ICOMAA - 2024

7th INTERNATIONAL HYBRID CONFERENCE ON MATHEMATICAL ADVANCES AND APPLICATIONS

ABSTRACT BOOK

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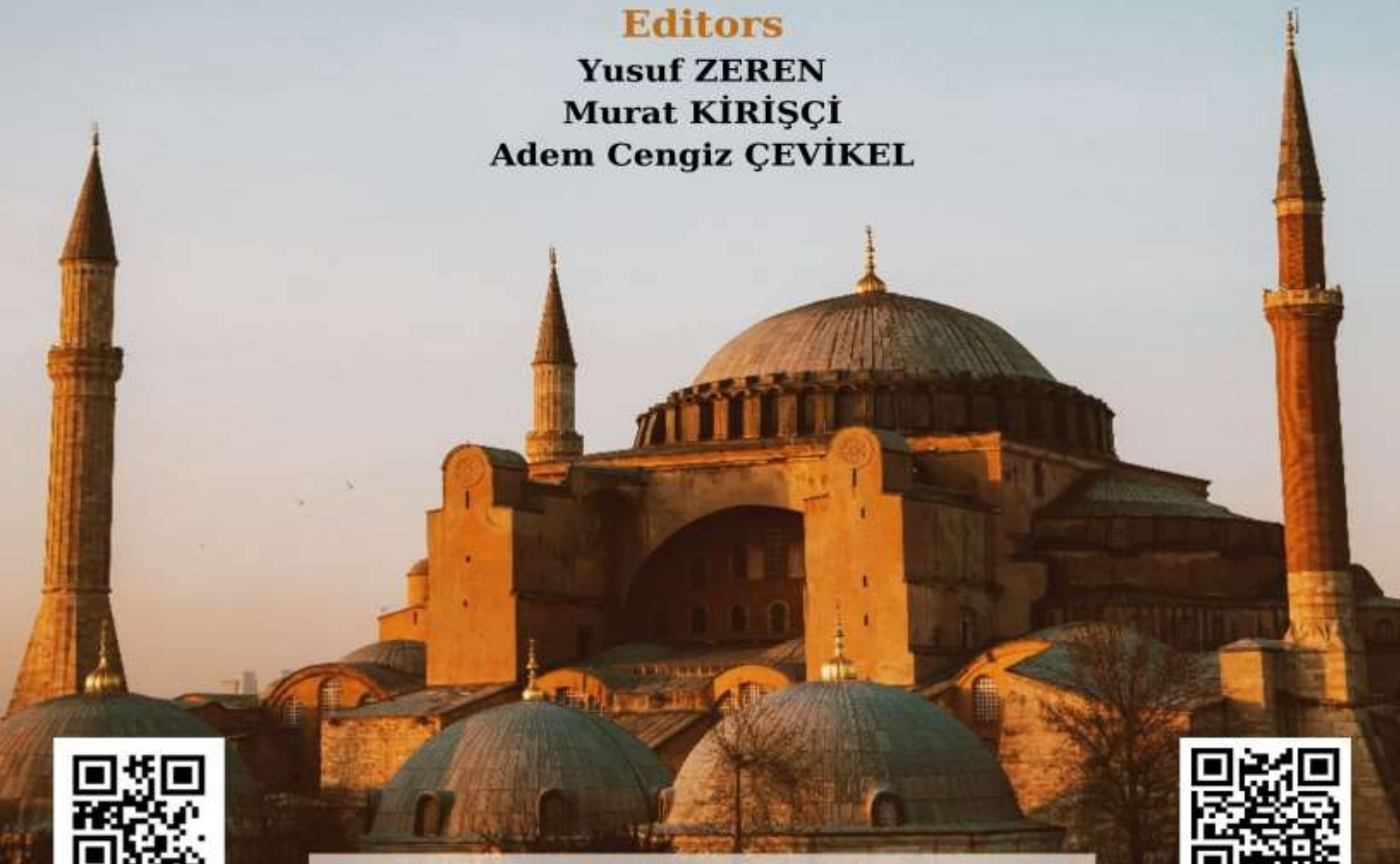
Yusuf ZEREN
Murat KİRİŞÇİ
Adem Cengiz ÇEVİKEL



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7th International HYBRID Conference on Mathematical Advances and Applications

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Abstract Book

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FOREWORDS

Dear Conference Participant,

Welcome to the International Hybrid Conference on Mathematical Development and Applications (ICOMAA-24) we organized the sixth. First of all, I would like to start my words by reminding one of G. H. Hardy's words:

"Mathematics, more than any other art or science, is a young man's game."

This phrase he expressed in his book “A Mathematician's Apology” is quite meaningful. Because Newton discovered his biggest ideas, fluxions and the law of gravitation, when he was just 24 years old. He found the 'elliptic orbit' at 37 years old. Also, Galois(at twenty-one), Abel(twenty-seven), Ramanujan(thirty-three), and Riemann(at forty) had passed away in their youth.

That's why we thought we should continue this series of conferences that brings together exciting and productive young mathematicians. So, we aim to bring together scientists and young researchers from all over the world and their work on the fields of mathematics and applications of mathematics, to exchange ideas, to collaborate and to add new ideas to mathematics in a discussion environment. With this interaction, functional analysis, approach theory, differential equations and partial differential equations and the results of applications in the field of Mathematicsare discussed with our valuable academics, and in mathematical developments both science and young researchers are opened. We are happe to host many prominent experts from different countries who will present the state-of-the-art in real analysis, complex analysis, harmonic and non-harmonic analysis, operator theory and spectral analysis, applied analysis.

I would like to express my gratitude to those who see and appreciate our efforts and innovative steps that we have made to improve our conference every year, to our dear invited speakers and to all our participants. I owe a debt of gratitude to the Scientific committee, organizing committee, local organizing committee and for their efforts throughout this conference series.

The conference brings together about 211 participants and 11 invited speakers from 34 countries (Azerbaijan, India, Algeria, Bangladesh, India, Iran, Iraq, Kazakhstan, Kosovo, Malaysia, Mexico, Morocco, Pakistan, Poland, Saudi Arabia, Turkey, United Arab Emirates, Uzbekistan, Yemen, United Arab Emirates, Egypt, Jordan, Kuwait, Nigeria, Bulgaria, United Kingdom, China, Thailand, Kazakhstan, United States, Oman, Czech Republic, Tunisia, Syrian Arab Republic, Poland, Tunisia, Nigeria,).

More than 50% of our participants participated from abroad. This shows that the conference meets the criteria of being international.

It is also an aim of the conference to encourage opportunities for collaboration and networking between senior academics and graduate students to advance their new perspective. Additional emphasis on ICOMAA-24 applies to other areas of science, such as natural sciences, economics, computer science, and various engineering

sciences, as well as applications in related fields. The articles submitted to this conference will be addressed on the conference web sites and, in the journals, listed below:

- Miskolc Mathematical Notes,
- Türkiye Mathematical Sciences
- Sigma Journal of Engineering and Natural Sciences,
- Istanbul Commerce University Journal of Sciences,
- Journal of Nonlinear Sciences and Applications,
- *Special Issue "Symmetries of Difference Equations, Special Functions and Orthogonal Polynomials" in Symmetry,

This booklet contains the titles and abstracts of almost all invited and contributed talks at the **7th International E-Conference on Mathematical Advances and Applications**. Only some abstracts were not available at the time of printing the booklet. They will be made available on the conference website https://2024.icomaas.com/ when the organizers receive them.

We wish everyone a fruitful conference and pleasant memories throughout the online conference.

Prof. Dr. Yusuf ZEREN
On Behalf of Organizing Committee
Chairman

It was a big excitement moment when Prof. Dr. Yusuf ZEREN discussed with me on the issue of "6th International Hybrid Conference on Mathematical Development and Applications" (ICOMAA-2024) in Yıldız Technical University, Istanbul. It is a great pleasure that this conference is going to take place now. As one of the organizers of the conference, I am delighted with all the delegates, distinguished mathematicians, speakers and young researchers in this international event. It is expected that delegates and participants will benefit from this conference experience and the legacy of information dissemination will continue.

I wish all of you to have a nice and enjoyable participation in the conference.

Prof. Dr. Necip ŞİMŞEK

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Edanur Ergül Arslan, Marmara University, Türkiye

CONTENTS

INVITED TALKS

.

Alexander MESKHI

Abstract

On weighted Cesáro, Copson and Tandori function spaces

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Abstract

The main objective of this talk is to provide a comprehensive demonstration of recent results regarding the structures of Cesàro, Copson, and Tandori function spaces. The definitions of these spaces involve local and global weighted Lebesgue norms, in other words, the norms of these spaces are generated by positive sublinear operators and by weighted Lebesgue norms.

Our main approach to studying these spaces will be the so-called discretization technique. Our technique will develop the approach initiated by K.G. Grosse-Erdmann in [1], enabling us to obtain the characterization in previously unavailable situations, thereby solving longstanding open problems. We will present the main tools of the discretization technique, and with this approach, we will obtain equivalent representations of these spaces. We will show that these spaces contain Herz spaces and Wiener Amalgam spaces as special cases by choosing particular (exponential and power type) weights or parameters.

We investigate the relation (embeddings) between these spaces and present the associate spaces' characterizations. We are going to show that the problem of characterizing pointwise multipliers between weighted Cesàro, Copson, and Tandori function spaces reduces to that of characterizing embeddings between weighted Cesàro, Copson, and Tandori function spaces.

Keywords: Cesaro space, Copson space, Tandory spaces, Hardy operator, Embedding theorems, associate space, Cesaro and Copson operators

References:

1. K.-G. Grosse-Erdmann. The blocking technique, weighted mean operators, and Hardy's inequality, Volume 1679 of Lecture Notes in Mathematics. Springer-Verlag, Berlin, 1998.
2. A . Gogatishvili, R. Mustafayev, and T. Ünver. Embeddings between weighted Copson and Cesàro function spaces. Czechoslovak Math. J., 67(142)(4):1105–1132, 2017.
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David Cruz-Uribe, OFS
The University of Alabama

Abstract

Dirichlet problem for a non-uniformly elliptic equation with L^1 data

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Abstract

The topic existence of solutions of uniformly elliptic equations with L^1 data was started by Stampacia [2]. On the study the $L^1(D)$ or $f(z)$ to be a measure μ of bounded variation the Dirichlet problem for elliptic and parabolic equations (also nonlinear) we quote the series of works by Boccardo and his coauthors [1]. In this note we have considered such problem in the setting of non-uniform elliptic equation

$$\sum_{i,j=1}^{N}\frac{\partial}{\partial z_i}\left(a_{ij}(z)\frac{\partial u}{\partial z_j}\right)+\sum_{i=1}^{N}b_i(z)\frac{\partial u}{\partial z_i}+c(z)u=f(z) \tag{1}$$

satisfying the conditions of non-uniform ellipticity

$$C_1(w(x)|\xi|^2+|\eta|^2)\le\sum_{ij=1}^{N}a_{ij}(z)\zeta_i\zeta_j\le C_2(w(x)|\xi|^2+|\eta|^2) \tag{2}$$

for $\forall\zeta\in\mathbb{R}^N$ with $\zeta=(\xi,\eta)$ and $\xi\in\mathbb{R}^n$, $\eta\in\mathbb{R}^m$; $n,m\ge 1$. Where $z=(x,y)\in D$ and $D\subset\mathbb{R}^N$ is a bounded subdomain. A sufficient condition is proposed on the functions $b_i(z), c(z), w(x)$ in order to the very weak solution existence for the homogeneous Dirichlet problem for the equation (1), $u|_{\partial D}=0$.

The proofs are based on the Sobolev-Poincare type non-uniform gradient inequality [3, 4]

$$\left(\frac{1}{|Q_R^{z_0}|}\int_D|f(z)|dz\right)^{1/q}\le CR\left(\frac{1}{w|Q_R^{z_0}|}\int_D\left[w(x)|\nabla_x f|^2+|\nabla_y f|^2\right]dz\right)$$

for a fixed $z_0=(a,b)\in D$ and all $f\in Lip_0(\bar{D})$ valid under the conditions $w\in A_2(\mathbb{R}^n)$ -Muckenhoupt class and being satisfied by some $q\ge 2$

$$\left(\int_{K_R^x}w(s)ds\Big/\int_{K_R^x}w(s)ds\right)^{\frac{1}{2}-\frac{m}{2}\left(\frac{1}{2}-\frac{1}{q}\right)}\ge C(r/R)^{1-\frac{m(n+2)}{2}\left(\frac{1}{2}-\frac{1}{q}\right)}$$

for all $r\in(0,R)$, $x\in K_R^a$ - the $n-$dimensional Euclidean ball centered in $a-$of radius R.

References:

1. L. Boccardo,T.Gallouet, Nonlinear elliptic and parabolic equations involving measure data, J. Funct. Anal.87, (1989),149–169.
2. G. Stampacchia, Le probleme de Dirichlet pour les equations elliptiques du second ordre a coefficients discontinus, Ann. Inst. Fourier Grenoble 15, (1965), 189–258.
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Almost Convergence And Applications

Mohammad MURSALEEN
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Abstract

The methods of almost summability and statistical summability have become an active area of research in recent years. The significance of the concept of summability has been strikingly demonstrated in various contexts, e. g. in Fourier Analysis, Analytic Continuation, Quantum Mechanics, Fixed Point Theory, Probability Theory and Approximation Theory [1].
In this talk we deal exclusively with the study of regular and almost regular summability methods and their applications to study the summability of Taylor series.

References:

1. M. Mursaleen, Applied Summability Methods, Springer Briefs, Heidelberg New York Dordrecht London, 2014.
2. G. G. Lorentz, A contribution to the theory of divergent sequences, Acta Math., 80 (1948) 167-190.
3. J. P. King, Almost summable sequences, Proc. Amer. Math. Soc. 17 (1966) 1219-1225.

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Nizamettin AYDIN

Abstract

Exponential Integrability in the Degenerate Regime

Scott RODNEY
scott.rodney@gmail.com

Abstract

In this talk I will discuss exponential integrability results obtained with D. Cruz-Uribe in 2018. Following this, I will describe possible generalizations and open questions.

Keywords: Exponential Integrability, degenerate elliptic equations, Sobolev Spaces

References:

1. D. Cruz-Uribe and S. Rodney, Bounded Weak Solutions to Elliptic Equations with Data in Orlicz Spaces, J. Diff. Eq. Vol. 297, pp. 409-432 (2021)
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Sofiène Tahar

Abstract

Mixed Problem for a Nonlinear Partial Differential Equation with Fractional Analog of the Barenblatt-Zheltov-Kochina Operator

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Abstract

The problems of unique regular solvability and the construction of the solution of a mixed problem for nonlinear differential equations that contain the fractional analog of the Barenblatt-Zheltov-Kochina operator are studied. The method of a Fourier series based on the separation of variables is used. Corresponding spectral problem is solved. A countable system of nonlinear integral equations is obtained. Sufficient coefficient conditions for the unique solvability of the countable system are established. The method of successive approximations combined with the method of compressing mapping are applied in the proof of existence and uniqueness of countable system. The solution of mixed problem is constructed in the form of Fourier series. Absolute and uniform convergence of Fourier series is proved.

Keywords: *Mixed problem, nonlinear differential equations, fractional analog of Barenblatt-Zheltov-Kochina operator, Hilfer fractional operator, rehular solvability.*

References:

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5. G. I. Chandirov, Mixed problem for quasilinear equations of hyperbolic type. Diss. ... Doc. Physics and Mathematics. Azerb. State Univers., Baku, 1970.

Stabilization of solutions to second order in time systems of viscoelastic fluid flow

Varga KALANTAROV
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Abstract

The talk will be devoted to the initial boundary value problem for the second order in time equations modelling the dynamics of viscoelastic fluids. Our man goal is to prove existence of an exponential attractor of the semigroup generated by the considered problem and investigate the problem of stabilization of the system by controllers depending on finitely many parameters.

Tiling Morrey spaces and weighted Morrey spaces

Yoshihiro Sawano
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Abstract

We consider the boundedness property of the operator on weighted Morrey spaces. It is still an open problem to have a complete Muckenhoupt type characterization for Morrey spaces. This talk is address to this problem together with some related observations. We use tiling Morrey spaces.

Keywords: tiling Morrey spaces, weighted Morrey spaces

References:

1. Y. Sawano and H. Tanaka, Tiling Morrey spaces – as a dyadic toy model, in preparation
2. G. Di Fazio, D.I. Hakim and Y. Sawano, Morrey Spaces, Vol. I. Introduction and applications to integral operators and PDE's. Monographs and Research Notes in Mathematics. CRC Press, Boca Raton, FL, 2020. 479 pp. ISBN: 978-1-4987-6551-0; 978-0-429-08592-5 46-02
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CONTRIBUTED TALKS

G $^{\alpha}_{\omega}$-Grill Topological Spaces

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Abstract

This work is centered around the concept of expanding topological spaces. In this study, we introduce and examine novel operators namely Φ^{α}_{ω} **and** Ψ^{α}_{ω}, along with their connection to the grill. We explore various topological properties associated with these operators, as well as their relationships with other established operators. Furthermore, we extend the notion of Fedral topological spaces by introducing G^{α}_{ω} - grill topological spaces, which are induced by the operators Φ^{α}_{ω} and Ψ^{α}_{ω}.

Keywords: Grill topological space, Induced topology, operators, Fedral topological spaces.

References:

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REFINEMENTS OF THE GENERALIZED NUMERICAL RADIUS OF HEINZ-TYPE INEQUALITIES

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Abstract

In this talk, we improve the generalized numerical radius version of the Heinz means inequalities by employing convexity and the Hermit-Hadamard inequality. Moreover, we present novel proofs for the generalized numerical radius of Heinz-type inequalities.

Keywords: Heinz inequality, unitarily invariant norm, numerical radius, generalized numerical radius, Hermit-Hadamard inequality.

References:

1. A. Abu-Omar and F. Kittaneh, A generalization of the numerical radius, Linear Algebra Appl. 569(2019), 323-334.
2. R. Bhatia, C. Davis, More matrix forms of the arithmetic–geometric mean inequality, SIAM J. Matrix Anal. Appl. 14 (1993) 132–136.
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On the Returnability of Linear Control Systems through Bounded Controls in Finite Time

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Abstract

We study the two-dimensional Brunovsky system. Given an initial point x0 in R^2, we consider the problem of finding a set of bounded controls that allows to return to the state x0 in finite time T(x0), see [1].
The Korobov's controllability function (CF) method [2], [3] is used. In particular, the case where CF represents the motion time from x0 to the same point. Additionally, we present the solution of the aforementioned problem with the condition that the objective is achieved in the optimal time.

Keywords: Brunovsky system, bounded control, controllability function, optimal time control.

References:

1. Choque-Rivero A. E., Mullisaca E. C. and González G. A. Returning to the same point through bounded controls in finite time, 2022 IEEE International Autumn Meeting on Power, Electronics and Computing (ROPEC), Ixtapa, Mexico, (2022), 1–4.
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Topological Descriptors and Polynomials of Hourglass Benzenoid Series

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Abstract

Topological indices and coindices, numerical quantities derived from the chemical graph of a molecule, are widely employed in modeling the physicochemical properties of molecular compounds. This research focuses on the investigation of various topological descriptors of the Hourglass Benzenoid series HB_k. Specifically, we compute and analyze a range of topological descriptors for the HB_k series, including well-established indices such as the generalized modified Zagreb indices. Additionally, we derive the polynomial indices of the molecular graphs associated with the HB_k series.

Keywords: Topological indices and coindices, Hourglass Benzenoid series HBk, polynomial indices.

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Fractional maximal operator in the local Morrey-Lorentz spaces and some applications

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Abstract

In this study, we obtain the necessary and sufficient conditions for the boundedness of the fractional maximal operator in the local Morrey- Lorentz spaces. We use sharp rearrangement inequalities while proving our result. We apply this result to the Schrödinger operator for the nonnegative potential belongs to the reverse Hölder class. The boundedness of Schrödinger-type operators in the local Morrey- Lorentz spaces are obtained.

Keywords: Local Morrey-Lorentz spaces, fractional maximal operator, Schrödinger operator.

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Existence and Uniqueness of Positive solution for a Singular Caputo-Fractional Boundary Problem

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Abstract

In this work, some existence and uniqueness results are presented for a certain singular Caputo-fractional differential equation with integral boundary conditions. The problem is firstly transformed to an equivalent fractional integral equation and well-known fixed-point theorems such that Banach and Schauder are then applied. In addition, the contractive form of the Krasnosel'skii cone theorem is used in order to prove existence of positive solutions for the problem.

Keywords: Banach and Schauder fixed point, Completely continuous operator, Fractional differential.

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Coefficient Estimates for Certain Subclasses of Analytic Functions Associated with The Combination of Differential Operators

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Abstract

In this study, we introduce and study some new subclasses of analytic functions defined by the combination of Al-Oboudi differential and Noor integral operators, and obtain coefficient estimates and Fekete-Szegö inequalities for these new subclasses.

Keywords: Fekete-Szegö problem, Analytic functions, Starlike and convex functions of complex order, Al-Oboudi differential operator, Noor integral operator.

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Majorization Results for a Subclass of Meromorphic Functions Involving $q-$Al-Oboudi Differential Operator

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Abstract

In this study, we investigate several majorization results for a subordination class of meromorphic functions of complex order, defined by $q-$Al-Oboudi differential operator. Moreover, we point out some new or known consequences of our result, which is in the form of corollaries.

Keywords: Meromorphic functions, Majorization problem, Starlike functions of complex order, Subordination, $q-$Al-Oboudi differential operator.

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A Novel Class of Proximity Spaces

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Abstract

Proximity space is a frequent concept in mathematics, computer science, and pattern recognition. Acharjee et al. have presented a new mathematical framework called "primal." Thus, the primary goal of this work is to present and investigate the primal-proximity spaces. Furthermore, we build two novel operators using primal proximity spaces and study some of their essential characteristics. Additionally, the new operators create a weaker topology compared to the previous one. Furthermore, we explore some of their qualities and augment with specific instances.
Keywords: Primal, grill, primal-space, proximity space, primal-proximity spaces.

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ON SEPARATION AXIOMS FOR REGULAR GENERALIZED Gω –OPEN SETS IN GRILL TOPOLOGICAL

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Abstract

In this paper, we introduce and study some weak forms of separation axioms via generalized **G**$^{\omega}$–open sets called, G_g^{ω}–T_2–space, , G_{rg}^{ω}–$T3$–space and , G_{rg}^{ω}–T_4–space in grill topological space (X, τ, G) which are weak forms of T_2–space, $T3$–space and T_4–space in (X, τ), respectively. We introduce weak forms of separation axioms via regular generalized **G**$^{\omega}$–open sets, called G_{rg}^{ω}–T_2–space, G_{rg}^{ω}–$T3$–space and G_{rg}^{ω}–$T4$–space which are weak forms of G_g^{ω}–T_2–space, G_g^{ω}–$T3$–space and G_g^{ω}–$T4$–space, respectively in grill topological space (X, τ, G).

Keywords: Generalized closed sets; Regular closed sets; Grill topological spaces.

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FUNCTIONAL IDENTITIES WITH EPIMORPHISM ON XY = 0 = Y X IN PRIME RINGS

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Abstract

Let ξ be an involution of a non-commutative unitary prime ring R with the maximal symmetric ring of quotients and the extended centroid of R denoted by $Q_{ms}(R)$ and C, respectively. Consider the additive maps, G and H : R → Qms(R) with epimorphism ξ and if $Q(g)h + Q(h)g + g^{\xi} T(h) + h^{\xi} T(g) = 0$ for all g, h ∈ R satisfying gh = 0 = hg, then we worked out the characterization of the maps Q and T . By active implementation of the FI-theory and solving the challenging case of low dimensions, we apprehended the forms of these maps as generalized X-inner unless $\dim_C RC \leq 4$. Moreover, an important application is also included as an independent sections which speaks about the worth of the work.

Keywords: Prime ring, involution, derivation, idempotent element, (weak)
Jordan *-derivation, maximal symmetric ring of quotients, polynomial identity (PI), functional identity (FI).

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A New chaos based generating function of the Mersenne polynomias and its applications

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Abstract

In this paper, we propose a generating function for Mersenne polynomials with typical period doubling to chaos. In this context, the bifurcation diagram and Lyapunov exponent proved that the proposed generating function is a deterministic system that exhibits chaotic behavior for specific values of the control parameters. As an application, this proposed generating function is used as a chaos-based cryptosystem to encrypt different images..

Keywords:
Mersenne polynomials, Generating functions, Cryptosystem, Bifurcation diagram.

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Time-Reversible 5D Hyperchaotic System

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Abstract

In this talk, we present a newly proposed hyperchaotic system constructed by five differentional equations which is time-reversible. The stability analysis of the proposed system shows either hidden attractor or self-excited with a very complicated nature of equlibirum points. Some of the recent interesting hyperchaotic systems were presented in the references below.

Keywords: Hyperchaotic system, time-reversible, bifurcation.

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Exploring Neighboring Fibonacci Numbers and Related Sequences

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Abstract

Considering the strong bond between Fibonacci and Lucas numbers, we named the family of number sequences formed by successively increasing the initial value of Fibonacci numbers as neighbors of Fibonacci numbers. We created similar families of number sequences, which we call neighors….Number sequences, from the number sequences we call Narayana numbers, Cyclic numbers, Tribonacci numbers ,and Generalized numbers. General representations of these number sequences were obtained. Some properties of Fibonacci numbers, especially the Cassini feature, were investigated in the neighbors Fibonacci numbers. Some identities have been obtained and these identities have been proven. Some identities have been obtained from the determinants of matrices produced from neighboring Fibonacci numbers. Inspired by the Q matrix, which is the Fibonacci generator matrix, two different matrices that produce elements in a certain order for neighboring Fibonacci number sequences were identified, and the elements produced by the powers of these matrices were determined. In the section we call multi-representation arrays, the necessary algorithm for the representation of an array based on different numbers of elements has been created.

Keywords: Generalized Fibonacci sequences, multi-representation sequences,k-Fibonacci numbers

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The New Orthogonal Saban Frame and The Evolution of Orthogonal Saban Framed Curves in S^2

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Abstract

In this paper we define the modified orthagonal Saban frame with curvature in S^2 and show that the modified orthagonal Saban frame is a generalisation of the Saban frame. We study the evolution of curves on modified orthagonal Saban frame and we obtain the necessary conditions for the inextensible flow of curves on modified orthogonal Saban frame.

Keywords: Saban Frame, Modified Orthagonal Saban Frame, Evolution, Inextensible Flow.

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Induced Sushila Distribution: Statistical Properties and Applications

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Abstract

In this article, as a modification of the base Sushila distribution (SD) the induced Sushila distribution (ISD) is suggested. Various statistical properties of the ISD are established and proved as the survival function, odds function, hazard function, cumulative hazard function, reverse hazard function and mean inactivity times. Also, the moments, moment generating function, coefficient of skewness, coefficient of kurtosis, and coefficient of variation are obtained and investigated numerically. Also, the stress-strength reliability, distribution of order statistics and some entropies are obtained. The distribution parameters are estimated using the maximum likelihood method with some simulations. The proposed model is compared with some competitors in fitting real data set to illustrate its usefulness in the field.

Keywords: Sushila distribution; Induced distribution; Weighted distribution; Reliability analysis; Rényi entropy; Lifetime distribution.

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On the existence of solutions for p(t)-laplacian fractional boundary value problem via variational methods

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Abstract

The aim of this work is to study the existence of results for boundary value problem with fractional derivative and the equation of p(t)-laplacian type. We use the variational method to prove the solutions of our problem.

Keywords: Fractional derivative equation, nonlinear boundary value problem, fractional integral and fractional derivative, variational methods.

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On a difference equations linked to generalized Balancing numbers

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Abstract

In this work we propose theoretical explanations regarding how solutions are represented for higher-order difference equations, connecting these solutions to generalized Balancing numbers. Furthermore, we explore the stability traits and asymptotic tendencies of this equation.

Kyewords: General solution, generalized Balancing numbers, stability, difference equations.

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Existence solutions for fractional boundary value problems with p(t)-Laplacian type

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Abstract

In this work is to study the existence of the solutions to a boundary value problem with p(t)-Laplacian type, and the second term of this problem is non linear function. By using the fixed point theorem, which guarenties the solutions of our problem.

Keywords: Fractional differential equation, fractional derivative and integrale, existence fixed point theory.

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On Several New Generalized Fractional Inequalities For Differentiable Functions

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Abstract

Inequalities involving fractional operators have also been an active area of research. These inequalities play a crucial role in establishing bounds, estimates, and stability conditions for solutions to fractional integrals. I will explore numerical integration methods, specifically Midpoint rule and Trapezoid rule. I will also discuss adaption of these inequalities for various function classes, demonstrating how these inequalities suite different mathematical scenarios. Moreover, we will explore their version in fractional integrals, showcasing their flexbility in handing diverse fractional calculus operations. Furthermore, we have improved the error bounds of Trapezoid-type inequality.

Keywords: Midpoint-type inequalities; Trapezoid-type inequalities; Caputo-Fabrizio fractional integrls.

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A Comprehensive Study on Hermite-Hadamard Inequalities involving Tempered Fractional Integrals

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Abstract

In the current investigation, upper and lower limits are determined for inequalities of midpoint-type and trapezoid-type which incorporate Tempered fractional integral operators. These bounds are derived through the utilization of mappings characterized by bounded second derivatives. These inequalities encompass previously established results such as Riemann integrals and Riemann-Liouville fractional integrals. Additionally, we establish the Hermite-Hadamard inequality, which incorporates Tempered fractional integrals, utilizing the condition $F'(\sigma+\rho-x) \geq F'(x)$, for all $x \in \left[\sigma, \frac{\sigma+\rho}{2}\right]$, rather than relying on the convexity of the function.

Keywords: Hermite-Hadamard inequality, integral inequalities, bounded functions, Tempered fractional integrals.

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On an Inverse Scattering Problem for Discontinuous Second-Order Differential Operators with Herglotz Function of Spectral Parameter in Boundary Condition

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Abstract

We consider a boundary value problem generated by second-order differential operators on the half line ($0 \leq x < \infty$) with a discontinuous coefficient and Herglotz function of the spectral parameter in the boundary condition. This work aims to investigate the inverse scattering problem. In the process, an integral equation is derived from the given scattering data, and its unique solvability is proved. As a result, we present the reconstruction of the potential function.

Keywords: Second-order differential operators, boundary value problem, scattering data, spectral parameter, discontinuous coefficient.

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A Finite Element Solution of The Two-Dimensional Burgers' Equation

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Abstract

This study focuses on the investigation of numerical solutions of the two-dimensional Burgers' Equation. To achieve that aim, the study offers two-point discretization in time and the Galerkin Finite Element Method. In the present method, the backward finite difference in time and the finite element method in space are applied to solve the two-dimensional Burgers' equation, and then the resulting system of the nonlinear ordinary differential equations obtained at each time step is solved by using computer codes generated in MATLAB. To show the efficiency of the presented method, the numerical solutions evaluated for various values of viscosity at different times are stated in terms of the error norms. These methods are seen to be a very good choice to obtain a high degree of accuracy for the numerical solution of the Burgers' equation in two dimensions.

Keywords: Two-Dimensional Burger's equation, time discretization, the backward finite difference, Galerkin finite element method**.**

Acknowledgements

This study has been supported by Yildiz Technical University Scientific Research Projects Unit (BAP) under Grant No. FDK-2023-5821.

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Nonexistence of Global Solutions for the m-Biharmonic Heat Equation

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Abstract

Inthispresentation, weconsiderthem−Biharmonic heat equationwithvariablecoefficients.This type problem occurs in many mathematical models of applied science, such as heat transfer, chemical reactions.Undersuitableconditions on variablecoeffcients, weprovetheblowup of solutions.Weestablishtheblow-up time using a differentialinequalityargumenttodeterminewhenblow-upoccurs.

Keywords: Heat equation, m−Biharmonic equation, Nonexistence.

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On Weighted Ostrowski Inequalities on Time Scale Calculus

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Abstract

The theory of time scales is one of the important cornerstones of functional analysis and operator theory. Recently, it has been the subject of many studies from different disciplines. For example, it has become the field of study of many researchers working in mathematics, economics, physics, optics, engineering, and other fields. In this study, a new approach to the weighted Ostrowski-type inequality is presented using nabla calculus on time scales.

Keywords: Weighted function, Time scale, Ostrowski inequality.

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On the Algebraic Structures of Hybrid Numbers with Matrix Theory

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Abstract

Hybrid number system is defined as a non-commutative number system that includes complex, hyperbolic and dual numbers in special cases. In this study, we introduce nilpotent, idempotent and zero divisor elements for hybrid numbers with the help of 2x2 hybrid matrices. In addition, we obtain nilpotent hybrid numbers are lightlike parabolic pure hybrid numbers and idempotent hybrid numbers are lightlike hybrid numbers. Moreover, similar cases exist for zero divisor hybrid numbers, and we present examples supporting the theory.

Keywords: Hybrid number, nilpotent element, idempotent element, zero divisor element.

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On the strong solvability of a nonlocal boundary value problem for the Poisson's equation in a rectangular

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Abstract

The following nonlocal problem for the Poisson's equation in a rectangular domain is considered:

$$u_{xx} + u_{yy} = f(x;y),\ 0 < x < 2\pi,\ 0 < y < h, \quad (1)$$

$$u(x,0) = \varphi(x), u(x,h) = \psi(x),\ 0 < x < 2\pi, \quad (2)$$

$$u_x(0,y) = 0, u(0,y) = u(2\pi,y),\ 0 < y < h. \quad (3)$$

Such problems have specific features in comparison with problems with local conditions. For the Laplace equation in an unbounded domain, a similar problem was considered in [1,2], where the classical solution of the problem is studied. The homogeneous case of this equation was considered in [3] in a bounded domain in weighted Sobolev spaces.

Earlier in [4], problems with nonlocal boundary conditions for a shifted equation were considered. For elliptic equations, nonlocal problems were considered in [5].

In this paper, we study problem (1)-(3) in a weighted Sobolev space with a weight from the Mackenhoupt class. The notion of a strong solution of this problem is defined. Using the Fourier method, under certain conditions on the functions $\varphi(x), \psi(x)$ and $f(x;y)$ we prove the correct solvability of this problem.

Keywords: Laplace equation, nonlocal problem, weighted Sobolev space, strong solution.
This work was supported by the Azerbaijan Science Foundation-Grant № AEF-MCG-2023-1(43)-13/06/1-M-06.

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Blow-up Result for a Fourth-Order Wave Equation with Dynamic Boundary Conditions

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Abstract

The paper aims to study the following fourth-order partial differential equation of quasi-linear type with bi-hyperbolic characteristics under dynamic boundary conditions:
where $a, b, t \geq 0, x \in \Omega$ and Ω is an open bounded connected region in $\mathbb{R}^n (n \geq 1)$ with a smooth boundary $\Gamma = \partial\Omega$. We employ a concavity approach based on the blow-up lemma by M. O. Korpusov [1] to establish the blow-up result under positive initial energy.

$$\begin{cases} u_{tt} + \Delta^2 u - \Delta u = bf(-\Delta u), & \text{in} \quad \Omega \times (0,T) \\ \Delta u = 0, \quad a\dfrac{\partial u_t}{\partial \eta} = \Delta^2 u & \text{on} \quad \Gamma \times (0,T) \\ u(x,0) = u_0(x), \quad u_t(x,0) = u_0(x) \end{cases}$$

Keywords: Blow-up, fourth-order wave equation, dynamic boundary conditions, positive initial energy.

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On the Extension of Singular Q-Dirac Type Operators

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Abstract

In this work, we consider a singular q-Dirac type operator. We construct a space of boundary values. Later, we give a description of all maximal dissipative, self-adjoint and other extensions of these operators.

Keywords: Singular q-Dirac type operators, a space of boundary values, extensions.

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Orthogonally Additive Maps

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Abstract

In this study, we define and explore orthogonally additive maps. Our main result claims that, order continous orthogonally additive maps in vector lattices associated with laterally to order continuity refers its order continuity.

Keywords: Orthogonally additive maps, Order continous, Laterally order continuity.

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Numerical Solution of Some Integral Equations

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Abstract

In many areas related to engineering and brunches of sciences, differential and integral equations have an important place. Many complicated problems arising from these areas are expressed with these equations.
In our work, we consider a class of an integral equation and worked on the numerical solution of these integral equation class. Results are given by table and graphically.

Keywords: Numerical solution, Integral equation, Collocation methods.

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Different approach to divisibility by two -digit prime numbers

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Abstract

In this study, divisibility by two-digit prime numbers has been examined from a different perspective. Generalizations of divisibility that are suitable for all types of groupings have been created by the system that we call the prime resiude circle of the prime number.

Keywords: **P**rime numbers, divisibility, remainder groups

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Huffman encryption with amino acids

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Abstract

As an alternative to the DNA encryption that exists in the literature, it consists of three organic bases an encryption algorithm was created based on amino acid groups. This algorithm 441 different amino acids are based on cartesian multiplications of amino acid groups when creating the pair is formed. Our character set is made by binary conversions of Ascii codes the character set has been translated to base 2. 256 Of the extended Ascii codes are with this system it was created. The cartesian multiplications of amino acids by Decumbering them between 0 and 20 are it was created. Amino acids will express the digits of Ascii values in the base 21 it is grouped in this way. Since some amino acids arise with more than one codon(degeneration) can convert the resulting amino acid sequence into a list of organic bases in more ways than one. This means that if we want, if we choose the codons of amino acids in a certain way, we can calculate the numbers A, T, G, C we can partially change it. Using this, Huffman will give us the shortest value when we apply we have created a list of organic bases.

Keywords: DNA, cryptology, Huffman coding,

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Stability of the KdV equation with delay

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Abstract

In this work, we study the well-posedness and the exponential stability of the Korteweg-de Vries equation with internal feedback without delay and a boundary feedback with delay under some assumption on the length of the spatial domain using a Lyapunov functional approach.

Keywords: KdV equation, time delay, well-posedness, exponential stability, Lyapunov functional.

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A class of entire functions defined by Hadamard product

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Abstract

In this paper we obtained some results for entire functions defined by Atshan and Rafid operator.

Let Φ be the class of entier univalent functions of the form:

$$f(z) = (z - z_0)\sum_{k=2}^{\infty} a_k (z - z_0)^k,$$

if the function satifies the following condition :

$$\sum_{k=2}^{\infty} \mathrm{K}(\mathrm{k}, \theta, \mu)[1 + \lambda(\mathrm{k} - 1)][(\mathrm{k} - 1)(1 - 2\alpha) + |\mathrm{k} - 2\beta + 1|]\, b_k a_k R^{\mathrm{k}-1} \leq 2(\beta - 1)$$

then

$$f(z) E_{\mu}^{\theta}(f, g, \lambda, \beta, \alpha).$$

Keywords: Entire function, hadamart prodact, Atshan and Rafid operator.

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On Some Advanced Expressions Involving a Homeomorphism for Amalgam Spaces

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Abstract

In this work, the author considers an amalgam space $\left(L^{p},l^{q}\right)$ with $1\leq p,q\leq\infty$. Moreover, the multipliers and completion properties of these spaces are investigated. Finally, the author shows an isomorphism between the space of multipliers and amalgam space.

Keywords: homeomorphism, amalgam space, approximate identity.

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IFS of Orbital Type and Continuity Dependence Property

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Abstract

We discuss on some class of iterated function systems satisfying the condition of orbital type and present some of their properties. Next we provide the sufficient conditions guaranteeing the continuity dependence property. The attractors of the considered IFSs change continuously with respect to the change of parameters. Illustrating examples will be presented.

Keywords: Iterated function system, Continuity dependence, Attractor, Hausdorff metric.

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Leveraging AI Technologies in Teaching Mathematics

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Abstract

Mathematics education is a cornerstone of college curricula, yet many students struggle with its abstract concepts and complex problem-solving techniques. Traditional teaching methods often fail to adequately address individual learning needs and engagement levels. AI technologies offer promising solutions to these challenges by providing personalized learning experiences, adaptive feedback mechanisms, and innovative instructional tools. This research explores the integration of Artificial Intelligence (AI) technologies into mathematics education at university level by delving into the current landscape, challenges, and opportunities associated with employing AI in teaching mathematics, focusing on its impact on student learning outcomes, pedagogical approaches, and the role of instructors.The research employs a mixed-methods approach, combining quantitative analysis of student performance data with qualitative examination of instructor and student experiences. The study focuses on a sample of college-level mathematics courses where AI technologies, such as intelligent tutoring systems, automated grading systems, and virtual assistants, are integrated into the curriculum. Preliminary findings indicate that AI-enhanced mathematics instruction leads to improved learning outcomes, increased student engagement, and enhanced instructor efficiency. AI algorithms can adapt content delivery based on individual student progress, offering personalized remediation and enrichment activities. Automated grading systems streamline assessment processes, providing timely feedback to students and reducing instructor workload. Virtual assistants equipped with natural language processing capabilities facilitate interactive learning experiences, allowing students to ask questions and receive instant explanations. However, challenges persist in the implementation of AI technologies in mathematics education. Concerns regarding data privacy, algorithm bias, and accessibility need to be addressed to ensure equitable learning opportunities for all students.

Keywords: AI, Teaching Mathematics, Tecnology in Teaching & Learning, AI Challenges.

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On Reducing and Minimality of Exhausters by Inclusion

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Abstract

Exhausters are effective tools to present optimality conditions and determine steepest descent and ascent directions for nonsmooth and nonconvex optimization problems. Moreover, reduction and minimality of an exhauster is a leading problem because of its non-unique structure. In this work, we present some results on reducing exhausters by means of $\theta\rho$-representations of compact convex sets. For this purpose, namely, to reduce the number of sets in a given exhauster, we define the set of all active angles of each set according to the $\theta\rho$-representations and we propose a technique to decide whether a set is required for the exhauster or not. Finally, we discuss the minimality (by inclusion) of an exhauster.

Keywords: Exhausters, Reduction of exhausters, Positively homogeneous functions, Nonconvex functions, Nonsmooth optimization problems.

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On the Blow-up Solutions to a Fourth Order Pseudo-Parabolic Equation with Gradient Non-Linearity

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Abstract

In this note, the initial and periodic boundary value problem was solved for the following fourth-order pseudo-parabolic equation with gradient non-linearity and pseudo term

$$u_t - a\Delta u_t - \Delta u + \Delta^2 u = -\nabla.(|\nabla u|^{p-2}\nabla u)$$

where $a \geq 0$.
Local existence-uniqueness result for mild solutions was found for any initial data in $L^2(\Omega)$.
In addition, the existence of blow-up solutions was proved and a lower bound for the blow-up time was obtained.

Keywords: Fourth order pseudo parabolic equation, Gradient non-linearity, Existence-uniqueness, Blow-up, Lower blow-up time

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New generating functions of the products of Gaussians numbers with some numbers and polynomials

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Abstract

In this work, by using properties of the symmetric functions, we prove a new theorem and we derive new generating functions for the product of Gaussian numbers (Gaussian Tribonacci, Gaussian Tribonacci Lucas, Gaussian Padovan), (p,q) numbers : (p,q) Fibonacci, (p,q)Lucas, (p,q) Pell Lucas.

Keywords: Gaussian Tribonacci, Gassian Trobonacci Lucas, Gaussian Padovan, generating function,

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Korovkin type approximation of q-conformable fractional linear positive operator

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Abstract

Conformable fractional calculus and q-calculus are mathematical concepts that have been studied in various fields. The conformable fractional q-derivative is a new deformation and generalization of the natural integral transform [1]. It has been used to solve linear differential equations with given initial conditions [2]. The study of conformable q-fractional calculus has led to the definition of conformable fractional q-derivative and q-integral, and their fundamental theorems have been proved [3]. The q-calculus derivative is a continuous approximation of the fractal derivative of a fractal function [4]. Fractional calculus, including conformable fractional calculus, is widely used in various fields such as biology, control systems, and engineering to describe physical phenomena more accurately.

In this study, q-calculus and conformable fractional calculus are used in the theory of approximations. A new sequence of linear positive operators is defined using the derivative and integral definitions of q-calculus and conformable fractional calculus. The Korovkin type approximation theorem is proved for this operator.

Keywords: Linear positive operators, q-calculus, conformable fractional derivative, Korovkin type theorem.

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On the Prediction of Cardiovascular Diseases with Machine Learning Classification Algorithms

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Abstract

Cardiovascular disease constitutes 37% of non-communicable disease deaths, leading to the highest number of deaths and disabilities worldwide. Early diagnosis of cardiovascular diseases, which cause a large majority of deaths, has become important. With the advancement of technology, the amount of data in the health sector has increased today. The classification of data using machine learning techniques and the extraction of meaningful information through predictive analyses with this increasing amount of data in the health sector is important for the early diagnosis of cardiovascular diseases. This study aims to contribute to the early diagnosis of the disease by reaching the most successful classification prediction algorithm applied to a dataset with 11 features created from 70,000 real patient data. Initially, the dataset was analyzed, and the PCA (Principal Component Analysis) method was applied. It has been determined which features may cause cardiovascular diseases, and the features have been visualized comparatively. With feature engineering, the patient's blood pressure was categorized as normal, high blood pressure, optimal, and hypertension. Subsequently, cardiovascular disease detection was performed using logistic regression, decision tree, random forest, support vector machines, k-nearest neighbors, XGBoost, gradient boosting, LightGBM, AdaBoost, and ExtraTree methods. The XGBoost method was found to be more successful than other methods with an accuracy rate of 96.60%. This method was followed by LightGBM with an accuracy rate of 91.21% and ExtraTree with 90.26%. After the classification process, a confusion matrix was used to understand whether the model's accuracy reflects reality. The accuracy rate of the XGBoost method has been interpreted graphically with the ROC (receiver operating characteristic) curve, one of the methods for evaluating the success of classification models. The AUC (Area under the ROC Curve) score, which is the area under the ROC curve, has been calculated.

Keywords: Machine Learning, Cardiovascular Disease, Data Analysis, Classification Algorithms.

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Baer Annihilator Conditions for Nearrings

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Abstract

A ring with unity is called Baer if the left annihilator of each nonempty set is generated by an idempotent element. This concept has been generalized to nearrings. However, the Baer concept of nearrings is divided into at least four different classes. We examine certain nearring decompositions obtained by using Baer annihilator conditions. Examples are used to demonstrate our results.

Keywords: Nearring, Baer Ring, Annihilator Conditions, Semicentral Idempotent.

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The Golden Fibonacci Matrix Calculus

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Abstract

In this paper, we extend the Golden Fibonacci calculus, which is an application of the Fibonacci number sequences, to matrices. We introduce the Golden exponential, Golden trigonometric and Golden hyperbolic matrix functions. We define the Golden derivative operator of matrix functions and investigate the Golden derivatives of newly defined functions.

Keywords: Fibonacci sequence, Golden-Fibonacci calculus, matrix functions.

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Some results of the $(N,p,q)(E,pq)$ summability method and tauberian theorems for $(N,p,q)(E,pq)$ statistically convergence in m-normed spaces

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Abstract

This paper aims to generalized the Norlund-Euler summability method and introduce a novel type of convergence associated with it, termed as generalized Norlund-Euler statistical convergence. Furthermore, we establish several results pertaining to this convergence notion. Additionally, we demonstrate Tauberian theorems for the Norlund-Euler summability method within the framework of statistical convergence in an m-normed space X.

Keywords: Statistical convergence; (N,p,q)(E,pq) summability method; Korovkin's type; approximation theorem; Rate of generalized weighted (N,p,q)(E,pq) statistical convergence; Tauberian theorems for (N,p,q)(E,pq) summability method.

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Solution of Langevin and p-Laplacian fractional differential equations in tempered sequence spaces

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Abstract

In this study, l_n^{α}, $p \geq 0$ tempered sequence spaces with the Hausdorff non-compactness measure are examined. In this space, the Darbo fixed point theorem and the existence of solutions of Langevin and p-Laplacian operators in the infinite system are examined and numerical examples are given.

Keywords: Tempered sequence spaces, fractional derivative, Banach space, measure, Hausdorff measure, non-compactness, Langevin, p-Laplacian

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RELATIVE IDEALS IN TERNARY SEMIGROUPS

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Abstract

In this paper, after introducing the notion of relative left (right, lateral, two sided) ideal and relative bi (quasi) ideal in ternary semigroups, some important properties of these ideals are
studied. The smallest relative left (right, lateral, two sided, bi, quasi) ideal containing X is defined and its characterization is given. Finally, it was shown that the image and inverse image of relative ideals provide the same properties.

Keywords: relative ideals, bi ideals, left ideals, ternary semigroups.

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Developing an Original Image Encryption Method Using the Collatz Conjecture and Happy Numbers

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Abstract

The aim of this research is to develop, implement, and evaluate an original image encryption method using the Collatz conjecture and happy numbers to ensure the security of images. Numerical values corresponding to the pixel tones of images were utilized as a tool for this purpose. New pixel tone values were obtained by applying mathematical operations based on whether these numerical values were even, odd, or happy numbers. Four distinct encryption methods were developed using the Collatz Conjecture and Happy Numbers in the Python programming language. To determine the reliability of the encryption methods against artificial intelligence applications, Google-Gemini artificial intelligence software was used. Additionally, Geogebra dynamic geometry software and Jamovi statistical program were employed to establish mathematical relationships between loop count, encryption time, and pixel count. According to the research findings, it was determined that the encryption method using only the Collatz conjecture was more successful in terms of image privacy compared to the method using only happy numbers. The encryption method utilizing both the Collatz conjecture and happy numbers was found to be superior to other methods in terms of image privacy and processing time. It was observed that increasing the loop count in the software written in Python enhanced the image privacy. It was also established that loop and pixel counts affected the encryption time of images. In the encryption algorithm utilizing both the Collatz conjecture and happy numbers, a one-unit increase in loop count resulted in a 0.46-unit increase in time in seconds, while a 10,000-unit increase in pixel count led to a 0.866-unit increase in time in seconds. When the image encrypted using only the Collatz conjecture and happy numbers was tested against artificial intelligence software, some correct predictions were made, whereas in the encrypted image using both the Collatz conjecture and happy numbers, the artificial intelligence made several incorrect predictions. It is recommended that technology users or different researchers, if they choose to utilize one of the developed image-based encryption methods, opt for the Collatz conjecture-happy numbers algorithm or solely the Collatz algorithm for better performance in terms of time and privacy.

Keywords: Image Encryption, Happy Numbers, Collatz Conjecture, Programming

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A Multiplicative Gluing Formula for Reidemeister-Franz Torsion of High Dimensional Closed Manifolds

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Abstract

Let *M* be a *2n*-dimensional (n≥2), closed, oriented, smooth manifold which is obtained by a connected sum of two closed, oriented, smooth manifolds M_1 and M_2 . Milnor shows that Reidemeister-Franz torsion acts multiplicatively with respect to such gluings. Namely, the torsion of *M* is the product of the torsions of M_1 , M_2 , and the torsion of (*2n-1*)-sphere S^{2n-1} times a corrective term *T(H*)* coming from homologies. In this work, by using homological algebra techniques, we obtain a multiplicative gluing formula for the Reidemeister-Franz torsion of *M* with untwisted $\mathbb{R}$-coefficients so that the corrective term *T(H*)* becomes 1. Moreover, considering a connected sum decomposition for any *2n*-dimensional, closed, oriented, smooth manifold *W*, we develop a useful formula, without a corrective term, to compute the Reidemeister-Franz torsion of *W* with untwisted $\mathbb{R}$-coefficients in terms of the Reidemeister-Franz torsions of its building blocks in the decomposition.

Keywords: Reidemeister-Franz torsion, connected sum, orientable closed manifolds.

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New Technique of Adomian Method for Singular IVPs in a Class Second Order Ordinary Differential Equations

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Abstract

This paper focuses on the Adomian Decomposition Method (ADM) with a new differential operator as a technique for solving second-order Ordinary Differential Equations(ODEs). The linear and nonlinear singular initial value problems (SIVPs) were effectively solved. Numerical examples and comparisons with exact solution demonstrate the effectiveness of the proposed approach.

Keywords: Adomian decomposition method, singular initial value problems, second order ordinary differential equations.

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Dynamics of Reaction-Diffusion Equations with Cosine Basis Set

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Abstract

Dynamic transition theory aims to identify and classify transitions between various stable states of a system [1]. The dynamic transitions occurring when a one spatial dimensional reaction-diffusion equation is expressed as $u_t = L_\lambda u + g(u, u_x)$, incorporating second and third-order nonlinearities, have been previously investigated in the literature [2, 3]. This examination was carried out for the form corresponding to the sinusoidal basis set of eigenvectors associated with the linear operator L . In this study, the eigenvectors of the linear operator are in the form of $\cos(n\,x)$, and the nonlinear operator contains higher-order nonlinearities. Under these assumptions, the first dynamic transitions of a given one spatial dimensional reaction-diffusion equation will be classified.

Keywords: Dynamic Transition Theory, Reaction-Diffusion Equations, Center Manifold Reduction

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Encryption with Tribonacci Numbers and Integral Transform

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Abstract

In this study, a cryptographic method has introduced by using Tribonacci numbers and Elzaki integral transform. The terms of the tribonacci number sequence are encoded into numbers, letters and symbols. The encryption process was carried out with the Elzaki integral transformation of a selected hyperbolic function.

Keywords: Encryption, Tribonacci numbers, Elzaki integral transform, hyperbolic function.

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Computing Fuzzy F-Index of Fuzzy Zero Divisor Graphs of $\mathbb{Z}_n$

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Abstract

In this article, we focus on investigating the theoretical formulation of forgotten fuzzy topological index (F-Index) of the fuzzy zero divisor graph of the commutative ring $\mathbb{Z}_n$ for some specific values of n. Moreover, we develop Matlab-based algorithms that directly calculate the values of the studied fuzzy graphs, such as the adjacency matrix, eigenvalues, characteristic polynomials and energies, which have an important place in the application.

Keywords: Fuzzy zero divisor graph, fuzzy topological index, forgotten topological index, adjacency matrix.

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On Nonlocal p-Laplacian Equation with Dynamical Boundary Conditions

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Abstract

We will study on nonlocal ∞-Laplacian type diffusion equation obtained as the limit as p → ∞ to the nonlocal analogous to the p-Laplacian evolution. We deal both with smooth and with singular kernels and show existence and uniqueness of solutions.

Keywords: Mosco convergence, Nonlocal diffusion, Limit solutions

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Application of Different Mathematical Series to Photonic Crystal Designs and Their Comparisons

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Abstract

Multilayered photonic crystals (PC), which have gained importance in recent years and find numerous engineering applications are designed with special arrangements of dielectric materials. These PCs can block, reflect, or transmit high-frequency signals within specific frequency ranges, depending on their structure (materials used, their orders, thicknesses etc.) In literature, the order of the layer materials is chosen according to different mathematical series such as Fibonacci series etc. each result with different operational characteristics [1, 2].

In this study, three different plasma type PC designs are proposed based on Fibonacci, Thue Morse, and Cantor series, and results are compared to investigate their advantages with respect to each other. As an example, in Fig. 1 Cantor series (a) and multilayered PC structure designed according to its second stage (b) are briefly shown.

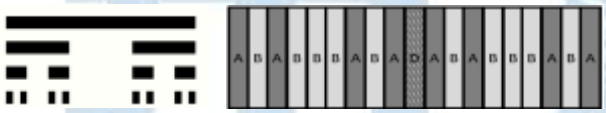

Figure 1. a-) Obtaining the 2nd, 3rd and 4th stages of the Cantor Series by dividing the cells,b-) The multilayered PC structure created for the 2nd stage of the Cantor Series.

In this figure, A and B are layer materials and D represent the defect layer between them which are taken as dielectric and plasma. Each proposed design exhibits different operational performance due to nature of the selected mathematical series. The results of this study, even it is in the specific area, is found as valuable due to its future applicability for different areas under various scientific disciplines.

Keywords: Photonic crystals, Fibonacci, Thue Morse, Cantor series

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Some new Bernstein type operators

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Abstract

This paper aims to establish a new class of Bernstein type operators via an adaptation of Bézier bases which are formulated with the inclusion of some shape parameters. We present a uniform convergence result for these operators and, subsequently, examine the convergence properties by utilizing the weighted statistical convergence notion. Furthermore, we estimate the rate of the weighted statistical convergence of these operators. We conclude our work by providing a numerical example with explanatory graphs to show their approximation behaviours.

Keywords: Computer graphics; error analysis

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Beyond classical Bernstein: Novel operators for improved approximation

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Abstract

We introduce a novel class of Bernstein-type operators inspired by new bases, incorporating tunable shape parameters. These parameters offer greater control over the approximation process. We demonstrate the uniform convergence of these operators and delve deeper into their convergence properties using the concept of weighted statistical convergence. Furthermore, we quantify the rate of this convergence. Finally, a numerical example with illustrative graphs showcases the effectiveness of these operators in approximating functions.

Keywords: Cconvergence; rate of approximation

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Existence and Uniqueness Solutions of the Non-homogeneous Nonlinear Volterra Factional Equations

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Abstract

By using an iterative method, this paper finds a solution of the non-homogeneous nonlinear fractional integral equation (NLFIE) and shows that this solution is unique. Next, we will use some examples to apply the theorem to a type of (NLFIE).

Keywords: Volterra fractional equation; iterative method; complete metric space**.**

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On the basicity of the system of eigenfucntions for a discontinuous differential operator in grand variable Lebesgue spaces

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Abstract

When a person wants to examine the vibration problem of a loaded string with fixed ends, Fourier methods gains value and then it is reached the basicity of the system of eigenfunctions in some Banach funftion spaces. These type studies have been done at various Banach space such as Lebesgue, grand-Lebesgue, and Morrey-type spaces. In this study, the basicity of the system of eigenfunctions are considered in grand variable Lebesgue space $L^{p(\cdot),\theta}(\Omega)$. These spaces unify two non-standard function spaces: a variable exponent Lebesgue space and a grand Lebesgue space. This space will allow the basicity properties of the system to be examined in a wider space.

Keywords: grand variable lebesgue space, theory of close base, basicity, second-order discontinuous spectral problem.

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Wiener-Hopf Solution of Mixed Boundary-Value Problem for Dielectric Loaded Coaxial Waveguide

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Abstract

This study investigate the propagation of TEM waves along a coaxial waveguide with a step discontinuity on its inner wall loaded dielectric material. The main aim of this study is to give the details of the rigorous Wiener-Hopf method to solve the corresponding mixed-boundary value problem. The application of the Fourier transform to the Helmholtz equation in cylindrical coordinates leads to modified Wiener-Hopf equation whose formal solution is obtained by using the factorization and decomposition procedures. The solution of the field terms involves infinite sets of unknown coefficients satisfying infinite set of linear algebraic equations. The solution of this system is possible numerically.

Keywords: Coaxial, mixed boundary-value problem, waveguide, Wiener-Hopf method.

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The Boundedness of Commutators of A Class of Sublinear Operators with Rough Kernel on Herz Triebel-Lizorkin Spaces with Variable Exponent

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Abstract

In 2013, The Herz type Besov and Triebel-Lizorkin spaces with variable exponent were introduced in [1]. In 2023, the authors [2] first discussed the characterization of Herz Triebel–Lizorkin spaces with variable exponent via two families of operators. By this characterization, the authors proved that the Lipschitz commutators of sublinear operators is bounded from Herz spaces with variable exponent to Herz Triebel–Lizorkin spaces with variable exponent. Inspired of [1,2], in this work we consider the boundedness of commutators of a class of sublinear operators with rough kernel on Herz Triebel-Lizorkin spaces with variable exponent.

Keywords: Lipschitz space, Herz Triebel-Lizorkin spaces, variable exponent, sublinear operator, rough kernel.

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Poincaré and Sobolev Inequality in Degenerate Sobolev Spaces

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Abstract

Sobolev spaces without weights occur as spaces of solutions for elliptic and parabolic partial differential equations. For degenerate PDE's, which means equations with various types of singularities in the coefficients, we look for solutions in weighted Sobolev spaces. In this work, we are interested in the existence, uniqueness, boundedness and regularity of solutions of Dirichlet problems in certain degenerate Sobolev spaces. To prove these important properties of solutions we need both local type and global type Poincaré inequalities and local type and global type Sobolev inequalities.

Keywords: Poincare Inequality, Sobolev Inequality

Acknowledgement: This study was supported by the 2211-E Domestic Direct Doctoral Scholarship Program of the Scientific and Technological Research Council of Turkey (TUBITAK).

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The Schouten-Van Kampen Connection with respect to the Cheeger-Gromoll Metric

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Abstract

In this paper, we study some properties of the Schouten-Van Kampen connection associated to the Levi-Civita connection of the Cheeger-Gromoll metric on the cotangent bundle.

Keywords: Cotangent bundle, Cheeger-Gromoll metric, Schouten-Van Kampen connection.

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DYNAMICAL ANALYSIS OF CONFORMABLE FRACTIONAL ORDER LOTKA-VOLTERRA PREDATOR-PREY MODEL

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Abstract

In this study, a mathematical model that describes the interaction between guava fruit and pests is discussed. The model based on Lotka-Volterra system of equations consist of conformable fractional order differential equations with piecewise constant arguments. From the solutions of the model in the subinterval leads to two dimensional discrete dynamical system. The equilibrium points of the discrete system are obtained and its stability conditions are determined by using Schur-Cohn criterion. We also deal with the theoretical analysis of the existence and direction Neimark-Sacker bifurcation of the discrete model at the positive equilibrium point. Theoretical analysis and numerical simulations show that discrete dynamical system shows complex dynamical behaviour such as stable periodic solutions Neimark-Sacker bifurcation, and chaos at the positive equilibrium point of the system according to changing the parameter r that is growth rate of guava borers.

Keywords: Discretization, Neimark-Sacker bifurcation, Conformable fractional derivative, Lotka-Volterra system, Stability.

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Rough λ-Statistical Cluster Points of Sequences of Fuzzy Numbers

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Abstract

In this talk, first we define the concept of rough λ-statistical convergence for a sequence of fuzzy numbers. After that, we investigate the rough λ-statistical limit set of this sequence for roughness degree r>0. Additionally, we define the sets of rough λ-statistical limit points and rough λ-statistical cluster points for such sequences. Finally, we analyze various properties of these sets and establish inclusion relations among them.

Keywords: Fuzzy numbers, rough statistical convergence, λ-statistical convergence, statistical limit point, statistical cluster point.

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The Cones of monoton functions generated by generalized potentials

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(joint work with Amiran Gogatishvili and Abek Azhar)

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Abstract

We present characterizations of the relations of the cones of monotone functions generated by generalized potentials modeled upon weighted Lorentz spaces. We will obtained O'Neil type inequality, using these estimates we will study boundedness of generalised potentials in weighted Lorents spaces. This problem is redusing to study boundedness of Cesaro and Copson operators in weighted Lebesgue spaces restricted on the cone of monoton functions. Aslo we will consider restrictions on the cone of double monoton functions (quasicoancave functions). We will used results obtained by Gogatishvili and Stepanov [1]. Gogatishvili and Neves [2], W.D. Evans, A. Gogatishvili and B. Opic [3]

Keywords: Cones of monoton functions, generalized potentials, Lorentz space, O'Neil type inequality, Cesaro and Copson operators

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Explosive and Exponential Growth in an r(x)-Triharmonic Equation

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Abstract

In this work deal with an r(x)-triharmonic equation characterized by variable exponents. We begin by establishing a criterion for finite-time blow-up and subsequently derive an upper bound estimate for the blow-up time. Moreover, we explore the exponential growth rate of solutions under specific conditions.

Keywords: r(x)-Triharmonic equation, explosive, exponential growth, variable exponent.

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Blow-up and Exponential Growth in a m(x)-Biharmonic Equation

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Abstract

In this study, we examine a m(x)-biharmonic equation with variable exponents. Initially, we establish a criterion for finite-time blow-up and then proceed to obtain an upper bound estimate for the blow-up time. Furthermore, we investigate the exponential growth rate of solutions under certain conditions.

Keywords: m(x)-Biharmonic equation, blow up, exponential growth, variable exponent.

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Application of superiorization method to linear inverse problems via a gradient projection algorithm

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Abstract

Recently, a method called superiorization has been used to increase the efficiency of iterative algorithms. By allowing perturbations in iterative algorithms, it is investigated whether the perturbed algorithm fulfills the task of the original algorithm or obtains a superior output. Our aim in this study is to apply the superiorization method to linear inverse problems through a gradient projection iterative algorithm that has been shown to be resistant to perturbations.

Keywords: Superiorization method, bounded perturbation resilience, linear invers problems, gradient projection algorithm

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Multivalued theory with measure of noncompactness for fractional différential inclusions

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Abstract

We consider a nonlinear Hadamard fractional differential inclusions with three point integral boundary conditions. By using the set-valued analog of Monch fixed point theorem associated with the technique of measure of noncompactness, we prove the existence of at least one solution. We establish some Filippov's-type results for this problem.

Keywords: Differential inclusions, Hadamard fractional derivative, Measure of noncompactness, Filippov's Theorem.

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On the Hop Domination Number of Fuzzy Graphs

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Abstract

Let $G = (V, \mu, \rho)$ a fuzzy graph. A subset $H \subseteq V(G)$ of a fuzzy graph G is a hop-dominating set of G if every $v \in V - H$ is a hop dominated by at least one vertex in H. The minimum cardinality of a hop-dominating set of G is called a hop-domination number of G and is denoted by $\gamma_h(G)$. In this paper, we initiate the study on the hop domination number of a fuzzy graph. We obtain some bounds on the hop domination number. We also characterize the family of paths, trees, and cyclic graphs. We determine the hop number $\gamma_h(G)$ for several classes of fuzzy graphs and obtain Nordhaus-Gaddum-type results for this parameter. Further, some bounds of $\gamma_h(G)$ are investigated. Also, the relations between $\gamma_h(G)$ and other known parameters in fuzzy graphs are investigated.

Keywords: SI-open set, interior and closure operators, ideals.

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Existence, Uniqueness Results and Stability for Coupled System of Fractional Hybrid Differential Equations with Mixed Fractional Derivatives and Laplacian Operators and Three-Point Boundary Conditions

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Abstract

In this work we investigate the existence and uniqueness of solutions for a new class of coupled system of fractional hybrid differential equations which containing of mixed fractional derivatives between the Riemann-Liouville and the Caputo fractional derivatives of different orders with Laplacian operators, by using Leray-Schauder alternative fixed point theorem type in generalized Banach space and Banach contraction principle. The stability of the Ulam type of the proposed coupled system is also studied. At the end an example is given to illustrate the theory and results obtained.

Keywords: Mixed Fractional Derivatives; Ulam's stability; Coupled system; Laplacian operators

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Constructing the asymptotics of the solution to a quasilinear elliptic type equation with respect to a small parameter

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Abstrac

Let $G \subset R^n$ be a bounded domain with a rather smooth boundary and $Q = G \times [0,T]$ be a cylinder with a lateral surface S. In the cylinder Q we consider the following problem:

$$L_\varepsilon u = -\varepsilon^p \sum_{i=0}^{n} \frac{\partial}{\partial x_i}\left(\frac{\partial u}{\partial x_i}\right)^p - \varepsilon \sum_{i=0}^{n} \frac{\partial^2 u}{\partial x^2{}_i} + \frac{\partial u}{\partial x_0} - \sum_{i=1}^{n} \frac{\partial^2 u}{\partial x_i^{\,2}} + au - f(x, x_0) = 0 \quad (1)$$

$$u\big|_{x_0=0} = 0,\ u\big|_s = 0,\ u\big|_{x_0=T} = 0 \quad (2)$$

here $(x, x_0) \in G \times [0,T]$, $x = (x_1, x_2, \ldots, x_n)$, $\varepsilon \succ 0$, is a small parameter, $a \succ 0$ is a real number, $p = 2k+1 \succ n$ (k is a natural number); $f(x, x_0)$ is a rather smooth function.

İn this paper, we were established the asymptotics of the approximate solution of problem (1)-(2) with respect to the small parameter and showed bounded of residual term in $W^1{}_{2k+1}(Q)$ space.

Keywords: Partial derivative, function, small parameter, asymptotic solution, degenerated problem, boundary layer type function.

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Some Generalizations of S-ideals in Noncommutative Rings

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Abstract

The notion of S-prime ideal is introduced by Hamed and Malek in commutative rings [1]. Very recently Abouhalaka defined that in noncommutative sense and give some properties of them [2]. In this work we investigate the generalizations of S-ideals in noncommutative rings.

Keywords: S-ideal, S-prime ideal, S-weakly prime ideal, S-primary ideal, m-system, noncommutative ring.

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A Theorem on Absolute Riesz Summability

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Abstract

Let (φ_n) be a sequence of positive real numbers. The series $\sum a_n$ is said to be summable $\varphi-\left|\overline{N}, p_n;\delta\right|_k$, $\delta \geq 0$ and $k \geq 1$, if

$$\sum_{n=1}^{\infty} \varphi_n^{\delta k+k-1} \left| u_n - u_{n-1} \right|^k < \infty$$

where $u_n = \frac{1}{P_n}\sum_{v=0}^{n} p_v s_v$ and (p_n) is a sequence of positive numbers such that

$$P_n = \sum_{v=0}^{n} p_v \to \infty,\ n \to \infty \quad (P_{-m} = p_{-m} = 0,\ m \geq 1).$$

This paper presents a new general theorem on $\varphi-\left|\overline{N}, p_n;\delta\right|_k$ summability of the series $\sum a_n \lambda_n$. The new theorem also includes a known theorem on absolute Riesz summability factors of an infinite series.

Keywords: absolute summability, infinite series, Riesz mean, summability factors.

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Simulating Time Delays and Space-Time Memory Interactions: An Analytical Approach

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Abstract

This study introduces an innovative analytical framework designed to elucidate the implications of incorporating the Caputo spatial and temporal memory indices, coupled with a proportional time delay, into (non)linear (1+2) −evolutionary models. The solution is presented in the form of a Cauchy product of an absolutely convergent series which illustrates the acting of the aforementioned parameters. Using a unique extension of the differential transform method into higher-dimensional fractional space, our methodology transforms the evolution equation into a (non)linear higher-order recurrence equation to determine the coefficients of a novel fractional series expansion. We also polished theoretically our approach to illustrate the influence of the parameters under our interest. The visual analysis of the level curves for the derived solution reveals a continuous deformation from a stationary state to an integer state solution, wherein the Caputo derivative parameters function as slider controls. Furthermore, the graphical analysis highlights a perceptible analogy between the functionalities of the Caputo-time fractional derivative and the proportional time delay, thereby reinforcing the notion that Caputo derivatives effectively function as memory indices. Notably, this method has proven to be highly effective in furnishing solutions for fractional higher-dimensional extension of evolutionary equations.

Keywords: Caputo Space-time PDEs, Proportional time-delay, Multi-fractional differential transform.

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SOLUTION OF DELAY DIFFERENTIAL EQUATIONS USING EXTREME LEARNING MACHINE

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Abstract

We expand upon the orthogonal neural network-based method in combination with an Extreme Learning Machine (ELM) to tackle variable-order delay differential equations, encompassing both initial and boundary conditions. The network weights are trained via ELM, while the derivative terms within the equations are approximated using operational matrices of orthogonal polynomials. Furthermore, we investigate the numerical solution of various delay differential equations, such as pantograph and neutral delay equations. Graphical analysis reveals the impact of changing the number of neurons on solution accuracy.

Keywords: Delay differential equations, operational matrices, orthogonal polynomials, Extreme Learning Machine, Neural networks.

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Hermite Collocation Approach for the Solution of a Class of Fractional Differential Equations

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Abstract

In the brunches of engineering and sciences, differential equations are commonly used for expressing many complicated problems arising from these areas.

In this work, we work on the approximate solution of a class of a fractional differential equation class. We expressed the matrix form of the system and MATLAB are used for the solution of this algebraic system. Results are given by table and graphically.

Keywords: Hermite Polynomial, Fractional differential equation, Collocation methods

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Fredholm and Frame-Preserving Weighted Composition Operators

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Abstract

Let $\mathbb{C}^n = C \times \cdots \times C$ be the n-dimensional complex Euclidean space. Let Ω be a bounded domain in $\mathbb{C}^n$ and let $H(\Omega)$ be the space of all holomorphic functions on Ω. We denote by H, a complex Hilbert space of functions in $H(\Omega)$. In this paper we generalize the results of Cao, He and Zhu [1] to the case of weighted composition operators and characterize Fredholm and frame-preserving weighted composition operators on some general Hilbert spaces of holomorphic functions in bounded domains in $\mathbb{C}^n$

Keywords: Weighted composition operators, Frodholm operators, frames, Hilbert spaces of holomorphic functions

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On Banach frameness of degenerate exponential system in Lebesgue spaces

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Abstract

This study deals with the frameness of weighted exponential system $E(\omega, Z) = \{\omega(t)e^{int}\}_{n\in Z}$ in the space $L_p(-\pi,\pi), p > 1$, with the weight function $\omega(t)$ of general form. Theorem on a property of expansion system and criterion of Banach frameness for $E(\omega, Z)$ in $L_p(-\pi,\pi), p > 1$, were proved. In particular, it is proved that the system $E(\omega, Z)$ with defect cannot form atomic decomposition for $L_p(-\pi,\pi), p > 1$. The obtained results are the generalizations of those on the atomic decomposition of power weighted exponential system in $L_p(-\pi,\pi), p > 1$, and the frameness of weighted exponential system in $L_2(-\pi,\pi)$.

Keywords: frameness, basicity, completeness, minimality, weighted exponential system.

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Dynamics of a plankton system with delay-diffusion and stochastic effect: a mathematical study

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Abstract

We investigated a nonlinear model of the interaction between Algae-Zooplankton Species, which was addressed using a pair of Holling type – II- Ratio dependent functional response interaction impacted with discrete delay and stochastic perturbation along with diffusion. Based on numerical analysis, we studied the model without delay, stochastic impact and diffusion. We analyzed the model using a linear analysis technique and found that the delay, stochasticity and diffusion could affect the system. If the delay parameter exceeded a certain critical value, the stable state became unstable. Furthermore, the impact of environmental fluctuation and diffusion in our model which has great role to shape the dynamics of the considering system. Finally numerical simulation results are compared with the analytical findings. All of these results are expected to be useful in the study of plankton dynamics in aquatic ecosystems.

Keywords: Algae-zooplankton, stability, delay, stochasticity, difussion.

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Constructing and Comparing Novel Musical Systems using Mathematical Structures

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Abstract

The connection between mathematics and music, much like its correlation with other disciplines, is well understood. Therefore, the increasing focus on research exploring the relationship between mathematics and music is considered to be of significant importance. In this context, the aim is to investigate and compare the usage of mathematical concepts such as Lucas Numbers, Tribonacci Numbers, Metallic Ratios, and certain irrational numbers, each holding considerable importance in mathematics, in the frequency values planned to be created within the project.
Additionally, our intention is to compose music using these generated frequencies and study their effects on the psychology of healthy individuals through medical testing methods such as EEG (Electroencephalography) in the future.

Keywords: Lucas Numbers, Metallic Ratios, Music, EEG

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On Trigonometric approximation of continuous functions in two variables by almost Euler means of double conjugate Fourier series

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Abstract

The theorems based on the degree of approximation of continuous functions in two variables by almost Euler means of double conjugate Fourier series have been determined via weighted Lipschitz class. Some corollaries also have been derived from our theorems.

Keywords: Degree of approximation, weighted Lipschitz class, Double conjugate Fourier series, Almost Euler means.

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Exploring counterexamples to Hamada's conjecture: Insights from nonisomorphic designs

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Abstract

Let G be a design defined by the flats of a given dimension in $PG(t,q)$ (or $AG(t,q)$) and D be a design with the same parameters as G. In [3], it was conjectured that the p-rank of D is less than or equal to the p-rank of G, and the equality holds if and only if D is isomorphic to G. It was shown that ''only if'' part of this conjecture is not true in general [1,4,5]. In this talk, we explore similarities among certain counterexamples of the conjecture, provide a summary of computational results from techniques outlined in [2,6], and offer insights into our investigation for counterexamples within higher-dimensional affine spaces.

Keywords: Geometric designs, Hamada's conjecture, resolvable designs.

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q-Stirling Sequence Spaces Associated with *q*-Bell Numbers

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Abstract

In this study, we build *q*-analogue of the *q*-Stirling matrix associated with *q*-Bell numbers $\mathbb{S}_q = (S_{nk}(q))$ defined by

$$\mathbb{S}_q = (S_{nk}(q)) = \begin{cases} \dfrac{S_q(n,k)}{B_q(n)}, & 0 \le k \le n \\ 0, & k > n \end{cases} \quad n,k \in \mathbb{N} = \{0,1,\dots\}.$$

Next, we define the sequence spaces $c(\mathbb{S}_q)$, $c_0(\mathbb{S}_q)$, $\ell_\infty(\mathbb{S}_q)$, $\ell_p(\mathbb{S}_q)$ ($1 \le p < \infty$) using this analog. Then, we provide some inclusion relations for these spaces and examine a few topological characteristics. Furthermore, we construct a basis for the space $\ell_p(\mathbb{S}_q)$, calculate α-, β-, γ- duals of the same space and describe certain matrix classes.

Keywords: *q*-Stirling numbers, *q*-Bell numbers, *q*-analogue, Dual spaces, Matrix transform.

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An application of time scale with calculus of variations

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Abstract

Economics is a branch of science that has an important connection with the application areas of time scales. In addition to combining the standard discrete and continuous models in economics, the time scale approach also opens the door to unequally spaced payments, for example. In this study, we will present a time-scale model and use the calculus of variations to obtain a solution. Calculating time scales also allows many more situations and models to occur in the economy.

Keywords: Calculus of variation, Economy, Time scale

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Generalization of Szasz operators involving multiple Sheffer polynomials

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Abstract

The present work deals with the mathematical investigation of some generalizations of the Szasz operators. In this work, the multiple Sheffer polynomials are introduced. The generalization of Szasz operators involving multiple Sheffer polynomials are considered. Convergence properties of these operators are verified with the help of the universal Korovkin-type result and the order of approximation is calculated by using classical modulus of continuity. Further, the convergence of these operators are also discussed in weighted spaces of functions on the positive semi-axis and estimate the approximation with the help of weighted modulus of continuity. The theoretical results are exemplified choosing the special cases of multiple Sheffer polynomials..

Keywords: Szasz operators, Modulus of continuity, Rate of convergence, Multiple Sheffer polynomials.

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Perfect Codes on the Zero-divisor Cayley Graphs Associated to the Residue Class Ring Modulon

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Abstract

A zero-divisor Cayley graph of a ring *R*, where *R* is the residue class ring modulo *n*, where *n* is a positive integer, is a graph with vertex set *R*, and two distinct vertices *x* and *y* are adjacent if and only if $x - y$ or $y - x$ is a zero-divisor of *R*. A subset *S* of the vertex set *V(G)* in a graph *G* is called a perfect code of *G* if *S* is an independent set such that every vertex in *V(G)\S* is adjacent to exactly one vertex in *S*. In this paper, we compute the perfect codes on the zero-divisor Cayley graphs associated to residue class ring modulo *n*. In addition, the necessary and sufficient conditions for the perfect code acceptance on the zero-divisor Cayley graphs are also characterized.

Keywords: Zero-divisors, Cayley graphs, Zero-divisor Cayley graphs, Perfect codes, Ring.

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Analytical Approximate Solutions of (n+1)-Dimensional Fractional Generalized M-Burgers Equation via Variational Homotopy Perturbation Method

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Abstract

The models with fractional Burgers' equation has huge applications in literature and it is still need to make some researches on the solution procedures of those models. In this article, we apply variational homotopy perturbation (VHP) method for finding the analytical approximate solutions of the $(n+1)$-dimensional fractional generalized M-Burgers ($(n+1)$-DFGMB) equation with force term. Here, we involve Caputo fractional derivative to fractionalize the $(n+1)$-dimensional generalized M-Burgers equation with force term. Moreover, here we apply the well-known Banach fixed point theorem for checking the existence and uniqueness of the obtained solutions of the considered $(n+1)$-dimensional FOGMB equation with force term. In this study, we confirm that the VHP method is more effective, straightforward and suitable than the homotopy perturbation (HP) method for obtaining the analytical approximate solutions of the $(n+1)$-DFGMB equation with force term. The result of this article is an extension of the corresponding results of Kilicman et al. (2021) and Sripacharasakullert et al. (2019). Finally, we provide some 2D and 3D figures for showing the graphical comparison between the obtained analytical approximate solutions and the corresponding exact solutions for different parameter's values.

Keywords: Caputo fractional derivative, $(n+1)$-DFGMB equation with force term, VHP method, Banach fixed point theorem, Analytical approximate solutions.

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Weighted and Voronovskaja type approximation by q-Sz´asz-Kantorovich operators involving Appell polynomials

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Abstract

In this article, we concentrate on the Sz´asz-Jakimovski-Leviatan operators imposed by Appell polynomials using q-calculus. We analyze the classical Sz´asz-Jakimovski-Leviatan-Kantorovich and derive the approximation results connected to the non-negative parameters $\varsigma \in [\ 1/2\ ,\infty)$ in q-analogue. In order to combining with the earlier investigation by utilizing the Korovkin's theorem we study the local as well as global approximation theorems in terms of uniform modulus of continuity of order one and two. We calculate the rate of convergence by using of Lipschitz-maximal functions. Moreover, theVoronovskaja-type approximation theorem is also calculated here.

Keywords: Sz´asz-Mirakyan operators; Appell polynomials; Generated exponential function; q-integer; q-calculus; Modulus of continuity; Rate of convergence

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On basicity of the exponential system in grand variable exponent Lebesgue spaces

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Abstract

In this study, the basicity of the exponential and trigonometric systems are considered in grand variable Lebesgue space $L^{p(.),\theta}(\Omega)$. These spaces unify two non-standard function spaces: a variable exponent Lebesgue space and a grand Lebesgue space. And it is not easy to study basicity in these type spaces. Because this space is not a separable space.

Keywords: variable exponent space, theory of close base, basicity, second-order discontinuous spectral problem.

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Investigating the Mesh Intensity Effect and Orthogonal Symmetry on Cup Drawing Simulations with an Emphasis on Solution Time and Earing Perspective

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Abstract

The intensity of the mesh is essential for correctly representing the behavior of materials under intricate forming processes, such as cup drawing tests. This study investigated the influence of varying mesh intensities on the computational efficiency and accuracy of simulations, with a specific emphasis on in-plane and out-of-plane meshed geometries along with the orthogonal symmetric feature often used in cup drawing tests. In addition, the study examined the impact of the anisotropic constitutive model Hill48 producing convex yield locus on the simulation outcomes. The results were assessed for the AA6061-T4 aluminum alloy sheet from an engineering perspective, including the earing profiles, punch force-displacement responses and solution times. An essential component of this inquiry was the evaluation of the GPU usage and solution time. The numerical results were compared with each other in order to distinguish the influence of the mesh discretization. As a result, the element intensity in-plane and out-of-plane significantly affected the solution time. Moreover, a substantial reduction in solution time was observed when the symmetrical features were regarded.

Keywords: Finite element analysis, plasticity modeling, Hill48 yield criterion, cup drawing, AA6061-T4 alloy

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On a System of Difference Equations of Fifth-Order

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Abstract

We investigate the following system of difference equations

$$x_n = \frac{x_{n-3}y_{n-4}x_{n-5}}{y_{n-1}x_{n-2}(\alpha_n+\beta_n x_{n-3}y_{n-4}x_{n-5})},$$

$$y_n = \frac{y_{n-3}x_{n-4}y_{n-5}}{x_{n-1}y_{n-2}(\gamma_n+\delta_n y_{n-3}x_{n-4}y_{n-5})}, \; n \in \mathbb{N}_0,$$

where $(\alpha_n), (\beta_n), (\gamma_n)$ and (δ_n) are real sequences and initial values, x_k, y_k, $k = \overline{-5,-1}$ are real numbers. Firstly, we obtain the general solutions of mentioned system of difference equations. The solutions of the above system of difference equations are obtained when the parameters are constant. Additionally, the solutions are acquired when the parameters α and γ are equal to 1 or not equal to 1. In addition, we study the asymptotic behavior of the well- defined solutions of aforementioned system of difference equations. Finally, the forbidden set of the initial conditions is defined by using obtained formulas.

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Sampling Algorithms for the Pattern-avoiding Inversion Sequences

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Abstract

An *inversion sequence* of length n is an integer sequence $e = e_1 \dots e_n$ such that $0 \leq e_i < i$ for each $0 \leq i \leq n$. We use I_n to denote the set of inversion sequences of length n. Let $[k] := \{0,1,\dots,k-1\}$ denote the alphabet and τ be a word of length k over this alphabet. We say that an inversion sequence $e \in I_n$ contains the pattern τ if there is a subsequence of length k in e that is order isomorphic to τ; otherwise, e avoids the pattern τ. For instance, $e = 00221515 \in I_8$ avoids the pattern 0321 because there is no subsequence $e_i e_j e_k e_l$ of length four in e with $i < j < k < l$ and $e_i < e_l < e_k < e_j$. On the other hand, $e = 01124216$ contains the patterns 0321 because it has subsequences $0---421$ order isomorphic to 0321. For a given pattern τ, we let $I_n(\tau)$ denote the set of all τ-avoiding inversion sequences of length n. Pattern-avoiding inversion sequences have been systematically studied by researchers during the last decade, see [1-6] and references therein. We provide sampling algorithms for pattern-avoiding inversion sequences and specifically apply them to the classes $I_n(0312)$, $I_n(0321)$, $I_n(0221)$, and $I_n(0212)$. Based on our random samples, we study some statistics such as the number of zeros, the number of distinct elements, the number of repeated elements, the maximum elements, and the number of left-to-right maximum elements. By using these sampling algorithms, we obtain training data and train a neural network to make predictions whether a given sequence contains a specific pattern or not. This project was partially supported by Tübitak-Ardeb grant no 120F352. The numerical calculations were partially performed at TUBITAK ULAKBIM, High Performance and Grid Computing Center (TRUBA resources).

Keywords: inversion sequences, pattern avoidance, random sampling

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A New Analytic Framework for Arithmetic Integrals: Proving the Prime Number Theorem

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Abstract

The Prime Number Theorem, stating that the number of prime numbers less than x approximates $\frac{x}{\log(x)}$, forms a cornerstone of analytic number theory. We establish a framework where, given a monotonically increasing arithmetic function α and a monotonically decreasing analytic function β, there exists a differentiable and continuous analytic function η such that, for all x in the domain $\int \alpha(x)\beta(x)dx = \int \eta(x)\beta(x)dx$ under a strong hypothesis $\eta(x) \sim \alpha(x)$. Utilizing this, a new proof of the Prime Number Theorem is provided. Moreover, the framework shows potential as a tool for formulating analytical counterparts to arithmetic functions in number theory.

Keywords: Analytic number theory, Arithmetic functions, Prime numbers

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Higher Order of Conformable Frational Shehu Transform, Generalization and its Application

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Abstract

In present work, we have been interested to generalizing the higher order of the Shehu transform to the conformable fractional which have been demonstrated, and we use it to find the general analytical solutions of conformable fractional differential equations with variable coefficients and a systems of fractional differential equations in the case nonhomogeneous. The illustrative examples indicate that the used transform is effective and applicable for solving the most difficult problems.

Keywords: Conformable fractional derivative, Conformable fractional Shehu transform, System of fractional differential equations.

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Halpern-Type Inertial Iteration Methods with Self-Adaptive Step Size for Split Common Null Point Problem

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Abstract

In this paper, two Halpern-type inertial iteration methods with self-adaptive step size are proposed for estimating the solution of split common null point problems
(SpCNPP) in such a way that the Halpern iteration and inertial extrapolation are computed simultaneously in the beginning of each iteration. We prove the strong convergence of sequences driven by the suggested methods without estimating the norm of bounded linear operator when certain appropriate assumptions are made. We demonstrate the efficiency of our iterative methods and compare them with some related and well-known results [1,2,3,4]using relevant numerical examples.

Keywords: split common null point problem; Halpern; inertial; self adaptive algorithms; strong convergence.

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Lupas Bernstein-Kantorovich operators using Jackson and Riemann type (p, q)-integrals.

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Abstract

In this paper, Lupas Bernstein-Kantorovich operators have been studied using Jackson and Riemann type (p, q)-integrals. It has been shown that (p, q) -integrals as well as Riemann type (p, q)-integrals are not well defined for $0<q<p<1$ and thus further analysis is needed. Throughout the paper, the case $1\leq q<p<\infty$ has been used. Advantages of using Riemann type (p, q)-integrals are discussed over general (p, q)-integrals. Lupas Bernstein-Kantorovich operators constructed via Jackson integral need not be positive for every $f \geq 0$. So, to make these operators based on general (p, q)-integral positive, one needs to consider strictly monotonically increasing functions, and to handle this situation Lupas Bernstein-Kantorovich operators are constructed using Riemann type (p, q)-integrals. However, Lupas (p, q)- Bernstein-Kantorovich operators based on Riemann type (p, q)-integrals are always positive linear operators. Approximation properties for these operators based on Korovkin's type approximation theorem are investigated. The rate of convergence via modulus of continuity and function of f belonging to the Lipschitz class is computed.

Keywords: (p, q)-integers, Riemann type (p, q)-integrals, Lupas (p, q)-Bernstein-Kantorovich operators, Korovkin type approximation, modulus of continuity.

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ON S_I -OPEN SETS IN IDEAL TOPOLOGICAL SPACES

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Abstract

This paper presents the concept of S_I-open set and explores its relationship with other known sets. The S_I-open sets are introduced as a new class of sets, and their properties and characteristics are examined. Additionally, the interior operator and closure operator are studied in relation to the class of S_I-open sets. The findings contribute to a deeper understanding of the S_I-open sets and their implications in the field of topological spaces.

Keywords: SI-open set, interior and closure operators, ideals.

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Solving AL-Hasani Differential Equation by Adomian Decomposition Method

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Abstract

This paper introduces the Hassani differential equation, a novel extension of both Chebyshev's and Hermit's differential equations. The Adomian decomposition method is employed to solve this newly proposed equation. Additionally, the paper presents the Hasani polynomials. Several examples are provided to demonstrate the effectiveness of the Adomian decomposition method in solving the Hassani differential equations.

Keywords: Hasani Differential Equation, Chebyshev Differential Equation, Hermite Differential Equation.

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On the Hop Domination Number of Fuzzy Graphs

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Abstract

Let $G = (V, \mu, \rho)$ a fuzzy graph. A subset $H \subseteq V(G)$ of a fuzzy graph G is a hop-dominating set of G if every $v \in V - H$ is a hop dominated by at least one vertex in H. The minimum cardinality of a hop-dominating set of G is called a hop-domination number of G and is denoted by $\gamma_h(G)$. In this paper, we initiate the study on the hop domination number of a fuzzy graph. We obtain some bounds on the hop domination number. We also characterize the family of paths, trees, and cyclic graphs. We determine the hop number $\gamma_h(G)$ for several classes of fuzzy graphs and obtain Nordhaus-Gaddum-type results for this parameter. Further, some bounds of $\gamma_h(G)$ are investigated. Also, the relations between $\gamma_h(G)$ and other known parameters in fuzzy graphs are investigated.

Keywords: fuzzy graph, hop number, hop-domination number.

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Modified Adomian decomposition method for the Solution of the Partial Differential Equations in the First-order

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Abstract

This paper explores the applicability of the Modified Adomian Decomposition Method (MADM) for solving first-order partial differential equations, encompassing both singular and non-singular cases. We present a comprehensive discussion on the utilization of the Adomian Decomposition Method (ADM) for tackling this class of equations. Subsequently, illustrative examples are provided to demonstrate the efficacy of ADM in obtaining solutions for both singular and non-singular first-order partial differential equations.

Keywords:
Modified Adomian Decomposition Method (MADM), Adomian Decomposition Method (ADM), First-order PDE; singular and nonsingular PDE.

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Numerical Study of Nanofluid Flow through a Porous Stretchable Surface in the Existence Motile Microorganisms Subject to Convective Boundary Conditions

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Abstract

Nanotechnology booming day by day and have number of applications in the field of engineering especially in the heat and mass transfer domain. In this work, nanofluid flow through a stretching surface under the influences of various physical parameters namely thermal radiation, activation energy and motile microorganisms is scrutinized. Most importantly the impact of convective boundary conditions is considered. The basic goal is to evaluate the increment in heat and mass transfer numerically due to the presence of motile microorganisms. For mathematical treatment, the model is developed in the form of partial differential equations along with boundary conditions then this model transformed into ordinary differential equations by making use of suitable similarity variables. Finally, numerical outcomes are computed by implementing 'bvp4c' built command of MATLAB with the aid of shooting approach. Evaluated results are presented graphically and described in the results and discussion section adjacently numeric values are tabulated in the tables. From results the increment in the flow profiles are noticed due to the involvement of porosity and bioconvection Rayleigh number variables. Also at the end our computed results are validated with published results in comparison table.

Keywords: Stretching Surface, Maxwell Nanofluid, Numerical Analysis, Porous media, Convective Boundary Conditions.

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Generalization of Hermite-Hadamard-Mercer Type Inequalities for Generalized Convex Functions on the Co-ordinates with Their Computational Analysis

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Abstract

In this paper, we establish Jensen-Mercer Inequality for coordinated h-convex functions. Hermite-Hadamard-Mercer type inequalities for h-convex functions on the co-ordinates on the rectangle from the plane are obtained, with the help of newly established inequality. The generalization of Hermite-Hadamard-Mercer type inequalities for generalized convex functions on coordinates enriches the theoretical foundation of convex analysis and provides valuable tools for solving optimization problems and analyzing data. We conduct a computational analysis to illustrate the applicability and effectiveness of the generalized inequalities in practical scenarios on the coordinates.

Keywords: Jensen Inequality, Jensen Mercer Inequality, Hermite-Hadamard-Mercer type inequalities, coordinated convex functions

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On Generalized I.V-m Convex Functions and Associated Fractional Integral Inequalities

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Abstract

The main focus of the current study is to introduce the idea of generalized m-convex set based on a monotone mapping. This class of convex sets unifies several all ready known and new notion of convexity. Based on the significance our developed generalized m-convex set, we introduce the idea of generalize interval-valued (I.V) m-convex functions. Moreover, by considering the our proposed definition, we construct I.V Jensen inequality, unified fractional Hermite-Hadamard inequality, Hermite-Hadamard-Fejer inequality and its variant for the product of two generalized I.V-m convex functions. Later on we present some applications, graphical and numerical demonstration of our primary findings as well.

Keywords: m-convex set, m-convex functions, Fractional calculus, Jensen inequality, Hermite-Hadamard inequality.

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The Risk Assessment of Wastewater Treatment with an Integrated Decision-Making Method

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Abstract

The effectiveness of the traditional risk analysis approach is enhanced by the integration of fuzzy logic and Multi-Criteria Decision Making (MCDM) methods. Human decisions are ambiguous and blurred and do not fit to express with absolute numerical values. For this reason, using verbal variables in modeling human decisions is more realistic. This paper proposes a new fuzzy-based hazard evaluation approach to deal with the risk assessment process. The proposed methodology consists of MCDM with a fuzzy system, which includes a hybrid structure consists the Fermatean Fuzzy Analytic Hierarchy Process (FFAHP) method with cosine similarity and also the Neutrosophic Analytic Hierarchy Process (NFAHP) to support the facing of uncertainty in the risk assessment. This study aims to present a new integrated approach based on some MCDM methods in the FFS environment to recognize and rank environmental risks. The proposed approach can provide complete rankings and more logical results using the benefits of FFS.

Keywords: Risk Analysis, Group decision-making Fermatean Fuzzy Set, Neutrosophic Set, Envinronment, Sustainability

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Multi-Criteria Group Decision-Making with Application: Fermatean Fuzzy Soft Sets Approaches

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Abstract

This study presents a new algorithm for group decision-making solutions using Fermatean Fuzzy Soft Matrices (FFSMs), and experts give confidence weights. Fermatean Fuzzy Set (FFS) is a generalization of the intuitionistic fuzzy set (IFS) and the Pythagorean fuzzy set(PFS). Therefore, in real-life problems of uncertainty, the decision-making mechanism in FFS outcomes is better than IFS and PFS decision-making. Fermatean Fuzzy Soft Set (FFSS) is derived from the combination of FFS and Soft Set. FFSM is also the matrix representation of FFSSs. Based on the cardinalities of the FFSS, experts have been given a new method that assigns confident weight. Confident weight is given according to the experience and knowledge of each expert. The choice matrix and the combined choice matrix are created first for this process. FFSMs and choice matrices given for each expert are multiplied, and the matrices obtained are summed. Fermatean distance measurements were used to check the accuracy of the results by applying the algorithm. Problems with portfolio selection are ideally suited for multi-attribute decision-making algorithms. Within the multi-attribute decision-making paradigm, complicated subjective preferences and diversified financial indices influence investment decisions. The application of the algorithm based on an FFSM was selected for the investment portfolio selection problem.

Keywords: Group decision-making Fermatean Fuzzy Soft Set, Fermatean Fuzzy Soft Matrix, Distance measurements, Cardinal matrix, portfolio selection

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A Note On $A_a^{\mathcal{I}}$-Statistical Convergence

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Abstract

This study deals with a generalized statistical convergence via ideals. Let $A = (a_{nk})$ be a non-negative regular summability matrix and $a = (a_n)$ be a positive non-increasing sequence. First of all, we define the concepts of $A_a^{\mathcal{I}}$-statistical convergence and $A_a^{\mathcal{I}^*}$-statistical convergence. We then present a result that $A_a^{\mathcal{I}^*}$-statistical convergence implies $A_a^{\mathcal{I}}$-statistical convergence.

Keywords: $\mathcal{I}$-convergence, $A_a^{\mathcal{I}}$-statistical convergence, $A_a^{\mathcal{I}^*}$-statistical convergence.

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A Result Concerning The Summability

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Abstract

Buck gave that a sequence that is C_1-summable to its limit superior is statistically convergent. Some statistical analogues of the result were given by Orhan and Khan in 1997 and by Demirci in 1998. Motivated by these results, we obtain a new result for the A-statistical convergence with the rate of $o(a_n)$ where $A = (a_{nk})$ is a non-negative regular summability matrix and $a = (a_n)$ is a positive non-increasing sequence.

Keywords: A-statistical convergence, A-statistical convergence with the rate of $o(a_n)$, A-summability

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Deferred Statistical Convergence in Partial Metric Spaces

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Abstract

Partial metric space and basic properties of this space were given by Matthews as a generalization of the usual concept of metric space. In this study, we investigate the concept of deferred statistical convergence and deferred strongly Cesaro summability in partial metric spaces. Also, some inclusion relations between these concepts are given.

Keywords: Deferred statistical convergence, Cesaro convergence, Partial metric space.

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Land Price Prediction Using Machine Learning

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Abstract

In the study models built on land pricing in certain locations were analyzed with the help of machine learning. In this context, many models have been produced and the model that gives the best results has been determined. The supervised and unsupervised learning algorithms are also studied.

Keywords: Machine Learning, Land Price Prediction, Regression

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Different Constructions of the Pentagon Fractal by Escape Time Algortihm

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Abstract

There are different types of methods to construct the self-similar sets. Iterated function systems (IFS), L-systems, escape time algorithm can be given the examples of these methods. In this study, we aim to obtain Pentagon fractal by using expanding and different folding mappings via escape time algorithm.

Keywords: Pentagon fractal, escape time algorithm, Iterated function system

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Existence Resultsfor Mixed Type Fractional Boundary Value Problem

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Abstract

Fractional differential equations including both left and right fractional derivatives are also attracting much attention, there are many results on boundary value problems concerning mixed fractional derivatives of different types. For instance we refer the reader to [3, 4].

The concept of the conformable fractional derivative was introduced in 2014 by Khalil et al. [2]. Benmezai et al. [1] introduced in 2019 a new fixed point theorem using strongly positive-like operators and then apply their fixed point theorem to a nonlinear fractional differential equation involving Riemann-Liouville derivative. In this paper, we introduce the concept of the conformable fractional derivative in such mixed nonlinear fractional boundary value problem and apply their recent fixed point theorem to our problem.

Keywords: Conformable fractional derivative, Fractional differential equations, Existence, Nonexistence, fixed point theorem.

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Conjugate Gradient Method Associated with Smoothing Technique to Solve Image Restoration Problems

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Abstract

In this study, total variation and l_1 −norm regularization-based non-smooth image restoration problems are considered. Two new-generation smoothing techniques are modified for the regularization terms. A smoothing conjugate gradient method (SCGM) is proposed by combining the conjugate gradient method with new generation smoothing techniques. A numerical algorithm for the SCGM is provided. Additionally, numerical applications of the algorithm to test images with various types of noise are demonstrated and the results are compared with similar algorithms. Experimental results show the effectiveness of the proposed algorithm.

Keywords: Nonlinear conjugate gradient algorithm, smoothing function, image restoration.

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A Smoothing Newton Algorithm for Solving Nonlinear Complementarity

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Abstract

In this study, we deal with solving the nonlinear complementarity problem (NCP). We first reformulate the NCP problem as a system of non-smooth and non-linear equations. Then, we propose two different types of smoothing functions for the new formulation of the NCP. The relations between the original and smoothing problems are analyzed. A new smoothing Newton algorithm is developed to solve smoothed problems, and the efficiency of our algorithm is illustrated by some numerical examples. Finally, the comparison of the obtained results with the same-class methods is presented.

Keywords: Nonlinear complementarity problem, Smoothing functions, Newton algorithms.

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Direct Scattering Problem of Discontinuous Sturm-Liouville Operator on the Positive Half Line

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Abstract

In this work, we consider Sturm-Liouville operator with piecewise continuous coefficient and transmission conditions at some point on the positive half-line. The new integral representation of Jost solution is given. The scattering data of this problem is investigated. The resolvent operator is constructed and the eigenfunction expansion formula of this boundary value problem is obtained.

Keywords: Sturm-Liouville equation, direct scattering problem, scattering data, eigenfunction expansion.

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Computation of H-Bases via Full QR Decomposition

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Abstract

An H-basis is a specific generating set for a polynomial ideal. In this study, we describe a method to compute H-basis which is based on the computing a basis for the module of syzygies using full QR-decomposition of matrices. We illustrate the method by several examples.

Keywords: H-basis, Syzygy, QR Decomposition.

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Trace Regularization Problem for a Fourth Order Differential Operator on Separable Banach Space

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Abstract

In our study, we derive second regularized trace formula of the fourth-order operator with unbounded operator coefficient on Banach space.

Keywords: Separable Banach space, Dense embedding, Trace class operator, Regularized Trace, Resolvent operator.

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Dickson Collocation Method For Approximate Solutions Of Mass-Spring System with Two Freedom Degree

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Abstract

In this paper, the approximate solutions of freedom vibration equations of the mass-spring system with two freedom degree are investigated. The system is modeled by a system of the second order linear ordinary differential equations. To obtain approximate solutions, a collocation method based on the Dickson polynomials is presented. The forms of approximate solutions and their derivatives are expressed in the matrix forms. By aiding of the required matrix forms and collocation points, the problem is reduced to a system of algebraic linear equations. Numerical applications are made to demonstrate the effectiveness and practicability of the technique. The results obtained are compared with the results of other methods in literature. The calculations for the example have been made using MATLAB.

Keywords: Approximate solutions, Collocation method, Collocation points, Dickson polynomials, The mass-spring system with two freedom degree, Vibration equations.

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A New Approach to Ostrowski Inequalities on Time Scale with Nabla Calculus

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Abstract

The theory of time scales has recently become prominent in many disciplines of the scientific world. It has become the field of study of many researchers working in mathematics and economics, physics, optics, engineering, and other fields. In this study, we bring a new approach to the generalized Ostrowski inequality using the nabla calculus on time scales.

Keywords: Time scale, Ostrowski inequality, Nabla calculus.

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Normal Differential Operators for First Order in the Weighted Hilbert Spaces

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Abstract

The relationship between the formal normality properties of the minimal operator generated by the differential operator expression and operator coefficient of this differential operator expression is established in this work. Later on, the general form of all normal extensions of the minimal operator in the weighted Hilbert space of vector-functions on finite interval is found. Finally, the structure of spectrum of these type extensions is investigated.

Keywords: Weighted Hilbert space, formal normal and normal operator, extension, spectrum.

Acknowledgement: The present research was supported by the TÜBİTAK (Project Number: 123F039), the Scientific and Technological Research Council of Turkey.

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Mathematical Modeling by Machine Learning and Improvement Suggestions

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Abstract

Machine learning algorithms have been applied on many fields such as finance, data mining, banking, and automotive sector, health for classification, prediction, clustering [1]. There are plenty of studies in the literature on the subject [2], [3]. In this study, "Early Stage Diabetes Risk Prediction" data set from the UCI Machine Learning Repository generated by Islam et al. was used; the dataset contains some diabetic information about 520 people with 15 categorical and 1 numerical totaly 16 attributes and 2 labels [4], [5]. Machine learning models were created by various machine learning algorithms such as K-Nearest neighbor, Naive bayes, Support vector machines, Random Forest, Decision trees and Boosting algorithms. In order to maximize the model performance metrics, the hyperparameters of the machine learning algorithms were investigated by grid search. As a result, model achievements were compared each other.

Keywords: Machine learning, k-nearest neighbor algorithm, random forest algorithm, support vector machines, Naive bayesian algorithm.

This study was supported by Yildiz Technical University Scientific Research Projects Coordination Unit. Proje Number: FYL-2024-6295.

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On Multiplication Module Over Non-commutative Rings

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Abstract

Multiplication modules have been widely studied over commutative rings, with numerous results characterizing their properties. However, the exploration of multiplication modules in the context of non-commutative rings has been comparatively limited. This paper aims to address this gap by conducting a thorough investigation into the key aspects of multiplication modules in the realm of non-commutative ring theory. We provide a definition of multiplication modules over non-commutative rings, wherein a module *M* is multiplication if every submodule *N* can be generated by an ideal of the ring R. Additionally, nilpotent submodules are defined as those submodules *N* for which $N^k = 0$ for some *k* in $\mathbb{Z}$. A definition is also given for the product of submodules in multiplication modules under the condition that ideal multiplication is commutative in the ring. Through the derivation of various associated results, this work is a generalization of multiplication module theory to non-commutative settings.

Keywords: Multiplication modules, Product of submodules, non-commutative rings, Nilpotent.

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On the solutions of a higher-order difference equation with quadratic term

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Abstract

We aim to derive the closed-form solutions to a higher-order difference equation with arbitrary real parameters and arbitrary real initial conditions. We show that under certain conditions, every well-defined solution is unbounded, converging to zero or converging to a periodic solution. We show the existence of periodic solutions.

Keywords: Difference equations, stability, boundedness character, periodicity.

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Multidimensional Lacunary Statistical Convergence of Rough Variables in Trust

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Abstract

Li presented a definition of rough space in 2003. Also he served four kind kinds of convergence concepts for rough variable such as convergence almost surely, convergence in trust, convergence in mean and convergence in distribution. The goal of this paper is to present the notions of double lacunary statistical convergent sequence, double lacunary statistically Cauchy sequence for fuzzy variables in trust. Additionally, some results are examined.

Keywords: Double lacunary statistical convergence, double lacunary sequences, rough space, trust.

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Generalization of Asymptotically Deferred Equivalent Theorems

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Abstract

In 1998 Kolk introduced the concept of B-statistical convergence by using a sequence of infinite matrices. By considering his definition, our goal is to present a natural combination of the definitions of B-statistical convergence and asymptotically deferred statistical equivalent sequences. To achieve this, we will examine which type of summability matrices preserve asymptotically deferred statistical equivalent sequences. Additionally, some important regularity type theorems will be presented.

Keywords: B- statistical convergence, rates of convergence, deferred Cesaro means, asymptotic regular matrix.

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Generation of Julia sets, Mandelbrot sets and Biomorphs using a new approximation method

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Abstract

Fractals are known as the most engaging and charming field of study due to their unique characteristics and self-similarity. Iterative techniques have been demonstrated to significantly improve fractal formation. We present a novel method for visualizing Julia and Mandelbrot sets for complex polynomials of the form $G(z) = z^m + az + b$, where z is a complex variable, $a, b \in \mathbb{C}$, and $m \in \mathbb{N} \cup \{0\}$. This work proposes a novel escape criterion for Julia and Mandelbrot sets using a recently proposed approximation technique. To generate biomorphs, we employ the escape time methodology and the proposed iteration method. We conduct graphical and numerical experiments to analyze how iteration parameters affect the geometry of created sets. Moreover, we examine the fascinating behavior of Julia and Mandelbrot sets for different m for certain fixed input parameter values. The examples provided show how this modification may result in a wide range of shapes.

Keywords: Fractals, Julia sets, Mandelbrot sets, Biomorphs, Iterative methods.

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A New Generating Functions For Products of Some Numbers With Symmetric Functions

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Abstract

In this paper, we introduce a new generating functions for the product of symmetric functions in several variables with (p,q)-numbers such as: (p,q)-Fibonacci, (p,q)-Lucas, (p,q)-Pell, (p,q)-Pell Lucas, (p,q)-Jacobsthal and (p,q)-Jacobsthal Lucas numbers.

Keywords: Symmetric functions, Generating functions, (p,q)-Fibonacci, (p,q)-Pell, (p,q)-Jacobsthal.

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Applied model for increasing the security of work files used in the Industry 4.0

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Abstract

Nowadays, the modeling is one of the basic tools applied in many practical areas such as Engineering. An industrial mathematics tool helps to improve the efficiency of the industry operation. The Industry 4.0 represents today's trend in the development of automation and data exchange in production technologies ([1],[2]). This includes cyber-physical systems, the Internet of Things and cloud computing Industry 4.0 creates the so-called smart factory. Industry 4.0 opens up new challenges to the industrial as well as to applied scientists. With the advent of Industry 4.0, more and more enterprises in the manufacturing spheres are looking to go through automation processes, with the main objective of reducing production costs and increasing productivity. For these processes to exist, a constant exchange of data and work files between machines and highly skilled employees is required [3]. It requires an extensive application of the modern technologies such as Internet and Windows. Note the majority of production machines in factories are now supported by older versions of the Windows operating system, some of which even doesn't have security updates to the operating system to ensure seamless communication with other parts of the system. This in turn invariably leads to system vulnerabilities and increased risk of process downtime for longer periods of time [4]. Some of the official documentation on production machines recommends that a parallel IT infrastructure be built to ensure machine encapsulation and limit the opportunities for cyber attacks, explicitly stating that bringing the machine into a segmented network is not secure enough. This, in turn, leads to the complication of standard IT infrastructure workflows. The study proposes a working model by which the communication process between highly skilled employees and machines in production can be facilitated and automated without compromising security. The model involves an intermediate secure cloud server between the employee and the production machine to avoid direct communication. The purpose of the cloud server is to automate the process of communication, as well as provide the ability to restore the information data sets stored on employees and production machines. The paper proposes a rigorous method to calculate the required disk space on the intermediate server to ensure the recovery of information sets due to deletion or cyber attacks caused by malware. After integrating the proposed operating model, it is not necessary to create a parallel infrastructure to encapsulate the production machines, while not compromising the security of the IT infrastructure. The proposed model and methods could be applied not only to Industry 4.0. It could be the main goal of our research in the future.

Keywords: Industry 4.0, vulnerabilities, network, security, scientific modeling.

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Hopf Bifurcation Analysis of Time-Delay Zika Virus Model

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Abstract

The Zika virus is transmitted to humans by mosquitoes and sexually, causing a disease known as Zika fever or Zika disease. The virus was first detected in a human in Nigeria in 1954, after being previously seen in monkeys in 1947. To develop a time-delayed dynamic model, an infection delay was added to an ODE model that describes the dynamics of the Zika virus spread between human and mosquito populations. The aim of this study is to investigate the stability and bifurcation of the endemic equilibrium with respect to a non-zero delay. If the delay exceeds a critical value, the system becomes unstable and experiences a Hopf bifurcation. The theoretical analysis is validated through numerical simulation.

Keywords: Stability, Hopf bifurcation, Modeling of epidemic disease.

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A Study on the Approximation by Generalized Max-Product Bleimann-Butzer-Hahn Operators of Fuzzy Numbers

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Abstract

In this work, the max-product (non-linear) Bleimann-Butzer-Hahn operators were generalized to encompass any compact interval $[a_n, b_n]\ such\ that\ \lim_{n\to\infty} b_n = \infty, \lim_{n\to\infty} \frac{b_n}{n} = 0$, as it was proven that they had the same order of uniform approximation as in the specific case of the interval [0,∞). Furthermore, it was proven that the monotonicity and shape properties were preserved by these operators on $[a_n, b_n]\ such\ that\ \ lim_{n\to\infty} b_n = \infty, lim_{n\to\infty} \frac{b_n}{n} = 0.$ Moreover, for applications, a fuzzy number $\bar{H}_n^{(M)}(\rho; [a_n, b_n])(t)$ was generated, preserving the support and the core of an arbitrary ρ , and they were utilized through metrics D_C to improve convergence estimates. Several direct conclusions were also obtained. Finally, a comparison and an illustrative graphic were presented, demonstrating how these operators converged to a fuzzy function.

Keywords: Non-linear Bleimann-Butzer-Hahn on [a_n,b_n], Improved estimation of approximation, shape-preserving properties..

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Stepanov-Like Pseudo Almost Periodic Solution for Competitive and Cooperative Nicholson's Blowflies system

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Abstract

In this paper, we explore a type of competitive and cooperative Nicholson's blowflies systems. Using Lyapunov functional and analytical methods, we determine the conditions for the existence and exponential convergence of Stepanov pseudo almost periodic solutions. Additionally, we provide an example and numerical simulations to support our theoretical findings.

Keywords: exponential dichotomy, competitive and cooperative Nicholson's blowflies system, Stepanov-Like pseudo periodic.

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An Investigation of Entire Topological Indices in Selected Graph Families.

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Abstract

In this research, we study some entire Zagreb indices by elucidating their behavior within three prominent graph families: subdivision graphs, central graphs, and corona products. We unveil the enigmatic properties of these complex structures by deriving explicit formulae for the first, second, and modified first entire Zagreb indices within each family. For subdivision graphs, we unveil a remarkably elegant expression unveiling the index's dependence on the base graph and its subdivision level. Central graphs yield a concise formula capturing the intricate interplay between the degree of the central vertex and the vertex degrees in the periphery. Finally, we traverse the complex network of corona products, revealing a formula that integrates the indices of the constituent graphs. Our findings offer valuable insights into the structural fingerprints encoded by entire Zagreb indices within these diverse graph families, paving the way for further exploration and applications in domains such as chemical modeling and network analysis.

Keywords: Modified first entire Zagreb index, first entire Zagreb index, second entire Zagreb index, forgotten entire Zagreb index, central graph of a graph, subdivision graph.

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Solving Congruence Equations through Imprimitive Actions

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Abstract

In the paper, it is shown that for all primes numbers p of the form $p \equiv 1\ (mod\ 4)$ and for all integers x there exist some integers y such that $x^2 + y^2 \equiv 0\ (mod\ p)$, by using an imprimitive action of the modular subgroup $\Gamma_0(p)$ on the set $\left\{\frac{k}{lp} \middle| k, l\ \epsilon\mathbb{Z},\ \ (k, lp) = 1\right\}$ with respect to the group $\Lambda_p(p)$.

Keywords: Congruence equations, imprimitive action, modular subgroup, prime numbers.

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On the Asymptotic Behaviour of the Unstable Bloch Eigenvalues of a Polyharmonic Matrix Operator

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Abstract

We explore the asymptotic behaviour of the so-called unstable Bloch eigenvalues of the Polyharmonic matrix operator $(-\Delta)^l + V(x)$ with $\frac{1}{2} < l < 1$, in the single resonance domain which is a subset of resonance domain– the set of eigenvalues situated close to the diffraction hyperplanes. The single resonance domain approaches full measure asymptotically across the entire resonance domain. In our analysis, we discover a significant trend: as energy levels increase, the eigenvalues are related to those of a Sturm-Liouville operator. Our methodology builds upon perturbation theoretic techniques developed by Veliev, which is presented in [1].

Keywords: Perturbation theory, system of poyharmonic operators, eigenvalue, asymptotic, resonance domain.

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Empowering Preservice Teachers: Integrating Digital Tools for College-Level Mathematics Instruction

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Abstract

In an era marked by technological advances, the integration of digital tools into university-level mathematics teaching has become increasingly vital. The study examines the selection and integration strategies that secondary mathematics teacher candidates use to enhance the teaching and learning experience in higher education. The study aims to explore the symbiotic relationship between technology and pedagogy, showcasing innovative approaches and best practices for effectively using digital tools in college-level mathematics courses. The study navigates the evolving landscape of mathematics education, where digital tools empower preservice teachers to shape the future of learning in higher education.

Keywords: Digital Tools, College-Level Mathematics, Preservice Teachers, Integration Strategies, Technology in Education

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A Novel Pentagonal Formation: Exploring the Properties of the Isosceles Pentagon and Isosceles Pentagon Prizm (Bird House)

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Abstract

This study introduces novel pentagonal formations for both 2D and 3D shapes, namely the Isosceles Pentagon *(İkizkenar Beşgen*) and Isosceles Pentagon Prism (Bird House) *(İkizkenar Beşgen Prizma (Kuş Evi))*. The Isosceles Pentagon is distinguished by its unique symmetry, comprising two isosceles right triangles and three equilateral triangles. The central point, denoted as "S," maintains equal distances from each vertex.

This study aims to elucidate the properties of these innovative 2D and 3D shapes and explore their potential applications within the geometry curriculum. By analyzing their geometric characteristics and structural attributes, we endeavor to provide insights into the rich mathematical concepts embodied by these formations. Additionally, we discuss the relevance and implications of incorporating these shapes into educational contexts, offering new perspectives for geometric instruction and exploration.

Keywords: Geometry, Pentagonal Formations, Isosceles Pentagon, Isosceles Pentagon Prism, Geometric Properties, Mathematical Exploration

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On Modified Diophantine Equation of Balancing Numbers

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Abstract

The terms of the sequence of balancing numbers n are the solutions of the Diophantine equation

$$1 + 2 + \cdots + (n-1) = (n+1) + \cdots + (n+r)$$

for some positive integers r, which is called the balancer of n [1]. In this study, we examine a new Diophantine equation constructed by making a slight modification to the Diophantine equation given above. Also, we investigate some basic properties of the new integer sequence obtained by using this Diophantine equation and derive algebraic identities that the terms of this sequence provide. Moreover, we present some algebraic relations between this sequence and the other integer sequences.

Keywords: Balancing numbers, Diophantine equation, Integer sequence.

This study supported by the Scientific and Technological Research Council of Türkiye (TÜBİTAK), grant number 123F048.

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Approximation Of Schwartz Differentiable Functions Of Several Variables By The Sequence Of Integral Operators

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Abstract

The problem of approximation of differentiable functions by the sequences of integral operators with positive kernels were studied by many authors. This stuy is devoted to approximation of functions of several variables having derivatives in Schwartz sense.

Let R^m be the m-dimensional Euclidean space of points $x = (x_1, \dots, x_m)$, $|x|^2 = \sum_{i=1}^{m} x_i^2$.

Recall that a function f: $R^m \to R$ defined in a neigbourhood of fixed point $x_0 \in R^m$

Has a Schwartz derivative $f_\delta'(x_0)$, if

$$f(x_0 + h) - f(x_0 - h) = 2f_\delta'(x_0)h + o(h), \quad h \to 0$$

And has a second Schwartz derivative $f_\delta''(x_0)$, if

$$f(x_0 + h) - 2f(x_0) + f(x_0 - h) = f_\delta''(x_0)hh + o(|h|^2) \quad h \to 0$$

Keywords: integral oparators, Schwartz derivatives, generalized derivatives.

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Investigation of Traveling Wave Solutions of Combined pKP–BKP equation

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Abstract

This study delves into the realm of nonlinear partial differential equations, focusing on the analysis of traveling wave solutions of the potential Kadomtsev-Petviashvili and B-type Kadomtsev-Petviashvili (pKP-BKP) equations. This equation describes interactions between exponentially localized structures and has been used as a model for shallow water fluctuations and for the electrostatic wave potential in plasmas. To obtain solutions of the pKP-BKP equation, both the classical and the new Kudryashov methods are employed. It has been tested that the obtained solutions provide equations using the computer algebraic system. Besides, the traveling wave solutions are analyzed through their 2-dimensional, 3-dimensional profiles, and contour plots.

Keywords: Combined pKP-BKP equation, The classical Kudryashov method, the new Kudryashov method.

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A High-Order Hybrid Computational Scheme for Solving the RLW Equation

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Abstract

Regularised Long Wave (RLW) Equation is introduced by Peregrine and Benjamin et al. [1,2,3] to define the nonlinear dispersive waves and is given in the form

$$u_t + u_x + \epsilon u u_x - \mu u_{xxt} = 0$$

The analytical solutions of the RLW equation are only available on the restricted solution interval of the boundary and initial conditions. Therefore, the approximate solutions of this equation are of increasing importance to see the nature of solitary waves. In this work, in order to obtain the numerical solutions of RLW equation, a high-order hybrid computational method is developed. Our proposed approximation technique is based on combining cubic B-spline and fourth-order compact finite difference scheme for the spatial discretization, while Adam's Moulton scheme is utilized for the temporal discrezation. To see the efficiency and compatible of the method, a test problem is choosen and results are shown in tables and graphs with the results in previous works. The error norm of L_∞, the invariants of the solitary wave and rate of the convergence are calculated to show the accuracy of the proposed method and are given with their analytical values for the comparison. The obtained results verify that the suggested scheme displays high accuracy in obtaining the approximate solution of the RLW equation.

Keywords: RLW equation, Solitary waves, Cubic B-spline, Finite difference method, Adam's Moulton sheme.

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Relation-theoretic fixed point results for nonlinear rational contractions with an application on its dislocated Metric Spaces

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Abstract

Weighted In this paper, we prove the results on the existence and uniqueness of fixed points in the setting of dislocated metric space under the aspects of new generalized (phi, psi) -rational contraction using a binary relation. We also provide an example to illustrate our newly proven results. Finally, we give an application to the fractional differential equation.

Keywords: Binary relation, (phi-psi)-rational contraction, Dislocated metric spaces, functional differential equation.

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Exitence of solution of Integral Equations in Cone metric spaces

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Abstract

In this study, we use comparison mapping for contractive conditions in cone metric spaces to demonstrate the existence of a solution to mixed type integral equations. We use examples to show how our findings can be put to use.

Keywords: Integral equation, Cone metric spaces, Contractive condition.

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Main concepts of Ulam stability to differential equations

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Abstract

The main goal of this talk is to emphasize on the application of Ulam type stability for boundary value problems for differential equations with various types of derivatives, such as ordinary derivatives and fractional derivatives. We will give the basic concepts of the idea of Ulam type stability and we will discuss the main points in the proofs of Ulam type stability. The considerations will include Ulam-Hyers stability, Ulam-Hyers-Rassias stability of boundary value problems for the mentioned above differential equations with various derivatives. We will point out how a common misunderstanding in some published papers could be avoided. The new ideas about the application of Ulam type stability will give a tool for further studies in this area. It will help many authors to avoid common mistakes maked in the proofs of this types of stability..

Keywords: Ulam type stability, differential equations, boundary value problem.

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A Finite difference Scheme for two-point Fractional Boundary Value Problem of Conformable Fractional Derivative

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Abstract

The conformabal fractional derivative is a new class of fractional derivative. It does not hold memory effect and it is a natural extention of the ordinary derivative to a non-integer differentiation. The present work considers two-point boundary value problems with convection term and the highest-order derivative of the conformable derivative on [0 , L]. We solve the problem numerically using a finite difference method on a uniform mesh. We prove that the method is of first order convergent. Numerical experiments are carried out to verify the theory.

Keywords: Conformable fractional derivative, finite difference method, convergence, singular solution

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On Extension of a N-wave Solution Procedure

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Abstract

We present an extension of a well known analytical technique which employs wave transformation and logarithmic transformation [1,2,3]. In this approach, dispersion relations and phase shifts play important role in finding various solutions. Obtained solutions are visualized by plotted graphs.

Keywords: N-wave solutions, mixed solutions, logarithmic transformation.

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Lucas Difference Sequence spaces defined by Orlicz function in 2-normed spaces

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Abstract

In this paper, we define the new sequence spaces defined by Orlicz function over 2-normed space by Lucas difference matrix and its matrix domain and examine some topological and geometrical properties related to these concepts and find some inclusion relation among these spaces.

Keywords: Difference sequence space, Lucas numbers, Orlicz function, Banach Saks property, infinite matrix.

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Solvability Problems of Elliptic Equations in non-standart Banach Sobolev Function Spaces

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Abstract

In this work, the results about the local existence theorems in “non-separable case” in grand Sobolev spaces and local solvability in "separable case" in weighted grand Sobolev spaces are expressed for m-th order elliptic equations. In addition, the results obtained for concepts such as extension theorem, trace operator, trace space, which are necessary for existence theorems for elliptic equations, are given.

Keywords: Grand Sobolev spaces, weighted grand Sobolev spaces, elliptic operator, local solvability, extension theorem, trace space

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Stability of Perturbed Set Differential Equations Related to Unperturbed Set Differential Equations with Initial Time Difference

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Abstract

We have investigatedthat the qualitative behavior of a perturbed set differential equation that differs in the initial position and initial time concerning the unperturbed set differential equation. We compare the classical notion of stability criteria to the notion of initial time difference stability of set differential systems. We present some comparison results.

Keywords: Set differential equations, perturbed differential systems, initial time difference, stability, comparison results.

AMS (MOS) subject classification: 34D10, 34D99.

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On the annihilators of holonomic D-modules

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Abstract

Let *R* be either a polynomial ring $k[x_1, x_2, \dots, x_n]$ or a formal power series ring $k[[x_1, x_2, \dots, x_n]]$ with n variables over a field k of characteristic zero. Then the ring of *k* -linear differential operators *D=D(R,k)* consists of *k* space endomorphisms of *R* generated by multiplications of elements in *R* and the usual differential operators $\partial_i = \frac{\partial}{\partial_i}$ for $1 \leq i \leq n$.

In this study, we examine the holonomic modules over *D(R,k) and* give an elementary proof of the well known fact that the annihilator of a holonomic D-module is zero.

Keywords: D-modules, holonomic modules, faithful modules

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Weighted Hardy Inequalities – Equivalent Characterizations

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Abstract

In this talk we will primarily focus on the characterizations of weighted Hardy inequalities. Hardy inequalities can be characterized using a variety of well-known techniques, and there are several equivalent conditions. In this presentation, we will discuss new methods for obtaining equivalent conditions.

Keywords: Weighted inequalities, Hardy operator, equivalent conditions, discretization

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Improvement of Rough Approximations Using Somewhat Open Sets

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Abstract

In this paper, we introduce new rough set models leveraging the concepts of somewhat open sets. We define Pj-somewhat open and Cj-somewhat open sets obtained using j-adhesion and containment neighbourhoods. Then, based on these sets, we define new types of rough approximations and accuracy measures. We also compare this approach with the previous ones, and show that it is more accurate than those in the case of reflexive relations. Finally, we show that the rough approximations based on Pj-somewhat open sets are more accurate than those based on Cj-somewhat open sets.

Keywords: Rough sets, lower and upper approximations, somewhat open sets, neighbourhood spaces.

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On the existence and uniqueness of a solution to a mixed problem for one class of equations

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Abstract

It is known that mixed problems both for equations correct according to I.G. Petrovsky may turn out to be incorrect, and for incorrect equations they may be correct. In this article, we study the existence and uniqueness of a solution to a mixed problem for a class of equations with complex-valued coefficients that behave as parabolic, despite the fact that over time they can switch from parabolic type to Schrödinger type, or even to antiparabolic type.

Note that the main characteristic property of these equations is that for the equations of the corresponding spectral problems, the argument of the roots of the characteristic polynomial of J. Birkhoff is not constant.

Keywords: Cauchy problem, parabolic equation, classical solution, existence, uniqueness.

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Novel Perspectives on Hermite-Hadamard Inequalities with Tempered Fractional Integrals

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Abstract

This research delves into the derivation of midpoint-type and trapezoid-type inequalities via tempered fractional integrals by utilizing functions whose second derivatives are bounded. Furthermore, we obtain a new version of the Hermite-Hadamard inequality, incorporating tempered fractional integrals. Notably, our approach diverges from conventional methods by evolving the condition $F'(\sigma+\rho-\eta) \geq F'(\eta)$, for all $\eta \in \left[\sigma, \frac{\sigma+\rho}{2}\right]$, instead of relying on the convexity of the function.

Keywords: Hermite-Hadamard inequality, integral inequalities, bounded functions, tempered fractional integrals.

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An Interconnected system of difference equations with coefficients linked to Fibonacci numbers

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Abstract

In this work we solve a system of difference equation . We give a representation of its general solution in terms of Fibonacci numbers and the initial values. Some theoretical justifications related to the representation for the general solution are also given.

Kyewords: System of difference equations · General solution · Fibonacci sequence , stability.

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Generalized Complex Francois Numbers

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Abstract

In this paper, we introduce the generalized complex Francois numbers and provide some of their properties, such as Binet's formula, the generating function, Cassini, Catalan, and d'Ocagne identities. Furthermore, we compute summation formulas for generalized complex Francois numbers.
Keywords: Binet's formula, Fibonacci numbers, Francois numbers, complex Fibonacci numbers.

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Interaction Between Grains And Surrounding Fluid: Impact Phenomena

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Abstract

The interaction between fluid and a single grain or two grains in a straight thin channel is investigated both analytically and numerically. A two-way nonlinear 2D unsteady interaction takes place between the fluid and the grain. The study consists of the following stages; In the first stage, the nonlinear interaction between a small particle with a certain thickness and/or camber and the fluid is modelled and the characterisation of this model will be described. Then, a possible impact between the body and the channel walls is discussed in detail and some analytical approach is presented. Finally, small-time behaviour of the interacting two bodies is analysed analytically.

This mathematical study is expected to provide improvements in the analysis and simulation studies of some problems in the industrial field and contribute to innovative approaches in the related field. Particle separation systems that provide the separation of foreign particles that can damage aircraft engines and food separation in the field of food technologies are among the main application areas of the model. The study includes numerical and analytical studies and comparisons between those two.

Keywords: Fluid-Body Interaction, Impacts, Particle Movement

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Asymptotic behavior and blow up of solutions for a p-Biharmonic equation with logarithmic source term

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Abstract

In this presentation, we consider p-Biharmonic equation with logarithmic source term. This type equation arises many branches of sciences such as inflation cosmology, nuclear physics, supersymmetric field theories and quantum mechanics. Firstly, we prove the asymptotic behavior of solutions. Later, we consider the blow up of solutions.

Keywords: Asymptotic behavior, Blow up, p-Biharmonic equation, Logarithmic term.

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Heart Sound Time-Frequency Feature Extraction for Improved Heart Disease Detection Using the Short-Time Fourier Transform, S-Transform, and MFCCs

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Abstract

Accurate analysis of heart sounds is crucial for diagnosing and monitoring cardiovascular diseases. This study presents a comprehensive approach to extracting informative time-frequency features from heart sound signals, leveraging advanced signal processing techniques. The Short-Time Fourier Transform (STFT) is employed to obtain time-varying spectral representations, revealing frequency variations and intensity changes across cardiac cycles. Spectrogram analysis provides visual representations of the frequency content and temporal evolution, enabling the identification of spectral peaks, bandwidth, and temporal patterns associated with cardiac events. Furthermore, the S-transform, a hybrid of the STFT and wavelet transform, offers high-resolution time-frequency representations. It captures subtle changes in frequency content and temporal dynamics, crucial for detecting abnormalities in heart sounds. Mel-Frequency Cepstral Coefficients (MFCCs) are derived from the Mel-frequency scale, known to mimic the human auditory system's response. MFCCs encode spectral and temporal characteristics of heart sound signals, providing a compact representation of the spectral envelope and temporal variations. By leveraging these state-of-the-art signal processing techniques, this study aims to extract comprehensive time-frequency features from heart sound signals. These features can be used to train machine learning models for accurate classification and anomaly detection, ultimately improving the diagnosis and monitoring of cardiovascular diseases.

Keywords: Short-Time Fourier Transform (STFT), S-transform, Mel-Frequency Cepstral Coefficients (MFCCs).

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Mathematical Modelling of The Effects on Educational Success By Machine Learning Algorithms

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Abstract

Nowadays, machine learning, which is used for classification, clustering and prediction in many fields such as health, media, banking, industry and finance, is also used in the field of education [1]. There are many studies in the literature examining the factors affecting the educational success of students with machine learning [2], [3], [4], [5], [6], [7], [8]. In this study, the data set called "Higher Education Students Performance Evaluation" which contains 145 information from the https://archive.ics.uci.edu/dataset/ website and has no missing data, was used to investigate the factors affecting the academic success of students by using machine learning methods k-nearest neighbor, naïve bayes, random forest, support vector machines, decision tree and boosting [9]. Modeling was developed using the Python language in the Anaconda Navigator environment [10]. Hyperparameters maximizing the model success of the established mathematical models was identified and model success criteria was determined.

Keywords: Machine learning, k-nearest neighbor, random forest, naïve bayes, support vector machines, education and training.

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Some Dunford-Pettis Operators in Banach Lattices

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Abstract

In this talk, we introduce and study some Dunford-Pettis Operators in Banach Lattices. For example, weak Dunford-Pettis operator, weak* Dunford-Pettis operator, almost Dunford-Pettis operator, order (L)-Dunford-Pettis operator and so on.

Keywords: Banach Lattice, Dunford-Pettis operator, Banach Space, Topological Space, weak Dunford-Pettis operator, weak* Dunford-Pettis operator, almost Dunford-Pettis operator

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