ANALYSIS, TOPOLOGY AND APPLICATIONS
(ATA 2024)

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BOOK OF ABSTRACTS

Čačak, 2024.

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Machine Learning in optimizing Carbon Nanotubes and Graphene Production

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ABSTRACT:

Machine learning plays a key role in this work, designing new technologies for producing carbon nanotubes (CNTs) and graphene by electrolysis in molten salts. The aim is to achieve non-expensive, high-quality materials, making them economically viable for various applications. For the production of multi-walled carbon nanotubes (MWCNTs), experiments employ both non-stationary and stationary current regimes, while for graphene production, constant and reversing cell voltage as well as constant and reversing overpotential methods are considered. The electrolysis process offers ecological and economical advantages with precise control over parameters such as applied voltage, current density, temperature, electrolyte type, and graphite material. To determine the relationship between these parameters and material quality, explainable tree-based Machine Learning (ML) models are employed, trained using labeled data from domain experts. The extracted rules from the ML model guide optimal production, resulting in high-yield materials that are up to ten times more cost-effective than existing technologies. This contributes to the advance of cost-efficient and high-quality carbon nanomaterials for a wide range of applications.

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2-Normed structures on soft vevtor spaces

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ABSTRACT:

Molodtsov [5] introduced the concept of soft set which can be considered as a new mathematical approach for vagueness. After Das and Samanta defined soft vector space and soft norm, Yazar et al. defined soft vector space by using the concept of soft point given in [1,2]. This study defines the concept of a soft 2-normed space. The concepts of a Cauchy sequence and a convergent sequence in soft 2-normed space have been considered. It has been demonstrated that every convergent sequence is a Cauchy sequence in a soft 2-normed spaces. Furthermore, it is demonstrated that a convergent sequence possesses a unique limit. Additionally, the concept of a soft 2-inner product space is introduced and examined its important properties. This is followed by the demonstration of the Cauchy-Schwarz Inequality and the Parallelogram law within these spaces. Finally, the convergence of sequences in a soft 2-inner product space is analysed.

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Translational regular variation and asymptotic equivalence

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ABSTRACT:*Consider the class of positive functions $\mathcal{F} = \{x = x(t), t > a, a > 0 : x(t) \to \infty \text{ as } t \to \infty\}$, We say that functions $x, y \in \mathcal{F}$ aremultiplicatively strongly asymptotic equivalent if $\rho_1 : \lim_{n\to\infty} \frac{x(t)}{y(t)} = 1$. and additively strongy asymptotic equivalent if $\rho_2 : \lim_{n\to\infty} (x(t) - y(t)) = 0$. A measurable function $f : [a, \infty) \to (0, \infty), a > 0$, is <u>translationally</u> regularly varying in the sense of <u>Karamata</u>(see, for instance, [1]) if for each $\lambda \in \mathbb{R}$, $\lim_{t\to\infty} \frac{x(\lambda+t)}{x(t)} < \infty$. The class of such functions is denoted by $T_r(RV_\varphi)$. In this paper, we will prove the Representation Theorem, the Uniform Convergence Theorem, and the Characterization Theorem of functions $f \in T_r(RV_\varphi)$ in terms of Karamata. Also, let functions x and y be elements of class $\mathcal{F}$. We will prove that, for any fixed $\in T_r(RV_\varphi)$, the relation(1) $x(t)\rho_2 y(t), t \to \infty$ implies the relation (2) $f(x(t))\rho_1 f(y(t)), t \to \infty$. Let for each $x \in \mathcal{F}$ and $y \in \mathcal{F}$ the fulfillment of relation (1) implies the fulfillment of relation (2) for some measurable function $f : [a, \infty) \to (0, \infty), a > 0$. Here we will consider how the function f is related to the class of functions $T_r(RV_\varphi)$. Regarding (1) and (2)see, for example, [2].*

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On the space of τ-smooth idempotent probability measures

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ABSTRACT:
For a Tyhonoff spavce X we study the space $I_\tau(X)$ of t-smooth idempotent probability measures on X. The topology on this space is defined by using open sets in the space X. It is shown, among others, that the operator I_τ preserves Čech completeness.

Keywords: *idempotent probability measure, Čech complete space, compact space*

Holder and Lipschitz continuity of mapping in the Sobolev classes $W^{1,p}(G)$

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ABSTRACT:
In this research among the other things, we combine the method of the flattering the boundary with Sobolev-Riesz embeddings theorem.
Our results include domains which are locally good Green-ian and C^1 domains.
In particular we study Dirichlet problem for generalized harmonic mappings and boundary behaviour of partial derivatives for solutions to certain Laplacian-gradient inequalities and generalized harmonic mappings.

Keywords: *The Sobolev-Riesz embedding theorem, Laplacian-gradient inequalities*

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Exploring Noise Effects:
From Signal Components to Artistic Interpretations

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ABSTRACT:

The presented study is initiated by analyzing the features of signals in the joint time-frequency plane. This analysis focuses on the mutual relation of relevant coefficients of two representations of the signal: the time-frequency energy distribution and the inverse complexity map. The inverse complexity approach provides an entropy-based insight into the signal structure, acting as an edge detector of signal components in the time-frequency domain. These two representations result in mostly disjoint time-frequency supports, overlapping only in the proximity of the signal components in the case of signals corrupted by additive white Gaussian noise. The reason for such behavior of the two representations is found in the signal-shaped variance of the time-frequency energy distribution in the presence of noise, which distorts complexity in the vicinity of signal components.

Relevant coefficients are considered for images and their associated inverse complexity maps. The behavior of the two representations coincides for TFDs and images in noise-free conditions, while an alternative noise model is required to provide the expected overlapping of prominent regions and their edges for noisy images. In fact, additive noise in images does not cause distortions in the local variance; which are, on the contrary, an effect of multiplicative noise (speckle). By analyzing high-resolution images of paintings from various periods, we identify a demarcation line signifying the introduction of speckle in figurative art during the impressionist period. Building upon these findings, we conduct a psychophysical analysis of visual perception in modern art.

Problem of non-axisymmetric motion of a two-phase viscous fluid in an elastic shell

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ABSTRACT: *Asymmetric propagation of small-amplitude waves in a thin-walled, cylindrical, momentless shell of two-phase, viscous, bubbly fluid is studied. The shell is assumed to be straight, infinitely long, and unbound (with the environment). In the long-wave approach, a liquid-gas mixture with a small amount of air is taken as a sample for numerical calculations. When solving the problem, it is assumed that the bubbles in the liquid are spherical in shape and their radius is very small compared to the characteristic sizes in the problem. It is considered here that the properties of bubbly liquids are based on the spherical shape of the bubbles, which is especially shows when these bubbles are subjected to large stretching and compression. Analytical results are based on the analytical solution of the mathematical model obtained by phenomenological methods from the general laws and principles of the two-phase viscous fluid-viscosity hydrodynamic system of the whole environment mechanics and physics. In the study, hydrodynamics of the acoustic waves generated by the excitation of the shell together with the heterogeneous liquid solution, depending on the various physical parameters of the components and phases of the system, were studied.*

Keywords: *Twophase media, viscous fluid, gas bubbles, non axisymmetric wave propogation, cylindrical elastic shell.*

References:

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A new approach to hesitant fuzzy soft topological spaces

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ABSTRACT: *In [2] defined the concept of soft set as a novel mathematical instrument in 1999. In [3,4] proposed a concept of a hesitant fuzzy set as an extension of a fuzzy set in order to overcome the difficulties associated with determining the degree of membership of an element in a set. The concept of hesitant fuzzy set was revised and presented in [1]. Since then, many researchers have studied hesitant fuzzy set . This study defines hesitant fuzzy soft sets and provides definitions and analyses of the subset, intersection, union, and complement operations on these sets. Moreover, the union and intersection operations on the family of hesitant fuzzy soft sets are also defined. The remainder of this paper will present the concept of hesitant fuzzy soft topology, after which the definitions of interior, closure of a hesitant fuzzy soft set are given, along with an analysis of their properties. Finally, the definition of hesitant fuzzy soft continuous mapping is provided, and the mapping is characterised. The definition of hesitant fuzzy soft open or closed mappings allows us to identify the necessary and sufficient condition for a mapping to be hesitant fuzzy soft open (closed).*

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Some fixed point theorems on soft A-metric spaces

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ABSTRACT:

Soft A-metric spaces [1] *are designed using the soft points of soft sets and the notion of A-metric spaces. Since this new version of metric spaces is a generalization of soft metric spaces, it has a great importance and it is worth considering. The aim of this paper is to contribute for investigating on soft A−metric space and its different aspects. For this purpose, firsty, we give the definition of soft contraction mapping on soft A-metric spaces. After that, we prove some fixed point theorems for soft contractive mappings on soft A-metric spaces and we give some examples that satisfy these fixed point theorems.*

Keywords: soft A-metric spaces, fixed point theorem, fixed points

References:

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Fixed point theorems in *b*-fuzzy metric spaces

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ABSTRACT: *In this paper we present several fixed point results on b-fuzzy metric spaces. We prove existence and uniqueness of fixed point for selfmappings defined on b-fuzzy metric spaces that satisfy non-linear contractive type condition, by using topological methods and the concept of strictly convex and normal structure. The second result provides existence and uniqueness of a common fixed point theorem for a pair of R-weakly commuting mappings defined on b-fuzzy metric spaces satisfying nonlinear contractive conditions of Boyd-Wong type. Several corollaries of proved results are discussed and compared to previously known results. The obtained results are ilustrated with a couple of relevant examples.*

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Set's Forcing Recurrence Near Zero in Additive Subsemigroup of Positive Real Numbers

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ABSTRACT: *The subsets of natural numbers with the property that "whenever a point in a topological dynamical system enters a compact set along a said subset of natural numbers, that compact set contains a recurrent point" came into notice of [1]. They defined the notion of set's forcing recurrence and characterized subsets of natural numbers that force recurrence and uniform recurrence in terms of broken IP-sets and broken syndetic sets, respectively. In this paper, these notions are elegantly extended for the subsets of dense additive subsemigroups of positive real numbers that force recurrence near zero, force uniform recurrence near zero, contain broken IP-set near zero and contain broken syndetic set near zero, where ultrafilters converging to zero are recurrently used as a main tool. In [4] proved that the set of all ultrafilters on dense subsemigroups of the additive semigroup of positive real numbers that converge to zero is a compact right topological subsemigroup of Stone-Čech Compactification of the dense subsemigroup. Recurrent point near zero is defined and a dynamical realization of IP-set near zero is exhibited in this paper. It is proved that a subset of a dense countable subsemigroup of the additive semigroup of positive real numbers forces recurrence near zero (uniform) if and only if it contains a broken IP-set near zero (piecewise syndetic, respectively).*

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Observational and formal topologies

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ABSTRACT:

In this talk we have an overview on our recent results on observational topology and formal topology. In observational topology we add a mathematical model for 'an observer' to the current notion of topology, and we will see that: we find the new features of the space. The observational topology creats a new kind of information systems which they are examples of formal contexts. These kind of formal contexts lead us to the notion of ' formal topology'. This concept is also will be considered in this talk. We will present two new concepts of continuity. These kinds of continuities create new kind of topological entropies for the semidynamical systems created by the continuous maps.

Keywords: observational topology, formal topology, semidynamical system, observer, formal context.

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Anti-Gaussian quadrature rules related to multiple orthogonal polynomials

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ABSTRACT:
Multiple orthogonal polynomials represent one of the generalizations of orthogonal polynomials, in the sense that they satisfy orthogonality with respect to r different weight functions simultaneously. Anti-Gaussian quadrature formulas on the space of algebraic polynomials were introduced in 1996 by Laurie ([1]). These quadrature formulas have the property that their error is equal in magnitude but of opposite sign to the corresponding Gaussian quadrature rules. Here, we analyze a set of anti-Gaussian quadrature rules for the optimal set of quadrature rules in Borges' sense (see [2]), which refers to the observed multiply orthogonal polynomials, and define a set of averaged quadrature formulas.

Keywords: multiple orthogonal polynomials, anti-Gaussian quadrature rule, optimal set of quadrature rules in Borges' sense

References:
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Baire-like properties of the space of minimal usco maps

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ABSTRACT:
The class of minimal usco maps has a lot of properties similar to continuous functions. They have found many applications in various fields of mathematics, like optimization, functional analysis, the study of differentiability of Lipschitz functions, and the study of weak Asplund spaces. We are interested in the topological properties of the space of minimal usco maps equipped with the topology of uniform convergence on compacta. In this study, we focus on various notions connected to completeness, namely complete metrizability, Čech-completeness, strong Choqet property, Choquet property and Baire property.

Keywords: mininal usco, (strong) Choquet space, Baire space

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Polynomial indicator of flat bands

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ABSTRACT:

We present a universal and straightforward algebraic method for recognition of the existence of flat bands in crystal lattices, which uses only information on the coefficients of the characteristic polynomial of the Bloch Hamiltonian complex matrix to identify conditions that guarantee existence of nondispersive eigenvalues.

This is a joint work with Ivan Damnjanović, Milan Damnjanović and Ivanka Milošević.

About G-Topological Groups

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ABSTRACT:*For a Hausdorf topological spaces X, the limits of the convergent sequences in X defines a function from the set of convergent sequences to itself. Hence some topological concepts can be stated in term of convergent sequences. Motivated by this, recently many authors have been in afford to define some topological definitions associated with different convergences. Connor and Grosse-Erdmann [1] replacing the sequential convergence with a function defined on a subspace of the real sequences introduced G-methods.Then following this, the notions of G- continuity, G-compactnes and G-connectedness have studied in the papers [2], [3], [4], [6] and [7]. G-methods are extended   to arbitrary sets rather than topological spaces and G-hulls,G-closures,G-kernelsand G-interior are presented in [5]. In this work we define G-topological group and then extend the usual properties of topological groups to the G-topological groups.*

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Distribution of eigenvalues of threshold graphs

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ABSTRACT:
An interval in which a given graph has no eigenvalues is called a gap interval. We show that for any real number $R>0$ there exist infinitely many threshold graphs with gap interval of length R We provide a recurrence relation for the computation of the characteristic polynomial of threshold graphs and based on it, we conclude that the sequence of the least positive (resp. largest negative) eigenvalues of a growing sequence of threshold graphs is convergent. We also discuss possible limit points and their distribution on real line.
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Keywords: *threshold graphs, least positive eigenvalue, limit points*

[1] Abdullah Alazemi, Milica Anđelić, and Haneen Zaidan, Threshold graphs with an arbitrary large gap set, *Bulletin of Malaysian Mathematical Sciences*, 47, #88, 2024

ON SOME BOUNDARY VALUE PROBLEMS FOR THE FOURTH ORDER DIFFERENTIAL OPERATOR EQUATION

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ABSTRACT: *The aim of the paper is first to study domains of definitions in terms of boundary conditions of minimal and maximal operators, as well as selfadjoint extensions of the minimal operator associated with a fourth-order differential operator equation. Further, we give necessary and sufficient conditions for those operators to have a purely discrete or continuous spectrum. Studied operators with exit from space associated with fourth order differential expressions, coefficients of which are unbounded operators. Introduced direct sum of Hilbert spaces with appropriately defined scalar product in it where minimal symmetric operator. Given representation of domain of maximal operator, also obtained necessary and sufficient conditions for existence selfadjoint extensions as well as self-adjoint extensions having purely discrete spectrum.*

Keywords: *minimal operator, maximal operator, differential operator equation, selfadjoint extensions with exit from space, spectrum eigenvalues*

Inequalities for hyperaccretive quasinormal operators in norm ideals of compact operators

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ABSTRACT:

Norm inequalities for bounded hyperaccretive quasinormal operators in norm ideals of compact operators (including nuclear (trace) operators and Hilbert-Schmidt operators) have been studied, which includes some extensions of the arithmetic-geometric mean inequalities and Young's norm inequality for N-hyperaccretive operators. In addition, some aspects of accretive derivations and contractive perturbations on different norm ideals of compact operators are discussed. Furthermore, connections between hyperaccretivity and hypercontractivity of operators are presented, which lead to dual type norm inequalities for hyperaccretive and hypercontractive operators. Some of these results are achieved using the technique of inner product type transformers, which will be discussed in more detail.

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Derivative estimates for generalized harmonic functions

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ABSTRACT:

The aim of this paper is to obtain <u>Schwarz-Pick</u> type inequalities for (β, α)-harmonic functions u in the unit disc, where α and β are complex parameters satisfying

$Re\ \alpha + Re\ \beta > -1$. We obtain sharp estimate of the norm of derivates for such functions at zero in terms of the L^p norm of the boundary function. Asymptotically sharp estimate are obtained for $D\ u(z)$, as $|z| \to 1$, as well as for the higher order derivatives.

The obtained results provide a significant improvement over previous research on the subject. This is joint work with Miloš Arsenović.

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U-Chain Connectedness

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ABSTRACT:

*Let U be an open covering of the set X and $x, y \in X$. A **chain** in U that connects x and y is a finite sequence of sets $U_1, U_2, ..., U_n$ of U such that $x \in U_1$, $y \in U_n$ and $U_i \cap U_{i+1} \neq \emptyset$ for every $i = 1, 2, ..., n-1$. The set C is U-**chain connected** in X, if for every $x, y \in C$, there exists a chain in U that connects x and y.*

In this talk we will define the connected and the chain connected set as well as their properties by using tne notion of U-chain connectedness. Furthermore with this notion we will define some topological spaces and other notions. At the end we will give a generalisation of this notion in a more general space then a topological.

Keywords: *Connectedness, Chain Connectedness, U-Chain Connectedness*

Some properties of remainders of uniform spaces and uniformly continuous mappings

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ABSTRACT: In this work we study the remainders of uniform spaces and uniformly continuous mappings.

The cover α of the uniform space (X, U) is called co-cover, if $\alpha \cap F \neq \varnothing$ for each free Cauchy filter F in (X, U).

Theorem 1. The remainder $(\widetilde{X} \setminus X, \widetilde{U}_{\widetilde{X} \setminus X})$ of uniform space (X, U) is τ-bounded if and only if every uniform cover has a co-cover cardinality $\leq \tau$.

Theorem 2. The remainder $\hat{f}\mid_{\hat{X} \setminus X} : (\hat{X} \setminus X, \hat{U}_{\hat{X} \setminus X}) \to (Y, V)$ of uniformly continuous mappings $f : (X, U) \to (Y, V)$ is complete if and only if the uniform space (X, U) is open subspace of the space $(\hat{s}X, \hat{s}U)$.

Keywords: *uniform cover, co-cover, remainder, free Cauchy filter*

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Selection principles in topological vector spaces

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ABSTRACT: The theory of the selection principles is one of the main directions of set-theoretic topology. In this work we study important properties of the M-bounded, H-bounded and R-bounded properties in topological vector space and games in topological vector space. Topological vector space L is said to be M-bounded (H-bounded, R-bounded), if L a uniformly Menger [1] (uniformly Hurewicz [1], uniformly Rothberger [1]) space with respect to the translation-invariant uniformity [2].

As known, to each selection principle for topological spaces it is naturally associated the corresponding game and often selection principles can be characterized game-theoretically. In topological vector space case to each selection principle one can assign also the corresponding game: the game MbG associated to the M**-**bounded property is defined in the following way. Two players, ONE and TWO, play a round for each positive integer. In the n-th round ONE chooses a 0-neighborhoods U_n and TWO responds choosing a finite subsets A_n. TWO wins a play $U_1, A_1; U_2, A_2,...$ if $L = \bigcup_{n \in N} A_n + U_n$; and otherwise ONE wins.

Keywords: *Topological vector space,* M *-boundedness,* H *-boundedness,* R *-boundedness*

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About compactness types of uniform spaces

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ABSTRACT: *It is well known that compact, finally compact and countable Find and studying uniform analogues of these classes of compact is an important and interesting problem in uniform topology. This work we introduces and studies compact, uniformly finally compact and uniformly countable compact spaces.*

Definition 1. *A uniform space (X,U) is said to be compact (uniformly finally compact) if every finitely additive open cover has a finite (countable) uniform refinement.*

Definition 2. *A uniform space (X,U) is said to be uniformly countable compact if every countable finitely additive open cover has a finite uniform refinement.*

Theorem 1. *The uniform space (X,U) is compact if and only if (X,U) is uniformly finally compact and uniformly countable compact.*

Keywords: *compact, uniformly finally compact, uniformly countable compact, cover*
compact spaces play an important role in set-theoretical topology.

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Green function for T_α Laplacian on the unit ball in $\mathbb{R}^n$

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ABSTRACT:

In this paper we derive explicit form of Green functions for the class of partial differential operators, which arise as an real analogue of invarian Laplacianson the unit ball in $\mathbb{C}^n$. Also, we will investigate growth of theese Green functions on the boundary of unit disc, as well as the gowth of it's partial derivatives.

Keywords: Green function. Invariant laplacian, Poisson equation

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Several modification of the Chebyshev measures and computation of the corresponding orthogonal polynomials in symbolic form

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ABSTRACT:

Repeated modifications for distinct and the same linear divisors have been studied by Gautschi in [1] and applied to generate special Gaussian rules for dealing with nearby poles (see [2]). In this paper, these problems were treated in symbolic form. Namely, the rational modification of the Chebyshev measure of the first kind with repeated identical and distinct quadratic divisors was considered. The corresponding moments were calculated in terms of the hypergeometric functions and coefficients of the three term recurrence relation of the corresponding orthogonal polynomials were obtained in symbolic form. In the second part of the talk the orthogonal polynomials with respect to the convex combination of two Chebyshev measures of the first and second kind were considered. All calculations were done in software Mathematica with intensive use of package Orthogonal Polynomials.

Keywords: orthogonal polynomials, Chebyshev measure, symbolic computations, software, recurrence relation

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Simulations and bisimulations for weighted finite automata based on continuous recurrent neural networks

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ABSTRACT:
The problem of the existence of bisimulations for automata over real numbers, their modeling and implementation of proposed models are investigated. Theoretical background of the investigation is given in [1], in the context of WFA over a semiring. Bisimulations between WFA are based on systems of homogeneous Sylvester equations and two vector equations which are inconsistent in general case. Our intention is to apply multicriteria optimization, solving linear systems and continuous-time zeroing Neural Network (ZNN) dynamical systems to find approximate solutions.
In addition, forward and backward simulations between WFA are based on systems of matrix and vector inequalities. Typically, such inequalities possess infinite number of solutions. Linear systems and ZNN dynamics is used to generate the best approximate solution.

Keywords: *Weighted finite automata, zeroing neural network, simulation, bisimulation, Sylvester matrix equations*

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Implementation of trapezoidal fuzzy numbers in the Defining interrelationships between ranked criteria II method and application in the MCDM model

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ABSTRACT:

In various decision-making problems, and especially in multi-criteria decision-making (MCDM), one often encounters the problem of imprecise input parameters used to make a decision. In order to quantify such values, various theories are applied that treat this area well, among others the Fuzzy theory, which enables working with imprecise and incomplete data, which is often the case in real situations.

In this paper, the implementation of trapezoidal fuzzy numbers in the DIBR II (Defining interrelationships between ranked criteria) method was carried out, in order to adapt it for working with fuzzy data and to enable more precise evaluation of criteria in MCDM. A numerical example is given that illustrates the application procedure of the method and the application of the method in the MCDM model with the fuzzy Simple additive weighting (SAW) method to the problem of selecting a construction contractor, which is a frequent challenge in practice, is shown.

In order to check the consistency and validation of the output results, an analysis of the sensitivity of the methodology to changes in the weighting coefficients of the criteria was performed. This analysis helps in understanding how robust the outputs are to changes in the input parameters. In addition, a comparative analysis was performed, in which the obtained results were compared with the results of other methods. This kind of analysis makes it possible to see the advantages and disadvantages of the proposed approach in relation to existing methods and contributes to its further validation and potential application in practice

On pseudo-interior or Menger n-sponge

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ABSTRACT:
In their paper „Nobeling spaces and pseudo-interiors of Menger compacta", A. Chigogidze, K.Kawamura and E.D. Tymchatynal, among the others results, proved that the pseudo-interior of Menger universal space μ^n is homeomorphic to Nobeling space N_n^{2n+1}. In this talk we provide a simple and short proof of that fact.

Keywords: Nobeling space, universal Menger space

Logarithmic velocities of numerous sequences

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ABSTRACT: *Let S be the set of positive real sequences and let $x = (x_n) \in S$. For each $k \in \mathbb{N}$ we define a new sequence (1) $V^{(k)}(x) = (V^{(k)}(x))$ in the following way (2) $V_n^{(1)}(x) = \frac{x_{n+1}}{x_n} n \in \mathbb{N}$, and $V_n^{(k+1)}(x) = \frac{V_{n+1}^{(k)}(x)}{V_n^{(k)}(x)}, n \in \mathbb{N}$. The sequence $V^{(k)}(x)$ is called quotient velocity for the sequence x of order k. We consider that it is $V^{(0)}(x) = x$. The objects given by (1) and (2) have a significant role in the theory of selection principles and the theory of games(see [1],[2]). In this paper, we introduce the notion of logarithmic velocity for the sequence $x \in S$. For each $k \in \mathbb{N}$, we define a new sequence $V_L^{(k)}(x) = (V_{L,n}^{(k)}(x))$ as follows*

$$V_{L,n}^{(1)}(x) = \log_{x_n} x^{n+1} = \frac{\log x_{n+1}}{\log x_n}, for\ n \in \mathbb{N},$$

$$V_{L,n}^{(k+1)}(x) = \log_{V_{L,n}^{(k)}(x)} V_{L,n+1}^{(k)}(x), for\ n \in \mathbb{N}.$$

Logarithmic velocity for the sequence $x \in S$ improve many results in the theory of selection principles.

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Numerical approximation of some parabolic time-dependent problems with Dirac delta function

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ABSTRACT:

One interesting class of parabolic problems model processes in heat-conduction media with concentrated capacity in which the heat capacity coefficient contains a Dirac delta function as the coefficient with the derivation of the time. In this paper we study the convergence of finite difference schemes that approximates the initial-boundary problems for the heat equation with concentrated capacity and time-dependent coefficients. In a one-dimensional case, we assume that the generalized solution ot the problem belongs to the Sobolev space $W_2^{s,s/2}$, $5/2 < s < 3$ and proved the estimate of the rate of convergence in a special discrete $\widetilde{W}_2^{1,1/2}$ Sobolev norm. In two-dimensional case, assuming that solution of problem in the Sobolev space $W_2^{3,3/2}$ (respectively $W_2^{4,2}$) we proved the estimate of the convergence in $\widetilde{W}_2^{1,1/2}$ (respectively $\widetilde{W}_2^{2,1}$) Sobolev norm. These estimates are compatible with the smoothness of the coefficients and solution of the problem.

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MULTI-CRITERIA MODELS WITH MULTIPLE DOMINANT CRITERIA

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ABSTRACT:
In paper [1], the concept of dominant criterion was introduced, and in paper [2], this method of multi-criteria analysis was additionally investigated with a new approach. Now we present a new method of multi-criteria analysis in which we have more than one criterion in the model that is dominant in the sense as defined in [1].

Keywords: *dominant criterion, multi-criteria analysis*

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Some topological properties of e-spaces

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ABSTRACT:

In [1], e-spaces and e-continuous functions were introduced and investigated. If a topological space is an e-space, then we say that such a space has e-property. In this work we study preservation of e-property under some normal functors. We consider the following functors: Π^n, SP^n (where n is a natural number). It is known that the functor of n-th permutation degree SP^n preserves τ-continuity of functions [2]. In this work we proved that the functor of n-th permutation degree SP^n preserves e-property of topological spaces. It is known that every homeomorphic image of an e-space is an e-space, i.e. e-property of topological spaces is preserved by homeomorphisms (see Proposition 2.11 in [1]). In this work we generalize this proposition for a closed-open mapping.

Keywords: *extrimal space, e-continuous functions, functor of n-th permutation degree.*

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Connections among G-metric spaces and (3,j)-metric spaces and [3,Δ,j]-metric spaces, j∈{1,2}

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ABSTRACT:

In this paper, we examine the connections among G-metric spaces and (3,j)-metric spaces and [3,Δ,j]-metric spaces, j∈{1,2}. We prove that: a G-metric is a 3-metric; a G-metric is a [3,Δ,1]-metric; a G-symmetric is a [3,Δ,2]-metric. We give examples of: a G-metric which is not a [3,Δ,2]-metric; a [3,Δ,2]-metric which is not a G-metric and a [3,Δ,1]-metric which is not G-metric.

Properties of equi-Baire 1 and equi-Lebesgue families of functions

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ABSTRACT:

The notion of equi-Baire 1 family of functions was introduced by Lecomte in [4] and rediscovered by Alikhani-Koopaei in [1]. It was motivated by the epsilon-delta characterization of F_σ-measurable functions due to Lee, Tang and Zhao in [5]. The aim of the talk is to present several properties of equi-Baire 1 and equi-Lebesgue families of functions between metric spaces and their behaviour with respect to pointwise and uniform convergence. We will give a criterion for a choice of a uniformly convergent subsequence from a sequence of functions that form an equi-Baire 1 family, which solves a problem posed in [2]. We will also present Ascoli-type theorem for locally bounded F_σ-measurable functions [3].

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Non restricted non tangential limits for functions in the Zygmund
class of separately (α,β) harmonic functions in the unit polydisc

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ABSTRACT:

We investigate functions u defined on the unit polydisc D^n which are (α_j, β_j) harmonic with respect to each of
the variables z_j, in particular boundary behavior of such functions
at points of the distinguished boundary T^n of the polydisc.
In particular we show that limits exist almost everywhere on T^n if u belongs to the appropriate Zygmund class. Along the way we derive tools needed to get this reslut, which are estimates for various maximal functions.

Keywords: *non tengential limits, Zygmund class*

A note on some retractions of the space of thin maximal linked systems

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ABSTRACT:
In [1], some homotopy properties of the space of maximal linked systems have been stiidied . It is shown that the superextension functor λ preserves the retraction and some homotopy properties of topological spaces, and also proved that this functor λ is covariant homotopy functor . This work is s a continuation of the work [1]. We consider the functor of thin maximal linked systems λ^* as a subfunctor of the superextension functor λ . We prove that the functor of thin maximal linked systems λ^* preserves some retractions of topological spaces. In particular, the functor of thin maximal linked systems λ^* preserves the deformation retract, strong deformation retract, weak retract and weak deformation retract of topological spaces.

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CONTINUITY OVER COVERINGS

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ABSTRACT:
We repeat the definition of continuity over coverings started in the work of Victor Klee. The corresponding notion of homotopy is discussed in details, comparing the approaches of several authors..
The right definition is used to define shape, a tool more adequate than usual homotopy theory, for classification of spaces with complicated local structure , for example attractors in dynamical systems..

Weaker forms of commutativity and common fixed points in Menger PM-spaces

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ABSTRACT:

In this talk, we will present some of fixed point results achived for Menger PM-spaces recently. In one part of these results is proved that orbital continuity for a pair of self-mappings is a necessary and sufficient condition for the existence and uniqueness of a common fixed point for these mappings defined on Menger PM-spaces with a nonlinear contractive condition. We will explore if the converse of these results holds. Also, we will show that these results remain true if we use some weaker forms of commutativity like R-weakly commutativity of type A_f (or type A_g). These results generalize some known results.

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In a Non-single Poor Enviroment, an Algorithm and Program to Find an Effective Solution For Oil Filtration Border Problem

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ABSTRACT:
The study investigates pressure changes, pressure distribution across the layer, and the impact of parameters characterizing the properties of fluids during the filtration process within layered heterogeneous porous media. In the numerical modeling of fluid filtration processes in heterogeneous porous media, a discrete model of the problem is developed using the method of variable direction schemes and differential sweeping. A computational algorithm is devised to solve a two-dimensional boundary problem for oil filtration processes. Computational experiments are conducted based on the developed mathematical model and numerical solution algorithm, and the results are presented as visual graphs. The study investigates pressure changes, pressure distribution across the layer, and the impact of parameters characterizing the properties of fluids during the filtration process within layered heterogeneous porous media. In the numerical modeling of fluid filtration processes in heterogeneous porous media, a discrete model of the problem is developed using the method of variable direction schemes and differential sweeping. A computational algorithm is devised to solve a two-dimensional boundary problem for oil filtration processes. Computational experiments are conducted based on the developed mathematical model and numerical solution algorithm, and the results are presented as visual graphs.

Topological embeddings of T_k-topological spaces

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ABSTRACT:

Let $({\mathbb Z}, T_k)$ be a T_k-topological space on the set of integers, where the topology T_k is generated by the set S_k as a subbase, $k \in {\mathbb Z}$, and $S_k:=\{S_{k, t}\, \vert \, S_{k, t}:=\{2t, 2t+1, 2t+2k+1\},\, t \in {\mathbb Z} \}$ [1,2] . Then, for $k_1, k_2 \in {\mathbb N}$, the paper initially proves that $({\mathbb Z}, T_{k_1})$ is topologically embedded in $({\mathbb Z}, T_{k_2})$ if and only if $k_1 \leq k_2$.

Based on this feature, let $\mathcal{T}$ be the set of T_k-topological spaces, $k \in {\mathbb N}$.

Then we study an existence problem of a universal element in $\mathcal{T}$.

Keywords: topological embedding, T_k-topological space, digital topology, Khalimsky topology.

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Some fixed point theorems in [3,Δ,2]-metric spaces

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ABSTRACT:
In this article we prove the existence and uniqueness of fixed points for self mappings on [3,Δ,2]-metric spaces related to a nondecreasing map $\varphi:[0,\infty)\to [0,\infty)$ such that $\varphi^n(t) \to 0$ as $n\to\infty$, for all $t\in(0,\infty)$.

Continuous surjections between function spaces with pointwise topology

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ABSTRACT:
This is a joint work with Ali Eysen and Arkady Leiderman. For a topological space X let $C_p(X)$ denote the set of all continuous functions on X with the pointwise topology. Assume T: $C_p(X) \longrightarrow C_p(Y)$ is a continuous linear surjection, where X and Y are Tychonoff spaces. We show that Y has some topological property P provided X has the same property. For example, this is true when P is zero-dimensionality. In case X and Y are metric spaces, we have more such properties. We also discuss the same question when T is uniformly continuous surjection.

Keywords: continuous linear surjections between function spaces, pointwise convergence topology, uniformly continuous surjections

Studying the existence of universal elements in classes of semi-open mappings

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[*]Results of this talk are given in the paper
"Studying the existence of universal elements in classes of semi-open mappings"
which is a joint work of D. Georgiou, A. Megaritis and F. Sereti,
accepted for publication to Topology and its Applications.

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ABSTRACT: The universality problem for classes of topological spaces (respectively, classes of frames and classes of mappings), is a question which seeks its answer in whether there exist or not universal elements in a given class of spaces (respectively, frames and mappings). The study of universal elements is considered to be an important branch of Topology since these elements are the "representative of their corresponding classes. Especially, this "representative gives information for all members of the class. That is, instead of studying properties of each member of this class, we can investigate the properties of the universal element and export results for the whole class.

With this talk, assuming that all considered mappings are continuous, we investigate this universality problem in classes of semi-open mappings, verifying the existence of universal mappings in such classes. Given two topological spaces X and Y, a mapping $f : X \to Y$ is called *semi-open* if $\text{Int}_Y(f(U)) \neq \emptyset$, for every non-empty open subset U of X. Also, if f and g are two mappings of spaces with domains D_f and D_g and ranges R_f and R_g, respectively, then a pair (i, j), where i is an embedding of D_g into D_f and j is an embedding of R_g into R_f such that $f \circ i = j \circ g$, i.e. the diagram of Figure 1 is commutative, is said to be an *embedding of g into f*.

$$
\begin{array}{ccc}
D_f & \xrightarrow{\;f\;} & R_f \\
\big\uparrow{\scriptstyle i} & & \big\uparrow{\scriptstyle j} \\
D_g & \xrightarrow{\;g\;} & R_g
\end{array}
$$

Figure 1: Embedding of g into f

An element f of a class $\mathbb{F}$ of mappings is said to be *universal* in $\mathbb{F}$ if for every $g \in \mathbb{F}$, there exists an embedding of g into f. Then, the main result of this presentation, is given as follows:

Let $\mathbb{E}$ and $\mathbb{L}$ be saturated classes of spaces. In the (non-empty) class $C^{\text{sop}}(\mathbb{E}, \mathbb{L})$ of all semi-open mappings with domain in $\mathbb{E}$ and range in $\mathbb{L}$ there exist universal elements.

Based on this result, we present the existence of universal mappings in various classes of mappings determined by the semi-open property.

Analysing the symptoms of the Covid-19 pandemic using fuzzy soft-set theory

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ABSTRACT:
The global spread of the novel coronavirus disease (COVID-19) has been rapid since its emergence in 2019. The disease has been identified as a significant threat to public health, with governments, health institutions and the general population facing potential challenges. A general overview of the epidemic reveals that the primary symptoms observed are fever, cough, and shortness of breath. However, it is noteworthy that cases without symptoms have also been reported. This article proposes that all potential symptoms be considered across different regions of the world, with each region evaluated on its own merits. Additionally, to gain insight into the overall situation, the average situation is taken into account. In order to achieve this, the fuzzy soft matrix, a concept derived from fuzzy soft set theory, is employed to define the interaction function. This is then utilized in conjunction with an algorithmic decision-making method, the latter of which has been developed based on this aforementioned definition.

Generalized Periodicity

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ABSTRACT:
Starting with the Beverton-Holt difference equation and with the famous Cushing-Henson conjectures for a periodic environment, we begin our journey in the discrete case, continue to the time scales case, and with a detour to the quantum case, we arrive at the isolated time scales case, then return to the continuous case and end up with a generalization of the concept of periodic functions.

Bounded Linear and Compact Operators on the Generalised Hahn Space

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ABSTRACT: The Hahn space was originally introduced and studied by Hahn [3] in 1922, in connection with the theory of singular integrals, and later generalised by Goes [2]. A survey of recent results on the generalised Hahn space can be found, for instance, in [4]. There are a relatively large number of recent research papers on the Hahn space and its generalisation . We study the most important recent results in the characterisations of bounded linear and compact operators on the generalised Hahn space in [6]. Furthermore, we deal with some applications. Recent related research can be found, for instance, in [5, 1, 7] and in the survey paper [4].Finally, we present a few interesting applications of our results, some of which can be found in [5] and [7].

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