Romanian Itinerant Seminar on Mathematical Analysis and its Applications

Seminarul Itinerant Românesc de Analiză Matematică şi Aplicaţii
Universitatea Babeş-Bolyai Cluj-Napoca, 20-21 aprilie 2018
Rezumatele conferinţelor din program

Andrei-Florin ALBIŞORU
(Universitatea Babeş-Bolyai Cluj-Napoca)

Title: *A transmission-type problem for the Stokes and Brinkman systems*
Abstract. The purpose of the talk is to give a well-posedness result for a boundary value problem of transmission-type for the Stokes and generalized Brinkman systems in complementary Lipschitz domains in $\mathbb{R}^3$. First, we introduce the Sobolev spaces in which we seek the solution of the above mentioned problem. Secondly, we introduce the trace and conormal derivative operators. Next, we state the main properties of the layer potential operators for the Stokes system. Finally, we use the well-posedness of another transmission-type problem and the means of Fredholm operator theory to establish our desired result.

Sebastian ANIŢA
(Universitatea Al. I. Cuza şi Institutul de Matematică Octav Mayer, Iaşi)

Title: *Regional control for some reaction-diffusion systems*
Abstract. Some regional control problems related to population dynamics with diffusion are presented. We discuss an optimal control problem where the control acts in a subdomain of the habitat and we deduce the structure of the optimal control using the necessary optimality conditions. The shape and the position of the subdomain where the optimal control acts are investigated using the level set method. We also discuss the zero-stabilizability related to reaction-diffusion models in biology. A necessary condition and a sufficient condition for zero-stabilizability are derived, and in case of stabilizability we indicate a stabilizing feedback control with simple structure. We also deal with the optimal subdomain problem (where the stabilizing control acts). For all problems, we take into account the cost of the action in the subdomain and derive iterative algorithms for approximation of the optimal subdomain (where the control acts).

Alina Ramona BAIAS
(Universitatea Tehnică din Cluj-Napoca)

Title: *Subdifferential formulae for convex risk functions*
Abstract. This paper present different methods for computing subdifferential formulae for convex risk functions. The idea is to combine the already known methods of convex optimization with the modern risk measures (which can be irregular) in order to provide better tools for quantifying risk.

Constantin BUŞE
(Universitatea Politehnica Timişoara)

Title: *On the determined growth of the spectrum for generators of evolution semigroups*
Abstract. To every strongly continuous semigroup we can associate a family of indexes that help us to monitor the asymptotic behavior of solutions of the abstract Cauchy problems associated to the infinitesimal generators. In particular, these problems are autonomous. In our talk we analyse this issue in the special context of evolution semigroups associated to non-autonomous and periodic Cauchy problems.

Adela CAPĂTĂ
(Universitatea Tehnică din Cluj-Napoca)

Title: *Existence results for vector equilibrium problems via a generalized KKM principle*
Abstract. In this talk, new existence results for globally efficient solutions of a vector equilibrium problem given as a sum of two functions are presented. For the proof of the main result, a generalized KKM principle is used.

Aurelian CERNEA
(Universitatea Bucureşti)

Title: *Qualitative properties of solutions for a second order differential inclusion*
Abstract. We study the following problem:

$$x''(t) \in A(t)x(t) + F(t, x(t)), \quad x(0) = x_0, \quad x'(0) = y_0, \tag{1}$$

where $F : [0, T] \times X \to \mathcal{P}(X)$ is a set-valued map, X is a Banach space, $x_0, y_0 \in X$, and $\{A(t)\}_{t\geq 0}$ is a family of linear closed operators from X into X that generates an evolution system of operators $\{\mathcal{U}(t, s)\}_{t,s\in[0,T]}$. The general framework of evolution operators $\{A(t)\}_{t\geq 0}$ that define problem (1) has been developed by Kozak and improved by Henriquez.
We consider this problem in the case when the set-valued map is not convex valued, but is Lipschitz in the second variable. We obtain several existence results for mild solutions of this problem using fixed point techniques and using classical selection results as Kuratowsky and Ryll-Nardzewski, Bressan and Colombo, De Blasi and Pianigiani. At the same time several qualitative results concerning mild solutions of this problem as: local controllability along a reference solution, arcwise connectedness of the solution set and variational inclusions associated to problem (1) are provided.

Nicuşor COSTEA
(Universitatea Politehnica şi Institutul de Matematică S. Stoilow, Bucureşti)

Title: *Producing bounded Palais-Smale sequences for locally Lipschitz functionals and applications to PDI's*
Abstract. At the beginning of 1990's Schechter developed a theory for finding bounded Palais-Smale sequences for C^1-functionals defined on a Hilbert space, by proving a deformation lemma which did not require the Palais-Smale compactness condition, but using instead the restriction of the function to a closed ball of radius R and imposing a boundary condition on a region of the corresponding sphere which prevents deformations from exiting the ball. Dropping the boundary condition and imposing a mild compactness condition one obtains either a critical point or an eigenvalue.
A natural question arises: Can this be done for functionals, not necessarily differentiable, defined on a Banach space?
We provide a positive answer assuming that the functional is locally Lipschitz and the space is reflexive and has strictly convex dual. As applications we consider Dirichlet partial differential inclusions of the type

$$\begin{cases} -Au \in \partial_C f(x, u), & \text{in } \Omega, \\ u = 0, & \text{on } \partial\Omega, \end{cases}$$

with Au being either the p-Laplacian ($\Delta_p u = \operatorname{div}(|\nabla u|^{p-2}\nabla u)$),
or the Φ-Laplacian ($\Delta_\Phi u = \operatorname{div}\left(\frac{\varphi(|\nabla u|)}{|\nabla u|}\nabla u\right)$, $\Phi(t) = \int_0^t \varphi(s)ds$) and the nonlinearity f is measurable w.r.t. the first variable and locally Lipschitz w.r.t. the second variable. Remarkable differences occur due to the loss of homogeneity of the differential operator.
This presentation has been partially supported by a grant of the Romanian National Authority for Scientific Research, CNCS - UEFISCDI, project number PN-III-P4-ID-PCE-2016-0035 "Typical and Nontypical Eigenvalue Problems for Some Classes of Differential Operators".

Maria FĂRCĂŞEANU
(Universitatea Craiova şi Institutul de Matematică S. Stoilow, Bucureşti)

Title: *On a family of torsional creep problems involving rapidly growing operators in divergence form*
Abstract. Let $\Omega \subset \mathbb{R}^N$ $(N \geq 2)$ be a bounded domain with smooth boundary and $\{p_n\}$ be a sequence of real numbers converging to $+\infty$ as $n \to \infty$. For each integer $n > 1$ we define the function $\phi_n(t) = p_n|t|^{p_n-2}te^{|t|^{p_n}}$, for all $t \in \mathbb{R}$, and we prove the existence of a unique nonnegative variational solution for the problem $-\text{div}\left(\frac{\phi_n(|\nabla u(x)|)}{|\nabla u(x)|}\nabla u(x)\right) = \phi_n(1)$, when $x \in \Omega$, subject to the homogeneous Dirichlet boundary condition. Next, we establish the uniform convergence in Ω of the sequence of solutions for the above family of equations to the distance function to the boundary of Ω.
This talk is based on some recent results obtained in collaboration with Mihai Mihăilescu.
This presentation is partially supported by CNCS-UEFISCDI Grant No. PN-III-P4-ID-PCE-2016-0035.

Anca GRAD
(Universitatea Babeş-Bolyai Cluj-Napoca)

Title: *A backward step with inertial effects algorithm solving a monotone inclusion problem*
Abstract. This presentation contains an algorithm which solves a monotone inclusion problem, representing a joint work with R.I. Boţ and E.R. Csetnek. The problem under investigation is stated in a Hilbert space and is:

$$0 \in Ax + Dx + N_C(x),$$

where $A, B : \mathcal{H} \rightrightarrows \mathcal{H}$ are two maximally monotone operators, $D : \mathcal{H} \to \mathcal{H}$ is an $\eta-$ cocoercive operator with $\eta > 0$ and $C := zerB \neq \emptyset$. We perform a penalization of the operator B via a backward step and endow the algorithm with inertial effects. The generated sequence of iterates convergence of to a solution of the monotone inclusion problem, via a regularity condition involving the Fitzpatrick function of B. We rediscover as particular cases the algorithms from [3]. Such an approach is justified because in minimization problems inertial algorithms lead to optimal solutions that cannot be detected by their non-inertial variants.

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Daniela Ioana INOAN
(Universitatea Tehnică din Cluj-Napoca)

Title: *Existence of solutions for equilibrium problems with trifunctions*
Abstract. We consider a quasi-equilibrium problem formulated with a trifunction. To obtain sufficient conditions for the existence of solutions, we associate a dual problem, generalizing a method used for equilibrium problems with bifunctions. As applications of the main result, we study mixed equilibrium problems and hemivariational inequalities governed by semi-monotone operators of two variables. This is a joint paper with József Kolumbán.

Petru JEBELEAN
(Universitatea de Vest Timişoara)

Title: *Periodic solutions to Fisher-Kolmogorov type perturbations of the relativistic operator*
Abstract. We discuss the existence of multiple periodic solutions for differential equations of the form

$$-\left[\phi(u')\right]' = \lambda u(1-|u|^q),$$

and for difference equations of type

$$-\Delta\left[\phi(\Delta u(n-1))\right] = \lambda u(n)(1-|u(n)|^q);$$

here $q>0$ is fixed, Δ is the forward difference operator, $\lambda>0$ is a real parameter and

$$\phi(y) = \frac{y}{\sqrt{1-y^2}} \quad (y\in(-1,1)).$$

The approach is variational and relies on critical point theory for convex, lower semicontinuous perturbations of C^1-functionals. The talk is based on joint work with Călin Şerban [1].

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Gabor KASSAY
(Universitatea Babeş-Bolyai Cluj-Napoca)

Title: *On a sufficient condition for weak sharp efficiency in multiobjective optimization*
Abstract. In this talk we provide sufficient conditions entailing the existence of weak sharp efficient points of a multiobjective optimization problem. The approach uses variational analysis techniques, like regularity and subregularity of the diagonal subdifferential map related to a suitable scalar equilibrium problem naturally associated to the multiobjective optimization problem.

Vasile LUPULESCU
(Universitatea Constantin Brâncuşi Tg. Jiu)

Title: *Neutral functional equation with causal operators in Banach spaces*
Abstract. This paper is dedicated to the presentation of some results concerning the existence of solutions for neutral functional differential equations involving causal (abstract Volterra or nonanticipative) operators in Banach spaces. We provide several existence results, under various assumptions. Some applications are given. The results of this paper represent generalizations of some similar results obtained in the case of dimensional finite spaces by Constantin Corduneanu and presented in his book: Functional Equations with Causal Operators, Taylor and Francis, New York, 2002.

Roxana MATEI
(Universitatea de Vest Timişoara)

Title: *Input-output characterizations for pointwise dichotomy of linear skew-product flows*
Abstract. We discuss various connections between some pointwise input-output properties with respect to an integral equation and the pointwise exponential dichotomy of a linear skew-product flow. The main results will establish characterizations for pointwise and global exponential dichotomy of linear skew-product flows in terms of pointwise and global admissibility. Finally, we will present further aims regarding the pointwise dichotomy of the discrete skew-product flows.

Radu MICULESCU
(Universitatea Bucureşti)

Title: *The canonical projection associated to certain possibly infinite generalized iterated function system as a fixed point*
Abstract. In this paper, influenced by the ideas from A. Mihail, *The canonical projection between the shift space of an IIFS and its attractor as a fixed point*, Fixed Point Theory Appl., 2015, Paper No. 75, 15 pp., we associate to every generalized iterated function system F (of order m) an operator $H_F : C^m \to C$, where C stands for the space of continuous functions from the shift space on the metric space corresponding to the system. We provide sufficient conditions (on the constitutive functions of F) for the operator H_F to be continuous, contraction, φ-contraction, Meir-Keeler or contractive. We also give sufficient condition under which H_F has a unique fixed point π_0. Moreover, we prove that, under these circumstances, the closer of the imagine of π_0 is the attractor of F and that π_0 is the canonical projection associated to F. In this way we give a partial answer to the open problem raised on the last paragraph of the above mentioned Mihail's paper.

Claudia Luminiţa MIHIŢ
(Universitatea de Vest Timişoara)

Title: *On some splitting properties in infinite-dimensional spaces*
Abstract. The aim of this paper is to present qualitative results for the bisplitting and trisplitting properties of variational systems in Banach spaces. In particular, some characterizations for the dichotomy, respectively trichotomy concepts are obtained.

Gheorghe MOROŞANU
(Universitatea Babeş-Bolyai Cluj-Napoca)

Title: *Approximate solutions to the telegraph differential system*
Abstract. Consider in $D = \{(x,t) \mid \ 0 < x < 1, \ 0 < t < T\}$ the telegraph differential system (see, for example, [4])

$$\begin{cases} Lu_t - v_x + Ru = f_1(x,t), \\ Cv_t - u_x + Gv = f_2(x,t). \end{cases} \tag{1}$$

In practice $0 < L =$ inductance; $0 \leq R =$ resistance; $0 < C =$ capacitance per unit length; $0 \leq G =$ conductance; $f_1(x,t) =$ voltage per unit length impressed along the line in series with it; $f_2(x,t) = 0$; $u = u(t,x) =$ current flowing in the line; $v = v(t,x) =$voltage across the line.
We associate with (1) some boundary conditions, for example,

$$v(0,t) = ru(0,t), \ -u(1,t) = h(v(1,t)), \ 0 < t < T, \tag{2}$$

and initial conditions

$$u(x,0) = u_0(x), \ v(x,0) = v_0(x), \ 0 < x < 1. \tag{3}$$

Here h is a continuous nondecreasing function. If h is linear then both equations in (2) express Ohm's law. R, G and r are either constants or nonlinear functions.
For existence and uniqueness of the solution (u,v) to problem (1), (2), (3) see, for example, [5, Chapter III]. Following an idea of J.L. Lions, we construct regularizations of problem (1), (2), (3) by adding the terms $-\varepsilon u_{tt}$ and $-\varepsilon v_{tt}$, $\varepsilon > 0$, to the left-hand sides of the two equations in (1), plus some conditions at $t = T$ for u and v (more precisely, either $u(\cdot,T) = u_T$, $v(\cdot,T) = v_T$ or $u_t(\cdot,T) = 0$, $v_t(\cdot,T) = 0$) in order to obtain complete problems. The solutions of these new problems are **more regular** (with respect to t) than (u,v), and for ε sufficiently small they approximate (u,v) (see [1] and [2]).
On the other hand, if the inductance L in (1) is small enough and R is a positive constant, then (u,v) is close to the **more regular** solution of the parabolic problem obtained by setting $L = 0$ in (1) and removing the condition $u(x,0) = u_0(x)$, $0 < x < 1$ ([3]).

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Constantin NICULESCU
(Universitatea Craiova)

Title: *Convexity structures associated to means. New results*
Abstract. In any complete metric space, the existence of contractive barycentric maps is equivalent to the existence of means of arbitrary finite order and yields the existence of a convexity structure along geodesics. This fact, noticed by de J.D. Lawson and Y. Lim in 2017, is the starting point of our talk, dedicated to the generalization of Hardy-Littlewood-Polya majorization theory.

Ludmila NOVAC
(Universitatea de Stat din Moldova)

Title: *Models of informational extended games and their applications*
Abstract. We consider a class of informational extended games, by assumption that players have some information about the choices of other players (e.g. the strategies which will be applied). We analyze the discreet case (so called informational extended bimatrix games) and the informational extended games with continuous functions. The conditions of the Nash equilibria existence for the informational extended games are defined. We analyze some applications of the informational extended games.

Carolina OPINCA (Universitatea de Stat din Moldova)

Title: *Basic principles of decision-making under conditions of uncertainty and risk*
Abstract. Depending on the degree of uncertainty of the forthcoming behavior of the initial parameters of decision-making, the conditions of risk and uncertainty are distinguished. Under the risk conditions, the probability of occurrence of individual events that affect the final result can be established with some degree of accuracy, but in uncertainty, because such information is not available, such probability can not be established.

Alexandru ORZAN
(Universitatea Babeş-Bolyai Cluj-Napoca)

Title: *On a special class of fractional set-valued functions*
Abstract. Linear fractional real-valued functions play an important role in scalar optimization and have been intensively studied in the literature. We introduce a new class of fractional set-valued functions, defined by means of affine set-valued functions in the sense of V.V. Gorokhovik (2008).

Diana OTROCOL
(Universitatea Tehnică din Cluj-Napoca)

Title: *Heun inverse problem*
Abstract. We consider some families of probability distributions and the associated indices of coincidence $S_n(x)$. We are interested in studying if $S_n(x)$ is a Heun function (joint work with Adina Barar and Daniela Inoan).

Radu PĂLTĂNEA
(Universitatea Transilvania Braşov)

Title: *Results for K-functionals of order one and two*
Abstract. We consider the connections between the K-functionals and moduli of continuity.

Adrian PETRUŞEL
(Universitatea Babeş-Bolyai Cluj-Napoca)

Title: *Approximation results for the fixed points of non-self operators in metric spaces*
Abstract. Starting from some classical results of R. Conti, A. Haimovici and K. Iseki, and from a more recent result of S. Reich and A.J. Zaslavski, we present several theorems of approximation of the fixed points for non-self mappings on metric spaces. Both metric and topological conditions are involved. Some of the results are generalized to the multi-valued case (joint work with R. Precup and M.A. Şerban).

Cornel PINTEA
(Universitatea Babeş-Bolyai Cluj-Napoca)

Title: *Characterizations of some properties of the closed convex sets through their Gauss range*
Abstract. We characterize two types of closed convex sets by some topological properties of the ranges of their associated Gauss maps. These topological properties are considered in the particular case of the epigraphs of the lower semicontinuous proper convex functions (joint work with Juan Enrique Martinez Legaz).

Constantin POPA
(Universitatea Ovidius Constanţa)

Title: *Iterative solution of weighted linear least squares problems*
Abstract. We present in this paper an extension of two previous algorithms proposed by J.D. Riley (1955) and G.H. Golub (1965) for iterative solution of weighted linear least squares problems. We prove convergence of the extended algorithm and also provide a convergence rate in terms of the singular values of a generalized singular value decomposition (joint work with Doina Carp, Tobias Preclik and Ulrich Ruede).

Dorian POPA
(Universitatea Tehnică din Cluj-Napoca)

Title: *On Ulam stability of some linear operators*
Abstract. In this talk are presented some results on Ulam stability for linear differential operators and linear operators in approximation theory.

Nicolae POPOVICI
(Universitatea Babeş-Bolyai Cluj-Napoca)

Title: *A systematization of quasiconvexity concepts for set-valued maps*
Abstract. We present a systematization of different classes of quasiconvex set-valued maps, defined by means of the l-type and u-type preorder relations, currently used in set-valued optimization. In particular, we identify those classes of set-valued maps for which it is possible to extend the classical characterization of convex real-valued functions by quasiconvexity of their affine perturbations. This talk is based on a joint work with Kazuki Seto and Daishi Kuroiwa (Shimane University, Japan).

Augusta RAŢIU
(Universitatea Lucian Blaga Sibiu)

Title: *Weighting method for vector optimization problems*
Abstract. To obtain the efficient solution for a vector optimization problem we use the weighting method. Some numerical results are presented.

Ionel ROVENTA
(Universitatea Craiova)

Title: *Optimal filtration for the approximation of controls*
Abstract. We consider a finite-differences semi-discrete scheme for the approximation of different controls. The high frequency numerical spurious oscillations lead to a loss of the uniform (with respect to the mesh-size) controllability property of the semi-discrete model in the natural setting. We prove that, by filtering the high frequencies of the initial data in an optimal range, we restore the uniform controllability property. Moreover, we obtain a relation between the range of filtration and the minimal time of control needed to ensure the uniform controllability, recovering in many cases the usual minimal time to of control.

Ioan A. RUS
(Universitatea Babeş-Bolyai Cluj-Napoca)

Title: *"Homogeneous" second order differential equations: zeros separation principles*
Abstract. In this paper we study the following problems:
Problem 1. Let I be an open interval in $\mathbb{R}$ and $F : I \times \mathbb{R}^3 \to \mathbb{R}$ be a continuous function with $F(x, 0, 0, 0) = 0$, $x \in I$. We consider the following differential equation

$$F(x, y, y', y'') = 0 \tag{1}$$

Let $y \in C^2(I)$ be a nontrivial solution of this equation. In which conditions we have that:
(1) the zeros of y and y' separate each other?
(2) the zeros of y and y'' separate each other?
(3) the zeros of y' and y'' separate each other?
Problem 2. Let y_1, y_2 be two linearly independent solution of (1). In which conditions we have that:
(1) the zeros of y_1 and y_2 separate each other?
(2) the zeros of y_1' and y_2' separate each other?
(3) the zeros of y_1'' and y_2'' separate each other?
Problem 3. Let $I \subset \mathbb{R}$ be an open interval and $F, G : I \times \mathbb{R}^3 \to \mathbb{R}$ two continuous functions with $F(x, 0, 0, 0) = 0$ and $G(x, 0, 0, 0) = 0$, $x \in I$. We consider the following system of differential equations

$$\begin{cases} F(x, y, z, y') = 0 \\ G(x, y, z, z') = 0 \end{cases} \tag{2}$$

Let $(y, z) \in C^1(I, R2)$ be a solution of (2). In which conditions we have that:
(1) the zeros of y and z separate each other?

(2) the zeros of y' and z' separate each other?

Problem 4. Let (y_1, z_1) and (y_2, z_2) be two linearly independent solutions of (2). In which conditions we have that:
(1) the zeros of y_1 and y_2 separate each other?
(2) the zeros of y_1' and y_2' separate each other?
(3) the zeros of z_1 and z_2 separate each other?
(4) the zeros of z_1' and z_2' separate each other?
Some other problem are formulated.

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Denisa STANCU-DUMITRU
(Universitatea Politehnica şi Institutul de Matematică S. Stoilow, Bucureşti)

Title: *The convergence of nonnegative solutions for the family of problems $-\Delta_p u = \lambda e^u$ as $p \to \infty$*
Abstract. Let $\Omega \subset \mathbb{R}^N$ $(N \geq 2)$ be a bounded domain with smooth boundary. We show the existence of a positive real number $\lambda^\star$ such that for each $\lambda \in (0, \lambda^\star)$ and each real number $p > N$ the equation $-\Delta_p u = \lambda e^u$ in Ω subject to the homogeneous Dirichlet boundary condition possesses a nonnegative solution u_p. Next, we analyze the asymptotic behavior of u_p as $p \to \infty$ and we show that it converges uniformly to the distance function to the boundary of the domain. This is based on a joint work with M. Mihăilescu and C. Varga.
This presentation is partially supported by CNCS-UEFISCDI Grant No. PN-III-P4-ID-PCE-2016-0035.

Cristian VLADIMIRESCU
(Universitatea Craiova)

Title: *Stability for a system of 1-D coupled damped nonlinear oscillators*
Abstract. The stability of the null solution of a system of differential equations describing some coupled nonlinear oscillators is discussed. Under some assumptions we obtain new stability results. Our approach allows extensions to both the case of several coupled oscillators and the case of the whole real line.

Adrian VIOREL
(Universitatea Tehnică din Cluj-Napoca)

Title: *A dissipative dynamical system associated to nonsmooth nonconvex optimization problems*
Abstract. We investigate the asymptotic behavior of a dynamical system governed by a second order, dissipative evolution equation related to the minimization of a nonconvex functional on a Hilbert space. Based on an existence and regularity analysis of the evolution equation, we show that its solutions converge towards critical points of the underlying (energy) functional. By exploiting the very specific structure of the dissipative dynamical system and its asymptotic behavior, viable approximations for the original optimization problem can be constructed.