# Abstracts

**The Tenth Congress of Romanian Mathematicians**

June 30 - July 5, 2023, Piteşti, Romania

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**Bilinear closed graph theorem in the framework of asymmetric normed spaces**
Ahmed Abbassi
*École Normale Supérieure de Bousaada, Bousaada, Algeria*

We introduce the continuity of bililinear mappings between asymmetric normed spaces and we prove bilinear versions of the closed graph theorem in the framework of asymmetric normed spaces. The closed graph theorem for the continuous bilinear operators between asymmetric normed spaces can be derived from the asymmetric closed graph theorem in the linear case.

**Theorem 1.** *Assume that $(X_1, p_1), (X_1, p_1)$ are Hausdorff asymmetric normed space, right K-complete and of the half second category, $(Y, q)$ is right K-complete and the graph of the bilinear mapping $T : X_1 \times X_2 \longrightarrow Y$ is closed in $(X_1 \times X_2) \times Y$. Then T is continuous.*

**Boundedness results for solutions of certain second order non-autonomous ordinary differential equations**
Daniel Adams
*Federal University of Agriculture, Abeokuta, Nigeria*

We shall consider the second order non-autonomous nonlinear ordinary differential equations:

$$a(t)x'' + b(t)f(x, x') + c(t)[g(x') + m(x)]h(x') = p(t, x, x')$$

and

$$(a(t)x')' + b(t)f(x, x') + c(t)[g(x') + m(x)]h(x') = p(t, x, x'),$$

where $a, b, c, f, g, m, h$ and $p$ are real valued functions which depend at the most on the argument displayed explicitly. In this talk, we shall use different forms of integral inequalities and two forms of mean value theorem for integrals to investigate the boundedness of all solutions and their derivatives.

**Universal constructions for Poisson algebras. Applications**
Ana Agore
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania & Vrije Universiteit Brussel, Brussels, Belgium*

We introduce the *universal algebra* of two Poisson algebras $P$ and $Q$ as a commutative algebra $A := \mathcal{P}(P, Q)$ satisfying a certain universal property. The universal algebra is shown to exist for any finite dimensional Poisson algebra $P$ and several of its applications are highlighted. For any Poisson $P$-module $U$, we construct a functor $U \otimes - : {}_A\mathcal{M} \to {}_Q\mathcal{P}\mathcal{M}$ from the category of $A$-modules to the category of Poisson $Q$-modules which has a left adjoint whenever $U$ is finite dimensional. Similarly, if $V$ is an $A$-module, then there exists another functor $- \otimes V : {}_P\mathcal{P}\mathcal{M} \to {}_Q\mathcal{P}\mathcal{M}$ connecting the categories of Poisson representations of $P$ and $Q$ and the latter functor also admits a left adjoint if $V$ is finite dimensional. If $P$ is $n$-dimensional, then $\mathcal{P}(P) := \mathcal{P}(P, P)$ is the initial object in the category of all commutative bialgebras coacting on $P$. As an algebra, $\mathcal{P}(P)$ can be deescribed as the quotient of the polynomial algebra $k[X_{ij} \,|\, i, j = 1, \cdots, n]$ through an ideal generated by $2n^3$ non-homogeneous polynomials of degree $\leq 2$. Two applications are provided. The first one describes the automorphisms group $\mathrm{Aut}_{\mathrm{Poiss}}(P)$ as the group of all invertible group-like elements of the finite dual $\mathcal{P}(P)^{\mathrm{o}}$. Secondly,

we show that for an abelian group $G$, all $G$-gradings on $P$ can be explicitly described and classified in terms of the universal coacting bialgebra $\mathcal{P}(P)$.

**The $C^*$-dynamical system of amenable quasi-lattice ordered groups and positive elements**
Mamoon Ahmed
*Princess Sumaya University for Technology, Ahman, Jordan*

Let $(G, P)$ be a quasi-lattice ordered group. In a previous paper the author took a different approach, avoiding crossed-products. He constructed a universal covariant representation of $(G, P)$ using direct sums of covariant representations.

In this talk, we show that amenability of $(G, P)$ can be established by showing the existence of a positive, faithful, linear map of $C^*(G, P)$ onto a certain subalgebra of $C^*(G, P)$.

**A finitary characterization of generalized hybrid sets over infinite universes**
Andrei Alexandru
*Romanian Academy, IIT, Iaşi, Romania*

Group-valued fuzzy sets are mappings from a crisp set to a group. In particular, classical hybrid sets (defined as multisets with possibly negative multiplicities) are examples of such group-valued fuzzy sets. The theory of atomic finitely supported structures (which has historical roots in the permutative models of set theory with atoms) allows a discrete representation of infinite structures by analyzing the properties of their finite supports. This atomic framework actually generalizes the classical Zermelo-Fraenkel set theory by allowing infinitely many basic elements having no internal structures (called atoms) instead of a single basic element represented by the empty set. Here we describe the groups in the framework of finitely supported sets, and then we introduce and analyze the finitely supported group-valued fuzzy sets. In this way we generalize the properties of hybrid sets and other classical group-valued fuzzy sets known in the Zermelo-Fraenkel framework.

**The two-phase thin free boundary problem for almost minimizers**
Mark Allen
*Brigham Young University, Provo, USA*

We consider the two-phase thin free boundary problem which is the fractional Laplacian analogue of the two-phase Bernoulli free boundary problem. We consider the situation of almost-minimizers to the corresponding functional. We show that there is a separation of phases; consequently, the problem is reduced to the study of the one-phase problem. We adapt the techniques for the case in which $s = 1/2$ to the full range $0 < s < 1$ for almost minimizers to show that the free boundary is $C^{1,\alpha}$ in a neighborhood of flat points. This is joint work with Mariana Smit Vega Garcia.

**On toric Fano fibrations**
Florin Ambro
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

We discuss the classification of germs of toric Fano fibrations, extending work of A. Borisov in the case of $\mathbb{Q}$-factorial toric singularities. As an application, we verify in the toric case a conjecture of V. Shokurov on the existence of complements with bounded index and prescribed singularities.

**New results for biharmonic quadratic maps between spheres**
Rareş Ambrosie
*Alexandru Ioan Cuza University, Iaşi, Romania*

In this talk, we report on biharmonic quadratic maps between spheres. First, we prove a characterization formula for biharmonic maps in Euclidean spheres. Then, for the special case of maps between spheres whose components are given by homogeneous polynomials of the same degree, we find a more specific form for their bitension field. Further, we apply this formula to the case when the degree is 2, and we prove that a quadratic form from $\mathbb{S}^m$ to $\mathbb{S}^n$ is non-harmonic biharmonic if and only if it has constant energy density $(m+1)/2$. We end by presenting some classification results for biharmonic $q$-forms.

**Totally geodesic Lagrangian submanifolds of the pseudo-nearly Kähler $\mathbf{SL}(2,\mathbb{R}) \times \mathbf{SL}(2,\mathbb{R})$**
Mateo Anarella
*KU Leuven/UPHF, Leuven, Belgium*

In this talk we will analyze the nearly Kähler structure of the pseudo-Riemannian manifold $\tilde{M} = \mathrm{SL}(2,\mathbb{R}) \times \mathrm{SL}(2,\mathbb{R})$. We can define a natural almost product structure $P$, compatible with the nearly Kähler metric, by swapping the vector fields tangent to each component of $\tilde{M}$. Given a Lagrangian submanifold $M$, we will study the different forms the restriction $P|_{TM}$ can take. We classify, up to isometries, all totally geodesic Lagrangian submanifolds of $\tilde{M}$.

**Hypoellipticity and the Helffer-Nourrigat conjecture**
Iakovos Androulidakis
*National and Kapodistrian University of Athens, Greece*

Hypoelliptic differential operators play a central role in various fields, from stochastic analysis to contact and sub-riemannian geometry. A computable criterion of hypoellipticity was proposed by Helffer and Nourrigat in 1979. In this lecture we will give an overview of hypoellipticity and present the proof of the Helffer-Nourrigat conjecture. This is joint work with Omar Mohsen and Robert Yuncken.

**Controlling a nonlinear Fokker-Planck equation via inputs with nonlocal action**
Ştefana-Lucia Aniţa
*Octav Mayer Institute of Mathematics of the Romanian Academy, Iaşi, Romania*

It is well known that a Fokker-Planck equation models the dynamics of the probability density function of the solution to the related stochastic differential equation. This suggests that a possible approach of a stochastic optimal control problem would be to reduce its study to the one of a deterministic optimal control problem related to a Fokker-Planck equation. Our talk concerns an optimal control problem $(P)$ associated to a nonlinear Fokker-Planck equation. As mentioned, this problem is deeply related to a stochastic optimal control problem $(P_s)$ for a McKean-Vlasov equation. The existence of an optimal control is obtained for the deterministic problem $(P)$. The existence of an optimal control is established and necessary optimality conditions are derived for a penalized optimal control problem $(P_h)$ related to a backward Euler approximation of the nonlinear Fokker-Planck equation (with a constant discretization step $h$). Using a passing-to-the-limit-like argument one derives the necessary optimality conditions for problem $(P)$.

**Clustering of functional data with outliers**
Cristina Anton
*MacEwan University, Edmonton, Canada*

We propose a method for clustering multivariate functional data with outliers based on a family of latent mixture of t-distributions models. The parameters of these models are estimated using an expectation maximization algorithm. The proposed method is illustrated for simulated data and for the analysis of the traffic flow in Edmonton, Canada.

**Computational aspects of arithmetic group cohomology**
Marian Anton
*Central Connecticut State University, New Britain, USA & Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

The integral cohomology of $GL_n$ and its stable version $GL$ over a ring of integers $\mathcal{O}_F$ in a number field $F$ has been the source of rich mathematical ideas. One approach is to localize the problem at each prime $p$. In this talk, we look at mod $p$ cohomology of $GL_n\mathcal{O}_F[1/p]$ where $F$ is the cyclotomic field of $p$-roots of unity. In particular, we describe some explicit cycles in the mod $p$ homology of $SL_2\mathcal{O}_F[1/p]$ which are relevant for the general case.

**Proof-carrying parameters in certified symbolic execution**
Andrei Arusoaie
*Alexandru Ioan Cuza University, Iaşi, Romania*

Complex frameworks for defining programming languages aim to generate various tools (e.g. interpreters, symbolic execution engines, deductive verifiers, etc.) using only the formal definition of a language. When used at an industrial scale, these tools are constantly updated, and at the same time, it is required to be trustworthy. Ensuring the correctness of such a framework is practically impossible. A solution is to generate proof objects as correctness artefacts that can be checked by an external trusted checker. A logic suitable for developing such frameworks is matching logic. K framework is a canonical example having matching logic-based foundation. Since the (symbolic) configurations of the programs are represented by matching logic patterns, the algorithms computing the dynamics of these configurations can be seen as pattern transformers and a proof object should be generated for the relationship between these patterns. In this talk, we show that conjunctions and disjunctions of patterns, produced by semantics or analysis rules, can be safely normalized using unification and antiunification algorithms. We also provide a prototype implementation of our proof object generation technique and a checker for certifying the generated objects.

**Well-posedness for the surface quasi-geostrophic front equation**
Ovidiu-Neculai Avădanei
*University of California, Berkeley, USA*

We consider the well-posedness of the surface quasi-geostrophic (SQG) front equation. Hunter-Shu-Zhang established well-posedness under a small data condition as well as a convergence condition on an expansion of the equation's nonlinearity. In the present article, we establish unconditional large data local well-posedness of the SQG front equation, while also improving the low regularity threshold for the initial data. In addition, we establish global well-posedness theory in the rough data regime by using the testing by wave packet approach of Ifrim-Tataru. This is joint work with Albert Ai.

**Renormalization, fractal geometry, and the Newhouse phenomenon**
Artur Avila
*University of Zürich, Zürich, Switzerland*

As discovered by Poincaré in the end of the 19th century, even small perturbations of very regular dynamical systems may display chaotic features, due to complicated interactions near a homoclinic point. In the 1960s, Smale attempted to understand such dynamics in term of a stable model, the horseshoe, but this was too optimistic. Indeed, Newhouse showed that even in only two dimensions, a homoclinic bifurcation gives rise to particular wild dynamics, such as the generic presence of infinitely many attractors. This Newhouse phenomenon is associated to a renormalization mechanism, but also with particular geometric properties of some fractal sets within a Smale horseshoe. When considering two-dimensional complex dynamics those fractal sets become much more beautiful but unfortunately also more difficult to handle.

**Spectrum of $p$-adic linear differential equations**
Tinhinane Amina Azzouz
*YMSC Tsinghua University-Yanqi Lake Beijing Institute of Mathematical Sciences and Applications, Beijing, China*

In the ultrametric setting, linear differential equations present phenomena that do not appear over the complex field. Indeed, the solutions of such equations may fail to converge everywhere, even without the presence of poles. This leads to a non-trivial notion of the radius of convergence, and its knowledge permits obtaining interesting information about the equation. Notably, it controls the finite dimensionality of the de Rham cohomology. In practice, the radius of convergence is really hard to compute and it represents one of the most complicated features in the theory of $p$-adic differential equations. The radius of convergence can be expressed as the spectral norm of a specific operator and a natural notion, that refines it, is the entire spectrum of that operator, in the sense of Berkovich. In our previous works, we introduce this invariant and compute the spectrum of differential equations over a power series field and in the $p$-adic case with constant coefficients.

In this talk, we will discuss our last results about the shape of this spectrum for any linear differential equation, the strong link between the spectrum and all the radii of convergence, notably a decomposition theorem provided by the spectrum.

**Finite element analysis for convection-diffusion problems**
Constantin Bacuta
*University of Delaware, Newark, DE, USA*

We consider a model convection-diffusion problem and present our recent numerical and analysis results regarding mixed finite element formulation and discretization in the singular perturbed case when the convection term dominates the problem. Using the concepts of optimal norm and saddle point reformulation, we found new error estimates for the case of uniform meshes. We compare the standard linear Galerkin discretization to a saddle point least square discretization that uses quadratic test functions, and explain the non-physical oscillations of the discrete solutions. We also relate a known upwinding Petrov-Galerkin method and the streamline diffusion discretization method, by emphasizing the resulting linear systems and by comparing appropriate error norms. The results can be extended to the multidimensional case in order to find efficient approximations for more general singular perturbed problems including convection dominated models.

**An alternate way for introducing finite differences and finite element discretization**
Cristina Bacuta
*University of Delaware, Newark, DE, USA*

When introducing discretization of boundary value problem solutions in a first course on numerical methods, the traditional way is to start with a finite difference approach followed by a separate finite element approach. In this talk, we describe a different way that emphasizes on the connections between the two methods and the advantage of their simultaneous analysis. For a model problem, we write the finite difference and the finite element systems such that the two corresponding linear systems have the same stiffness matrices. then, we compare the right hand side load vectors for the two methods. Using the connection between a Green function and the linear finite element basis functions, we find an explicit form of the inverse of the stiffness matrix. We simplify the proofs for the standard finite differences error estimates in the discrete infinity norm and the energy norm. This is joint work with Constantin Bacuta.

**Multigrid Uzawa algorithm for general saddle point problems**
Lori Badea
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

We introduce and analyze a multigrid inexact Uzawa algorithm for solving general saddle point problems. For the definition of the problem and that of the Uzawa algorithm, we adopt the framework introduced in I. Ekeland and R. Temam, Convex analysis and variational problems, North-Holland Publishing Company, Amsterdam, Oxford, 1976, where the saddle point is defined by optimizations on convex sets. The results are obtained for Hilbert spaces and therefore they can be applied to obtain convergence results for the multigrid methods in finite element spaces. We prove the convergence of the algorithm and, also, we give new convergence proofs for the Uzawa algorithm itself in order to better characterize its convergence. The numerical experiments performed for the driven-cavity Stokes problem showed a very good convergence of the proposed multigrid method, even better than that theoretically obtained.

**Parity results for 3-regular partitions and quadratic forms**
Cristina Ballantine
*College of the Holy Cross, Worcester, USA*

A partition of a nonnegative integer $n$ is a way to write $n$ as an unordered sum of positive integers. Denote by $p(n)$ be the number of partitions of $n$. Asymptotically, how often is $p(n)$ even? We do not know, but it is conjectured that $p(n)$ is even half the time. We will consider the number, $b_3(n)$, of 3-regular partitions, i.e., partitions with no parts divisible by 3, and find infinitely many arithmetic progressions where $b_3(n)$ takes even values. To prove our result we investigate a quadratic form in a classical way. This is joint work with Mircea Merca and Cristian-Silviu Radu.

**Divergence measures and their use in statistical inference**
Vlad Ştefan Barbu
*LMRS, University of Rouen-Normandy, France & Centre for Demographic Research Vladimir Trebici, INCE, Romanian Academy, Romania*

This presentation is concerned with statistical methodology based on divergence measures.

Divergence measures are of great importance in statistical inference; equally important are their limiting versions, known as divergence rates. In the first part of our presentation, we focus on generalized divergence measures for Markov chains. We consider generalizations of Alpha divergence measure (Amari and Nagaoka, 2000) and Beta divergence measures (Basu et. al, 1998) and investigate their limiting behaviour. We also study the corresponding weighted generalized divergence measures and the associated rates (Belis and Guiasu, 1968; Guiasu, 1971; Kapur, 1994).

In the second part of our presentation, we focus on hypothesis testing based on weighted divergences. More precisely, we present a goodness of fit test and a homogeneity test and we study their performance. This type of tests based on weighted divergences allow us to focus on specific subsets of the support without, at the same time, losing the information of the others. With this method we achieve a significantly more sensitive test than the classical ones but with comparable error rates.

**Securing IoT Apps with Information Flow Control**
Iulia Bastys
*Chalmers University of Technology, Gothenburg, Sweden*

IoT apps enhance our (digital) lives by connecting a variety of otherwise unconnected services and devices. "Get an email every time you park your BMW with a map to where you're parked" or "Back up your iOS photos to Google Drive" are a couple of examples of such apps. The apps are freely available on IoT app platforms and anybody with an account on the platform can create and publish such apps. In this talk I will show examples of malicious apps stealthily exfiltrating private user data, such as photos or location, through what we call URL-based attacks. Our experiments reveal that most popular IoT app platforms (IFTTT, Microsoft Power Automate, and Zapier) are susceptible to this type of attacks. Next, I will introduce the attacker model for this setting and finally, I will present our framework for information flow tracking in IoT apps, which secures the apps against such URL-based attacks.

**On the tensor product of cocomplete quantale-enriched categories**
Adriana Balan
*University Politehnica of Bucharest, Bucharest, Romania*

Fifty years ago, Lawvere's observation that ordered sets and metric spaces can be seen as enriched categories over a quantale opened a wide path for the quantitative theory of domains, using and generalising ideas from category theory, algebra, and topology. Among the most useful and pleasing properties of such quantale-enriched categories are undoubtedly (co)completeness with respect to certain classes of (co)limits and commutation of such limits and colimits (with prominent examples featuring the ordered case, like Heyting algebras, continuous or completely distributive lattices).

The present talk considers cocomplete enriched categories over a commutative quantale $\mathcal{V}$. These are known in a variety of guises: as algebras for the $\mathcal{V}$-valued powerset monad on $\mathsf{Set}$, as injective $\mathcal{V}$-categories with respect to fully faithful functors, as cocomplete lattices equipped with an action of $\mathcal{V}$, or even as complete semimodules over $\mathcal{V}$, seen as an idempotent semiring.

There is a symmetric monoidal closed structure on the category $\mathsf{CoCts}(\mathcal{V})$ of cocomplete $\mathcal{V}$-categories and cocontinuous $\mathcal{V}$-functors. The corresponding tensor product $\otimes$ arises naturally, using for example the commutativity of the $\mathcal{V}$-valued powerset monad on $\mathsf{Set}$. Several descriptions of this tensor product will be presented, via Galois connections or the $\mathcal{V}$-valued variant of Raney's $G$-ideals. Nuclear objects/morphisms with respect to this tensor product will turn to be deeply related with the usual projectivity with respect to the class of regular epis in $\mathsf{CoCts}(\mathcal{V})$, hence with completely distributive cocomplete $\mathcal{V}$-categories. In particular, the nuclearity of the Dedekind-MacNeille-Isbell completion will be discussed.

**Higher order coefficients in some different classes of microstructures**
Loredana Bălilescu
*University of Piteşti, Piteşti, Romania*

In this talk, we use Bloch decomposition to introduce higher order macrocoefficients, namely the dispersion tensor or the Burnett coefficients in different classes of microstrucures: periodic types, perforated and non-perforated, and the generalized Hashin–Shtrikman non-periodic structures. We also study the dependence of the fourth-order tensor in terms of the microstructure.

[1] L. Bălilescu, T. Ghosh, J. San Martín, *Higher order coefficients in periodically perforated domains*, in preparation (2023)

[2] L. Bălilescu, C. Conca, T. Ghosh, J. San Martín, M. Vanninathan, *Bloch wave spectral analysis in the class of generalized Hashin-Shtrikman micro-structures*, Mathematical Models and Methods in Appl. Sci. (2022), 32 (3), pp. 497-532

[3] L. Bălilescu, C. Conca, T. Ghosh, J. San Martín, M. Vanninathan, *The dispersion tensor and its unique minimizer in Hashin-Shtrikman micro-structures*, Archive for Rational Mechanics and Analysis (2018), 230 (2), pp. 665–700

**Mathematical Models in Artificial Intelligence for Astronomy Applications**

Mihai Bărbosu
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Mathematical models are fundamental to the design and implementation of Machine Learning (ML) and Artificial Intelligence (AI) techniques. These models provide formal representations of the problems and guide the performance of adapted algorithms. ML and AI have emerged as powerful tools in the field of astronomy and have proven to be instrumental in automating the analysis of vast amounts of astronomical data, allowing astronomers to process and extract meaningful information efficiently. This paper explores several AI methods that have revolutionized the way we classify and discover new celestial objects, study astronomical images, light curves, transient events in the universe, or the approach we take in optimizing astronomical instruments. Moreover, the integration of AI into celestial mechanics enhanced our understanding of the dynamics of celestial objects, enabling more accurate orbit predictions and efficient mission planning, empowering spacecraft to navigate with minimal human intervention.

**Personalized Screening Schedules for Chronic Diseases**

Ionuţ Bebu
*The George Washington University, Washington DC, USA*

Periodic evaluations are required in the clinical management of chronic diseases in order to identify opportunities for early treatment that can avert further progression and complications. For example, in nephropathy, patients with type 1 diabetes are screened annually for the onset of microalbuminuria, an early sign of chronic kidney disease. However, as our understanding of the etiology of diseases improves, there is the opportunity to design personalized schedules for future visits based on the estimated risk of progression, instead of a fixed schedule for the entire population. Herein we describe a framework for constructing such personalized screening schedules. A screening interval to the next visit is selected to optimize some function such as limiting the probability that the event will occur (e.g. $< 0.05$) prior to the next visit, or limiting the time that progression might go undetected before the next visit. The methods are illustrated using screening for retinopathy and nephropathy in the DCCT/EDIC study.

**Stability and instability for geometric PDEs**
Ioan Bejenaru
*UC San Diego, USA*

In this talk we focus on two important geometric PDEs: the heat flow for harmonic maps and Schrödinger Maps. We discuss the stability versus instability/blow-up phenomena for small perturbations of their solitons within the equivariant class (a natural symmetry preserved by these PDEs).

**Special holonomy on compact conformal manifolds**
Florin Belgun
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

On a compact conformal manifold, we consider as well a compatible Riemannian metric and a closed, non-exact Weyl connection (which is detemined by a compatible metric on the universal covering, for which the fundmental group acts by homotheties). Our aim is to classify locally the structure of a compact conformal manifold for which both a Riemannian and a closed Weyl connection have special (i.e. non-generic) holonomies. If the Weyl connection has irreducible holonomy, the Riemannian metric turns out to be Vaisman or a mapping torus of an isometry of a Nearly Kähler or a Nearly parallel G2 metric, while if the Weyl structure is Locally Conformally a Product (LCP), then it turns out that the Riemannian metric is also (locally) a product, and can be described locally as a special kind of double warped product.

**Cohomology with multilinear differentials and applications**
Constantin-Nicolae Beli
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Romania*

The cohomology with multiliear differentials is defined same as the usual cohomology, but with the group of cocycles, which are given by the relation $da = 0$, replaced by the larger group of those cochains $a$ such that $da$ is multilinear, i.e. linear in each variable.

This notion allows us to produce an exact sequence involving the 2-torsion of the Brauer group of a number field. With the help of this sequence, we define a function with many arithmetic properties, which is useful in the theory of the spinor genus of integral quadratic forms.

In the case when $F = \mathbb{Q}$ our map is given in terms of Legendre symbols of the type $(a + b\sqrt{m}, p)$ and by using its properties we were able to recover all existing biquadratic reciprocity laws, as well as produce new ones.

**Some examples of "curved" multilinear operators invariant under modulation**
Cristina Benea
*Nantes Université, Nantes, France*

We display some examples of modulation-invariant multi-linear operators which present certain curvature features: they either carry (maximal) oscillatory factors that are complex exponentials or they can be represented as more classical operators along curves. This is joint work with Bernicot, Lie, Vitturi, Bernicot, Lie and respectively with Oliveira.

**Helly-Bray theorem revisited; weak convergence in the sense of b.v.**
Habib Benfriha
*University of Oran1, Oran, Algeria*

In this talk we introduce a convergence notion on the set $bv(I)$ of all functions with bounded variation on $[a,b]$ or $(a,b)$; $I=[a,b]$ or $I=(a,b)$. We show that the weak convergence of a sequence of positive measures on $I$ is equivalent with the new type of convergence on the set $bv(I)$ of the repartition on the measures. We use the direct and inverse convergence theorem of Helly and Bray. The compactness phenomena is also studied.

**Valuations and key polynomials**
Andrei Bengus-Lasnier
*Institute of Mathematics and Informatics - Bulgarian Academy of Sciences, Sofia, Bulgaria*

My talk will be concerned with key polynomials and their potential ultrametric encoding. Key polynomials have been used to establish structure theorems for valued rings (e.g. generating sequences, valuative trees) in order to find strategies for proving local uniformization in positive characteristic.

My concern has been to build correspondences between these tools and more geometric objects, that would preserve the structure carried by these key polynomials. The simplest framework for key polynomials reduces to parametrizing extensions of valuations of a fixed valued field $(K,\nu)$ to a one variable polynomial ring $K[X]$. By passing to the algebraic closures $\overline{K}$ one can associate to any key polynomial a minimal pair $(a,\gamma)$ where $a\in\overline{K}$ and $\gamma\in\Gamma_\nu\otimes\mathbb{Q}$, $\Gamma$ being the value group of $\nu$. For a wide range of valuations (transcendental valuations) we have a perfect correspondence between key polynomials and associated minimal pairs.

I will present the basic theory of key polynomials as well as how to associate a minimal pair, thus giving us an ultrametric object to focus on: the ball with centre $a$ and radius $\gamma$.

**Fractional powers approach of maximal accretive operators for a class of third order abstract Cauchy problems**
Mohammed Benharrat
*National Polytechnic School of Oran-Maurice Audin, Algeria*

In this talk we explore the theory of fractional powers of maximal accretive operators to obtain results of existence, regularity and behavior asymptotic of solutions for linear abstract evolution equations of third order in time.

**The support of free convolutions**
Hari Bercovici
*Indiana University, Bloomington IN, USA*

The connectedness of the support of free convolutions (additive and multiplicative) has been studied for special (Jacobi) distributions by several authors (Bao, Erdos, Schnelli, Moreillon, Ji). We show that many of these results remain true for arbitrary distributions. The proofs use recent insights about analytic subordination. This is joint work with C. K. Ho and S. Belinschi.

**The Lorentz force equation: a functional analytic approach**
Cristian Bereanu
*University of Bucharest, Bucharest, Romania*

In this talk we consider the Lorentz force equation with periodic conditions on a fixed interval. In Special Relativity, this equation models the motion of a slowly accelerated electron under the influence of an electric field and a magnetic field. We provide a rigourous critical point theory by showing that the solutions are the critical points in the Szulkin's sense of the corresponding Poincare non-smooth Lagrangian action. By using a novel minimax principle, we prove a variety of existence and multiplicity results. This is a joint work with D. Arcoya and P. Torres.

**Photometric observations of 159 small near-earth objects in the frame of EU NEOROCKS Programme**
Mirel Bîrlan
*Astronomical Institute of the Romanian Academy, Bucharest, Romania*

NEOROCKS is an EU HORIZON project which was started in 2020. This project is devoted to improve our knowledge of the Near Earth Objects (NEO) population using different observational techniques. In this work the result of photometric observations of small NEOs that were conducted within the NEOROCKS project by the team at Paris observatory in the past three years will be presented.

Photometric observations were performed using French assets, in particular the 1.2m telescope at the Haute-Provence observatory. Several observational runs were performed in 2020-2023 and more runs are still scheduled in 2023. To date, we observed 159 NEOs. Among them, 85 objects are classified as Potentially Hazardous Asteroids (PHAs), representing NEOs with minimum orbital intersection distance MOID $< 0.05$ au and absolute magnitude H $< 22$. The majority observed NEOs fall into the H $= 17 - 23$ magnitude range and have diameters of less than 500 m. Results of taxonomic classification of these objects will be presented.

Acknowledgments: We acknowledge funding from the European Union's Horizon 2020 research and innovation program under grant agreement No. 870403.

**Exponential mixing for incompressible stochastic flows and an example of Pierrehumbert**
Alex Blumenthal
*Georgia Institute of Technology, Atlanta, USA*

Many systems of real-world interest are observed, numerically and empirically, to exhibit chaotic behavior, yet it remains a notoriously challenging problem to prove, for concrete systems in general position, whether or not chaotic behavior is present in positive-volume sets of phase space, e.g., sensitive dependence on initial conditions or rapid decay of correlations. Remarkably, this problem is more tractable in the presence of noise. In this talk I will discuss a framework for proving a positive Lyapunov exponent and almost-sure exponential correlation decay for a class of random incompressible flows due to Pierrehumbert. Joint work with Michele Coti-Zelati and Rishabh Gvalani.

**An inverse problem related to a system of ordinary differential equations that describes the motion of a meteoroid**

Ioana Boacă
*Astronomical Institute of the Romanian Academy, Bucharest, Romania*

In this work we present the main properties of a meteoroid detected with the use of all-sky cameras. We determined ballistic coefficient $\alpha$ and the mass-loss parameter $\beta$ starting from the measured values of the velocity of a meteoroid by using the least square method (an inverse problem related to a system of ordinary differential equations). Once the ballistic coefficient $\alpha$ and the mass-loss parameter $\beta$ for are determined for a selected sample of fireball events showing noticeable deceleration ($V_f/V_0 < 0.8$) we are able to determine which of the meteoroids can produce meteorites on the Earth's surface.

**Analytical solutions to peridynamic models in elasticity and diffusion**

Florin Bobaru
*University of Nebraska-Lincoln, Lincoln, Nebraska, USA*

Peridynamic models are described by integro-differential equations (IDEs) with associated initial and nonlocal boundary conditions. I will present some recent results on obtaining analytical solutions to transient diffusion (heat and mass transfer, etc.) and elastodynamics problems using the idea of separation of variables employed in the classical partial differential equations (PDEs) problems. We show that, formally, the solutions to the initial and boundary values problems for IDEs are identical to those of the corresponding PDEs-based problems with the exception of the presence of a "nonlocal factor" which becomes equal to one in the PDE case. The discussion covers both 1D and 2D cases, and extensions to 3D problems are immediate. For a number of examples we prove uniform convergence of the series solutions. If time permits, I will also discuss some interesting connections between analytical classical solutions and approximate nonlocal solutions. This work is in collaboration with Prof. Z. Chen (Huazhong University of Science and Technology, China) and Dr. S. Jafarzadeh (Lehigh University, USA), and is detailed in https://doi.org/10.1007/s42102-022-00080-7 (for diffusion) and a paper to appear in Int. J. of Engineering Science.

**Dislocations interacting with growing cracks: a peridynamic approach**

Florin Bobaru
*University of Nebraska-Lincoln, Lincoln, Nebraska, USA*

We introduce a peridynamic (PD) model for Discrete Dislocation Dynamics and verify its accuracy in uniaxial tension in a single crystal and a polycrystal. The model is then used to simulate elastoplastic fracture by considering interactions between dislocations and a growing crack. For mode I elastoplastic fracture in a single crystal, we observe that the crack path is attracted towards regions of high density of gliding dislocations, leading to an undulating crack paths, as observed in experiments but never replicated by continuum-level computational models before. Tests on different sample sizes show how the proximity of constraints to the crack tip can lead to plastic hardening. Ductile-to-brittle transition happens naturally in this model when the crack, under mode I displacement-controlled loading, approaches a free edge.The new PD model can be used to investigate complicated elastoplastic fracture problems in which the interaction between dislocation motion and damage is critical. This work is in collaboration with Prof. Ziguang Chen's group at Huazhong University of Science and Technology, Wuhan, China. For details please see: https://doi.org/10.1016/j.ijplas.2022.103462

**Euclidean dynamics and quadratic irrationals**
Florin Boca
*University of Illinois at Urbana-Champaign, USA*

The periodic points of the Gauss map coincide with the reduced quadratic irrationals, known to be related with the Pell equation and with closed geodesics on the modular surface. Classical work of Pollicott proved uniform distribution of these numbers with respect to the Gauss probability measure, when ordered by their associated closed primitive geodesic length. An effective version was established more recently by Ustinov. This talk will discuss the distribution of periodic points of Gauss type shifts arising from other types of Euclidean continued fractions and the corresponding classes of reduced quadratic irrationals. This is joint work with Maria Siskaki.

**Analysis and control in poroelastic systems with applications to biomedicine**
Lorena Bociu
*NC State University, Raleigh, USA*

We present new results related to well-posedness, sensitivity analysis, and optimal control problems for quasi-static nonlinear poroelastic systems with applications in biomechanics. The PDE systems under consideration represent nonlinear, implicit, degenerate evolution problems, which fall outside of the well-known implicit semigroup monotone theory. We also consider scenarios where the local, accurate, 3D poroelastic PDE systems are coupled with systemic, 0D, lumped models of the remainder of blood circulation, in order to account for the global features of the problem. Our results have applications in biology, medicine and bio-engineering, including tissue perfusion, fluid flow inside cartilages and bones, and design of bioartificial organs.

**$\pi$ and the irreducibility of polynomials that take a prime value**
Nicolae Bonciocat
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

Given an integral polynomial $f$, we show how $\pi$ is related to lower bounds on the positive integer values $m$ for which the primality of $f(m)$ guarantees the irreducibility of $f$. Our study relies on finding suitable zero-free angular sectors and zero-free lens-shaped regions for $f$ and its reciprocal. The results are based on joint work with C. M. Bonciocat.

**On the dynamics of a class of differential systems with two limit cycles**
Rachid Boukoucha
*University of Bejaia, Bejaia, Algeria*

An important problem of the qualitative theory of differential equations is to determine the limit cycles. In 1900 Hilbert in the second part of his 16th problem proposed to find an estimation of the uniform upper bound for the number of limit cycles of all polynomial vector fields of a given degree, and also to study their distribution or configuration in the plane. This has been one of the main problems in the qualitative theory of planar differential equations in the 20th century. In this work, we consider the special class family of the polynomial differential system. We give an explicit expression of invariant algebraic curves, then we prove that these systems are integrable and we introduce an explicit expression of a first integral. Moreover, we determine sufficient conditions for a polynomial differential system. to possess two limit cycles, explicitly given. Concrete examples exhibiting the applicability of our result are introduced.

**Multiple weak solutions for anisotropic systems with variable exponents**
Maria-Magdalena Boureanu
*University of Craiova, Craiova, Romania*

We are interested in anisotropic systems involving nonhomogeneous differential operators. We discuss the generality of these operators and we present examples of systems which represent particular cases of our system. The study is conducted in the framework of the variable exponent spaces and we rely on a three critical points theorem of Ricceri type for the main result.

**Change of scalars and bounded silting complexes**
Simion Breaz
*Babeş-Bolyai University, Cluj-Napoca, Romania*

I will discuss the transfer, via extension of scalars functors, of the (co)silting property associated to some complexes (as objects in the derived category of a module category). In the case of commutative rings, we will see that the derived versions of the (co)extension of scalars functors preserve (co)silting objects of (co)finite type. In the last part of the talk, I will discuss some cases when these functors reflect the (co)silting property.

**Relating Catlin and D'Angelo $q$-types invariants**
Vasile Brînzănescu
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

One clarifies the relationship between the two most standard ways to measure the order of contact of $q$-dimensional complex varieties with a real hypersurface. These invariants play an important role in the Kohn algorithm for the Neumann problem for $(p, q)$-forms. Joint work with Andreea Nicoară.

**Barycenters in non-positively curved metric spaces**
Victor-Emmanuel Brunel
*CREST, Paris, France*

Barycenters are a natural extension of the notion of linear averaging in metric spaces. We will present concentration inequalities for barycenters of i.i.d. random variables taking values in a metric spaces, under a condition of non-positive curvature. Examples of non-positively curved spaces are Euclidean and Hilbert spaces, metric trees, the cone of positive definite matrices equipped with a specific Riemannian metric (for which barycenters correspond to geometric means), etc. In particular, we will give extensions of Hoeffding's and Bernstein's inequalities. The talk will start with a short introduction on metric spaces, geodesics, curvature (in Alexandrov's sense) and geodesic convexity, and will not require any prior knowledge on metric geometry.

**On Korovkin Theorem**
Ileana Bucur
*The Technical University of Civil Engineering, Bucharest, Romania*

The famous Korovkin Theorem asserts that if a sequence $(T_n)_n$ of positive linear operators on the Banach space $C$ of all continuous real functions defined on the interval $[0,1]$ are such that the sequences $(T_n(1))_n, (T_n(x))_n, (T_n(x^2))_n$ are uniformly convergent to the functions $1, x$, respectively $x^2$, then the sequence $(T_n(f))_n$ converges uniformly to $f$ for any $f \in C$.

We give a large generalization of this result for a set $A$ of real, bounded, measurable functions on $X$ and a sequence $(T_n)_n$ of kernels on $X$ such that the sequence $(T_n(a))_n$ converges simply or uniformly to a function $a$ for all $a \in A$. We show that the same approximation holds for all measurable functions "controlled" by $A$.

An application to excessive and fine topology is given.

**Non extinction versus compactness inverse Tchebyshev inequality**
Gheorghe Bucur
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

Starting with a Galton-Watson process $(Z_n)_n$ having $\mu_0 = (\lambda_n)_n$ as initial distribution and $\mu = (\mu_n)_n$ the "reproduction law on $\mathbb{N}$" the problem of *non-extinction* of $(Z_n)_n$ is strongly related to $\mu$. We give some relation of this phenomena with the compactness of the sequence $(Z_n)_n$ sometimes given by the law $\mu$ itself. The ingredient used in the proof is a converse of Tchebyshev's inequality.

**On sovereign, balanced and ribbon (quasi-)Hopf algebras**
Daniel Bulacu
*University of Bucharest, Bucharest, Romania*

We present examples of balanced and ribbon (quasi-)Hopf algebras, obtained from a sort of double construction which associates to a braided category (resp. rigid braided) a balanced (resp. ribbon) one. This is joint work with Blas Torrecillas (University of Almeria, Spain).

**On the homogenization of some problems with sign-changing coefficients**
Renata Bunoiu
*CNRS and IECL, University of Lorraine, Metz, France*

This talk focuses on the presentation of some homogenization results for sign-changing problems. The problems studied are inspired by metamaterials, composite materials that can produce an index of refraction negative, and which have practical applications in optics, electromagnetism, acoustics. By adapting the T-coercivity method on the one hand and homogenization techniques on the other hand, we prove that the problems under study, as well as the homogenized problems, are well posed and we obtain results of convergence of the initial solutions towards the solutions of the homogenized problems. Based on joint works with L. Chesnel, K. Ramdani, M. Rihani, C. Timofte.

**Burnside vanishing type results for fusion categories**
Sebastian Burciu
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

In this talk we extend a classical vanishing result of Burnside from the character tables of finite groups to the character tables of commutative fusion rings, or more generally to certain classes of abelian real non-negative hypergroups. We also treat the dual vanishing result. As applications we prove new identities that hold in the Grothendieck ring of any weakly-integral fusion category satisfying the dual Burnside vanishing result. Based on a joint work with Sébastien Palcoux.

**Convergence of $\alpha$-Euler to Euler for low regularity**
Adriana Valentina Busuioc
*Institut Camille Jordan, Université Jean Monnet Saint-Etienne, France*

We consider the $\alpha$-Euler equations on a bounded domain with Dirichlet boundary conditions in dimension two. We prove the convergence to the Euler equations when $\alpha$ goes to 0 when the potential vorticity belongs to $L^p$ with $p \geq 1$ or is a bounded positive measure.

**A special graph convex covering problem**
Radu Buzatu
*Moldova State University, Chişinău, Moldova*

The general graph convex covering problem is known to be NP-complete. We focus on the special kind of this problem, which in some cases is computationally significantly easier. We present recent results and provide several applications of special graph convex covering problem.

**A classical logic for linguistic vagueness**
Marian Calborean
*University of Bucharest, Bucharest, Romania*

Vagueness in language is treated as statistical dispersion, using the interplay of preference relations and monadic predicates. A conservative extension of classical first-order logic allows defining a tolerant and a strict predicate for each monadic predicate. Results include the failure of weak non-contradiction and of a weak law of excluded middle, and the validity of weak tolerance principles.

**Recent results on Hardy inequalities for magnetic $p$-Laplacians**
Cristian Cazacu
*University of Bucharest & Gheorghe Mihoc-Caius Iacob Institute of Mathematical Statistics and Applied Mathematics of the Romanian Academy, Bucharest, Romania*

In this talk we present some recent results on improved Hardy inequalities for the magnetic $p$-Laplacian due to adding nontrivial magnetic fields. We also show that for Aharonov Bohm magnetic fields the sharp constant in the Hardy inequality becomes strictly larger than in the case of a magnetic-free $p$-Laplacian. In the end we post some remarks with open problems.

This exposure is based on a joint work with David Krejčiřík (Czech Technical University, Prague, Czech Republic), Nguyen Lam (Memorial University of Newfoundland, Canada) and Ari Laptev (Imperial College London, United Kingdom).

Partially supported by CNCS-UEFISCDI Romania, Grant No. PN-III-P1-1.1-TE-2021-1539.

**An overview of computations of Categorical Enumerative Invariants**
Andrei Căldăraru
*University of Wisconsin-Madison, Madison WI, USA*

Catgeorical Enumerative Invariants were introduced by Costello (2005) and, in a different form, by Cotello, Tu, and the author (2020). They are a sequence of numerical invariants associated to a Calabi-Yau category and a splitting of its non-commutative Hodge filtration. In my talk I will survey recent progress in computing such invariants for elliptic curves (generalizing GW, FJRW and BCOV theories in enumerative geometry/mirror symmetry) and for rational surface singularities (generalizing Saito theory in singularity theory). This talk is based on joint work with Junwu Tu, Si Li, Yunfan He, Weng-Him Cheung.

**On a class of hyperbolic fractional integro-differential inclusions**
Aurelian Cernea
*University of Bucharest, Bucharest, Romania*

A Darboux problem associated to a fractional hyperbolic integro differential inclusion defined by a Caputo type fractional derivative is studied. By employing a method originally introduced by Filippov it is obtained an existence result for this problem in the situation when the values of the set-valued map are not convex. Also, it is provided the existence of solutions continuously depending on a parameter for the problem studied. This result allows to deduce a continuous selection of the solution set of the problem considered.

**Roumieu Regularity of differential operators of constant strength**
Rachid Chaili
*University of Science and Technology, Oran, Algeria*

The aim of this work is to show that every solution of hypoelliptic differential equations of constant strength with coefficients in Roumieu spaces is in some Roumieu space. Recall that a differential operator $P(x, D)$ is of constant strength in $\Omega$ if

$$\forall x, y \in \Omega, \exists C > 0, \forall \xi \in \mathbb{R}^n : \sum_{\alpha} |P^{(\alpha)}(x, \xi)| \leq C \sum_{\alpha} |P^{(\alpha)}(y, \xi)|.$$

Theorem: Let $P(x, D)$ be a differential operator of constant strength in a neighborhood of $x_0$, and let $M_p$ a Roumieu sequence, then there exists a open neighborhood $\Omega$ of $x_0$ such that, if the coefficients of $P(x, D)$ are in $R_M(\Omega)$ and the operator $P_0(D) = P(x_0, D)$ is $d-$hypoelliptic we have

$$\forall u \in \mathcal{D}'(\Omega) : P(x, D)u \in R_M(\Omega) \Rightarrow u \in R_{M^d}(\Omega),$$

where $R_M(\Omega)$ designates the Roumieu space of ultra-differentiable functions in $\omega$ defined by the sequence $M_p$.

**Recent results in proof mining and applications of interactive theorem proving**
Horaţiu Cheval
*University of Bucharest, Bucharest, Romania*

Proof mining is a research program in applied logic developed by Ulrich Kohlenbach and his collaborators since the 1990's, concerned with the extraction of hidden effective results from nonconstructive mathematical proofs, through an analysis guided by proof theoretical tools. In this talk, we will present some recent results in optimization and nonlinear analysis obtained in the context of proof mining. We will also discuss the potential applications of interactive theorem proving to the field, and implementations in the Lean proof assistant of some results and techniques from proof mining.

**An invariant theoretic approach to the representation-type of a finite-dimensional algebra**
Călin Chindriş
*University of Missouri, Columbia MO, USA*

The Tame-Wild Dichotomy, a fundamental result due to Y. Drozd, asserts that every finite-dimensional algebra is of tame or wild representation type, and these types are mutually disjoint. This talk is aimed at capturing the Tame-Wild dichotomy within the framework of Geometric Invariant Theory (GIT). To this end, we introduce the class of GIT-finite algebras (among which are all representation-finite algebras) and that of GIT- tame algebras (among which are all GIT-finite algebras and all tame algebras). We will give a characterization of the GIT-finiteness/GIT-tameness of an algebra in terms of its weight spaces of semi-invariants/moduli spaces of representations. We will also present a string of conjectures about GIT-finite/GIT-tame algebras, Schur-finite/Schur-tame algebras, and rigidity in $\tau$-tilting theory.

**Quasifinite fields of prescribed characteristic and Diophantine dimension**
Ivan Chipchakov
*Institute of Mathematics and Informatics of the Bulgarian Academy of Sciences, Sofia, Bulgaria*

Let $\mathbb{P}$ be the set of prime numbers, $\overline{\mathbb{P}}$ the union $\mathbb{P} \cup \{0\}$, and for any field $E$, let $\mathrm{char}(E)$ be its characteristic, $\mathrm{ddim}(E)$ the Diophantine dimension of $E$, $\mathcal{G}_E$ the absolute Galois group of $E$, and $\mathrm{cd}(\mathcal{G}_E)$ the Galois cohomological dimension of $\mathcal{G}_E$. It is presently unknown whether the inequality $\mathrm{cd}(\mathcal{G}_E) \leq \mathrm{ddim}(E)$ always holds. The main result of this talk proves the existence of quasifinite fields $\Phi_q : q \in \mathbb{P}$, with $\mathrm{ddim}(\Phi_q)$ infinity and $\mathrm{char}(\Phi_q) = q$. This is done by modifying the proof of the existence of $\Phi_0$, obtained by Ax (in: Proc. Amer. Math. Soc. 16 (1965), 1214-1221). Our main result also shows that for any integer $m > 0$ and $q \in \overline{\mathbb{P}}$, there is a quasifinite field $\Phi_{m,q}$ such that $\mathrm{char}(\Phi_{m,q}) = q$ and $\mathrm{ddim}(\Phi_{m,q}) = m$. This is used for proving that for any $q \in \overline{\mathbb{P}}$ and each pair $k, \ell \in (\mathbb{N} \cup \{\infty\})$ satisfying $k \leq \ell$, there exists a field $E_{k,\ell;q}$ with $\mathrm{char}(E_{k,\ell;q}) = q$, $\mathrm{ddim}(E_{k,\ell;q}) = \ell$ and $\mathrm{cd}(\mathcal{G}_{E_{k,\ell;q}}) = k$. Furthermore, the field $E_{k,\ell;q}$ can be chosen to be perfect unless $k = 0 \neq \ell$. Joint work with Boyan Paunov.

**Abstract connectives in Institution Theory**
Claudia Chiriţă
*University of Bucharest, Bucharest, Romania*

Goguen and Burstall's institution theory has reshaped areas such as model theory and formal specification by providing category-theoretic abstractions of concepts from mathematical logic. One of the main advantages of this approach is that it declutters the workspace by allowing us to study logical phenomena unhindered by unnecessary details: many results in institution theory are agnostic to the structure of sentences or models. But this kind of abstraction is sometimes excessive when we want to illuminate specific features of logics, and calls for extensions of the original notion of institution. For example, stratified institutions recover local satisfaction as in possible-world semantics, capturing a wide class of modal logics. We continue this line of work by introducing an abstract concept of selection of connectives to deal with syntax in a modular manner, arriving at an intermediate level between concrete logics and institutions. To illustrate its use, we show how logics with typed modalities can be obtained through combinations of connectives.

**An average equal to 1 for every non-trivial finite group**
Mihai Chiş
*West University of Timişoara, Timişoara, Romania*

For a finite group $G$ and and a set $T^*$ of representatives for the conjugacy classes of non-trivial elements of $G$, we define a canonical integer associated with every element in $T^*$ and show that the average value of this over $T^*$ is equal to 1.

**Brill-Noether loci in codimension two**
Youngook Choi
*Yeungnam University, Gyeongsan, Republic of Korea*

Let $\mathcal{M}_g$ be the moduli space of smooth complex curves of genus $g$. It is well known that a general curve of genus $g$ has no linear series $g^r_d$ whose Brill-Noether number $\rho(g,r,d)(:= g-(r+1)(g-d+r))$ is negative. The Brill-Noether locus $\mathcal{M}^r_{g,d}$ is defined by the sublocus of $\mathcal{M}_g$ whose elements represent curves possessing a linear series $g^r_d$. In 1987, D. Eisenbud and J. Harris proved that $\mathcal{M}_{23}$ has Kodaira dimension $\geq 1$ by showing that $\mathcal{M}^1_{23,12} \neq \mathcal{M}^2_{23,17}$. In 2000, G. Farkas established that $\mathcal{M}_{23}$ has Kodaira dimension $\geq 2$ by demonstrating that $\mathcal{M}^1_{23,12}$, $\mathcal{M}^2_{23,17}$, and $\mathcal{M}^3_{23,20}$ are mutually distinct. In this talk, we discuss conditions for the existence/non-existence of a smoothable limit linear series on a curve of compact type such that two smooth curves are bridged by a chain of two elliptic curves. This work gives relations among Brill-Noether loci of codimension at most two in the moduli space of complex curves and shows Brill-Noether loci of codimension two have mutually distinct supports.

**On almost monomial groups**
Mircea Cimpoeaş
*University Politehnica Bucharest & Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

We study a class of finite groups, called almost monomial groups, which generalize the class of monomial groups and is connected with the theory of Artin $L$-functions. Our method of research is based on finding similarities with the theory of monomial groups, whenever it is possible.

**Specification, implementation and verification of an image format in Dafny**
Ştefan Ciobâcă
*Alexandru Ioan Cuza University, Iaşi, Romania*

Dafny is a verification-oriented programming language, based on deductive verification. It can be used to specify and verify imperative computations.

Programming software systems in Dafny increases our level of trust in their correctness, which is desirable for critical systems, such as system software.

However, specifying, implementing and verifying software in Dafny can be orders of magnitude more difficult than using a traditional programming language, because of the additional burden of specifying and proving the system. Furthermore, there are comparatively fewer educational resources and less know-how for structuring such verified software.

In this talk, I will show how Dafny can be used to specify a recently devised image format based on run-length encoding, and how to implement and verify the corresponding encoding/decoding algorithm.

I will go over the various design options for structuring the verification effort. I will explain what is the best structure, which enables a more straight forward verification process.

**Equations in groups: between decidability and undecidability**
Laura Ciobanu
*Heriot-Watt University, Edinburgh, UK*

For a group or semigroup or ring $\mathcal{G}$, solving equations where the coefficients are elements in $\mathcal{G}$ and the solutions take values in $\mathcal{G}$ can be seen as akin to solving systems of linear equations in linear algebra, Diophantine equations in number theory, or more generally, polynomial systems in algebraic geometry.

In this talk I will give a survey about solving equations in infinite non-abelian groups, with emphasis on free groups, and show how imposing certain constraints on the solutions can tilt the balance between decidability and undecidability.

**Challenging logical doubts with an extended version of finitism**
Gabriel Ciobanu
*Alexandru Ioan Cuza University & IIT Romanian Academy, Iaşi, Romania*

Mathematics is based heavily on intuition. Regarding the reliability of our intuitions, we decide how credulous or sceptical we are when setting out the fundamental beliefs (based on perception, experience, caution). The axiom of choice (AC) allows us to make an infinite number of arbitrary choices; it has generated a large amount of controversy (Banach-Tarski paradox is one of the non-intuitive consequence of AC). Hilbert's finitism says that any theorem about finite objects that can be obtained using ideal infinite objects can be also obtained without them. We extend this finitism by using the set theory with atoms ZFA (including the axiom of infinity) by adding a new axiom saying that we work with finitely supported sets. Inspired by the permutation models (introduced in 1922 by Fraenkel and developed by Mostowski in 1938 to show the independence of AC from the other axioms of ZF/ZFA), the finitely supported sets are infinite sets having finitely many elements up to permutations of the underlying structure of atoms. Many ZF results can be translated in this new frame by replacing "(non-atomic) set" with "finitely supported (atomic) set". We prove that most of the important ZF results are valid for finitely supported sets. However, some results are no longer valid in this framework. We prove that AC and the choice principles are not valid in this new set theory based on finitely supported sets. Moreover, the continuum hypothesis is not valid in this extended version of finitism based on finitely supported sets.

**Bounds for the size of $D(n)-$sets**

Mihai Cipu
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

The notion of $D(n)-$set emerged from several very old problems. One of the fundamental questions remains how large a $D(n)-$set can be. The aim of the talk is to present some recent answers along with essential ideas in the proofs.

**Successive determination of the coefficients of $AR(p)$ time series using the Cholesky decomposition**

Daniel Ciuiu
*Technical University of Civil Engineering Bucharest and Romanian Institute for Economic Research, Romanian Academy, Romania*

In this talk we will determine successively the $AR(p)$ coefficients of a time series starting with the $AR(1)$ model, continuing with $AR(2)$, $AR(3)$, ... and finishing with $AR(p)$ model.

We use the essential fact that the matrix of linear system of the Yule–Walker algorithm is symmetric and positive defined. That's why we solve the linear system by Cholesky method.

We consider all $AR(\widetilde{p})$ with $\widetilde{p} < p$ having $p$ coefficients, last $p - \widetilde{p}$ of them being zero. We use also the linearity of the solutions of linear systems with the same matrix. More exactly, we go from $AR(\widetilde{p})$ to $AR(\widetilde{p}+1)$ coefficients by determining the difference between coefficients.

**From Monte Carlo to neural networks approximations of boundary value problems**

Iulian Cîmpean
*University of Bucharest & Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

We present probabilistic and neural network approximations for solutions to Poisson equation subject to Holder continuous Dirichlet boundary conditions in general bounded domains in $\mathbb{R}^d$. Our main results are two-folded: On the one hand we show that the solution to Poisson equation can be numerically approximated in the sup-norm by Monte Carlo methods, without the curse of high dimensions and efficiently with respect to the prescribed approximation error. On the other hand, we show that the obtained Monte Carlo solver renders a random ReLU deep neural network (DNN) that provides with high probability a small approximation error and low polynomial complexity in the dimension. This is joint work with L. Beznea, O. Lupascu, I. Popescu, and A. D. Zarnescu.

**Controllability of the linear elasticity as a first order in time and space system**
Nicolae Cîndea
*Université Clermont Auvergne, Clermont-Ferrand, France*

The aim of this talk is to present some results concerning the boundary controllability of the linear elasticity system considered as a first-order system in both space and time. Using the observability inequality known for the usual second-order elasticity system, we deduce an equivalent observability inequality for the associated first-order system. Then, the control of minimal $L^2$-norm can be found as the solution to a space-time mixed formulation. This first-order framework is particularly interesting from a numerical perspective since it is possible to solve the space-time mixed formulation using only piecewise linear $C^0$-finite elements. Numerical simulations illustrate the theoretical results.

These results are obtained in a joint work with Arthur Bottois.

**Bee's eyes among lattice points**
Cristian Cobeli
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

Our object is to explore patterns, visibility phenomena and distribution problems on lattice points in dimensions two or in large dimensions. Measuring segments and angles from different points of view we observe that the cardinality of certain sets with particular properties far exceeds the number we might have initially expected.

**Stable unital bases, hyperfocal subalgebras and basic Morita equivalences**
Tiberiu Coconeţ
*Babeş-Bolyai University, Cluj-Napoca, Romania*

We investigate a conjecture introduced by Barker and Gelvin involving source algebras of $p$-blocks of group algebras. We reduce this conjecture to a similar statement about the hyperfocal subalgebras of the source algebras. The class of blocks verifying the conjecture is closed under basic Morita equivalences.

**A class of nonlinear dynamic contact problems in thermoviscoelasticity**
Marius Cocou
*Aix-Marseille University, Marseille, France*

This work is concerned with the analysis of a class of dynamic contact problems with Coulomb friction between two thermoviscoelastic bodies with nonlinear elasticity and viscosity operators. The presented results extend to thermomechanical processes the unified approach used recently to solve some isothermal dynamic contact problems with complex boundary conditions including relaxed unilateral contact, pointwise friction, and adhesion. We study a mixed variational formulation given as an evolution system of two coupled nonlinear equations for which the Lagrange multipliers satisfy the contact constraints including the frictional heat generation condition. The existence of a strong solution is proved by using an equivalent fixed point problem for a multifunction, several estimates, and some existence results for variational equations.

**Spaces of holomorphic sections vanishing along subvarieties**
Dan Coman
*Syracuse University, Syracuse NY, USA*

Let $L$ be a holomorphic line bundle on a compact normal complex space $X$ of dimension $n$, let $\Sigma = (\Sigma_1, \ldots, \Sigma_\ell)$ be an $\ell$-tuple of distinct irreducible proper analytic subsets of $X$, and $\tau = (\tau_1, \ldots, \tau_\ell)$ be an $\ell$-tuple of positive real numbers. We consider the space $H^0_0(X, L^p)$ of global holomorphic sections of $L^p := L^{\otimes p}$ that vanish to order at least $\tau_j p$ along $\Sigma_j$, $1 \leq j \leq \ell$, and give necessary and sufficient conditions to ensure that $\dim H^0_0(X, L^p) \sim p^n$. We also discuss the convergence of the corresponding Fubini-Study currents and their potentials, and the distribution of normalized currents of integration along zero divisors of random holomorphic sections in $H^0_0(X, L^p)$ as $p \to \infty$. This is joint work with George Marinescu and Viêt-Anh Nguyên.

**Exact solution of the atemporal Schrödinger equation with a perturbed-harmonic potential using Laplace transform**
Diana Rodica Constantin
*Astronomical Institute of the Romanian Academy, Bucharest, Romania*

In the two body problem, we consider Schrödinger's equation in the stationary case with a harmonic potential perturbed by the $\frac{C}{r^2}$ term for the case $0 < \mu C \ll 1$ , $\mu$ being the reduced mass of the system. We call this potential, denoted $V_{ph}$, a pseudo-harmonic potential with a centrifugal term. Applying Laplace transform method, we obtain the analytic solution in the $V_{ph}$ - potential problem. Using directly and inverse Laplace transforms, we give exact forms of the energy eigenvalues and the wave functions for this potential. Concluding, we give the observable expression of root-mean-square charge radius.

**The spherical harmonics role in 3D visualization of the orbitals for hydrogen-like atoms**
Diana Rodica Constantin
*Astronomical Institute of the Romanian Academy, Bucharest, Romania*

We work in the physical model of the hydrogen-like atom. Thus, in a quantum framework, based on the Schrödinger's equation with Coulomb-potential, we focus on the angular components of the wave eigen-functions provided by the quantum model and corresponding to quantum states with $n \leq 4$. To visualize the orbital shapes of these states, we constructed their 3D-geometric representations in the spherical coordinate system. Furthermore, by means of the corresponding spherical harmonics, we calculate the angular nodal values $\theta$ which explain the configurations of these orbital states.

**ICA model estimation using a mixed learning rule based on neural network and genetic algorithm**

Doru Constantin
*University of Piteşti, Piteşti, Romania*

This paper presents a new method of estimating the independent component analysis model based on the use of a training algorithm based on a mixed learning algorithm of neural networks type with genetic algorithms. The mixed training algorithm is applied to optimize the objective function used to estimate the ICA model. The experimental results for the new independent component estimation algorithm are established in specific blind source separation applications. The presented results are a joint work with Costel Bălcău.

**Cotangent cohomology for matroids**

Alexandru Constantinescu
*Freie Universität Berlin, Germany & Simion Stoilow Institute of Mathematics of the Romanian Academy, Romania*

The first and the second cotangent cohomology modules ($T^1$ and $T^2$) of a commutative ring $R$ control the algebraic deformations of the associated affine scheme. The first module is in bijection with the first order deformations (i.e.deformations with parameter space $\mathbb{C}[\varepsilon]/(\varepsilon)^2$) and the second module contains the obstructions to lifting such deformations to larger parameter spaces. Any grading on $R$ is inherited by $T^1$ and $T^2$. In such a setting, the degree zero components control the algebraic deformations of the associated projective scheme. The main result of my talk states that $T^1$ a Stanley-Reisner completely characterizes if the underlying simplicial complex is a matroid. Furthermore, in such cases, one can completely recover the matroid from the multigraded components of $T^1$. This is far from being true for simplicial complexes in general. I will also present a simple formula for computing $T^1$ for a matroid, and some partial results on $T^2$ for matroids.

**Bulk-edge correspondence for unbounded Dirac-Landau operators**

Horia Cornean
*Aalborg University, Aalborg, Denmark*

We consider two-dimensional unbounded magnetic Dirac operators, either defined on the whole plane, or with infinite mass boundary conditions on a half-plane. Our main results use techniques from elliptic PDEs and integral operators, while their topological consequences are presented as corollaries of some more general identities involving magnetic derivatives of local traces of fast decaying functions of the bulk and edge operators. One of these corollaries leads to the so-called Streda formula: if the bulk operator has an isolated compact spectral island, then the integrated density of states of the corresponding bulk spectral projection varies linearly with the magnetic field as long as the gaps between the spectral island and the rest of the spectrum are not closed, and the slope of this variation is given by the Chern character of the projection. The same bulk Chern character is related to the number of edge states which appear in the gaps of the bulk operator. This is joint work with M. Moscolari and K. Sørensen.

**Scheme-based theory exploration (and algorithm synthesis) by lazy thinking**
Adrian Crăciun
*West University of Timişoara, Timişoara, Romania*

Lazy Thinking is a deductive, scheme-based synthesis method, proposed by Bruno Buchberger as part of a mathematical theory exploration model and implemented to some extent in the Theorema system. Lazy Thinking works as follows: try to prove the correctness of an algorithm (i.e. its specification) using an algorithm scheme (algorithmic idea). All definitions and properties of concepts involved in the specifications are known. The proof is likely to fail, since the proposed algorithmic solution has "holes", i.e. is expressed in terms of unknown components. Following an analysis of the failing proof, conjectures are generated and added to the knowledge, such that the failure can be overcome. These conjectures turn out to be specifications for the unknown components. Algorithms that satisfy the generated specifications can then either be retrieved from the knowledge base, or synthesized by lazy thinking in subsequent rounds of exploration.

We give some examples of scheme-based theory exploration, including the synthesis of a Groebner Bases algorithm.

**Mappings of finite distortion and mappings of finite distortion; the modulus method**
Mihai Cristea
*University of Bucharest, Bucharest, Romania*

We study the geometric properties of some classes of mappings for which an inverse Poletsky modular inequality holds. Our approach is basically on Riemannian manifolds and we give in these classes of mappings some extensions of the theorems of Lindelöf and Fatou from the classical complex analysis. We also find some conditions for the existence of injective minimizers for mappings of bi-conformal energy.

**Coagulation equations for non-spherical clusters**
Iulia Cristian
*University of Bonn, Bonn, Germany*

In this talk, we investigate the long-time asymptotics of a coagulation model which describes the evolution of a system of particles characterized by their volume and surface area. The aggregation mechanism takes place in two stages: collision and fusion of particles. We assume the coagulation kernel has a weak dependence on the area variable. We discover that the long-time analysis of the system is strictly related to the chosen fusion rate. We prove existence of self-similar profiles for some choices of the functions describing the fusion rate for which the particles have a shape that is close to spherical. On the other hand, for other fusion mechanisms, we show that the particle distribution describes a system of ramified-like particles.

Lastly, we talk about how we are able to recover the standard coagulation equation in the case of fast fusion.

This is joint work with J. J. L. Velázquez (University of Bonn).

**Spaces of Riemann-Lebesgue integrable functions**
Anca Croitoru
*Alexandru Ioan Cuza University, Iaşi, Romania*

We present some properties of the Riemann-Lebesgue integrable functions with respect to a vector measure. The Riemann-Lebesgue integral is an extension of the Riemann integral and was introduced by Kadets and Tseytlin in 2000. Joint work with Hemanta Kalita.

**Some Bourgain-Brézis type solutions via complex interpolation**
Eduard Curcă
*Alexandru Ioan Cuza University, Iaşi, Romania*

In 2002 Bourgain and Brézis proved that given a vector field $v \in \mathcal{S}'(\mathbb{R}^d) \cap \dot{W}^{1,d}(\mathbb{R}^d)$ there exists a vector field $u \in L^\infty(\mathbb{R}^d) \cap \dot{W}^{1,d}(\mathbb{R}^d)$ such that $\operatorname{div} u = \operatorname{div} v$ . We prove several results of a similar nature in which we take into consideration the Fourier support of the solutions. For instance, in the case $d \geq 3$ we prove the following: for any vector field $v \in \mathcal{S}'(\mathbb{R}^d) \cap \dot{B}_q^{d/p,p}(\mathbb{R}^d)$ (where $p \in [2,\infty)$ and $q \in (1,2)$), with $supp\ \widehat{v} \subseteq \mathbb{R}^d \backslash (-\infty,0)^d$, there exists a vector field $u \in L^\infty(\mathbb{R}^d) \cap \dot{B}_2^{d/p,p}(\mathbb{R}^d)$, with $supp\ \widehat{v} \subseteq \mathbb{R}^d \backslash (-\infty,0)^d$, such that $\operatorname{div} u = \operatorname{div} v$ and

$$\|u\|_{L^\infty \cap \dot{B}_2^{d/p,p}} \lesssim \|v\|_{\dot{B}_q^{d/p,p}} .$$

Our arguments rely on a version of the complex interpolation method combined with some ideas of Bourgain and Brézis.

**On $q$-sums of bicomplex Jacobsthal numbers**
Sule Curuk
*Pamukkale University, Türkiye*

In this study, we investigated bicomplex numbers whose coefficients were selected from one of the special number sequences.Also, we examined some important properties of this newly defined sequence we created by giving the q form and finding the exponential generating function. Morever, we also gave the odd and even term sums of these numbers.

**Cohomological obstructions to group stability**
Marius Dadarlat
*Purdue University, West Lafayette, IN, USA*

For a countable discrete groups $G$ we consider $\varepsilon$-representations of $G$ into unitary groups $U(n)$. These are unital maps $\rho : G \to U(n)$ such that $\|\rho(st) - \rho(s)\rho(t)\| < \varepsilon$ for all $s, t \in G$. Kazhdan has shown that the surface groups of genus $> 1$ admit $\varepsilon$-representations which are far from genuine representations in the point-norm topology. We exhibit new classes of hyperbolic groups $G$ which have the same instability features. More precisely, there exist a finite subset $F \subset G$ and $C > 0$ with the following property. For any $\varepsilon > 0$ there is an $\varepsilon$-representation $\rho : G \to U(n)$ such that for any representation $\pi : G \to U(n)$, $\max_{s \in F} \|\rho(s) - \pi(s)\| > C$.

**Compactness of 2-Lipschitz mappings**
Elhadj Dahia
*École Normale Supérieure de Bousaada, Bousaada, Algeria*

Let $(X, d_X)$ and $(Y, d_Y)$ are pointed metric spaces and let $E$ be a Banach space, we say that a map $T : X \times Y \longrightarrow E$ is a 2-Lipschitz operator if there is a constant $C > 0$ such that for each $x, x' \in X$ and $y, y' \in Y$,

$$\left\| T(x,y) - T\left(x,y'\right) - T\left(x',y\right) + T\left(x',y'\right) \right\| \leq C.d_X\left(x,x'\right) d_Y\left(y,y'\right).$$

In this work, we introduce and investigate the compactness concept for the 2-Lipschitz operators, we show the basics of this new class of non-linear mappings. We see that the nature of this extension allow us to transfer some properties of the bilinear compact operators (and also the linear compact operators) to the 2-Lipschitz case.

**Hyperbolic manifolds built on the geometries of their cusps or submanifolds**
Florin Damian
*Moldova State University, Vladimir Andrunachievici Institute of Mathematics and Computer Science, Chişinău, Moldova*

We consider geometric methods that give the possibility to build and investigate hyperbolic manifolds of dimensions 3, 4 and 5, with certain required geometric properties, such as cusps geometry, the geometry of a totally geodesic submanifold, etc. Our methods are based on varying the distance and position of rigid bundles of hyperplanes. Some of these constructions look like 2-dimensional pants in dimension 3. Also we use these examples and methods to obtain non-face-to-face incidence schemes for fundamental polyhedra and as a result to build new manifolds and some exotic tilings on universal coverage space. The communication will be focused on the transfer of methods from discrete geometry to algebraic topology and vice versa.

**Transcendental Okounkov bodies**
Tamás Darvas
*University of Maryland, College Park, USA*

We show that the volume of transcendental big (1,1)-classes on compact Kahler manifolds can be realized by convex bodies, thus answering questions of Lazarsfeld–Mustata and Deng. In our approach we use an approximation process by partial Okounkov bodies, and we study the extension of Kähler currents. (Joint work with R. Reboulet, M. Xia, D. Witt Nystrom, K. Zhang.)

**$B_n$ Generalized pseudo-Kähler structures**
Liana David
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

We define the notions of $B_n$ generalized pseudo-Hermitian and $B_n$ generalized pseudo-Kähler structures on an odd exact Courant algebroid $E$. When $E$ is in the standard form (or of type $B_n$) we express these notions in terms of classical tensor fields on the base of $E$. This is analogous to the bi-Hermitian viewpoint on generalized Kähler structures on exact Courant algebroids. We describe left-invariant $B_n$ generalized pseudo-Kähler structures on Courant algebroids of type $B_n$ over Lie groups of dimension two, three and four. This is joint work with Vicente Cortes (accepted in J. Geom Analysis 2023).

**Local, global and general results for finite groups**
Marian Deaconescu
*Deva, Romania*

I will comment on three group-theoretical results: one having a local condition, another based on a global condition and yet another with no conditions at all.

**Probabilistic tools for the fragmentation equation**
Madalina Deaconu
*Inria Nancy - Grand Est & IECL, Nancy, France*

Stochastic modeling is a fundamental tool in understanding, describing, predicting and even generalizing complex phenomena. We develop in this talk fragmentation models which are used in many applications such as: in chemistry, the formation of polymers; in astrophysics, the formation of stars and planets; in geophysics, the formation of fractures or earthquakes, etc. The equation represents the evolution of the concentration of mass of particles which undergo fragmentation in time. We present here an overview of a large class of probabilistic representations of the fragmentation equation, and we develop and study the interconnections in between these representations. These probabilistic tools range from Markov chains to stochastic differential equations with jumps

The mathematical difficulties are numerous and we underline the advantage of the probabilistic interpretation in this context. An important feature of these stochastic models is given by the construction of simple numerical method, allowing to describe the behaviour of the mass of the particles over time.

This is a common work with Antoine Lejay (Inria Nancy - Grand Est & Institut Élie Cartan de Lorraine).

**$C^*$-algebras from $k$ group representations**
Valentin Deaconu
*University of Nevada, Reno, USA*

We introduce certain $C^*$-algebras and $k$-graphs associated to $k$ finite dimensional unitary representations $\rho_1, ..., \rho_k$ of a compact group $G$. We define a higher rank Doplicher-Roberts algebra $\mathcal{O}_{\rho_1,...,\rho_k}$, constructed from intertwiners of tensor powers of these representations. Under certain conditions, we show that this $C^*$-algebra is isomorphic to a corner in the $C^*$-algebra of a row finite rank $k$ graph $\Lambda$ with no sources. For $G$ finite and $\rho_i$ faithful of dimension at least 2, this graph is irreducible, it has vertices $\hat{G}$ and the edges are determined by $k$ commuting matrices obtained from the character table of the group. We illustrate with some examples when $\mathcal{O}_{\rho_1,...,\rho_k}$ is simple and purely infinite, and with some $K$-theory computations.

**Casorati inequalities for statistical submanifolds**
Simona Decu (Marinescu)
*The Bucharest University of Economic Studies, Bucharest, Romania*

We present some inequalities between intrinsic and extrinsic curvature invariants, namely the normalized $\delta$-Casorati curvatures and scalar curvature of statistical submanifolds in Kenmotsu statistical manifolds of constant $\phi$-sectional curvature, endowed with semi-symmetric metric connection. Furthermore, we investigate the equality cases of these inequalities. We point out also an illustrative example. This talk is based on a joint work with Gabriel Vîlcu.

[1] S. Decu, G.-E. Vîlcu, *Casorati Inequalities for Statistical Submanifolds in Kenmotsu Statistical Manifolds of Constant $\phi$-Sectional Curvature with Semi-Symmetric Metric Connection*, Entropy 24 (6), 2022.

[2] S. Decu, S. Haesen, L. Verstraelen, G.-E. Vîlcu, *Curvature invariants of statistical submanifolds in Kenmotsu statistical manifolds of constant $\phi$-sectional curvature*, Entropy 20, 2018.

[3] S. Decu, S. Haesen, L. Verstraelen, *Optimal inequalities characterising quasi-umbilical submanifolds*, J. Inequal. Pure Appl. Math. 2008.

**Large sets with limited tube occupancy**
Ciprian Demeter
*Indiana University, Bloomington, USA*

Split the unit square into $N^2$ congruent little squares. Is there a choice of $N$ little squares such that each line of arbitrary orientation intersects only $O(1)$ of them? This question is connected to the hypothetical existence of bases of uniformly bounded spherical harmonics of arbitrary degree on the two dimensional sphere. We discuss a few joint results with Ruixiang Zhang. The talk will be entirely elementary.

**Matrix representations of plasma equations**
Suleyman Demir
*Eskisehir Technical University, Eskisehir, Türkiye*

The existing correspondences between variables of electromagnetism and multifluid plasma permit to formulate a system of equations of multifluid plasma in a form analogous to electromagnetism governed by Maxwell equations. Using the resemblance between the basic equations of electrodynamics and plasma dynamics, some matrices related to a special hypercomplex number system have been introduced for the reformulation of plasma equations. After a brief survey on basic plasma equations, the matrix representations of Maxwell-type plasma equations have been presented to simplify equation manipulations. The derived expressions in this work prove that matrices can be used for summarizing the well-known equations of plasma compactly and elegantly.

**VLSM: a general theory for reasoning about faulty distributed systems**
Denisa Diaconescu
*University of Bucharest, Bucharest, Romania*

Formally modeling and reasoning about (asynchronous, message passing) distributed systems with faults is a challenging task. Depending on the system model, an execution of a distributed protocol may be subject to many kinds of faults, from simple recoverable component crashes to Byzantine adversarial actions.

We recently proposed the theory of Validating Labeled State transition and Message production systems (VLSMs) as a general approach to modeling and reasoning about distributed protocols executing in the presence of faults. In particular, VLSM executions can be subject to equivocation behavior. Equivocation refers to claiming different beliefs about the state of the protocol to different parts of the system in order to steer the protocol-abiding components into making inconsistent decisions. A key issue is the fact that messages received from equivocating components seem to be valid messages. For example, if a system tries to come to a consensus about the value of a bit, an equivocating component may claim the bit is 0 to one part of the system, and 1 to the other. Equivocation behavior cannot be produced by a single protocol execution, but only by multiple protocol executions, i.e., an equivocating component behaves as if running multiple copies of the protocol.

In consensus protocols, it is common for components to "validate" received messages in order to ensure that malformed messages are not received. We formalize this idea into a general notion of validator for a system. We show that the effect that Byzantine components can have on honest validators is no different than the effect equivocating components can have on non-equivocating validators. By this, we point out that equivocation fault tolerance analysis is a viable alternative to Byzantine fault tolerance analysis.

The talk will be self-contained and is based on joint work with Vlad Zamfir, Wojciech Kołowski, Brandon Moore, Karl Palmskog, and Traian Florin Şerbănuţă.

**Uniform homological stability and moments of $L$-functions**
Adrian Diaconu
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania & University of Minnesota, USA*

In this talk, I will begin by recalling the conjectural asymptotic formula for the moments of quadratic Dirichlet $L$-functions, and discuss the importance of studying the moments of this family of $L$-functions. Then I will explain the main ideas behind a novel approach to obtain an asymptotic formula for all these moments in the rational function field setting. Based on joint work with Bergstrm, Petersen, and Westerland.

**Computationally feasible strategies for linear temporal logic objectives**
Cătălin Dima
*Université Paris-Est Créteil, France*

Real-life agents seldom have unlimited reasoning power. In this talk, we propose and study a new formal notion of computationally bounded strategic ability in multi-agent systems. The notion characterizes the ability of a set of agents to synthesize an executable strategy in the form of a Turing machine within a given complexity class, that ensures the satisfaction of a linear temporal logic formula in a parameterized game arena. We show that the new concept induces a proper hierarchy of strategic abilities - in particular, polynomial-time abilities are strictly weaker than the exponential-time ones. We also propose an "adaptive" variant of computational ability which allows for different strategies for each parameter value, and show that the two notions do not coincide. Finally, we define and study the model-checking problem for computational strategies. We show that the problem is undecidable even for severely restricted inputs, and present our first steps towards decidable fragments. Talk based on joint work with Wojtek Jamroga.

**On varieties coming from phylogenetic group-based models**
Rodica Andreea Dinu
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania & University of Konstanz, Germany*

Group-based models appear in algebraic statistics as mathematical models coming from evolutionary biology, respectively the study of mutations of organisms. The aim of this talk is to present a study of the Gorenstein property for phylogenetic group-based models. The main result is given by the fact that the varieties associated to a trivalent tree and any of the groups $\mathbb{Z}_3$ and $\mathbb{Z}_2 \times \mathbb{Z}_2$ are Gorenstein Fano varieties, which extends the results of Buczyńska and Wiśniewski for the group $\mathbb{Z}_2$. This talk is based on joint work with Martin Vodička.

**Geometry of the $p$-adic upper half-plane**
Gabriel Dospinescu
*CNRS, École Normale Supérieure de Lyon, France*

I will discuss some $p$-adic analogs of classical results in the $l$-adic Langlands and Jacquet-Langlands correspondences, which involve Drinfeld upper half-planes, Lubin-Tate spaces and their étale coverings. This is a joint project with Pierre Colmez and Wieslawa Niziol.

**Normal families and normal functions in $\mathbb{C}^n$.**
Peter Dovbush
*Moldova State University, Vladimir Andrunachievici Institute of Mathematics and Computer Science, Chisinau, Moldova Republic of*

This talk surveys various generalizations and strengthenings of the classical theorems of Marty, Zalcman, Zalcman–Pang, Montel, Schottky, Schwick, Royden, Mandelbrojt, Lohwater–Pommerenke, Lehto–Virtanen and Lindelöf with an emphasis on some surprising recent developments which are contained in my papers: Complex Var. Elliptic Equ., 65.5 (2020), 66.12 (2021), 67.1 (2022), J. Geom. Anal. 31.5 (2021), Rev. Roumaine Math. Pures Appl. 67 (2022), no. 1-2, Vestnik Moskov. Univ. Ser. I Mat. Mekh. 6 (1981), Vestnik Moskov. Univ. Ser. I Mat. Mekh. 1 (1981).

**The $p$-ellipticity condition for non-divergence-form operators**
Oliver Dragičević
*University of Ljubljana, Ljubljana, Slovenia*

In a joint work with A. Carbonaro we applied the notion of $p$-ellipticity for a study of generalized Schrdinger operators with complex coefficients, for which we proved bilinear $L^p \times L^q \to L^1$ estimates with $p, q$ being conjugate exponents. Such inequalities admit applications to holomorphic functional calculus. We also discuss a similar result for yet more general operators, namely, those involving first-order perturbations. As shown recently by A. Poggio, this requires a suitable extension of $p$-ellipticity.

**The paradox of knowability in epistemic temporal logic**
Alexandru Dragomir
*University of Bucharest & Institute for Logic and Data Science, Bucharest, Romania*

The Knowability Thesis states that all truths are knowable, and it constitutes one of the main tenets of semantic anti-realism. The Omniscience Thesis states that all truths are already known, and it is obviously false. These two theses have very intuitive translations in the language of modal epistemic logic. The Paradox of Knowability (also known as the Church-Fitch Paradox) is the derivation of the obviously false Omniscience Thesis from the intuitive Knowability Thesis, using the axioms and inference rules of modal epistemic logic.

Edgington (1985) solved the paradox by offering a new interpretation of the Knowability Thesis in which all factual (non-epistemic) truths are indexed to the actual world. The consequence of this indexing is that the derivation of the Omniscience Thesis from the Knowability Thesis is blocked.

The aim of my presentation is to propose a semantic interpretation of Edgington's Knowability Thesis in a framework based on Hoshi's (2009) work in Epistemic Temporal Logic and Temporal Public Announcement Logic.

[1] Hoshi, T., *Epistemic dynamics and protocol information*, PhD thesis, Stanford, CA, USA (2009)
[2] Edgington, D.,*The Paradox of Knowability*, Mind, 94 (376), 557-568 (1985)

**Multilevel methods for optimal control of elliptic equations with stochastic coefficients discretized using stochastic collocation**

Andrei Drăgănescu
*University of Maryland Baltimore County, Baltimore, USA*

The aim of this research is to develop efficient multigrid preconditioners for a classic linear-quadratic optimization problem constrained by an elliptic equation with stochastic coefficients. Using a discretize-then-optimize approach, in previous work we have shown that strategies inherited from the associated deterministic optimal control problem extend to the stochastic version when a stochastic Galerkin discretization is employed. In this talk we show that similar strategies succeed when discretizing the elliptic equation using a sparse grid stochastic collocation approach.

**Deductive synthesis of sorting algorithms on lists and on binary trees in Theorema**

Isabela Drămnesc
*West University of Timisoara, Timişoara, Romania*

I will describe the principles and the implementation of AlCons (Algorithm Constructor), a system for the automatic proof–based synthesis of sorting algorithms on lists and on binary trees, in the frame of the Theorema system. The core of the system is a dedicated prover based on specific inference rules and strategies for constructive proofs over the domains of lists and of binary trees, aimed at the automatic synthesis of sorting algorithms and their auxiliary functions from logical specifications. The specific distinctive feature of this approach is the use of multisets for expressing the fact that two lists (trees) have the same elements. This allows a more natural expression of the properties related to sorting, compared to the classical approach using the permutation relation (a list is a permutation of another). Moreover, the use of multisets leads to special inference rules and strategies which make the proofs more efficient, as for instance: expand/compress multiset terms and solve meta-variables using multiset equalities. Additionally, the use of a Noetherian induction strategy based on the relation induced by the strict inclusion of multisets, facilitates the synthesis of arbitrary recursion structures, without having to indicate the recursion schemes in advance. The necessary auxiliary algorithms (like, e.g., for insertion and merging) are generated by the same principles from the synthesis conjectures that are automatically produced during the main proof, using a "cascading" method, which in fact contributes to the automation of theory exploration. The prover is implemented in the frame of the Theorem system and works in natural style, while the generated algorithms can be immediately tested in the same system.

**A linear programming approach for mean-field games: theory and numerical aspects**
Roxana Dumitrescu
*King's College London, UK*

In this talk, we present recent results on the linear programming approach to mean-field games in a general setting. This relaxed control approach allows to prove existence results under weak assumptions, and lends itself well to numerical implementation. We consider mean-field game problems where the representative agent chooses both the optimal control and the optimal time to exit the game, where the instantaneous reward function and the coefficients of the state process may depend on the distribution of the other agents. Furthermore, we establish the equivalence between mean-field games equilibria obtained by the linear programming approach and the ones obtained via other approaches used in the previous literature. We then present a fictious play algorithm to approximate the mean-field game population dynamics in the context of the linear programming approach.

**Holomorphic $\mathrm{sl}(2,\mathbb{C})$-differential systems on Riemann surfaces and curves in compact quotients of $\mathrm{SL}(2,\mathbb{C})$**
Sorin Dumitrescu
*Université Côte d'Azur, Nice, France*

We explain the strategy of a recent result that constructs holomorphic $\mathrm{sl}(2,\mathbb{C})$–differential systems over some Riemann surfaces $\Sigma_g$ of genus $g \geq 2$, such that the image of the associated monodromy homomorphism is some cocompact Kleinian subgroup $\Gamma \subset \mathrm{SL}(2,\mathbb{C})$. As a consequence, there exist holomorphic maps from $\Sigma_g$ to the quotient $\mathrm{SL}(2,\mathbb{C})/\Gamma$, that do not factor through any elliptic curve. This answers positively a question asked by Huckleberry and Winkelmann, also raised by Ghys.

This is a joint work with Indranil Biswas (TIFR, Mumbai), Lynn Heller (BIMSA, Beijing) and Sebastian Heller (BIMSA, Beijing).

**Modal Frame Incompleteness. An account through second order logic**
Mircea Dumitru
*University of Bucharest, Bucharest, Romania*

Propositional modal logic is usually viewed as a generalization and extension of propositional classical logic. The main argument of this paper is that a good case can be made that modal logic should be construed as a restricted form of second order classical logic. The paper makes use of the embedding of modal logic in second order logic and henceforth it goes on examining one aspect of this second order connection having to do with an incompleteness phenomenon. The leading concept is that modal incompleteness is to be explained as a kind of exemplification of standard order incompleteness. Moreover the modal incompleteness phenomenon is essentially rooted in the weaker expressive power of the language of sentential modal logic as compared to the stronger expressive power of the language of second order logic.

**Study of magnetic flux in active region NOAA 11967**
Liliana Dumitru
*Astronomical Institute of the Romanian Academy, Bucharest, Romania*

Using a nonlinear force-free field (NLFFF) methods, we calculated the magnetic flux for the active region (AR) NOAA 11967 appearing in the southern hemisphere of the Sun in 2014 January 26. This was noted by the fact that its area increased a lot throughout its evolution on the surface of the solar disk, but also by a significant number of solar flares. It developed 83 solar flares of C class and 28 of M class. We highlighted the variation of magnetic flux values and analyzed its evolution, especially around solar flares. The data used were is photospheric magnetic magnetograms Spaceweather HMI Active Region Patch (SHARP) from the Helioseismic and Magnetic Imager (HMI) onboard the Solar Dynamics Observatory (SDO), with a cadence of 12 minutes.

**The Fekete–Szegö problem for spirallike mappings and non-linear resolvents in Banach spaces**
Mark Elin
*Braude College, Karmiel, Israel*

Generalizing classical results in complex analysis, we study the Fekete–Szegö problem on the open unit ball of a complex Banach space. Namely, we establish the Fekete–Szegö type inequalities over the class of spirallike mappings (relative to an arbitrary strongly accretive operator), and some of its subclasses.

In addition, we consider families of non-linear resolvents for holomorphically accretive mappings vanishing at the origin. We solve the Fekete–Szegö problem over these families.

Based on join work with Fiana Jacobzon.

**The first eigenvalue, maximum principle and regularity results for a class of Monge-Ampere type operators**
Cristian Enache
*American University of Sharjah, Sharjah, United Arab Emirates*

In this talk we are going to first define the notion of a first eigenvalue for a class of Monge-Ampère type operators. To this end, we are going to exploit the property that an elliptic operator satisfies a maximum principle if a certain coefficient is less than the first eigenvalue of the operator. For instance, in the linear case, it is well known that for the operator $Lu = -\Delta u + \lambda u$ the maximum principle holds if $\lambda < \lambda_1$, where $\lambda_1$ is the first Dirichlet eigenvalue of the Laplacian. Therefore, $\lambda_1$ is the supremum of all $\lambda \in \mathbb{R}$ such that the maximum principle holds. In this talk we extend this idea to a general class of Monge-Ampère type operators. More precisely, under certain assumptions on the operator and the underlying domain $\Omega$, we show that some maximum principle hold, we establish the existence of a principal eigenvalue, as well as some Lipschitz and $\gamma$-Holder regularity results for the corresponding eigenfunction.

**Estimation of therapeutic equivalence using bioequivalence methods for algopirin tablets versus excedrin analgesic**
Florin Constantin Enache
*Carol Davila University of Medicine and Pharmacy, Bucharest, Romania*

A clinical study was performed in order to prove the non-inferiority in relieving headache of a unique dose of treatment using Algopirin®, a fixed combination with acetylsalicylic acid (ASA, aspirine), acetaminophen, caffeine and clorpheniramine a new analgesic combination versus Excedrin®, which contains the same active substances but in much higher doses. Pain intensity was quantified using a Visual Analog Scale (VAS) score which was established by patients on a 1-100 points scale, before and 30 min, 60 min, 120 min, 180 min and 240 min after drug intake. The clinical trial was a cross-over study with two periods and two sequences, usual in bioequivalence studies, each subject being its own control. Consequently in this study were applied specific statistical methods for bioequivalence studies. The primary endpoint in the statistical evaluation was the Area Under the Pain Curve (AUC). For verification of therapeutic equivalence there were applied both parametric (method of confidence intervals) and non-parametric methods (Wilcoxon-Man Whitney two one-sided test for bioequivalence, and confidence interval associated with Wilcoxon signed rank statistic based of Hodges - Lehmann estimator). If the 90% confidence interval for ratio of means of areas under curve was included in the interval 80 125% the products were considered as therapeutically equivalent. The results of all applied tests indicated a therapeutic equivalence of the formulations though amounts of active substances are much lower in Algopirin®.

**Frobenius complexity and rational twist in positive characteristic**
Florian Enescu
*Georgia State University, USA*

The talk with discuss the existence of Frobenius actions on the injective hull of the residue field of a local ring and the related concept of Frobenius complexity. The concept puts in perspective the twisted construction on a graded ring in prime characteristic, a general construction which brings to light a number of combinatorial properties related to the generation of this algebra over its zero degree piece. I will discuss the major developments in this area of research and highlight some current open questions. Some of the work presented is joint with Yongwei Yao.

**A symbiosis of constraint optimization, symmetries and symmetry breaking for scalable Cloud deployment problems**
Mădălina Erascu
*West University of Timişoara, Timişoara, Romania*

Constraint optimization, symmetries and symmetry breaking have long been studied by mathematicians. Despite this, when it comes to apply them to real-world problems, for example the deployment in the Cloud of the component-based applications, challenges appear. One such challenge is the scalability issue of general constraint optimization techniques, for example constraints programming, mathematical programming, optimization modulo theory, and the application of suitable symmetry breakers to deal with this issue. We overcome it by methodologically analyzing the particularities of the problem to be solved with the aim of identifying search space reduction methods. These are methods exploiting: (1) the symmetries of the underlying problem (Cloud deployment of component-based applications), (2) the graph representation associated to the structural constraints specific to each particular application, and (3) their combination. An extensive experimental analysis has been conducted on 4 classes of real-world problems, using 19

symmetry breaking strategies and 3 types of optimization solvers. As a result, the combination of two symmetry breakers, a variable reduction strategy with a columnwise symmetry breaker, led to a scalable deployment. However, one would expect that the best symmetry breaker is one composing a higher number of individual symmetry breakers as more symmetries are broken so the search space is significantly reduced. The experiments proved that this is not true. An explanation is that, on one hand, the large number of added constraints influences the solving time, and, on the other hand, the symmetry breakers interact badly with the underlying optimization techniques implemented by the solvers we used. This is joint work with Bogdan David, Flavia Micota and Daniela Zaharie.

**Solutions for nonlinear elliptic equations with singular potentials**
Maria Fărcăşeanu
*Gheorghe Mihoc-Caius Iacob Institute of Mathematical Statistics and Applied Mathematics of the Romanian Academy, Bucharest, Romania*

In this talk, we present recent results on the classification and existence of solutions for some nonlinear elliptic equations with singular potentials. This is joint work with Florica Cîrstea. The presentation is partially supported by CNCS-UEFISCDI Grant No. PN-III-P1-1.1-PD-2021-0037.

**Some applications of hyperbolic geometry to algebraic geometry**
Simion Filip
*University of Chicago, Chicago, USA*

Quadratic forms of signature (1,n) appear naturally in some of the cohomology groups of complex algebraic manifolds. They also appear frequently in cohomology groups that do not, a priori, admit such quadratic forms, and seem to be closely related to the group of (pseudo-)automorphisms of the algebraic manifold. I will discuss joint work with John Lesieutre and Valentino Tosatti in which we consider some situations of the latter kind where the geometry and dynamics of Calabi–Yau manifolds is controlled by certain hyperbolic reflection groups. The necessary background will be explained.

**Lyapunov exponents, Anosov representations, and Hodge theory**
Simion Filip
*University of Chicago, Chicago, USA*

Discrete subgroups of semisimple Lie groups arise in a variety of contexts, sometimes "in nature" as monodromy groups of families of algebraic manifolds, and other times in relation to geometric structures and associated dynamical systems. I will explain a method to establish that monodromy groups of certain variations of Hodge structure give Anosov representations, thus relating algebraic and dynamical situations. Among many consequences of these interactions, I will explain a proof of a conjecture of Eskin, Kontsevich, Moller, and Zorich on Lyapunov exponents, some uniformization results for domains of discontinuity of the associated discrete groups, and Torelli theorems for certain families of Calabi-Yau manifolds (including the mirror quintic). The discrete groups of interest live inside the real linear symplectic group, and the domains of discontinuity are inside Lagrangian Grassmanians and other associated flag manifolds. The necessary context and background will be explained.

**Critical locus for complex Hénon maps**
Tanya Firsova
*Kansas State University, Manhattan KS, USA*

For one dimensional maps, the dynamics of the map is to a large extent determined by the orbits of the critical points. Complex Hénon maps are automorphisms, and as such they do not have critical points. Critical loci, the sets of tangencies between dynamically defined foliations/laminations often serve as a good analog of the critical points. We study the critical loci in the escape region, defined by E. Bedford, J. Smillie and J. Hubbard. We give a description of the critical locus for Hénon maps in an HOV region, the first description in the non-perturbative setting. We also discuss the connection between the critical loci in different dynamically significant regions and the monodromy of the critical locus. This is a joint work with R. Radu and R. Tanase.

**Traces for Non-Differentiable Functions on Irregular Domains**
Mikil Foss
*University of Nebraska-Lincoln, Lincoln, USA*

Given a uniformly continuous function on an open domain, there is a unique continuous extension to the boundary. The trace operator provides a function that captures the boundary values of this extension. Gagliardo's trace theorem extends this concept to the Sobolev spaces. There have since been many generalizations and refinements of Gagliardo's theorem. Typically, these trace theorems require some differentiability of the function within its domain and some regularity of the domain's boundary. These assumptions ensure there is a well-defined boundary value function. Moreover, this trace will, itself, possess some differentiability and a certain Lebesgue point property. I will present a trace theorem that provides a well-defined boundary-value function that exists in a fractional Sobolev space and has the Lebesgue point property yet requires no differentiability within the domain and allows very irregular boundaries. The result is motivated by boundary-value problems involving nonlocal operators that are defined for integrable but not necessarily differentiable functions.

**Piecewise smooth solutions to scalar balance laws with singular source terms**
Evangelia Ftaka
*NC State University, Raleigh, USA*

We will present a local well-posed result for piecewise regular solutions with a single shock of scalar balance laws, with singular integral of convolution type kernels. In a neighborhood of the shock curve, a description of the solution is provided for a general class of initial data.

**Positivity of theta divisors on some abelian threefolds**
Mihai Fulger
*University of Connecticut, Storrs, USA*

Guided by the problem of computing Seshadri constants and infinitesimal Newton-Okounkov bodies of theta divisors on abelian varieties, we focus on the first open case, the case of threefolds. We carry out the case of products of curves, and the case of Jacobians of quartic curves with 56 distinct bitangency points. This is in joint work with Victor Lozovanu.

**A Serre spectral sequence for moduli spaces of tropical curves**
Nir Gadish
*University of Michigan, Ann Arbor, USA*

The moduli space of genus g tropical curves with n marked points is a fascinating topological space, with a combinatorial flavor and deep algebro-geometric meaning. In the algebraic world, forgetting the n marked points gives a fibration whose fibers are configuration spaces of a surface, and Serre's spectral sequence lets one compute the cohomology "in principle". In joint work with Bibby, Chan and Yun, we construct a surprising tropical analog of this spectral sequence, manifesting as a small graph complex and featuring the cohomology of compactified configuration spaces on graphs.

**Renormalization for Fibonacci maps**
Denis Gaidashev
*Uppsala University, Uppsala, Sweden*

Real infinitely renormalizable unimodal maps with Fibonacci combinatorics are known to have an attractor whose basin may have positive measure - a wild attractor. We describe a constructive technique which allows to tell if a Fibonacci map indeed has a wild attractor.

**On fractional in time diffusion equations**
Ciprian Gal
*Florida International University, Miami, USA*

This talk provides the introduction to fractional diffusion processes and provides a unified analysis and scheme for the existence and uniqueness of strong and mild solutions to such fractional (in time) kinetic equations. This class of equations is characterized by the presence of a nonlinear time-dependent source, generally of arbitrary growth in the unknown function, a time derivative in the sense of Caputo and the presence of a large class of diffusion operators.

**On some classes of operators on $C(K, X)$**
Ioana Ghenciu
*University of Wisconsin-River Falls, USA*

Suppose $X$ and $Y$ are Banach spaces, $K$ is a compact Hausdorff space, $\Sigma$ is the $\sigma$-algebra of Borel subsets of $K$, $C(K, X)$ is the Banach space of all continuous $X$-valued functions (with the supremum norm), and $T : C(K, X) \to Y$ is a strongly bounded operator with representing measure $m : \Sigma \to L(X, Y)$.

We show that if $T$ is a strongly bounded operator and $\hat{T} : B(K, X) \to Y$ is its extension, then $T$ is limited if and only if its extension $\hat{T}$ is limited and that $T^*$ is completely continuous (resp. unconditionally converging) if and only if $\hat{T}^*$ is completely continuous (resp. unconditionally converging).

We prove that if $K$ is a dispersed compact Hausdorff space and $T$ is a strongly bounded operator, then $T$ is limited (weakly precompact, has a completely continuous, resp. unconditionally converging adjoint) whenever $m(A) : X \to Y$ is limited (weakly precompact, has a completely continuous, resp. unconditionally converging adjoint), for each $A \in \Sigma$.

**Conformal self mappings of the fundamental domains of analytic functions**
Dorin Ghişa
*York University, Toronto, Canada*

Conformal self mappings of a given domain of the complex plane onto itself can be obtained by using Riemann mapping theorem in the following way. Two different conformal mappings $f$ and $g$ of that domain onto one of the standard domains: the unit disc, the complex plane, or the Riemann sphere are taken and the $f$ composed with the inverse of $g$ is what we are looking for. Yet, this is just a theoretical construction, since the Riemann mapping theorem does not offer any concrete expression of those functions. The Möbius transformations are concrete, but they can be used only for particular circular domains. We are proving in this talk that conformal self mappings of fundamental domains of any analytic function can be obtained via Möbius transformations as long as we allow those domains to have slits. Moreover, those mappings enjoy group properties. Graphic illustrations are offered for the most familiar classes of functions. This is a joint work with Andrei-Florin Albişoru.

**A local-global principle for rational points of projective homogeneous varieties**
Philippe Gille
*CNRS, Lyon, France*

This is a report on joint work with R. Parimala (Emory University). A semiglobal field $F$ is the function field of a curve on a complete field $K$ for a discrete valuation. Using patching theory we discuss a local-global principle for rational points of projective homegeneous varieties over $F$, e.g. projective quadrics, varieties of Borel subgroups of a reductive $F$-group.

**Energy growth in Hamiltonian systems with small dissipation**
Marian Gîdea
*Yeshiva University, New York City. USA*

We consider a Hamiltonian system subject to small, time dependent, conformally symplectic perturbation. One may expect such a system to manifest energy dissipation. Surprisingly, we show that the system exhibits orbits whose energy grows by a significant amount, provided that the perturbation satisfies some explicit conditions that hold generically.

This result generalizes the Arnold diffusion problem in Hamiltonian systems to the case of systems with small dissipation. This is related to a conjecture by Chirkov asserting that Arnold diffusion may play a role in systems with small dissipation.

**On the Fremlin tensor product of lattice ordered algebras and Banach lattice algebras**
Omer Gok
*Yildiz Technical University, Istanbul, Türkiye*

In this study, we introduce the Fremlin tensor product of lattice ordered algebras and the Fremlin projective tensor product of Banach lattice almost $f$-algebras, $d$-algebras. We say that a Banach lattice is a Banach lattice algebra if it is a Banach algebra where the multiplication of positive elements is positive. A lattice ordered algebra $A$ is called an almost $f$-algebra if $ab = 0$ whenever $a \wedge b = 0$ for every $a, b \in A$. A lattice ordered algebra $A$ is said to be a $d$-algebra if $ca \wedge cb = ac \wedge bc = 0$ for every $c \in A^+$ , whenever $a \wedge b = 0$ for every $a, b \in A$. A lattice ordered algebra $A$ is called an $f$-algebra if $ca \wedge b = ac \wedge b = 0$ for every $c \in A^+$ , whenever $a \wedge b = 0$ for every $a, b \in A$.

**Teichmüller's theorem in higher dimensions**
Anatoly Golberg
*Holon Institute of Technology, Holon, Israel*

Our main goal in the present talk is to extend the Teichmüller theorem on separating rings to higher dimensions (a main problem here is that there is no analogue of the Uniformization Theorem in $\mathbb{R}^n$, $n \geq 3$). In addition, we apply this result to studying the boundary correspondence problems. We emphasize that our approach may allow us to weaken regularity for quasiconformality assumptions of the mappings. Such applications to mappings of finite directional dilatations will be also presented. The talk is based on joint works with T. Sugawa and M. Vuorinen.

**The torsion problem of the $p$-Bilaplacian**
Andrei Grecu
*University of Craiova, Craiova, Romania*

For each bounded and open set $\Omega \subset \mathbb{R}^N$ ($N \geq 2$) with smooth boundary denoted by $\partial\Omega$ and each real number $p \in (1,\infty)$ we analyse the torsion problem of the $p$-Bilaplacian, namely $\Delta(|\Delta u|^{p-2}\Delta u) = 1$ in $\Omega$ with $u = \Delta u = 0$ on $\partial\Omega$. Firstly, we show that for each $p \in (1,\infty)$ the problem has a unique weak solution $u_p$. Secondly, we prove that $u_p$ converges uniformly, as $p \to \infty$, in $C^1(\overline{\Omega})$ to a certain function, say $v_2$, which is exactly the unique solution of the problem $-\Delta u = 1$ in $\Omega$ with $u = 0$ on $\partial\Omega$. Next, we show that each solution $u_p$ is also a solution for the minimization problem

$$\mathcal{T}(p;\Omega) := \inf_{u \in \mathcal{X}_p(\Omega)\setminus\{0\}} \frac{\frac{1}{|\Omega|}\int_\Omega |\Delta u|^p \, dx}{\left(\frac{1}{|\Omega|}\int_\Omega u \, dx\right)^p},$$

where $\mathcal{X}_p(\Omega) := \{u \in W^{2,p}(\Omega) \cap W_0^{1,p}(\Omega) : \ u(x) \geq 0, \ a.e. \ x \in \Omega\}$ Further, we show that the function $(1,\infty) \ni p \mapsto \mathcal{T}(p;\Omega)$ is strictly increasing provided that $\Omega$ is a convex and bounded open set for which $|\Omega|^{-1}\int_\Omega v_2 \ dx$ is small. Finally, using this monotonicity result, we give an alternative variational characterization of the constant $\mathcal{T}(p;\Omega)$ when $|\Omega|^{-1}\int_\Omega v_2 \ dx$ is small. That last variational characterization fails to hold true when $|\Omega|^{-1}\int_\Omega v_2 \, dx > 1$.

**A probabilistic numerical approach to the inverse Cauchy problem**
Andreea Grecu
*ISMMA, Bucharest, Romania*

We study a probabilistic numerical approach for the reconstruction of the unknown boundary data of the steady state heat equation in anisotropic media, having discrete measurements inside the domain and on a part of the boundary. We shall discuss the continuous and the discrete problems, and provide some corresponding spectral and probabilistic error estimates. Finally, a parallel (CPU/GPU) algorithm shall be presented. This is based on joint work with Iulian Cîmpean and Liviu Marin.

**Long-term behavior of the Bak-Sneppen Branching Diffusions**
Ilie Grigorescu
*University of Miami, Coral Gables, FL, USA*

We present results on the asymptotic behavior of a system of interacting diffusions evolving in a bounded domain in $\mathbb{R}^d$ by tracing the empirical measure asymptotically, when the number of particles $N$, respectively time $t$, approach infinity. When $N \to \infty$, we obtain a hydrodynamic limit $\mu_t$ (Law of Large Numbers on the path space). This is the macroscopic profile and satisfies a semi-linear PDE with non-local boundary conditions. When $t \to \infty$, we obtain the quasi-stationary distributions (qsd) in explicit formula involving the resolvent of the Dirichlet kernel. The interaction is a hybrid between the Fleming-Viot branching diffusions and the Bak-Sneppen minimal fitness process. Like the original model, self-organizing criticality is present in the one-to-one mapping between the intensity of the branching mechanism and the family of qsd. Simple examples will illustrate the emergence of the concepts involved.

**Boundary value problems on domains with cusps**
Nadine Große
*University of Freiburg, Freiburg, Germany*

We consider boundary value problems of the Laplacian with Dirichlet (or mixed) boundary conditions on domains with singularities. In two dimensions these singularities include also cusps. Our approach is by blowing up the singularities via a conformal change to translate the boundary problem to one on a noncompact manifold with boundary that is of bounded geometry and of finite width. This gives a natural geometric interpretation in the appearing weights and additional conditions needed to obtain well-posedness results. This is joint work with Bernd Ammann (Regensburg) and Victor Nistor (Universite de Lorraine).

**Stochastic population dynamics**
Alexandru Hening
*Texas A&M University, College Station, Texas, USA*

A fundamental question from population biology is finding conditions under which interacting species coexist or go extinct. I present results that lay the foundation for a general theory of stochastic coexistence. This theory extends and makes rigorous Modern Coexistence Theory and leads to resolving a number of conjectures due to Chesson, Ellner, and Palis. I explain how this theory can be used to complete the classification of three-species stochastic ecological systems and end with an important example that shows that random environmental fluctuations can rescue species from extinction.

**Alexander modules and Mellin transform**
Moisés Herradón Cueto
*Universidad Autónoma de Madrid, Madrid, Spain*

I will talk about the study of Alexander modules of algebraic varieties using Gabber and Loeser's Mellin transform. The main strength of this approach is that it allows the application of the full machinery of the theory of perverse sheaves, and even mixed Hodge modules. We obtain new results about the structure of Alexander modules, especially about their torsion part and, in the multivariable case, their artinian submodules. It also yields a mixed Hodge structure on the maximal artinian submodules of the Alexander modules. This is based on joint work with Eva Elduque, Laurentiu Maxim and Botong Wang.

**Statistical Methods in the Study of Human Genetic Diversity based on Y-Chromosome Analysis**

Ramona Hodişan
*University of Oradea, Oradea, Romania*

Population genetics studies the human evolution by researching the genetic diversity of populations. Besides the DNA typing process, the statistical interpretation of the data is essential. The purpose of this study is to present and exemplify the traditional methods of calculating the main statistical parameters used in the study of Y chromosome diversity. After the DNA extraction and quantification steps, the amplification through PCR technique, the separation and detection of repetitive sequences alleles (short tandem repeats - STR), the analyses and the statistical interpretation step follows. The statistic measures can be generated by a computer program, but they can be calculated in a traditional way also, using classic formulas. The first step in statistical analysis is to centralize the data into frequency tables, afterwards the calculations are performed to determine heterozygosity, the diversity of genes and haplotypes. In order to estimate the rarity of a DNA profile, the random match probability is calculated, the probability ratio, together with the inclusion and the exclusion probability. The application and understanding of the statistical concepts in the study of population diversity helps to describe and to understand the population structures. Joint work with Marius Bembea.

**Milnor Fiber Consistency via Flatness**

Alex Hof
*University of Wisconsin-Madison, Madison, USA*

The Milnor fibration gives a well-defined notion of the smooth local fiber of a holomorphic function at a critical point. Milnor's work in the isolated case suggests that this fiber's topology should be controlled by the scheme-theoretic invariants of the critical locus; we give results which demonstrate that this is true in a relative sense. Specifically, we show that the local smooth fiber varies nicely in families where the embedded critical locus satisfies certain algebraic consistency requirements and discuss implications for homogeneous polynomials and other special cases.

**On the $\mathrm{GL}(n)$-module structure of a class of relatively free algebras**

Elitza Hristova
*Institute of Mathematics and Informatics of the Bulgarian Academy of Sciences, Sofia, Bulgaria*

Let $K\langle X\rangle$ denote the free associative algebra generated by a set $X = \{x_1, \ldots, x_n\}$ over a field $K$ of characteristic 0. For any integer $p \geq 2$, let $I_p$ denote the two-sided associative ideal in $K\langle X\rangle$ generated by all commutators of length $p$. The group $\mathrm{GL}(n, K)$ acts in a natural way on the quotient $K\langle X\rangle / I_{p+1}$ and the $\mathrm{GL}(n, K)$-module structure of $K\langle X\rangle / I_{p+1}$ is known for $p = 1, 2, 3, 4$. In this talk, we give some results on the $\mathrm{GL}(n, K)$-module structure of $K\langle X\rangle / I_{p+1}$ for any $p \geq 1$. More precisely, we give a bound on the values of partitions $\lambda$ such that the irreducible $\mathrm{GL}(n, K)$-module with highest weight $\lambda$ appears in the decomposition of $K\langle X\rangle / I_{p+1}$ as a $\mathrm{GL}(n, K)$-module. We discuss also applications of these results related to the algebras of $G$-invariants in $K\langle X\rangle / I_{p+1}$, where we take $K = \mathbb{C}$ and $G$ to be one of the classical complex groups $\mathrm{SL}(n, \mathbb{C})$, $\mathrm{O}(n, \mathbb{C})$, $\mathrm{SO}(n, \mathbb{C})$, or $\mathrm{Sp}(2k, \mathbb{C})$ (for $n = 2k$).

**Direct limits of Gorenstein injective modules**
Alina Iacob
*Georgia Southern University, Statesboro, USA*

One of the open problems in Gorenstein homological algebra is: when is the class of Gorenstein injective modules closed under arbitrary direct limits? It is known that if the class of Gorenstein injective modules, $\mathcal{GI}$, is closed under direct limits, then the ring is noetherian. The open problem is whether or not the converse holds. We give equivalent characterizations of $\mathcal{GI}$ being closed under direct limits. More precisely, we show that the following statements are equivalent:
(1) The class of Gorenstein injective left $R$-modules is closed under direct limits.
(2) The ring $R$ is left noetherian and the character module of every Gorenstein injective left $R$-module is Gorenstein flat.
(3) The class of Gorenstein injective modules is covering and it is closed under pure quotients.
(4) $\mathcal{GI}$ is closed under pure submodules.

**Families of mappings with generalized parametric representation on $\mathbb{B}^n$**
Mihai Iancu
*Babeş-Bolyai University, Cluj-Napoca, Romania*

We consider biholomorphic mappings on the Euclidean unit ball $\mathbb{B}^n$ which embed into normal Loewner chains whose differential at the origin satisfies a first-order homogeneous linear differential equation for a time-dependent linear operator. More precisely, we discuss the dependence of $\widetilde{S}_A^T(\mathbb{B}^n)$ with respect to $A$ and $T$, where $\widetilde{S}_A^T(\mathbb{B}^n)$ is a compact family of mappings that have generalized parametric representation on $\mathbb{B}^n$ given by $A : [0,\infty) \to L(\mathbb{C}^n)$ and starting at $T \in [0,\infty)$.

Joint work with Hidetaka Hamada (Kyushu Sangyo University, Fukuoka, Japan) and Gabriela Kohr (Babeş-Bolyai University, Cluj-Napoca, Romania).

**The small data global well-posedness conjecture for 1D defocusing dispersive flows**
Mihaela Ifrim
*University of Wisconsin, Madison, USA*

The conjecture broadly asserts that small data should yield global solutions for 1D defocusing dispersive flows with cubic nonlinearities, in both semilinear and quasilinear settings. The aim of the talk will be to present some very recent results in this direction. This is joint work with Daniel Tataru.

**Minimality of vortex solutions for Ginzburg-Landau type functionals**
Radu Ignat
*Institut de Mathématiques de Toulouse, Université Paul Sabatier - Toulouse 3, France*

We analyse vortex solutions to Ginzburg-Landau type systems depending on a small parameter $\epsilon > 0$ in the unit ball $B^N$. The aim is to show the minimality of the symmetric solution $u : B^N \to \mathbb{R}^N$ corresponding to a vortex of degree one. We establish this minimality in dimension $N \geq 7$ for every $\epsilon > 0$. In dimension $2 \leq N \leq 6$, if $u : B^N \to \mathbb{R}^{N+1}$, we show a sharp dichotomy result between the minimality of the "non-escaping" vortex solution (i.e., confined in the space $\mathbb{R}^N \times \{0\}$) and the vortex solutions "escaping" in the $(N+1)$ direction according to the parameter $\epsilon$. Finally, we also discuss minimality of the vortex solution to the Ginzburg-Landau model for gradient fields. This is a series of works in collaboration with Luc Nguyen, Mircea Rus, Valeriy Slastikov and Arghir Zarnescu.

**Large-time behaviour for anisotropic stable nonlocal diffusion problems with convection**
Liviu Ignat
*Simion Stoilow Institute of Mathematics of the Romanian Academy & ICUB University of Bucharest, Bucharest, Romania*

We study the large-time behaviour of nonnegative solutions to the Cauchy problem for a nonlocal heat equation with a nonlinear convection term. The diffusion operator is the infinitesimal generator of a stable Lévy process, which may be highly anisotropic. The initial data are assumed to be bounded and integrable. The mass of the solution is conserved along the evolution, and the large-time behaviour is given by the source-type solution with this mass of a limit equation that depends on the relative strength of convection and diffusion. When diffusion is stronger than convection the original equation simplifies asymptotically to the purely diffusive nonlocal heat equation. When convection dominates, it does so only in the direction of convection, and the limit equation is still diffusive in the subspace orthogonal to this direction, with a diffusion operator that is a "projection" of the original one onto the subspace. The determination of this projection is one of the main issues. When convection and diffusion are of the same order the limit equation coincides with the original one.

Most of our results are new even in the isotropic case in which the diffusion operator is the fractional Laplacian. We are able to cover both the cases of slow and fast convection, as long as the mass is preserved. Fast convection, which corresponds to convection nonlinearities that are not locally Lipschitz, but only locally Hölder, has not been considered before in the nonlocal diffusion setting.

This is a joint work with Jørgen Endal (Norwegian University of Science and Technology, Trondheim, Norway) and Fernando Quirós (Universidad Autonoma de Madrid, Spain).

**Families of curves on cones that give rise to components of the Hilbert scheme of curves**
Hristo Iliev
*Institute of Mathematics and Informatics of the Bulgarian Academy of Sciences, Sofia, Bulgaria*

In the present report we consider curves on a cone that pass through its vertex and are also triple covers of the base of the cone that is is a general smooth curve of genus $\gamma$ and degree $e$ in $\mathbb{P}^{e-\gamma}$. Using the free resolution of the ideal of such a curve found by Catalisano and Gimigliano, as well as a technique involving very flat families introduced by Ciliberto, we show that the deformations of such curves remain on cones over a deformation of the base curve. This allows us to prove that for every $\gamma \geq 3$ and $e \geq 4\gamma + 5$ there exists a non-reduced component $\mathcal{H}$ of the Hilbert scheme $\mathcal{I}_{3e+1,3e+3\gamma,e-\gamma+1}$ of smooth curves of genus $3e + 3\gamma$ and degree $3e + 1$ in $\mathbb{P}^{e-\gamma+1}$. We show that $\dim T_{[X]}\mathcal{H} = \dim \mathcal{H} + 1 = (e - \gamma + 1)^2 + 7e + 5$ for a general point $[X] \in \mathcal{H}$.

The reported results are based on arXiv:2302.08707 [math.AG]. The last develops an approach of the same authors aimed at constructing non-reduced components of the Hilbert scheme of curves in projective spaces of high dimension introduced in arXiv:2208.12470 [math.AG].

**PBW theorems, Shuffle algebras, and Lyndon words**
Bogdan Ion
*University of Pittsburgh, Pittsburgh, USA*

I will discuss PBW-type theorems for irreducible, symmetric, braided Hopf algebras, and their applications to the structure of symmetrically braided shuffle algebras.

**Modelling shallow water flow on curved surfaces**
Stelian Ion
*Gheorghe Mihoc-Caius Iacob Institute of Mathematical Statistics and Applied Mathematics of Romanian Academy, Bucharest, Romania*

Starting with the pioneering papers of Saint-Venant and Bussinesq the shallow water equations received an increasing interest in both directions of practical applications and theoretical investigations. The enlarging domain of applications has imposed to modellers to weaken the strength of some modeling assumptions concerning the flow variables distribution and the geometrical characteristics of the support surface of the flow. In this context a challenging issue is how the curvature of the surface affects the dynamics of the flow, especially the pressure distribution along the water depth. The model analysed here exhibits an explicit dependence on the curvatures of the surface while the pressure is no more linearly distributed with respect to water depth (hydrostatic distribution).If the curvatures of the surface are set equal to zero then the model coincide with the classical shallow water equations with hydrostatic distribution of the pressure field. In the end of the paper we present a comparative analysis of the solutions of the classical and the new model in the case of a largely used test flow, the flow over a bump.

**Counting embedded curves in 3-folds**
Eleny Ionel
*Stanford University, Stanford, California, USA*

There are several ways of counting holomorphic curves in Calabi-Yau 3-folds. Counting them as maps gives rise to the Gromov-Witten invariants. In general, these are not integer counts due to the presence of multiple covers with symmetries. But one can consider instead images of such maps (possibly with multiplicity), regarded either as subsets or as integral currents. Generically these images are smoothly embedded curves.

In earlier joint work with Thomas Parker we constructed an integer count of embedded pseudo-holomorphic curves in symplectic Calabi-Yau 3-folds, and related it to the Gromov-Witten invariants. In recent work with Aleksander Doan and Thomas Walpuski we extended these arguments to also prove that the former invariants satisfy a finiteness property. The new ingredients are compactness (and regularity) results for pseudo-holomorphic cycles/currents without an a priori genus bound, instead of the Gromov compactness for pseudo-holomorphic maps. In this talk I will outline some of the key ideas involved in these constructions.

**Wave propagation in damaged brittle materials**
Ioan Ionescu
*Sorbonne Paris Nord University, France*

One of the still misunderstood problem remains the behavior of brittle materials (as ceramics) just after fragmentation.

Two different types of mechanical models to describe damage in ceramics are considered. The first one is a micro-mechanics based damage model where damage is introduced through a physical parameter. During the damage process the mechanical model loses its isotropy and its homogeneity but the geometric homogeneity is preserved. In the second one damage is introduced by the presence of micro-cracks in an isotropic and homogeneous elastic solid. This geometric heterogeneity induces a loss of isotropy and of homogeneity. Both models take into account the physical reality, where geometric and material heterogeneities are present. For both models we have used a discontinuous Galerkin (DG) numerical scheme, which ensures an efficient parallelization, with a leapfrog scheme for the time discretization and an Exact-Upwind-type choice of the flux. In the second model the main focus lies on the contact conditions at crack surfaces (including crack opening and closure and stick-and- slip with Coulomb friction). Here the interfacial numerical flux is obtained by solving a non-linear and non-smooth system associated to the boundary conditions. We have done some specific numerical simulations on wave propagation in a damaged ceramics us- ing both models. The geometry and the boundary conditions of the numerical simulations were chosen to correspond to some experimental settings.

**Nonlinear two-dimensional water waves with arbitrary vorticity**
Delia Ionescu-Kruse
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

We consider the two-dimensional water-wave problem with a general non-zero vorticity field in a fluid volume with a flat bed and a free surface. The nonlinear equations of motion for the chosen surface and volume variables are expressed with the aid of the Dirichlet-Neumann operator and the Green function of the Laplace operator in the fluid domain. Moreover, we provide new explicit expressions for both objects. The field of a point vortex and its interaction with the free surface is studied as an example. In the small-amplitude long-wave Boussinesq and KdV regimes, we obtain appropriate systems of coupled equations for the dynamics of the point vortex and the time evolution of the free surface variables. This is joint work with Rossen Ivanov.

**Holomorphic Factorization of Vector Bundle Automorphisms**
George Ioniţă
*University of Bern, Switzerland and ETH Zürich, Switzerland*

A classical result from any Linear Algebra course states that the group $\mathrm{SL}_m(\mathbb{C})$ is generated by elementary matrices $\mathrm{Id} + \alpha E_{ij}$, $i \neq j$, i.e., matrices with ones on the diagonal and at most one nonzero element outside the diagonal. The same question for matrices in $\mathrm{SL}_m(R)$, where $R$ is a commutative unital ring is a very complicated and much studied question.

If for example $R$ is the ring of complex valued functions (continuous or holomorphic) from a space $X$, then given a map $f : X \to \mathrm{SL}_m(\mathbb{C})$ one has to find a factorization into a product of upper and lower diagonal unipotent matrices

$$f(x) = \begin{pmatrix} 1 & 0 \\ G_1(x) & 0 \end{pmatrix} \begin{pmatrix} 1 & G_2(x) \\ 0 & 1 \end{pmatrix} \cdots \begin{pmatrix} 1 & G_N(x) \\ 0 & 1 \end{pmatrix},$$

where the $G_i$'s are maps $G_i : X \to \mathbb{C}^{m(m-1)/2}$. A necessary condition for this factorization to exist is that the map $f$ is homotopic to a constant map (or *null-homotopic*).

For continuous complex valued functions on a finite dimensional topological space $X$, the problem was studied for a long time and it was finally solved by Vaserstein. In 2012 Ivarsson and Kutzschebauch settled its holomorphic analogue. This is also called Gromov's Vaserstein problem as it was suggested by Gromov in 1989 as a possible application of his h-principle. The first generalization to the case of (special) vector bundle automorphisms was done in the topological case by Hultgren and Wold.

We will present the holomorphic counterpart of Hultgren and Wold's result, but only for holomorphic vector bundles of rank 2. Our main result is the following: let $X$ be a Stein space and $E \to X$ be a holomorphic vector bundle of rank 2 over $X$. Then a special holomorphic automorphism can be written as a (finite) product of unipotent holomorphic automorphisms if and only if it is null-homotopic. In the case of a trivial vector bundle $E \simeq X \times \mathbb{C}^n$, the special holomorphic automorphisms correspond to holomorphic maps $f : X \to \mathrm{SL}_n(\mathbb{C})$.

**Riemann-Lebesgue integrability in interval-valued multifunctions setting**

Alina Emilia Iosif
*Petroleum-Gas University of Ploieşti, Ploieşti, Romania*

We present Riemann-Lebesgue integrability for interval-valued multifunctions relative to an interval-valued set multifunction. Some classic properties of this type of integral, such as monotonicity, additivity, order continuity, bounded variation are pointed out. Joint work with Alina Gavriluţ and Anca Croitoru.

**BGG for de Rham complexes associated to modular forms**

Adrian Ioviţă
*Concordia University, Montreal, Canada & University of Padova, Italy*

Given a p-adic weight, one has a sheaf of Banach modules with integrable connection and filtration, on a strict neighbourhood of the ordinary locus in an appropriate modular curve. The de Rham cohomology of this module with connection can be calculated in terms of overconvergent modular forms of various weights, using the local action of the Lie-algebra $sl_2$ on this sheaf, in a way similar to the classical Bernstein-Gelfand-Gelfand method (for short BGG).

**Tackling unsupervised anomaly detection through dictionary learning**
Paul Irofti
*University of Bucharest & Institute for Logic and Data Science, Bucharest, Romania*

Dictionary learning (DL) is a factorization method with many applications to audio and image processing, compression, classification, and computer vision, where it gives better performance than popular transforms. Finding an optimal dictionary that generates at the same time the sparsest representations of data and the smallest approximation error is a hard problem. Our study investigates how the standard DL optimization problem can be modified to perform anomaly detection. We start from a result presented at ICASSP'22 that focuses on uniform sparse representations models that recover the subspace of the majority of samples in a dataset using a K-SVD-type algorithm. Afterwards we continue with on-going work and results in this direction.

**Villadsen idempotents**
Cristian Ivănescu
*MacEwan University, Edmonton, Canada*

J. Villadsen constructed examples now known as Villadsen algebras, which form an exciting class of $C^*$-algebras: it provides examples of $C^*$-algebras for which the $K_0$-group is not weakly unperforated or simple $C^*$-algebras with stable rank other than one. We use Villadsen construction to build a $C^*$-algebra, which is idempotent in the sense that the algebra is isomorphic to its tensor product with itself. The Villadsen algebras are conjectured classifiable by sufficiently many invariants; hence Villdsen idempotents should play an essential role in studying Villdsen algebras. This is joint work with Dan Kucerovsky, UNB.

**Saywer's duality principle for Lebesgue and grand Lebesgue spaces**
Pankaj Jain
*South Asian University, New Delhi, India*

Starting from the classical Sawyer's duality principle that deals with the duality of weighted Lebesgue spaces $L^p_v$ for non-negative non-increasing functions, in this talk, we shall discuss this principle for weighted grand Lebesgue spaces $L^p_v$. As applications to these principles, we shall derive boundedness of various integral operators on the cone of monotone functions.

**Local boundary representations for a local operator system**
Maria Joiţa
*University Politehnica of Bucharest & Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

In this talk, we will discuss about the notion of local boundary representation for a local operator system introduced by C. S. Arunkumar [*Local boundary representations of locally $C^*$-algebras*, J. Math. Anal. Appl. 515(2022), 2, Paper No. 126416, 14 pp.].

**$p$-adic $L$-functions in $GL(2n)$-families**
Andrei Jorza
*University of Notre Dame, Notre Dame IN, USA*

$p$-adic $L$-functions have been crucial in some of the most striking advances in number theory, most notably in recent advances towards proving the Birch and Swinnerton-Dyer conjecture for certain abelian surfaces by Loeffler and Zerbes. Recently, with Barrera, Dimitrov, Graham and Williams we have constructed such $p$-adic $L$-functions in $GL(2n)$-families around unramified representations. I will present further work, with Mladen Dimitrov, on parahoric families, with an eye toward proving trivial zero conjectures.

**Ulrich bundles on cubic fourfolds**
Yeongrak Kim
*Pusan National University, Busan, South Korea*

An Ulrich sheaf on a closed subscheme $X$ of $\mathbb{P}^N$ of dimension $n$ and degree $d$ is a nonzero coherent sheaf $\mathcal{F}$ on $X$ whose cohomology table $\{h^i(X, \mathcal{F}(j))\}$ is a multiple of the cohomology table of the structure sheaf of $\mathbb{P}^n$. When $X = V(F)$ is a hypersurface, studying Ulrich sheaves on $X$ is closely related to determinantal representations of $F$ and matrix factorizations of $F$ in the sense of Eisenbud. In this talk, we discuss the existence of rank 6 Ulrich bundles on a smooth cubic fourfold. The main idea is to construct a sheaf which has the same topological type as an Ulrich bundle of given rank using the twisted cubics lying on a cubic fourfold, and then to deform it into a locally free sheaf. This is a joint work with D. Faenzi.

**Can one find all coherent structures supported by a nonlinear wave equation?**
Eduard-Wilhelm Kirr
*University of Illinois at Urbana-Champaign, USA*

I will present a new mathematical technique aimed at discovering all coherent structures supported by a given nonlinear wave equation. It relies on global bifurcation analysis which shows that, inside the Fredholm domain, the coherent structures organize themselves in in manifolds which either form closed surfaces or must reach the boundary of this domain. I will show how one can find all the limit points at the Fredholm boundary for the particular case of Nonlinear Schrödinger/Gross-Pitaevskii Equation and use these limit points to find all coherent structures and their bifurcation points.

**The Stokes operator on manifolds with cylindrical ends**
Mirela Kohr
*Babeş-Bolyai University, Cluj-Napoca, Romania*

We study the Stokes operator on a manifold with cylindrical ends. In the process, we prove Fredholm, regularity, and invertibility results. An important role is played by an adapted pseudodifferential calculus on manifolds with straight cylindrical ends which contains the inverses of its $L^2$-invertible, elliptic operators of nonnegative order. We also describe the construction of the corresponding Stokes layer potentials. Joint work with Victor Nistor (Metz) and Wolfgang L. Wendland (Stuttgart).

**Spectral theory of strings and the Camassa-Holm equation**
Aleksey Kostenko
*University of Ljubljana, Slovenia & University of Vienna, Austria*

Generalized indefinite stings, the object introduced by J. Eckhardt and the speaker almost 10 years ago, serve as yet another canonical model of a self-adjoint operator with simple spectrum. One of our main goals in this talk is to overview developments in spectral theory of strings. In particular, we plan to present a characterization of spectral measures/Weyl-Titchmarsh functions of (relative) Hilbert-Schmidt perturbations of some model strings. Our second goal is to demonstrate the application of this result to the Camassa-Holm equation, a remarkable nonlinear wave equation, for which generalized indefinite strings serve as Lax (isospectral) operators. Based on joint work with J. Eckhardt (Loughborough).

**A Markov process for a continuum infinite particle system with attraction**
Jurij Kozicki
*Maria Curie-Sklodowska University, Lublin , Poland*

The talk is based on a joint work with M. Röckner. An infinite system of point particles placed in $\mathbb{R}^d$ is studied. The particles are of two types; they perform random walks in the course of which those of distinct type repel each other. The interaction of this kind induces an effective multi-body attraction of the same type particles, which leads to the multiplicity of states of thermal equilibrium in such systems. The pure states of the system are locally finite counting measures on $\mathbb{R}^d$. The set of such states $\Gamma^2$ is equipped with the vague topology and the corresponding Borel $\sigma$-field. For a special class $\mathcal{P}_{\exp}$ of probability measures defined on $\Gamma^2$, we prove the existence of a family $\{P_{t,\mu} : t \geq 0,\ \mu \in \mathcal{P}_{\exp}\}$ of probability measures defined on the space of càdlàg paths with values in $\Gamma^2$, which is a unique solution of the restricted martingale problem for the mentioned stochastic dynamics. Thereby, the corresponding Markov process is specified.

**The monodromy of subvarieties on abelian varieties**
Thomas Krämer
*Humboldt Universität, Berlin, Germany*

An important task in algebraic geometry and Hodge theory is to control the monodromy of families of subvarieties in a given variety. In their recent work on the Shafarevich conjecture, Lawrence and Sawin have shown that any non-isotrivial family of smooth hypersurfaces in an abelian variety has big monodromy when twisted by a generic local system of rank one. I will explain how to go beyond hypersurfaces: The same big monodromy theorem holds for every family of subvarieties of dimension at most half the dimension of the abelian variety. The proof uses a combination of geometric arguments, representation theory and perverse sheaves; this is joint work with Ariyan Javanpeykar, Christian Lehn and Marco Maculan.

**Bending analysis of a nonhomogeneous rectangular plate resting on foundation using Rayleigh-Ritz method**

Yajuvindra Kumar
*Government Girls Degree College, Behat, India*

Bending analysis of a thin nonhomogeneous uniform rectangular plate resting on Winkler foundation subjected to uniformly distributed load, hydrostatic pressure and bi-sinusoidal load is presented. The mathematical model is developed using classical plate theory. The two opposite edges of the plate are either clamped or simply supported. The Rayleigh-Ritz method with simple algebraic polynomials is used to calculate the results. The displacements and bending moments are calculated for different boundary conditions. The effects of nonhomogenity parameters, aspect ratio and foundation parameter on displacement and bending moments are thoroughly examined. Numerical results in special cases have been compared with previously published ones.

**Hamiltonicity in Vertex-transitive Graphs**

Klavdija Kutnar
*University of Primorska, Koper, Slovenia*

A path (cycle) containing every vertex in a graph is called a Hamilton path (Hamilton cycle, respectively). A graph is called vertex-transitive if for any pair of vertices $u$ and $v$ there exists an automorphism mapping $u$ to $v$. In 1969, Lovasz asked whether every finite connected vertex-transitive graph has a Hamilton path.

With the exception of the complete graph on two vertices, only four connected vertex-transitive graphs that do not have a Hamilton cycle are known to exist. These four graphs are the Petersen graph, the Coxeter graph and the two graphs obtained from them by replacing each vertex by a triangle. The fact that none of these four graphs is a Cayley graph has led to a folklore conjecture that every Cayley graph has a Hamilton cycle. (A Cayley graph is a graph whose automorphism group admits a regular subgroup.) Both of these two problems are still open. However, a considerable amount of partial results are known.

I will survey some results about the topic. Special emphasis will be given to a solution to one of the problems posted recently by Gregor, Merino and Mütze, together with a connection to another long standing problem regarding vertex-transitive graphs - the problem about the existence of semiregular automorphisms in vertex-transitive graphs.

**Analytical and calibration properties for a stochastic shallow water system**

Oana Lang
*Imperial College London, UK*

In this talk I will present a strategy for proving existence of a unique maximal pathwise solution for a stochastic shallow water model. The solution is proven to be global with positive probability. Time permitting, I will explain how the model can be stochastically calibrated using a new technique developed in [2].

[1] *Well-posedness Properties for a Stochastic Rotating Shallow Water Model*, J. Dyn. Diff. Equat. (joint with D. Crisan)

[2] *Noise calibration for the stochastic rotating shallow water model*, arXiv:2305.03548 (joint with A. Lobbe and D. Crisan)

**A necessary and sufficient condition on a singular kernel for the continuity of an integral operator in Hölder spaces and applications to layer potentials**

Massimo Lanza de Cristoforis
*Università degli Studi di Padova, Padova, Italy*

Volume and layer potentials are integrals on a subset $Y$ of the Euclidean space $\mathbb{R}^n$ that depend on a variable in a subset $X$ of $\mathbb{R}^n$.

Here we follow an abstract approach by assuming that $X$ and $Y$ are subsets of a metric space $M$ and that $Y$ is equipped with a measure $\nu$ that satisfies upper Ahlfors growth conditions that include non-doubling measures as done by J. García-Cuerva and A. E. Gatto in a series of papers in case $X = Y$ and for standard kernels, and we prove a necessary and sufficient condition on a singular kernel for an integral operator to be bounded in Hölder spaces.

Then we present some application to layer potentials that are associated to the fundamental solution of an arbitrary constant coefficient second order elliptic operator with real principal coefficients.

**Higher rational and higher Du Bois singularities and applications**

Radu Laza
*Stony Brook University, Stony Brook NY, USA*

Two standard notions of singularities are rational and Du Bois singularities. In this talk, I will discuss recent generalizations of these notions - the higher rational and higher Du Bois singularities. After reviewing the definitions and basic properties of these classes of singularities, I will discuss about some concrete geometric applications, specifically to the geometry of moduli spaces of Calabi-Yau varieties. This is joint work with R. Friedman.

**Advanced properties of homogeneous linear recurrences with applications to stochastic problems**

Alexandru Lazari
*Moldova State University, Vladimir Andrunachievici Institute of Mathematics and Computer Science, Chişinău, Moldova*

Important properties of homogeneous linear recurrences over the set of complex numbers and its subsets are presented. We start with definition of generating vector and characteristic polynomial and formulate an efficient minimization method. Next, we go deeper into homogeneous linear recurrent processes over numerical rings and sign-based ring subsets. Littlewood, Newman and Borwein homogeneous linear recurrences are analyzed too.

After that, the convergence, periodicity and boundedness of homogeneous linear recurrent processes are studied. Small perturbations in homogeneous linear recurrences are considered and asymptotic behavior is analyzed using Jury Stability Criterion.

In the end, the stochastic systems with final sequence of states are defined and it is shown that their evolution time has a homogeneous linear recurrent distribution. The obtained results are applied for probabilistic characterization of the evolution time. Also, extended applications to games and optimization problems, defined on these stochastic systems, are mentioned.

**Numerical semigroups and weighted homogeneous surface singularities**
Tamás László
*Babeş-Bolyai University, Cluj-Napoca, Romania*

The aim of this talk is to create a bridge between the theory of numerical semigroups and the theory of complex normal surface singularities. We explain how one of the two theories might provide meaningful and enriching questions, ideas and simultaneously powerful tools to the other. In this talk we consider the case of numerical semigroups associated with weighted homogeneous surface singularities and show a solution to the Frobenius problem of these semigroups. Then, using the "flat classification" from the theory of numerical semigroups we can characterize those semigroups which arise in this way. The first part of this work was made jointly with A. Némethi (Rényi Inst. of Math., Budapest), the other part is a joint work with Zs. Baja (UBB, Cluj).

**A hierarchical structure within Harmonic Analysis; The Trilinear Hilbert Transform**
Victor Lie
*Purdue University, USA*

In this talk we will discuss a natural hierarchical structure that governs a vast teritory within the classical harmonic analysis area:

1. *non-zero curvature problems:* this usually involves the study of objects that lack (generalized) modulation invariance; prominent examples within this class are the "curved" Carleson operator and the linear and bilinear Hilbert transforms along "non-flat" curves.

2. *zero-curvature problems:* this focuses on objects that, on top of the standard dilation and translation symmetries, also exhibit a (generalized) modulation invariance; prominent examples within this class are the classical Carleson operator and the Bilinear Hilbert transform.

3. *hybrid problems:* this refers to the study of objects that share both zero and non-zero curvature features; prominent examples within this class are the Polynomial Carleson operator and the newly introduced Bilinear Hilbert–Carleson operator as well as the "hybrid" Trilinear Hilbert transform.

In the first part of the talk we will elaborate on the main concepts and problems, with an emphasis on an intuitive and at the same time panoramic view of the subject.

The second part of the talk will be centered around some very recent (joint) contributions of the speaker within the realm of the hybrid problem category. In this context, we will discuss the key role played by the *LGC-methodology* in the resolution of some difficult questions regarding the behavior of suitable quadrilinear forms that serve as models for the celebrated open question on the boundedness of the Trilinear Hilbert transform.

**The parametric eighth-degree interpolation spline function**
Xiaoyan Liu
*University of La Verne, La Verne CA, USA*

The C-3 parametric interpolation spline function is presented in this talk, which has the similar properties of the classical cubic Hermite interpolation spline with additional flexibility and higher approximation rates. To be specific, a group of eighth-degree base functions with three parameters is constructed. Furthermore, the interpolation spline function is defined based on the proposed base functions. The interpolation error and the technique for determining the optimal interpolation are also given. The results show that when the interpolation conditions remain unchanged, the proposed interpolation spline functions possess C-3 continuity, and the shape of the curve can be controlled by the parameters. When the optimal values of parameters are chosen, the interpolation spline function can reach high approximation rates.

**Some themes around the notion of catenary**
Rafael López
*University of Granada, Spain*

The catenary is the shape of a hanging chain suspended from its endpoints. In this talk, we will give some topics around the catenary curve, such as its extension to higher dimensions and the study of catenaries in other ambient spaces. As a special interest, we focus on the axisymmetric singular minimal surfaces, which are models of domes and roofs. We will discuss if catenary rotation surfaces and paraboloids can be candidates for models of domes.

**Recent progress on the Skolem problem**
Florian Luca
*Wits University, South Africa*

The celebrated Skolem-Mahler-Lech Theorem states that the set of zeros of a linear recurrence sequence is the union of a finite set and finitely many arithmetic progressions. The corresponding computational question, the Skolem Problem, asks to determine whether a given linear recurrence sequence has a zero term. Although the Skolem-Mahler-Lech Theorem is almost 90 years old, decidability of the Skolem Problem remains open. One of the main contributions of the talk is to present an algorithm to solve the Skolem Problem for simple linear recurrence sequences (those with simple characteristic roots). Whenever the algorithm terminates, it produces a standalone certificate that its output is correct – a set of zeros together with a collection of witnesses that no further zeros exist. We give a proof that the algorithm always terminates assuming two classical number-theoretic conjectures: the Skolem Conjecture (also known as the Exponential Local-Global Principle) and the $p$-adic Schanuel Conjecture. Preliminary experiments with an implementation of this algorithm within the tool SKOLEM point to the practical applicability of this method. In the second part of the talk, we present the notion of an *Universal Skolem Set*, which is a subset of the positive integers on which the Skolem is decidable regardless of the linear recurrence. We give two examples of such sets, one of which is of positive density (that is, contains a positive proportion of all the positive integers). Joint work with Yuri Bilu (Bordeaux), Joel Ouaknine (MPI-SWS) and James Worrell (Oxford).

**On programming language definitions as matching logic theories**
Dorel Lucanu
*Alexandru Ioan Cuza University, Iaşi, Romania*

Matching logic (ML) (http://www.matching-logic.org/) is a logic that allows to uniformly specify and reason about programming languages and properties of their programs. ML serves as the foundation of the K framework (https://kframework.org/), where the semantics of a programming language is (conceptually) represented as a ML theory and the goal is to automatically generate sound tools for the language starting from the K definition of the language. Such a tool is the K Prover (KP), a generic tool able to prove program properties expressed as reachability ML patterns. In this talk, we discuss some aspects regarding how to axiomatize programming languages as ML theories, including what kind of representation is the most suitable for proving and for proof checking.

**Exponential dichotomies via evolution semigroups**
Nicolae Lupa
*Politehnica University of Timişoara, Timişoara, Romania*

We generalize the classical concept of the evolution semigroup associated to an evolution family, replacing the usual right translation semiflow with a certain general real semiflow. We prove that under some suitable conditions, the evolution semigroup we consider is similar to the classical evolution semigroup. This enables us to apply well established results to completely characterize a wide class of dichotomies in terms of spectral conditions.

**Asymptotic behaviour of a one-dimensional avalanche model through a particular stochastic process**
Oana Lupaşcu-Stamate
*Gheorghe Mihoc-Caius Iacob Institute of Mathematical Statistics and Applied Mathematics of the Romanian Academy, Bucharest, Romania*

We develop the study of a binary coagulation-fragmentation equation which describes the avalanches phenomena. We construct rst an adapted stochastic process and obtain its behaviour to the equilibrium. Our model is based on self-organized critical (SOC) systems and in particular on a simple sand pile model introduced in Bressaud and Fournier. Furthermore, we dene a stochastic differential equation for this process and propose a numerical method in order to approximate the solution. The key point of our work is a new interpretation of the avalanches phenomena by handling stochastic differential equations with jumps and the analysis of the invariant behaviour of the stochastic process. The results are obtained jointly with Madalina Deaconu (Nancy).

**Concentration limit for non-local dissipative convection-diffusion kernels on the hyperbolic space**

Dragoş Manea
*Simion Stoilow Mathematical Institute of the Romanian Academy, Bucharest, Romania*

We study a non-local, non-linear convection-diffusion equation on the hyperbolic space $\mathbb{H}^N$, governed by two kernels, one for each of the diffusion and convection parts. One main novelty is the construction of the non-symmetric convection kernel defined on the tangent bundle and invariant under the geodesic flow.

Next, we consider the relaxation of this model to a local problem, as the kernels get concentrated near the origin of each tangent space. Under some regularity and integrability conditions, we prove that the solution of the concentrated non-local problem converges to that of the local convection-diffusion equation. We prove and then use in this sense a compactness tool on manifolds inspired by the work of Bourgain-Brézis-Mironescu.

**Khovanov homology and four-dimensional topology**

Ciprian Manolescu
*Stanford University, Palo Alto, USA*

Over the last forty years, most progress in four-dimensional topology came from gauge theory and related invariants. Khovanov homology is an invariant of knots in $\mathbb{R}^3$ of a different kind: its construction is combinatorial, and connected to ideas from representation theory. There is hope that it can tell us more about smooth 4-manifolds; for example, Freedman, Gompf, Morrison and Walker suggested a strategy to disprove the 4D Poincare conjecture using Rasmussen's invariant from Khovanov homology. It is yet unclear whether their strategy can work. I will explain several recent results in this direction and some of the challenges that appear. A key problem is to certify when a knot is slice (bounds a disk in four-dimensional half-space), which can be tackled with machine learning. The talk is based on joint work with Sergei Gukov, Jim Halverson, Marco Marengon, Lisa Piccirillo, Fabian Ruehle, Mike Willis, and Sucharit Sarkar.

**The dual and predual of Bloch space of matrices**

Liviu-Gabriel Marcoci
*Technical University of Civil Engineering, Bucharest, Romania*

The Bloch and Bergman spaces have been studied for a long time in complex analysis and in the last thirty years the interest concerning these spaces has increased. A direction of research (see Arregui & Blasco) was to study vector valued analytic function, but considered from a Banach point of view. In this talk we present matricial Bloch space together with the dual and its predual.

**Schur multipliers techniques in the solid spaces of infinite matrices**
Anca-Nicoleta Marcoci
*Technical University of Civil Engineering Bucharest, Romania*

It has been known for a long time that there is a formal relation between classical harmonic analysis and the theory of infinite matrices. However, still many challenging problems in this new theory so-called harmonic analysis of infinite matrices. In this talk, we present some results regarding solid spaces of infinite matrices using Schur multipliers.

**Extensions of SLE theory, and connections with other fields – with an Addendum on Hyperbolic Neural Networks and beyond, in the memory of Octavian Ganea**
Vlad Margarint
*University of Colorado at Boulder, USA*

Schramm-Loewner Evolutions (SLE) were introduced in 2000 by Oded Schramm in order to give meaning to scaling limits of interfaces of some models of Planar Statistical Physics. In the last years, there were many models that were proven to have their interfaces in the scaling limit described by SLE. The SLE curves are studied through the Loewner Differential Equation with a Brownian motion driver. I will present some recent work on extensions of this model in two directions. First, I will present an extension of the dynamics from Brownian Motion driver to Semimartingale driver and secondly from one driver to multiple drivers. A very important example of multiple drivers SLE, due to its connections with Conformal Field Theory (CFT), is the one in which the driver is Dyson Brownian Motion. I will present my recent results in these two directions and discuss also future directions. I will also touch on how another pillar of modern Probability Theory, namely Random Matrix Theory, can bring new insights into the Multiple SLE model.

The last part of my talk will be dedicated to the memory of my friend Octavian Ganea (MIT, Tenure track at NYU) who passed away last year at just 34. Octavian and his family along with a part of the Romanian community and international friends were instrumental in helping me during my degree for the many months in which I had far from enough financial resources to live in Zurich. I will touch on his research achievements in Hyperbolic Neural Networks and beyond, with the scope to popularize his work in Romania, our home country. I will also share some nice memories from our time together at ETH Zurich. Everybody is invited!

**Stable numerical solution of the Cauchy problem in anisotropic heat conduction with non-smooth coefficients**
Liviu Marin
*University of Bucharest & Gheorghe Mihoc-Caius Iacob Institute of Mathematical Statistics and Applied Mathematics of the Romanian Academy, Bucharest, Romania*

We study the recovery of the missing discontinuous/non-smooth thermal boundary conditions on an inaccessible portion of the boundary of the domain occupied by a solid from Cauchy data prescribed on the remaining boundary assumed to be accessible, in case of stationary anisotropic heat conduction with non-smooth/discontinuous conductivity coefficients. This inverse BVP is ill-posed and hence should be regularized/stabilised via a method developed based on *a priori* knowledge on the solution to this inverse problem and the smoothing feature of the direct problems involved. The original problem is transformed into a control one which reduces to solving an appropriate minimisation problem in a suitable function space. The latter problem is tackled by employing an appropriate variational method which yields a gradient-type iterative algorithm that consists of two direct problems and their corresponding adjoint ones.

This approach yields an algorithm designed to approximate specifically merely $L^2$–boundary data in the context of a non-smooth/discontinuous anisotropic conductivity tensor, hence both the notion of solution to the direct problems involved and the convergence analysis of the approximate solutions generated by the algorithm proposed require special attention. The numerical implementation is realised for two-dimensional homogeneous anisotropic solids using the finite element method, whilst regularization is achieved by terminating the iteration according to two stopping criteria.

This is a joint work with Mihai Bucataru (University of Bucharest & "Gheorghe Mihoc-Caius Iacob" Institute of Mathematical Statistics and Applied Mathematics of the Romanian Academy) and Iulian Cîmpean (University of Bucharest & "Simion Stoilow" Institute of Mathematics of the Romanian Academy).

**Similarity-based Set Matching**
Mircea Marin
*West University of Timişoara, Timişoara, Romania*

We propose am extension set matching to similarity relations. In this way, we incorporate some background knowledge into solving techniques with similarity relations. Although our set terms are interpreted as (finite) classical sets, their elements (arguments of set terms) might be related to each other by a similarity relation, which induces also a notion of similarity between set terms. We design a matching algorithm and study its properties. It can be useful in applications where the exact set matching techniques need to be relaxed to deal with quantitative extensions of equality such as similarity relations.

**The *H*-infinity control problem for parabolic systems**
Gabriela Marinoschi
*Gheorghe Mihoc-Caius Iacob Institute of Mathematical Statistics and Applied Mathematics of the Romanian Academy, Bucharest, Romania*

The *H*-infinity control is a technique used in control theory to design robust stabilizing feedback controllers that force a system to achieve stability with a prescribed performance even if the system output may be corrupted by perturbations. We present the *H*-infinity control problem with state feedback for infinite dimensional boundary control systems of parabolic type with distributed disturbances and discuss an application to an equation with a Hardy potential.

**Special classes of solutions to the Gross-Clark system**
Mihai Maris
*Université Paul Sabatier - Toulouse 3, Toulouse, France*

The Gross-Clark system has beeen used to describe the motion of an uncharged impurity in a Bose codensate. We will present several classes of particular solutions to this system: ground states, bubble-vortices and traveling waves. In each case we will discuss the existence, give some qualitative properties, and compare to corresponding results for the Gross-Pitaevskii equation. This is a joint work with David Chiron and Joe Alhelou.

**Hilbert irreducibility for some algebraic groups with density one**
Vlad Matei
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

In joint work in progress with Lior Bary Soroker and Daniele Garzoni we look at polynomials $f(t_1, t_2, \ldots, t_n, X) \in \mathbb{Q}[t_1, \ldots, t_n, X]$ which satisfy the condition that $f(t_1^{l_1}, \ldots, t_n^{l_n}, X)$ is absolutely irreducible for any tuple $(l_1, \ldots, l_n)$ of positive. and $\deg_X(f) \geq 2$. We show that that density of specializations $f(a_1^{m_1}, \ldots, a_n^{m_n}, X)$ where $a_1, \ldots, a_n$ are fixed multiplicatively independent elements and $1 \leq m_i \leq N$ is 1 as $N$ goes to infinity.

**Three-field weak solutions for a class of boundary value problems**
Andaluzia-Cristina Matei
*University of Craiova, Craiova, Romania*

We consider a class of boundary value problems with physical significance in contact mechanics. More precisely, we draw attention to the weak solvability of a boundary value problem consisting of the Cauchy equilibrium equation, a constitutive law governed by a bipotential, a homogeneous displacement boundary condition, a traction boundary condition, a frictional contact condition modeled with the subdifferential of convex functions and a frictionless contact condition described by means of the Clarke subdifferential. We deliver a weak formulation as a variational-hemivariational system, the unknown being a triple consisting of the displacement field, the Cauchy stress tensor and a Lagrange multiplier related to the friction force on the frictional contact zone. We investigate the existence of the weak solutions by using a fixed point theorem for set-valued mappings and a minimization technique.

**Incompresability of first order logic in transformer under a probabilistic multivariate normal model with independence**
Heinrich Matzinger
*Georgia Institute of Technology, Atlanta, USA*

We consider the problem of first order logic learning by transformer assuming given an adequate ontology. Hence, in our setting the transformer does not need to learn the vector representation of words, but is given such a vector with components corresponding to all the categorization and properties used in the first order logic. We show that under assumption of independence a disjunction of conjunctions can not be approximated closely as one liner functional followed by a ReLU in case of independent properties. We analyze how this may affect the performance of transformers.

**Higher Du Bois and higher rational singularities of hypersurfaces**
Laurenţiu Maxim
*University of Wisconsin-Madison, USA*

The notions of higher Du Bois and higher rational singularities of hypersurfaces were recently introduced and studied by Jung-Kim-Saito-Yoon, Mustata-Olano-Popa-Witaszek and Friedman-Laza, as natural generalizations of Du Bois and rational singularities, respectively. In this talk I will present a homological characterization of these notions, in terms of characteristic classes introduced in prior work with M. Saito and J. Schuermann. As a preliminary step, I will describe such singularities using the Hodge filtration on the vanishing cycle complex. (Joint work with R. Yang and M. Saito.)

**On almost Knig-Egervry graphs**
Eugen Mândrescu
*Holon Institute of Technology, Holon, Israel*

Let $\alpha(G)$ denote the cardinality of a maximum independent set, while $\mu(G)$ be the size of a maximum matching in graph G=(V,E) . If $\alpha(G) + \mu(G) = |V|$, then G is called a König-Egerváry graph, while if $\alpha(G) + \mu(G) = |V| - 1$, then G is an almost König-Egerváry graph. If G is not a König-Egerváry graph, but there exists a vertex $v \in V$ (an edge $e \in E$) such that G-v (G-e ) is König-Egerváry, then G is called a vertex almost König-Egerváry (C. E. Larson, R. Pepper, The Electronic Journal of Combinatorics **18** (2011) #P180) (an edge almost König-Egerváry graph, respectively).

In this talk, we present some relationships between all these types of almost König-Egerváry graphs, as well as several specific properties.

Joint work with Vadim E. Levit, Ariel University, Israel.

**Dirac, Lagrange and monotone structures in energy-based mathematical modeling of dynamical systems**
Volker Mehrmann
*Institut für Mathematik, Technische Universität Berlin, Germany*

Most real world dynamical systems consist of subsystems from different physical domains, modelled by partial-differential equations, ordinary differential equations, and algebraic equations, combined with input and output connections. To deal with such complex system, in recent years the class of dissipative port-Hamiltonian (pH) descriptor systems has emerged as a very successful modeling methodology. The main reasons are that the network based interconnection of pH systems is again pH, Galerkin projection in PDE discretization and model reduction preserve the pH structure and the physical properties are encoded in the geometric properties of the flow as well as the algebraic properties of the equations. Furthermore, dissipative pH system form a very robust representation under structured perturbations and directly indicate Lyapunov functions for stability analysis. Using global geometric and algebraic points of view, via Dirac, Lagrange or monotone spaces or manifolds, translations between different representations are presented. Characterizations are also derived when a general differential-algebraic system can be transformed into one of these structured representations. Numerical approaches for computing the structural information and the described transformations are derived and the results are demonstrated with some real world examples.

**Reaction-diffusion systems: source stability estimates with boundary observations**
Elena-Alexandra Melnig
*Alexandru Ioan Cuza University & Octav Mayer Institute of Mathematics of the Romanian Academy, Iaşi, Romania*

We consider systems of reaction-diffusion equations coupled in zero order terms, in annular domains. We establish Lipschitz estimates in $L^2$ for the source in terms of the solution and/or its normal derivative on a connected component of the boundary. The main tool is an appropriate Carleman estimate in $L^2$-norm for nonhomogeneous parabolic systems.

**On the parts with the same parity in all the partitions of $n$**
Mircea Merca
*University Politehnica of Bucharest, Bucharest, Romania*

The first appearance of parity in partitions arose in Legendre's interpretation of Euler's pentagonal number theorem. Since then, the parity of parts has played a central role in many works on partitions. We investigate the number of the parts with the same parity in all the partitions of $n$ and provide connections with other counting functions. As applications of some truncated theta series, we introduce a collection of identities and infinite families of linear inequalities involving the number of the parts with the same parity in all the partitions of $n$. Moreover, we provide connections with partitions with non-negative rank, partition with non-negative crank and Garden of Eden partitions. Additive evaluations of some multiplicative functions are investigated in this context.

**Positivity in the quantum K theory of Grassmannians**
Leonardo Mihalcea
*Virginia Tech, Blacksburg, United States*

The quantum K theory ring of a complex projective manifold X is a deformation of the ordinary Grothendieck ring of vector bundles on X, defined in the early 2000's by Givental and Lee. In this talk I will discuss a proof for a positivity property of the Schubert structure constants for the quantum K ring of a Grassmann manifold. This is joint work with A. Buch, P.E. Chaput and N. Perrin.

**Monotonicity properties of the $p$-torsional rigidity in convex domains**
Mihai Mihăilescu
*University of Craiova, Craiova, Romania & Gheorghe Mihoc-Caius Iacob Institute of Mathematical Statistics and Applied Mathematics of the Romanian Academy, Bucharest, Romania*

For any bounded and convex set $\Omega \subset \mathbb{R}^N$ ($N \geq 2$) with smooth boundary, $\partial\Omega$, and any real number $p > 1$, we denote by $u_p$ the *p-torsion function* on $\Omega$, that is the solution of the *torsional creep problem* $\Delta_p u = -1$ in $\Omega$, $u = 0$ on $\partial\Omega$, where $\Delta_p u := div(|\nabla u|^{p-2}\nabla u)$ is the $p$-Laplace operator. Our aim is to investigate the monotonicity with respect to $p$ for the *p-torsional rigidity* on $\Omega$, defined as $T_p(\Omega) := \int_\Omega u_p dx$. More precisely, we establish that there exist two constants $D_1 \in \left[\frac{1}{2}, e^{\frac{-1}{N+1}}\right]$ and $D_2 \in [1, N]$ such that for each bounded and convex set $\Omega \subset \mathbb{R}^N$ with $\frac{|\partial\Omega|}{|\Omega|} \leq D_1$ the function $p \mapsto T_p(\Omega)$ is decreasing on $(1, \infty)$ while for each bounded and convex set $\Omega \subset \mathbb{R}^N$ with $\frac{|\partial\Omega|}{|\Omega|} \geq D_2$ the function $p \mapsto T_p(\Omega)$ is increasing on $(1, \infty)$. Moreover, for each real number $s \in (D_1, D_2)$ there exists a bounded and convex set $\Omega \subset \mathbb{R}^N$ with $\frac{|\partial\Omega|}{|\Omega|} = s$ such that the function $p \mapsto T_p(\Omega)$ is not monotone on $(1, \infty)$. This is a joint work with Cristian Enache and Denisa Stancu-Dumitru.

**Dynamics of semigroup actions and amalgamated pressure.**
Eugen Mihăilescu
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

We study dynamics on infinite trajectories generated by a set of endomorphisms on a compact metric space $X$, and introduce the amalgamated pressure and other notions of pressure for multipotentials. These notions of pressure are motivated by the thermodynamic formalism for certain random walks and perturbations, and by the problem of classification for semigroup actions. They are useful for dimension estimates. We introduce also a measure-theoretic amalgamated entropy for invariant probability measures on $X$. Then for a set of $C^2$-smooth maps on a Riemannian manifold having joint stable and unstable cone fields, we apply the amalgamated pressure $P^A$ of unstable type to estimate the Hausdorff dimension of arbitrary slices transversal to the stable cones.

**On evolution anisotropic periodic variable-coefficient Navier-Stokes equations**
Sergey E. Mikhailov
*Brunel University London, UK*

We consider the evolution (non-stationary) anisotropic Navier-Stokes equations with variable space-periodic viscosity coefficients in $\mathbb{R}^n$. Employing the Galerkin algorithm, we prove the existence of a global weak spatially-periodic solution for the Navier-Stokes system in a periodic Sobolev space. The solution uniqueness and regularity results are also discussed.

**Kimura semigroups, Davis numbers and the set-theoretic quantum Yang-Baxter equation**
Gigel Militaru
*University of Bucharest, Bucharest, Romania*

We prove that the category of solutions of the set-theoretic quantum Yang-Baxter equation of Frobenius type is equivalent to the category of pointed Kimura semigroups. As applications, all nondegenerate, idempotent, bijective, involutive, finite order or unitary solutions are classified. For instance, if $|X| = n$, then the number of isomorphism classes of all such solutions on the set $X$ that are (a) left non-degenerate, (b) bijective or (c) unitary is: (a) the Davis number $d(n)$, (b) $\sum_{m|n} p(m)$, where $p(m)$ is the partition number, or (c) $\tau(n) + \sum_{d|n} \left\lfloor \frac{d}{2} \right\rfloor$, where $\tau(n)$ is the number of divisors of $n$. Several others applications are given. Joint work with Ana Agore and Alexandru Chirvasitu.

**An exact sequence for the graded Picent group**
Virgilius-Aurelian Minuţă
*Babeş-Bolyai University, Cluj-Napoca, Romania*

We introduce a notion of group graded Picent group associated to a strongly group graded algebra, and we establish an exact sequence linking this group and the Picent group of the 1-component. This sequence is a version of the Beattie - del Ro sequence from 1996. Furthermore, we show that there is an interesting connection between these two exact sequences, which involves the 5-term exact sequence.

One motivation for these results comes from our proof that there is a link between character triples and a special type of group graded Morita equivalences. These algebra equivalences are obtained via group graded bimodules which satisfy some additional conditions involving how the elements of the bimodule interact with the centralizer subalgebra of the aforementioned algebras. Classes of isomorphisms of such bimodules form the graded Picent group, which is a subgroup of the graded Picard group.

This is a joint work with Andrei Marcus.

**On the Radon-Carleman problem in irregular domains**
Irina Mitrea
*Temple University, Philadelphia, USA*

The talk focuses on recent advances in the Radon-Carleman Problem in irregular domains. Specifically we compute and/or estimate the essential norm and/or Fredholm radius of singular integral operators of double layer type, associated with elliptic PDE, on function spaces naturally intervening in the formulation of boundary value problems for said PDE. This program is carried out in a very general geometric setting. This is joint work with Dorina Mitrea and Marius Mitrea.

**The permutation entropy and its applications on full-scale compartment fire data**
Flavia Mitroi-Symeonidis
*Academy of Economic Studies, Bucharest, Romania*

Given the sparse literature on the usefulness of the entropy in analyzing fire data, we investigate the order characteristics of the compartment fire based on experimental data. We compare several known algorithms used extract the underlying probabilities, checking their suitability to point out the abnormal values and structure of the time series. We claim that the permutation entropy is suitable to detect the occurrence of the flashover and unusual data in fire experiments.

**Time-periodic weak solutions for incompressible fluids interacting with elastic shells**
Claudiu Mîndrilă
*Charles University, Prague, Czech Republic*

Consider a smooth bounded 3D domain containing a Newtonian fluid which verifies the Navier-Stokes equations. To a flat part of this reference domain, an elastic membrane is attached and is allowed to move only in normal (vertical) direction. We assume that, on the boundary, the velocity of the fluid equals the velocity of the membrane. The system evolves under the action of external time-periodic forces. Provided that the magnitude of the forces and the volume of the domain remain sufficiently small, we prove that at least one time-periodic weak solution exists. This is a joint result with S. Schwarzacher (Uppsala Universitet & Charles University).

**Regularity properties of Orlicz-Sobolev spaces on metric measure spaces**
Marcelina Mocanu
*Vasile Alecsandri University of Bacău, Bacău, Romania*

In this talk we summarize several results on the regularity of Orlicz-Sobolev functions on a metric space with a doubling measure and present some of their generalizations to the case where the role of the Orlicz space is played by a more general rearrangement invariant Banach function space. The topics to be discussed include the density of Lipschitz functions in Sobolev-type spaces, aspects of pointwise behavior of Orlicz-Sobolev functions (quasicontinuity, Lebesgue points) and various types of differentiability (approximate, almost everywhere, in $L^{\Phi}$- sense). Poincaré inequalities and maximal operators of Hardy-Littlewood type are key tools. Some regularity properties have been recently generalized to the setting of Musielak-Orlicz-Sobolev spaces, a flexible framework for the study of nonlinear PDE's and variational problems.

**Migration of silting-like properties via adjoint pairs**
George Ciprian Modoi
*Babeş-Bolyai University, Cluj-Napoca, Romania*

Consider two triangulated categories $\mathcal{D}_1$ and $\mathcal{D}_2$ and a triangle functor $\varphi_* : \mathcal{D}_2 \to \mathcal{D}_1$ having both left adjoint $\varphi^*$ and a right adjoint $\varphi^!$. We say that a property of an object in $\mathcal{D}_1$ a (co)ascends, respectively (co)descends via these functors provided that it is preserved, respectively reflected by $\varphi^*$ ($\varphi^!$). We present several results describing how the property of being (co)silting (co)ascends and/or (co)descends. The motivating example is the study of the conditions in which (co)silting property (co)ascends/descends via the induction, restriction and coinduction functors induced by a morphism of commutative algebras $\varphi : A \to B$. We generalize this example by imposing condition that the categories $\mathcal{D}_1$ and $\mathcal{D}_2$ have an internal tensor (that is, they are actually tensor triangulated categories), such that the unit object for the tensor functor is silting in both cases. We want to advertise this setting, by explaining how natural this supplementary condition is.

**Asymptotic analysis of a nonlinear boundary value problem with friction**
Dilmi Mourad
*Ferhat Abbas Sétif 1 University, Algeria*

In this talk, we consider the non linear problem in a stationary regime in a three dimensional thin domain $\Omega^\epsilon$. In the first step, we derive a variational formulation of the mechanical problem and prove the existence and uniqueness of the weak solution. We study the asymptotic analysis, in which the small parameter $\epsilon$ is the height of the domain used. Then the estimates for the displacement independent of the $\epsilon$, the limit of the weak problem and the specific Reynolds equation are obtained.

**Inverse entropy for endomorphisms**
Radu Munteanu
*University of Bucharest, Bucharest, Romania*

We introduce a notion of inverse entropy for an arbitrary measure preserving endomorphism on a probability space. We provide a general formula for inverse measure-theoretic entropy relating it to the folding entropy. We compute the inverse entropy for some concrete examples. The inverse entropy can differentiate between endomorphisms which have the same forward measure theoretic entropy. We study the relationship between inverse measure-theoretic entropy and toplogical inverse entropy. This is joint work with Eugen Mihailescu.

**A new approach to the Fourier Extension Problem for the paraboloid**
Camil Muscalu
*Cornell University, Ithaca NY, USA*

The plan of the talk is to describe a new approach to the so-called Restriction Conjectures, that Itamar Oliveira and I have developed recently. Without entering into details, this new point of view allows one to prove that (essentially) all the relevant conjectures (linear or multi-linear) are true, provided that one of the functions involved has a tensor structure.

**Invariants of singularities and higher rational and Du Bois singularities**
Mircea Mustaţă
*University of Michigan, Ann Arbor, United States*

I will discuss a certain invariant of singularities, the minimal exponent, defined for hypersurface singularities and recently extended to complete intersections. I will explain how this invariant governs two classes of singularities that have been introduced recently, the $k$-Du Bois and $k$-rational singularities, refining the classical notions of Du Bois and rational singularities.

**The Laplace plane of asteroid satellites**
Gabriela-Ana Nadabaică
*Alexandru Ioan Cuza University, Iaşi, Romania*

In the context of a perturbed two body problem, in which the Keplerian motion of the small object (the satellite) is perturbed by the oblateness of the central body (the asteroid) and the attraction of a third body (the Sun), we discuss the long-term evolution of the inclination and the longitude of the ascending node of a satellite orbiting an oblate body. To this end, we provide an analytical study describing the location of the Laplace plane as a function of several parameters, such as the magnitude of the forces involved, the distance from the oblate body, the obliquity of the Sun's orbit. This plane, also called the invariable plane, has its normal vector located between the normal vector of the equatorial plane and the normal vector of the Sun's orbital plane. The analytical study is complemented by numerical tests in which there are propagated several orbits within the context of both Cartesian and Hamiltonian approaches.

**On a class of quasi-Frobenius algebras**
Laura Năstăsescu
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

We start with two matrix coalgebras $\mathcal{E}$ and $\mathcal{F}$, and then we adjoint two families of elements which in a matrix formal way behave like some kind of skew-primitives with respect to $\mathcal{E}$ and $\mathcal{F}$. In this way we construct in a natural way a class of finite dimensional coalgebras. We show that the obtained coalgebras are quasi-co-Frobenius and are co-Frobenius only when $\mathcal{E}$ and $\mathcal{F}$ have the same size. By taking the dual algebras, we obtain a large class of quasi-Frobenius algebras which are not Frobenius.

**Data assimilation for fluid-structure interaction (FSI). Applications to 4d-flow MRI**
Mihai Nechita
*Tiberiu Popoviciu Institute of Numerical Analysis, Romanian Academy, Cluj-Napoca, Romania*

Numerical analysis for partial differential equations (PDEs) traditionally considers problems that are well-posed in the continuum. However, when a part of the boundary is inaccessible for measurements or no information is given on the boundary at all, the problem might be ill-posed and solving it requires regularization.

In this talk, we consider fluid-structure interaction (FSI) models for which noisy velocity measurements in a subset of the computational domain are given. We present a stabilized finite element method (FEM) for this ill-posed unique continuation/data assimilation problem, based on PDE-constrained optimisation with discrete regularisation.

Such a stabilized FEM for ill-posed FSI problems can be used in applications related to blood flow and medical imagining data, e.g. 4d-flow MRI data measuring the 3d velocity field of a tissue. We will illustrate such applications with numerical examples.

**On the resilience of a nature-inspired class of algorithms**
Elena Nechita
*Vasile Alecsandri University, Bacău, Romania*

During the last decades, the community of researchers from various domains has shown a growing interest towards systems resilience. Obviously, systems of any kind are expected to meet requirements and maintain their operational characteristics as long as possible, while facing changing (sometimes unpredictable) conditions, environments and/or challenges. The concept of resilience has emerged for complex, dynamic systems and can be generally defined as the capacity of a system to tolerate disturbances while retaining its structure and functions. The list of domains where systems resilience is important is long and specific definitions have been provided: engineering, economics, environment, ecology, psychology and neurobiology, sociology. In computer science, resilience has been defined mainly for networks and large scale distributed systems, security and soft infrastructure systems. Given the wide interest and importance of the concept, not only for researchers but for policymakers too, numerous and sometimes diverging interpretations and perceptions have been proposed for resilience. Several studies proposed conceptual and theoretical models for resilience, such as for societal resilience, for disaster risk management or for high-performance computing systems. Our paper presents several considerations on the resilience of a nature-inspired class of algorithms, namely the Ant Colony Optimization heuristic algorithms.

**Quantum groups and quiver varieties**
Andrei Neguţ
*MIT, Cambridge, USA*

We will survey the well-established connection between quantum (loop) groups and Nakajima quiver varieties, and focus on the correspondence between

- the action of preprojective $K$-theoretic Hall algebras on the $K$-theory groups of quiver varieties, and

- stable envelopes of quiver varieties, which are defined using the symplectic geometry of the latter.

**Weak anisotropic Hardy inequalities and essential self-adjointness of drift-diffusion operators**
Irina Nenciu
*University of Illinois at Chicago, Chicago, USA*

We consider the problem of essential self-adjointness of the drift-diffusion operator $H = -\frac{1}{\rho}\nabla \cdot \rho \mathbb{D}\nabla + V$ on domains $\Omega \subset \mathbb{R}^d$. We give criteria showing how the behavior as $x \to \partial\Omega$ of the coefficients $\rho$, $\mathbb{D}$, and $V$ balances to ensure essential self-adjointness of $H$ by using a new, weak anisotropic Hardy inequality. This talk is based on joint work with G. Nenciu (IMAR).

**Norms of averaging operators on hyperbolic groups**
Bogdan Nica
*Indiana University - Purdue University Indianapolis, USA*

Consider an infinite, finitely generated group. A natural operator, acting on complex-valued functions on the group, is the averaging operator defined by a finite subset. What can be said about its norm(s)? I will discuss this question in a geometric situation: the subset is a sphere or a ball, and the ambient group is hyperbolic (in the sense of Gromov).

**Polynomials over structured grids**
Bogdan Nica
*Indiana University - Purdue University Indianapolis, USA*

The study of multivariate polynomials over finite grids - that is, cartesian products of finite subsets of a field - is a rich theme rooted in algebra, with ramifications in combinatorics and in theoretical computer science. A prime illustration of the theme is Alon's Combinatorial Nullstellensatz. I will discuss a "structured" generalization of the Combinatorial Nullstellensatz. The talk is based on the recent paper "Polynomials over structured grids" (Combinatorics, Probability and Computing 2023).

**Rings, boolean algebras and Yang-Baxter systems**
Florin Felix Nichita
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

After a short discussion on the Euler's relation, we introduce a matrix version of the Euler's relation. We also refer to the Yang-Baxter equation, and to Yang-Baxter systems. The main part of this presentation is on the unification of rings and Boolean algebras. These new structures are related to the Yang-Baxter equation and to Yang-Baxter systems.

**Morse functions statistics**
Liviu Nicolaescu
*University of Notre Dame, Notre Dame, IN, USA*

I will describe investigations of the entire "population" of Morse functions on a smooth compact manifold. I will concentrate on two questions. How does a typical/average Morse function look like? Are there many atypical Morse functions?

**The Hornich-Hlawka functional inequality**
Constantin Niculescu
*University of Craiova, Craiova, Romania*

We analyze the role played by $n$-convexity for the fulfillment of a series of linear functional inequalities that extend the Hornich-Hlawka functional inequality,

$$f(x) + f(y) + f(z) + f(x + y + z) \geq f(x + y) + f(y + z) + f(z + x) + f(0).$$

**Layer potentials on manifolds with cylindrical ends: the Laplace operator**
Victor Nistor
*Université de Lorraine, Metz, France*

We study the method of Layer Potentials on manifolds with cylindrical ends. This includes domains in $\mathbb{R}^n$ with outlets at infinity. One of the main difficulties is the characterization of the Fredholm properties of the resulting integral operators, which requires information on the behavior at infinity. Joint work with Marius Mitrea and Mirela Kohr. We apply our results to the study of the Laplacian. Applications for the Stokes system and further results on the Laplacian will be discussed in the subsequent talk by Mirela Kohr.

**Magnetic geodesics in $\mathbb{R}^7$**
Ana-Irina Nistor
*Gheorghe Asachi Technical University of Iaşi, Iaşi, Romania*

The study of magnetic trajectories originates in Physics and they represent the trajectories of charged particles moving on a Riemannian manifold under the influence of an external magnetic field, given by a divergence-free vector field. In the absence of the magnetic field, the particle moves freely, describing the geodesics of the ambient space. After recalling some well-known results in the field, we study the magnetic geodesics as the solutions of the Lorentz equation defined by the cross product corresponding to the 7-dimensional Euclidean space. We find several examples of such trajectories and moreover, we motivate our results making a comparison with the 3-dimensional Euclidean case, ambient space which was among the first ones approached in the study of magnetic trajectories.

**Uniform estimates for transmission problems in the smooth and polygonal cases**
Victor Nistor
*Université de Lorraine, Metz, France*

We consider the regularity in broken Sobolev spaces for second order, strongly elliptic transmission problems. We consider two cases: that of polygonal domains (joint work with C. Bacuta and H. Li) and that of smooth domains and interfaces (but in arbitrary dimension, joint work with S. Labrunie and H. Mohsen). We show that the "constants" appearing in the classical estimates grow at most polynomialy in the coefficients of the operator.

**On biconservative surfaces**
Cezar Oniciuc
*Alexandru Ioan Cuza University, Iaşi, Romania*

In this talk, I will present some old and new results on biconservative surfaces, with a special focus on biconservative surfaces in four dimensional space forms.

**Brownian motion with power law drifts**
Adina Oprişan
*New Mexico State University, Las Cruces, New Mexico, USA*

We will discuss the influence of some power law drifts on the exit time of the Brownian motion from the half-line. The behavior of the process far away from zero will have the greatest influence on the exit time and we are evaluating the lifetime of the process using large deviations techniques. This talk is based on a joint work with D. DeBlassie and R. Smits.

**Bott-Chern cohomology of compact Vaisman manifold**
Alexandra Otiman
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania & Aarhus Institute of Advanced Studies, Aarhus, Denmark*

Vaisman manifolds are a special class of locally conformally Kähler manifolds that possess remarkable cohomological properties. In this talk we give an explicit description of the Bott-Chern cohomology groups of compact Vaisman manifolds. We infer that the Bott-Chern numbers and the Dolbeault numbers of a Vaisman manifold determine each other. On the other hand, we show that the cohomological invariants introduced by Angella-Tomassini are unbounded for Vaisman manifolds. Finally, we give a cohomological characterization of the Dolbeault and Bott-Chern formality for Vaisman metrics. This is joint work with Nicolina Istrati.

**Well-posedness and long time behavior for Viscous Fractional Cahn-Hilliard Equations with Memory**

Eylem Öztürk
*Hacettepe University, Ankara, Türkiye*

We examine a viscous Cahn-Hilliard phase-separation model with memory and where the chemical potential possesses a nonlocal fractional Laplacian operator. The existence of global weak solutions is proven using a Galerkin approximation scheme. A continuous dependence estimate provides uniqueness of the weak solutions and also serves to define a precompact pseudometric. This, in addition to the existence of a bounded absorbing set, shows that the associated semigroup of solution operators admits a compact connected global attractor in the weak energy phase space. The minimal assumptions on the nonlinear potential allow for arbitrary polynomial growth.

**Braided Lie algebras of gauge transformations for noncommutative Hopf-Galois extensions**

Chiara Pagani
*University of Bologna, Bologna, Italy*

Hopf-Galois algebra extensions are seen as principal bundles in noncommutative geometry. In this context, it is an open problem the definition of algebraic counterparts of the groups of bundle automorphisms and gauge transformations.

I will present recent results on the study of braided Lie and Hopf algebras of infinitesimal gauge transformations for noncommutative $H$-Galois algebra extensions which are equivariant ($H$-$K$ Hopf modules) under a triangular Hopf algebra $K$.

Talk based on joint works with P. Aschieri (Piemonte Orientale) and G. Landi (Trieste).

**Cohomology rings of abelian arrangements**

Roberto Pagaria
*Bologna University, Bologna, Italy*

We briefly recall the definition of hyperplane arrangements, toric arrangements and their generalization called abelian arrangements. The cohomology ring of the complement is known from a result by Orlik and Solomon (1980) in the hyperplane case. The toric case is due to De Concini and Procesi (2005) and to Callegaro, DAdderio, Delucchi, Migliorini, and I (2020). In this talk, we present a new and unified presentation of the cohomology ring of all abelian (non-compact) arrangements. This is a work in progress with Evienia Bazzocchi e Maddalena Pismataro.

**On intersections of orbits of rational functions**
Fedor Pakovich
*Ben Gurion University, Beer Sheva, Israel*

Let $A$ be a rational function of degree at least two on $\mathbb{CP}^1$. For a point $z_1 \in \mathbb{CP}^1$ we denote by $O_A(z_1)$ the forward orbit of $A$, that is, the set

$$\{z_1, A(z_1), A^{\circ 2}(z_1), \dots\}.$$

In the talk, we address the following problem: *given two rational functions $A$ and $B$ of degree at least two, under what conditions do there exist orbits $O_A(z_1)$ and $O_B(z_2)$ having an infinite intersection?* We show that under a mild restriction on $A$ and $B$ this happens if and only if $A$ and $B$ have an iterate in common, that is, if and only if $A^{\circ k} = B^{\circ l}$ for some $k, l \geq 1$. Put another way, unless rational functions $A$ and $B$ have the same global dynamics, an orbit of $A$ may intersect an orbit of $B$ at most at finitely many places.

**Simple integral fusion categories**
Sébastien Palcoux
*Yanqi Lake Beijing Institute of Mathematical Sciences and Application, Beijing, China*

A well-known open problem is whether there exists a finite quantum group which cannot be "cooked up" from finite groups, and more generally, an integral fusion category which is not weakly group-theoretical. In the simple case, we will see that it is equivalent to the existence of non-pointed simple integral modular category. A way to investigate this problem is to look for simple integral fusion rings, and see whether a non-grouplike one can be categorified, or at least a modular data. In joint works with Max A. Alekseyev, Winfried Bruns, Sebastien Burciu, Huang Linzhe, Zhengwei Liu, Fedor V. Petrov, Yunxiang Ren and Jinsong Wu, we developed several categorification criteria, involving modular arithmetic, hypergroup theory, quantum Fourier analysis, localization strategies (of the pentagon equations), and we applied them as efficient filters for above investigation. We obtained classification results of the Grothendieck rings of simple integral fusion categories up to rank 8, and of the modular data of integral modular fusion categories up to rank 12.

**Globalising Jones and Alexander polynomials via Lagrangians in configuration spaces**
Cristina Palmer-Anghel
*University of Geneva, Switzerland & Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

Jones and Alexander polynomials are two important knot invariants and our aim is to see them both from a unified model constructed in a configuration space. More precisely, we present a *common topological perspective* which sees both invariants, based on configurations on *ovals and arcs* in the punctured disc. The model is constructed from a graded intersection between *two explicit Lagrangians in a configuration space*. It is a polynomial in two variables, recovering the Jones and Alexander polynomials through specialisations of coefficients. Then, we prove that the intersection before specialisation is (up to a quotient) an invariant which globalises these two invariants, given by an explicit interpolation between the Jones polynomial and Alexander polynomial.

We also show how to obtain the quantum generalisation, coloured Jones and coloured Alexander polynomials, from a graded intersection between *two Lagrangians in a symmetric power of a surface*.

**Homological mapping class group representations and lower central series**
Martin Palmer-Anghel
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

A long-standing open question about mapping class groups of surfaces is whether they are linear, i.e. act faithfully on finite-dimensional vector spaces. In genus zero, for the braid groups, the answer is yes, as proven by Bigelow and Krammer using one of the family of Lawrence representations of the braid groups. Motivated by this, I will describe an analogue of the family of Lawrence representations for higher-genus surfaces – depending on a chosen representation $V$ of the discrete Heisenberg group. A subtlety is that these mapping class group representations are in general twisted, essentially as a consequence of the non-commutativity of the discrete Heisenberg group. However, I will explain how to untwist them for particular choices of $V$ (and for any $V$ if we restrict to the Torelli group). This all represents joint work with Christian Blanchet and Awais Shaukat. The appearance of the discrete Heisenberg group in the construction arises from the study of the lower central series of (partitioned) surface braid groups: I will also outline recent joint work with Jacques Darné and Arthur Soulié that answers the stopping question for these lower central series.

**Newton-like components in the Chebyshev-Halley family of degree n polynomials**
Dan Paraschiv
*Universitat de Barcelona, Barcelona, Spain*

We study the Chebyshev-Halley methods applied to the family of polynomials $f_{n,c}(z) = z^n + c$, for $n \geq 2$ and $c \in \mathbb{C}^*$. We prove the existence of parameters such that the immediate basins of attraction corresponding to the roots of unity are infinitely connected. We also prove that the corresponding dynamical plane contains a connected component of the Julia set, which is a quasiconformal deformation of the Julia set of the map obtained by applying Newton's method to $f_{n,-1}$.

**Stability of water waves in infinite depth with constant vorticity**
Emilian Parau
*University of East Anglia, UK*

The stability of periodic travelling waves on fluid of infinite depth is examined in the presence of a constant background shear field. The effects of gravity and surface tension are ignored. Linear growth rates are calculated using both an asymptotic approach valid for small-amplitude waves and a numerical approach based on a collocation method. Both superharmonic and subharmonic perturbations are considered. This is joint work with Prof. Mark Blyth (UEA)

**Scattering of waves in random media**
Muhammad Shafiq ur Rehman Paswal
*Government College University Faisalabad, Faisalabad, Pakistan*

My research work is related with developing efficient numerical methods for acoustic wave scattering in random media which can be expressed as random perturbations of homogeneous media. Random Helmholtz problem will be analyzed by deriving some wave number explicit solution estimates and then establishing a multi-modes expression of the solution as a power series of the perturbation parameter.

**Regularity estimation in multivariate functional data analysis**
Valentin Patilea
*CREST Ensai, Rennes, France*

Combining information both within and between sample paths, we propose simple, nonparametric estimators for the local regularity of surfaces in two-dimensional functional data framework. The independently generated surfaces are measured with error at possibly random discrete times. Non-asymptotic exponential bounds for the concentration of the regularity estimators are derived. A diagnosis tool for checking anisotropy is proposed. A a first application, we consider the estimation of the parameters of a process from the class of multi-fractional Brownian sheets with time deformation. A second application is the adaptive, minimax optimal smoothing of surfaces.

**A statistical and topological data analysis of 2D and 3D scenes extracted from electronic images**
Vic Patrangenaru
*Florida State University, Tallahassee, USA*

We consider statistical and topological data analysis of 2D and 3D image data. We first consider methodologies for 2D image data based on the Region Covariance Descriptor (RCD) and Topological Data Analysis (TDA) rooted in the simplicial as well cubical persistent homologies. Our 2D example concerns images of leaf data which consist of pictures of two leaves-A and B-from the same tree, twenty of each leaf, from different perspectives. The novel statistical procedures introduce are used for first correctly determining that leaf A images and leaf B images are in fact those of different leaves as for the develop of classification techniques. Next, we collected a total of 52 clamshells from the same species, and placed seven mathematical landmarks on them, that were matched across the data. The 3D surfaces of those shells were reconstructed, using Metashape Software (Agisoft). The 3D projective shape space has a Lie group structure. A two sample test for Veronese-Whitney mean 3D projective shapes for comparing two groups of shells, based on their size, was using a test statistic for mean change on a Lie group. Joint work with A. Algahtani, R. L. Paige.

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**Rational points on Atkin-Lehner quotients of geometrically hyperelliptic Shimura curves**
Oana Pădurariu
*MPIM Bonn, Germany*

Guo and Yang give defining equations for all geometrically hyperelliptic Shimura curves $X_0(D,N)$. In this talk, I will describe how we created a database containing all their Atkin-Lehner quotients and how we computed their sets of $\mathbb{Q}$-rational points when these sets are finite. We also determine which rational points are CM for many of these curves. This is joint work with Ciaran Schembri.

**Categorical Donaldson-Thomas theory of $\mathbb{C}^3$ and beyond**
Tudor Pădurariu
*Columbia University, New York, USA*

Donaldson-Thomas invariants (DT) are (integer) virtual count of sheaves on a threefold. For Calabi-Yau threefold, there are several refinements of DT invariants, for example to a graded vector space whose Euler characteristic is the numerical DT invariant. When the threefold is a local surface, there are further refinements to a dg category, due to Yukinobu Toda. I will explain joint results with Yukinobu Toda on the structure of these categorifications of DT invariants. I will focus on the example of points on $\mathbb{C}^3$. I will also discuss the construction of a categorical analogue of BPS invariants of $\mathbb{C}^3$ and their application in a categorical DT/ Pandharipande-Thomas (PT) correspondence.

**Sets of functions which have the property $\mathcal{V}$, The Von Neumann Density Theorem**
Gavriil Păltineanu
*The Technical University of Civil Engineering, Bucharest, Romania*

A set of functions $F \subset C(X; I = [0,1])$ has property $\mathcal{V}$ if $1 - f \in F$ and $f \cdot g \in F, \forall f, g \in F$. Von Neumann is the one who drew attention to the collection of functions with property $\mathcal{V}$ in [4]. Moreover, he claims, without proof, a density theorem for such families of functions. A careful analysis of these sets and their properties was made by R. I. Jewett in [3].

In this talk we present a new and more accessible proof for the majority of the results from [3]. We especially mention our proof of Lemma 1 which plays an essential role in the whole paper [3]. Also we mention some new results, such as Propositions 1 and 2, which make the connection between the Uryson sets and the sets which have property $\mathcal{V}$, and Corollary 3, from which Theorem 4.18 of [5] immediately follows. This is joint work with G. Bucur.

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**Zariski's dimensionality type of singularities. Case of dimensionality type 2.**
Laurenţiu Păunescu
*The University of Sydney, Sydney, Australia*

In the 1970s O. Zariski introduced a general theory of equisingularity for algebroid and algebraic hypersurfaces over an algebraically closed field of characteristic zero. His theory builds up on understanding the dimensionality type of hypersurface singularities, notion defined recursively by considering the discriminants loci of successive "generic" corank 1 projections. The theory of singularities of dimensionality type 1, that is the ones appearing generically in codimension 1, was developed by Zariski in his foundational papers on equisingular families of plane curve singularities. In this talk we completely settle the case of dimensionality type 2, by studying Zariski equisingular families of surfaces singularities, not necessarily isolated, in the three-dimensional space.

**Examples of countable groups stable in permutations**
Liviu Păunescu
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

We introduce stability in permutations for systems of equations and show that it is a group property. We present the links between this notion and soficity for groups. We than show some examples of stable and non-stable groups.

**Compactification of moduli of vector bundles**
Mihai Pavel
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

We present several restriction theorems for semistable sheaves over a projective variety. Our results generalize the classical restriction theorems of Mehta and Ramanathan to the singular case, and they apply in particular to Gieseker-semistable sheaves. As an application, we construct different compactifications of the moduli space of vector bundles in higher dimensions.

**Unidirectional Adhesive Contact Between Plates with Elastic-Perfectly Plastic Deformation**
Ramiro Peñas Galezo
*Universidad del Atlántico, Barranquilla, Colombia*

This work presents a model of adhesive contact of plates with irreversible damage to the bonding field, arranged on a single plane. Each of the plates can be deformed elastically or under perfect plasticity. The loads on each plate act perpendicular to their plane. The proof of existence and uniqueness of solutions is obtained from the theory of nonlinear partial differential equations with m-accretive operators.

**Convergence estimates for some semilinear second order differential equations with two small parameters in Hilbert space**
Andrei Perjan
*Moldova State University, Chişinău, Moldova*

In the real Hilbert space $H$ we consider the following Cauchy problem:

$$\begin{cases} \varepsilon u''_{\varepsilon\delta}(t) + \delta\, u'_{\varepsilon\delta}(t) + Au_{\varepsilon\delta}(t) + B\big(u_{\varepsilon\delta}(t)\big) = f_\varepsilon(t), \quad t \in (0,T), \\ u_{\varepsilon\delta}(0) = u_{0\varepsilon}, \quad u'_{\varepsilon\delta}(0) = u_{1\varepsilon}, \end{cases} \tag{$P_{\varepsilon\delta}$}$$

where $A : V \subset H \to H$, be a linear self-adjoint operator and $B$ is nonlinear $A^{1/2}$ lipschitzian or monotone operator, $u_{0\varepsilon}, u_{1\varepsilon} \in H$, $f_\varepsilon : [0,T] \to H$ and $\varepsilon, \delta$ are two small parameters. We investigate the behavior of solutions $u_{\varepsilon\delta}$ to the problem $(P_{\varepsilon\delta})$ in two different cases: $(i)$ $\varepsilon \to 0$ and $\delta \geq \delta_0 > 0$, relative to the solutions to the following unperturbed system:

$$\begin{cases} \delta l'_\delta(t) + Al_\delta(t) + B\big(l_\delta(t)\big) = f(t), \quad t \in (0,T), \\ l_\delta(0) = u_0; \end{cases} \tag{$P_\delta$}$$

$(ii)$ $\varepsilon \to 0$ and $\delta \to 0$, relative to the solutions to the following system:

$$Av(t) + B\big(v(t)\big) = f(t), \quad t \in [0,T), \tag{$P_0$}$$

The mathematical model $(P_{\varepsilon\delta})$ governs various physical processes, which are described by the Klein-Gordon equation, the Sine-Gordon equation, the Plate equation and others equations.

**Abstract Volterra Operators and Applications**
Adrian Petruşel
*Babeş-Bolyai University, Cluj-Napoca, Romania*

Several notions of abstract Volterra operators on spaces of functions of one variable are well known. In this talk, we propose a notion of abstract Volterra operator in spaces of functions of several variables. Some fixed point equations with such abstract Volterra operators are studied and an application to a Darboux-Ionescu problem is given. The talk is based on a recent joint work with I. A. Rus.

**Extensions of Sobolev inequalities**
Carlos Pérez
*University of the Basque Country & BCAM, Spain*

We will discuss some extensions of classical Sobolev type inequalities for linear and non-linear operators by showing that many operators satisfy a pointwise bound by the Riesz potential applied to the gradient. Joint work with Cong Hoang and Kabe Moen.

**Size of tangencies to non-involutive distributions**
Cornel Pintea
*Babeş-Bolyai University, Cluj-Napoca, Romania*

By the classical Frobenius Theorem, a distribution is completely integrable if and only if it is involutive. In this paper, we investigate the size of tangencies of submanifolds with respect to a given non-involutive distribution. We provide esti- mates for the size of the tangency set in terms of its Hausdorff dimension. This generalises earlier works by Derridj and the first author. Our results apply in the setting of contact and symplectic structures as well as of Carnot groups. We illustrate the sharpness of our estimates by a wide range of examples and round the paper off with additional comments and open questions.

**Number theory concepts in Group Theory**
Iulia-Cătălina Pleşca
*Alexandru Ioan Cuza University, Iaşi, Romania*

In recent times, a plethora of concepts from number theory have been adapted from number theory to group theory. We do a summary of the most important results and introduce some new ones regarding groups that have integer harmonic mean of element orders. This is joint work with Marius Tarnauceanu.

**Dirichlet problem for a fine scale mixture of two highly different conductive materials with interfacial barrier**
Dan Polişevschi
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

The paper deals with the asymptotic behavior of heat transfer in a bounded domain formed by two $\epsilon$-periodically interwoven components, with the magnitudes of the conductivities differing by $\epsilon^2$. The components might be both connected. At the interface, the heat flux is continuous and the tempera-ture subjects to a first-order jump condition. Using the two-scale convergence technique of the homogenization theory, we determine the macroscopic law when the order of magnitude of the jump transmission coefficient is $\epsilon^r, -1 < r \leq 1$. The homogeneous Dirichlet condition is imposed on the exterior boundary.

**Equivariant Iwasawa theory of Selmer groups and applications**
Cristian Popescu
*University of California, San Diego, USA*

I will discuss my recent joint work with Rusiru Gambheera, leading to an unconditional proof of an Equivariant Main Conjecture for the Selmer groups of general number fields defined by Burns–Kurihara–Sano. Further, I will discuss two applications of this result: a proof of the Burns–Kurihara–Sano Conjecture on Fitting ideals of Selmer groups and a proof of the refined Coates–Sinnott Conjecture on Fitting ideals of even Quillen $K$–groups of number fields. Our work relies on and improves upon the recent breakthrough results of Dasgupta–Kakde on the Brumer–Stark Conjecture, on which I will comment very briefly.

**Extensions of rings which are filtered colimits of smooth, or complete intersection algebras.**
Dorin Popescu
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

An extension $u : A \to A'$ of Noetherian rings is a filtered colimit of smooth algebras if and only if $u$ is a regular morphism. In non Noetherian rings the things are more difficult. The Zariski Uniformization Theorem says that a valuation ring containing a field $k$ of characteristic zero is a filtered union of its smooth $k$-subalgebras. More general, if $V \subset V'$ is an immediate extension of valuation rings of characteristic zero, that is it induces trivial extensions on value groups and residue fields, then $V'$ is a filtered union of its smooth $V$-subalgebras, When $V$ contains a field of characteristic $\neq 0$ and $V \subset V'$ is essentially finite then the above result does not hold by an example of Ostrowski. However, $V'$ is a filtered union of its complete intersection $V$-subalgebras.

**Rhaly operators in some Banach sequence spaces**
George Popescu
*University of Craiova, Craiova, Romania*

We discuss fundamental properties of Rhaly operators in some Banach sequence spaces, namely boundedness, compactness and facts about the spectrum on $l^\infty$ and $l^p$ for $p > 1$. This is a joint work with Gabriel Prajitura (SUNY Brockport).

**Interpolation with neural networks**
Ionel Popescu
*University of Bucharest & Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

One of the problems in neural networks is that they have good intepolation powers. We show that one can interpolate with shallow neural networks as long as the activation function is not a polynomial of $d - 2$ where s is the size of the data. Moreover this purely existential result is complemented by a constructed one where the size of the hidden layer is of size $d \cdot \log(d)$. Joint work with Vlad Raul Constantinescu.

**The local tropicalization of splice type singularities**
Patrick Popescu-Pampu
*Université de Lille, Lille, France*

Splice type singularities are a huge extension of the class of Brieskorn-Pham-Hamm complete intersections. They were introduced by Neumann and Wahl around 2000. They are defined by explicite systems of equations, whose structures depend on special types of decorated trees, called splice diagrams. The links of those singularities realise all known integral homology sphere links of complex isolated complete intersections. I will describe the local tropicalizations of splice type singularities and how this knowledge allows to prove that they are Newton non-degenerate complete intersections, which implies that each one of them may be resolved using a single toric morphism. This is common work with Maria Angelica Cueto and Dmitry Stepanov.

**A numerical method to solve fractional Fredholm-Volterra equations**
Octavian Postăvaru
*University Politehnica of Bucharest-CITI, Bucharest, Romania*

The Goolden ratio is famous for the predictability it provides both in the microscopic world as well as in the dynamics of macroscopic structures of the universe. The extension of the Fibonacci series to the Fibonacci polynomials gives us the opportunity to use this powerful tool in the study of Fredholm-Volterra integro-differential equations. In this talk, we define a new hybrid fractional function consisting of block-pulse functions and Fibonacci polynomials (FHBPF). For this, in the Fibonacci polynomials we perform the transformation $x \to x^{\alpha}$, with $\alpha$ a real parameter. In the method developed in this talk, we propose that the unknown function $D^{\alpha} f(x)$ be written as a linear combination of FHBPF. We consider the fractional derivative $D^{\alpha}$ in the Caputo sense. Using theoretical considerations, we can write both the function $f(x)$ and other involved functions of type $D^{\beta} f(x)$ on the same basis. For this operation, we have to define an integral operator of Riemann-Liouville type associated to FHBPF, and with the help of hypergeometric functions, we can express this operator exactly. All these ingredients together with the collocation in the Newton-Cotes nodes transform the integro-differential equation into an algebraic system that we solve by applying Newton's iterative method. We conclude the paper with some examples to demonstrate that the proposed method is simple to implement and accurate. There are situations when by simply considering $\alpha \neq 1$, we obtain an improvement in accuracy by 12 orders of magnitude.

**Rhaly operators in $l^2$**
Gabriel Prăjitură
*SUNY Brockport, NY, USA*

Rhaly operators are one of possible generalizations of the Cesaro operator. We will discuss some of their properties in Hilbert spaces and go over some open problems as such when is a Rhaly operator bounded, when is it compact, what kind of spectral pictures are possible and so on.

This is joint work with George Popescu from the University of Craiova.

**Energy-localization in Navier-Stokes models with reaction terms**
Radu Precup
*Babeş-Bolyai University, Cluj-Napoca, Romania*

We discuss the localization of velocity for a problem of the type

$$\begin{cases} -\text{div}\ (A(x)\nabla u) + \eta_0(x)\, u + \kappa_0(x)\,(u\cdot\nabla)\, u + \nabla p = \Phi(x,u) \quad \text{in } \Omega \\ \text{div}\ u = 0 \quad \text{in } \Omega \\ u = 0 \ \text{ on } \partial\Omega, \end{cases}$$

where $\Phi$ is a reaction term dependent on velocity. First we obtain the localization of the enstrophy, namely $r \leq |u|_{H_0^1(\Omega)} \leq R$, and then, the localization of the kinetic energy, that is $r \leq |u|_{L^2(\Omega)} \leq R$. The bounds $r$ and $R$ are estimated in terms of the reaction force $\Phi$ and of system coefficients. The proofs are based on the fixed point formulation of the problem and on the fixed point index. The results come from a joint work in progress with Mirela Kohr, in continuation of the paper: M. Kohr, R. Precup, *Analysis of Navier-Stokes models for flows in bidisperse porous media*, J. Math. Fluid Mech. (2023) 25:38.

**Learning with categorical functional data**
Cristian Preda
*Université de Lille, Lille, France*

Categorical functional data viewed as sample of continuous-time jump stochastic processes with finite set of state are considered in the framework of unsupervised and supervised statistical learning. Dimension reduction for visualisation, clustering and regression are illustrated through numerical simulation and application on health data.

**Some rings have the same diophantine theory as $\mathbb{Z}$**
Mihai Prunescu
*University of Bucharest & Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

Different methods of logic and model theory are applied to diophantine problems. Several rings with the same diophantine theory as $\mathbb{Z}$ are produced, and some of them have unusual properties: neither $\mathbb{Z}$, nor some usual logical relations, are diophantine in those rings.

**Spectral regularity for a class of pseudo-differential operators with 'dilation' perturbation.**
Radu Purice
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

We consider a real Hörmander symbol of the type $S^0_{0,0}(\mathbb{R}^d \times \mathbb{R}^d)$, with a perturbation of the form $x \mapsto x + F(\delta \cdot x)$ with $F$ a smooth function with all its derivatives globally bounded, and $|\delta| \leq 1$. First, we prove that varying $\delta$ above $\delta = 0$ the Hausdorff distance between the spectra is bounded by $\sqrt{|\delta|}$, and second, we show that the distance between the spectral edges is of order $|\delta|$.

This work is done in collaboration with Horia Cornean (Aalborg University).

**Stable cohomology of line bundles on flag varieties**
Claudiu Raicu
*University of Notre Dame, Notre Dame, USA*

A fundamental problem at the confluence of algebraic geometry, commutative algebra and representation theory is to understand the structure and vanishing behavior of the cohomology of line bundles on flag varieties. Over fields of characteristic zero, this is the content of the Borel-Weil-Bott theorem and is well-understood, but in positive characteristic it remains wide open, despite important progress over the years. By embedding smaller flag varieties as Schubert subvarieties in larger ones, one can compare cohomology groups on different spaces and study their eventual asymptotic behavior. I will describe a sharp stabilization result, as well as explicit stable cohomology calculations in a number of cases of interest. Joint work with Keller VandeBogert.

**Concentration effects in modern PDE**
Bogdan Raiţă
*Scuola Normale Superiore di Pisa, Pisa, Italy*

The aim of this talk is to review old and new results concerning the interaction between nonlinearity and weak convergence of PDE constrained sequences. This is a ubiquitous theme in the study of nonlinear PDE, of which we will place special emphasis on problems with variational structure. We will review classical results in the study of weak (lower semi-) continuity of variational integrals, concerning A-quasiconvexity, compensated compactness, and null Lagrangians. We will conclude with new results pertaining primarily to concentration effects in weak convergence, which we used to answer questions of Coifman-Lions-Meyer-Semmes and De Philippis. Time permitting, we will express our results in the language of generalized Young measures (cf. Di Perna-Majda measures, defect measures). Joint work with A. Guerra and M. Schrecker.

**Mixing properties and entropy for Lorenz maps on the interval**
Peter Raith
*Universität Wien, Vienna, Austria*

Let $f : [0,1] \to [0,2]$ be a continuous strictly increasing function with $f(0) < 1 < f(1)$. Then $T_f x := f(x) - \lfloor f(x) \rfloor$, where $\lfloor y \rfloor$ is the largest integer smaller or equal to $y$, is called a Lorenz map. Given $\varepsilon > 0$ another Lorenz map $T_{\widetilde{f}}$ (again $\widetilde{f} : [0,1] \to [0,2]$) is said to be $\varepsilon$-close to $T_f$ if $\left\| \widetilde{f} - f \right\|_\infty < \varepsilon$. Continuity properties of the topological entropy and the topological entropy are investigated. In particular the topological entropy is continuous if $h_{\text{top}}(T_f) > 0$. Assuming that $f$ is differentiable except on a finite set and $\inf f' > 1$ topological transitivity and topological mixing are investigated.

**Dynamic complexity and time-scale separation in models for dengue fever**
Peter Rashkov
*Institute of Mathematics and Informatics Bulgarian Academy of Sciences, Sofia, Bulgaria*

Dengue fever's epidemiology is characterised by co-circulating multiple variants of the pathogen, the dengue virus. Mathematical modelling of dengue faces the challenges of finding a balance between accurate description of the disease dynamics, the different time scales of the dynamics of the human host and the mosquito vector populations, and the associated levels of complexity which allow for establishing tractable causal relationships. One approach in modelling vector-borne diseases like dengue has been to use host-only models that include the vector dynamics in an implicit fashion. We present the theoretical rationale that allows us to reduce the complexity of host-vector model via time-scale separation and rigorously derive the quasi-steady state approximation. Then we discuss some issues which emerge repeatedly in the mathematical models of dengue: differences in structure (host-only vs. host-vector models), ecological effects due to seasonal changes in the vector population, immunological effects such as disease severity, and which have an effect on the model's dynamic behaviour. Numerical bifurcation analysis is used to compare the structure of a host-vector model for dengue (with two variants and reinfection) and its variant resulting from a quasi-steady state approximation to that of a host-only model.

**Special cases of left quasiregular representations that have good regularity properties in the Calkin algebra**

Florin Rădulescu
*Università di Tor Vergata, Rome, Italy & Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

Let $G$ be a discrete group and $H$ a subgroup (of infinite index). We are interested in regularity properties of the quasiregular representation $G/H$ of $G$ into the Calkin algebra of $\ell^2(G/H)$. More generally we are interested in the case when $G/H$ is replaced by a countable set $X$ on which $G$ acts. A well known example when this happens is the case when $G$ is $\Gamma \times \Gamma$ and $H$ is the diagonal subgroup (second variable acting from the right). In this case the biexactness phenomena (and hence Akemann Ostrand property) holds true, as proved by N. Ozawa, G. Skandalis and others, for a large class of groups. In particular, in this case the quasiregular representation, modulo compacts, is weakly contained in the left regular representation of the larger group. In joint work with Jacopo Bassi we prove that temperedness of the quasiregular representation holds true for $G = SL(3, Z)$ and $H = SL(2, Z)$. We also prove weakly mixing type properties for the left and right representation of $SL(3, Z)$ on $\ell^2(Sl(3, Z))$, modulo the compacts. Also in joint work with Jacopo Bassi we find some situations when Akemann Ostrand phenomena holds for large subgroups of $SL(3, Z) \times SL(3, Z)$ acting on $\ell^2(Sl(3, Z)$. An ingredient of the proof is provided by the Furstenbergs theory of quasi projective transformations. The method also applies for $PSL(2, Z[1/p])$ instead of $SL(3, Z)$, ($p$ a prime number).

**Homomorphic encryption**

Georgiana Miruna Roşca
*Bitdefender, Romania*

Homomorphic encryption (HE) is a special type of encryption that allows computations to be performed directly on encrypted data without having to decrypt it. Using HE, the users can benefit from the expertise of special entities such as banks or hospitals without ever disclosing their private information.

In this talk, I will first give a short introduction into HE and motivate our interest in it. Then, I will discuss its current limitations. I will conclude my talk by presenting some applications of HE that we have investigated at Bitdefender, such as private set intersection or running machine learning models on encrypted data.

**A higher degree Weierstrass function**

Eugenia Roşu
*Leiden University, Leiden, Netherlands*

The Weierstrass $\pi$-function plays a great role in the classic theory of complex elliptic curves. A related function, the Weierstrass $\sigma$-function, is used by Guerzhoy to construct preimages under the $\xi$-operator of newforms of weight 2, corresponding to elliptic curves. In this talk, I will discuss a generalization of the Weierstrass $\sigma$-function and an application to harmonic Maass forms. More precisely, I will describe a construction of a preimage of the $\xi$-operator of a newform of weight $k$ for $k > 2$. This is based on joint work with C. Alfes-Neumann, J. Funke and M. Mertens.

**Matching Logic – A for computing, languages, and formal verification**
Grigore Roşu
*University of Illinois, Urbana-Champaign, Illinois, USA*

Matching logic is a unifying foundational logic for programming languages, specification, verification. It serves as the foundation of the K framework: a formal language framework where all programming languages must have a formal semantics and all language tools are automatically generated by the framework from the semantics at no additional costs, in a correct-by-construction manner. Matching logic also captures computation as proof. That is, any computation done with any machine following a pre-determined set of rules (a program, a processor, etc) becomes a rigorous mathematical proof of a theorem in a corresponding matching logic theory.

**Splitting-up methods for SDEs with generalized reflection on convex and nonconvex domains**
Eduard Rotenstein
*Alexandru Ioan Cuza University, Iaşi, Romania*

We consider stochastic variational inequalities with generalized reflection. More precisely, the multivalued term which drives the equation is perturbed, in a multiplicative manner, by a matrix operator, with Lipschitz properties. This new multivalued term preserves neither the maximal monotonicity of the subdifferential operator nor the Lipschitz property of the matrix involved. We construct some splitting-up approximation schemes for the above problems, considered in both the convex and the non-convex framework. This is a joint work with Andreea Negruţ (Simion Stoilow Institute of Mathematics of the Romanian Academy).

**The approximation of the controls for the wave equation with a lower rate numerical vanishing viscosity**
Ionel Rovenţa
*University of Craiova, Craiova, Romania*

We study the approximation of a boundary control for the linear one-dimensional wave equation, when a lower rate numerical vanishing viscosity term is added. The high frequency spurious oscillations introduced by the classical method of space discrete numerical schemes lead to nonuniform controllability properties. Based on an extra numerical viscosity term, which is weaker than the one used previously in literature, we are able to prove the convergence of the sequence of discrete controls to a control of the continuous wave equation, when the mesh size tends to zero.

**Defining and reasoning about corecursive functions in Coq**
Vlad Rusu
*Inria, Lille, France*

Corecursive functions are, informally speaking, functions whose normal behaviour includes non- termination. They naturally occur in synchronous and in lazy programming languages. In order to formally reason about corecursive functions one can try to define them in a proof assistant such as Coq. But there are limitations on the functions that can be defined in this way: corecursive calls must be guarded - they may only occur directly under a call to a constructor of the functions codomain. Coinductive proofs have to satisfy a similar requirement. In this talk I shall present an approach for defining and reasoning about corecursive functions in Coq beyond the guarded fragment.

**On a correspondence between ideal coideals and coideal subrings of Hopf algebroids**
Paolo Saracco
*ULB - Université Libre de Bruxelles, Bruxelles, Belgium*

An ubiquitous result relates coideal subalgebras of a Hopf algebra $H$ with one-sided ideal coideals in $H$. In some favourable cases, this relation becomes a one-to-one correspondence. For instance, in a celebrated paper from 1972, Takeuchi exhibited a bijection between normal Hopf ideals and sub-Hopf algebras of a commutative Hopf algebra, providing also a purely algebraic proof of the fact that affine commutative $\Bbbk$-group schemes form an abelian category.

In this talk, I will report on our results concerning a similar correspondence between coideal subrings and left ideal coideals in an arbitrary bialgebroid and its relationship with the structure theorem for relative Hopf modules. In particular, we will discuss a one-to-one correspondence between certain normal Hopf ideals (satisfying a purity condition) and certain sub-Hopf algebroids of a commutative Hopf algebroid and how this relates with the quotient theory of affine groupoid schemes.

Based on a joint work with A. Ghobadi, L. El Kaoutit, J. Vercruysse.

**Processes with zero-range interaction**
Anamaria Savu
*University of Alberta, Edmonton, Canada*

Zero-range processes are interacting particle systems where particles hop between the lattice sites with rates that depend solely on the number of particles of the departure site. The behaviour on the long wavelength and time-scale of zero-range processes have been extensively studied, and asymptotic results such as hydrodynamic scaling limit, central limit theorem, or large deviations of the empirical distribution of particles have been established. We will discuss the $q$-boson and $q$-block two specific zero-range processes. Also, we discuss the attractiveness and propose that the hydrodynamic scaling limit of the system is a first-order quasilinear partial differential equation.

**On Oresme numbers and their geometric interpretations**
Elifcan Sayin
*Pamukkale University, Denizli, Türkiye*

In this study, we examined the geometric interpretation of Oresme sequences with rational coefficients $O_(n+2) = O_(n+1) - 1/4O_n$ with initial conditions $O_0 = 0$ and $O_1 = 1/2$ defined by Nicole Oresme. We defined the nth vector of the Oresme sequence and calculated the area and volume. We gave the general solution of four squares equation involving Oresme vectors. Moreover we obtained a relationship between the Oresme sequence and the generalized Fibonacci sequence in the vector space.

**Some answers and questions on Frobenius-Schur indicator values in fusion categories**
Peter Schauenburg
*Université de Bourgogne, Dijon, France*

Frobenius-Schur indicators, born early in the 20th century for representations of finite groups, and subsequently generalized to various degrees all the way to pivotal fusion categories, are an important theoretical tool in the study of Groups, Hopf algebras and tensor categories. For concrete examples it is often difficult to calculate these numerical invariants explicitly, or to say something decisive about the values that can(not) occur. We will report on some results, old problems, and work in progress on such questions, mostly concerning categories constructed from finite groups.

**A variational theory for integral functionals involving finite-horizon fractional gradients**
Hidde Schönberger
*KU Eichstätt-Ingolstadt, Eichstätt, Germany*

The center of interest in this talk are variational problems with integral functionals depending on finite-horizon nonlocal gradients, which correspond to truncated versions of the Riesz fractional gradient. We contribute several new aspects to both the existence theory of these problems and the study of their asymptotic behavior. Our overall proof strategy builds on finding suitable translation operators that allow to switch between the three types of gradients: classical, fractional, and nonlocal. These provide useful technical tools for transferring results from one setting to the other. Based on this approach, we show that quasiconvexity, which is the natural convexity notion in the classical calculus of variations, gives a necessary and sufficient condition for the weak lower semicontinuity of the nonlocal functionals as well. As a consequence of a general Gamma-convergence statement, we obtain relaxation and homogenization results. Finally, the analysis of the limiting behavior for varying fractional parameters yields a rigorous localization with a classical local limit model.

This is based on a joint work with Javier Cueto (University of Nebraska-Lincoln) and Carolin Kreisbeck (KU Eichsttt-Ingolstadt).

**Regular surfaces in Step 2 Carnot groups**
Raul Paolo Serapioni
*Università di Trento, Trento, Italy*

A natural class of regular surfaces inside a Carnot group $\mathbb{G}$ are the non critical level sets of horizontal $\mathcal{C}^1$ functions $\mathbb{G} \to \mathbb{R}^k$.

These surfaces can be locally characterized as graphs of *uniformly intrinsic differentiable functions* acting between complementary subgroups of $\mathbb{G}$.

In turn, for a large class of step 2 groups, uniformly intrinsic differentiable functions can be characterized as functions with continuous *intrinsic derivatives*. Here intrinsic derivatives are non linear first order differential operators depending on the structure of the ambient group $\mathbb{G}$.

These results extend the ones obtained by Luigi Ambrosio, Francesco Serra Cassano and Davide Vittone inside Heisenberg groups.

**Stationary measures on projective spaces**
Cagri Sert
*University of Zürich, Zürich, Switzerland*

We give a classification of stationary probability measures on projective spaces for random products of matrices without any algebraic assumptions. Our works build on and extend previous works by Furstenberg, Kifer, Guivarc'h, Raugi, Benoist, and Quint. Joint works with Richard Aoun.

**On classification of Hopf superalgebras**
Taiki Shibata
*Okayama University of Science, Okayama, Japan*

In this talk, we give a classification method of finite-dimensional Hopf superalgebras using the Radford-Majid bosonization. The method enables us to classify Hopf superalgebras of dimension up to ten. This is a joint work with Kenichi Shimizu and Ryota Wakao.

**Applications of the Nakayama functor to tensor categories**
Kenichi Shimizu
*Shibaura Institute of Technology, Saitama, Japan*

This talk is based on my joint work with Taiki Shibata. A Hopf algebra is said to be co-Frobenius if it admits a non-zero cointegral. A Frobenius tensor category is an abstraction of the category of comodules over a co-Frobenius Hopf algebra. In this talk, I will present recent results on Frobenius tensor categories generalizing known results on co-Frobenius Hopf algebra. A technical difficulty compared to the case of Hopf algebras is that there is no obvious notion of cointegrals for tensor categories. Our opinion is that the Nakayama functor for a locally finite abelian category alternates cointegrals in a categorical setting. I will introduce basic results on the Nakayama functor and outline the proof of our recent result that the class of Frobenius tensor categories is closed under exact sequences.

**Fixed Points, Semigroups and Rigidity of Holomorphic Mappings**

David Shoikhet
*Holon Institute of Technology, Holon & The Galilee Research Center for Applied Mathematics, Karmiel, Israel*

There is a long history associated with the problem of iterating of holomorphic mappings and finding their fixed points with the modern results of F. Bracci, M. Contreras, S. Diaz- Madrigal, K. Goebel, G. Kohr, M.Kohr, T. Kuczumow, S.Reich, T. Sugawa and J.-P. Vigue being among the most important.

Historically, complex dynamics and geometrical function theory have been intensively developed from the beginning of the twentieth century. They provide the foundations for broad areas of mathematics. In the last fifty years the theory of holomorphic mappings on complex spaces has been studied by many mathematicians with many applications to nonlinear analysis, functional analysis, differential equations, classical and quantum mechanics. The laws of dynamics are usually presented as equations of motion which are written in the abstract form of a dynamical system: $\frac{dx}{dt} + f(x) = 0$, where $x$ is a variable describing the state of the system under study, and $f$ is a vector-function of $x$. The study of such systems when $f$ is a monotone or an accretive (generally nonlinear) operator on the underlying space has recently been the subject of much research by analysts working on quite a variety of interesting topics, including boundary value problems, integral equations and evolution problems.

In this talk we give a brief description of the classical statements which combine the celebrated Julia Theorem of 1920, Carathéodory's contribution in 1929 and Wolff's boundary version of the Schwarz Lemma of 1926 with their modern interpretations for discrete and continuous semigroups of hyperbolically nonexpansive mappings in Hilbert spaces. We also present flow-invariance conditions for holomorphic and hyperbolically monotone mappings.

Finally, we study the asymptotic behavior of one-parameter continuous semigroups (flows) of holomorphic mappings. We present angular characteristics of the flows trajectories at their Denjoy-Wolff points, as well as at their regular repelling points (whenever they exist). This enables us by using linearization models in the spirit of functional Schroeder's and Abel's equations and eigen-value problems for composition operators to establish new rigidity properties of holomorphic generators which cover the famous Burns-Krantz Theorem.

**On the product expansion of normal subsets in simple groups**

Iulian Ion Simion
*Babeş-Bolyai University, Cluj-Napoca, Romania*

By the product expansion of two subsets $A$ and $B$ of a group $G$, we mean a way of measuring how much $A \cdot B$ grows with respect to the size of $A$ and the size of $B$. Such questions are related to a conjecture of Thompson, which states that for any non-abelian finite simple group there is a conjugacy class $C$ of $G$ such that $C^2 = G$. Motivation also comes from the theory of expander graphs. If $S$ is a generating set for $G$ and $S^m = G$ for some $m$, then $2m$ is an upper bound on the diameter of the Cayley graph $\Gamma = \Gamma(G, S)$. This in turn translates into bounds on the expansion constant of $\Gamma$. After presenting more background and further motivating conjectures, we comment on recent contributions to covering numbers of normal subsets in simple algebraic groups.

**Statistical testing tools for evaluating cryptographic applications**
Emil Simion
*University Politehnica of Bucharest, Bucharest, Romania*

In this talk we discuss the importance of randomness in cryptographic operations and how statistical tests can aid in detecting and quantifying deviations from true randomness. We explore statistical tests for randomness, including the NIST Statistical Test Suite and other commonly employed tests, along with their interpretation and limitations. Joint work with Ioana Corina Bogdan, Elena Corina Cipu.

**Rubio de Francia's Extrapolation**
Arun Pal Singh
*University of Delhi, New Delhi, India*

I shall talk about the Rubio de Fracia's extrapolation and its application to get the boundedness of certain integral operators in the framework of Lebesgue type spaces.

**Hardy inequality for non-increasing functions on weighted grand variable exponent Lebesgue spaces**
Monika Singh
*University of Delhi, New Delhi, India*

I shall talk about the weighted norm inequality with variable non-decreasing exponent for the Hardy operator restricted to the class of non-increasing functions in the framework of the grand Lebesgue spaces.

**Numerical solution of pulsatile blood flow in patient specific elastic carotid artery**
Sarita Singh
*Doon University Dehradun Uttarakhand, India*

At the carotid bifurcation, the risk factor increases as a result of changes in the flow of blood and phenomena such as flow separation, the rotating flow, and the effects of the shear stress caused by the walls, which all contribute to an increased risk of injury. This raises the likelihood that the carotid artery will be damaged. In this regard, the current study numerically replicates the pulsatile blood flow in an elastic carotid artery particular to a patient using physiological pulses, non-Newtonian models, and turbulent models. The outcome of wall shear stress demonstrated how much more significant rigid or elastic walls are than Newtonian or non-Newtonian blood, which is more significant than laminar or turbulent flow. The critical pressure in the Carreau model is higher than that in the Newtonian model, which is higher than that in the Power-law model, according to comparisons made between other non-Newtonian models and the Newtonian one.

**The computational content of super strongly nonexpansive mappings**

Andrei Sipoş
*University of Bucharest & Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

Strongly nonexpansive mappings are a core concept in convex optimization. Recently, they have begun to be studied from a quantitative viewpoint: U. Kohlenbach has identified the notion of a modulus of strong nonexpansiveness, which leads to computational interpretations of the main results involving this class of mappings. This forms part of the greater research program of 'proof mining', initiated by G. Kreisel and highly developed by U. Kohlenbach and his collaborators, which aims to apply proof-theoretic tools to extract computational content from ordinary proofs in mainstream mathematics. The quantitative study of strongly nonexpansive mappings has later led to finding rates of asymptotic regularity for the problem of inconsistent feasibility, where one essential ingredient has been a computational counterpart of the concept of rectangularity. Last year, Liu, Moursi and Vanderwerff have introduced the class of super strongly nonexpansive mappings, and have shown that this class is tightly linked to that of uniformly monotone operators. What we do is to provide a modulus of super strong nonexpansiveness, give examples of it in the cases e.g. averaged mappings and contractions for large distances and connect it to the modulus of uniform monotonicity. In the case where the modulus is supercoercive, we give a refined analysis, identifying a second modulus for supercoercivity, specifying the necessary computational connections and generalizing quantitative inconsistent feasibility.

**Total multiplication groups of middle Bool loops**

Parascovia Sîrbu
*Moldova State University, Chişinău, Moldova*

The multiplication group (total multiplication group) of a loop $(Q, \cdot)$ is the group generated by all its right and left translations (respectively, by all its right, left and middle translations). We investigate the total multiplication groups of middle Bol loops, i.e. of loops satisfying the middle Bol identity $x(yz \setminus x) = (x/z)(y \setminus x)$. The last identity is the necessary and sufficient condition when anti-automorphic inverse property is invariant under the isotopy of loops [1]. It is proved that total multiplication groups of isostrophic loops are isomorphic. Commutative middle Bol loops are characterized [2]. An open problem in the theory of loops is if the loops with invariant flexibility ($x \cdot yx = xy \cdot x$), under the isotopy of loops, are middle Bol loops [3]. If this conjecture is true than the loops with invariant middle Bol identity under the isostrophy of loops are Moufang loops. A necessary and sufficient condition when the middle Bol identity is invariant under the isostrophy of loops is given in [4], and it is proved that commutative loops with invariant flexibility under the isostrophy of loops are Moufang loops.

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**Convergence criteria, well-posedness concepts and numerical validation**
Mircea Sofonea
*University of Perpignan Via Domitia, Perpignan, France*

We deal with a class of elliptic quasivariational inequalities with constraints in reflexive Banach spaces. We use arguments of monotonicity, convexity and compactness in order to prove a convergence criterion for such inequalities. This criterion allows us to consider a new well-posedness concept in the study of the corresponding inequalities, which extends the classical Tykhonov and Levitin-Polyak well-posedness concepts used in the literature. Then, we introduce a new penalty method, for which we provide a convergence result. Finally, we consider a variational inequality which describes the equilibrium of a spring-rods system, under the action of external forces. We apply our abstract results in the study of this inequality and provide the corresponding mechanical interpretations. We also present numerical simulations which validate our convergence results.

**On the pressure of dilute Bose gases**
Jan Philip Solovej
*University of Copenhagen, Denmark*

I will give an overview of the mathematical description of quantum many-body systems, in particular, the ground states of gases of many interacting identical particles. Such systems can be experimentally implemented in (very) cold atomic gases. The atoms are either bosons (e.g. Lithium7) or fermions (e.g., Lithium6). Bosons in three dimensions at very low temperature form Bose-Einstein condensates (although we do not know how to show this rigorously) and become superfluid. I will discuss recent rigorous results on the pressure of three dimensional Bose gases in the limit when they become dilute. The formula is in agreement with the theory of superfluidity and thus validates aspects of the theory. I will also review what is known in other dimensions and for Fermi gases. This is based on work with my former students Agerskov, Fournais, and Reuvers.

**Categorical aspects of extension theory**
Yorck Sommerhäuser
*Memorial University of Newfoundland, St. John's, Canada*

Extensions of ordinary Hopf algebras can be described with the help of four structure elements: a measuring, a cocycle, a comeasuring, and a dual cocycle. To describe extensions of Yetter-Drinfel'd Hopf algebras, one needs two additional structure elements: a deviation map and a codeviation map. These two new structure elements are maps whose domain and codomain do not only involve the kernel and the cokernel of the Yetter-Drinfel'd Hopf algebra extension, but also the underlying Hopf algebra with respect to which the Yetter-Drinfel'd Hopf algebras are defined. However, given an arbitrary Yetter-Drinfel'd module, it is possible to derive from the deviation and the codeviation map two other maps whose domain and codomain only involve the kernel and the cokernel just mentioned, as well as this Yetter-Drinfel'd module. Formulated in this way, the description applies not only to the category of Yetter-Drinfel'd modules, but also to more general categories.

In the talk, we discuss this alternative form of the description in greater detail. The talk is based on ongoing research that is not yet available in published form.

**(Disguised) toric dynamical systems and their (disguised) toric locus**
Miruna-Stefana Sorea
*SISSA, Trieste, Italy*

We study families of polynomial dynamical systems inspired by biochemical reaction networks. These systems are known to enjoy very strong dynamical properties and, due to their remarkable algebraic and combinatorial structures, they were called toric dynamical systems by G. Craciun, A. Dickenstein, A. Shiu and B. Sturmfels. We consider the class of disguised toric dynamical systems, which contains toric dynamical systems, and to which all previous dynamical properties extend naturally. The set of parameters giving rise to (disguised) toric dynamical systems is called the (disguised) toric locus. We show that some reaction networks have an empty toric locus or a toric locus of Lebesgue measure zero in parameter space, while their disguised toric locus is of positive measure. We also propose some algorithms for detecting the disguised toric locus. Moreover, we prove that the (disguised) toric locus is preserved under invertible affine transformations of the network. Finally, we emphasize the topological structure of the toric locus, showing that it is connected. This is based on several recent joint works with L. Brustenga i Moncus, G. Craciun, S. Haque, J. Jin, M. Satriano, P. Yu.

**Effective dynamics of translationally invariant magnetic Schrödinger equations**
Christof Sparber
*University of Illinois Chicago, Chicago, USA*

We study the large field limit in Schrödinger equations with magnetic vector potentials describing translationally invariant $B$-fields with respect to the $z$-axis. Using analytic perturbation theory, we derive an approximate description of the solution, provided the initial data is compactly supported in the Fourier-variable dual to $z$. The effective dynamics is thereby seen to produce high-frequency oscillations and large magnetic drifts. In a second step we show that this asymptotic description is stable under a fairly general class of singular perturbations by using the theory of almost invariant subspaces. This is joint work together with Gheorghe Nenciu and Evelyn Richman.

**Strong solutions to parabolic equations with non-monotone multivalued terms**
Vasile Staicu
*University of Aveiro, Aveiro, Portugal*

The aim of this talk is to present some recent joint results with Mitsuharu Otani concerning the local and the global existence of strong solutions to the following parabolic differential inclusion in $Q_T := [0,T] \times \Omega$:

$$\frac{\partial}{\partial t} u(t,x) - \triangle_p u(t,x) \in -\partial\phi(u(t,x)) + G(t,x,u(t,x)),$$

where $\Omega$ is a bounded open subset of $\mathbb{R}^N$ with smooth boundary $\partial\Omega$, $T > 0$, $\triangle_p$ is the $p$-Laplace differential operator, $\partial\phi$ denotes the subdifferential of a proper lower semicontinuous convex function $\phi : \mathbb{R} \to [0,\infty]$ and

$$G : Q_T \times \mathbb{R} \to 2^{\mathbb{R}} \setminus \{\emptyset\}$$

is a nonmonotone multivalued mapping.

We firstly set up a framework which enables us to treat wider nonlinearity of $G(\cdot,\cdot,u)$, more precisely, to cover the growth condition on $G(\cdot,\cdot,u)$ up to the Sobolev-subcritical range, and secondly we adapt and improve the techniques and arguments developed in [3] and [4], in order to

obtain existence results for the initial boundary value problem to parabolic inclusion generalizing corresponding results given by many authors, especially given in [1], [2] and [4] where the semi-linear case $p = 2$ is considered.

We give two types of local existence results for the cases where $G(\cdot, \cdot, u)$ is upper semicontinuous and lower semicontinuous, and also discuss the extension of large or small local solutions along the lines of arguments developed in [1].

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**Progress on canonical trace ideals**

Dumitru Stamate
*University of Bucharest, Bucharest, Romania*

The trace of a module $M$ is the sum of the images of all $R$-module homomorphisms from $R$ into $M$. When $R$ has a canonical module $\omega_R$, the trace of the latter is called the canonical trace ideal of $R$ and it measures how far is the ring from being Gorenstein. I will report on the use of the canonical trace to define new classes of rings sitting between the Cohen-Macaulay and the Gorenstein ones. This is based on joint works with Herzog and Hibi, and with Herzog and Kumashiro, respectively.

**Vector integrals and applications**

Cristina Stamate
*Octav Mayer Institute of Mathematics of the Romanian Academy, Iaşi, Romania*

We present some types of integrals for vector multifunctions relative to a vector submeasure with applications in mathematical economics.

**Random variables with overlapping number operator and Weyl algebras**

Aurel Stan
*The Ohio State University at Marion, Marion, USA*

If a random variable has finite moments of all orders, then its moments can be recovered from the number operator. Any function of the number operator can be written as a series, in which each term is a composition of a multiplication operator by a polynomial and a power of the differentiation operator. This series is called the position-momentum decomposition of the operator. We present first a general discussion of the random variables for which this series has only a finite number of non-zero terms, that means the function of the number operator belongs to the Weyl algebra. We then focus our attention to the case when this function is a polynomial of degree at most two and the position-momentum decomposition is at most quadratic in the differentiation operator, recovering the random variables whose orthogonal polynomials are the Hermite, Laguerre, and Jacobi polynomials.

**Some characteristic properties of the solutions in the three-phase-lag heat conduction**
Chiriţă Stan
*Alexandru Ioan Cuza University, Iaşi, Romania*

In this talk we consider the three-phase-lag model of heat conduction that involves second-order effects in phase lag of the heat flux vector. This model leads to a fourth-order in time equation of Moore-Gibson-Thompson type. We use the thermodynamic restrictions derived from the compatibility of the constitutive equation with the Second Law of Thermodynamics to study the properties of the solutions of the initial boundary value problems associated with the model in concern. In this connection we establish a series of well-posedness results concerning the related solutions like: uniqueness, continuous data dependence, exponentially stability or domain of influence. Furthermore, based on the thermodynamic restrictions, we show that the thermal model in question admits damped in time propagating waves as well as exponentially decaying standing modes. We also show that when the thermodynamic restrictions are not fulfilled, then wave solutions appear that cause the energy blows up as time goes to infinity.

**Modifications of locally conformally Kähler spaces**
Miron Stanciu
*University of Bucharest & Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

We define locally conformally Kähler (lcK) spaces with possible singularities and talk about a few recent results obtained on them, chiefly the existence of a type of Vaisman Theorem about the compatibility of an lcK and a Kähler structure. We then define quasi-lcK metrics and use them to show that even though modifications of lcK spaces are not always lcK, they are quasi-lcK. This is a joint work with O. Preda.

**Fusion systems on pro-$p$ groups**
Radu Stancu
*Université de Picardie Jules Verne, France*

Fusion systems are a generalization of the conjugation action of a finite group on one of its Sylow $p$-subgroups. We define the fusion system on a pro-$p$-group, and give the saturation axioms in this context. We show that classical theorems as Alperin fusion theorem also hold for saturated fusion systems on pro-$p$-groups. In particular, one can show that morphisms in a saturated fusion system on an uniform pro-p-group can be written as a composition of restrictions of a finite number of automorphisms. This is a joint work with Peter Symonds.

**The monotonicity of the principal frequency of the anisotropic $p$-Laplacian**
Denisa Stancu-Dumitru
*University Politehnica of Bucharest & University of Bucharest ICUB Research Group, Bucharest, Romania*

For a smooth bounded, convex domain $\Omega \subset \mathbb{R}^D (D \geq 2)$ and $H : \mathbb{R}^D \to [0, \infty)$ a convex, even, and 1-homogeneous function of class $C^{3,\alpha}(\mathbb{R}^D \setminus \{0\})$ for which the Hessian matrix $D^2(H^p)$ is positive definite in $\mathbb{R}^D \setminus \{0\}$ for any $p \in (1, \infty)$, we study the monotonicity of the principal frequency of the anisotropic $p$-Laplacian, constructed using the function $H$, on $\Omega$ with respect to $p \in (1, \infty)$. As an application, we find a new variational characterization for the principal frequency on domains $\Omega$ having a sufficiently small inradius. This is a joint work with Marian Bocea and Mihai Mihăilescu. This presentation is partially supported by CNCS-UEFISCDI Grant No. PN-III-P1-1.1-TE-2021-1539.

**Explicit MPC solution using Hasse diagrams: construction, storage and retrieval**
Florin Stoican
*University Politehnica of Bucharest, Bucharest, Romania*

Model Predictive Control (MPC) is a popular control strategy which has proved its mettle in both theoretical and industrial process control applications. Essentially, MPC is a feedback control problem that uses an accurate model of the process to predict the evolution of its state vector and optimize a sequence of constrained control actions over a finite time horizon. One of its variants is the explicit MPC formulation which exploits the multi-parametric nature of the optimization program This material provides new methods for the construction, storage and retrieval of the explicit MPC solution in the case with quadratic cost and linear constraints. By exploiting the geometric interpretation of the MPC problem, we: i) construct the explicit solution (i.e., enumerate the critical regions and associated affine laws) in an efficient manner; ii) store it as a partially ordered set; and iii) provide a modified graph traversal algorithm for efficient point location (i.e., identifying the currently active critical region and its associated control law).

**Random walk methods for reactive transport in porous media**
Nicolae Suciu
*Tiberiu Popoviciu Institute of Numerical Analysis, Romanian Academy, Cluj-Napoca, Romania*

Densities of computational particles moving along trajectories of It diffusion processes are often used to approximate solutions of parabolic and elliptic PDEs. Alternatively, particle densities can be approximated by using random walks on lattices, which provide weak solutions of the It equation. In this approach, densities are readily obtained with a global random walk procedure (GRW), by using the binomially distributed numbers of random walk jumps to count the number of particles at every lattice site and time step. Since there is no need anymore to compute individual particle trajectories, GRW schemes increase the computational efficiency and the smoothness of the solution. Particularly, GRW schemes for reactive transport achieve a microscopic description of the process by using as many particles as the number of molecules involved in reactions.

In this talk, I will first present the derivation of the GRW schemes for coupled nonlinear PDEs used in modeling reactive transport in porous media. Then, I will illustrate the approach for one- and two-dimensional biodegradation problems. Finally, I discuss the perspective of using microscopic descriptions by GRW simulations and space-time averages to model experimental concentration measurements.

**Towards an integral version of rational homotopy theory**
Alexandru Suciu
*Northeastern University, Boston, USA*

In previous work, we introduced the notion of binomial cup-one algebras, which are differential graded algebras endowed with Steenrod cup-one products and compatible binomial operations. Given such an $R$-dga, $(A, d)$, defined over the ring $R = \mathbb{Z}$ or $\mathbb{Z}_p$ (for $p$ a prime) and with $H^1(A)$ a finitely generated, free $R$-module, we show that $A$ admits a functorially defined 1-minimal model, unique up to isomorphism. Furthermore, we associate to this model a pronilpotent group, $G(A)$, which only depends on the 1-quasi-isomorphism type of $A$. These constructions, which refine classical notions from rational homotopy theory, allow us to distinguish spaces with isomorphic (torsion-free) cohomology that share the same rational 1-minimal model, yet whose integral 1-minimal models are not isomorphic. This is joint work with Richard Porter.

**On the Dimension of the Space of Homogeneous $k$-modified Harmonic Polynomials of a Fixed Degree**
Eleutherius Symeonidis
*Catholic University of Eichstätt-Ingolstadt, Eichstätt, Germany*

The solutions $u : \Omega \to \mathbb{R}$ ($\Omega$ a domain in $\mathbb{R}^d$, $d \geq 2$) of the equation

$$x_d \cdot \left( \frac{\partial^2 u}{\partial x_1^2} + \ldots + \frac{\partial^2 u}{\partial x_d^2} \right) + k \cdot \frac{\partial u}{\partial x_d} = 0$$

are called *k-modified harmonic functions*, where $k \in \mathbb{R}$. In our talk we study solutions that are homogeneous polynomials on $\mathbb{R}^d$ of a fixed (but arbitrary) degree $n$ and determine the dimension of their space in all but a finite number of values of $k$.

**4 generated pseudo Symmetric semigroups and their homogeneity**
Nil Şahin
*Bilkent University, Ankara,Türkiye*

Let $S$ be a 4-generated pseudo symmetric semigroup generated by the positive integers $\{n_1, n_2, n_3, n_4\}$ where $\gcd(n_1, n_2, n_3, n_4) = 1$. $k$ being a field, let $k[S]$ be the corresponding semigroup ring and $I_S$ be the defining ideal of $S$. Tangent cone of $S$ is $k[S]/I_{S_*}$ where $I_S =< f_* | f \in I_S >$. We discuss homogeneity of $S$ when the tangent cone is Cohen-Macaulay.

**Multiplicity in some relativistic systems with odd nonlinearities**
Călin Şerban
*West University of Timişoara, Timişoara, Romania*

We discuss the existence of multiple pairs of nontrivial solutions for potential systems involving odd perturbations of the relativistic operator under Dirichlet, periodic and Neumann boundary conditions. Both parametric and non-parametric nonlinearities are addressed. The approach is variational and relies on critical point theory for convex, lower semicontinuous perturbations of $C^1$-functionals.

Based on joint work with Petru Jebelean.

[1] P. Jebelean and C. Şerban, *Relativistic type systems with parametric odd nonlinearities*, Commun. Pure Appl. Anal., 22 (2023), 736-750

**Dirichlet problem for a fine scale mixture of two highly different conductive materials with interfacial barrier**
Alina Ştefan
*University of Piteşti, Piteşti, Romania*

The paper deals with the asymptotic behavior of heat transfer in a bounded domain formed by two $\epsilon$-periodically interwoven components, with the magnitudes of the conductivities differing by $\epsilon^2$. The components might be both connected. At the interface, the heat flux is continuous and the temperature subjects to a first-order jump condition. Using the two-scale convergence technique of the homogenization theory, we determine the macroscopic law when the order of magnitude of the jump transmission coefficient is $\epsilon^r, -1 < r \leq 1$. The homogeneous Dirichlet condition is imposed on the exterior boundary.

**Toward Extended Unified Method. Solution of Nonautonomies and Inhomogeneous Nonlinear Evolution Equations and Wave Configurations.**
Mohamed Tantawy
*6th October University, Giza, Egypt*

We present a summarized on the extended unified method EUM for finding exact solutions to nonautonomous and inhomogeneous nonlinear evolution equations NELs. The solutions are classified as polynomial and rational function solutions with multi-auxiliary functions that satisfy appropriate ordinary differential equations ODEs. Direct and indirect nonlinear interactions are suggested via nonlinear combinations and bilinear transformations with nonlinear combinations of basic traveling wave solutions. The EUM technique was adopted providing examples of nonautonomous and inhomogeneous NLEs. Coupled self-similar-traveling wave of the (2+1) Nizhnik Novikov Veselov (NNV) equation revealed that they exhibit symmetrical profiles about x = 0 and y = 0. Nonautonomous waves were obtained by varying nonlinear and dispersion terms. Further, (3+1)-dimensional Yu-Toda-Sasa-Fukuyama 3D-YTSF equation in a two-layer heterogeneous liquid is constructed. The derivations are not straightforward. Solutions of the equation obtained, which contain arbitrary functions and their space and time derivatives. The solutions are evaluated explicitly and are represented in graphs. It is shown that they reveal abundant novel waves geometric structures. The problem considered in the present work is completely novel, and, also, the wave structures are revealed.

**Applications of mass spreading to regularity for the Boltzmann equation**
Andrei Tarfulea
*Louisiana State University, Baton Rouge, USA*

The Boltzmann equation models a high-energy gas with elastic collisions. From the mathematical point of view, it presents a nonlocal degenerate-parabolic PDE with very few coercive quantities. The existence of global smooth solutions remains an open problem, and the state of the art is summarized by the conditional regularity program: as long as the hydrodynamic quantities (mass, energy, and entropy densities) remain under control (satisfying four time-independent inequalities), the problem is well-posed.

We eliminate two of the four inequalities from the conditional regularity result by showing that solutions of the Boltzmann equation dynamically (and instantly) fill any vacuum regions; the estimates only depend on an initial (possibly small) core of mass. We then examine how this mass spreading effect enhances known results on the construction, regularity estimates, uniqueness, and continuation for solutions starting from very rough initial data.

**On Solving Hyperbolic Differential Equations with Constraints Numerically**
Nicolae Tarfulea
*Purdue University Northwest, Hammond, USA*

Hyperbolic differential equations with constraints arise in many physical applications (e.g., electromagnetism, magnetohydrodynamics, and general relativity). Frequently, the numerical solutions to such evolution problems are computed on artificial space cutoffs because of the necessary boundedness of computational domains. A challenging problem is choosing appropriate boundary conditions at the artificial boundaries. In this talk, I will present a few ideas and techniques for finding constraint preserving boundary conditions for a large class of constrained hyperbolic differential equations.

**Free boundary problems in fluid dynamics**
Daniel Tătaru
*University of California, Berkeley, USA*

In fluid dynamics, free boundary problems describe evolutions where on one hand the fluid is moving, governed by either the compressible or the incompressible Euler equations, while on the other hand the boundary of the fluid is also moving. The aim of this talk will be to describe several interesting problems and some recent results in this direction.

**Moduli spaces of holomorphic bundles framed along a real hypersurface**
Andrei Teleman
*Aix-Marseille Université, Marseille, France*

Let $X$ be a connected, compact complex manifold, and $S \subset X$ be a separating real hypersurface. $X$ decomposes as a union of compact complex manifolds with boundary $\bar{X}^{\pm}$ with $\bar{X}^{+} \cap \bar{X}^{-} = S$. Let $\mathcal{M}$ be the moduli space of $S$-framed holomorphic bundles on $X$, i.e. of pairs $(E, \theta)$ (of fixed topological type) consisting of a *holomorphic* bundle $E$ on $X$ endowed with a *differentiable* trivialization $\theta$ on $S$. This moduli space is the main object of a joint research project with Matei Toma.

The problem addressed in my talk: compare, via the obvious restriction maps, the moduli space $\mathcal{M}$ with the corresponding Donaldson moduli spaces $\mathcal{M}^{\pm}$ of boundary framed holomorphic bundles on $\bar{X}^{\pm}$. The restrictions to $\bar{X}^{\pm}$ of an $S$-framed holomorphic bundle $(E, \theta)$ are boundary framed formally holomorphic bundles $(E^{\pm}, \theta^{\pm})$ which induce, via $\theta^{\pm}$, the same tangential Cauchy-Riemann operators on the trivial bundle on $S$. Therefore one obtains a natural map from $\mathcal{M}$ into the fiber product $\mathcal{M}^{-} \times_{\mathcal{C}} \mathcal{M}^{+}$ over the space $\mathcal{C}$ of Cauchy-Riemann operators on the trivial bundle on $S$. Our result states: *this map is bijective*. Note that, by theorems due to S. Donaldson and Z. Xi, the moduli spaces $\mathcal{M}^{\pm}$ can be identified with moduli spaces of boundary framed Hermitian Yang-Mills connections.

**Optimality conditions and Lagrange multipliers for shape and topology optimization problems**
Dan Tiba
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

We discuss first order optimality conditions for geometric optimization problems with Neumann boundary conditions and boundary observation. The methods we develop here are applicable to large classes of state systems or cost functionals. Our approach is based on the implicit parametrization theorem and the use of Hamiltonian systems. It establishes equivalence with a constrained optimal control problem and uses Lagrange multipliers under a new simple constraint qualification. In this setting, general functional variations are performed, that combine topological and boundary variations in a natural way.

**Homogenization results for non-local problems in composites with imperfect interfaces**
Claudia Timofte
*University of Bucharest, Bucharest, Romania*

In this talk, we shall present some homogenization results for a class of non-local problems in a two-phase composite material made up of a hosting medium in which a periodic array of perfect heat conductors is inserted. The temperature in the hosting medium is governed by a standard heat equation, while, inside each inclusion, the temperature depends only on time and satisfies a non-standard ordinary differential equation, involving a non-local condition. Across the interface between the two conductive regions, the thermal potentials of the two phases are coupled through an imperfect transmission condition. By using periodic homogenization techniques, several macroscopic models are obtained at the limit, depending on the magnitude of the interfacial heat exchange ([1-2]). Joint work with Micol Amar and Daniele Andreucci.

[1] M. Amar, D. Andreucci, C. Timofte, *Heat conduction in composite media involving imperfect contact and perfectly conductive inclusions*, Mathematical Methods in the Applied Sciences, 45 (17), 11355-11379, 2022

[2] M. Amar, D. Andreucci, C. Timofte, *Asymptotic analysis for non-local problems in composites with different imperfect contact conditions*, Applicable Analysis, 2022, DOI: 10.1080/00036811.2022.2120867.

**Homogenisation problems for a class of free discontinuity functionals**

Rodica Toader
*University of Udine, Udine, Italy*

I shall present some results on stochastic homogenisation problems for free discontinuity functionals with bounded cohesive surface terms recently obtained in collaboration with G. Dal Maso (SISSA).

**Curvature functionals, elastic Willmore-type energies and applications to physics and biophysics**

Magdalena Toda
*Texas Tech University & National Science Foundation, USA*

Functionals involving surface curvature are extensively used as models for elastic phenomena. Their critical points are frequently representative of physically relevant structures such as biomembranes or material interfaces. This talk will combine a variational characterization of curvature functionals and their critical surfaces, with computational models of elastic surfaces.

Examples will be presented, from minimal surfaces to generalizations of Willmore and Helfrich surfaces. Applications of elastic surface theory to biomembranes and protein models will be discussed briefly, in the context of geometric PDE, calculus of variations, differential geometry and Lie groups. If time permits, some recent results in terms of stability for p-Willmore surfaces will be presented. Likewise, some analysis for surfaces with boundaries (fixed boundary or/and fixed boundary) may be discussed.

Some computational models will be presented briefly, based on recent results and models created in collaboration with Alvaro Pampano, Hung Tran, Anthony Gruber, and Eugenio Aulisa.

**Skew category algebras and induction of precosheaves of algebras**

Constantin-Cosmin Todea
*Technical University of Cluj-Napoca, Cluj-Napoca, Romania*

A covariant functor from a small category $\mathcal{C}$ to the category of unital associative $k$-algebras ($k$ is a commutative ring with identity) is called a precosheaf of $k$-algebras. Category (convolution) algebras generalize group algebras and have been highlighted in the case of groupoid algebras notably in noncommutative geometry. Skew category algebras extend the concept of a skew group algebra to a precosheaf of $k$-algebras and, we show that we can view a skew category algebra as a unital subalgebra of some twisted tensor product. We also define and investigate induction of precosheaves of $k$-algebras by extending the work (in the group case) of Puig and Turull.

**The weak null condition on Kerr backgrounds**
Mihai Tohăneanu
*University of Kentucky, Lexington, Kentucky, USA*

Understanding global existence for systems satisfying the weak null condition plays a crucial role in the proof of stability of Minkowski in harmonic coordinates. In this talk I will present a proof of global existence for a semilinear system of equations on Kerr spacetimes satisfying the weak null condition. This is joint work with Hans Lindblad.

**Long time stability of the implicit Euler scheme for an incompressible two-phase flow model**
Florentina Tone
*University of West Florida, Pensacola, SUA*

In this talk we present results on the stability for all positive time of the fully implicit Euler scheme for an incompressible two-phase flow model. More precisely, we consider the time discretisation scheme and with the aid of the discrete Gronwall lemma and of the discrete uniform Gronwall lemma we prove that the numerical scheme is stable.

**Random walks in divergence free random environments**
Bálint Tóth
*Rényi Institute of Mathematics, Budapest, Hungary & University of Bristol, Bristol, UK*

I will survey results and some open questions related to random walks (and diffusions) in divergence-free drift fields. The problems are mainly motivated by the need of understanding long time asymptotic behaviour (normal or anomalous diffusion) of advective motion of particles in disordered media – e.g. in incompressible turbulent flow. Probabilistic and analytic aspects will be highlighted.

**Numerical modeling of fluid-structure interaction**
Catalin Trenchea
*University of Pittsburgh, Pittsburgh USA*

Fluid-structure interaction problems arise in many applications. In biomedicine, such models are used to describe the interaction between blood and arterial walls. Other applications include geomechanics and aerodynamics. When a deformable structure is porous and allows flow through it, poroelastic models are commonly used to describe its behavior. The numerical simulation of fluid-elastic/poroelastic structure interaction problems has received considerable attention, but still remains a significant challenge in the mathematical and computational sciences. Main difficulties stem from the the intricate multiphysics nature of the problem, and strong nonlinearities. In this talk, we will present some recent advances in numerical modeling of fluid-structure interaction problems, including adaptive, partitioned methods where the domain movement is handled using an Arbitrary Lagragian-Eulerian approach.

**Existence and uniqueness of (infinitesimally) invariant measures for second order partial differential operators on Euclidean space**

Gerald Trutnau
*Seoul National University, Seoul, South Korea*

We consider a locally uniformly strictly elliptic second order partial differential operator in $\mathbb{R}^d$, $d \geq 2$, with low regularity assumptions on its coefficients, as well as an associated Hunt process and semigroup. The Hunt process is known to solve a corresponding stochastic differential equation that is pathwise unique. In this situation, we study the relation of invariance, infinitesimal invariance, recurrence, transience, conservativeness and $L^r$-uniqueness.

Our main result is that recurrence implies uniqueness of infinitesimally invariant measures, as well as existence and uniqueness of invariant measures. We can hence make in particular use of various explicit analytic criteria for recurrence that have been previously developed in the context of (generalized) Dirichlet forms and present diverse examples and counterexamples for uniqueness of infinitesimally invariant, as well as invariant measures and an example where $L^1$-uniqueness fails although pathwise uniqueness holds. Furthermore, we illustrate how our results can be applied to related work and vice versa.

This is joint work with Haesung Lee (Busan).

**Long time behavior in some fluid-structure interaction problems**

Marius Tucsnak
*Université de Bordeaux, Bordeaux, France*

We consider systems describing the coupled motion of rigid bodies and viscous fluids. We discuss two situations. In the first case the solid is fully immersed in a 3D viscous fluid filling the remaining part of the space. In the second one, the solid undergoes vertical motion only and it is floating at the surface of a fluid described by the equations of viscous shallow water waves. In both cases, the main ingredient is the refined study of a newly introduced object, called the "fluid-structure semigroup".

**Multidimensional Stein method and asymptotic independence**

Ciprian Tudor
*University of Lille, Lille, France*

Let $(X_1, X_2, \ldots, X_n)$ be a random vector and denote by $P_{(X_1,X_2,\ldots,X_n)}$ its probability distribution on $\mathbb{R}^n$. We develop a multidimensional Stein-Malliavin calculus which allows to measure the Wasserstein distance between the law $P_{(X_1,X_2,\ldots,X_n)}$ and the probability distribution $P_Z \otimes P_{(X_2,\ldots,X_n)}$, where $Z$ is a Gaussian random variable. We also regard the particular case of random vectors in Wiener chaos and we give an asymptotic version of this result. As an example, we derive the rate of convergence for the Wasserstein distance for a two-dimensional sequence of multiple stochastic integrals, the first converging to a normal law and the second to a Rosenblatt distribution.

**Reduced representations of non linear manifolds: from reduced basis to (conditional) vector quantization of measures**

Gabriel Turinici
*Université Paris Dauphine - PSL, Paris, France*

We investigate the efficient representation of sets of objects such as parametric solutions of PDEs or controlled PDEs, images or other high dimensional objects. When the set is close to some lower dimensional linear manifold, the "reduced bases" techniques have been employed successfully. But sometimes the manifold is not linear and techniques closed to "vector quantization" methods can be employed. We will describe in this talk some recent works, including existence results, related to the theoretical foundations of quantization of measures with a finite set of Dirac masses in the context Huber-energy kernels. We will next show how this can be used in applications in transport equations, physics, machine learning measure dependent PDEs, and numerical statistics.

**Quasiconformal and Sobolev distortion of Assouad-type dimensions**

Jeremy Tyson
*University of Illinois Urbana-Champaign & National Science Foundation, USA*

Fraser and Yu (2018) introduced a one-parameter family of dimensional values $\dim_A^\theta(X)$, $0 < \theta < 1$, which capture the quantitative and scale-invariant covering properties of a metric space $(X, d)$ with respect to a pair of geometrically related scales $0 < R < 1$ and $r = R^{1/\theta}$. This family of dimensions, termed the *Assouad spectrum*, interpolates between the box-counting and Assouad dimensions. As an application, Fraser–Yu exhibited homeomorphic spaces for which standard notions of dimension (e.g. Hausdorff, box-counting, and Assouad dimension) coincide, but which have different Assouad spectra. Thus Assouad spectra can witness the bi-Lipschitz inequivalence of spaces in situations where classical dimensional notions are insufficient for this purpose. Assouad spectra have by now been computed or estimated for a wide variety of examples, including (both deterministic and random) self-affine fractals, Kleinian limit sets, and sets obtained via certain Diophantine constructions. We will discuss the distortion of Assouad spectra and Assouad dimension under mappings in various regularity classes, including Hölder, Sobolev, and quasiconformal mappings.

**On $p$-isogenies of elliptic curves with multiplicative reduction**

George Ţurcaş
*Babeş-Bolyai University, Cluj-Napoca, Romania*

Given a fixed number field $K$, for which primes $p$ does there exist an elliptic curve an elliptic curve $E$, defined over $K$, admitting a $K$-rational $p$-isogeny and which has multiplicative reduction at the primes above some other prime $q$? We report on recent findings regarding the previous question, focusing on the case when K is quadratic. Time permitting, we will explain how these results, asserting non-existence of $p$-isogenies for certain elliptic curves, have applications to Diophantine equations.

**Narrowing revisited**
Ionuţ Ţuţu
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

Originally developed by James Slagle (1974) and Dallas Lankford (1975), narrowing has been a staple of equational logic programming for nearly half a century. The method is a refinement of paramodulation, another prominent inference rule for equational reasoning introduced by George Robinson and Lawrence Wos a few years earlier. Both are used for solving queries in first-order logics with equality, and both are known to be sound and complete – under different assumptions. However, narrowing is often more advantageous in practice because it leads to a much smaller search space. In this talk, we re-examine narrowing from an algebraic perspective following Virgil Căzănescu's approach to programming via rewriting and we show how the method can be used for computing solutions modulo axioms to equational queries in order-sorted algebra. In this process, we also give a new rewriting-based implementation of narrowing that can be easily adapted to other equational formalisms.

**Optimal harvesting of stochastic populations - Theoretical results and numerical methods**
Sergiu Ungureanu
*City, University of London, London, UK*

We consider the problem of harvesting from a stochastic population while avoiding extinction. Using ergodic optimal control, we find the optimal harvesting strategy which maximizes the asymptotic yield of harvested individuals. When the benefit is linear in the harvested amount, we find that a bang-bang strategy is optimal under very general conditions. The effects of parameter changes are explored. More realistic environments have very complex stochasticity. On top of the usual white-noise environmental variation, there can be seasonal variation, and the environment can suffer from large but random changes. It is likely impossible to explicitly solve complex models with many layers of stochasticity, but numerical methods can help and therefore the models are useful. We find theoretical results that justify the use of the Markov chain approximation method, developed by Kushner & Martins (1991) and Kushner & Dupuis (1992), in finding numerical approximations of the optimal strategies and value functions in a very large class of models. These models can have general cost functions of harvesting or seeding, price functions reactive to market conditions and random fluctuations, seasonal fluctuations, and large-scale random fluctuations. The numerical methods are used to explore for interesting intuitions and unusual findings, which would not have been available theoretically.

**Dimension spectrum of conformal Iterated Function Systems**
Mariusz Urbanski
*University of North Texas, Denton, USA*

I will define conformal iterated function systems $S$ over a countable alphabet $E$ and their limit sets (attractors) $J_E$. I will discuss the formula for the Hausdorff dimension of this limit set, commonly referred to as a version of Bowen's formula, involving topological pressure. The main focus will be on the set

$$Sp(E) = \{HD(J_F) : F \subset E\},$$

called the dimension spectrum of the systenm $S$. I will prove that always

$$Sp(E) \supset (0, \theta_E),$$

where $theta_E$ is the finiteness parameter of $S$ (will be defined). I will also construct a system for which $Sp(E)$ is a proper subset of $(0, HD(J_E)]$. I will then discuss the property that

$$Sp(S) = (0, HD(J_E)],$$

called the full spectrum dimension property. In particular, I will discuss the conformal iterated function systems and their various subsystems, generated by real and complex continued fraction algorithms, and will show that many of them (subsystems) enjoy the full spectrum dimension property.

**Quotient range operators in commutative and noncommutative frameworks**
Florian-Horia Vasilescu
*University of Lille, Villeneuve d'Ascq, France*

We present the construction of adequate analytic functional calculi, for what we call quotient range operators, in real, quaternionic and cliffordian Banach spaces, using the already known complex case.

**On the minimal free resolution of the residue field**
Oana Veliche
*Northeastern University, Boston, MA, USA*

In a paper from 1968, Golod proved that the Betti sequence of the residue field of a local ring attains the upper bound given by Serre if and only if the homology algebra of the Koszul complex of the ring has trivial multiplications and trivial Massey operations. This is the origin of the notion of Golod ring. Using the Koszul complex components as building blocks Golod also constructed a minimal free resolution of the residue field of a Golod ring. With Van Nguyen, we extend this construction for an arbitrary local ring, up to the degree five, and explicitly show how the multiplicative structure of the homology of the Koszul algebra is involved, including the triple Massey products. The talk will illustrate: first, various consequences of this construction, and second, using a further analysis of the homology of the Koszul algebra, a construction of the minimal free resolution of a complete intersection local ring.

**Generalizations of Yetter-Drinfel'd modules and the center construction of monoidal categories**

Joost Vercruysse
*Université Libre de Bruxelles, Brussels, Belgium*

A Yetter-Drinfel'd module over a bialgebra $H$, is at the same time a module and a comodule over $H$ satisfying a particular compatibility condition. It is well-known that the category of Yetter-Drinfel'd modules (say, over a finite dimensional Hopf algebra $H$) is equivalent to the center of the monoidal category of $H$-(co)modules as well as to the category of modules over the Drinfel'd double of $H$. Caenepeel, Militaru and Zhu introduced a generalized version of Yetter-Drinfeld modules. More precisely, they consider two bialgebras $H$, $K$, together with an bimodule coalgebra $C$ and a bicomodule algebra $A$ over them. A generalized Yetter-Drinfel'd module in their sense, is an $A$-module that is at the same time a $C$-comodule satisfying a certain compatibility condition. Under finiteness conditions, they showed that these modules are exactly modules of a suitably constructed smash product build out of $A$ and $C$. The aim of this talk is to show how the category of these generalized Yetter-Drinfel'd can be obtained as a relative center of the category of $A$-modules, viewed as a bi-actegory over the categories of $H$-modules and $K$-modules. Moreover, we also show how other variations of Yetter-Drinfel'd modules, such as anti-Yetter-Drinfel'd modules, arise as a particular case.

**On anomalous diffusion**

Vlad Vicol
*New York University, New York, USA*

In this talk, I will discuss a joint work with Scott Armstrong in which we construct a class of incompressible vector fields that have many of the properties observed in a fully turbulent velocity field, and for which the associated scalar advection-diffusion equation generically displays anomalous diffusion. We also propose an analytical framework in which to study anomalous diffusion, via a backward cascade of renormalized eddy viscosities. Our proof is by "fractal" homogenization, that is, we perform a cascade of homogenizations across arbitrarily many length scales.

**Reshaping Convex Polyhedra**

Costin Vîlcu
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania*

This talk is based on a joint work with Joseph O'Rourke (Smith College, USA).

Given a convex polyhedral surface $P$, we define a *tailoring* as excising from $P$ a simple polygonal domain that contains one vertex $v$, and whose boundary can be sutured closed to form a new convex polyhedron via Alexandrov's Gluing Theorem. In particular, a *digon-tailoring* cuts off from $P$ a *digon* containing $v$, a subset of $P$ bounded by two equal-length geodesic segments that share endpoints, and can then zip closed.

In the first part of this talk, I will present properties of the tailoring operation on convex polyhedra. The main result is that $P$ can be reshaped to any polyhedral convex surface $Q$ inside $P$ by a sequence of tailorings.

In the second part of this talk, I will present *vertex-merging* processes on convex polyhedra (each vertex-merge being in a sense the reverse of a digon-tailoring), creating embeddings of $P$ into enlarged surfaces. The aim is to produce non-overlapping polyhedral and planar unfoldings.

**Recent progress in completely integrable PDE**
Monica Vişan
*University of California, Los Angeles, USA*

I will survey recent work on low regularity conservation laws, equicontinuity, and optimal well-posedness for several completely integrable systems. I will describe the method of commuting flows and the increasingly sophisticated techniques that have been required in order to achieve sharp results across a spectrum of integrable models. This is based on joint work with B. Harrop-Griffiths, R. Killip, T. Laurens, and M. Ntekoume.

**Boolean asynchronous systems: revisiting commutativity**
Şerban Emilian Vlad
*Oradea City Hall, Oradea, Romania*

The digital circuits (i.e. the Boolean systems) have been widely studied informally in electronics. Asynchronicity represents that general case in this study when each computation is made independently of the other computations. And commutativity is defined in [1] as: "if two transitions can occur in either order from a given state, then there is at least one common resulting state which is independent of the order". We identify the Boolean asynchronous systems with the functions $\Phi : \{0,1\}^n \to \{0,1\}^n$ and our main concern is to formalize the concept of commutative system, using the framework from [2]. Some first conclusions are presented.

[1] Robert M. Keller, *A fundamental theorem of asynchronous parallel computation*, In: Feng, Ty. (eds) Parallel Processing. SCC 1974. Lecture Notes in Computer Science, vol 24. Springer, Berlin, Heidelberg

[2] Serban E. Vlad, *Boolean Systems: Topics in Asynchronicity*, Academic Press, 2023

**From perturbations of operators to noncommutative condensers**
Dan-Virgil Voiculescu
*University of California, Berkeley, USA*

The quasicentral modulus plays a key role in normed ideal perturbations of Hilbert space operators, in the multivariable analogues of the Weyl - von Neumann - Kuroda and Kato - Rosenblum theorems. I will explain a non-commutative analogy with condenser capacity in nonlinear potential theory.

**A central limit theorem for the modified massive arratia flow**
Max von Renesse
*Universität Leipzig, Leipzig, Germany*

The Modified Massive Arratia Flow is a model of infinitely many sticky Brownian particles where the diffusion scaled proportionally to the aggregate mass of the particles. The model was introduced by Konarvovskyi and later studied by Konarovskyi and Renesse who showed that the diffusive behaviour of the model is governed locally by the quadratic Wasserstein distance. In this talk we present a central limit theorem for the occupation measure of the process in the case of countably many starting points. A central ingredient of the proof is quantitative decorrelation estimates in terms of the alpha-mixing coefficient for which we present explicit non-standard coupling constructions.

**Do products of locally conformally Kähler manifolds (LCK, for short) carry an LCK metric?**
Victor Vuletescu
*University of Bucharest, Bucharest, Romania*

An LCK (locally conformally Kähler) manifold is a Hermitian manifold which admits a Galois cover which has a Kähler metric such that the deck group is acting by holomorphic homotheties. The product of two LCK manifolds does not have a natural product LCK structure. It is believed that a product of two compact complex manifolds is never LCK. We classify all known examples of compact LCK manifolds in two classes: manifolds containing a curve and manifolds of Inoue type. In the talk we will outline the description of these classes and the proof that a product of a compact complex manifold and an LCK manifold belonging to one of these classes above does not admit an LCK structure. The talk is based on joined work with L. Ornea and M. Verbitsky.

**On families $\mathbf{QSL_3}$ of quadratic systems with invariant lines of total multiplicity exactly 3**
Nicolae Vulpe
*Moldova State University, Vladimir Andrunachievici Institute of Mathematics and Computer Science, Chişinău, Moldova*

We consider the family $\mathbf{QSL_3}$ of quadratic differential systems possessing invariant straight lines, finite and infinite, of total multiplicity exactly three. In a sequence of papers, the complete study of quadratic systems with invariant lines of total multiplicity at least four was achieved. In addition, some subfamilies of quadratic systems possessing invariant lines of total multiplicity at least three were also studied, among them the Lotka-Volterra family. However, there were still systems in $\mathbf{QSL_3}$ that remain to be studied. So we complete the study of the geometric configurations of invariant lines of $\mathbf{QSL_3}$ by studying all the remaining cases and give the full classification of this family modulo their configurations of invariant lines. This classification is done in affine invariant terms and we present here the "bifurcation" diagram of the configurations in the 12-parameter space of coefficients of the systems. This diagram provides an algorithm for deciding for any given system whether it belongs to $\mathbf{QSL_3}$ and in case it does, by producing its configuration of invariant straight lines.

**The nonlocal Bernstein technique and the nonlocal obstacle problem**
Marvin Weidner
*Universitat de Barcelona, Barcelona, Spain*

The Bernstein technique is an elementary but powerful tool in the regularity theory for elliptic and parabolic equations. It is based on the insight that, if derivatives of a solution are also subsolutions to an equation, then the maximum principle can be used in order to obtain regularity estimates for these solutions. In the first part of this talk, we explain how the Bernstein technique can be extended to a large class of integro-differential equations driven by nonlocal operators that are comparable to the fractional Laplacian. In the second part, we discuss several applications of this technique to the regularity theory for the nonlocal obstacle problem in a bounded domain. This talk is based on a joint work with Xavier Ros-Oton and Dami Torres-Latorre.

**A series Evans function approach to stability of traveling waves of reaction-diffusion systems**
Tzi-Sheng Yang
*Tunghai University, Taichung, Taiwan*

By suitable change of variables, the linearized eigenvalue problem around a traveling wave of a reaction-diffusion system can be transformed into an ODE system with two finite regular singular points. The fundamental solutions of the ODE system subject to one-sided boundary conditions are derived as infinite series, whose exponents and leading coefficients correspond to the constant multiples of matrix eigenvalues and the associated eigenvectors for the asymptotic eigenvalue problem, respectively. Then, the series Evans function is derived, which is analytic on the natural domain excluding the exceptional points. Accordingly, the number of the point spectrum lying in the right half of $\mathbb{C}$ and outside the small disks centered at the exceptional points, can be numerically identified by counting the winding numbers of the images of suitable contours mapped by the series Evans function. In the mean while, using the perturbation method, the number of the point spectrum lying inside the small disks centered at the exceptional points, can also be numerically identified in a similar way. Applying the series Evans function to the two-species Lotka-Volterra competition system as illustration, the stabilities for several types of traveling waves with exact forms, with respect to specific asymptotically exponential weighted spaces, are numerically concluded.

**On the motion of a large number of small rigid bodies in a viscous incompressible fluid**
Arghir Dani Zărnescu
*Simion Stoilow Institute of Mathematics of the Romanian Academy, Romania & Basque Center for Applied Mathematics, Bilbao, Spain*

We consider the motion of $N$ rigid bodies – compact sets $(\mathcal{S}_\varepsilon^1, \cdots, \mathcal{S}_\varepsilon^N)_{\varepsilon>0}$ – immersed in a viscous incompressible fluid contained in a domain in the Euclidean space $\mathbb{R}^d$, $d = 2, 3$. We show the fluid flow is not influenced by the presence of the infinitely many bodies in the asymptotic limit $\varepsilon \to 0$ and $N = N(\varepsilon) \to \infty$ as soon as

$$\operatorname{diam}[\mathcal{S}_\varepsilon^i] \to 0 \text{ as } \varepsilon \to 0,\ i = 1, \cdots, N(\varepsilon).$$

The result depends solely on the geometry of the bodies and is independent of their mass densities. Collisions are allowed and the initial data are arbitrary with finite energy.

**Global well-posedness and asymptotic behavior for a reaction-diffusion system of competition type**

Samia Zermani
*University of Carthage, Tunisia*

We analyze a reaction-diffusion system describing the growth of microbial species in a model of flocculation type that arises in biology. Existence of global classical positive solutions is proved under general growth assumptions, with flocculation and deflocculation rates polynomially bounded above, that guarantee uniform sup norm bounds for all time t obtained by an $L^p-$energy functional estimate. We also show finite time blow up can occur when the yield coefficients are large enough. Also, using arguments relying on the spectral and fixed theory, we show persistence and existence of nonhomogenous population steady-states. Finally, we present some numerical simulations to show the combined effects of motility coefficients and the flocculation-deflocculation rates on the coexistence of species.

**Generalized Faà di Bruno Hopf algebras**

Yinhuo Zhang
*University of Hasselt, Belgium*

We introduce the $(m, g, a_0)$-Bell polynomials to construct the graded pointed Hopf algebras $\mathcal{H}_{\mathrm{FbB}}^{(m,g)}$ and their Hopf Ore extensions, which contain the well-known Faà di Bruno Hopf algebra. We then give the isomorphism theorem of those Hopf algebras and study their Hopf subalgebras. The noncommutative versions of $\mathcal{H}_{\mathrm{FbB}}^{(1,g_1^r)}$ are determined. Finally, we use some special Lyndon words to construct several free bialgebras containing some basic combinatorial bialgebras and the noncommutative Faà di Bruno bialgebra as quotients.

**Berezin type operators and Toeplitz operators on Bergman Spaces**

Ruhan Zhao
*State University of New York at Brockport, Brockport NY, USA*

We introduce a class of integral operators called Berezin type operators. It is a generalization of the Berezin transform, and has close relation to the Bergman-Carleson measures. We mainly study the boundedness and the compactness of Berezin type operators from a weighted Bergman space to a weighted Lebesgue space on the unit ball of $\mathbb{C}^n$. We also show that Berezin type operators are closely related to Toeplitz operators. This is a joint work with Gabriel Prajitura and Lifang Zhou.