V Workshop de Teses e Dissertações em Matemática

Caderno de Resumos

31 de Agosto a 02 de setembro de 2015

ICMC-USP

Realização:

Apoio:

Objetivo

Em sua quinta edição, o Workshop de Teses e Dissertações em Matemática tem como finalidade promover a integração e a divulgação da pesquisa do programa de pós-graduação em matemática do ICMC-USP. Consiste em um momento propício para discussões, uma vez que os alunos em fase final da produção de sua tese ou dissertação, são incentivados a ministrarem palestras divulgando os resultados obtidos em suas pesquisas.

Comitê Científico

Jaqueline Godoy Mesquita

Juliana Fernandes da Silva Pimentel

Pedro Henrique Apoliano Albuquerque Lima

Thaís Fernanda Mendes Monis

Thaís Maria Dalbelo

Thiago Castilho de Mello

Comissão Organizadora

Ana Maria Mathias Morita

Ginnara Mexia Souto

Patricia Tempesta

Rafaella de Souza Martins

Endereço:

V Workshop de Teses e Dissertações em Matemática
Instituto de Ciências Matemáticas e de Computação
Universidade de São Paulo
Av. Trabalhador São Carlense, 400
CEP: 13566-590 - São Carlos - SP
FAX: +55 (16) 3371-2238
e-mail: wpgmat@icmc.usp.br

Contents

Palestras

Rigorous Construction of Manifolds of Solutions of PDEs

Camila Leão Cardozo and Marcio Fuzeto Gameiro

Our aim is to rigorously compute implicitly defined manifolds of solutions of infinite dimensional nonlinear equations. Using a multi-parameter continuation method on a finite dimensional projection, a triangulation of the manifold is computed and then is used to construct local charts of the global manifold in the infinite dimensional domain of the operator. The goal is to apply the method to compute portions of a two-dimensional manifold of equilibria of the Cahn-Hilliard equation.

Acknowledgements: We would like to thanks FAPESP by financial support.

References

[1] Gameiro, Marcio; Lessard, Jean-Philippe; Pugliese, Alessandro, Computation of Smooth Manifolds Via Rigorous Multi-parameter Continuation in Infinite Dimensions, *Found. of Comput. Math.*, (to appear).

[2] M. L. Brodzik, The computation of simplicial approximations of implicitly defined p-dimensional manifolds, *Comput. Math. Appl.*, 36(6):93-113, (1998).

(Camila Leão Cardozo) ICMC-USP
E-mail address: `cardozo@icmc.usp.br`

(Marcio Fuzeto Gameiro) ICMC-USP
E-mail address: `gameiro@icmc.usp.br`

Local Homology Module with Respect to a Pair of Ideals

Carlos Henrique Tognon and Victor Hugo Jorge Pérez

We assume here that R is a commutative ring with nonzero identity. For a R-module M and an ideal I of ring R there are two important functors in commutative algebra and algebraic geometry which are the functor of I-torsion $\Gamma_I(\bullet)$ and the functor of the I-adic completion $\Lambda_I(\bullet)$. It should be noted that the functor of I-torsion $\Gamma_I(\bullet)$ is left exact and your i-th derived functor right $\mathrm{H}_I^i(\bullet)$ is called the i-th local cohomology functor with respect to I. The local cohomology theory of Grothendieck has proved to be an important tool in algebraic geometry, commutative algebra and algebraic topology. His theory dual local homology is also studied for many mathematical: Greenlees and May [3], Tarrío [1], and Cuong and Nam [2], etc. In this context we introduce a generalization of the concept of the local homology module, which we call a local homology module with respect to a pair of ideals (I, J), and study its various properties. Since we have the definition of $\mathrm{H}_i^{I,J}(-)$ we can raise some questions about this R-module. Among these questions we may ask, for example, if there are any relations with this module $\mathrm{H}_i^{I,J}(M)$ and the local cohomology module with respect to a pair of ideals, such as if a is the dual of other.

References

[1] L. Alonso Tarrío, A. Jeremías López, J. Lipman, *Local homology and cohomology on schemes*, Ann. Sci. École Norm. Sup., 1 - 39,1997.

[2] N.T. Cuong, T.T. Nam, *The I-adic completion and local homology for Artinian modules*, Math. Proc. Cambridge Philosophical Society, 61 - 72, 2001.

[3] J.P.C. Greenlees, J.P. May, *Derived functors of I-adic completion and local homology*, Journal of Algebra, 438 - 453, 1992.

(Carlos Henrique Tognon) ICMC-USP
E-mail address: `tognon@icmc.usp.br`

(Victor Hugo Jorge Pérez) ICMC-USP
E-mail address: `vhjperez@icmc.usp.br`

Relations between a topological game and the G_δ-diagonal property

Dione A. Lara and Leandro F. Aurichi

We present a selection principle that is equivalent to the space X having the G_δ-diagonal property. We also discuss some games related with that property.

References

[1] J. G. Ceder. *Some generalizations of metric spaces*. Pacific J. Math., 11 1961, 105-125
[2] K. Kunen. *Set Theory: An Introduction to Independence Proofs*. North-Holland Publishing Company, 1980.
[3] R. Engelking. *General topology*. Heldermann Verlag, 1989.

(Dione A. Lara) ICMC-USP
E-mail address: dione@icmc.usp.br

(Leandro F. Aurichi) ICMC-USP
E-mail address: aurichi@icmc.usp.br

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

Henrique B. da Costa, Alexandre N. de Carvalho and Pedro Marín-Rubio

The main objective of our work is to study the asymptotic dynamics and continuity for parabolic equations. We are particularly interested in the case where the spacial domain is unbounded. In order to do that we start with a Chafee-Infante equation on the one-dimensional space and look for clues of asymptotic stability when we approximate the unbounded domain by a family of bounded ones. Inspired by the work of Mielke, [4], we prove upper semicontinuity of attractors. Although Mielke just conjectured lower semicontinuity of attractors, we will discuss what we expected to find in this sense.

Existence and upper semicontinuity of attractors has being a topic of various studies and on the other hand lower semicontinuity has been systematically put aside. In order to study evolution equations on unbounded domains the usual Lebesgue spaces are not optimal, so we exploit weighed and locally uniform Lebesgue spaces. We will define and talk about some properties of these particular spaces, as well as on semigroup generation and attractors for equations on locally uniform spaces.

Acknowledgements: We would like to thanks CAPES and FAPESP by financial support.

References

[1] Arrieta, J., Cholewa, J., Dlotko, T. and Rodríguez-Bernal, A. *Asymptotic behavior and attractors for reaction diffusion equations in unbounded domains*, Nonlinear Analysis, 56, 2004 515–554.

[2] Arrieta, J., Cholewa, J., Dlotko, T. and Rodríguez-Bernal, A. *Dissipative parabolic equations in locally uniform spaces*, Math. Nachr. 280, No. 15, 2007, 1643–1663.

[3] Carvalho, A., Langa, J.A., Robinson, J. *Attractors for infinite-dimensional non-autonomous dynamical systems*, New York, Springer Verlag, 2012.

[4] Mielke, A. *The complex Ginburg-Landau equation on large unbounded domains: sharper bounds and attractors*, Nonlinearity, 10, 1997, 199–222.

(Henrique Barbosa da Costa) ICMC-USP
E-mail address: `hbcosta@icmc.usp.br`

(Alexandre Nolasco de Carvalho) ICMC-USP
E-mail address: `andcarva@icmc.usp.br`

(Pedro Marín-Rubio) Universidad de Sevilla
E-mail address: `pmr@us.es`

Maximal topologies with respect to a family of subsets

Henry Jose Gullo Mercado and Leandro Fiorini Aurichi

Let (X, τ) be a topological space and let $\mathcal{F}$ be the family of all subsets of X that satisfy a topological property P (invariant under homeomorphisms). If we add new open sets to the topology and if $\mathcal{F}$' is the family of all subsets of the new space which satisfy the property P, we can have that $\mathcal{F} \neq \mathcal{F}$'. In such cases we say that the space is maximal with respect to the family $\mathcal{F}$. We show here some characterizations of maximal spaces with respect to the family of some of its subsets: compacts, dense, discrete and convergent sequences.

References

[1] A. Dow, M.G. Tkachenko, V. V. Tkachuk and R. G. Wilson, Topologies generated by discrete subspaces, *Glasnik Math. J.* 37 (2002) 53-75.

[2] Douglas E. Cameron, Maximal and minimal topologies, *Transactions of the american mathematical society*, Volume 160, October 1971.

[3] E. K. van Douwen, Applications of maximal topologies, *Topology and Its Applications*, 51 (1993), 125-139.

[4] Ofelia T. Alas, Vladimir V. Tkachuk, and Richard G. Wilson, Closres of discrete sets often reflect global properties, *Topology Proc.*, volume 25 (2000) 27-44.

(Henry Jose Gullo Mercado) ICMC-USP
E-mail address: henrygu@icmc.usp.br

(Leandro Fiorini Aurichi) ICMC-USP
E-mail address: aurichi@icmc.usp.br

How does the cross-ratio can appear in surfaces in $\mathbb{R}^4$?

Jorge Luiz Deolindo Silva and Farid Tari

Uribe-Vargas introduced the cr-invariant (cross-ratio) in cusps of Gauss of surfaces in $\mathbb{R}^3$. For surfaces in $\mathbb{R}^4$, the point $P_3(c)$ has behavior similar the cusps of Gauss. We show the existence of local and multi-local curves at points $P_3(c)$ and we have established cross-ratio invariants at points $P_3(c)$ that are used to recover two modulus in 4-jet of the projective parametrization of the surface.

Acknowledgements: We would like to thanks FAPESP/2012-00066-9 by financial support.

References

[1] Bruce, J. W. and Nogueira, A. C. *Surfaces in $\mathbb{R}^4$ and duality.* Quart. J. Math. Oxford Ser. (2), 49, 433–443, **1998**.

[2] Bruce, J. W. and Tari, F. *Families of surfaces* in $\mathbb{R}^4$. Proc. Edinb. Math. Soc. 45, 181–203, **2002**.

[3] Deolindo-Silva, J. L. and Kabata, Y. *Projective classification of jets of surfaces in $\mathbb{P}^4$ and applications*, **2015**.

[4] Deolindo-Silva, J. L. and Tari, F. *Cr-invariant for surfaces in $\mathbb{R}^4$*, **2015**.

[5] Little, J. A. *On the singularities of submanifolds of heigher dimensional Euclidean space.* Annli Mat. Pura et Appl. (4A) 83, 261–336, **1969**.

[6] Mochida, D. K. H., Romero-Fuster, M. C. and Ruas, M. A. S. *The geometry of surfaces in 4-space from a contact viewpoint.* Geometria Dedicata. 54, 323–332, **1995**.

[7] Nuño-Ballesteros, J. J. and Tari, F. *Surfaces in $\mathbb{R}^4$ and their projections to 3-spaces.* Roy. Proc. Edinburgh Math. Soc. 137A, 1313–1328, **2007**.

[8] Oset-Sinha, R. and Tari, F. *Projections of surfaces in $\mathbb{R}^4$ to $\mathbb{R}^3$ and the geometry of their singular images.* Rev. Mat. Iberoam. 31, 1, 33–50, **2015**.

[9] Uribe-Vargas, R. *A projective invariant for swallowtails and godrons, and global theorems on the flecnodal curve.* Mosc. Math. J. 6, 731–768, 772, **2006**.

(Jorge Luiz Deolindo Silva) ICMC-USP
E-mail address: `deolindo@icmc.usp.br`

(Farid Tari) ICMC-USP
E-mail address: `faridtari@icmc.usp.br`

Equilibrium States for Derived from Anosov diffeomorphisms

Jorge Luis Crisostomo Parejas and Ali Tahzibi

Consider a continuous map $f : M \to M$ on a compact metric space M. We say that a f-invariant probability measure μ is an equilibrium states for f associated to potential $\phi : M \to \mathbb{R}$ if it satisfies

$$h_\mu(f) + \int \phi d\mu = \sup_\nu \{h_\nu(f) + \int \phi d\nu\}$$

where the supremum is taken over all f-invariant probability measures.

In this presentation, we will talk about equilibrium states for derived from Anosov diffeomorphisms on $\mathbb{T}^3$ associated to potential defined for the Anosov (action on homotopy) model.

(Jorge Luis Crisostomo Parejas) ICMC-USP
E-mail address: jorgemat@icmc.usp.br

(Ali Tahzibi) ICMC-USP
E-mail address: tahzibi@icmc.usp.br

Rate of convergence of attractors for semilinear singularly perturbed problems

Leonardo Pires and Alexandre Nolasco de Carvalho

In this talk we exhibit a class of singularly perturbed parabolic problems which the asymptotic behavior can be described by a system of ordinary differential equation. We estimate the continuity of attractors in the Hausdorff metric by rate of convergence of resolvent operator. Application to spatial homogenization and large diffusion except in a neighborhood of a point will be considered.

References

[1] J. M. Arrieta and F.D.M. Bezerra and A. N. Carvalho *Rate of convergence of Attractors for some sinsingular perturbed parabolic problems*, Top. Methdos Nonlinear Anal, 2014.

[2] A.N. Carvalho and J.W. Cholewa and T.Dlotko *Equi-exponential attraction and rate of convergence of attractors for singularly pertubed evolution equations*, Cadernos de matemática, 2010.

[3] E. Santamaria and J. M. Arrieta *Estimates on the distance of inertial manifolds*,Discrete and continuous dinamical systems, 2014.

(Leonardo Pires) ICMC-USP
E-mail address: `leopires@icmc.usp.br`

(Alexandre Nolasco de Carvalho) ICMC-USP
E-mail address: `andcarva@icmc.usp.br`

FRS - genericity of plane curves

Mostafa Salari Noghabi and Farid Tari

We propose a way to study the geometry of deformations of singular plane curves. We obtain information on the inflections and vertices appearing on the deformed curve. We also obtain the configuration of the evolute of the singular curve and its deformations. We deal with local phenomena that occur generically in two-parameter families of curves. These include the case of regular curves at inflections of order ≤ 3 and the cases of the cusp and ramphoid cusp singularities.

References

[1] M. Salarinoghabi and F. Tari, Flat and round singularity theory of plane curves . Preprint, 2015.
[2] T. Fukunaga and M. Takahashi, Evolutes of fronts in the Euclidean plane. *Journal of Singularities* 10 (2014), 92–107.
[3] R. Oset Sinha and F. Tari, Projections of space curves and duality. *Q. J. Math* 64 (2013), 281–302.
[4] F. Tari, Geometric properties of the solutions of implicit differential equations. *Discrete Contin. Dyn. Syst.* 17 (2007), 349–364.
[5] C. T. C. Wall, Flat singularity theory. *J. Lond. Math. Soc.* 87 (2013), 622–640.
[6] C. T. C. Wall, Geometric properties of generic differentiable manifolds. *Lecture Notes in Math.*, 597 (1977), 707–774.

(Mostafa Salari Noghabi) ICMC-USP
E-mail address: mostafa@icmc.usp.br

(Farid Tari) ICMC-USP
E-mail address: faridtari@icmc.usp.br

Bourgin-Yang version of the Borsuk-Ulam theorem for mod p-cohomology spheres

Nelson A. Silva AND Denise de Mattos

Let G be a compact Lie group. The *length* is a cohomological index theory introduced by Bartsch[1] motivated by the definition of category and equivariant cup-length. It depends on a set $\mathcal{A}$ of G-spaces, a multiplicative equivariant cohomology theory h^* and a choice of an ideal $I \subset h^*(\mathrm{pt})$. The notation for this index is $(\mathcal{A}, h^*, I)$ − length or simply ℓ.

For the p-tori groups of dimension $k \geq 1$, ie, $G = (\mathbb{Z}/2)^k$, $(\mathbb{Z}/p)^k$ or $(S^1)^k$, we calculate $\ell(X)$, where X is a G-compact space and has the same $\mathbb{F}_2$, $\mathbb{F}_p$ or $\mathbb{Q}$-cohomology of an n-sphere, respectvely. The results coincide with those of Bartsch's[1] for the particular case of representation spheres without fixed points of the group action.

As a straightforward consequence of the monotonicity of length we obtain a simple proof of the Borsuk-Ulam theorem which gives a necessary condition for the existence of G-equivariant maps between such cohomology spheres, where $G = (\mathbb{Z}/2)^k$, $(\mathbb{Z}/p)^k$ or $(S^1)^k$, with p prime number. Using a construction due to Segal[4], a Bourgin-Yang version of the Borsuk-Ulam theorem is obatained in this context.

References

[1] Bartsch, T. *Topological Methods for Variational Problems with Symmetries*, Lecture Notes in Mathematics 1560, Springer-Verlag Berlin Heidelberg (1993).
[2] tom Dieck, T. *Transformation Groups*, de Gruyter, Berlin (1987).
[3] Fadell, E. R. and Husseini, S. *An ideal-valued cohomological index theory with applications to Borsuk-Ulam and Bourgin-Yang theorems*, Ergodic Theory Dynam. Systems 8 (1988), Charles Conley Memorial Issue, 73-85.
[4] Segal, G. *Equivariant K-theory*, Publ. Math. IHES **34** (1968) 129-151.

(Nelson A. Silva) ICMC-USP
E-mail address: nelson@icmc.usp.br

(Denise de Mattos) ICMC-USP
E-mail address: deniseml@icmc.usp.br

Whitney equisingularity at the normalization

Otoniel Nogueira da Silva and Maria Aparecida Soares Ruas

We study topological equisingularity and Whitney equisingularity of families of germs of complex analytic varieties, by means of their normalizations. We present some results for families of space curves, in this case we show that equisingularity at the normalization is equivalent to the concept of weak simultaneous resolution introduced by B. Teissier in [5] and equisingularity at the normalization with an additional hypothesis is equivalent to the concept of Whitney equisingularity of the family. We present some examples showing that to obtain the Whitney equisingularity of a family of space curve, we need to look at the algebraic structure of the normalization of the family.

Acknowledgements: We would like to thank CAPES by financial support.

References

[1] R. Callejas-Bedegral, K. Houston, M.A.S. Ruas, *Topological triviality of families of singular surfaces*, preprint, arXiv: math/0611699v1[math.CV].

[2] J. Briançon; A. Galligo; M. Granger. *Déformations équisingulières des germes de courbes gauches réduites*, Université de Nice,1979.

[3] J. Fernández de Bobadilha, M. Pe Pereira. *Equisingularity at the Normalisation*, J. Topol., no. 4, 879-909., 2008.

[4] J. Pérez, V.H., N. Ballesteros, J.J., *Finite determinacy and Whitney equisingularity of map germs from $\mathbb{C}^n$ to $\mathbb{C}^{2n-1}$*, Manuscripta math., 2009.

[5] B. Teissier., *Résolution simultanée I et II in Séminaire sur les singularités des surfaces*, Ecole Polytechnique Palaiseau,1976.

(Otoniel N. Silva) ICMC-USP
E-mail address: otoniel@icmc.usp.br

(Maria A. S. Ruas) ICMC-USP
E-mail address: maasruas@icmc.usp.br

Markov sections for Anosov actions of $\mathbb{R}^k$

Rodrigo Ribeiro Lopes and Carlos Alberto Maquera Apaza

The Markov partitions was introduced by Adler and Weiss [5] for hyperbolic automorphisms on the torus $\mathbb{T}^2$. In 1970, Bowen [1] proved the existence of Markov partitions for Axiom A diffeomorphism. This object proved to be an important tool for the comprehension of those dynamical systems. Following the work of Bowen, Ratner [2] showed the existence of Markov partitions for topologically transitive Anosov flows. As application of Ratner's results, we have the work of Ghys [4]. He proved, under certain conditions, that codimension one Anosov flows are suspensions of automorphisms on the torus.

Now in our work, we construct Markov sections for topologically transitive Anosov action of $\mathbb{R}^k$ on closed manifolds. We use the notion of transitive for Anosov action given by Barbot, Maquera [3]. This is a work with Prof°Carlos Maquera and Prof°Régis Varão(Unicamp).

Acknowledgements: We would like to thanks CAPES and CNPQ by financial support.

References

[1] Bowen, R.: *Markov partitions for Axiom A diffeomorphisms*, American Journal of Math., 92, 725 − 747 (1970)

[2] Ratner, M.: *Markov partitions for Anosov flows on $n-$dimensional manifolds*, Israel Journal of Math, 15, 92 − 114 (1973)

[3] Barbot, T. and Maquera,C.:*Transitivity of codimension-one Anosov actions of $\mathbb{R}^k$ on closed manifold*, Ergodic Theory and Dynamical Systems, 31, 1 − 22 (2011)

[4] Ghys, E.: *Codimension one Anosov flows and suspensions*, Lecture Notes in Math., 1331, Springer, Berlin, 59 − 72 (1988)

[5] Adler, R. and Weiss,B.: *Entropy, a complete metric invariant for automorphisms of the torus* Proc. Nat. Acad. of Science, 57 1573 − 1576 (1967)

(Rodrigo R. Lopes) ICMC-USP
E-mail address: rodrigol@icmc.usp.br

(Carlos A. Maquera Apaza) ICMC-USP
E-mail address: cmaquera@icmc.usp.br

Long-time dynamics of full von Karman system with restricted dissipation and thermal effects

Rodrigo Nunes Monteiro, Irena Lasiecka and Ma To Fu

This work is concerned with the long-time dynamics of a thermoelastic full von Karman system. The problem is defined with boundary configuration containing clamped and free parts. In the present paper, without adding rotational inertia or any mechanical dissipation on vertical displacement of the nonlinear plate we show that the PDE system generates a well-posed dynamical system whose long-time behavior is characterized by a global attractor that is finite dimensional and smooth.

References

[1] G. Avalos and I. Lasiecka , *Exponential stability of a thermoelastic system without mechanical dissipation,* Dedicated to the memory of Pierre Grisvard. Rend. Istit. Mat. Univ. Trieste 28 (1996), suppl., 1-28 (1997).

[2] A. Benabdallah and I. Lasiecka, *Exponential decay rates for a full von Karman system of dynamic thermoelasticity,* J. Differential Equations 160 (2000), no. 1, 51-93.

[3] I. Chueshov and I. Lasiecka, *Von Karman Evolution Equations. Well-posedness and Long Time Dynamics,* Springer Monographs in Mathematics. Springer, New York, 2010.

[4] I. Lasiecka, *Uniform stabilizability of a full von Karman system with nonlinear boundary feedback,* SIAM J. Control Optim. 36 (1998), no. 4, 1376-1422.

[5] I. Lasiecka, *Uniform decay rates for full von Karman system of dynamic thermoelasticity with free boundary conditions and partial boundary dissipation,* Comm. Partial Differential Equations 24 (1999), no. 9-10, 1801-1847.

(Rodrigo Nunes Monteiro) ICMC-USP
E-mail address: monteiro@icmc.usp.br

(Irena Lasiecka) TUofM
E-mail address: lasiecka@memphis.edu

(Ma To Fu) ICMC-USP
E-mail address: matofu@icmc.usp.br

Pullback attractors for wave equations with acoustic boundary conditions

Thales Maier de Souza and Ma to fu

This work is concerned with a class of problems which models acoustic wave motion in a bounded domain equipped with an acoustic boundary condition. We consider a wave equation in a bounded domain Ω coupled with an ordinary differential equation on the boundary $\partial\Omega$ and also a compatibility condition added by physical motivations. This kind of problem is inspired in the model which was initially proposed by Beale and Rosencrans [1]. We propose a non-autonomous model of this problem by adding a $\varepsilon g(x,t)$ force. Our main result is the existence of pullback attractor and its upper semicontinuity as $\varepsilon \to 0$.

References

[1] Beale, J. T.; Rosencrans, S. I. *Acoustic boundary conditions*, Bull. Amer. Math. Soc., Vol. 80, Number 6, p.1276-1278, 1974.

[2] Beale, J. T. *Spectral properties of an acoustic boundary condition*, Indiana Univ. Math. J., Vol 25, p.895-917, 1976.

[3] Frigeri, S. *Attractors for semilinear damped wave equation with an acoustic boundary condition*, Journal of Evolution Equations, 10, 29-58, 2010.

[4] Frota, C.L.; Goldstein, J.A. *Some nonlinear wave equations with acoustic boundary conditions*, Jornal Differential Equations, Vol. 164, p. 92-109, 2000.

[5] Gal, C.G.; Goldstein, G.R.; Goldstein, J.A. *Oscillatory boundary conditions for acoustic wave equations* Journal Evolution Equations, 3, 623-635, 2003.

[6] Mugnolo, D. *Abstract wave equation with acoustic boundary conditions*, Mathematische Nachrichten, 279, 299-318, 2006.

(Thales Maier de Souza) ICMC-USP
E-mail address: maier@icmc.usp.br

(Ma To Fu) ICMC-USP
E-mail address: matofu@icmc.usp.br

Fourth order models describing suspension bridges

Vanderley Ferreira Junior and Ederson Moreira dos Santos

Suspension bridges are elastic structures characterized by complex patterns of oscillation. Modeling such patterns leads to the study of nonlinear equations partial differential equations. Two models to describe such oscillations are discussed.

For the first, blowup of traveling waves in an one-dimensional model is established. The results apply to the Swift-Hohenberg equation. The other model is two-dimensional and allows a more complete description of the deformations. An evolution problem for a semilinear nonlocal biharmonic wave equation is presented.

Acknowledgements: I would like to thank FAPESP by financial support.

(Vanderley Ferreira Junior) ICMC-USP
E-mail address: valves@icmc.usp.br

(Ederson Moreira dos Santos) ICMC-USP
E-mail address: ederson@icmc.usp.br

Strictly positive definite kernels on two-point homogeneous spaces

Victor Simões Barbosa and Valdir Antonio Menegatto

In this work we present a necessary and sufficient condition for the strict positive definiteness of a continuous, isotropic and positive definite kernel on a two-point compact homogeneous space. The characterization adds to others previously obtained by D. Chen at all ([2]) in the case in which the space is a sphere of dimension at least 2 and Menegatto at all ([3]) in the case in which the space is the unit circle. We have included an application to the differentiability of positive definite kernels on these spaces.

References

[1] Barbosa, V. S.; Menegatto, V. A., *Strictly positive definite kernels on two-point compact homogeneous space*, arXiv:1505.00591, 2015.

[2] Chen, D.; Menegatto, V. A.; Sun, Xingping; *A necessary and sufficient condition for strictly positive definite functions on spheres*. Proc. Amer. Math. Soc. 131 (2003), no. 9, 2733-2740.

[3] Menegatto, V. A.; Oliveira, C. P.; Peron, A. P.; *Strictly positive definite kernels on subsets of the complex plane*. Comput. Math. Appl. 51 (2006), no. 8, 1233-1250.

(Victor S. Barbosa) ICMC-USP
E-mail address: victorsb@icmc.usp.br

(Valdir A. Menegatto) ICMC-USP
E-mail address: menegatt@icmc.usp.br

Pôsteres

Global study of a family of quadratic systems with invariant hyperbolas

Caio Pena, Regilene D. S. Oliveira and Alex C. Rezende

In this poster we investigate a particular family of planar quadratic differential systems with two invariant hyperbolas. We classify such systems presenting all their global phase portraits in the Poincaré disk. Among the techniques used in this investigation we point out the Poincaré Compactification and the local classification of singular points.

References

[1] F. Dumortier, J. Llibre, J. C. ArtÃ©s. *Qualitative theory of planar differential systems.* New York: Springer, 2006.

[2] R. D. S. Oliveira, A. C. Rezende, N. Vulpe. *Family of quadratic differential systems with invariant hyperbolas: a complete classification in the space* $\mathbb{R}^{12}$, Notas do ICMC–USP – Série Matemática 393 (2014), 1–50.

(Caio Augusto de Carvalho Pena) ICMC-USP
E-mail address: caio.pena@usp.br

(Regilene Delazari dos Santos Oliveira) ICMC-USP
E-mail address: regilene@icmc.usp.br

(Alex Carlucci Rezende) ICMC-USP
E-mail address: arezende@icmc.usp.br

Codimension one isometric immersions between Lorentz spaces

Claudia Evelyn Escobar Montecino and Guillermo Antonio Lobos Villagra

In this dissertation following the article “Codimension one isometric immersions between Lorentz Spaces” by L.K. Graves [2], we shall generalize the Theorem of Hartman and Nirenberg which classifies codimension one isometric immersions between Euclidean spaces with the usual metric, now using a metric with one negative-definite direction. The proof of this theorem consists in study the completeness of the relative nullity foliation of immersion, it will split in two cases, if the fotiation carries a degenerate or nondegenerate metric. Done it is possible to use the Moore‘s Lema to get f as a product of certain functions.

References

[1] Lamport, L. *LaTeX: A Document Preparation System*, Addison-Wesley,1986.

[2] L. Graves, *Codimension one isometric immersions between Lorentz Spaces*. Trans. Amer. Math. Soc. 252, 1979, 367-392.

[3] B. O’Neill, *Semi-Riemannian Geometry with applications to Relativity*. Pure and Applied Mathematics Vol.103, Academic Press 1983.

[4] K. Nomizu, *On hypersurfaces satisfying a certain condition on the curvature tensor*. TÃ´hoku Math. J.,20, 1968, 46-59.

[5] J. D. Moore, *Isometric immersions between of Riemannian products*. J. Differential Geometry, 5, 1971, 159-168.

(Claudia Evelyn Escobar Montecino) DM-UFSCAR
E-mail address: claudia.escobarm@usach.cl

(Guillermo Antonio Lobos Villagra) DM-UFSCAR
E-mail address: lobos@dm.ufscar.br

Galois closures of quartic subfields of rational function fields over finite fields

David Alberto Saldaña Monteza AND Herivelto Martins Borges Filho

This is my abstract.

The project studies the results proved by Robert C. Valentini in the Article: **Galois closures of quartic subfields of rational function fields**. This result determines the polynomial number $f(x)'s$ of degree 4 over a finite field $\mathbb{F}_q$ such that $\mathbb{F}_q(x)/\mathbb{F}_q(f(x))$ is an extension of Galois with a prescribed group of Galois . We use the cubic resolvent and we study the case whether this is irreducible or not, and using the Theory of Cyclic Extension or Theory of Kummer with the theory of Ramification, we establish a set of convenient arithmetical conditions. When k is an arbitrary field, y is transcendental over k, L is a field such that $k \neq L \subset k(y)$ if some coefficient in the irreducible polynomial over $k[x]$ is not constant in y, then it can be used as a gerator for L/k. Now we can use this to extend the proven results in [**1**].

Acknowledgements: We would like to thank CNPQ for their financial support.

References

[1] Robert C. Valentini. Galois closures of quartic subfields of rational function fields. Elsevier,(2013).

[2] Robert C. Valentini, Manohar L. Madan. A Haupsatz of L.E. Dickson and Artin-Schreier extensions. J. Reine Angew. Math. 318 156-177,(1980)163-164.

[3] B. Huppert, Endliche Gruppen. I, Springer-Verlag, Berlin, Heidelberg, and New York, 1967,(1980)177-214.

[4] R. Scognamillo, H. Zannier. Introductory Notes on Valuation Rings and Function Fields in One Variable, Edizioni Della Normale. (2014), Pag. 12-29.

(David Monteza) ICMC-USP
E-mail address: `monteza@usp.br`

(Herivelto Martins Borges Filho) ICMC-USP
E-mail address: `hborges@icmc.usp.br`

The Bloch-Wigner exact sequence and Algebraic K-Theory

David M. Carbajal Ordinola and Behrooz Mirzaii

Algebraic K-theory is a branch of algebra that in some sense tries to generalize the subject of linear algebra over any ring with unit. It associates to any ring R a sequence of abelian groups $K_n(R)$, called K-groups of R. They play important role in many areas of mathematics, such as Algebraic Geometry and Number Theory, his study has come to involve mathematical tools and they led to the creation of new methods of investigation [5].

Michael Atiyah calls this subject the *Stable Linear Algebra.* This description seems very convincing when one studies K_0 and K_1 of a ring because can be described using elementary linear algebra. For instance when R is a local ring, $K_0(R) \simeq \mathbb{Z}$ and it can be described using the rank of finitely generated free R-modules. Moreover $K_1(R) \simeq R^\times$ and it is closely related to the determinant of invertible matrices over R [1]. The group $K_2(R)$ is more complicated and is defined using the elementary matrices by introducing the Steinberg group of R and the Steinberg relations [1], and the group $K_3(R)$ is the first K-group that does not have an easy description.

A theorem of Bloch and Wigner asserts the existence of the exact sequence $0 \to \mathbb{Q}/\mathbb{Z} \to K_3^{\mathrm{ind}}(F) \to \mathfrak{p}(F) \to \bigwedge_{\mathbb{Z}}^2 F^\times \to K_2(F) \to 0$, where F is an algebraically closed field of characteristic zero. Here $\mathfrak{p}(F)$ is called the pre-Bloch group of F, $K_3^{\mathrm{ind}}(F)$ is called the indecomposable part of $K_3(F)$, the homomorphism $\mathfrak{p}(F) \to \bigwedge_{\mathbb{Z}}^2 F^\times$ is defined by $[a] \mapsto a \otimes (1-a)$ and its kernel is called the Bloch group of F. This exact sequence has been the source of many interesting ideas that has led to the solution of important conjectures [3], [5]. These ideas can be extended over commutative local rings [2].

References

[1] Milnor, J. Introduction to Algebraic K-Theory. Annals of Mathematics Studies, No. 72. Princeton University Press, Princeton, N.J.; University of Tokyo Press, Tokyo, 1971.

[2] Mirzaii, B. Mokari, F. Y. Bloch-Wigner theorem over rings with many units II. Journal of Pure and Applied Algebra. 219 (2015), 5078–5096.

[3] Suslin, A. A. K_3 of a field and the Bloch group. Proc. Steklov Inst. Math. 183 (1991), no. 4, 217–239.

[4] Van der Kallen, W. The K_2 of rings with many units. Ann. Sci. École Norm. Sup. (4) 10 (1977), no. 4, 473–515.

[5] Weibel, C. A. The K-book: An Introduction to Algebraic K-theory, Graduate Studies in Mathematics, 145. American Mathematical Society, Providence, Rhode Island, 2013.

David M. Carbajal Ordinola, ICMC-USP
E-mail address: davidcarbajal@icmc.usp.br

Behrooz Mirzaii, ICMC-USP
E-mail address: bmirzaii@icmc.usp.br

Existence and Stability of global solution to a dissipative nonlinear Bresse system

Eiji Renan Takahashi and Luci Harue Fatori

In this work we studied a nonlinear Bresse system with three frictional dissipations. More specifically, consider the following system

$$\begin{aligned} \rho_1\varphi_{tt} - k(\varphi_x + \psi + lw)_x - k_0 l(w_x - l\varphi) + f_1(\varphi,\psi,w) + \gamma_1\varphi_t = 0, \text{ in } (0,L)\times(0,\infty); \\ \rho_2\psi_{tt} - b\psi_{xx} + k(\varphi_x + \psi + lw) + f_2(\varphi,\psi,w) + \gamma_2\psi_t = 0, \text{ in } (0,L)\times(0,\infty); \\ \rho_1 w_{tt} - k_0(w_x - l\varphi)_x + kl(\varphi_x + \psi + lw) + f_3(\varphi,\psi,w) + \gamma_3 w_t = 0, \text{ in } (0,L)\times(0,\infty); \end{aligned}$$

with Dirichlet boundary conditions, i.e.,

$$\varphi(0,t) = \varphi(L,t) = \psi(0,t) = \psi(L,t) = w(0,t) = w(L,t) = 0, \quad \forall t \geq 0,$$

and initial conditions

$$\varphi(0,\cdot) = \varphi_0, \varphi_t(0,\cdot) = \varphi_1, \psi(0,\cdot) = \psi_0, \psi_t(0,\cdot) = \psi_1, w(0,\cdot) = w_0, w_t(0,\cdot) = w_1;$$

where all coefficients are positive constants and $f_i : \mathbb{R}^3 \to \mathbb{R}$, $i = 1,2,3$, is the nonlinear terms of the system such that there is a constant $\gamma_i \geq 1$ and a continuous function $\sigma_i : \mathbb{R} \to \mathbb{R}^+$ satisfying

$$\begin{aligned} |f_i(s_1,r,t) - f_i(s_2,r,t)| &\leq \sigma_i(|r|,|t|)(1 + |s_1|^{\gamma_i} + |s_2|^{\gamma_i})|s_1 - s_2| \quad \forall (s_1,r,t),(s_2,r,t) \in \mathbb{R}^3, \\ |f_i(s,r_1,t) - f_i(s,r_2,t)| &\leq \sigma_i(|s|,|t|)(1 + |r_1|^{\gamma_i} + |r_2|^{\gamma_i})|r_1 - r_2| \quad \forall (s,r_1,t),(s,r_2,t) \in \mathbb{R}^3, \\ |f_i(s,r,t_1) - f_i(s,r,t_2)| &\leq \sigma_i(|s|,|r|)(1 + |t_1|^{\gamma_i} + |t_2|^{\gamma_i})|t_1 - t_2| \quad \forall (s,r,t_1),(s,r,t_2) \in \mathbb{R}^3. \end{aligned}$$

If the functions f_i are null, we return to a case already studied[2]. Our main goal is to establish the existence and uniqueness of the system's solution, as well as exponential decay through multiplicative techniques.

Acknowledgements: We would like to thank CAPES by financial support.

References

[1] L. H. Fatori, M. A. Jorge Silva and Vando Narciso. *Attractor for a semilinear Timoshenko system*, Submitted, 2014.
[2] R. N. Monteiro. *Comportamento Assintótico para Sistemas de Bresse Dissipativos e Taxa Ótima*, Dissertação de Mestrado, PGMAC-UEL, 2011.
[3] F. Alabau Boussouira, J. E. Muñoz Rivera, and D. S. Almeida Júnior, Stability to weak dissipative Bresse system, J. Math. Anal. Appl. 374, no. 2, 481-498, 2011.

(Eiji Renan Takahashi) PGMAC-UEL
E-mail address: eiji_soueu@hotmail.com

(Luci Harue Fatori) PGMAC-UEL
E-mail address: lucifatori@uel.br

Graphs and stable Gauss maps

Flavio Henrique de Oliveira and Ana Claudia Nabarro

We consider graphs that are invariants associated to stable Gauss maps from closed orientable surfaces to the 2-sphere. We study the problem of realization of these graphs by stable Gauss maps and we also obtain models of surfaces for each graph.

Acknowledgements: We would like to thanks CAPES by financial support.

References

[1] C. Mendes de Jesus, S. Moraes, and M. Romero Fuster. *Stable gauss maps from a global viewpoint.* Bulletin of the Brazilian Mathematical Society, New Series, 42(1):87?103, 2011.

[2] J. W. Bruce, P. J. Giblin, and F. Tari. *Parabolic curves of evolving surfaces.* International Journal of Computer Vision, 17:291-306, 1996.

[3] J. W. Bruce. *Generic geometry and duality.* LMS Lecture Note sÃ©ries 201, Edited by J.P. Brasselet (1994) pp 29-60.

[4] J. W. Bruce, P. J. Giblin, and F. Tari. *Families of surfaces: height functions, Gauss maps and duals*, in Real and Complex Singularities, ed. W.L. Marar, Pitman Research Notes in Mathematics 333, pp. 148-178, 1995.

(Flavio Henrique de Oliveira) ICMC-USP
E-mail address: flavio.992@icmc.usp.br

(Ana Claudia Nabarro) ICMC-USP
E-mail address: anaclana@icmc.usp.br

Polar actions and foliations on Hadamard manifolds

Francisco Carlos Caramello Junior and Luiz Hartmann

This work presents some recent results on the theory of polar foliations, also known as singular riemannian foliations with sections, on nonpositively curved manifolds, as seen in Töben [3]. Polar actions are also studied, for they are active research subject that motivate and illustrate polar foliations. The main results are the nonexistence of polar foliations on compact manifolds of nonpositive curvature and a global description of polar foliations on Hadamard manifolds as a product of a compact isoparametric foliation and the trivial foliation of the euclidean space. We also present a shorter proof of a slightly stronger version of the later in the special case of polar actions, exploiting their relation with taut submanifolds provided by a theorem of Bott and Samelson [1]. This furnishes us a classification result (up to diffeomorphism) for foliations defined by Lie group actions on Hadamard manifolds, using Dadok's theorem in [2].

Acknowledgements: We would like to thank CNPQ for the financial support.

References

[1] Bott, R., Samelson, H., *Applications of the theory of Morse to symmetric spaces*, American Journal of Mathematics 80, 964-1029, 1958.

[2] Dadok, J., *Polar coordinates induced by actions of compact Lie Groups*, Transactions of the American Mathematical Society 288, 125-137, 1985.

[3] Töben, D., *Singular riemannian foliations on nonpositively curved manifolds*, Mathematische Zeitschrift 255, 427-436, 2007.

(Francisco Carlos Caramello Junior) DM-UFSCar
E-mail address: `franciscocaramello@gmail.com`

(Luiz Hartmann (Advisor)) DM-UFSCar
E-mail address: `hartmann@dm.ufscar.br`

The Artin presentation theorem

Letícia Melocro and Denise de Mattos

Braid groups first appeared, although in a disguised form, in an article by Adolf Hurwitz published in 1891 and devoted to ramified coverings of surfaces. The notion of a braid was explicitly introduced by Emil Artin in the 1920's to formalize topological objects that model the intertwining of several strings in the Euclidean 3-space. Artin pointed out that braids with a fixed number n of strings form a group, called the *Artin braid group of braids on n-strands*, denoted by $B(n)$. Since this early result, the theory of braids and the braid groups have been extensively studied by topologists and algebraists. This has led to a rich theory with numerous ramifications.

The main objetive of this work is to present a geometric description of the braid groups of the disk and show that the group $B(n)$ admits a presentation in terms of generators and relations in the famous theorem of Artin presentation.

Continuing this work, later we will define a total ordering of the braid groups, which is invariant under multiplication on both sides. The ordering will be defined using a combination of Artin's combing technique and the Magnus expansion of free groups.

Recently, Rolfsen, Dynnikov, Dehornoy and Wiest, demonstrated topological reasons for the existence of a left-ordering of the braid groups over the disk, i.e., there is a strict total ordering of the braids that is invariant under multiplication from the left. They also showed the pure braid groups over the unit disk are biorderable, i.e., there is a left and right invariant strict total ordering for this group. In our master's project, we will study the results related with this topic, developed in [5].

References

[1] E. Artin, *Theory of braids*, Ann. of Math., 48 (1946), 101 − 126.
[2] Cohen, Daniel E. *Combinatorial group theory a topological approach*, Mathematical Society Student Texts 14. Cambridge University, 1989.
[3] Hansen, Vagn L. *Braids and Covering: selected topics*, Mathematical Society Student Texts 18. Cambridge University, 1989.
[4] D. L. Johnson, *Presentations of Groups*, 2nd ed., Cambridge University Press, (1997).
[5] Rolfsen D. Rolfsen, P. Dehornoy, I. Dynnikov and B. Wiest, *Ordering Braids*, Amer. Math. Soc., (2008).

(Letícia Melocro) ICMC-USP
E-mail address: `leticia.melocro@usp.br`

(Denise de Mattos) ICMC-USP
E-mail address: `deniseml@icmc.usp.br`

Solvability near of the characteristic set for a class of complex vector fields

Lorena S. Hernandez and Paulo L. Dattori da Silva

Abstract

Let

$$L = \partial/\partial t + (a + ib)(x)\partial/\partial x$$

be a complex vector field defined on $\Omega = \mathbb{R} \times S^1$, where a and b are real-valued C^∞ functions in $\mathbb{R}$. Assume that $(a + ib)(0) = 0$ and $b(x) \neq 0$, for $x \neq 0$.
Denote $\Sigma = \{0\} \times S^1$.
We have that L is elliptic on $\Omega \setminus \Sigma$ and L satisfies condition $(\mathcal{P})$.
In this talk we will address to the solvability of L in a full neighborhood of Σ.
We say that L is solvable at Σ if given f belonging to a subspace of finite codimension of $C^\infty(\Omega)$ there exists $u \in C^\infty(\Omega)$ solving the equation $Lu = f$ in a neighborhood of Σ.
The solvability of L at Σ depends on the interplay between the order of the vanishing of a and b at $x = 0$.

References

[1] A. P. Bergamasco and P. L. Datrori da Silva *Global solvability for a special class of vector fields on the torus.*, Contemp. Math, 400, 2006, 11-20.

[2] P. L Datrori da Silva and E. R. da Silva *Solvability near the characteristic set for a special class of complex vector fields*, Springer Basel, 2012, 183-192 .

(Lorena S. Hernandez) ICMC-USP
E-mail address: loresohe@usp.br

(Paulo L. Dattori da Silva) ICMC-USP
E-mail address: pdattori@icmc.usp.br

Baouendi-Treves Theorem

Luís Márcio Salge and Éder Ritis Aragão Costa

In this work, we present the Baouendi-Treves approximation formula which states that given an involutiove structure $\mathcal{L}$ and a smooth function u that satisfies

$$\mathcal{L}u = 0,$$

then u can be locally approximated, in the topology of C^{∞}, by a sequence of polynomials in their first integrals.

References

[1] S. Berhanu, P. Cordaro and J. Hounie, *An Introduction to Involutive Structures*, Cambridge University Press, 2008.

(Luís Márcio Salge) ICMC-USP
E-mail address: lmsalge@icmc.usp.br

(Éder Ritis Aragão Costa) ICMC-USP
E-mail address: ritis@icmc.usp.br

Volumes of Right-Angled Hyperbolic Polyhedra

Omar Chavez Cussy and Carlos Henrique Grossi Ferreira

The class of right-angled polyhedra in a hyperbolic space $\mathbb{H}^n$ is the most studied class of Coxeter polyhedra. We present some recent results on a structure of the set of volumes of right-angled polyhedra in hyperbolic space.

These results can be useful not only for studying polyhedra, but also the correspondig 3-manifolds. The simplest and smallest bounded polyhedron in $\mathbb{H}^3$ with all dihedral angled $\pi/2$ is the dodecahedron. The second smallest is the 14-hedron, eight copies of which were used by Lobell in 1931 to construct the first example of a closed orientable hyperbolic 3-manifold. Its generalizations, referred as Lobell manifolds, were defined for any $n \geq 5$ as the right-angled hyperbolic polyhedra having $2n + 2$ faces: two n-gonal and $2n$ pentagonal managed similar to the lateral surface of a dodecahedron, it is known as the Lobell polyhedra Rn. We give the volume formula for these polyhedra in terms of the Lobachevsky function and present the initial list of smallest volume bounded right-angled hyperbolic polyhedra.

We would like to thank CAPES by financial support.

References

[1] Vesnin, A. *Volumes and Normalized Volumes of Right-Angled Hyperbolic Polyhedra*, 2010.

(Omar Chavez Cussy) ICMC-USP
E-mail address: omarchavez@usp.br

(Carlos Henrique Grossi Ferreira) ICMC-USP
E-mail address: grossi@icmc.usp.br

Timoshenko system with indefinite damping

Taís de Oliveira Saito and Luci Harue Fatori

In this work we considered the Timoshenko system with an indefinite damping mechanism in the vertical displacement, i.e., a damping function $a(x)$ that might change sign. More specifically

$$\begin{aligned} \rho_1\varphi_{tt} - k(\varphi_x + \psi)_x + a(x)\varphi_t = 0, \text{ in } (0, L) \times (0, \infty); \\ \rho_2\psi_{tt} - b\psi_{xx} + k(\varphi_x + \psi) = 0, \text{ in } (0, L) \times (0, \infty); \end{aligned} \tag{1}$$

with positive constants ρ_1, k, ρ_2, b together with initial conditions

$$\begin{aligned} \varphi(x, 0) = \varphi_0, \quad \varphi_t(x, 0) = \varphi_1, \\ \psi(x, 0) = \psi_0, \quad \psi_t(x, 0) = \psi_1; \end{aligned} \tag{2}$$

and boundary conditions

$$\varphi(0, t) = \varphi(L, t) = \psi_x(0, t) = \psi_x(L, t) = 0, \quad \forall t \geq 0. \tag{3}$$

We showed that this system has an exponentially stable solution provided the wave speeds are the same, $\bar{a} = \int_0^L a(x)dx \geq 0$ and $||a - \bar{a}|| \leq \epsilon$ for ϵ small enough.

Acknowledgements: We would like to thank CAPES by financial support.

References

[1] J.E. Muñoz Rivera, R. Racke, *Timoshenko systems with indefinite damping*, Journal of Mathematical Analysis and Applications, 1068-1083, 2008.
[2] D.S. Almeida Junior, M.L.Santos, J.E. Muñoz Rivera, *Stability to weakely dissipative Timoshenko systems*, Mathematical Methods in the Applied Sciences, 1965-1976, 2013.
[3] J.E. Muñoz Rivera, R. Racke, *Exponential stability for wave equations with nondissipative damping*, Nonlinear Analysis 68, 2531-2551, 2008.

(Taís Saito) PGMAC-UEL
E-mail address: taissaito@hotmail.com

(Luci Harue Fatori) PGMAC-UEL
E-mail address: lucifatori@uel.br