operators* $\tilde{A}$, $\tilde{B} \in L(\mathcal{F})$ *such that* $\tilde{A}|_{\mathcal{D}_A} = A$ *and* $\tilde{B}|_{\mathcal{D}_B} = B$

A theorem given by A. Koranyi was an important tool to obtain this result.

References

[1] J. Prüss. *Evolutionary Integral Equations and Applications.* Monographs Math., **87**, Birkhäuser Verlag, 1993.

[2] R. Bruzual and M. Dominguez. *Extensions of operator valued positive definite functions on an interval of* $\mathbb{Z}^2$ *with the lexicographic order.* Acta Sci. Math. (Szeged) **66**, 2000, 623-631.

[3] A. Koranyi. *On some classes of analytic functions of several variables.* Trans. Amer. Math. Soc. **101**, 1961, 520-554.

[4] M. G. Krein. *Sur le problème du prolongement des fonctions hermitiennes positives et continues.* Dokl. Akad. Nauk. SSSR **26**, 1940, 17-22.

[5] M. L. Gorbachuck. *Representation of positive definite operator functions.* Ukrain. Math. J. **17**, No 2, 1965, 29-46.

[6] Z. Sasvári. *Positive definite and definitizable functions.* Akademie Verlag, 1994.

Controllability of coupled systems of PDEs

Alberto Mercado*
Departamento de Matemática
Universidad Técnica Federico Santa María
Valparaíso, Chile

Abstract

In this talk we will present the basic ideas of the moment method for controllability of evolution PDEs, which is based on the properties of the exponential real functions $\{e^{\lambda_n t}\}$ in the space $L^2([0,T])$, where $\{\lambda_n\}$ is the family of eigenvalues of the involved differential operators. Since the seminal work of Fattorini-Russell (1971), where it was proved the null-controllability of parabolic equations, this method has been widely used.

We are interested in the boundary controllability of systems of coupled equations. We will present some recent results for a system coupling the Kuramoto Sivashinsky (KS) system with the heat equation, and some related problems.

*e-mail: `alberto.mercado@usm.cl`

Periodicity on quantum calculus: averaging results and Massera's theorem

Jaqueline Godoy Mesquita*
Departamento de Matemática
Universidade of Brasília
Brasilia, Brazil

Abstract

Quantum calculus (q-calculus) has recently been attracting the attention of many researchers, since it is a powerful tool for applications in several fields of physics such as cosmic strings and black holes, conformal quantum mechanics, nuclear and high energy physics, fractional quantum Hall effect, and high-T_c superconductors. Thermostatistics of q-bosons and q-fermions can be established using basic numbers and employing the q-calculus based on the Jackson derivative.

In 2012, Bohner and Chieochan ([1]) introduced in the literature the concept of periodicity for functions defined on quantum calculus. In this talk, our goal is to present some results concerning periodicity on quantum calculus. We will show results such as periodic averaging theorem and Massera's theorem for q–diference equations, as well as examples to illustrate our main results. These results can be found in [2, 3] and these works are joint with Martin Bohner.

References

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

[2] M. Bohner, J. G. Mesquita, Periodic averaging principle in quantum calculus. *Journal of Mathematical Analysis and Applications (Print)*, v. 435, p. 1146-1159, 2016.

[3] M. Bohner, J. G. Mesquita, Massera's Theorem in Quantum Calculus, *Proceedings of American Mathematical Society*, to appear.

*e-mail: `jgmesquita.unb@gmail.com`

Variational formulation of damage models

Jaime Ortega*
Departamento de Ingeniería Matemática
Universidad de Chile
Santiago, Chile

Abstract

In this talk we will show the model of damage and the propagation of fractures in solid mechanics. This problem can be considered as a variational problem of minimization of elastic energies in which a damage model is introduced. For its resolution we use techniques associated to shape optimization and in particular differentiation with respect to the domain.

*e-mail: jortega@dim.uchile.cl

On the chaotic dynamics of fractional difference operators

Carlos Lizama*
Departamento de Matemática y Ciencia de la Computación
Universidad de Santiago de Chile
Santiago, Chile

Marina Murillo-Arcila†
Institut de Matemàtiques i Aplicacions de Castelló
Universitat Jaume I
Castelló, Spain

Alfred Peris‡
Institut Universitari de Matemàtica Pura i Aplicada
Universitat Politècnica de València
Valencia, Spain

Abstract

We study the dynamics of the non-local fractional difference operator Δ^{α} for $0 < \alpha < 2$. An analysis of the point spectrum of Δ^{α}, derived from its representation as a Toeplitz operator, allows us to obtain its chaotic properties, that include those of topological dynamics (topological mixing, Devaney chaos, etc) and of measure-theoretical nature (strong mixing, ergodicity, etc).

References

[1] A. Baranov and A. Lishanskii. *Hypercyclic Toeplitz Operators.* Results. Math. 70 (2016), 337–347.

[2] F. Bayart and É. Matheron, *Dynamics of linear operators*, Cambridge University Press, Cambridge, 2009.

[3] C. Lizama. *The Poisson distribution, abstract fractional difference equations, and stability.* Proc. Amer. Math. Soc. 145 (9) (2017), 3809–3827.

[4] C. Lizama. *ℓ_p-maximal regularity for fractional difference equations on UMD spaces.* Math. Nach., 288 (17/18) (2015), 2079–2092.

[5] K. G. Grosse-Erdmann and A. Peris Manguillot. *Linear chaos.* Universitext, Springer-Verlag London Ltd., London, 2011.

*e-mail: carlos.lizama@usach.cl
†e-mail: murillom@uji.es
‡e-mail: aperis@upv.es

A class of fractional Sobolev spaces in the study of non local equations

Humberto Prado*
Departamento de Matemática y Ciencia de la Computación
Universidad de Santiago de Chile
Santiago, Chile

Abstract

Our aim in this talk is to present a class of spaces on which we can show existence of radial solutions and regularity properties for a class of non local, non-linear equations. On these spaces we obtain the appropriate domains on which the non local operators associated to the equations can be rigorously defined. Then, is onto these domains where we can prove existence of solutions. We include and discuss applications of the theory to equations of physical and geometrical interest involving the fractional powers of the Laplace operator.

*This research has been partially supported by Fondecyt grant 1170571, e-mail: humberto.prado@usach.cl

Smoothness of topological equivalence for non autonomous systems

Gonzalo Robledo*
Departament of Mathematics
University of Chile
Santiago, Chile

Abstract

The topological conjugacy between the nonautonomous ODE system

$$x' = A(t)x \tag{1}$$

and a family of perturbations

$$y' = A(t)y + f(t, y) \tag{2}$$

has widely studied [1, 2, 3] when: i) the system (1) satisfies some properties of dicohotomy and ii) the nonlinearity of (2) verifies some mild assumptions. Nevertheless, the smoothness properties of the topological conjugacy have not been studied in depth and we present some preliminary results for the particular case when (1) is asymptotically stable (not necessarily uniform).

References

[1] K.J. Palmer, *A generalization of Hartman's linearization Theorem*. J. Math. Anal. Appl., **41** (1973) 753–758.

[2] A. Reinfelds A., D. Šteinberga, *Dynamical equivalence of quasilinear equations*. Int. J. Pure and Appl. Math., **98**:355-364.

[3] J. Shi, K. Xiong, *On Hartman's linearization theorem and Palmer's linearization theorem*, J. Math. Anal. Appl., **92** (1995) 813–832.

[4] J. Prüss. *Evolutionary Integral Equations and Applications*. Monographs Math., **87**, Birkhäuser Verlag, 1993.

*Partially supported by FONDECYT 1170968, e-mail: `grobledo@uchile.cl`

Ergodic large time behavior for some nonlocal evolution problems

Erwin Topp*
Departamento de Matemática y Ciencia de la Computación
Universidad de Santiago de Chile
Santiago, Chile

Abstract

In this talk we revisit the main ideas about ergodic large time behavior for parabolic Hamilton-Jacobi equations, and discuss the last results on the subject concerning nonlocal operators.

*e-mail: erwin.topp@usach.cl

Some advances on differential equations with piecewise constant arguments

Ricardo Torres*
Instituto de Cs. Físicas y Matemáticas
Universidad Austral de Chile
Valdivia, Chile

Abstract

This time we are going to talk about our recent contributions done to the field of impulsive differential equations with piecewise constant arguments of generalized type (IDEPCAG), related to existence, uniqueness, periodicity, approximation and asymptotics. We are going to show some examples applied mainly to CNN systems (Cellular neural networks) and comment some future research lines. This work is a consequence of the last 6 years of cooperative work with Prof. Manuel Pinto.

References

[1] S. Castillo, M. Pinto, R. Torres, *Asymptotic formulae for solutions of impulsive differential equations with piecewise constant argument of generalized type*, Submitted.

[2] M. Pinto, *Cauchy and Green matrices type and stability in alternately advanced and delayed differential systems*, J. Difference of Eqs. Appl., **17**(2) (2011), pp. 235–254.

[3] M. Pinto, D. Sepúlveda, R. Torres, *Exponential periodic attractor of an impulsive Hopfield-type neural network system with piecewise constant argument of generalized type*, Electron. J. Qual. Theory Differ. Equ. 2018, No. 34, 1-28.

[4] M. Pinto, R. Torres *An uniform approximation of an impulsive CNN-Hopfield system by an impulsive differential equation with piecewise constant argument of generalized type on an infinite interval*, in preparation.

[5] R. Torres, *Differential Equations with Piecewise Constant Argument of Generalized Type with Impulses*, Master's thesis, Facultad de Ciencias, Universidad de Chile, (2015).

*Partially supported by Fondecyt projects 1120709 and 1170466, e-mail: `ricardo.torres@uach.cl`

Wavefronts in a nonlocal resource-limited model

Manuel Pinto*
Department of Matematics
University of Chile
Santiago, Chile

Elena Trofimchuk†
Department of Differential Equations
Igor Sikorsky Kyiv Polytechnic Institute
Kyiv, Ukraine

Sergei Trofimchuk ‡
Instituto de Matemática y Física
Universidad de Talca
Talca, Chile

Abstract

The so called food-limited model with spatiotemporal nonlocal reaction

$$\partial_t u(t,x) = \partial_{xx} u(t,x) + u(t,x)\left(\frac{1-(K*u)(t,x)}{1+\gamma(K*u)(t,x)}\right), \quad x \in \mathbb{R}, \qquad (*)$$

is one of the most studied equations of population dynamics. It can be also viewed as a natural extension of the nonlocal KPP-Fisher equation which is obtained from $(*)$ by setting $\gamma = 0$. The wave solutions $u(t,x) = \phi(x+ct)$ of $(*)$ are key elements for understanding the whole evolution process governed by the above equation. These solutions have been the object of investigation in various works, see [1, 2, 3] for more references. By focusing attention on traveling waves to $(*)$ and their properties, in our talk we will review previously reported studies, present some new results and formulate several open problems.

References

[1] S.A. Gourley and M.A.J Chaplain. *Traveling fronts in a food-limited population model with time delay.* Proc. R. Soc. Edinb. Sect. A **132** (2002) 75–89.

[2] C. Ou and J. Wu. *Traveling wavefronts in a delayed food-limited population model.* SIAM J. Math. Anal. **39** (2007) 103–125.

[3] J. Wei, L. Tian, J. Zhou, Z. Zhen, J. Xu. *Existence and asymptotic behavior of traveling wave fronts for a food-limited population model with spatio-temporal delay.* Japan J. Indust. Appl. Math. **34** (2017) 305–320.

*Partially supported by FONDECYT Grant 1170466, e-mail: pintoj@uchile.cl
†e-mail: trofimch@imath.kiev.ua
‡Partially supported by FONDECYT 1150480, e-mail: trofimch@inst-mat.utalca.cl

Abstracts of Posters

Existence and uniqueness of solutions of measure functional differential equations with state-dependent delay

Henrique Costa dos Reis*
Departamento de Matemática
Universidade of Brasília
Brasilia, Brazil

Jaqueline Godoy Mesquita†
Departamento de Matemática
Universidade of Brasília
Brasilia, Brazil

Abstract

In this work, we establish the existence and uniqueness of solutions of measure functional differential equations with state-dependent delay. Such equation has the following form:

$$x(t) = x(t_0) + \int_{t_0}^{t} f(s, x_{\rho(s,x_s)}) \mathrm{d}g(s),$$

where x is a unknown function with values in $\mathbb{R}^n$, the symbol x_s denotes the function $x_s(t) = x(t+s)$ defined on $(-\infty, 0]$, f is a regulated function, g is nondecreasing and $\rho : I \times G\left((-\infty, 0], \mathbb{R}^n\right) \to [0, \infty)$.

References

[1] F. A. da Costa, *Análise qualitativa de equações diferenciais abstratas*, 2016.

[2] M. Federson, Š. Schwabik, Generalized ODE approach to impulsive retarded functional differential equations, *Differential Integral Equations* 19 (2006), no. 11, 1201-1234. 1993.

[3] J. Hale, *Theory of Functional Differential Equations*, 2nd ed., Springer-Verlag, New York, 1977.

[4] Y. Hino, S. Murakami, T. Naito, *Functional Differential Equations with Infinite Delay*, Springer-Verlag, 1991.

[5] Š. Schwabik, *Generalized ordinary differential equations*, Series in Real Anal., vol.5, World Scientific, Singapore, 1992.

*Partially supported by CAPES and CNPq, e-mail: henrique.costa.reis@hotmail.com
†Partially supported by FAPDF, FEMAT and CNPq, e-mail: jgmesquita.unb@gmail.com

Existence and uniqueness of solutions for abstract neutral differential equations with state dependent delay

Denis Fernandes*
Departament of Mathematics
University of São Paulo
São Carlos, Brazil

Abstract

We study the existence and uniqueness of mild and strict solutions for abstract neutral differential equations with state-dependent delay of the form

$$\frac{d}{dt}\left[u(t) + G(t, u_{\sigma_1(t,u_t)})\right] = Au(t) + F(t, u_{\sigma_2(t,u_t)}), \quad t \in [0, a], \tag{1}$$

$$u_0 = \varphi \in \mathcal{B}_X = C([-p, 0]; X), \tag{2}$$

where $A : D(A) \subset X \to X$ is the generator of an analytic semigroup of bounded linear operators $(T(t))_{t\geq 0}$ on a Banach space $(X, \|\cdot\|)$ and $F(\cdot),\ G(\cdot), \sigma_i(\cdot)$, $i = 1, 2$, are suitable functions.

References

[1] Hernandez, E., Pierri, M., Wu, J. $\mathbf{C^{1+\alpha}}$-strict solutions and wellposedness of abstract differential equations with state dependent delay. *J. Differential Equations* 261, (2016) 12, 6856-6882.

[2] Lunardi, A. *Analytic semigroups and optimal regularity in parabolic problems*, PNLDE Vol. *16*, Birkhäauser Verlag, Basel, 1995.

[3] Sadovskii, B. N. On a fixed point principle. *Funct. Anal. Appl.* **1** (1967), 74-76.

[4] Sinestrari, Eugenio. On the abstract Cauchy problem of parabolic type in spaces of continuous functions. *J. Math. Anal. Appl.* 107 (1985), 16-66.

*Supported by FAPESP, e-mail: `denisfer@usp.br`

Fundamental solutions for discrete dynamical systems involving the fractional Laplacian

Jorge González*
Departamento de Matemática y Ciencia de la Computación
Universidad de Santiago de Chile
Santiago, Chile

Abstract

In this poster we prove representation results for solutions of a time-fractional differential equation involving the discrete fractional Laplace operator in terms of generalized Wright functions. Such equations arise in the modeling of many physical systems, for example chain processes in chemistry and radioactivity. Our focus is in the problem:

$$\mathbb{D}_t^{\beta} u(n,t) = -(-\Delta_d)^{\alpha} u(n,t) + g(n,t),$$

where $0 < \beta \leq 2$, $0 < \alpha \leq 1$, $n \in \mathbb{Z}$, $(-\Delta_d)^{\alpha}$ is the discrete fractional Laplacian and $\mathbb{D}_t^{\beta}$ is the Caputo fractional derivative of order β. Also is presented important special cases as consequences of the representations obtained, such as heat and wave discrete equation.

*Joint work with V. Keyantuo, C. Lizama and M. Warma, e-mail: jorge.gonzalezcam@usach.cl

Well posedness for the Blackstock-Crighton-Westervelt equation on Banach spaces

Laura Rezzieri Gambera*
Departament of Mathematics
São Paulo State University (Unesp)
São José do Rio Preto, Brazil

Andréa Prokopczyk†
Departament of Mathematics
São Paulo State University (Unesp)
São José do Rio Preto, Brazil

Carlos Lizama‡
Departamento de Matemática y Ciencia de la Computación
Universidad de Santiago de Chile
Santiago, Chile

Abstract

The Blackstock-Crighton-Westervelt equation was studied in [2] to show optimal regularity and exponential stability in L_p-spaces with Dirichlet and Neumann boundary conditions. In [1] is shown well-posedness and asymptotic behaviour of solutions in Hilbert spaces.

In this work we will will use the theory of semigroups [3] and resolvent operators [4] to study the Blackstock-Crighton-Westervelt equation in the form

$$(-aA - \partial_t)(u''(t) + c^2 Au(t) + bAu'(t)) = f(t, u, u_t),\ t \geq 0, \tag{1}$$

defined in a Banach space X with initial conditions $x = u(0)$, $y = u'(0)$, $z = u''(0)$, and $-A : D(A) \subset X \to X$ a closed linear densely defined operator that satisfies appropriate conditions.

References

[1] R. Brunnhuber, B. Kaltenbacher, *Well-posedness and asymptotic behaviour of solutions for the Blackstock-Crighton-Westervelt equation.* Discrete Contin. Dyn. Syst., 34(11): 4515-4535, 2014.

[2] R. Brunnhuber, S. Meyer, *Optimal regularity and exponential stability for the Blackstock-Crighton equations in L_p-spaces with Dirichlet and Neumann boundary conditions.* J. Evol. Equ. 16, 945?981, 20016.

[3] A. Pazy, *Semigroups of Linear Operators and Applications to Partial Differential Equations.* Springer-Verlag, New York, 1983.

[4] J. Prüss, *Evolutionary Integral Equations ans Applications.* Monographs Math., 87, Birkhäuser Verlag, 1993.

*Partially supported by CAPES, e-mail: laura.rgambera@gmail.com
†e-mail: andreacp@ibilce.unesp.br
‡e-mail: carlos.lizama@usach.cl

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

Paulo N. Seminario Huertas*
Institute of Mathematics and Computer Sciences
University of São Paulo
São Carlos-SP, Brazil

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.

References

[1] J.A. Carrillo. *Global Weak Solutions for the Initial-Boundary-Value Problems to the Vlasov-Poisson-Fokker-Planck System*, Math. Meth. in the Appl. Sci. **21**, 907-938 (1998).

[2] J.A. Carrillo and J. Soler. *On the initial value problem for the Vlasov-Poisson-Fokker-Planck system with initial data in L^p spaces*, Math. Meth. in the Appl. Sci., **18**, 825-839 (1995).

[3] J. L. Lions. *Equations differentielles opérationelles et problèmes aux limites*, Springer, Berlin, 1961.

*Partially supported by CAPES PROEX-8477445/D and by CNPq DS 141602/2018-0, e-mail: pseminar@icmc.usp.br