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Faculty of Mathematics and Computer Science, Ovidius University of Constanţa

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Analysis, PDEs & Applied Mathematics
– List of abstracts –

Feedback Control for a SDE

Stefana Anita

IMOM & IMAR

Abstract: We investigate the relationship between a stochastic optimal control problem with feedback input and a deterministic optimal control problem with open-loop control and related to a Kolmogorov equation.

Despre transformata Hilbert biliniara maximal modulata

Cristina Benea

Université de Nantes

Abstract: Introducem o noua clasa de operatori biliniari care prezinta in acelasi timp trasaturi caracteristice transformatei Hilbert biliniare (invarianta la modulatii) si operatorilor de tip Carleson-Stein-Wainger (nucleu singular, modulat de o faza polinomiala). Cele doua comportamente contradictorii conduc la o analiza bazata pe doua rezolutii si un portret timp-frecventa dilatat. Colaborare cu F. Bernicot, V. Lie, M. Vitturi.

h-transform of Doob and nonlocal branching processes

Ana Maria Boeangiu

IMAR

Abstract: We study the h-transform of Doob for nonlocal branching processes, we show that the branching property is preserved provided that h is a coherent state and we emphasize the probabilistic representation of the solution to the associated nonlinear evolution equation. The tools are from the analytic and probabilistic potential theory. The talk is based on a joint work with Lucian Beznea and Oana Lupascu-Stamate.

Comparing epidemiological models with the help of visualization dashboards

Olteàn-Péter Boròka

Sapientia Hungarian University of Transylvania

`-- Talk Cancelled --`

Abstract: In 2020 due to the SARS-nCoV-2 there appeared varied epidemiological models in major studies, which differ on complexity, on type, etc.. In accordance with the hypothesis, a complex model, which takes into consideration more parameters, is more accurate and gives more reliable results than a simpler one.

In this paper we study three different epidemiological models, a SIR, a SEIR and a SEIR-type model. Our aim is to set up differential equation models, which take into consideration same parameters, however the systems of equation and number of parameters deviate from each other. From this study a visualization dashboard is implemented, and with it we are able not only to study the models but also to make users understand the differences between complexity of epidemiological models, and ultimately, to share a more specific overview about them which are defined by differential equations.

In order to validate our results, we make a comparison between the three models and the empirical data from East-Italy and Wuhan, based on the infectious cases resultant COVID-19 disease. To validate our results we calculate the parameters values with help of the Truncated Newton optimization algorithm.

A GDM-based regularization algorithm for the Cauchy problem in anisotropic heat conduction

Mihai Bucataru

Universitatea din Bucuresti & Institute of Mathematical Statistics and Applied Mathematics of the Romanian Academy (ISMMA)

Abstract: In the present talk we investigate the numerical reconstruction of missing boundary conditions (boundary temperatures and normal heat flux) on an inaccessible portion of the boundary in anisotropic heat conduction (Özişik, 1993). This inverse Cauchy problem is approached by transforming it into a control problem or, equivalently, a minimisation problem, for which a gradient descent method (GDM)-based iterative algorithm that consists of the resolution of direct and adjoint problems at each step is obtained. The numerical implementation is realised by employing the finite-difference method (FDM) (Jovanovic and Sli, 2014) for two-dimensional (non)homogeneous (an)isotropic solids. Both exact and noisy Cauchy data are considered on the over-prescribed and accessible boundary and a corresponding regularizing/stabilising stopping criterion, which is based on either the discrepancy principle (Morozov, 1966) or the simplified L-curve method (Kindermann and Raik, 2020), is also provided. The retrieved numerical results prove the convergence, stability and accuracy of the proposed algorithm. This is a joint work with Liviu Marin and Iulian Cimpean.

Acknowledgments. The work of Mihai Bucataru and Liviu Marin was supported by a grant of the Romanian Ministry of Research and Innovation, CNCS–UEFISCDI, project number PN–III–P1–1.1–TE–2019–0348, within PNCDI III. The work of Iulian Cmpean was supported by a grant of the Romanian Ministry of Research and Innovation, CNCS–UEFISCDI, project number PN–III–P1–1.1–PD–2019–0780.

Second order uncertainty principles: sharp constants and minimizers

Cristian Cazacu

Universitatea din Bucuresti & ISMMA

Abstract: We study sharp second order inequalities of Caffarelli-Kohn-Nirenberg type in the euclidian space $\mathbb{R}^N$, where N denotes the dimension. This analysis is equivalent to the study of uncertainty principles for special classes of vector fields. In particular, we show that when switching from scalar fields $u : \mathbb{R}^N \to \mathbb{C}$ to vector fields of the form $\vec{u} := \nabla U$ (U being a scalar field) the best constant in the Heisenberg Uncertainty Principle (HUP) increases from $\frac{N^2}{4}$ to $\frac{(N+2)^2}{4}$, and the optimal constant in the Hydrogen Uncertainty Principle (HyUP) improves from $\frac{(N-1)^2}{4}$ to $\frac{(N+1)^2}{4}$. We also provide minimizers for the improved sharp constants. As a consequence of our results we answer to an open question of Maz'ya (Integral Equations Operator Theory 2018, Section 3.9) in the case $N = 2$ regarding the HUP for divergence free vector fields. This is a joint work with Joshua Flynn (University of Connecticut, USA) and Nguyen Lam (Memorial University of Newfoundland, Canada). This talk is partially supported by CNCS-UEFISCDI Romania, Grant No. PN-III-P1-1.1-TE-2019-0456.

Rugosity effects in liquid crystals

Razvan-Dumitru Ceuca

Basque Center for Appplied Mathematics & Universidad del Pais Vasco

Abstract: Liquid crystals are found in many technological and biological applications, making control of such systems a tempting goal. Especially in thin domains, surface effects can dominate, and thus their structure, or design, is a key to influencing the behaviour of the bulk of the sample. In this talk we will discuss an approach to understanding how fine scale oscillations on a liquid crystal/homogeneous solid interface (rugosity) can give rise to "effective" surface conditions, phrased mathematically as a homogenisation problem. Our results apply to more general systems, and we can produce stronger, explicit results in concrete systems with simpler geometries. We propose that the results may be interpreted as a design problem for liquid crystalline systems.

Well-posedness for thermo-electro-viscoelasticity of Green-Naghdi type

Adina Chirila

Transilvania University of Brasov

Abstract: We study the linear theory of thermo-electro-viscoelasticity of Green-Naghdi type for the case of a one-dimensional body. For the corresponding mathematical model, we prove the uniqueness of the solution by means of the Laplace transform after rewriting the constitutive equations in an appropriate form. Moreover, we derive a result of continuous dependence upon the supply terms. This is a joint work with Professor Adriano Montanaro from the University of Padua, Italy.

Solvability of a class of Saddle Point Problems and Convergence Results

Mariana Florentina Chivu

Universitatea din Craiova

Abstract: A class of saddle point problems is analyzed. We study the existence and the uniqueness of the solution of those mixed variational systems with Lagrange multiplier by considering the non-differentiable and differentiable cases, respectively. Then, we deliver some convergence results. Also, to illustrate the abstract results, some examples arising from contact mechanics will be given.

Classification of singular solutions to nonlinear elliptic equations with a gradient term

Maria Farcaseanu

The University of Sydney & Politehnica University of Bucharest

Abstract: In this talk, we present recent classification results of the behavior near zero for the positive solutions of some nonlinear elliptic equations with singular potentials and gradient-dependent nonlinearities. This is joint work with Florica Cirstea (The University of Sydney).

Instability of the soliton for the focusing, mass-critical generalized KdV equation

Cristian Gavrus

Johns Hopkins University

Abstract: In this talk we will discuss recent joint work with Benjamin Dodson. We discuss the proof of instability of the soliton for the focusing, mass-critical generalized KdV equation. This means that the solution to the generalized KdV equation for any initial data with mass smaller than the mass of the soliton and close to the soliton in L^2 norm must eventually move away from the soliton.

A new Cosserat shell model: modelling and existence of the solution

Ionel-Dumitrel Ghiba

Universitatea "Alexandru Ioan Cuza" din Iasi & IMOM

Abstract: We present a new geometrically nonlinear Cosserat shell model incorporating effects up to order $O(h^5)$ in the shell thickness h. The method that we follow is an educated 8-parameter ansatz for the three-dimensional elastic shell deformation with attendant analytical thickness integration, which leads us to obtain completely two-dimensional sets of equations in variational form. We give an explicit form of the curvature energy in terms of the wryness tensor. Moreover, we consider the matrix representation of all tensors in the derivation of the variational formulation, because this is convenient when the problem of existence is considered, and it is also preferential for numerical simulations. The step by step construction allows us to give a transparent approximation of the three-dimensional parental problem.

The asymptotic behavior of solutions to a class of inhomogeneous problems: an Orlicz-Sobolev space approach

Andrei Grecu

Universitatea din Craiova

Abstract: The asymptotic behavior of the sequence $\{v_n\}$ of nonnegative solutions for a class of inhomogeneous problems settled in Orlicz-Sobolev spaces with prescribed Dirichlet data on the boundary of domain Ω is analysed. We show that $\{v_n\}$ converges uniformly in Ω as $n \to \infty$, to the distance function to the boundary of the domain.

Joint work with Denisa Stancu-Dumitru.

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On some results concerning convex sums of biholomorphic mappings in $\mathbb{C}^n$

Eduard Stefan Grigoriciuc

Babes-Bolyai University of Cluj-Napoca

Abstract: Let $\mathbb{B}^n$ be the Euclidean unit ball in $\mathbb{C}^n$ and let U be the unit disc in $\mathbb{C}$. The aim of this work is to study convex combinations of biholomorphic mappings on $\mathbb{B}^n$ using an extension of the result proved by Chichra and Singh. They obtained the conditions in which a convex combination of the form $(1-\lambda)f + \lambda g$ is starlike on U, when f and g are starlike on the unit disc U and $\lambda \in [0,1]$. In this paper, we construct a similar result for the case of several complex variables and then we use the result to characterize convex sums of biholomorphic starlike mappings on the Euclidean unit ball $\mathbb{B}^n$.

Existence and uniqueness of solutions for stochastic transport models

Oana Lang

Imperial College London

Abstract: I will focus on the differences and similarities of the analytical properties for two stochastic shallow water models. One of these models is derived using the Location Uncertainty approach (Mémin, 2014) and the other one is derived using the Stochastic Advection by Lie Transport method (Holm, 2015). Both systems are designed for turbulent compressible fluids and are driven by transport noise. Our methodology is based on approximating sequences of solutions with suitable convergence properties, and can be extended to more general systems of SPDEs.

Despre Controlul Regional al Ecuatiilor cu Derivate Partiale

Bogdan Maxim

Universitatea "Alexandru Ioan Cuza" din Iasi

Abstract: Plecand de la un sistem de tip reactie difuzie vom prezenta o metoda prin care putem gasi o regiune optimala pe care sa intervenim cu un control optimal (ce trebuie determinat) astfel incat sa fie minimizata o functionala de cost. Deducerea conditiilor de optimalitate si construirea unui algoritm conceptual care sa permita simularea in Matlab a problemei sunt punctele de reper ale prezentarii.

Computing connectivities of Fatou components for a family of rational maps

Dan Paraschiv

Universitat de Barcelona

Abstract: By asymptotic iteration of holomorphic maps, the dynamical plane is partitioned into 2 sets, the Julia (chaotic) and Fatou (stable) sets. The geometry and topology of the Julia sets are almost always fractal-like(Cantor sets, sets homeomorphic to Sierpinski carpet, etc). In the parameter plane the most famous example is the Mandelbrot set, the parameter plane of the quadratic family. By adding a perturbation at a point of a holomorphic map, even richer dynamics may be obtained (McMullen, Devaney). For a family of perturbation maps, Canela has proven the existence of a rational map such that the connected components of the Fatou set (Fatou components) have arbitrarily large connectivity in one dynamical plane. We generalise this result to a larger family of maps and also precisely compute all the achievable connectivities.

New way of computing the exponential for double precision numbers

Iulia-Catalina Plesca

Universitatea "Alexandru Ioan Cuza" din Iasi

Abstract: Computing exponentials is frequently needed and most mathematical programming libraries contain a function for computing exponentials for real numbers. In this presentation, we discuss the current algorithms and propose a faster new one to compute the exponential of numbers in double precision. We rely on the C language.

Old and new in compensated compactness

Bogdan Raita

Max Planck Institute Leipzig

Abstract: We will review aspects of the theory of Compensated Compactness, starting with the fundamental work of Murat and Tartar and concluding with recent results obtained jointly with A. Guerra, J. Kristensen, and M. Schrecker. Broadly speaking, the object of this study is to gain a better understanding of the interaction between weakly convergent sequences and nonlinear functionals. The general framework will be that of variational integrals defined on spaces of vector fields satisfying linear pde constraints that satisfy Murat's constant rank condition. We will focus on the weak (lower semi-)continuity of these integrals, as well as the Hardy space regularity of the integrands.

Torsional creep problems in Finsler metrics

Denisa Stancu-Dumitru

Universitatea Politehnica Bucuresti

Abstract: The asymptotic behavior of solutions to a family of Dirichlet boundary value problems involving differential operators in divergence form on a domain equipped with a Finsler metric is investigated. Solutions are shown to converge uniformly to the distance function to the boundary of the domain which takes into account the Finsler norm involved in the equation. This implies that a well-known result in the analysis of problems modelling torsional creep continues to hold in this more general setting. This is based on a joint work with Maria Farcaseanu and Mihai Mihailescu. This presentation is partially supported by CNCS-UEFISCDI Grant No. PN-III-P1-1.1-TE-2019-0456.

Holomorphic dynamics in higher dimensions

Raluca Tanase

IMAR

Abstract: We discuss the dynamics of polynomial diffeomorphisms of $\mathbb{C}^2$, with emphasis on recent progress on hyperbolicity and partial hyperbolicity of complex Hénon maps.

Weighted Ingham's inequality for families of exponentials with no gap

Mihai-Adrian Tudor

Universitatea din Craiova

Abstract: We consider nonharmonic Fourier series for which the exponentials have the property that no more than three consecutive frequencies are arbitrarily close. In this case we are able to prove an Ingham's type inequality with weights.

Nonlinear evolution equations of non-local branching processes

Catalin-Ioan Vrabie

IMAR

Abstract: Our aim is to present a method of constructing non-local branching processes, emphasizing the nonlinear PDEs which are behind. Non-local branching processes appear in modeling the time evolution of a system of particles, where one particle moves according to a given base Markov process (called the spatial motion) until it dies and it is replaced by the second generation of particles, which start moving according to the same spatial motion until their own terminal time when they are themselves replaced by their offsprings, and the process continues on in this manner. Non-local here means that the descendants do not need to start from the place where their common parent died. The talk is based on a joint work with Lucian Beznea and Oana Lupascu-Stamate.