



**WebJME - Webinário de Jovens Pesquisadores
em Matemática Pura, Aplicada e Estatística**

Um prelúdio ao IV CBJME 2021

Títulos e resumos

<http://mat.ufpb.br/jovens/>

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Títulos e resumos

Sessão: Graduações e Identidades Polinomiais em Álgebras

Palestrante: Manuela da Silva Souza (UFBA)

Título: Gradings, graded polynomial identities and Specht property

Resumo: In this talk we speak about gradings, graded polynomial identities and Specht property for non associative algebras, especially for Jordan algebras.

Sessão: Loops e álgebras

Palestrante: Maria Eugênia Martin (UFPR)

Título: Sobre a rigidez das Álgebras de Jordan nilpotentes

Resumo: Nossa intenção é obter uma componente irredutível de uma variedade de álgebras de Jordan que seja o fecho de Zariski de uma união infinita de órbitas de álgebras, nenhuma delas sendo rígidas. É conhecido que, até dimensão quatro, toda componente de uma tal variedade é dominada por uma álgebra rígida. O contraexemplo surgiu ao estudar a variedade das álgebras de Jordan nilpotentes de dimensão 5.

Como ganho colateral desse estudo, pretendemos confirmar um análogo à Conjectura de Vergne, aberta desde 1970, formulado para o caso de álgebras de Jordan nilpotentes de dimensão menor ou igual a 5, isto é: não existem álgebras de Jordan nilpotentes rígidas na variedade das álgebras de Jordan de dimensão n , para $n \leq 5$.

Sessão: Representações de álgebras

Palestrante: Lucas Calixto (UFMG)

Título: Weyl modules and fusion products for current superalgebras

Resumo: We study a class of modules, called Chari-Venkatesh modules, for the current superalgebra $\mathfrak{sl}(1|2)[t]$. This class contains other important modules, such as graded local Weyl, truncated local Weyl and Demazure-type modules. We prove that Chari-Venkatesh modules can be realized as fusion products of generalized Kac modules. In particular, this proves a conjecture, that fusion products are independent of their fusion parameters, in the case where the fusion factors are generalized Kac modules. As an application, we obtain bases, dimension and character formulas for Chari-Venkatesh modules. Joint work with M. Brito and T. Macedo.

Sessão: Jovens perspectivas em Geometria Algébrica e Álgebra Comutativa

Palestrante: Gaia Comaschi (UNICAMP)

Título: The GIT moduli space of Pfaffian representations of cubic threefolds

Resumo: Given a 5-dimensional vector space V and a cubic form $F \in S^3(V^*)$, it is always possible to find a 6×6 skew-symmetric matrix of linear forms $M \in \mathbb{P}(V^* \otimes \wedge^2 \mathbb{C}^6)$ such that $\text{Pf}(M) = F$. We can thus construct the moduli space \mathfrak{P} of Pfaffian representations of cubic threefolds: this is the projective scheme obtained as the GIT quotient $\mathfrak{P} = \mathbb{P}(V^* \otimes \wedge^2 \mathbb{C}^6) // SL(6, \mathbb{C})$. In this talk I will present the

construction, together with some geometric properties, of \mathfrak{P} and I will illustrate how this scheme relates to moduli spaces of sheaves on cubic threefolds.

Sessão: Análise Funcional, Espaços de Banach e Aplicações

Palestrante: Elisa dos Santos (UFU)

Título: Daugavet equation for bounded functions

Resumo: In 1963, I. K. Daugavet proved that every compact linear operator from $C[0, 1]$ into $C[0, 1]$ satisfies a norm identity. After that, several authors have shown that various classes of linear operators on different Banach spaces satisfy such identity, which has become known as the Daugavet equation. Recently, the study of the Daugavet equation was extended in several ways: replacing the identity operator by a general operator, replacing the linear operators by bounded functions, and combining both ideas. Nowadays, the investigation of the Daugavet equation related problems is a fruitful area of Functional Analysis. In this talk, we will present some recent results about the Daugavet equation for bounded functions.

Sessão: Dinâmica dos Fluidos: Aspectos Teóricos e Computacionais

Palestrante: Anne Caroline Bronzi (UNICAMP)

Título: Solução fraca das equações de Euler incompressíveis com simetria helicoidal

Resumo: A existência global de solução fraca para as equações de Euler incompressíveis em dimensão três com vorticidade inicial com alguma regularidade é um importante problema em aberto. Em alguns casos específicos, ao se impor que o escoamento preserva alguma simetria, o problema pode tornar-se analiticamente tratável. Este é caso das simetrias planar e axial, em que diversos resultados de existência global de solução fraca são conhecidos. Uma outra simetria que começou a ser estudada mais recentemente é a simetria helicoidal, em que o escoamento é invariante por rotações e translações simultâneas em relação a um eixo de simetria. Apesar de muito presente na natureza, há pouca literatura matemática sobre escoamentos helicoidais, muito devido à sua estrutura mais complexa. Nesta palestra, abordaremos o problema de existência global de escoamentos helicoidais incompressíveis com vorticidade inicial em espaços de Orlicz. Este trabalho está sendo desenvolvido em colaboração com Helena Nussenzweig Lopes (UFRJ) e Milton Lopes Filho (UFRJ).

Sessão: Equações Diferenciais Lineares: problemas de regularidade e resolubilidade

Palestrante: Renata de Oliveira Figueira (UFSCar)

Título: The Cauchy problem for shallow water equations with analytic initial data

Resumo: We shall consider the Cauchy problem for two equations the "good" Boussinesq equation and the modified Korteweg-deVries equation with higher dispersion, which were introduced as a model for the "Great Wave of Translation" that John Scott Russel observed in 1834.

For both equations, we shall prove that its Cauchy problem are well-posed in a class of analytic functions that can be extended holomorphically in a symmetric strip of the complex plane around the x-axis. Also, we will discuss the time regularity of the solutions obtained.

This work is in collaboration with Rafael Barostichi and Alex Himonas.

Sessão: Progressos recentes em equações elípticas e suas aplicações

Palestrante: Pêdra Andrade (PUC-Rio and CIMAT-MX)

Título: Regularity theory for degenerate diffusion equations

Resumo: In this talk I will discuss regularity estimates for viscosity solutions to degenerate elliptic PDE with an arbitrary degree of degeneracy on the gradient argument, $\sigma(Du)F(D^2u) = f(x)$. We show bounded viscosity solutions are locally Hölder continuous. We further investigate minimal conditions on the degree of degeneracy σ under which 1 viscosity solutions become of class C . We develop new methods based on a technique tailored to prevent the sequence of degeneracy laws constructed through the process from being, itself, degenerate. This is joint work with Daniel Pellegrino, Edgard Pimentel, and Eduardo Teixeira.

Sessão: Tendências modernas em análise

Palestrante: Lucas Oliveira (UFRGS)

Título: Do (sharp) Fourier Restriction Inequalities Dream with Gaussian Extremizers?

Resumo: In this talk we will discuss some recent advances about sharp versions of Fourier Restriction Inequalities, giving special attention to the Strichartz inequalities (the adjoint Fourier restriction inequalities), and formulating some questions and results trying to pointing out when Gaussians are extremizers of such inequalities.

Sessão: Recent trends in nonlinear analysis and applications

Palestrante: Juliana Fernandes (UFRJ)

Título: Bubble solutions for semilinear elliptic equations

Resumo: In this talk we address positive solutions of semilinear elliptic equations with exponents near to critical values. The aim is to get the existence of a solution whose shape resembles a superposition of bubbles around the origin with different blow-up orders. This class of concentration phenomena is known as bubble-tower. This is a joint work with Monica Musso.

Sessão: Análise Geométrica

Palestrante: Rayssa Helena Aires de Lima Caju (University of Chicago and UFPB)

Título: The Allen-Cahn equation in the sphere: geometric and variational properties

Resumo: The Allen-Cahn equation establishes an important connection between the theory of minimal surfaces and PDEs. In particular, the characterization of solutions of this equation has been a subject of intense interest in the past few decades. One of the most well known problems related to this subject is the *De Giorgi's conjecture* which states that the only bounded monotone solutions to Allen-Cahn equation in \mathbb{R}^n are one-dimensional. Our main purpose in this talk is to characterize unstable solutions of least energy of the Allen-Cahn equation in the entire sphere \mathbb{S}^n . We prove that the ground state solutions are radially symmetric. Moreover they are unique up to rotations and correspond to the equator as a minimal hypersurface. Such information is useful in the study of the first critical values of a min-max sequence for the associated energy and a bifurcation problem.

Joint work with Pedro Gaspar, Marco Guaraco and Henrik Matthiesen.

Sessão: Geometria das Subvariedades

Palestrante: Adriana Araújo Cintra (UFJ)

Título: Minimal surfaces in Lorentzian Heisenberg group and Damek-Ricci spaces via the Weierstrass representation

Resumo: Damek-Ricci spaces are semidirect products of Heisenberg groups with the real line. They were considered in [3] (see also [2]), equipped with a left-invariant Riemannian metric, to give a negative answer, in high dimensions, to the question posed by Lichnerowicz: “is a harmonic Riemannian manifold necessarily a symmetric space?” In [5] the authors give a Weierstrass representation theorem for minimal surfaces in Riemannian manifolds. In [4] this representation has been extended for timelike and spacelike minimal surfaces in 3-dimensional Lorentzian manifolds. The results can be easily extended to the case of minimal surfaces in Lorentzian manifolds of higher dimension. In the paper [1] we discuss a Weierstrass type representation for minimal surfaces in the 3-dimensional Heisenberg group and in the 4-dimensional Damek-Ricci spaces, endowed with left invariant Riemannian or Lorentzian metrics. For the case of spacelike surfaces we employ the complex analysis, and for timelike surfaces our approach makes use of the paracomplex analysis. Then, we exhibit various examples of spacelike and timelike minimal surfaces in these spaces.

References

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[3] E. Damek, F. Ricci. A class of nonsymmetric harmonic Riemannian spaces, *Bull. Amer. Math. Soc.* 27 (1992), 139-142.

[4] J.H. Lira, M. Melo, F. Mercuri. A Weierstrass representation for minimal surfaces in 3-dimensional manifolds, *Results. Math.* 60 (2011), 311-323.

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Sessão: Lorentzian Geometry and its applications

Palestrante: Valter Borges Sampaio Júnior (UFPA)

Título: Ricci Almost Solitons on semi-Riemannian Manifolds

Resumo: In this talk we introduce Ricci almost solitons on semi-Riemannian manifolds. We also intend to show additional properties on its geometry which lead to classification of manifolds carrying such a structure. Particular attention is given to warped product manifolds, where we show

local characterization. As a consequence of this characterization we prove the existence of conformal vector fields on the base, the fiber and on the warped product. Most of the results present in this talk were obtained in collaboration with Prof. Ketil Tenenblat - UnB.

Sessão: Singularidade e folheações

Palestrante: José Edson Sampaio (UFC)

Título: A version of Mumford's Theorem on regularity of normal complex surfaces in any dimension

Resumo: In 1961, D. Mumford proved that a normal complex analytic surface X with simply connected link at o must be smooth at o . In the case that $X \subset \mathbb{C}^3$ is a complex surface with an isolated singularity at o , Mumford's result is equivalent to say that X is smooth at o if and only if X is a topological manifold at o . However, this result does not hold true if $\dim X > 2$. In this talk, we prove a version of Mumford's result in high dimension. More precisely, we prove that the following: Let $X \subset \mathbb{C}^n$ be a complex analytic set of dimension $k > 1$ which is Lipschitz normally embedded (LNE) at o . If X has simply connected link at o then the following conditions are mutually equivalent:

1. X is $2k$ -homology manifold and locally linearly contractible at o ;
2. X has no choking cycles at o and its link at o has trivial i -th integral homology group for all $2 \leq i \leq 2k - 2$;
3. The link of the tangent cone of X at o has trivial i -th integral homology group for all $2 \leq i \leq 2k - 2$;
4. X is smooth at o .

In particular, if any of the above items holds true, we obtain that $X_t := \frac{1}{t}X \cap \mathbb{S}^{2n-1}$ is diffeomorphic to \mathbb{S}^{2k-1} for all small enough $t > 0$. No restriction on the dimension or codimension and no restriction on the singularity to be isolated is needed. In order to know, a set $X \subset \mathbb{R}^n$ is called LNE at $p \in \mathbb{R}^n$ if there exist an open neighbourhood $U \subset \mathbb{R}^n$ of p and $C \geq 1$ such that $d_{X \cap U}(x, y) \leq C\|x - y\|$ for all $x, y \in X \cap U$, where $d_{X \cap U}$ denotes the inner distance of $X \cap U$.

Sessão: Mecânica celeste: do simplético ao satélite

Palestrante: Anete Soares Cavalcanti (UFRPE)

Título: An Existence Proof of a Symmetric Periodic Orbit in the Octahedral Six-Body Problem

Abstract: The Variational Methods applied to the n -body Newtonian problem allows to prove the existence of periodic orbits, in most cases with some symmetry. It was exploited by the Italian school in the 1990's (Coti-Zelati, Degiovanni-Gianonni-Marino, Serre-Terracini). They gave new periodic solutions for a mechanical systems with potentials satisfying a hypothesis called strong force, which excludes the Newtonian potential. The strong force hypothesis was introduced by Poincaré. In this work we proved a variational existence proof of a periodic orbit in the octahedral six-body problem with equal masses. Next we explain the main ideas of the proof.

Sessão: Otimização Contínua I

Palestrante: Geovani Nunes Grapiglia (UFPR)

Título: On the Complexity of an Augmented Lagrangian Method for Nonconvex Optimization

Resumo: In this work we study the worst-case complexity of an inexact Augmented Lagrangian method for nonconvex constrained problems. Assuming that the penalty parameters are bounded, we prove a complexity of bound of $O(|\log(\varepsilon)|)$ outer iterations for the referred algorithm to generate an ε -approximate KKT point, for $\varepsilon \in (0, 1)$. When the penalty parameters are unbounded, we prove an outer iteration complexity bound of $O(\varepsilon^{-2/(\alpha-1)})$, where $\alpha > 1$ controls the rate of increase of the penalty parameters. For linearly constrained problems, these bounds allow us to obtain bounds for the total number of calls of the oracle, when appropriate p-order unconstrained methods are used as inner solvers.

Sessão: **Otimização Contínua II**

Palestrante: Jefferson Divino Gonçalves de Melo (UFG)

Título: Iteration-Complexity of an Inexact Proximal Augmented Lagrangian Method for Solving Constrained Composite Optimization Problems

Resumo: In this talk, we will analyze the iteration-complexity of an inexact proximal augmented Lagrangian method for solving constrained (nonconvex) composite optimization problems. Each iteration of the proposed method consists of inexactly solving a proximal augmented Lagrangian subproblem by an accelerated composite gradient (ACG) algorithm followed by a suitable Lagrange multiplier update. It is shown that the proposed method generates an approximate stationary solution in at most $O(\log(1/p)/p^3)$ ACG iterations, where $p > 0$ is the given tolerance. It is also shown that the previous complexity bound can be sharpened to $O(\log(1/p)/p^{2.5})$ under additional mildly stronger assumptions. The above bounds are derived assuming that the initial point is neither feasible nor the domain of the composite term of the objective function is bounded. Some preliminary numerical results are presented to illustrate the performance of the proposed method.

Sessão: **Probabilidade e Processos Estocásticos**

Palestrante: Tertuliano Franco (UFBA)

Título: The slow bond effect: dynamical phase transition in scaling limits of interacting particle systems

Resumo: A curious phenomena that has inspired many works in the late years can be resumed as follows: the presence of a slow bond in a interacting random particle system may lead to different macroscopic behaviours depending on the strength of that slow bond. In this talk we will review some recent results and discuss intuitions behind them as well as some open problems.

Sessão: **Estatística e aprendizagem de máquinas**

Palestrante: Daiane Aparecida Zuanetti (UFSCar)

Título: Bayesian modeling for epistasis analysis using data-driven reversible jump

Resumo: We propose a procedure for modeling a phenotype using QTLs which estimate the additive and dominance effects of genotypes and epistasis. The estimation of the model is implemented through a Bayesian approach which uses the data-driven reversible jump (DDRJ) for multiple QTL mapping and model selection. We compare the DDRJ's performance with the usual reversible jump (R), QTLBim, multiple interval mapping (MIM) and LASSO using real and simulated data sets. The

DDRJ outperforms the available methods to estimate the number of QTLs in epistatic models and it identifies their locations in the genome, without increasing the number of false-positive QTLs in the considered data. Since QTL mapping is a regression model involving complex non-observable variables and their interactions, the model selection procedure proposed here is also useful in other areas of research.