

VI INTERNATIONAL **MEETING** ON MATHEMATICAL SCIENCES

December 10-12, 2024
Ayacucho - Perú

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In Memory of:

Carlos Teobaldo Gutierrez Vidalon

Distinguished mathematician

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VI Encuentro Internacional en Ciencias Matemáticas

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Presentación

El Encuentro Internacional en Ciencias Matemáticas (IMMS, por sus siglas en inglés) es un evento académico, que se lleva a cabo desde el año 2018, y congrega a importantes investigadores de diferentes países, dando a conocer sus investigaciones y a la vez motivando a estudiantes y profesores a seguir o iniciar trabajos conjuntos que lleven al progreso de la matemática.

Esta sexta edición el IMMS se llevará a cabo en la Universidad Nacional San Cristóbal de Huamanga, Ayacucho, Perú, del 10 al 12 de diciembre de 2024.

El evento está dedicado a la memoria del matemático peruano Carlos Teobaldo Gutiérrez Vidalón, reconocido investigador, nacido en Ayacucho, quien trabajó en el IMPA y en el ICMC de la USP de São Carlos, Brasil.

En esta edición participarán investigadores peruanos y extranjeros que compartirán sus trabajos a través de plenarias, conferencias y presentaciones orales.

El VI IMMS cubre una amplia gama de temas dentro de las matemáticas distribuidos entre las cuatro áreas principales de las matemáticas: Álgebra, Análisis, Geometría y Topología y Matemática Aplicada.

Estamos seguros que, al igual que los eventos anteriores, será del agrado y de mucho provecho académico para todos los participantes. A la vez que agradecemos desde ya la colaboración académica de todos los ponentes, por difundir sus investigaciones.

Ayacucho - Perú, Diciembre del 2024.

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Plenarias

El profesor Carlos Gutierrez (1944–2008)

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Resumen

La presentación tratará sobre Carlos Teobaldo Gutiérrez Vidalón: el Profesor de Matemáticas en la Enseñanza Secundaria, nacido en Ayacucho y egresado de la Universidad Nacional de Educación Enrique Guzmán y Valle (UNE) Perú; quien no solo ejerció la docencia en el mismo colegio donde cursó la secundaria, sino también desarrolló una fructífera actividad académica en importantes centros de investigación en Matemáticas; como el IMPA en Brasil, el ICMC de la Universidad de São Paulo en Brasil e importantes universidades en EUA. Fue miembro titular de la academia Brasileña de ciencias (1996) e incorporado a la Orden Nacional del Mérito Científico, presidente de la República (2002). En su homenaje desde el 2009 el ICMC y la Sociedad Brasileña de Matemáticas (SBM) han creado el «premio Gutiérrez» otorgado anualmente a la mejor Tesis Doctoral en Matemáticas.

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Cross ratio and Schwarzian derivatives: From high school to research in Mathematics

Ali Tahzibi * 1

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Abstract

In this talk we try to make a friendly introduction to cross ratio and Schwarzian derivative. The plan is to begin from a project that we realize in high schools and arrive to a research result in smooth ergodic theory.

References

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Discrete group actions: Geometry and dynamics.

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Abstract

At the end of the 19th Century, H. Poincaré studied discrete groups of Möbius transformations acting on the Riemann sphere that sprang from his study of differential equations. These can all be constructed by the very elementary geometric operations of reflections and inversions in circles, and one finds extreme beauty. He called these Kleinian groups, and their study has been for decades the paradigm of complex geometry and holomorphic dynamics, being a source of inspiration for the study of fractal geometry, chaos and Julia sets of rational maps. In this talk we shall review some basic facts about such group actions, and a generalization of these to several complex variables.

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On the existence of holomorphic foliations on Hopf manifolds

*Andrés Beltran*¹, *Arturo Fernández-Pérez*², *Hernán Neciosup*³

Abstract: In this paper, we investigate the problem of the existence of holomorphic foliations on 3-dimensional Hopf manifolds, with a particular focus on exceptional type manifolds. Hopf manifolds, being compact, non-Kähler complex manifolds, provide a fertile ground for the analysis of non-trivial phenomena in the study of holomorphic foliations. In particular, these manifolds exhibit geometric structures that allow for the emergence of complex dynamical behaviors, making them a case of special interest.

Keywords: Hopf manifold, foliations, biholomorphic transformations.

Sobre la existencia de foliaciones holomorfas en variedades de Hopf

Resumen: En este artículo, investigamos el problema de la existencia de foliaciones holomorfas en variedades de Hopf de dimensión 3, con un enfoque particular en las variedades de tipo excepcional. Las variedades de Hopf, al ser variedades complejas compactas no-Kähler, proporcionan un terreno fértil para el análisis de fenómenos no triviales en el estudio de foliaciones holomorfas. En particular, estas variedades exhiben estructuras geométricas que permiten la aparición de comportamientos dinámicos complejos, lo que las convierte en un caso de especial interés.

Keywords: Variedades de Hopf, foliaciones, transformaciones biholomorfas.

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El primer autor agradece el apoyo financiero por la Dirección de Gestión de la Investigación de la PUCP a través de la subvención GDI 2017-1-0061

5. Conclusion

In this work, we have addressed the problem of the existence of holomorphic foliations on 3-dimensional Hopf varieties, with a particular focus on those of exceptional type.

We have demonstrated that holomorphic foliations exist in a specific case of exceptional Hopf varieties in 3 dimensions. However, these results do not fully resolve the problem, as several open cases still require more detailed investigation. In particular, future research should aim to achieve a complete classification of foliations on these varieties and explore the relationship between the geometric and dynamic properties of the foliations and the underlying complex structures of Hopf varieties.

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On the existence of a BV solution for an equation involving the mean curvature operator

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Abstract

We prove the existence of a bounded variation solution for a quasilinear elliptic problem involving the mean curvature operator and a sublinear nonlinearity. We obtain such solution as the limit of the solutions of another quasilinear elliptic problem involving a parameter $p > 1$ as $p \rightarrow 1^+$. The analysis requires estimates independent on p , as well as a precise version of the Euler-Lagrange equation satisfied by the solution.

This is a joint work with Prof. Marcelo Montenegro, from IMECC-UNICAMP.

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Critical points of functionals at prescribed energy

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Abstract

We discuss the existence of critical points for a family of abstract and smooth functionals on Banach spaces under the energy constraint. In other words, for a family of functionals $\Phi_\mu : X \rightarrow \mathbb{R}$, given $c \in \mathbb{R}$, we look for solutions $(u, \mu) \in X \times \mathbb{R}$ of the system

$$\begin{cases} \Phi_\mu(u) = c \\ \Phi'_\mu(u) = 0. \end{cases}$$

By means of the Ljusternick-Schnirelmann theory we show, under suitable assumptions, multiplicity results. The abstract framework is then applied to some partial differential equations depending on a parameter for which we obtain multiple solutions as well as some bifurcation results.

The results are contained in a joint work with Kaye Silva (Universidade Federal de Goiás, BR) and Humberto R. Quoirin (Universidad Nacional de Córdoba, AG).

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Conferencias

Una desigualdad tipo Dimca - Greuel para foliaciones

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Abstract

Sea $\mathcal{F}$ una foliación holomorfa en $p \in \mathbb{C}^2$, y B una separatriz de $\mathcal{F}$. Bajo ciertas condiciones en la reducción de singularidades de $\mathcal{F}$ y B , demostramos la siguiente desigualdad tipo Dimca-Greuel $\frac{\mu_p(\mathcal{F}, B)}{\tau_p(\mathcal{F}, B)} < 4/3$, donde $\mu_p(\mathcal{F}, B)$ es la multiplicidad de $\mathcal{F}$ a lo largo de B y $\tau_p(\mathcal{F}, B)$ es la dimensión del cociente de $\mathbb{C}\{x, y\}$ por el ideal generado por las componentes de la 1-forma que define $\mathcal{F}$ y cualquier ecuación de B . En consecuencia, aportamos una nueva prueba de la conjetura $\frac{4}{3}$ -Dimca-Greuel para singularidades de gérmenes de curva plana irreducible, con ingredientes de foliaciones que difieren de las dadas por Alberich-Carramiñana, Almirón, Blanco, Melle-Hernández and Genzmer-Hernandes pero está en línea con la idea desarrollada por Wang.

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ON A NONLINEAR PROBLEM INVOLVING $p(u)$ –LAPLACIAN-TYPE OPERATORS WITH A NONLINEAR GRADIENT TERM

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Abstract

The purpose of this article is to obtain weak solutions for the nonlinear problems for $p(u)$ –Laplacian-like operators, originated from a capillary phenomena, with a nonlinearity which depends on the gradient. First, we solve a associated boundary-value local problem are given by using a singular perturbation technique and then we use the Schauder fixed-point theorem for obtain our result, in the framework of variable exponent Sobolev spaces.

1 Introduction

The main objective of this work is to look into the existence of weak solutions for the following local $p(u)$ -Laplacian problem

$$\begin{aligned} -\operatorname{div} \left(|\nabla u|^{p(u)-2} \nabla u + \frac{|\nabla u|^{2p(u)-2} \nabla u}{\sqrt{1 + |\nabla u|^{2p(u)}}} \right) &= f + g(u) |\nabla u|^{p(u)-1} && \text{in } \Omega, \\ u &= 0 && \text{on } \partial\Omega, \end{aligned} \quad (1)$$

where Ω is a bounded domain in $\mathbb{R}^n$ with a smooth boundary $\partial\Omega$, and $N \geq 2$, $p \in C(\overline{\Omega})$ for any $x \in \overline{\Omega}$; f is a given function and $g : \mathbb{R} \rightarrow \mathbb{R}$ is a bounded and continuous function that belongs to $L^1(\mathbb{R})$. The study of differential and partial differential equations with variable exponent has been received considerable attention in the last two decades, recently it was extended to the case when the exponent depend both on the space variable x and on the unknown solution u (see [1, 5]). Thus, the problem becomes local and more complicated. Problems of the type (1) can be presented as model for many physical applications, for instance mathematical image processing and computer vision (see [2, 6]). As far as we are aware, the authors have only studied problems with $p(x)$ -Laplacian-like operators, in the context of the study of capillarity phenomena (see [3, 4] and references therein).

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2 Notations and Main Results

We need some theorems on $W^{1,p(x)}(\Omega)$ which we call a variable exponent Sobolev space.

Let

$$p : \mathbb{R} \rightarrow [1, +\infty[\quad (2)$$

be the nonlinear exponent function. Set $C_+(\overline{\Omega}) = \{p(x) \in C(\overline{\Omega}) : p(x) > 1, \forall x \in \overline{\Omega}\}$; $p^+ = \max\{p(x); x \in C(\overline{\Omega})\}$, $p^- = \min\{p(x); x \in C(\overline{\Omega})\}$, $M(\Omega) = \{u : u \text{ is a real-valued measurable function on } \Omega\}$ and

$$L^{p(x)}(\Omega) = \{u \in M(\Omega) : \int_{\Omega} |u(x)|^{p(x)} dx < \infty\}.$$

We can introduce a norm on $L^{p(x)}(\Omega)$

$$|u|_{p(x)} = \inf\{\lambda > 0 : \int_{\Omega} |\frac{u(x)}{\lambda}|^{p(x)} dx \leq 1\}$$

and $(L^{p(x)}(\Omega), |\cdot|_{p(x)})$ becomes a Banach Space. The space $W^{1,p(x)}(\Omega)$ is defined by

$$W^{1,p(x)}(\Omega) = \{u \in L^{p(x)}(\Omega) : |\nabla u| \in L^{p(x)}(\Omega)\}$$

with the norm

$$\|u\|_{1,p(x)} = |u|_{p(x)} + |\nabla u|_{p(x)} \quad \forall u \in W^{1,p(x)}(\Omega).$$

We denote by $W_0^{1,p(x)}(\Omega)$ the closure of $C_0^\infty(\Omega)$ in $W^{1,p(x)}(\Omega)$. Of course the norm $\|u\| = |\nabla u|_{L^{p(x)}(\Omega)}$ is an equivalent norm to natural norm in $W_0^{1,p(x)}(\Omega)$.

Also, we have the space

$$W_0^{1,p(u)}(\Omega) = \{u \in W^{1,1}(\Omega) : \int_{\Omega} |\nabla u|^{p(u)} dx < \infty\} \quad \text{such that } 1 < p(u) < \infty \quad \text{for all } u \in \mathbb{R}$$

in which we will prove the existence of weak solutions for the local 'problem (1). It is a Banach space for the norm $\|u\|_{W_0^{1,p(u)}(\Omega)}$ when $p(u) \in C(\overline{\Omega})$. Since p is continuous, from a Sobolev embedding we have that $W_0^{1,p(u)}(\Omega)$ is separable and reflexive.

Theorem. Assume that

$$p : \mathbb{R} \rightarrow \mathbb{R} \quad \text{is a Lipschitz-continuous function}$$

and that $n < \alpha \leq p(u) \leq \beta < \infty \quad \forall u \in \mathbb{R}$. If $f \in W^{-1,\alpha'}(\Omega)$, then (1) has a weak solution in $u \in W_0^{1,p(u)}(\Omega)$.

Proof:

We apply using a singular perturbation technique combined with the theory of Sobolev spaces with exponent variables and the Schauder fixed-point theorem .

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Nonlinear Oscillator Behavior in Soliton Dynamics

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Abstract

In this talk, we examine the interaction of solitons with external forces in classical nonlinear partial differential equations, focusing on Korteweg-de Vries (KdV) type equations [1, 2, 3, 4], which model shallow water surface waves. External forces, which may be deterministic or stochastic, can represent physical disturbances such as wind stress on the water surface, spatially varying bathymetry, or localized pressure distributions. These forces introduce energy into the system and affect the soliton stability and trajectory. We investigate the phenomenon of trapped waves, which arises when the external force and soliton interact resonantly. In this regime, the soliton dynamics mirror those of a classical nonlinear oscillator, with its evolution described in the soliton-amplitude vs. soliton-phase space. For weak external forcing, we employ an adiabatic approximation (we assume that the soliton amplitude and phase change slowly over time), thus allowing for a reduction of the full partial differential equation to an effective two-dimensional dynamical system. This asymptotic reduction captures the essential features of soliton modulation, offering a simplified description of its long-term behavior. We compare the predictions of this reduced model with results from direct numerical simulations, discussing the primary differences and the regimes where the asymptotic theory is most accurate

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Ground state solutions for elliptic Kirchhoff–Boussinesq type problems with supercritical exponential growth

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Abstract

In this work, we are interested in studying the existence of a ground state solution for the problem

$$\Delta(w_\beta(x)\Delta u) \pm \operatorname{div}(w_\beta(x)|\nabla u|^{p-2}\nabla u) = f(x, u) \text{ in } B, \quad \text{and } u = \frac{\partial u}{\partial \nu} = 0 \text{ on } \partial B,$$

where B is the unit ball in $\mathbb{R}^4$, $w_\beta(x) = \left(\log \frac{e}{|x|}\right)^\beta$ or $w_\beta(x) = \left(\log\left(\frac{1}{|x|}\right)\right)^\beta$ for $\beta \in (0, 1)$, $2 < p < 4$ and $f : \mathbb{R} \rightarrow \mathbb{R}$ is a superlinear continuous class function with supercritical exponential growth. We utilize the Nehari manifold method to establish the existence result.

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Estability of the Energy for type III Thermo-porous- elastic System

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Abstract

In this talk, we will consider the porous elastic system

$$\begin{aligned} \rho\omega_{tt} - \mu\omega_{xx} - b\varphi_x + \beta_1\Theta_{tx} + a\omega_t &= 0 & \text{in } (0, 1) \times \mathbb{R}^+ \\ J\varphi_{tt} - \delta\varphi_{xx} + \beta_2\Theta_{tx} + \xi\varphi + b\omega_x &= 0 & \text{in } (0, 1) \times \mathbb{R}^+ \\ \alpha\Theta_{tt} - \sigma\Theta_{xx} + \beta_1\omega_{tx} + \beta_2\varphi_{tx} - \kappa\Theta_{txx} &= 0 & \text{in } (0, 1) \times \mathbb{R}^+. \end{aligned}$$

together with the boundary conditions

$$\omega(0, t) = \omega(1, t) = \varphi_x(0, t) = \varphi_x(1, t) = \Theta(0, t) = \Theta(1, t) = 0, \quad t \geq 0$$

and the initial conditions

$$\begin{cases} \omega(x, 0) = \omega_0(x), & \omega_t(x, 0) = \omega_1(x) & x \in (0, 1) \\ \varphi(x, 0) = \varphi_0(x), & \varphi_t(x, 0) = \varphi_1(x) & x \in (0, 1) \\ \Theta(x, 0) = \Theta_0(x), & \Theta_t(x, 0) = \Theta_1(x) & x \in (0, 1). \end{cases}$$

and, using Semigroup Theory, we will prove the existence of global solutions. Additionally, by using multipliers, we will demonstrate that their energy associated decays exponentially.

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Análisis de estabilidad para un modelo de convección turbulenta precipitante

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Abstract

La convección húmeda en la atmósfera tropical implica la interacción de nubes precipitantes profundas que pueden organizarse en diferentes patrones y propagarse a grandes distancias. Su modelización para predecir su evolución puede realizarse con modelos basados en EDP's, pero requiere la parametrización de distintos procesos microfísicos de las nubes. Los modelos simplificados pueden mantener un equilibrio entre complejidad y precisión, y seguir captando las observaciones cualitativas realizadas en la naturaleza. En este trabajo demostramos la existencia global y la unicidad de un modelo de convección turbulenta precipitante. El modelo considera una dinámica de humedad con cambios de fase. Asume una rápida autoconversión y evaporación de la lluvia junto con una aproximación de presión hidrostática. También se muestra la positividad de las variables asociadas a la humedad y a la temperatura potencial equivalente.

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Gluing-Orbit Property and Hypergluing

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Abstract

We will present recent work conducted jointly with Mayara Antunes, Bernardo Carvalho, Wellington Cordeiro. In this work, we investigate the consequences of the gluing-orbit (GO) property—introduced by Bomfim and Varandas in [2]—on local stable/unstable sets and how this property is inherited from the induced dynamics on the hyperspace.

More specifically, we show that the local stable/unstable sets of homeomorphisms on infinite metric spaces with the GO property contain compact and perfect subsets, as in [1]. Consequently, we prove that if a homeomorphism is positively countably expansive and has the GO property, then the space on which it is defined is a simple periodic orbit.

We also demonstrate that if the induced homeomorphism of a map on the hyperspace of compact subsets has the GO property, then the base map also has GO and is topologically mixing. The GO property, weaker than the specification property, implies topological transitivity but not necessarily mixing. Consequently, we show that there exist homeomorphisms with the GO property whose induced homeomorphism does not possess this property, in contrast with the properties of shadowing and specification.

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A Besov spaces approach and numerical insights to study a conservation law with partially nonlocal velocity

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Abstract

This work focuses on the analytical and numerical investigation of a novelty conservation law with partially non-local velocity. This law of conservation arose as an attempt to generalize a one-dimensional conservation law by adding a spatial dimension. Its main feature lies in the fact that its velocity field is defined through the composition of two partial non-local operators: the partial Riesz potential and the partial Hilbert transform. This conservation law with partially non-local velocity is

$$\begin{cases} \partial_t \theta \pm \nabla \cdot (\theta v) = 0, \text{ with } v = (\Lambda_1^{\alpha-1} \mathcal{H}_1 \theta, \Lambda_2^{\alpha-1} \mathcal{H}_2 \theta) \\ \theta(x, y, 0) = \theta_0(x, y), \end{cases}$$

where $\theta : \mathbb{R}^2 \times [0, \infty) \longrightarrow \mathbb{R}$ is a scalar function, the initial data $\theta_0(x, y)$ is not necessarily regular; moreover $\mathcal{H}_i$ and $\Lambda_i^{\alpha-1}$, with $i = 1, 2$, are the nonlinear and nonlocal operators, the partial Hilbert transform and the partial Riesz potential, respectively.

In the analytical study, we obtain the well-posedness this conservation law with partially nonlocal velocity within the framework of classical Besov spaces. On the other hand, for the numerical investigation, we employ approximations for the nonlocal operators present in this conservation law with partially nonlocal velocity and formulate the 2D fully-discrete Lagrangian-Eulerian method. Therefore, from a computational standpoint, we provide numerical evidence for the theoretical aspects and conduct a numerical investigation into the criteria governing attenuation of regularization type, the formation of singularities, and the emergence of abrupt gradients in solutions for this conservation law with partially nonlocal velocity.

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Estructura gradiente para un sistema Bresse no lineal a partir de una nueva propiedad de continuación única

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Abstract

Esta charla está dedicada a mostrar una nueva propiedad de continuación única para un sistema de ondas Riemannianas acopladas con una aplicación significativa a los modelos de Bresse no lineales que presentan factores de disipación localizados en el interior de la viga. En particular se probará la estructura gradiente para estos sistemas, destacando sus implicaciones y relevancia teórica.

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Familias de grafos araña elegantes

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Resumen

Un árbol se denomina araña si posee, como máximo, un vértice con grado mayor que dos. En este trabajo, desarrollamos y analizamos etiquetas específicas para ciertas familias de grafos de araña, construidas a partir de grafos camino con propiedades elegantes y etiquetas concretas. Esto permite establecer una correspondencia entre ciertos caminos elegantes y arañas elegantes, relación que se detalla mediante un algoritmo presentado en los preliminares. Finalmente, obtenemos todas las familias de arañas elegantes derivadas de grafos camino elegantes.

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Remarks on a formula of Ramanujan

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Abstract

In this talk, we will discuss a well-known formula of Ramanujan and its relationship with the partial sums of the Möbius function. Under some conjectures, we analyze a finer structure of the involved terms. It is a joint work with Steven M. Gonek (University of Rochester).

References

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Comunicaciones Orales

Desenredando los Racks

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Abstract

Los racks son estructuras algebraicas que, a primera vista, parecen simples conjuntos con una operación binaria. Sin embargo, bajo esta aparente simplicidad se esconde una rica teoría con conexiones sorprendentes en diversas áreas de la matemática. Esta charla se propone introducir el concepto de rack y su relación con la teoría de nudos y la clasificación de álgebras de Hopf.

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Una invitación a la Estabilidad Homológica

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Resumen

La estabilidad homológica ha demostrado ser una herramienta poderosa para el cálculo de la homología de grupos, como en los grupos lineales generales, los grupos de clases de mapeo o los automorfismos de grupos libres. La estabilidad de $GL(n)$ es fundamental para el cálculo de los K –grupos de orden superior de anillos. La estabilidad homológica tiene aplicaciones en teoría de representación, geometría algebraica y otras áreas. En esta charla, daremos una introducción a la estabilidad homológica y discutiremos algunas de sus aplicaciones, enfocándonos en la K –teoría algebraica.

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Modelado de Ritmos Circadianos mediante Series de Fourier: Análisis de Patrones Temporales con el Núcleo de Dirichlet

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Abstract

Los ritmos circadianos son ciclos biológicos que se repiten cada 24 horas y regulan procesos fisiológicos esenciales como el sueño, la temperatura corporal y la secreción hormonal. Este estudio aborda el análisis matemático de dichos ritmos mediante el uso de series de Fourier y el núcleo de Dirichlet, con el objetivo de identificar las frecuencias predominantes en señales biológicas periódicas y comprender el impacto de perturbaciones externas en estos ciclos. El método consiste en modelar datos biológicos como funciones periódicas y aplicar la serie de Fourier truncada, acompañada de una convolución con el núcleo de Dirichlet, para analizar patrones temporales. Los resultados obtenidos muestran que esta técnica permite descomponer señales complejas y detectar variaciones significativas en los ritmos circadianos, facilitando la interpretación de datos experimentales. Concluimos que el enfoque propuesto es una herramienta eficaz para estudiar la dinámica de procesos biológicos periódicos, contribuyendo al entendimiento de trastornos del sueño y cronobiología, con posibles extensiones a otros sistemas fisiológicos, como la actividad cardíaca y cerebral. Este enfoque matemático tiene aplicaciones relevantes en biología y medicina, proporcionando información valiosa para investigaciones futuras.

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Use of Unrestricted Minimization of a Spectral Function to Estimate the Visible Zone in Matlab 19.0

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Abstract

Due to the simplicity and wide applicability, unrestricted minimization in the visible zone (Vis) is an important tool to solve many optimization problems of parameters and operating conditions of photovoltaic systems. The purpose of this work is to use unrestricted minimization of a simplified objective function ξ to estimate the Vis zone. We used a quantitative method and a documentary technique, analyzing a sample of 34 Vis experimental data from the Heredia University station. The parametric method was applied by means of the Matlab 19.0 Software, specifically through the minimization of a mathematical model employing the basic algorithm with Armijo correction using backtracking. The result obtained is a feasible optimizer of ξ in 33 iterations, which determined a transfer model of the Vis zone of aerosol turbidity (β) 3.69×10^{-2} and ozone layer (l) 57.40×10^{-2} cm with statistical parameters of uncertainty 0.132%, 2.066% for the relative mean bias error (rMBE) and relative root mean square error (rRMSE) respectively. It is concluded that the atmosphere of the Heredia University presents a cloudy alternating white sky without an ozone hole.

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Reformulations of the Riemann Hypothesis based on the Nyman-Beurling criterion

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Abstract

Based on the Nyman-Beurling criterion, the Riemann Hypothesis can be reformulated as a problem of functional analysis. We will present the approach of J. Alcántara, B. Bagchi, B. Duarte and J. Yang.

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Estudio de la dinámica a largo plazo de un modelo SIR no autónomo con difusión espacial y migración no controlada

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Abstract

The presentation will present the progress of a graduate thesis project. The SIR model for infectious disease transmission, which was introduced by Kermack and McKendrick [8] in 1927, is one of the fundamental models of mathematical epidemiology (see [1, 2, 9] among others). Its classical form involves a system of autonomous ordinary differential equations for three classes; the susceptible S , infected I and recovered R , from a constant total population. Most works have focused on the persistence and extinction of the disease, the existence of the threshold value for which the infectious disease will grow or disappear, the local and global stability of the endemic and disease-free equilibria, and the existence of periodic solutions.

Our research aims to study the long-term dynamics for a non-autonomous SIR epidemiological model with spatial diffusion over a bounded domain of $\mathbb{R}^3$, when uncontrolled migration is considered under a false positive phenomenon. In particular, the evolution of the system when it is disease-free will be studied, considering non-autonomous equilibrium solutions on the total population.

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Local geometric study of the transport equation

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Abstract

In this paper we use the method of characteristics because is a very important tool for determining the integral surface locally of an initial value problem involving the one-dimensional transport equation. Also we study the uniqueness of the solution and the geometric properties of the initial curve and characteristic curves. From the research it is concluded that in order to have unique local solutions, $a(x, t)$ must be a Lipschitz function and satisfy the transversality condition. Additionally, we can say that the initial and characteristic curves are plane curves for $a(x, t) = m(x)n(t); (x, t) \in \omega$.
tequation

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Qualitative Study of the Lorenz Equation

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Abstract

The objective of this research was the qualitative analysis of the Lorenz equation and the visualization of the solution curves. For this purpose, the equilibrium points of the Lorenz system and the type of stability of these points for different values of the parameters were determined using Linearization Analysis, the Liapunov Direct Method and the Krasovski Method; in addition, a program was developed to graph the solution curves. It was concluded that the origin is always an equilibrium point, when the Rayleigh number is greater than one there are two other equilibrium points; the origin is asymptotically stable when this number is less than one and unstable when it is greater than one, the other two equilibrium points are asymptotically stable when the Rayleigh number verifies a certain inequality; on the other hand, if there exists a neighborhood of the origin whose points verify a system of two inequalities, then the origin is asymptotically stable; finally, when the Prandtl number, the proportionality constant and the Rayleigh number are equal to 10, 28 and $8/3$, respectively, then the graph of the curve has a complex but not chaotic behavior.

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