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GENERALIZED HERMITE POLYNOMIALS IN THE DESCRIPTION OF CHEBYSHEV-LIKE POLYNOMIALS

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Abstract:

This presentation is a survey on the description of the main properties of the multi-index or multi-dimensional Chebyshev polynomials, by using the generalized Hermite polynomials as tool. The Hermite polynomials play a fundamental role in the extension of the classical special functions to the multidimensional or multi-index case. We will also show that, starting from the multi-index Hermite polynomials, it is possible to introduce the Chebyshev polynomials of multidimensional type of first and second kind, and some of their generalizations.

Keywords: Operator theory, Hermite polynomials, Chebyshev-like polynomials

General area of research: Mathematics

ICFAS2023-ID: 1002

REAL INTERPOLATION METHODS WITH FUNCTION PARAMETER

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Abstract:

In the first part of my talk I will give a short introduction of the theory interpolation of linear operators. We give definitions of classical Lions-Peetre real interpolation methods (K and J methods), and some basic properties and theorems. In the second part of my talk I will discussed about two types of generalization of the classical Lions-Peetre real interpolation method using a function parameter. First was consider by Gustavsson [2] and second was con-sidered by Janson [3]. We will show the relation with these two methods. The original definition of Gustavsson was restricted on the so-call quasi-power parameter. We are able to consider this method for general function. Using the ideas from the book [1], we to show that the generalized method of Gustavsson and Janson's method are equivalent. Many properties which was obtained by Janson was problem to get for original Gustavsson method. It was reason that Gustavsson consider restricted class of parameter. We will obtained results for general Gustavson method without any restriction on the parameter.

References

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- [2] J. Gustavsson. A function parameter in connection with interpolation of Banach spaces. Math. Scand. 42 (1978), 289305.
- [3] S. Janson. Minimal and maximal methods of interpolation, J. Funct. Anal., 44 (1981), 5073.

Keywords: Interpolation methods

General area of research: Mathematics

ICFAS2023-ID: 1008

REGULARITY PROPERTIES FOR FRACTIONAL BOUSSINESQ EQUATIONS AND APPLICATIONS

Veli Shakhmurov

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Abstract:

In this talk, the existence, uniqueness and regularity properties of solution of the Cauchy problem for the fractional abstract Boussinesq equation is obtained. First, we consider the linear Boussinesq equation and prove the existence, uniqueness and the regularity properties of solutions. It can be used to obtain the existence and uniqueness of the regular solution of corresponding nonlinear Boussinesq equation. By applying this result, the Cauchy problem for finite or infinite systems of Boussinesq equations are studied.

Keywords: Boussinesq equations, semigroups of operators, hyperbolic-operator equations, cosine operator functions, operator-valued multipliers

General area of research: Mathematics

ICFAS2023-ID: 1009

INVARIANCE PROPERTY OF MINIMAL PRIME IDEALS

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Abstract:

Let R be a ring. An additive mapping $d : R \rightarrow R$ is called derivation of a ring R if $d(xy) = d(x)y + xd(y)$, for all $x, y \in R$. A family of additive mappings $(d_i)_{i \in \mathbb{N}}$ from R to itself with d_0 defined as the identity map on R is termed as a higher derivation if $d_n(xy) = \sum_{i+j=n} d_i(x)d_j(y) \forall x, y \in R$ and $n \geq 1$. In 1988, Herstein suggested a conjecture stating that every minimal prime ideal of a semiprime ring R is invariant under any derivation d of R . Partial results of this conjecture was brought up by many authors (see [Math. Z. (1982), {180}, 503–523] for more details). The best result based on this conjecture was given by Beidar and Mikhalev [Trudy Sem. Petrovski {10}, 227-234]. In 2006, Chuang and Lee [J. Algebra (2006) {302}(1), 305-312] proved the following: if the semiprime ring R either satisfies a polynomial identity or has only countably many elements, then there exists a family $\{P_\alpha\}_{\alpha \in A}$ of minimal prime ideals such that $\bigcap_{\alpha \in A} P_\alpha = 0$ and each $\{P_\alpha\}$ is d -invariant for any derivation d of R . In this line, Matczuk [Contemp. Math., Amer. Math. Soc. (2015) {634}, 223-225] proved that every minimal prime ideal P , which has nonzero annihilator of a semiprime ring R is invariant under any derivations d of R which was further generalized by Lee and Lin [Comm. Algebra, {46}(8), 3436-3441] for arbitrary rings.

Keywords: Minimal prime ideals

General area of research: Mathematics

ICFAS2023-ID: 1136

LIE GROUP TECHNIQUES FOR DIFFERENTIAL EQUATIONS

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Abstract:

Lie group analysis was created by the profound Norwegian mathematician Marius Sophus Lie (1842-1899) in the latter half of the nineteenth century. This technique systematically connects and broadens the well-known ad hoc methods to construct closed-form solutions of differential equations, particularly for nonlinear differential equations. In this talk we present Lie's theory in brief and its applications to differential equations.

Keywords: Lie group analysis

General area of research: Mathematics

ICFAS2023-ID: 1137

ALGEBRA FIELDS TIME TRANSFORMATIONS GEOMETRY OF SPACE GAGING

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Abstract:

ICFAS2021 presentation “Physics Formalism.....” highlighted application of 2x2 tensor PHYSICS Helmholtz decomposition fields theorem overcoming problem of current inconsistency of quantum mechanics versus general relativity, modeling Iyer Markoulakis theory of point gradient and rotational (curl) vortex fields. Gaging to absolute vacuum and zero constructing stringmetrics with Coulomb-Hilbert gauge transforms of electromagnetic wave-particle charge asymmetry with mass function of wave-particle., physics was extended to zero-point fluctuations analogous to a “zitterbewegung” oscillations that are fundamental universal musings!! Advancing, ICFAS2022 presentation “Algebra Gage Matrix PHYSICS” highlighted about gage time gage space fields probability signal matrix that was derived out of mathematical algorithm of probability wavefunction matrix of rotations having distributions of four-vector time space fields signal/noise ratio. Differential permutational matrices showing magic square matrix prime factorization processes based on critical matrix of fields signal/noise ratio metrics $[\Gamma]$ versus $[\Gamma_{critical}] = [\Gamma_{cr}]$ explained how gage gravity would act. Conditions of point density matrix pattern $[\rho_{object}]$ versus $[\rho_{critical}] = [\rho_{cr}]$ determining property of gage gravity was advanced further.

The author advances further on earlier developed algebra gage to provide algorithm equation graphical metrics, $[Y] = g_{fts} [X]$, where output matrix $[Y]$ is a metrically adjusted function of an input metrical matrix $[X]$ such that g_{fts} is a gage fibrational string parameter, where $g_{fts} = 1$ has been applied to get a resultant Algorithm Graphical Equation with scalar quantum gauge field $||[\mathcal{E}_{GR}]||$ in terms of general transforms. Typically, Laplacian, Fourier, and Legendre transforms has been applied to gage the spin, rotation, revolution, and ω_{qg} merely as a function of time, a breakthrough algorithmic physics transforms metrix in contrast with current mathematical physics having Lagrangian and Hamiltonian transforms of the energies. Universal constants, that may vary over a long period of observations have been essentially eliminated by breakthrough ansatz transforms metrix knowledge processing via mathematical transforms processes of the operator algebra. Fibrational Bundle Gage transforms PHYSICS Systems to get four-vector time matrix

fields $\begin{pmatrix} \hat{t}_{pr,\mu\nu} & \hat{t}_g^{\mu\nu} \\ \hat{t}_{l,\mu\nu} & \hat{t}_r^{\mu\nu} \end{pmatrix} = g_{ifts} [\text{transforms}]$, extracting time from this algorithm equation by having

mathematically inverse transforms, with $\hat{t}_{pr,\mu\nu}$:proper time, $\hat{t}_r^{\mu\nu}$: real time, $\hat{t}_g^{\mu\nu}$: global time, and $\hat{t}_{l,\mu\nu}$: locally time.

Instrumentation development measuring these observables provides a viable means of capturing observable measurable astrophysical signal/noise matrix of vibrational or sound and photonic or light gauge fields. Quantifying discontinuum PHYSICS shifting paradigm is possible by having algorithm identifying weight parametrically that is experimentally viable testable physically observable measurable quantity. This algorithm is given in terms of discontinuum energy field (DEF) = (gravity_bundle_transform)(weight) =

$\Sigma\{(\text{fiber_transforms})^*(\text{gage_velocity})\}$, allowing us to write the DCP algorithm equationally. We will be able to graphically determine (DEF) versus (gage_velocity) for varying matter_weights with experimentally observables' measurements. These are achievable by applying typical computer programming simulation techniques having trial-and-error methods to get precise as well as accurate results.

Mathematical quantification with gage discontinuum dissipative physics will be advanced towards efforts to unified fields PHYSICS having Grand Theory of the four super forces encompassing electromagnetism, gravity, strong nuclear and the weak nuclear fields. Application of gage physics algorithms developed here have usability spanning across many branches of science, engineering, and technology. Mathematics of algorithm heuristically extends to Information Systems, specifically artificial expert programs with quantum computing.

Keywords: Geometry of Space Gaging

General area of research: Mathematics

ICFAS2023-ID: 1032

RAMANUJAN PRIMES

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Abstract:

One of the well known results in prime number Theory is Bertrand's Postulate which states that there is at least one prime between n and $2n$ for any natural number $n > 1$. Ramanujan gave a beautiful generalization of this result by showing that the interval $(x/2, x]$ contains a lot of prime numbers for any real $x \geq 2$ and hence at least one prime proving Bertrand's Postulate. The n -th Ramanujan prime is defined as the least positive integer R_n such that for all $x \geq R_n$, the interval $(x/2, x]$ contains at least n primes. First few Ramanujan primes are $R_1=2$, $R_2=11$, $R_3=17$, $R_4=29$, $R_5=41$, $R_6=47$, $R_7=59$, $R_8=67$, $R_9=71$, $R_{10}=97$. In this talk, I will give an overview of Ramanujan primes and discuss about some of its interesting properties and recent results.

Keywords: Ramanujan primes

General area of research: Mathematics

ICFAS2023-ID: 1067

TOPOLOGICAL DATA ANALYSIS AND QUIVER REPRESENTATIONS

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Abstract:

Topological data analysis (TDA) is a rapidly growing field that utilizes topological methods to analyze complex data sets. TDA aims to understand the underlying structure of data by identifying topological characteristics such as connected components, and voids. One promising approach to TDA is through the use of quiver representations, a mathematical framework that encodes information about a system using directed graphs. Quiver representations have recently gained popularity in TDA due to their ability to efficiently represent topological structures such as persistence diagrams. Analysis of quiver representations employs algebraic geometry and representation theory techniques, which provide powerful tools for understanding the topology of complex data sets. In this talk, we will provide an overview of quiver representations in TDA.

Keywords: Topological data analysis

General area of research: Mathematics

ICFAS2023-ID: 1073

GENERALIZED HYPERCENTRALIZERS AND HYPERCOMMUTING MAPS IN ASSOCIATIVE RINGS

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Abstract:

Let R be an associative ring and $S \subseteq R$ any its subset. For a fixed integer $n \geq 1$, the n -th hypercentralizer of S is defined to be the set

$$H_{n,R}(S) = \{a \in R : \text{for each } x \in S \text{ there exist an integer } m = m(a, x) \geq 1 \text{ such that } [a, x^m]_n = 0\}$$

And, moreover, the generalized hypercentralizer of S is the set

$$H_R(S) = \{a \in R : \text{for each } x \in R \text{ there exist an integer } n = n(a, x) \geq 1 \text{ and } m = m(a, x) \geq 1 \text{ such that } [a, x^m]_n = 0\}.$$

In literature, $H_{1,R}(R)$, the first hypercentralizer of R , is simply called the hypercenter of R and $H_R(R)$, the generalized hypercentralizer of R is called the generalized hypercenter of R .

The classical hypercenter theorem proved by I.N. Herstein [2] asserts that the hypercenter of R always coincides with its center ($H_{1,R}(R) = Z(R)$), under the assumption that R does not contain non-zero nil two-sided ideals.

Later, in [1, Theorem 2], Chuang and Lin proved that if R is a ring without non-zero nil two-sided ideals then the n -th hypercentralizer of R coincides with the center of R ($H_{n,R}(R) = Z(R)$). They also proved that if R is a ring without non-zero nil right ideals then the generalized hypercentralizer $H_R(R)$ (simply called generalized hypercenter) coincides with the center [1, Theorem 4].

Here we will analyse the generalized hypercentralizer of some subsets of a prime K -algebra R without nil right ideals, where K is a field. More precisely, given a polynomial $f(x_1, \dots, x_n)$ over K , we will characterize the generalized hypercentralizer $H_R(T)$ in the case $T = \{f(r_1, \dots, r_n) \mid r_1, \dots, r_n \in R\}$ and show that $H_R(T)$ coincides with the center of R , unless when R is an order in a finite dimensional central simple algebra.

We then extend the result to the case when there exists a derivation $d : R \rightarrow R$ such that, for each $x \in T$ there exist integers $n = n(x) \geq 1$ and $m = m(x) \geq 1$ such that $[d(x)^m, x^m]_n = 0$.

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Keywords: Hypercenter, polynomial, prime ring, derivation

General area of research: Mathematics

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RIESZ BASES IN QUATERNIONIC HILBERT SPACES

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Abstract:

In this article, we introduce and study Riesz bases in a separable quaternionic Hilbert space. Some results on Riesz bases in a separable quaternionic Hilbert space are proved. It is also proved that a Riesz basis in a separable quaternionic Hilbert space is a frame for the quaternionic Hilbert space. Riesz sequences are defined and the equivalence of a Riesz basis and a complete Riesz sequence in a separable quaternionic Hilbert space is proved.

Keywords: Frames, Riesz basis, quaternionic Hilbert spaces

General area of research: Mathematics

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1. INTRODUCTION

Frames for Hilbert spaces, which plays an important role in many applications, were introduced way back in 1952 by Duffin and Schaeffer [10] as a tool to study of non-harmonic Fourier series. Duffin and Schaeffer introduced frames for particular Hilbert spaces of the form $L^2[a, b]$. They defined a frame as "A sequence $\{f_n\}_{n=1}^\infty$ in a Hilbert space, H is said to be a frame for H if there exist constants A and B with $0 < A \leq B < \infty$ such that

$$A\|x\|^2 \leq \sum_{n=1}^{\infty} |\langle x, f_n \rangle|^2 \leq B\|x\|^2, \quad x \in H \quad (1.1)$$

Moreover, the positive constants A and B , respectively, are called lower frame bound and upper frame bound, respectively, for the frame $\{f_n\}_{n=1}^\infty$. Collectively, these are referred to as frame bounds for the frame $\{f_n\}_{n=1}^\infty$. The inequality (1.1) is called the frame inequality for the frame $\{f_n\}_{n=1}^\infty$. A sequence $\{f_n\}_{n=1}^\infty$ is called a Bessel sequence if it satisfies upper frame inequality in (1.1) i.e., it has an upper bound that satisfies the inequality. A frame $\{f_n\}_{n=1}^\infty$ in H is said to be

- tight if it is possible to choose A, B with $A = B$ satisfying inequality (1.1).
- Parseval if it is possible to choose A, B with $A = B = 1$ satisfying inequality (1.1).
- exact if removal of any f_n leaves the collection $\{f_n\}_{n \neq k}$ no longer a frame for H .

After more than thirty years, in 1986, Daubechies, Grossmann, and Meyer [9], while studying frames, observed that frames can be used to approximate functions in $L^2(\mathbb{R})$. In an abstract setting, they observed that a function in $L^2(\mathbb{R})$ can be represented as a series in terms of elements of frames, which is similar to bases. Then one can also consider frames as one of the generalizations of orthonormal bases in Hilbert spaces as redundant frame expansions are more advantageous over basis expansions in a variety of practical applications. Nowadays, frames are regarded as an important and integral tool to study various areas of applications like representation of signals, characterization of function spaces, and other fields of applications such as signal and image processing [4], filter bank theory [3], wireless communications [12] and sigma-delta quantization [2]. For more literature on frame theory, one may refer to [5, 8].

In recent years, Khokulan, Thirulogasanthar, and Srisatkunarajah [13] introduced and studied frames for finite-dimensional quaternionic Hilbert spaces. Sharma and Virender [15] study some different types of dual frames of a given frame in a finite-dimensional quaternionic Hilbert space and gave various types of reconstructions with the help of a dual frame. Currently, a lot of work is being carried out in quaternionic Hilbert spaces related to the theory of frames. It is noted that the quaternionic Hilbert spaces are frequently used in applied physical sciences, especially in physics.

1.1. Motivation and Recent Work. Frames are used in the study which deals with the construction of a vector from the elements of the frames. Frames produce the construction of a vector just like the bases produce, but with the relaxation of the uniqueness of the coefficients. Thus frames are used as generalizations of bases. Very recently, Sharma and Goel [14] introduced and studied frames for separable quaternionic Hilbert spaces and Chen, Dang, and Qian [6] studied frames for Hardy spaces in the contexts of the quaternionic space and the Euclidean space in the Clifford algebra. Sharma and Virender [15] study some different types of dual frames of a given frame in a finite-dimensional quaternionic Hilbert space covering the dual part of frames in quaternionic Hilbert spaces. One of the classes of frames is a bit stronger and nicer for the computations. Frames of this class are referred to as Riesz frames which are somewhat like Riesz bases. These frames are nicer for computations in applications and are related closely to the theory of bases. In the present paper, we explore these aspects of Riesz bases in quaternionic Hilbert spaces and try to list the concepts related to Riesz bases in the setup of quaternionic Hilbert spaces. It is arranged simply and systematically which may be referred to or may be used whenever there is a requirement.

1.2. Outline. The paper is organized as follows: In section 2, we give notations and terminology used in the context of quaternionic Hilbert spaces together with some basic theory related to quaternionic Hilbert spaces. In section 2.1, the notations and terminology are given. In section 2.2, some basic definitions and some basic introduction to quaternionic Hilbert spaces are provided. Some fundamental results of functional analysis are listed in the context of quaternionic Hilbert spaces. Section 2.3, frames in quaternionic Hilbert spaces, comprise the definition of frames and the results related to frames in quaternionic Hilbert spaces. Finally, Section 3 is devoted to the concept of the Riesz bases in separable quaternionic Hilbert spaces. The basic results related to Riesz bases are listed and proved in this section. This section covers the important aspects of Riesz bases in quaternionic Hilbert spaces. Proper references are provided at the end.

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ON OPERATOR VALUE FRAME IN $L^2(\mathbb{R}^d)$

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Abstract:

In this paper, we prove that the Riesz wavelet basis in $L^2(\mathbb{R}^d)$ is image of an orthonormal wavelet basis under a bounded invertible operator. Also, we show that two orthonormal wavelet bases in $L^2(\mathbb{R}^d)$ are unitarily equivalent. Further, it is proved that the image of an orthonormal wavelet basis under unitary operator is an orthonormal wavelet basis. Furthermore, we prove that dual of Riesz wavelet basis always exists and is biorthogonal to it. Finally, we study dual wavelet frames for a given wavelet frame.

Keywords: Wavelet Frames, Riesz wavelet bases, orthonormal wavelet basis, OPV frames

General area of research: Mathematics

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1. INTRODUCTION

Wavelet frames were studied considerably by many researchers [1,2,3,4,6,8]. Below we give the formal definition of wavelet frame for $L^2(\mathbb{R}^d)$.

Definition 1.1. Let $d \in \mathbb{N}$, $\{\psi^1, \psi^2, \dots, \psi^N\} \subseteq L^2(\mathbb{R}^d)$. Define

$$\psi_{j,\bar{k}} = D_{2^j} T_{\bar{k}} \psi^l(\bar{x}) = 2^{\frac{j}{2}} \psi^l(2^j \bar{x} - \bar{k}),$$

for $\bar{x} \in \mathbb{R}^d, \bar{k} \in \mathbb{Z}^d, j \in \mathbb{Z}, l = 1, 2, 3, \dots, N$. The system $\psi_{j,\bar{k}}^l$ is called a wavelet frame for $L^2(\mathbb{R}^d)$ if there exist constants $0 < A \leq B < \infty$ such that

$$A \|f\|^2 \leq \sum_{l=1}^N \sum_{j \in \mathbb{Z}} \sum_{\bar{k} \in \mathbb{Z}^d} \left| \langle f, \psi_{j,\bar{k}}^l \rangle \right|^2 \leq B \|f\|^2, \quad \forall f \in H. \quad (1.1)$$

The scalars A and B are called the *lower* and *upper wavelet frame bounds* of the wavelet frame, respectively. They are not unique. If $A = B$, then $\{x_n\}$ is called an *A-tight wavelet frame* and if $A = B = 1$, then $\{x_n\}$ is called a *Parseval wavelet frame*. The inequality in (1.1) is called the *wavelet frame inequality* of the wavelet frame. If $\{\psi_{j,\bar{k}}^l\}$ satisfies the upper frame inequality in (1.1), then $\{\psi_{j,\bar{k}}^l\}$ is called a Bessel wavelet sequence. The system defined in Definition 1.1 is called the homogeneous system and for such systems, N can be as small as one. There is another more fundamental system, called a nonhomogeneous system:

$$\{\phi(x - k) \mid k \in \mathbb{Z}^d\} \cup \{\psi_{j,k}^l \mid j \geq 0, k \in \mathbb{Z}^d, l = 1, \dots, N\}.$$

For such systems, indeed one must have $N \geq 2^d - 1$.

Kaftal et al. [7] defined Operator Valued frames (OPV frames) in Hilbert spaces and studied various properties of OPV frames. More importantly, treating multi wavelet frames as OPV frames permits to parametrize them in an explicit and transparent ways. In [10], Poumai et al. gave the applications of OPV frames to the theory of quantum channel.

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A LOOK AT CHINESE CHECKERS PLANE VORONOI DIAGRAMS

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Abstract:

In this study, Voronoi diagrams, Fortune Algorithm and in Chinese Checkers plane, Voronoi diagrams were examined.

Keywords: Voronoi diagrams, Chinese Checkers plane geometry, Fortune algorithm

General area of research: Mathematics

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1. INTRODUCTION

Voronoi diagram, introduced by the Russian mathematician Georgy Voronoi, is a type of zoning diagram that divides a space according to certain points and describes the area around each point. These areas are bounded only by the other points closest to that point and are determined by a line consisting of the midpoints between these points. That is, the area around each point is the area of the closest point, and the boundaries between these points are determined by a line consisting of the midpoints exactly between these two points. That is, each point of the different n points given in the plane is considered a center, and each center region covers an area formed by points closer to it than the other nearest centers. These areas are called the Voronoi polygon of that point. Combining the Voronoi polygons created for all points creates the Voronoi diagram.

For example, when students living in a district are placed in schools based on address, which school is closest for each student can be determined and students can be placed in the closest school. Assuming that the population is evenly distributed, each school is considered a center. The region where this school is located, where there is no other school, and the largest circle region for the central school is created. The distance to the nearest other school should be equal to the radius of the circle created. Students living in this region can be enrolled in the central school and the shortest distance to the schools can save time and energy. Voronoi diagram can also be used to determine which schools are closest.

2. VORONOI DIAGRAMS

Voronoi diagram for a set of points $P = \{p_1, p_2, \dots, p_n\}$ in a Euclidean plane

$$V(P) = \{x \in U : d(x, p_i) < d(x, p_j), i, j \in \{1, 2, \dots, n\}, i \neq j\}$$

The set of the shape is called the 1st order Voronoi Diagram and the point x is inside the cell p_i

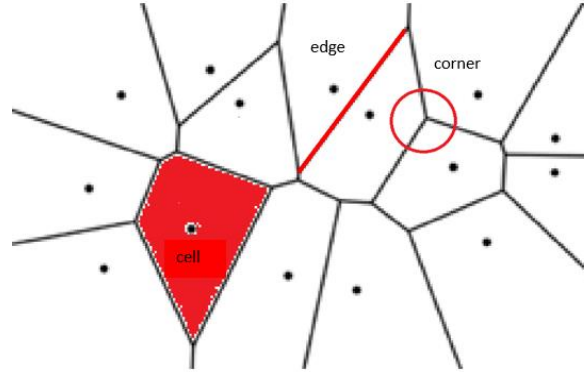


Fig.1. Voronoi diagram

2.1. Fortune Algorithm

The Fortune algorithm is an algorithm used to construct the Voronoi diagram. This algorithm consists of a beachline and a sweepline. A sweepline is a line that sequentially scans points on a plane, moving horizontally or vertically, and renders each point. Point events and circle events occur as the sweepline moves. As soon as the scan line intersects with a point, a straight line is formed perpendicular to the scan line, and after this point is scanned, a parabola is drawn. The focus of this parabola is the point we scan, while its focus is the sweepline. This situation is repeated for each point. The boundary formed by the merging of the parabola arcs formed in this way is called the beachline.

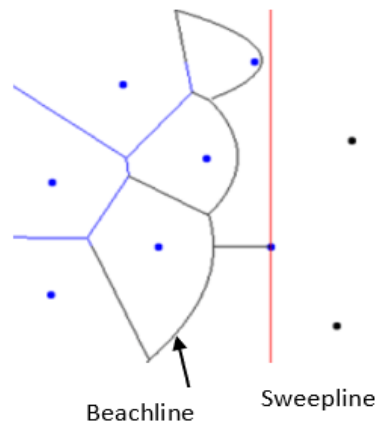


Fig. 2. Sweepline and beachline

In the Taxi plane, Taxi circles are calculated by using the middle set of any two points, as well as Voronoi diagrams are calculated by determining the beachline of the Taxi parabolas using the Fortune plane scan algorithm. These studies are shown in the article “Voronoi Diyagramı ve Taksi Düzlemi Üzerine” and in the thesis” Taksi Düzlemde Voronoi Diyagramları Üzerine”.

3. VORONOI DIAGRAM IN CHINESE CHECKERS PLANE

Chinese Checkers distance of points $A = (x_1, y_1)$ and $B = (x_2, y_2)$ on the plane,

$$d_C: \mathbb{R}^2 \times \mathbb{R}^2 \longrightarrow [0, \infty)$$

$$d_C(A, B) = \max\{|x_1 - x_2|, |y_1 - y_2|\} + (\sqrt{2} - 1) \min\{|x_1 - x_2|, |y_1 - y_2|\}$$

is defined with.

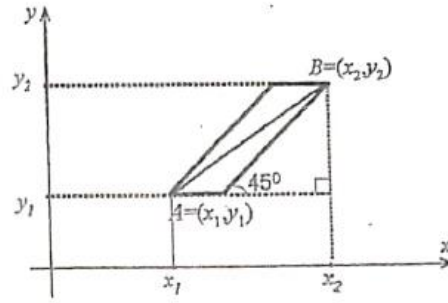


Fig. 3. Chinese Checkers distance

3.1. Chinese Checkers Circle

In the plane of Chinese Checkers, the geometric location of the points at a constant distance from a fixed point to Chinese Checkers is the circle of Chinese Checkers, but it is an octagon whose sides consist of angles of 45° .

Chinese Checkers circle with center $M = (a, b)$ and radius r in the analytical plane

$C_C = \{(x, y): \max\{|x - a|, |y - b|\} + (\sqrt{2} - 1) \min\{|x - a|, |y - b|\} = r \text{ and } x, y \in \mathbb{R}\}$
 is expressed as.

3.2. Distance of a Point to Line in Chinese Checkers Plane

Any point $P = (x_0, y_0)$ in the CC-plane is $m = \left| -\frac{a}{b} \right|$ CC-distance to $\ell \dots ax + by + c = 0$ line which is

$$d_C(P, \ell) = \begin{cases} \left| \frac{ax_0 + by_0 + c}{b} \right|, & m \leq q \\ \frac{\sqrt{2}}{|b|} \left| \frac{ax_0 + by_0 + c}{1 + m} \right|, & q \leq m \leq q + 2 \\ \left| \frac{ax_0 + by_0 + c}{a} \right|, & m \geq q + 2 \end{cases}$$

is defined by.

3.3. Middle Set in Chinese Checkers Plane

The geometric location of the points that are equidistant from the two points A and B in the Chinese Checkers Plane,

$$\{P = (x, y): d_C(P, A) = d_C(P, B), x, y \in \mathbb{R}\}$$

is the set indicated by.

An example of a Chinese Checkers Voronoi diagram will be given with the help of Chinese Checkers parabolas and Chinese Checkers middle sets in the Chinese Checker plane.

Example 1. Chinese Checkers parabolas are drawn by forming the equations of Chinese Checkers parabolas with focal points $A(3,0)$, $B(-3,0)$ and $C(0,3)$ and direction $y = -1$ in the Chinese Checker plane. The beachline of the parabolas is determined, and the Chinese Checkers Voronoi diagram is created. Firstly,

1. Equation of Chinese Checkers parabola with a focal point $A(3,0)$ and a $y = -1$ direction

$$\max\{|x - 3|, |y|\} + (\sqrt{2} - 1) \min\{|x - 3|, |y|\} = |y + 1|$$

is in the form. The solution of this equation is.

a) For $|x - 3| > |y|$, equation is this form $|x - 3| + (\sqrt{2} - 1)|y| = |y + 1|$.

a₁) For $x \leq 3$ and $y \leq 0$, in the $y > x - 3$ region, it is remainder of line $y = -\frac{x}{\sqrt{2}} + \frac{2}{\sqrt{2}}$.

a₂) For $x \leq 3$ and $y \geq 0$, in the $y < -x + 3$ region, it is remainder of line $y = \frac{x}{\sqrt{2} - 2} - \frac{2}{\sqrt{2} - 2}$.

a₃) For $x \geq 3$ and $y \leq 0$, in the $y > -x + 3$ region, it is remainder of line $y = \frac{x}{\sqrt{2}} - \frac{4}{\sqrt{2}}$.

a₄) For $x \geq 3$ and $y \geq 0$, in the $y < x - 3$ region, it is remainder of line $y = -\frac{x}{\sqrt{2} - 2} + \frac{4}{\sqrt{2} - 2}$.

b) For $|x - 3| < |y|$, equation is this form $|y| + (\sqrt{2} - 1)|x - 3| = |y + 1|$.

b₁) For $x \leq 3$ and $y \leq 0$, in the $y < x - 3$ region, it is remainder of line $y = -\frac{(\sqrt{2} - 1)}{2}x + \frac{3\sqrt{2} - 4}{2}$.

b₂) For $x \leq 3$ and $y \geq 0$, in the $y > -x + 3$ region, it is remainder of line $x = \frac{3\sqrt{2} - 4}{\sqrt{2} - 1}$.

b₃) For $x \geq 3$ and $y \leq 0$, in the $y < -x + 3$ region, it is remainder of line $y = \frac{(\sqrt{2} - 1)x}{2} + \frac{-3\sqrt{2} + 2}{2}$.

b₄) For $x \geq 3$ and $y \geq 0$, in the $y > x - 3$ region, it is remainder of line $x = \frac{3\sqrt{2} - 2}{\sqrt{2} - 1}$.

2. Equation of Chinese Checkers parabola with a focal point $B(-3,0)$ and a $y = -1$ direction

$$\max\{|x + 3|, |y|\} + (\sqrt{2} - 1)\min\{|x + 3|, |y|\} = |y + 1|$$

is in the form. The solution of this equation can be solved a similar way.

3. Equation of Chinese Checkers parabola with a focal point $C(0,3)$ and a $y = -1$ direction

$$\max\{|x|, |y - 3|\} + (\sqrt{2} - 1)\min\{|x|, |y - 3|\} = |y + 1|$$

is in the form. The solution of this equation can be solved a similar way.

The border formed by the merging of the Chinese Checkers parabola arcs with the focal point $A(3,0)$, $B(-3,0)$ and $C(0,3)$ and the $y = -1$ direction Chinese Checkers beachline and the Chinese Checkers beachline is as follows.

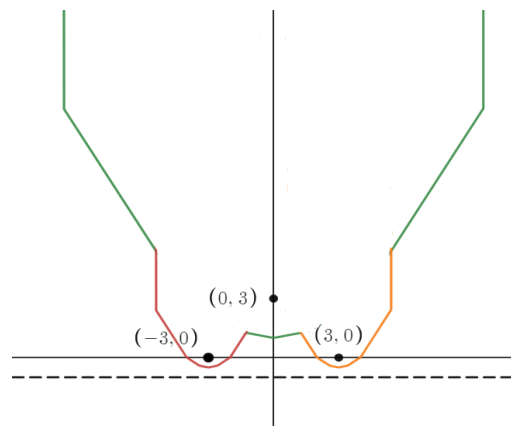


Fig. 2. Beachline of Chinese Checkers parabolas with focal points $A(3,0)$, $B(-3,0)$ and $C(0,3)$ and $y = -1$ direction

If the sweepline is shifted down 2 units, we observe Chinese Checkers beachline, when the equations of Chinese Checkers parabolas with $y = -3$ directions and focal points $A(3,0)$, $B(-3,0)$ and $C(0,3)$ are

found, the Chinese Checkers parabolas intersect at a point $K(0,0)$. The center of a Chinese Checkers circle, which considers the points $A(3,0)$, $B(-3,0)$ and $C(0,3)$ as vertices, is $K(0,0)$.

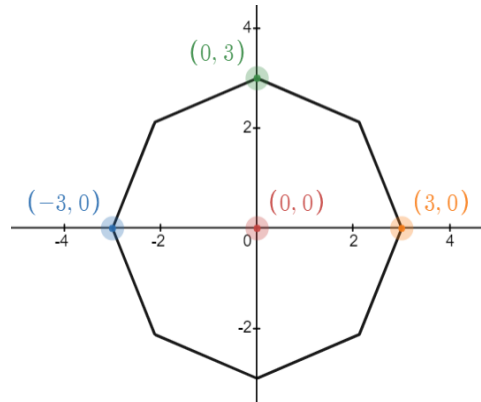


Fig. 3. Chinese Checker Circle passing through points $A(3,0)$, $B(-3,0)$ and $C(0,3)$ and center $K(0,0)$

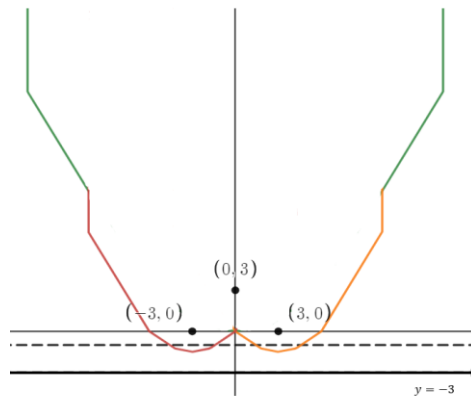


Fig. 4. Beachline of Chinese Checkers parabolas with focal points $A(3,0)$, $B(-3,0)$ and $C(0,3)$ and $y = -3$ direction

4. CONCLUSIONS

By calculating Voronoi diagrams in Chinese Checkers plane, its use in many areas has been facilitated. Artificial intelligence, geographic information systems, physics, biology, etc. These calculations can be used in many fields such as.

By using the relations in the Chinese Checkers plane, structures created with the Voronoi diagram calculations in the Chinese Checkers plane can be used as a new architectural structure in our today's digitalized world.

A city can be designed with Voronoi diagrams in the Chinese Checkers plane. Roads, traffic, school settlement, hospital etc. many problems can be solved with the ease of access to all important places such as.

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EFFICIENT MULTIPLE TESTING PROCEDURE FOR HETEROGENEOUS EFFECT WITH SURVIVAL FOREST

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Abstract:

Average treatment effect is an essential to define conditional relationship and it has a broad range of applications in molecular biology, epidemiology and time series analysis. This type of application might involve censored survival outcomes. On the other hand, in this setting, average treatment effect might not capture hazard or survival functions. For this reason, in this study, we have considered survival analysis which can be very important for estimation with average treatment effect on biological networks. Although, when we work with censored data, in particular, under high number of parameter (p) with respect to number of observation (n), the estimation of heterogeneous effect with survival outcomes can be computationally challenging. Thus, we have proposed survival forest for biological networks to gain from computational efficiency and to reduce standard error of the estimates. Moreover, we have used conditional randomization test since it has been found from previous studies that it is promising to define relationship on average treatment effect with survival outcomes. We have investigated properties of proposed model selection procedure to show its efficiency with simulated datasets which have different p and n values.

Keywords: Heterogeneous effect, survival forest , multiple testing

General area of research: Mathematics, Statistics

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1. INTRODUCTION

Heterogeneous treatment effect has a fundamental role and a broad range of applications in genetics, epidemiology and econometrics. Nevertheless, this type of applications can include censored survival outcomes. In this situation, heterogeneous effect may not capture hazard or survival functions. Thereby, we consider survival analysis which can be very valuable for estimation with heterogeneous treatment effect on biological networks. On the other hand, when we work with censored data, in particular, while the number of parameter (p) is more than number of observation (n), the estimation of heterogeneous effect with survival outcomes can be computationally challenging. On the other side, random forest algorithm is introduced by Breiman (2001). Therefore, Causal random forest have gained popularity in recent years by Athey and Wager (2019, 2020). Particularly, Survival ensembles is studied by Hothorn et al. (2006). Furthermore, Survival random forest is proposed by Ishwaran et al.(2008). Hence, we use causal survival forest for biological networks to find computationally inexpensive model selection procedure. Moreover, conditional independence is very important for causal models. For this reason, conditional randomization test can be very advantageous to define relationship on heterogeneous treatment effect with survival outcomes. We examine proposed model selection procedure to show its efficiency with the different number of parameter (p) and the number of observation (n).

Hereby, the outline of the paper is as follows: In Second Section, we define heterogeneous treatment effect while outcomes include survival function for biological networks. We explain causal forest procedure, which is a novel type of random forest algorithm of Breiman (2001), and some assumption of causal survival forest in Third Section. In Fourth Section, we provide the definition of conditional randomization test of Candes et al.(2018). We leave the Fifth and Sixth Sections for data analysis procedure and conclusion as well as future studies, respectively.

2. THEORY and METHOD

2.1 Heterogeneous treatment effect

The heterogeneous average treatment effect (ATE) is a measure used to compare treatments (or interventions) in randomized experiments, evaluation of policy interventions, and medical trials. Basically, this measure compares the difference in mean (average) outcomes between units assigned to the treatment and units assigned to the control. Imbens (2004) and Imbens and Angrist (1994) have studied nonparametric estimation and local version of ATE. More recently, Künzel et al. (2019) have proposed a meta-learner algorithm for ATE as a novel machine learning algorithm. More details about this measure with applications of social and biomedical sciences can be found in a book of Imbens and Rubin (2015). Accordingly, the basic mathematical description of binary ATE can be presented in Equation (1) (Neyman(1923,1990) and Rubin(1974)).

$$ATE(t) = E(Y_1) - E(Y_0), \quad (1)$$

Here, given n subject, T_i denotes the binary treatment indicator $\{0,1\}$ as shown by $(Y_i(1), Y_i(0))$ which is the pair of potential outcomes. Accordingly, $Y_i(0)$ is the value of outcome variable for individual i ($i=1, 2, \dots, n$) if they are not treated and $Y_i(1)$ is the value of the outcome variable for individual i if they are treated. As example, $Y_i(0)$ indicates the health status of the i th participant of a vaccine study if he/she merely takes the placebo (i.e., no vaccine is inserted), and $Y_i(1)$ shows the health status of the i th participant if he/she takes the vaccine.

On the other hand, right-censored survival data are frequently encountered in clinical trials and other biomedical research studies, and challenges are related to this setting have not been addressed in the existing literature.

Accordingly, in this study, we define survival estimators without censoring as follows: It is assumed that T_a is a potential survival time if we set Y to take value 1 or 0. Then, we can calculate differences between survival probabilities as below:

$$ACE(t) = P(T_1 > t) - P(T_0 > t). \quad (2)$$

So, this difference is a marginal function of potential outcomes and restricted mean survival times by putting time boundary τ can be computed via:

$$\int_0^\tau P(T_1 > t)dt - \int_0^\tau P(T_0 > t)dt. \quad (3)$$

Later, we define survival estimators with censoring as below.

$$ACE(t) = P(T_{Y=1, C=0} > t) - P(T_{Y=0, C=0} > t) \quad (4)$$

in which C denotes an accelerated failure time. Moreover, $T_{Y=1, C=0}$ is a potential survival time if we set Y to take the value 1 and $C=0$.

2.2- Random forest procedure

Random forest approach is firstly introduced by Breiman (2001). This algorithm is an ensemble learning procedure for the classification or regression and it is conducted by the construction of multiple of decision trees. Moreover, it is known as a variance reduction technique and also reduces Mean Square Error (MSE). More recently, Wager and Athey (2018) and Athey et al. (2019) have proposed a novel type of random forest for causal models by constructing censoring unbiased regression trees and forests by considering a class of censoring unbiased loss functions.

Hence, random forest algorithm can be defined as follows:

Step1: Consider pairs (X_i, Y_i) , $i = 1, \dots, n$ where $X_i \in R^d$ indicates independent variable and $Y_i \in R$ is a response variable .

Then, the function estimator is obtained as below:

Step2 : Calculate $((X_1, Y_1), \dots, (X_n, Y_n))$ pairs.

Step3: Conduct bootstrap sample $(X_1^*, Y_1^*) \dots, (X_n^*, Y_n^*)$ that is obtained randomly by drawing n times with replacement from the data $(X_1, Y_1), \dots, (X_n, Y_n)$.

Step4: Repeat step 2 and step3 by B times so that the random forest estimator can be found by

$$\hat{\mu}(x) = \frac{1}{B} \sum_{b=1}^B \frac{1\{X_i \in N_b(x)\}}{|N_b(x)|} .$$

In this expression, $N_b(x)$ shows terminal nodes which contains x in the

bth tree, B is the number of tree and finally, $|\cdot|$ represents cardinality

2.3- Conditional randomization test

Conditional independence is a very crucial statistical method to understand relationship between variables. Recently, Shah and Peters (2020) show that conditional independence testing for kernel logistic regression can be difficult without conditional assumption of (X, Y, Z) . Therefore, Candes et al. (2018) suggest a conditional randomization test for logistic regression without any distributional assumption of Y, while conditional distribution of X given Z is known. Our test procedure is based on decision about our variables whether our variables are dependent or not

Hereby, it can be described as follows:

$$\begin{aligned} H_0 : Y \perp\!\!\!\perp X | Z \\ H_1 : Y \not\perp\!\!\!\perp X | Z \end{aligned} \quad (5)$$

where the null hypothesis H_0 controls the independence of variables and the alternative one H_1 presents dependence of variables.

More recently, conditional randomization test (CRT) is introduced by Candes et al. (2018). They do not use any assumption about the distribution of Y. But, they accept that the conditional distribution of (X, Y, Z) is known. On the other hand, this testing procedure can be a challenging task when the number of parameter (p) is more than the number of observation (n). Accordingly, we suggest to apply survival forest for causal models in order to balance the difference between p and n. Thereby, we assume that the conditional distribution of $X|Z$ is known and $Q(\cdot|Z)$ indicates the distribution of X given $Z=z$ conditional on Z_1, \dots, Z_n . So, the CRT produces X values from data sets which have the distribution as follows:

$$X_1^{(1)} \sim Q(\cdot | Z_i) , \quad (6)$$

where it is obtained independently from $i=1, \dots, N$ and real values of X_i and Y_i . According to H_0 hypothesis, we can write

$$(X|Y=y, Z=z) = (X|Z=z) \sim Q(\cdot|z). \quad (7)$$

The two sides of equations have the same distribution. Thus, we may write the following equation:

$$(X^{(1)}, Y, Z) = (X, Y, Z) \text{ for all } X^{(1)} = (X_1^{(1)}, \dots, X_n^{(1)}) \text{ under } H_0. \quad (8)$$

If we have a difference between two sides of equation, we can reject H_0 . In order to obtain the test values of null hypotheses, we have to repeat these steps k times so that

$$(X_i^{(k)} | X, Y, Z) \sim Q(\cdot | Z_i) \text{ is obtained independently for } i=1, \dots, N \text{ and } k=1, \dots, K. \text{ Therefore, we assume that the conditional distribution of } (X, Y, Z), (X^{(1)}, Y, Z), \dots, (X^{(k)}, Y, Z) \text{ are identically distributed and exchangeable by null hypotheses. For this reason, } T(X, Y, Z) \text{ is exchangeable by}$$

$$T(X, Y, Z), T(X^{(1)}, Y, Z), \dots, T(X^{(k)}, Y, Z) \quad (9)$$

Finally, the calculation of the CRT can be given as the following two steps:

The algorithm for the conditional randomization test

Step1: Data (X_i, Y_i) where X_i and Y_i denote the independent variable and the dependent variable, respectively, for $i=1, \dots, n$ observations and $T(X, Y, Z)$ is test statistics when to check the conditional relationship between (X, Y) for $k \in (1, \dots, K)$ by copying the sample to $X^{(k)} L(X_i, Y_i)$ for all i so that $T(X^{(k)}, Y, Z)$ can be calculated

Step2: Results: p-value can be computed via

$$p = \frac{\{1 + \sum_{k=1}^K 1\} \{T(X^{(k)}, Y, Z) \geq T(X, Y, Z)\}}{1 + K},$$

where p-value is obtained by true x vector against the value of the CRT copies.

3. DATA ANALYSIS

In this part, we examine the proposed model selection procedure with three simulated datasets while the number of parameter is set to $p=10, 20$ and 40 , the number of observations is taken as $n=1000$. Then, at the beginning, we generate survival data and calculate failure times. Here, T is drawn from a proportional hazard model and C is from an accelerated failure time. In this simulation, we implement type2 in grf R programming package. Furthermore, the number of tree is taken as 2000 and the number of a sample sets to 1000. Then, firstly, we use average treatment effect, then calculate different scenarios for average treatment effect with/without censored data.

	p=10		p=20		p=40		Data type
	Est	SE	Est	SE	Est	SE	
ATE w/o sf	0.6071	0.0109	0.6010	0.0151	0.6118	0.0112	Non-censored
ATE w/ sf	0.6308	0.0145	0.6142	0.0158	0.6125	0.0113	Non-censored
ATE w/o sf	0.0083	0.0495	0.0512	0.0660	-0.0120	0.0180	Censored.data
ATEw/ sf	-0.1096	0.0487	0.0010	0.0259	0.0063	0.0177	Censored data

Table1: Estimation of average treatment effect with and w/o survival forest (sf). Here, Est and SE denote estimates and it is standard deviation.

In our analysis, we calculate estimate and standard error values of ATE with and w/o survival forest. From the results it is seen that when the numbers of parameter are 10 and 20 for censored data, the survival forest algorithm slightly reduce standar error. Then, we calculate p-values of conditional randomization test while False discovery rate is 0.1. When the number of parameter is 10, the CRT selects three variables with their p-values 0.231, 0.162 and 0.107, in order, and when the number of parameter equals to 20, the CRT selects four variables with p-values 0.212, 0.201, 0.187 and 0.118, respectively. Lastly, when the number of

parameter is set to 40, the CRT chooses six variables with p-values 0.241, 0.203, 0.182, 0.143, 0.121, 0.105, in order.

The results have showed that the ATE with random forest improves the accuracy of the estimates in censored data but under uncensored data the proposal approach has not improved accuracy of the estimates, however, decreased the standard error in all scenarios. As a result, these outcomes show that the ATE with survival forest can be promising to make inference under both censored and uncensored data. However, while the number of parameter has increased from 10 to 40, the difference between the standard error of ATE for censored data w/ survival forest and w/o survival forest has decreased. Although the standard error of ATE for censored data with survival forest is smaller than censored data without survival forest. Furthermore, when we apply the CRT for the ATE with different number of parameter, the CRT naturally has selected increasing the number of variable, while the number of parameter (p) has increased from 10 to 40.

4. CONCLUSION

In this study, we have proposed an alternative model selection procedure for average treatment effect while outcomes involve survival function. When the number of parameter (p) is more than the number observation (n), the estimation of average treatment effect can be computationally difficult task. Therefore, we have proposed causal survival forest to address this challenge. Lastly, Conditional randomization test has been implemented to control false discoveries while selecting significant variables after the estimation. In future study we can make more comprehensive data analysis with the different number of observation (n) and the number of parameter (p).

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DEEP NEURAL NETWORKS FOR HETEROGENEOUS EFFECT ON BIOLOGICAL NETWORKS

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Abstract:

The estimation of average treatment effect is an important problem in biostatistics, epidemiology, deep learning. Particularly, the heterogenous treatment effect measures the difference in mean outcomes between units assigned to the treatment and units assigned to the control. Moreover, causal forest which is a novel type of the random forest algorithm of Breiman (2001), gains a lot popularity in recent years for solving challenge of heterogeneous treatment effect in estimation of model parameters. Because this calculation can be computationally problematic specifically for classification of data under large number of parameter(s) regarding the number observations (n). However, very recently, feedforward neural networks have been used on broad range of applications on average treatment effect. Hereby, in this study, our aim is to find computationally efficient procedure to make improvement on accuracy by reducing standard error and to compare with/without deep neural networks to label data for average treatment effect on biological networks. We have examined proposed algorithm with the different n and p to evaluate its efficiency.

Keywords: Artificial neural networks, heterogeneous effect, random forest algorithm

General area of research: Mathematics, Statistics

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1. INTRODUCTION

The estimation of heterogeneous treatment effect is a crucial problem in machine learning, bioinformatics, and deep learning. Additionally, the average treatment effect (ATE) basically measures the difference in mean (average) outcomes between units assigned to the treatment and units assigned to the control. Moreover, causal forest that is an adaptation of the random forest algorithm of Breiman (2001) has a lot of attention in recent years in inference of heterogeneous treatment effect. On the other hand, this task can be computationally very tractable, in particular, for clustered data when we are working on while the number of parameter (p) exceeds the number of observations (n). However, more recently, feedforward neural networks have been applied on broad range of practical applications on average treatment effect. In this work, we aim to find computationally attractive procedure to make improvement on accuracy and specifically, to compare with and without random forest algorithm to label data for average treatment effect on deep neural networks. We have examined the proposed algorithm with different n and p to show its efficiency. More recently, deep neural networks have been applied for heterogeneous effect by Yoon et al.(2018), Shi et al. (2019), Loizos et. Al. (2018) and Ghosh et al.(2021). Furthermore, causal learning for classification has been studied Fernades and Provost (2022). Additionally, heterogeneous effect for classification with random forest algorithm has been proposed by Athey and Wager (2019). More recently, Chernozhukov et al. (2022) have studied random forest algorithm and neural networks for causal models, separately. On the other hand, random forest algorithm and deep neural networks have not been

implemented together for causal models yet, even though it is shown that random forest algorithm can improve accuracy on deep neural networks for high dimensional clustered data by Kong and Yu (2018). Therefore, in this work, we suggest the application of random forest and deep neural networks simultaneously while estimating average treatment effect for classification purpose under high dimensional data.

Accordingly, the outline of paper is as follows: In the second section we define heterogeneous treatment effect for biological networks, then, we explain random forest algorithm for causal models, so-called causal forest procedure in the third section. In fourth section, we define empirical risk minimization function for deep neural networks with heterogeneous effect on biological networks. Lastly, we leave the fifth and the sixth sections for numerical examples of proposed estimation procedure and the conclusion and the potential future research project to extend this study, respectively.

2. METHOD

2.1- The definition of heterogeneous treatment effect

The heterogeneous treatment effect is a measure used to compare treatments (or interventions) in randomized experiments, evaluation of policy interventions, and medical trials. On the other hand, the main purpose of average treatment effect (ATE) is to measure the difference in mean (average) outcomes between units assigned to the treatment and units assigned to the control (Rubin, 1974). For this reason, Imbens (2004) and Abadie and Imbest (2006) have considered non-parametric estimation and large sample properties of ATE. More details of average treatment effect can be found in the book of Angrist and Pischke (2009) and Wooldridge (2010). In this study, our aim is to estimate ATE for $D = (x_i, t_i, y_i)$ where x_i, t_i, y_i show the i-th feature vector, treatment effect and outcome vector which are binary (0,1), respectively.

Hence, heterogeneous treatment effect can be defined as follows:

$$ATE(t) = E(y|x, do(t = 1)) - E(y|x, do(t = 0)) \quad (1)$$

where $do(.)$ denotes do operator that is used to express mathematical form of ATE.

At the first stage, we have to define $p(y|x, do(t = 1))$ and $p(y|x, do(t = 0))$.

Then, we can calculate,

$$\begin{aligned} p(y|x, do(t = 1)) &= \int_z p(y|z, x, do(t = 1)) p(z|x, do(t = 1)) dz \\ &= \int_z p(y|z, x, do(t = 1)) p(z|x) dz. \end{aligned} \quad (2)$$

in which $p(y|z, x, do(t = 1))$ is a conditional distribution where z affects both X and Y variables.

Therefore, $p(y|x, do(t = 0))$ can be obtained with a similar procedure. $p(y|z, x, do(t = 1)) = p(y|z, x, (t = 1))$ if unconfounded assumption is hold.

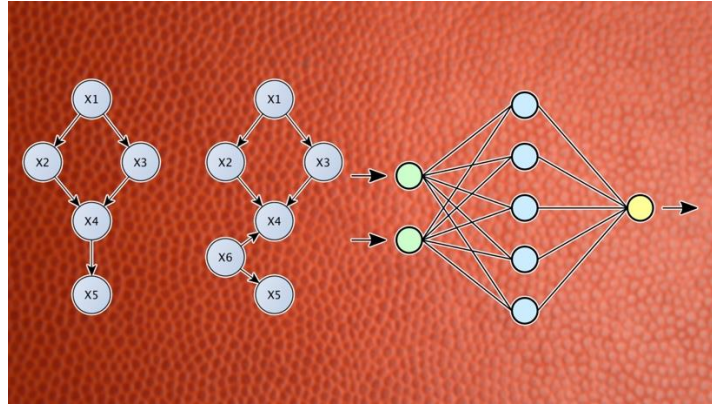


Figure1: Simple example for showing how deep neural networks work for causal models

2.2- Random forest procedure for causal models

Random forest is an ensemble learning procedure for the classification or regression and it is conducted by the construction of multiple for decision trees. Causal forest is an adaptation of the random forest algorithm of Breiman (2001) for the problem of inference of heterogeneous treatment effect. Despite their widespread success at prediction and classification, there are important difficulties to be cleared before random forest is directly useful for causal estimation. More recently, Wager and Athey (2018) and Athey et al. (2019) have proposed a novel type of random forest for causal models.

In this model, let us consider pairs (X_i, Y_i) , $i = 1, \dots, n$ where $X_i \in R^d$ indicates independent variable and $Y_i \in R$ is a response variable .

So, the function estimator is obtained as follows:

Step1 : Calculate $((X_1, Y_1), \dots, (X_n, Y_n))$ pairs.

Step2: Conduct bootstrap sample $(X_1^*, Y_1^*), \dots, (X_n^*, Y_n^*)$ which is obtained randomly drawing n times with replacement from the data $((X_1, Y_1), \dots, (X_n, Y_n))$.

Step3: Repeat step 1 and step 2 for B times

Hence, the random forest estimator is obtained by $\hat{\mu}(x) = \frac{1}{|\{i: X_i L(x)\}|} \sum_{i: X_i L(x)} (Y_i)$ where L presents the leaf which involving x .

2.3- Empirical risk minimization function for heterogeneous effect on deep neural networks

The estimation problem of average treatment effects (ATE) is a fundamental problem that is applicable in a wide variety of domains. Therefore, deep learning approaches to solve the ATE problem is one of the modelling approaches. Furthermore, the ATE estimation function can be trained for inferring the potential outcomes of the individual based on the feature information in a supervised way. So by modelling the ATE estimation function we use the feed-forward neural network. On the other hand, our framework is not forced to make this information trade-off - the dataset, which we learn our final ATE estimator contains the original dataset, and so includes as much information as it can use.

Deep neural network for average treatment effect has two components. The first component is a generator which includes encoder f_E , prediction encoder f_p , and inference subnetwork f_I and discriminator D . Here, the output of the encoder z is given by $\hat{z} = f_E(x, t, y, \epsilon_E)$ and inferred subnetwork (f_I) is

introduced to estimate z based on x given t such that $z = f_E(x, t, \epsilon_I)$, where ϵ_E presents the noise term.

On the other side, the second component is the prediction decoder (f_p) which is a function of output to estimate outcome y that is given a sample (x, t) and drawn the data distribution $p_d(x, t)$. Thus, $\hat{y} = f_p(z, x, t, \epsilon_p)$, here, the output of generator is randomized by noise terms $(\epsilon_E, \epsilon_I, \epsilon_p) \sim N(0, I)$ distributed as the standard normal. In this expression, ϵ_E shows encoder noise term and ϵ_p denotes a prediction encoder error term.

Furthermore, prediction discriminator D can be written as (z, x, t, y) with a probability in $[0, 1]$.

$D(z, x, t, y)$ and $1 - D(z, x, t, y)$ represent the estimates of probabilities the tuple (z, x, t, y) that is drawn from $q_E(z, x, t, y)$ and $q_p(z, x, t, y)$, respectively. Here, q_E and q_p are components of prediction network as an encoder and prediction encoder, in order.

Hence, we solve the following min-max optimization problem between generator and discriminator

$$\min \max E_{q_E(z, x, t, y)} \left[\log \left(D(\hat{z}, x, t, y) \right) \right] + E_{q_p(z, x, t, y)} \left[\log \left(1 - D(z, x, t, \hat{y}) \right) \right]. \quad (3)$$

3. NUMERICAL EXAMPLES

We examine the proposed estimation procedure with three simulated datasets when the numbers of parameter are taken as 10, 20 and 40 and the numbers of observations are chosen as 500 for clustered data. At the beginning of the inference, we calculate average treatment effect with random forest algorithm under clustered data. Then, we apply deep neural network to improve accuracy and reduce standard error for average treatment effect.

	p=10,		p=20,		p=40	
	Est	SE	Est.	SE	Est.	SE
ATE(all)	0.3161	0.1082	0.4186	0.1046	0.3416	0.1092
ATE(treated)	0.3395	0.1090	0.4065	0.1042	0.3332	0.1086
TMLE	0.3160	0.1069	0.4187	0.1038	0.3416	0.1085
ATE+RF+DNN	0.3161	0.1078	0.4186	0.1039	0.3415	0.1083

Table1: Comparison of random forest and random forest with deep neural network for average treatment effect when n=500. Here, Est. and SE present the estimate and standard error, respectively.

To further improve the performance of accuracy of causal models and decrease standard error which we implemented targeted maximum likelihood estimation (TMLE) approaches. In analyses part, we initially generate data for causal models, then, we add random forest procedure and lastly, we apply deep neural network while implementing TMLE for inference. From the results in Table 1, it is seen that the proposal approach decreases the standard error, in particular, when the dimension of the network increases. Furthermore, the effect of TMLE on inference improves the accuracy of the estimator while the dimension of the network has small or moderate size

4. CONCLUSIONS

In this work, we have provided an alternative estimation procedure for heterogeneous effect for clustered data on biological networks. While the number of parameter (p) exceeds the number of observation (n), estimation of heterogeneous effect can be computationally challenging. To solve this problem, we have used causal random forest algorithm and deep neural networks for causal models to overcome computationally

difficulties of the inference of heterogeneous effect. From results we have shown that proposal approach has decreased standard error in all dimensions. Hereby, we consider that our approach is a promising alternative. In order to generalize our findings, we will extend the study with comprehensive simulation analyses under various p and n .

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NOVEL TURBULENCE MODEL FOR A FLUID-FLUID INTERACTION PROBLEM

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Abstract:

We consider a fluid-fluid interaction problem, where two flows (with high Reynolds numbers for one or both of these flows) are coupled through a joint interface. A nonlinear coupling equation, known as the rigid lid condition, creates an extra level of difficulty, typical for atmosphere-ocean problems. We propose a novel turbulence model, NS- ω -C, from the recently introduced family of LES-C models. Combining it with the so-called Geometric Averaging partitioning method (GA), we obtain the NS- ω -C-GA model, that is shown to possess several key properties. Firstly, the preexisting solvers for the subdomains can be used, which is critical, e.g., for the atmosphere-ocean applications. Secondly, the LES-C turbulence models use defect correction to efficiently reduce the modeling error of the corresponding LES models; we demonstrate numerically, that the NS- ω -C model outperforms its LES counterpart, the NS- ω model. It has also been shown recently, that it is favorable for a LES model to have the non-filtered velocity in the interface terms. The NS- ω -C-GA model possesses this important property; we also show it to be stable and have optimal convergence properties.

Keywords: turbulence modeling; fluid-fluid interaction; LES-C; deferred correction; defect correction; large eddy simulation; high accuracy

General area of research: Mathematics

ICFAS2023-ID: 1005

ASSESSING TEMPORAL VARIATION OF MALAYSIAN SOILS USING MACHINE LEARNING TOOLS FOR FORENSIC INVESTIGATION

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Abstract:

Soil is useful in establishing a link between the victim, suspect and the crime scene of a criminal case. Soil compositional variations often origin (of location) dependent. Thus, one could identify the potential location of crime based on soil collected from the suspect. However, soil composition is also found to be diverse in time (temporal) and space (spatial). This work aims to evaluate the temporal variation of soils sampled from two locations, i.e., Fernarium park and forest, on the campus of Universiti Kebangsaan Malaysia (UKM), Selangor, Malaysia, using machine learning tools, i.e., principal component analysis (PCA), hierarchical clustering (HCA), and self-organizing maps (SOMs) techniques. Eight samples were obtained by sampling two soils from each location in 2019 and 2022, which were analyzed using ultra-high performance liquid chromatography (UHPLC) coupled with a UV-Vis detector. Consequently, 24 chromatograms were prepared, each described by 2541 variables. The temporal variation was inspected by the two locations based on the mean chromatographic patterns, scores plot of PCA, HCA dendrogram and SOM maps. Results showed that temporal variation of the soils in forest was detrimental and lower than that seen in the Fernarium. In conclusion, soils collected from the campus of UKM showed insignificant temporal variability. Moreover, machine learning tools are useful in elucidating the temporal variation of soils based on the high-dimensional UHPLC data.

Keywords: Self-organizing maps (SOMs), forensic soil analysis, ultra-high performance liquid chromatography (UHPLC), temporal variability

General area of research: Statistics

ICFAS2023-ID: 1007

SUBALGEBRAS OF LATTICE ORDERED ALGEBRAS

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Abstract:

In this talk, we are interested in lattice ordered algebras and their subalgebras. For example, d-algebras, almost f-algebras and f-algebras. We give some properties of them.

A real lattice ordered linear space (ℓ -space) A is said to be a lattice ordered algebra (an ℓ -algebra or a Riesz algebra) if it is a linear algebra (not necessarily associative) such that if $a, b \in A^+$, then $ab \in A^+$. An ℓ -algebra A is said to be

- (i) an f-algebra (function algebra) if $a \wedge b = 0$ implies $ac \wedge b = ca \wedge b = 0$ for all $c \in A^+$.
- (ii) an almost f-algebra if $a \wedge b = 0$ implies $ab = 0$,
- (iii) a d-algebra if $c(a \wedge b) = ca \wedge cb$ and $(a \wedge b)c = ac \wedge bc$ for all $a, b \in A$ and $c \in A^+$.

Keywords: Lattice ordered algebra, Riesz space, f-algebra

General area of research: Mathematics

ICFAS2023-ID: 1012

WAVE DIFFRACTION BY A CRACK IN A TRIANGULAR LATTICE

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Abstract:

Problems of wave diffraction by a crack in the infinite triangular lattice are considered. Namely, we study Dirichlet problems for the discrete Helmholtz equation in a plane with a hole. New results are obtained for the existence and uniqueness of the solution in the case of the real wave number $k \in (0, 2\sqrt{2})$ without passing to a complex wave number. Besides, Green's representation formula for the solution is derived with the help of difference potentials. To demonstrate the results, we propose a method for numerical calculation.

This work was supported by Shota Rustaveli National Science Foundation of Georgia (SRNSFG) [FR-21-301].

Keywords: Discrete Helmholtz equation, crack type problems, metamaterials, triangular lattice model

General area of research: Applied Mathematics

ICFAS2023-ID: 1014

POSITIVE SOLUTIONS OF A SINGULAR FRACTIONAL BOUNDARY VALUE PROBLEM WITH r -LAPLACIAN OPERATORS

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Abstract:

We investigate the existence and multiplicity of positive solutions for a system of Riemann-Liouville fractional differential equations with r -Laplacian operators and nonnegative singular nonlinearities depending of fractional integrals, supplemented with nonlocal uncoupled boundary conditions which contain Riemann-Stieltjes integrals and various fractional derivatives. In the proof of our main results we apply the Guo-Krasnosel'skii fixed point theorem of cone expansion and compression of norm type.

Keywords: Riemann-Liouville fractional differential equations, nonlocal boundary conditions, singular functions, positive solutions; multiplicity

General area of research: Mathematics

ICFAS2023-ID: 1015

FINITE RELATIONS AND ORTHOGONAL POLYNOMIALS

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Abstract:

We give positive answer to two conjectures posed by M. E. H Ismail in his monograph [Classical and quantum orthogonal polynomials in one variable, Cambridge University Press, Cambridge, 2005]. These results generalize the classical problems of Sonine and Hahn. (see K. Castillo and D. Mbouna, Proof of two conjectures on Askey-Wilson polynomials, Proc. Amer. Math. Soc., 151 (2023) 1655-1661.)

Keywords: Orthogonal polynomials, Sonine-Hahn problem

General area of research: Mathematics

ICFAS2023-ID: 1017

NODAL SOLUTIONS OF DOUBLE PHASE PROBLEMS WITH VARIABLE EXPONENT

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Abstract:

The talk is focused on a double phase problem with variable exponent and reaction term exhibiting the combined effects of a locally defined Carathéodory perturbation and of a critical term. Under suitable assumptions, we obtain a sequence of nodal (that is, sign-changing) solutions to our problem. Hence, we prove that such sequence of solutions converges to 0 in L^∞ and in an appropriate Musielak–Orlicz Sobolev space. Since the critical term inhibits the application of critical point results to energy functionals, our approach here is based on suitable cut-off functions and truncation techniques. This permits us to work with an auxiliary coercive problem, by using variational tools.

This talk is based on joint works with N.S. Papageorgiou (National Technical University of Athens) and P. Winkert (Technische Universität Berlin).

Keywords: Critical term, double phase problem, existence results, multiplicity of solutions, Musielak–Orlicz Sobolev space

General area of research: Mathematics

ICFAS2023-ID: 1019

SOME COMPACT OPERATORS TYPES ON BANACH LATTICES

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Abstract:

In this talk, we are interested in some compact types operators on Banach Lattices. For example, L-weakly compact operators, M-weakly compact operators, almost L-weakly compact operators, almost M-weakly compact operators, order weakly compact operators, AM-compact operators and soon. We give some properties of them.

Keywords: Banach Lattice, compact operator, L-weakly compact operator, M-weakly compact operator, AM-compact operator

General area of research: Mathematics

ICFAS2023-ID: 1020

DEMICOMPACT OPERATORS

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Abstract:

A linear operator $T: X \rightarrow X$ on a Banach space X is called demicompact if for every bounded sequence (x_n) in X such that $(x_n - Tx_n)$ converges, there is a convergent subsequence of (x_n) .

In this talk, we study the elementary properties of demicompact operators and relationship between other types of operators.

Keywords: Banach space, demicompact operator

General area of research: Mathematics

ICFAS2023-ID: 1021

DESIGN OF AN EXCHANGE PROTOCOL FOR THE QUANTUM BLOCKCHAIN

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Abstract:

We explore the idea of a quantum exchange protocol between two entities, validated by (at least) a third one. Two entities, part of a greater system, decide they want to trade quantum goods: their exchange is configurable, and allows them to select the type of good, from a selected preset, and the desired quantity, up to a maximum value (one of the quantum goods can be interpreted as quantum money/a form of quantum currency). Certain qubits should also be used as a way of storing the details of the transfer, after it has been validated (acting in a similar way to a quantum ledger). The quantum circuits of the proposed design are implemented using the Python programming language with the help of Qiskit, IBM's open-source quantum framework.

Keywords: Quantum algorithms, quantum blockchain, quantum information processing, quantum simulation

General area of research: Engineering, Quantum computing

ICFAS2023-ID: 1022

MODELING THE SPREAD OF HEMLOCK WOOLLY ADELGID

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Abstract:

In this paper, a mathematical model is proposed to explain the interaction between Eastern Hemlock Trees and the invasive species Hemlock Woolly Adelgid. The model dynamics show that the coexistence state is the most stable state, moreover the solutions exhibit traveling waves. Sensitivity analysis suggests that the mortality rate of Eastern Hemlock Trees and the predation intensity of Hemlock Woolly Adelgid drive the dynamics of the interaction. Although Eastern Hemlock trees are foundation tress that provide shelter for several species, based on the model and sensitivity analysis, selective and strategic removal of these trees will help curtail their destruction.

Keywords: Invasive species modeling, Hemlock Woolly Adelgid, Eastern Hemlock tree reaction diffusion equations

General area of research: Mathematics Biology

ICFAS2023-ID: 1024

**ON CONSTRUCTION OF MAXIMAL PARABOLIC CENTRALIZERS OF
ROOT ELEMENTS AND THE WEYL GROUP OF TYPE F_4 IN $E_6(K)$ FOR
FIELDS K OF CHARACTERISTIC 2**

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Abstract:

The purpose of this talk is to give an elementary and explicit construction of maximal parabolic centralizers of root elements in the Chevalley group $E_6(K)$ and to show that the centralizer of a Seigel involution in the Weyl group W of type $E_6(K)$ is the Weyl group of type F_4 , or equivalently it is the stabilizer of a totally singular line L in W , using properties of the generalized quadrangle (N, L) of type $\tilde{O}_6(2)$. The construction here of the maximal parabolic centralizers of root elements in $E_6(K)$ for fields K of characteristic 2, is somewhat novel, beginning as it does, with root bases of Levi-type and root bases of unipotent type, giving an explicit construction of the group generated by these two types.

Keywords: Generalized quadrangle, unipotent radical, Levi root, Weyl group, maximal parabolic, Chevalley group

General area of research: Mathematics

ICFAS2023-ID: 1025

ON PROBABILITY OF CONSTRUCTING CERTAIN FINITE GROUPS

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Abstract:

Let G be a finite group. Let $\alpha(G)$ denote the expected number of elements of G which have to be drawn random with replacement from G before a set of generators is found. Define $P(G)$ to be the probability that elements drawn at random with replacement from G generate G . For the above two definitions see[1]. In this talk we compute $\alpha(G)$ and $P(G)$ for certain p -groups, elementary abelian groups and nilptent groups of nilpotency class 2. For more information about probabilistic group theory one may refer to [2,3,4,5].

References

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Keywords: Probability number, expected number, nilpotent groups

General area of research: Probability theory and group theory, Mathematics

ICFAS2023-ID: 1026

APPELL AND SPI POLYNOMIALS

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Abstract:

This paper introduces explicit formulas and a recurrence formula for the computation of Appell polynomials. This recurrence formula can be used to efficiently compute the polynomials for large values of their parameters. To illustrate our results, we provide several examples of Appell polynomials and their corresponding formulas. We also introduce a new class of polynomials called SPI polynomials, which are related to sums of powers on integers.

Keywords: Appell polynomials, explicit formulas, recurrence relation

General area of research: Mathematics

ICFAS2023-ID: 1027

A SURVEY ON THE OPTIMAL TERNARY CYCLIC CODES FROM PERFECT NONLINEAR FUNCTIONS

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Abstract:

Let p be a prime and let $q = p^m$, where m is a positive integer. Let C_u denote p -cyclotomic coset modulo $p^m - 1$ containing u and $m_{\alpha^i}(x)$ denote the minimal polynomial of the element α^i over \mathbb{F}_p , where α is a generator of \mathbb{F}_p^* . The cyclic code of length $n = q - 1$ over \mathbb{F}_p with generator polynomial $m_{\alpha^u}(x)m_{\alpha^v}(x)$ is denoted by $\mathcal{C}_{(u,v)}$ where $1 \leq u, v < q - 1$ and $C_u \neq C_v$. The function $f: \mathbb{F}_q \rightarrow \mathbb{F}_q$ is called *perfect nonlinear* if the equation $f(x + a) - f(x) = b$ has at most 1 solution for every $a \in \mathbb{F}_q^*$ and $b \in \mathbb{F}_q$. In [1], Carlet, Ding and Yuan have constructed several families of optimal linear codes from perfect nonlinear monomials over \mathbb{F}_{3^m} and have shown a relationship between the linear codes from perfect nonlinear functions and the cyclic codes $\mathcal{C}_{(1,v)}$. In [2], Ding and Helleseht have presented some new classes of optimal ternary cyclic codes $\mathcal{C}_{(1,v)}$ over \mathbb{F}_{3^m} . Here, we will give a survey of ternary cyclic codes $\mathcal{C}_{(1,v)}$ according to values of v .

References

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2. C. Ding, T. Helleseht, Optimal ternary cyclic codes from monomials, IEEE Trans. Inf. Theory 59 (9) (2013) 2898–5904.

Keywords: Cyclic codes, perfect nonlinear functions

General area of research: Mathematics

ICFAS2023-ID: 1028

POWER COCENTRALIZING b -GENERALIZED DERIVATION ON k -TH COMMUTATORS IN PRIME RINGS

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Abstract:

Let R be a prime ring of characteristic different from 2 and 3, Q_r the right Martindale quotient ring of R , $n, k \geq 1$ positive integers, F and G b -generalized derivations of R . Suppose that

$$\left(F([r_1, r_2]_k)[r_1, r_2]_k - [r_1, r_2]_k G([r_1, r_2]_k)\right)^n = 0$$

for all $r_1, r_2 \in R$, then one of the following holds:

1. there exists $p \in Q_r$ such that $F(x) = xp$, $G(x) = px$;
2. R satisfies s_4 and there exist $a, q, p \in U$, such that $H(x) = ax + xp$, $G(x) = px + xq$ and $(a - q)^2 = 0$.

Keywords: Prime rings, differential identities, b -generalized derivation

General area of research: Mathematics

ICFAS2023-ID: 1029

LOCALLY RECOVERABLE CODES BASED ON THE INCIDENCE MATRIX OF SOME SPECIAL GRAPHS¹

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Abstract:

An (n, k, r) locally recoverable code (LRC) is a code of length n and dimension k over a finite field such that a symbol in any coordinate of a codeword can be recovered by accessing the symbols in at most r other coordinates. These codes are used in distributed storage systems by Microsoft Azure and Hadoop since they can recover a failed node by accessing the minimum number of the surviving nodes. A matrix is called as an (r, t) -regular matrix if its each row has uniform weight r and each column has uniform weight t . In this study, LRC codes are obtained by using the incidence matrix of the fullerene graphs and the flower snark graphs which is an (r, t) regular matrix.

Keywords: Locally recoverable codes, fullerene graph, flower snark graph

General area of research: Mathematics

ICFAS2023-ID: 1030

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EXAMINATION OF NON-NEWTONIAN FLOW THROUGH STENOSED ARTERIES USING AN ANALYTICAL MODEL

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Abstract:

The steady, laminar, incompressible, axisymmetric stenotic blood flow is investigated with a non-polynomial solution assumption. The wall geometry of the stenosis is constructed as a fixed cosine curve. The rheology of blood is modeled as a generalized power-law fluid. The variations of the coefficients constructing both axial and radial velocity profiles through the stenotic tube are calculated with the examination of the analytical relations in closed form. The streamlines, separation and reattachment points, velocity profiles, and pressure variations are also obtained for the Newtonian cases in order to check the validation of the analytical approach. We observed that the results obtained are in good agreement with the ones that are widely available in the literature. Comparisons were made with non-Newtonian studies, which are rare for low Reynolds numbers in the literature, and with the numerical analyses performed in this study. As an important result of the analytical approach, it was concluded that the location of the separation and reattachment points and the existence of the separation-reattachment region are directly related to one of the coefficients in the non-polynomial solution assumption. Added to this, the ratio of the Reynolds number to the power-law exponent has a remarkable meaning in the characterization of the flow streamlines. Also, we introduce a rather simple formula of Reynolds number for blood-like power-law fluids.

Keywords: Blood flow, non-Newtonian, stenosis, power-law, axial velocity, radial velocity

General area of research: Mathematics

ICFAS2023-ID: 1031

NUMERICAL SOLUTIONS OF INTEGRO-DIFFERENTIAL EQUATIONS

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Abstract:

The aim of this work is to construct numerical solutions of the second-order integro-differential equation by applying Residual method. The Residual method is based on the construction of the approximate solution by using the Bezier curves. In order to find the approximate solutions, unknown control points have to be found. First, integral of product of the Bernstein polynomials with monomials is generalized. After that Residual method is adapted to integro-differential equations. Finally the obtained method is applied to integro-differential equation to demonstrate the behaviour of the numerical solutions by graphs and convergency of the method by tables. From graphs and tables, it can be seen that the proposed method is efficient, applicable and has good accuracy for large step-sizes.

Keywords: Integro-differential equation, residual method, Bezier curve, Bernstein polynomials

General area of research: Mathematics

ICFAS2023-ID: 1033

ON LATTICE CONVERGENCES OF OPERATORS

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Abstract:

In this talk, we present lattice convergences of some operator between Riesz spaces. For example, Levi operators , KB-operators, Lebesgue operators , order-topology continuous operators and so on. Also, we investigate domination properties for these operators.

Keywords: Lattice convergences, Levi operators, KB-operators, Lebesgue operators, order-topology continuous operators

General area of research: Mathematics

ICFAS2023-ID: 1035

A NEW FORM OF GENERALIZED SPLINE FUNCTIONS

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Abstract:

Splines has an important role in Computational Science and Engineering where interpolation and approximation are required. Splines are piecewise polynomials with continuous derivatives at their knots. In order to allow tolerances, jumps and quantum leaps in the derivatives at the knots, quantum splines are defined. Quantum splines are created by combining classical spline theory and quantum calculus. q -B-splines of degree n are basis functions for quantum spline space which consists q -spline functions of degree n . q -B-spline functions are obtained with various methods, such as recurrence relation, divided difference, truncated power, and convolution have been given in previous studies. In this study, we give q -B-splines as a multiplication of matrices. In this way, the computational complexity will be eliminated and the calculations will be made in a systematical way. Even with this systematic process, algorithms for calculating q -spline functions will be given.

Keywords: Spline, B-spline, quantum calculus

General area of research: Mathematics

ICFAS2023-ID: 1036

DERIVATION ON SOME SPECIAL RING

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Abstract:

Let R be a commutative ring with 1_R and A is the set of multiplicative closed that has no zero divisor and a zero element. If $d: R \rightarrow R$ is the derivation on ring R , then $\delta_A: R_A \rightarrow R_A$, $\left(\forall \frac{r}{a} \in R_A\right) \delta_A\left(\frac{r}{a}\right) = \frac{d(r) \cdot a - r \cdot d(a)}{a^2}$ is the derivation on quotient ring of R_A . More over by the derivation $d: R \rightarrow R$ we have some fact. If I is the ideal- d on ring R , then $\bar{d}: R/I \rightarrow R/I$, by definition $(\forall (a + I) \in R/I) a + I \mapsto d(a) + I$ is the derivation on ring factor R/I . Take R_i a ring with derivation $d_i: R_i \rightarrow R_i$ for $i \in \mathbb{N}$. The cartesian ring $\prod_{i=1}^n R_i$ is also have a derivation ring with define by $\prod_{i=1}^n d_i: \prod_{i=1}^n R_i \rightarrow \prod_{i=1}^n R_i$, $(\forall (r_1, r_2, \dots, r_n) \in \prod_{i=1}^n R_i) (r_1, r_2, \dots, r_n) \mapsto (d_1(r_1), d_2(r_2), \dots, d_n(r_n))$.

Keywords: Ring theory, ring derivation

General area of research: Mathematics

ICFAS2023-ID: 1038

GENERALIZED SKEW DERIVATIONS WITH HYPERCOMMUTATING CONDITIONS

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Abstract:

Here we discuss the relationship between the structure of a ring R and the form of additive mappings satisfying hypercommuting conditions on some appropriate subsets of R . More precisely, let F and G be two generalized skew derivations with the same associated automorphism α satisfying the following condition:

$$[F(x)x - xG(x), x]_k = 0$$

for all $x \in L$, where L is a non-central Lie ideal of R and $k \geq 1$ a fixed integer.

If R is prime and $\text{char}(R)$ is different from 2 and 3, then one of the following holds:

1. there exist $\lambda \in C$ (the extended centroid of R) and $a \in Q_r$ (the right Martindale quotient ring of R) such that $F(x) = xa$, $G(x) = (a + \lambda)x$, for all $x \in R$;
2. $R \subseteq M_2(K)$, the ring of all 2×2 matrices over a field K , and one of the following conclusions occurs:
 - a) K is a finite field;
 - b) there exist $\lambda \in C$ and $a \in Q_r$ such that $F(x) + G(x) = ax + xa + \lambda x$, for all $x \in R$.

Keywords: Ring theory, ring derivation

General area of research: Mathematics

ICFAS2023-ID: 1039

A CONFORMALLY FLAT SPACETIME ADMITTING CURVATURE INHERITANCE SYMMETRY

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Abstract:

The object of the present paper is to study conformally flat spacetime admitting curvature inheritance symmetry. In this paper, we have shown that in conformally flat spacetime every curvature inheritance symmetry is a conformal motion. Next, we have established a conformally flat spacetime that admits curvature inheritance symmetry then it reduces to Einstein spacetime. Moreover, we have also found certain results on conformally flat spacetimes admitting the curvature inheritance symmetry and obeying Einstein's field equation with/without a cosmological term. It is observed that in a 4-dimensional relativistic perfect fluid conformally flat spacetime admits curvature inheritance and following Einstein's field equations in the presence of cosmological constant, then energy momentum tensor is covariantly constant. It is also observed that such spacetimes with perfect fluid satisfies the vacuum-like equation of state consecutively it is dark matter. Finally, an example of conformally flat spacetime has been exhibited.

Keywords: Curvature inheritance symmetry, conformal curvature tensor, conformally flat spacetime, Lambda-CDM model

General area of research: Mathematics

ICFAS2023-ID: 1040

SOLUTION OF SECOND-ORDER DYNAMIC EQUATIONS WITH CONSTANT COEFFICIENTS

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Abstract:

In this talk, we will consider second-order dynamic equations on time scales. We will introduce new solution techniques for the second-order equation with constant coefficients. Further, we will give new formulas for the solutions when the characteristic equation has complex roots.

Keywords: Time scale, dynamic equation, second-order

General area of research: Mathematics

ICFAS2023-ID: 1041

SPECTRAL ANALYSIS OF THE STURM-LIOUVILLE OPERATOR WITH NON-STANDARD WEIGHT AND INTEGRAL BOUNDARY CONDITION

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Abstract:

In this study, the spectral properties of Sturm-Liouville differential equation with integral type boundary condition and negative weight function will be presented. Unlike the classical literature, here the hyperbolic type representations of the fundamental solutions of the equation are obtained. Moreover, first the spectrum of the operator, and then the eigenvalues and spectral singularities under the Naimark and Pavlov conditions are investigated.

Keywords: Resolvent operator, spectral analysis, spectral singularities, Sturm-Liouville equations

General area of research: Mathematics

ICFAS2023-ID: 1042

A GRAPH ASSIGNED TO MODULES

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Abstract:

Let R be a ring and M be a right R -module. In this paper, we study about the small intersection graph of submodules of M : The small intersection graph $SI_R(M)$ of M is the simple undirected graph with the nontrivial submodules of M as vertices and two distinct vertices N and K of M are adjacent if and only if $N \cap K$ is a small submodule of M . First, we study some basic properties like connectedness, diameter, girth and completeness of $SI_R(M)$: Further, we study about $SI_{\mathbb{Z}}(\mathbb{Z}_n)$ where n is not a prime number. In particular, we prove that $SI_{\mathbb{Z}}(\mathbb{Z}_n)$ is weakly perfect.

Keywords: Small submodule, hollow module, small-intersection graph

General area of research: Mathematics

ICFAS2023-ID: 1045

STRUCTURAL PROPERTIES OF CYCLIC CODES OVER THE CLASS OF COMMUTATIVE RINGS AND THEIR APPLICATIONS

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Abstract:

Let k, m be positive integers and F_{2^m} be a finite field of order 2^m of characteristic 2. The main aim of this article is to study of structural properties of cyclic codes over the class of commutative ring $S_k = \frac{F_{2^m}[v_1, v_2, \dots, v_k]}{\langle v_i^2 - \alpha_i v_i v_j - v_j v_i \rangle}$, for $i, j=1, 2, 3, \dots, k$, where α_i are the non zero elements of F_{2^m} . Moreover, as an application, we obtain better and new quantum error correcting codes over the ring S_1 (for $k=1$). Furthermore, we acquire optimal linear codes with the help of Gray image of cyclic codes.

Keywords: Cyclic code, dual code, Gray map, quantum codes

General area of research: Mathematics (Algebra)

ICFAS2023-ID: 1046

CONVOLUTION THEOREMS FOR GENERALIZED ANALYTIC WAVELETS

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Abstract:

Gabor proposed the concept of analytic signal, i.e., a complex signal related to a given real signal using the Hilbert transform. In this talk, we generalize the approach of constructing analytic signal by using the fractional Boas transform. We call these analytic signals as the generalized analytic signals and we discuss some of its important properties. Finally, we define generalized analytic wavelets and give the related convolution and cross-correlation theorems.

Keywords: Hilbert transform, fractional Boas transform, generalized analytic signals generalized analytic wavelets

General area of research: Mathematics

ICFAS2023-ID: 1048

LITHIUM FOR GREENING THE SOCIETY

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Abstract:

Definitions of green technologies and green societies are often implied to renewable energies, electric vehicles, and materials recycling. In green society, services and goods generally obey circular economy and has low environmental footprint. Green technologies and green societies have one thing in common: more intensive use of metals. Demand for some metals should therefore increase substantially by 2050 to meet new needs. Since lithium is one of them, special attention is devoted for this metal. Lithium is used in everything from smartphones to electric vehicles (EVs) as Lithium-Ion Rechargeable Batteries (LIBs). The deployment of renewables and electric vehicles lead reduction of greenhouse gas emissions either.

Keywords: Low-carbon economy, Lithium-ion batteries (LiBs), green metals, lithium, electric vehicles (EVs)

General area of research: Lithium-ion Batteries

ICFAS2022-ID: 1051

GRADED WEAKLY STRONGLY QUASI PRIMARY IDEALS

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Abstract:

Let G be a group and R be a commutative G -graded ring with nonzero unity. In this article, we introduce and examine the concept of graded weakly strongly quasi primary ideals. A proper graded ideal P of R is said to be a graded weakly strongly quasi primary ideal if whenever $0 \neq xy \in P$, for some homogeneous elements $x, y \in R$, then either $x^2 \in P$ or $y^n \in P$, for some positive integer n . Among several results, we compare graded weakly strongly quasi primary ideals and other classical graded ideals such as graded strongly quasi primary ideals, graded weakly primary ideals and graded weakly 2-prime ideals etc.

Keywords: Graded primary ideal, graded weakly primary ideal, graded quasi primary ideal, graded weakly 2-prime ideal, graded strongly quasi primary ideal

General area of research: Mathematics

ICFAS2023-ID: 1053

COMMUTATIVITY OF CONSTANT NEAR-RINGS VIA GENERALIZED DERIVATIONS

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Abstract:

The main purpose of this paper, is to study the notion of generalized derivations with commutativity of a constant near-ring N , we give some results about that. The notion of derivation in rings is quite old and plays a significant role in various branches of mathematics. Studying the properties of rings equipped with mappings is an idea that began in the second half of the last century. Researchers have focused on two types of mappings defined on rings, namely, generalized derivations and derivations. Many authors studied the properties of prime and semiprime near-rings with derivations, such as commutativity of near-rings. In 1905, Dikson initiated the idea of near-rings. Later, in 1987, Bell and Gordon Mason did their work on derivation and prove some commutativity theorem for near-rings while the study of derivation was initiated during the 1950s and 1960s on ring. Where Posner (1957) started to study about derivations in rings and proved the existence of a non zero centralizing derivation on a prime ring that forces the given ring to be commutative. Every ring is near-ring but the converse is not true always. Throughout this paper, N is non empty set, equipped with two binary operations say '+' and '·'. N is called a left near-ring if (i) $(N, +)$ is a group (not necessarily abelian) (ii) $(N, ·)$ is a semigroup and (iii) $x.(y + z) = x.y + x.z$ for all $x, y, z \in N$. Similar for N is called a right near-ring. A near -ring is called a semiprime **if $x \in N$, $xyx=0$ for all $y \in N$ implies $x=0$** . A near-ring N is called prime, if $xNy = 0$ for $x, y \in N$, then $x = 0$ or $y = 0$. For all $x, y \in N$ as usual $[x, y] = xy - yx$, called the Lie product of x and y and also $xoy = xy + yx$, called Jordan product of x and y . A near-ring N is called a constant near-ring if $xy=y$ for all $x, y \in N$. Let d be an arbitrary additive endomorphism of N . Then d is a derivation on N if $d(xy) = d(x)y + xd(y)$ for all $x, y \in N$. An additive mapping $D:N \rightarrow N$ is said to be generalized derivation associated with a derivation d of N if $D(xy) = D(x)y + xd(y)$. A generalized derivation D is a generalized derivation associated with a derivation D if it is a right as well as a left generalized derivation as associated with a derivation d . Many analysts have studied generalized derivation in the context of algebras on certain normed spaces.

Keywords: Commutativity, derivation, n -torsion free, generalized derivation, semiprime near-ring, constant near-ring

General area of research: Mathematics

ICFAS2023-ID: 1066

ANALYSIS OF THE EFFECTS OF THE ATANGANA-BALEANU DERIVATIVE ON A SCABIES MODEL

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Abstract:

A human itch mite infestation causes scabies, which affects the skin. The disease of scabies is found worldwide and affects people of all races and social classes in equal numbers. In densely populated regions where intimate body and skin contact is common, scabies can spread quickly. In this study, the scabies model has been first remodeled with the Atangana-Baleanu (AB) derivative, and then a detailed analysis of the numerical properties of this fractional model is performed. In addition, we acquire a number of numeric graphs in which this scabies model plays a key role in forecasting and evaluating intricate phenomena within the system.

Keywords: Fractional differential equations, Atangana-Baleanu derivative, scabies model

General area of research: Mathematics

ICFAS2023-ID: 1072

Acknowledgement: The study is supported by Balıkesir University under the Grant no. BAP 2020/014.

MODE-MATCHING TECHNIQUE FOR COAXIAL WAVEGUIDE WITH DIFFERENT IMPEDANCE BOUNDARY CONDITIONS

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Abstract:

The present work considers the effect of different impedance boundary conditions on electromagnetic wave propagation with the help of mode-matching method. This approach based on matching the field components at the junctions under proper continuity conditions. The solution involves system of linear equations. A numerical solution to this system has been obtained for various values of the waveguide parameters to determine the reflected and transmitted waves.

Keywords: Mode-matching technique, Electromagnetic wave propagation

General area of research: Mathematics

ICFAS2023-ID: 1075

A SMARANDACHE CURVE ACCORDING TO THE DARBOUX FRAME AND THE KINEMATICS OF THIS CURVE IN E_1^3

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Abstract:

In differential geometry, curves have many important places and properties. In the theory of curves, especially helices, geodesics, circles and many other types of curves are studied. Researchers closely follow the work on curves. Researchers have worked with various curves besides existing studies. Special Smarandache curves are one of them. This curve is defined as a regular curve produced by the Frenet Frame of a regular unit speed curve.

Smarandache curves have been studied by some authors. A. T. Ali has introduced some special Smarandache curves in the Euclidean space. He introduced some special Smarandache curves in three-dimensional Euclidean space. In his master's thesis Karaman F. created all Smarandache curves that can occur under Frenet frames and examined. The curvatures and torsions of these curves are calculated individually.

In this study, a new image curve is defined, which is formed by rotating the curve whose position vector is any Smarandache curve by an angle θ around the vector $\vartheta = (\vartheta_x, \vartheta_y, \vartheta_z)$ and its translation by $\lambda \in \mathbb{R}$.

The curvatures and frames of the Smarandache curve formed by a timelike curve with unit velocity taken on a timelike surface according to the Darboux frame in Semi-Euclidean Space were created. Then, the image curve on the screw surface was obtained by applying translational and rotational motion (screw motion) using the quaternion multiplication under the same frame of this curve. Finally, the curvature and torsion of the obtained image curve were calculated.

Keywords: Smarandache curves, quaternion, screw surface, image curve, kinematic curve

General area of research: Mathematics

ICFAS2023-ID: 1076

DYNAMIC EFFECTS ON THE ELASTIC WHEELS OF URBAN RAILWAY VEHICLES

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Abstract:

Elastic wheels are used to reduce the shocks and vibrations induced by the rail road during the running process. Between the wheel body and the wheel crown there are elastic rubber elements, in addition to elastically absorbing disturbances from the track due to its geometric deviations, having the role of dampening vibrations. Thus, the wheel behaves as an intermediate elastic layer between the elastic track and the elastic system of the vehicle.

The authors present in the current paper a study of the vibrations of the vehicle with several suspended masses and show the advantages of elastic wheels for ensuring a superior quality of the vehicle's ride. The study highlights both the advantages and disadvantages of using rubber. A series of constructive solutions of elastic wheels and their elastic and damping characteristics are proposed.

The validation of the constructive solutions was done through laboratory experiences at the Politehnica University of Bucharest. It is shown that elastic wheels are not safe in the rolling process for heavy vehicles, they lend themselves to light vehicles used in urban transport such as trams or metro trains.

Keywords: Rubber, elastic wheels, vibrations, ride quality

General area of research: Railway vehicle dynamics

ICFAS2023-ID: 1077

THE STUDY OF THE RIDE QUALITY OF SUBWAY VEHICLES THAT HAVE PNEUMATIC SPRINGS IN THE ELASTIC SYSTEM

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Abstract:

In order to ensure a good ride quality and traffic safety in metro vehicles, pneumatic springs are used in the central suspension (i.e. between the bogie and the body). These, in addition to the role of elastic absorption of disturbing excitations from the running path, also have the role of dampening vibrations through the air lamination effect in the connecting pipe between the pneumatic cushion and the auxiliary air tank.

Through the action of the control and regulation system, the parallelism of the body chassis in curves is achieved with the plane of the running track, thus ensuring maintenance within the constructive dimensions of the subway tunnel. The effect of ensuring body floor height at platform level in subway stations is also mentioned.

By maintaining a constant arrow of the central suspension, the requirement imposed by the ride quality is also achieved, namely the achievement of a natural frequency of vertical oscillations of about 1 Hz.

In the paper, the authors present experimental characteristics of pneumatic suspensions that validate the theoretical conclusions.

Keywords: Pneumatic springs, vibrations, central suspension, ride quality

General area of research: Railway vehicle dynamics

ICFAS2023-ID: 1078

STUDY OF SKY-HOOK CONTROL LAW ON CLOSED-LOOP SYSTEMS USED FOR COMMAND AND CONTROL OF ACTIVE SUSPENSION IN SUBWAY VEHICLES

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Abstract:

With the increasing adoption of rail vehicle transport, their dynamic performance must be constantly improved in order to develop a more efficient and attractive means of transport. In order to achieve this desideratum, the suspension of the vehicle must be modified to correspond to the new technological standards of performance, safety and comfort.

The authors propose to study the role of an active command and control system of the subway vehicle suspension, which works based on the concept of controlling a certain signal with the signal itself, that is, through a closed loop, having the main role of isolating the vibrations due to the contact of the wheel-rail and limiting lateral displacements of the vehicle box by stabilizing its position relative to the bogie frame.

Some of the main control laws used in the adaptive command and control systems of the suspension of railway vehicles are presented, respectively the advantages of the implementation of sky-hook damping in the subway such as reduced complexity and easy maintenance.

Moreover, theoretical simulations illustrate the characteristics of sky-hook dampening used in the control chain of adaptive central suspensions of metro cars.

Keywords: Adaptive system, vibrations, central suspension, closed loop

General area of research: Railway vehicle dynamics

ICFAS2023-ID: 1079

RBF SOLUTIONS OF STEADY FLOW IN A DOUBLE LID-DRIVEN CAVITY EXPOSED TO MAGNETIC FIELD

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Abstract:

In this study, radial basis function (RBF) approximation is implemented to MHD flow problem in a double lid-driven cavity whose lids move in opposite direction. The impacts of both direction and strength of the magnetic field on streamlines are analyzed for different values of inclination angle (α) and Hartmann number (M). Numerical results indicate that increase in the inclination angle of the magnetic field affects the velocity component in the y-direction. However, the values of u-centerline velocity become almost zero regardless of the rotation of the magnetic field. It is also found that the location and the number of vortices depend on the inclination angle and Hartmann number.

Keywords: RBF, inclination angle, MHD flow, double lid-driven

General area of research: Mathematics

ICFAS2023-ID: 1081

**MONOTONE-ITERATIVE METHOD FOR NONLINEAR BOUNDARY
VALUE PROBLEM FOR GENERALIZED PROPORTIONAL CAPUTO
FRACTIONAL DIFFERENTIAL EQUATION THEORETICAL PROOFS
AND COMPUTER REALIZATION**

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Abstract:

A special type of fractional derivative is applied to a nonlinear differential equation. This derivative is called a generalized proportional Caputo fractional derivative. It is studied a boundary condition to the given equation. Initially, the linear fractional differential equation with a boundary condition is considered and its explicit solution is obtained. An appropriate integral fractional operator for the nonlinear problem is defined and applied to mild solutions, upper mild solutions and lower mild solutions of the given problem. A scheme for obtaining the solution is provided. The new defined integral operator with the monotone-iterative technique and the method of lower and upper solutions are applied to obtain the new algorithm for successive approximations to the mild solution.

The algorithm is theoretically well ground, computerized and applied to a particular example. The convergence of the sequence of mild lower solutions and the sequence of mild upper solutions to the mild solution of the given problem is illustrated.

Keywords: Nonlinear differential equation

General area of research: Mathematics

ICFAS2023-ID: 1082

DEVELOPMENT OF SILVER NANOWIRE ELECTRODES BY INKJET PRINTING TECHNIQUE FOR FLEXIBLE SOLAR CELLS

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Abstract:

The inkjet printing method provides experimental studies for printed electronics and patterned coating with a rapid process, allows quick design changes and low amount of material consumption. It makes it possible to develop electrodes by jetting dispersions containing nanoparticles of conductive materials onto a substrate and then applying the sintering becomes conductive. In this study, it is aimed to develop low electrical resistant and optical transparent electrodes on flexible substrates (Kapton and PEN) using ethylene glycol silver nanowire (AgNW) dispersion with inkjet printing technique. The effect of differences such as dispersion concentration, resolution, pattern, multilayer implementation were examined on the electrical sheet resistance and optical transmittance of the samples. The electrical sheet resistance of the electrodes was measured with four probe station and their optical transmittances were analyzed with UV-Vis Spectrophotometer. While the optical transmittance of the electrodes is changing from 62% to 51.8% at wavelength of 600-700 nm, sheet resistance is in the order of $k\Omega$ to $G\Omega$. Our results indicated that the obtained electrodes can be used in flexible solar cells and other flexible electro-optical devices.

Acknowledgement: This study was supported by TUBITAK 1001 (Project number: 121F379) and Photonic Material and Electro-Optical Device Development Project Number: CB-SBB-2019K12-149045.

Keywords: Silver nanowire, inkjet printing, flexible substrates

General area of research: Photonics

ICFAS2023-ID: 1083

PLS REGRESSION FOR FUNCTIONAL DATA

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Abstract:

In this work we have presented the method of partial least squares regression , or PLS regression for functional data.

We developed the results established by M.Tenenhaus, we illustrate the finite sample performance of the PLS predictors by a simulation study and through real examples from climatology.

We compare with others prediction methods existing in the literature.

Keywords: Functional processes, Partial least squares regression, covariance operator - El Nino series

General area of research: Mathematics

ICFAS2023-ID: 1084

A MULTI LAYER PERCEPTRON NEURAL NETWORK MODEL FOR TIME SERIES PREDICTION

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Abstract:

Multilayer perceptron (MLP) neural network model can be used for time series prediction by taking into account the temporal relationships between data points. The general approach for using MLP for time series prediction involves the following steps:

1. Data preparation: The time series data is prepared by dividing it into input and output sets. The input set typically consists of one or more lagged observations of the time series, while the output set consists of the next observation in the time series.
2. Model architecture: The MLP neural network is defined by specifying the number of hidden layers and the number of neurons in each layer. The activation function used in the neurons is also selected, with common choices including sigmoid, tanh, and ReLU.
3. Training the model: The MLP model is trained using an optimization algorithm such as backpropagation. During training, the model is presented with the input data and the corresponding target output. The weights of the neurons are adjusted iteratively to minimize the difference between the predicted output and the target output.
4. Testing the model: Once the MLP model is trained, it can be tested on a separate set of data to evaluate its performance. The performance can be measured using metrics such as mean squared error (MSE) or root mean squared error (RMSE).
5. Prediction: After testing, the MLP model can be used to make predictions on new data by feeding the lagged observations into the input layer and propagating them through the hidden layers to obtain the predicted output.

The purpose of this presentation is to discuss the MLP method and compare it to other time series models.

We are beginning to explore recent developments in time series forecasting.

Then we applied this method for Ninio's temperature prediction, we used a dataset with historical temperature values . Finally, we compared our results with other prediction methods available in the literature.

Keywords: Time series prediction, neural network predictor, multilayer perceptron

General area of research: Mathematics

ICFAS2023-ID: 1084

HIGHER DERIVATIONS SATISFYING CERTAIN IDENTITIES IN RINGS

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Abstract:

In a ring R , an additive map $\tau: R \rightarrow R$ is said to form a derivation if $\tau(ab) = \tau(a)b + a\tau(b)$ for all $a, b \in R$. A sequence of additive mappings $(\tau_i)_{i \in \mathbb{N}}$ with τ_0 defined as the identity map on R is termed as a higher derivation if $\tau_k(ab) = \sum_{i+j=k} \tau_i(a)\tau_j(b)$ for all $a, b \in R$ and $k \geq 1$. The paper focusses on the structure of a prime ring equipped with a higher derivation satisfying a particular functional identity. The idea is an extension to some remarkable results due to Herstein and Bell-Daif.

Keywords: Prime ring, martindale quotient of a ring, higher derivation, commutativity

General area of research: Mathematics

ICFAS2023-ID: 1086

ON FLOW OF QUANTUM GENETIC ALGEBRAS

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Abstract:

In mathematical genetics, genetic algebras are (possibly non-associative) used to model inheritance in genetics. In the application of genetics, this algebra often has a basis corresponding to genetically different gametes, and the structure constants of the algebra encode the probabilities of producing offspring of various types. There exist several classes of non-associative algebras (baric, evolution, Bernstein, train, stochastic, etc.), whose investigations have provided many significant contributions to theoretical population genetics. In recent years many authors have tried to investigate the difficult problem of classification of these algebras. Therefore, it is the interplay between the purely mathematical structure and the corresponding genetic properties that makes this subject so fascinating.

In the present talk, we define a quantum analog of Lotka-Volterra algebras using a coalgebra scheme. This new framework provides a fresh perspective for the treatment of generic algebras. Additionally, a flow of quantum analogs of Lotka-Volterra genetic algebras is investigated. It's worth mentioning that such types of algebras are first introduced in this work. We observe that a flow of algebras is a particular type of continuous-time dynamical system, with states that are algebras and a structural constant matrix that depends on time and satisfies certain analogs of the Kolmogorov-Chapman equations. Using quantum quadratic operators, it is constructed a flow of quantum Lotka-Volterra algebras for the given multiplication. Furthermore, time-dependent behavior properties of these ow algebras are examined. The algebraic properties of the introduced flows are also studied, such as finding idempotents and examining an algebra generated by a pair of idempotents. It is shown that the latter one is associative, while the flow is not associative.

Keywords: Genetic algebra, non-associate algebra, coalgebra

General area of research: Mathematics

ICFAS2023-ID: 1087

WEAKLY S-2-PRIME IDEALS

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Abstract:

The purpose of this paper is to introduce weakly S-2-prime ideal in commutative rings which is a generalization of S-2-prime ideal and both are generalization of prime ideals. Various fundamental results regarding weakly S-2-prime ideal are given and its algebraic properties are investigated. Furthermore, we examine the relations between weakly S-2-prime ideals and other classical ideals such as S-2-prime ideals, weakly S-prime ideals and weakly S-2-absorbing primary ideals. Also, we study the transfer the notion of weakly S-2-prime ideal to amalgamated duplication and Nagata idealization.

Keywords: S-prime ideals, weakly S-prime ideals, weakly S-2-prime ideals

General area of research: Mathematics, Algebra

ICFAS2023-ID: 1088

S-2-PRIME IDEALS

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Abstract:

In this paper, we introduce the concept of S-2-prime ideals which are generalization of prime ideals. Moreover, we describe their algebraic properties and a number of examples concerning S-2-prime ideals are given. Besides, our study gives a similar to the prime avoidance theorem and some applications of this theorem.

Keywords: 2-prime ideals, S-prime ideals, S-2-prime ideals

General area of research: Mathematics, Algebra

ICFAS2023-ID: 1089

A COMPARATIVE STUDY OF UNDERWATER IMAGE ENHANCEMENT TECHNIQUES

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Abstract:

In recent years, the growing interest of scientists in the field of image processing and analysis of underwater images and videos has been strengthened following the emergence of new underwater exploration techniques such as the emergence of autonomous underwater vehicles and the use of underwater image sensors facilitating the exploration of underwater mineral resources as well as the search for new species of aquatic life by biologists. Indeed, underwater images and videos have several defects and must be preprocessed before their analysis. Underwater landscapes are usually darkened due to the interaction of light with the marine environment: light is absorbed as it travels through deep waters depending on its wavelength. Additionally, light does not follow a linear direction but is scattered due to its interaction with micro particles in water, resulting in low contrast, low brightness, color distortion, and restricted visibility. The improvement of the underwater image is therefore more than necessary in order to facilitate its analysis. The research presented in this paper aims to implement and evaluate a set of classical techniques used to improve the quality of underwater images in several color representation spaces. These methods have the particularity of being simple to implement and do not require prior knowledge of the physical model at the origin of the degradation.

Keywords: Underwater image enhancement, contrast limited adaptive histogram equalization (CLAHE), single-scale retinex (SSR), multi-scale fusion, and screened poisson

General area of research: Mathematics

ICFAS2023-ID: 1096

SYNTHESIS, CHARACTERIZATION AND INVESTIGATION OF PHOTOCHEMICAL AND PHOTOPHYSICAL PROPERTIES OF ZINC (II) PHTHALOCYANINE

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Abstract:

Cancer is one of the biggest health problems of our era. Innovative solutions are being researched in cancer treatment, since traditional treatment methods against cancer can kill cancerous cells and damage healthy tissues. Within the scope of these studies, the photodynamic therapy (PDT) method has been developed. In this technique, singlet oxygen produced by the interaction of photosensitizer compounds with light in an oxygen-containing environment attacks and kills cancerous cells. The photosensitizer compound to be used for PDT must have some properties. At the beginning of these features is the ability of the photosensitizer compound to produce singlet oxygen in high efficiency as a result of its interaction with light [1]. In addition, the solubility must be good for its reach to the target cancerous tissue in the human body, and the compound must preserve its structure and not have a toxic effect as a result of its interaction with light. For this, studies have been carried out in the literature for the use of phthalocyanine compounds, which have a strong interaction with light and preserve their structure, as photosensitizers in the PDT method. These macrocyclic compounds generally have dark blue-green color in the visible region due to their strong absorption of light in this region. Since the solubility of phthalocyanine compounds is low, various substituted ligands are attached to the macro ring for increasing solubility [2,3].

In this study, it was aimed to synthesize the substituted zinc(II) phthalocyanine compound, which is intended to be used as a photosensitizer in the PDT method. Zinc(II) phthalocyanine was characterized using various spectral methods such as UV-Vis, FT-IR, NMR, and MALDI-TOF-MS. Aggregation, photochemical and photophysical properties of the compound were examined, and its usability as a photosensitizer in the PDT method was investigated and the capacity to produce singlet oxygen, photodegradation quantum yields and fluorescence quantum yields were calculated for the synthesized compound.

References

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Keywords: Phthalocyanine, photodynamic therapy, singlet oxygen, aggregation

General area of research: Inorganic Chemistry

ICFAS2023-ID: 1097

Acknowledgement: This study was supported by Yildiz Technical University BAP (Project number: FYL-2022-4826)

A NEW HPLC-DAD METHOD FOR THE DETERMINATION OF PARACETAMOL, OXOLAMINE CITRATE AND CHLORPHENIRAMINE MALEATE IN SYRUP FORMULATION

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Abstract:

A drug is a natural, semi-synthetic or synthetic chemical preparations obtained from animal, vegetable, mineral or synthetic sources that make it possible to diagnose, treat or protect against a disease, given to living beings by various forms such as tablet, syrup, capsule etc. It is very important to investigate and analyze the amounts of drug active ingredients contained in a drug in terms of therapeutic response, success in treatment and reduction of side effects. Selective and sensitive analytical methods are preferred for this aim. Chromatographic techniques are used in drug analysis as a common analysis method leading in the parameters of selectivity, sensitivity and better reproducibility.

The aim of this work is to develop a rapid, sensitive and accurate high performance liquid chromatography/diode array detector (HPLC-DAD) method for the simultaneous determination of paracetamol, oxolamine citrate and chlorpheniramine maleate in possible formulations of cough and cold medicines.

The chromatographic separation was performed on C18 HPLC column with the mobile phase consisting of phosphate buffer, methanol and acetonitrile. This simple, fast, economical and precise high performance liquid chromatographic method can be used for routine quality control analysis of the mentioned active drug substances.

Keywords: Paracetamol, oxolamine citrate, chlorpheniramine maleate, HPLC-DAD.

General area of research: Chemistry

ICFAS2023-ID: 1098

ON CONTACT TYPE ANTI-INVARIANT RIEMANNIAN SUBMERSIONS

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Abstract:

In this paper, we present some relations between almost complex and almost contact structures using contact type anti-invariant Riemannian submersions. These relations are discussed on Riemannian submersions that their base spaces are a Kaehler manifold and a complex space form.

Keywords: Complex structure, contact structure, Riemannian submersion, Kaehler manifold

General area of research: Mathematics (Differential Geometry)

ICFAS2023-ID: 1099

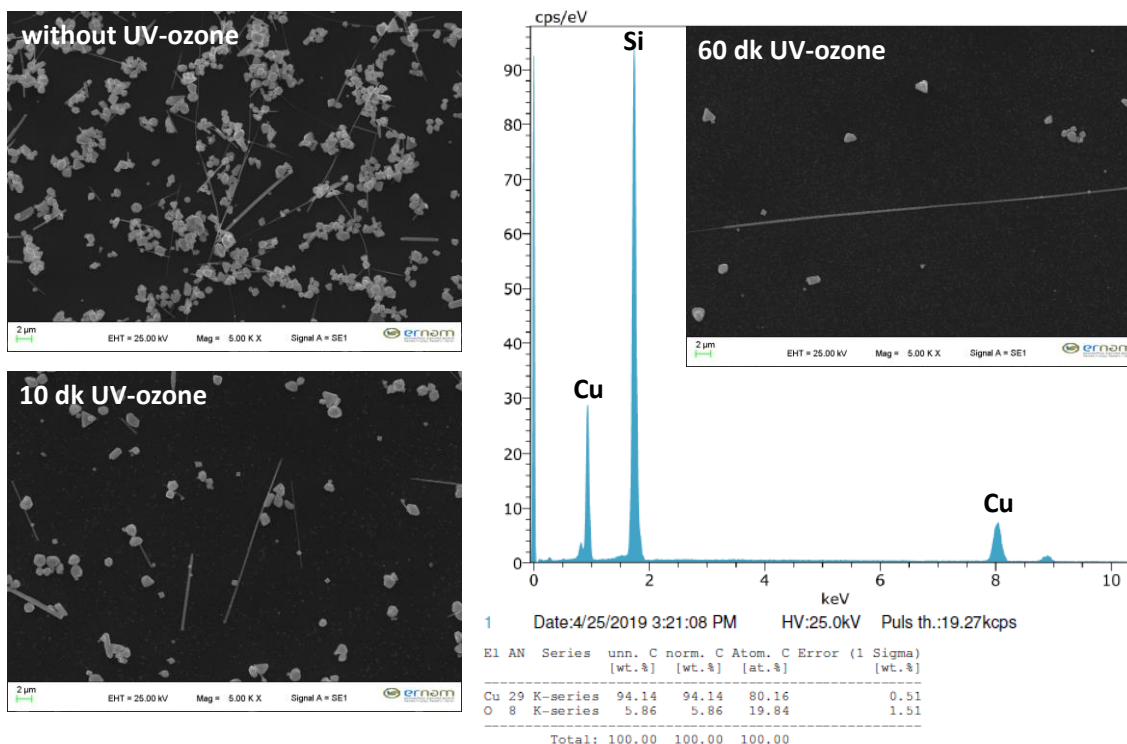
SYNTHESIS AND CHARACTERIZATION OF CU NANOWIRES AS A SERS ACTIVE SUBSTRATE

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Abstract:

Au, Ag, and Cu nanomaterials have been used as SERS-active substrates for many years due to their surface plasmons. Although the plasmonic efficiency is lower, Cu nanomaterials are the most promising among them considering their cost. Typically, high temperatures or complex processing steps are required for the synthesis of characteristic Cu nanowires. In this study, pure and highly elongated Cu nanowires were obtained at a very low temperature and in a single step. The Cu nanomaterials were characterized by SEM imaging and EDX analysis. Surface cleanliness is critical for the formation of Cu nanowires. Thanks to their morphologies, successful determination of the R6G analyte molecule at levels of 10^{-9} M is achieved. This result is quite valuable for Cu nanomaterials.



Keywords: Cu nanowire, CTAC, SERS
General area of research: Material Science
ICFAS2023-ID: 1101

BURGERS' N-TH HIERARCHY OF PARTIAL DIFFERENTIAL EQUATIONS

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Abstract:

We discuss the one-parameter Lie group transformations that leave differential equations invariant. We link these transformations to conservation laws that contain a recursion operator. We showcase how this concept may be used to determine invariant solutions for n-th order partial differential equation hierarchies, such as the famous nonlinear Burgers' hierarchy.

Keywords: Burgers' equation, conserved vectors, transformations, nonlinear equations

General area of research: Mathematics

ICFAS2023-ID: 1102

VIRTUAL TARGET SUPERVISION - INFLUENCE OF THE SERVICE BRAKE ON ROLLING STOCK

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Abstract:

The topic will present how the failing of the service brake will impact the emergency brake intervention using speed steps. The presentation will also include the calculation of the limits for braking curves in different configurations and for different types of trains, passenger or cargo trains. Also examples on how the driver should be warned, the moment in which the acceleration is restricted and service brake plus emergency brake are triggered will be presented and explained along with the formulas used to predict these points.

Keywords: Target supervision, braking curves, service brake, emergency, emergency brake, traction cut off

General area of research: Transportation

ICFAS2023-ID: 1104

A CRYPTOSYSTEM BY USING THE FORMULA OF DISCRETE POPULATION

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Abstract:

In cryptography, an original text or plaintext will be converted into text with specific codes or ciphertext. In this paper, to maintain the confidentiality and security of information, we used the formula of Discrete population to construct a matrix with order 2×2 as a key of this cryptosystem. Moreover, by the matrix key, we apply the Hill Cipher method and for the next, we also use the binary number system. The encryption process is carried out by multiplying the first key into a matrix with the plaintext matrix and then operating two binary number system operations. The decryption process begins with two operations on the binary number system and is then multiplied by the key matrix inverse. In the process of encryption and decryption, each character is converted to a decimal number based on the ASCII table and modulo 128 is used.

Keywords: Encryption, decryption, discrete population, hill cipher

General area of research: Cryptography

ICFAS2023-ID: 1106

SLANT RULED SURFACES WITH THE VIEW OF HYPER-DUAL CURVES

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Abstract:

The algebraic properties of hyper dual curves was introduced by Fike to solve the derivative problems in the complex derivative approximation and derivative calculations. A hyper-dual number composes of two dual numbers. Moreover, this number system is widely used in analysis, motion of multi-body systems, software systems, etc. Due to their areas of utilization, in this study, we give an geometric view to hyper dual curves. Hence, we obtain some substantial characterizations about each striction curve of the hyper-dual curve. Considering their geometric properties of both hyper dual curves and unit hyper-dual sphere, we acquire that each striction curve of the hyper-dual curve represents two slant ruled surfaces in Euclidean 3-space. Moreover, we obtain that these slant ruled surfaces have a common striction curve. Then, we prove some theorems and remarks. Finally, we give an example to verify the obtained results.

Keywords: Slant ruled surface, hyper dual curves, dual numbers

General area of research: Mathematics

ICFAS2023-ID: 1107

MODELLING REAL VALUED FUNCTIONS VIA OPTICAL LENSES

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Abstract:

In this study, we have focused on engineering a lens surface such that an incoming ray vertically which has a definite x -value, leaves the lens at another position, say x' . The lens surface (given by a function $f(x)$) is calculated such that the x -value of the incoming ray is mapped to $x' = F(x)$ for some function F which is used to engineer the lens surface. Finally, we give the (nonlinear) differential equation and solve it numerically for some functions F . Our approach differs from other studies in freeform lens design that we do not consider issues such as “image formation” however focus on the x coordinates of the incoming and outgoing rays, namely x and $F(x)$.

Keywords: Freeform lenses, real valued functions, mathematical modelling

General area of research: Optics, Mathematical Physics

ICFAS2023-ID: 1108

NEW FIXED POINT THEOREMS ON E_b -CONE METRIC SPACES

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Abstract:

The purpose of this paper is to introduce the concept of cone E_b -metric space and demonstrate a fundamental lemma for the convergence of sequences in such space. We prove some fixed point theorems of contractive mappings in this space in the setting of non-solid cones having semi-interior points. The results not only directly improve and generalize some fixed point results, but also expand and complement some previous results in cone E_b -metric spaces. As some applications, we use our results in cone E_b -metric space to obtain the existence and uniqueness of a solution for a nonlinear integral equation and solution of an ordinary differential equation with initial condition.

Key Words and Phrases: cone E_b -metric space, b -metric space, non solid cone, fixed point

General area of research: Mathematics

ICFAS2023-ID: 1111

ON THE SQUARE TRIANGULAR NUMBERS

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Abstract:

Polygonal numbers are natural numbers that can be represented by regular geometric forms. There are many types of polygonal numbers. But among the polygonal numbers, the well-known and studied type are the triangular numbers and the square numbers.

A triangular number is a natural number of the form $\frac{n(n+1)}{2}$ and square number is a natural number of the form n^2 , where $n \in \mathbb{Z}$.

Square triangular numbers are both square and triangular numbers. In this talk I will mention about which numbers are simultaneously square and triangular numbers (i.e. square triangular numbers).

Keywords: Polygonal numbers, triangular numbers, square numbers, pell equation

General area of research: Mathematics

ICFAS2023-ID: 1112

ON SOLUTIONS OF A SPECIAL DIOPHANTINE EQUATION

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Abstract:

A Diophantine equation is an equation in which all coefficients and variables are integers. The quadratic Diophantine equation of the form

$$ax^2 + bxy + cy^2 + dx + ey + f = 0 \quad (1)$$

and the well-known Diophantine equation is $x^2 - dy^2 = N$ which is called the Pell equation and a special case of (1).

In this talk, I will mention about the solutions of the special Diophantine equation

$$D: x^2 + (\sigma^2 + 4)y^2 - (2\sigma - 2)x - (2\sigma^4 + 8\sigma^2)y - \sigma^6 - 4\sigma^4 + \sigma^2 - 2\sigma - 3 = 0$$

Keywords: Diophantine equation, pell equation, continued fraction expansion

General area of research: Mathematics

ICFAS2023-ID: 1113

NETWORK ANALYSIS OF SAUDI AIRPORTS USING CENTRALITY, EFFICIENCY, AND ROBUSTNESS MEASURES

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Abstract:

Measures of vertex centralities, efficiency, and robustness are some of the concepts that have been used in network analysis for the study of a network system.

Airports play a crucial role in the economic development of a country. Therefore, one of Saudi Arabia's projects for the 2030 vision is King Salman International Airport, which is located in the capital city of Saudi Arabia, Riyadh, and is expected to transform Riyadh into one of the top ten city economies in the world.

Measures of centrality, such as degree centrality, betweenness centrality, closeness centrality, and eigenvector centrality, capture the notation of 'a vertex importance' in a network. While measures of efficiency, such as diameter and average distance, give an insight into a network connectedness. In addition, robustness measures, such as vertex connectivity and edge connectivity are used to ensure reliability of a network.

Efficiency and robustness of SAAN (Saudi Arabia's airports network) can be improved using suggestions based on calculations of the previous measures.

Based on our analysis, King Abdulaziz International Airport in Jeddah has the highest centrality. This paper provides valuable insights into SAAN which can be used to make suggestions related to efficiency and robustness of the network.

Keywords: Networks analysis, vertex centrality, efficiency measures, robustness measures

General area of research: Mathematics

ICFAS2023-ID: 1114

ABOUT THE GEOMETRIC OPTIC OF AN INCOMPRESSIBLE EULER'S SYSTEM WITH CONSTANT PRESSURE

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Abstract:

Let $\epsilon \in]0,1]$, $\mathbb{T} = \mathbb{R}/\mathbb{Z}$ the torus, Ω_r^0 the ball of centre zero and Radius $r \in \mathbb{R}_+^*$. We consider the Cauchy problem formed by the three-dimensional incompressible Euler's system with constant pressure and a mono-phase oscillating initial data

$$(\diamond): \quad \partial_t u^\epsilon + (u^\epsilon \cdot \nabla) u^\epsilon = 0, \quad \operatorname{div} u^\epsilon = 0, \quad u^\epsilon(0, x) = w\left(x, \frac{\varphi(x)}{\epsilon}\right).$$

Such that the phase $\varphi \in C^1(\Omega_r^0, \mathbb{R})$ no stationary and the profile $w \in C^1(\Omega_r^0 \times \mathbb{T}, \mathbb{R}^3)$ satisfies on $\Omega_r^0 \times \mathbb{T}$ the condition $\partial_\theta w(x, \theta) \neq 0$. The constraint $\operatorname{div} u^\epsilon = 0$ can be replaced by the condition that the Jacobian matrix of $u^\epsilon(0, x)$ is nilpotent [1].

For some couple of vectors filed (X, Y) , by introducing the Lie algebra

$$\operatorname{Span}\{X, Y, [X, Y], [X, [X, Y]], [Y, [X, Y]]\},$$

and solving the system $(D_x u^\epsilon(0, x))^3 = 0$, we give a classification of (φ, w) such that the problem (\diamond) has a C^1 locale solution defined over a domain independent of ϵ , and we show how this solution can be constructed [2,3].

References:

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Keywords: WKB analysis, nonlinear geometric optics, Euler's system, incompressible flow

General area of research: Mathematics/Applied Mathematics

ICFAS2023-ID: 1115

DYNAMICS OF A CANCER TUMOR GROWTH MODEL WITH A DRUG TERM

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Abstract:

Here, we investigate Michaelis-Menten type dynamics of phase-space analysis to a mathematical model of tumor growth with an immune responses. We then explore the effects of adaptive cellular immunotherapy on the model and describe under what circumstances the tumor can be eliminated. The addition of a drug term to the system can move the solution trajectory into a desirable basin of attraction. We show that the solutions of the model with a time-varying drug term approach can be evaluated by a more fruitful way in down to earth style. This is the solutions of the system without drug treatment, in the condition of stimulated immune processes. Mathematical analysis of the Michaelis-Menten type equations, regarding to dissipativity, boundedness of solutions, nature of equilibria, local and global stability have been investigated. We studied some features of behavior of one of three-dimensional tumor growth models with dynamics described in terms of densities of three cells populations: tumor cells, healthy host cells and effector immune cells. We found sufficient conditions, under which trajectories from the positive domain of feasible multipoint initial conditions tend to one of equilibrium points. Here, cases of the small tumor mass, healthy, and “death” equilibrium points have been examined. Biological implications of our results are discussed.

Keywords: Cancer tumor model, mathematical modeling, immune system, stability of dynamical systems, Equilibrium point, multiphase attractors

General area of research: Mathematics, Applied Mathematics

ICFAS2023-ID: 1116

NON-EXISTENCE OF SOME CIRCULANT INVOLUTORY AND ORTHOGONAL MDS MATRICES OVER RINGS

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Abstract:

Let $k > 1$ be a fixed integer. In 2014, Gupta et.al [“Cryptographically significant MDS matrices based on circulant and circulant-like matrices for lightweight applications, Cryptogr. Commun. 7(2)(2015)”] proved that the non-existence of orthogonal circulant MDS matrices of order 2^k and involutory circulant MDS matrix over the field of characteristic 2. The main aim of this paper is to prove that the non-existence of orthogonal circulant MDS matrices of order 2^k and involutory circulant MDS matrices of order k over the ring.

Keywords: MDS matrix, circulant, orthogonal

General area of research: Mathematics

ICFAS2023-ID: 1117

SCREEN SEMI-INVARIANT LIGHTLIKE HYPERSURFACES OF AN ALMOST PRODUCT-LIKE STATISTICAL MANIFOLD

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Abstract:

The main identities on screen semi-invariant lightlike hypersurfaces of an almost product-like statistical manifolds are obtained. Some examples of these hypersurfaces are presented.

Keywords: Lightlike hypersurface, almost product structure, statistical manifold

General area of research: Mathematics, Differential Geometry

ICFAS2023-ID: 1121

SOME NEW RESULTS ON DEGENERATE STIRLING NUMBERS AND BELL POLYNOMIALS

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Abstract:

In the present talk, we study three families of sequences, the degenerate Bell polynomials, the multivariate Bell polynomials and Carlitz degenerate Stirling numbers. We employ generating functions' techniques to obtain some identities involving these sequences. Moreover, we obtain some formulas for Lah polynomials as recurrence relations and explicit formula.

Keywords: Bell numbers, Bell partition polynomials, degenerate Stirling numbers, Lah numbers and polynomials

General area of research: Mathematics

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UNCREDIBILITY WITH FUZZY VARIABLES IN UNCERTAINTY THEORY

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Abstract:

In this paper, the subject of uncertainty theory has been examined. Information about the concept of measurable set and measurable space is given. Then, Borel algebra, Borel set, uncertainty space and credibility are introduced. Then, definitions and concepts of uncredibility were made, examples and theorems were shown. The importance of uncredibility in uncertainty was emphasized, and it was concluded that the probability of events happening would become impossible according to the situations where uncredibility approached 0 in fuzzy environments, and as a result, uncertainties could be used to make sense of them.

Keywords: Uncertainty, fuzzy variable, probability, belief degree, uncredibility.

General area of research: Mathematics

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A SPATIAL AGENT-BASED MODEL TO STUDY THE IMPACT OF AQUATIC HABITATS ON MALARIA PARASITE TRANSMISSION

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Abstract:

Malaria is a vector-borne disease potentially fatal, due to a parasite Plasmodium. Several countries have managed to eradicate the disease, while the eradication of malaria in some regions of the world remains difficult till now.

This work aims to study the spatio-temporal dynamics of malaria transmission, through the study of some particular characteristics of aquatic habitats, in order to specify the role of each characteristic and its implication on the parasite transmission.

We develop an agent-based model (ABM) to simulate malaria disease transmission. The proposed model is a spatially explicit inter-host model including the life cycle of the vector, the dispersals of vectors, hosts, and aquatic habitats and the interactions between them. Demographic processes for hosts and vectors are also taken into account.

ABM simulations, based on different initial distributions, provide quantitative results predicting disease prevalence in hosts and vectors. The obtained results in this study are asymptotic and highlight the role of aquatic habitats as a determining factor in the transmission of infections and the persistence of the disease. It is found that disease transmission is governed by the number of aquatic habitats and is less sensitive to spatial extent of these aquatic habitats and to the size of the vector population.

Limiting the number of aquatic habitats regardless of their genus is proving to be a very effective method of limiting the transmission of the disease.

Keywords: Agent-based models, modeling, malaria transmission, spatial transmission, simulation

General area of research: Applied Mathematics

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SEMIGROUP IDEALS AND COMMUTATIVITY OF PRIME NEAR RINGS WITH GENERALIZED REVERSE DERIVATIONS

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Abstract:

Let N be a near ring. As a generalization of reverse derivation the notion of generalized reverse derivation in near ring N was introduced by Reddy et al.[Reddy, S. J. C., Kumar, V. S., and Rao, B. V. G., Generalized reverse derivations on prime near rings, International Journal of Research in Mathematics & Computation, 3 (2015), 1-9.]. An additive mapping $f: N \rightarrow N$ is said to be a right (resp. left) generalized reverse derivation associated with a derivation d on N if $f(xy) = f(y)x + yd(x)$ (resp. $f(xy) = d(y)x + yf(x)$) for all $x, y \in N$. An additive mapping $f: N \rightarrow N$ is said to be a generalized reverse derivation associated with a derivation d on N if it is both a right generalized reverse derivation as well as a left generalized reverse derivation on N . All reverse derivations are generalized reverse derivations. The purpose of the present paper is to prove some theorems in the setting of a semigroup ideal U of a prime near ring N admitting a generalized reverse derivation, thereby extending some known results from generalized derivations to generalized reverse derivations. We show that if N is 2-torsion free and f and g are generalized reverse derivations on N such that fg acts as generalized reverse derivation on U , then $f = 0$ or $g = 0$ on U . We also prove some commutativity theorems in the setting of semigroup ideal U of a prime near ring N admitting a generalized reverse derivation. Moreover, we give an example which shows the necessity of primness hypothesis in the theorems.

Keywords and Phrases: Prime near ring, reverse derivation, generalized reverse derivation, semigroup ideal, commutativity

General area of research: Mathematics

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STRAIN EFFECTS IN CORE/SHELL NANOWIRES AND QUANTUM DOTS

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Abstract:

Reliable modelling and precise determination of the strain effects on the structural, electronic and optical properties of microscale planar and nanoscale core/shell semiconductor heterostructures is essential for the true prediction of their potential in fabricating electronic and optical devices operating at high temperatures. Strain effects on electronic and optical properties of microscopic planar semiconductor heterostructures have been extensively studied and is reasonably well understood. However, the theoretical understanding the physics and determining the magnitude of the strain effects in one dimensional cylindrical and zero-dimensional spherical core/shell semiconductor heterostructures is still an obstacle. In this work, a thermoelastic model is presented to determine strain effects on the structural, electronic and optical properties of microscale planar and nanoscale spherical and cylindrical core/shell semiconductor heterostructures as a function dimensions, composition and temperature. The model uses lattice mismatch induced shrink fit condition for strain across heterointerfaces to find contact pressure and then strain in order to consider the effect of the difference between lattice constants, linear expansion coefficients, anisotropy of elastic properties of constituent semiconductors. Qualitative understanding of strain shifts in core gaps and band offsets of spherical core/shell type I and type II heterostructure quantum dots and cylindrical nanowires will be discussed by using two band **k.p** *effective mass approximation*. Calculations suggest a parabolic increase (decrease) in core bandgaps and conduction band offsets in GaAs/InAs (GaSb), CdSe/CdS, CdSe/ZnS, and ZnSe/ZnS quantum dots. Furthermore, a parabolic decrease in core bandgap and conduction band offset of GaSb/InAs(InSb) and ZnSe/CdS QD as core (shell) diameter increases for a fixed shell (core) diameter. Excellent agreement between predicted and measured core bandgaps in CdSe and ZnSe based core/shell QDs suggests that proposed model can be a good design tool for the process simulation of nanoscale core/shell heterostructure nanowire and quantum dot based electronic and optical devices for high temperature applications.

Keywords: Semiconductors, heterostructures, core/shell quantum dots, strain

General area of research: Physics, Electronics Engineering

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DISCRETE MAXIMAL REGULARITY FOR FRACTIONAL EQUATIONS

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Abstract:

The maximal regularity inequality have been considered by many authors. We can list the following names: Da Prato and Grisvard, Sinestrari, Sobolevsky and Ashyralyev, Guidetti, Clément and Bajlekova, Eberhardt and Greiner and many others. The discrete maximal regularity (coercivity inequalities) are especially important because they establish two-sided estimates for the rate of convergence of difference methods. We are going to discuss such an inequality for difference schemes that approximate fractional equations.

Keywords: Banach space, fractional differential equations, analytic semigroup generator, discrete maximal regularity inequality

General area of research: Mathematics

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ANALYZING GENE SEQUENCES WITH ALGEBRAIC CODES

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Abstract:

In this study, a new algorithm was developed to analyze the structure of error correcting codes on Covid-19 (Sars-Cov 2) gene sequences. ORF1ab, which is the largest fragmented gene of the DNA chain and is more rarely mutated than other genes in the coronavirus family, was examined. When the starting points of the codes whose parameters were determined with the algorithm used were marked on DNA, the areas where the ORF1ab region is dense were determined.

Keywords: Algebraic codes, algorithms, DNA

General area of research: Mathematics, Bioinformatics

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DESIGN AND IN VITRO SIMULATIONS OF NANOCOMPOSITE SMART DRUG DELIVERY SYSTEMS FOR USAGE IN BRAIN TUMOUR TREATMENTS

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Abstract:

In this study, it was aimed to develop a nanocomposite smart drug delivery system that can be used in passive targeting in brain tumour treatment. In this study, paclitaxel (PTX), a chemotherapeutic drug, was loaded into HAP/GO composite structure and its activity on brain tumour cells was investigated. Hydroxyapatite nanocrystals (n-HAP) produced by hydrothermal process and graphene oxide (GO) produced by hummers method were used to increase the carrier capacity of the nanodrug system and to activate drug release kinetics and drug loading capacity. Nanocomposite smart drug delivery systems were characterized by FT-IR, Raman spectroscopy, XRD, TGA, TEM and SEM analysis. In this study, Classical U-Net, ResNet50 Convolutional Neural Networks were applied in the diagnosis of brain tumour. In addition, tumour segmentation were be performed with these methods and predictions were generated. The results were given in terms of accuracy, dice coefficient, sensitivity, sensitivity, specificity, necrotic dice coefficient, edema dice coefficient, enhancing dice coefficient. An application that automatically detects a brain tumour from MRI images using the developed nanocomposite smart drug release systems may minimise the human error rate while allowing earlier diagnosis of cancer, as well as saving time for healthcare professionals.

Keywords: Brain tumour imaging, hydroxyapatite, nanocomposite, smart drug delivery system

General area of research: Biomaterials, Biomedical

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