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ABSTRACT BOOK

EDITORS

Yusuf ZEREN
Murat KIRISCI
Adem Cengiz CEVIKEL

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Abstract Book

Editors

Prof. Dr. Yusuf ZEREN
Yıldız Technical University
İstanbul, TÜRKİYE

Prof. Dr. Adem Cengiz ÇEVİKEL
Yıldız Technical University
İstanbul, TÜRKİYE

Prof. Dr. Murat KİRİŞÇİ
İstanbul Üniversitesi-Cerrahpaşa
İstanbul, TURKEY

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FOREWORDS

Dear Conference Participant,

Welcome to the International Hybrid Conference on Mathematical Development and Applications (ICOMAA-25) we organized the eighth. 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 186 participants and 9 invited speakers from 25 countries (Algeria, Azerbaijan, Chile, Egypt, France, Georgia, India, Iran, Islamic Republic of, Italy, Kazakhstan, Kuwait, Malaysia, Mexico, Nigeria, Oman, Pakistan, Saudi Arabia, Syrian Arab Republic, Taiwan, Türkiye, United Arab Emirates, United States, Uzbekistan, Yemen).

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 **8th 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://2025.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 "8th International Hybrid Conference on Mathematical Development and Applications" (ICOMAA-2025) 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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Weighted Inequalities for Sub-Monotone Functionals

Amiran Gogatishvili[1]

[1]*Institute of Mathematical of the Czech Academy of Sciences Žitná 25, 115 67 Prague, Czech Republic*

gogatish@math.cas.cz

Abstract

We establish a set of relations between several quite diverse types of weighted inequalities involving various integral operators and fairlygeneral quasinorm-like functionals, which we call sub-monotone. The main result enables one to solve a specific problem by transferring it to another one for which a solution is known. Inequalities for Hardy, Copson, geometric mean and harmonic mean operators are shown to be interlinked. We give applications weighted inequalities restriected to cones of monotone functions.

Keywords: Weighted inequalities, integral operators, sub-monotone functional, Hardy operator, Copson operator, geometric mean operator, harmonic mean operator.

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6. The research was partially supported by the Czech Academy of Sciences (RVO 67985840), by Czech Science Foundation (GA\v{C}R), grant no: 23-04720S, by Shota Rustaveli National Science Foundation of Georgia (SRNSFG), grant no: FR22-17770.

On the first boundary value problem for the nonlinear elliptic and parabolic equations of second order

Farman Mamedov[1]
[1]*Institute of Mathematics and Mechanics of MSE & 2Azerbaican State Oil and Industry University*
farman-m@mail.ru

Abstract

For the nonlinear gradient term and degenerate elliptic and parabolic equations the solvability problem is investigated. Under the proper growth and local regularity conditions on the nonlinear part with respect to the gradient and low order summable term an existence of the strong solution is proposed. This result does not follow from the known results since the strong solution is studying and the low summability is considered; also, the new term is adding to the growth condition of the type $c(t,x)|u|^d$.

Keywords: elliptic equation, parabolic equation, Sobolev inequality, existence of solution, first boundary value problem.

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On Martínez–Kaabar Fractal–Fractional Laplace Transform

Mohammed K. A. Kaabar[1]
[1]*Washington State University, Pullman, 99163, WA, USA*
mohammed.kaabar@wsu.edu

Abstract

In this work, a new generalized form of Laplace transform is formulated in the context of Martinez–Kaabar (MK) fractal–fractional calculus. This transformation incorporates the generalized integral operator in the sense of MK calculus into the known Laplace transform definition. This work provides a new mathematical technique to solve various problems in sciences and engineering. The Abel integral equation and Volterra integral equations are investigated via this technique.

Keywords: fractional calculus, fractal-fractional calculus, Laplace transform, integral equation.

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On the Calderón-Zygmund theory of singular integrals

Cody B. Stockdale[1]

[1]*School of Mathematical and Statistical Sciences, Clemson University,*
cbstock@clemson.edu

Abstract

Calderón and Zygmund's seminal work on singular integral operators has greatly influenced modern harmonic analysis. We begin our discussion with some classical aspects of CZ theory, including examples and applications, and then focus on the crucial weak-type (1,1) estimate for CZ operators. We investigate techniques for obtaining weak-type inequalities that use the CZ decomposition and ideas inspired by Nazarov, Treil, and Volberg. We end with an application of these methods to the study of the Riesz transforms in high dimensions.

Keywords: Calderón-Zygmund operator, Singular integral operator, weak-type bounds

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Construction of finite time bounded controls via orthogonal polynomials

Abdon E. Choque Rivero[1]
[1]*Institute of Physics and Mathematics, Michoacan University of Saint Nicholas of Hidalgo, Mexico*
abdon.choque@umich.mx

Abstract

We investigate a family of Brunovsky systems of dimension n and construct bounded positional controls $un(x)$ designed to achieve finite-time stabilization. The control synthesis is based on orthogonal polynomials associated with a function distribution$\sigma(\tau, \theta)$, where $\tau \in [0, +\infty)$ and $\theta > 0$ is a parameter. This parameter θ is interpreted as Korobov's controllability function, $\theta = \theta(x)$, and plays a role analogous to that of a Lyapunov function. The postional control is explicitly defined as $un(x) = un(x, \theta(x))$.

Keywords: Finite-time stabilization, controllability function, Brunovsky systems, orthogonal polynomials.

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Friedmann Universe with Bulk Viscosity and Variable Cosmological Term

Abhay Singh[1]

[1]*Department of Mathematics, School of Research and Technology,*
People's University, Bhopal-462037, India
abhaysingh5784@gmail.com

Abstract

In this paper, the possibility of late time acceleration with bulk viscous fluid as the matter source in flat FRW universe is considered. By assuming the functional form of the Hubble parameter in the model to be a suitable function of time t, we explore cosmological hypotheses. The model of universe represents earlier decelerating and the current accelerating universe passing through a transition phase. Cosmological Term Λ being very large at initial epoch relaxes to genuine cosmological constant at recent time. The stability of the outcome has also been discussed, along with the physical, geometrical, and kinematic behaviour of the model.

Keywords: Energy Density, Deceleration parameter, Cosmological term, Hubble parameter, Bulk viscosity.

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Existence and Uniqueness Solutions for Singular Caputo-Fractional Differential Problem Via Fixed Point Theorems

Aboubaker El-Saddik Bouziane[1], *Berrabah Bendoukha*[2]
[1,2]*Department of Mathematics, Abdelhamid Ibn Badis University,*
aboubaker27@gmail.com
bbendoukha@gmail.com

Abstract

In this paper, we establish sufficient conditions for the existence and uniqueness of solutions for a certain class of problem for fractional singular differential equation with Caputo derivative and one integral boundary condition. Ours results are given by applying some standard fixed-point theorem (Banach and Leray Schauder).

Keywords: Fractional equation, Caputo derivative, Fixed point, Integral condition.

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Axiomatizability and Non-Standard of Certain Quasivarieties of Modular Lattices

Arapbay Meruert[1], Basheyeva Ainur[2], and Lutsak Svetlana[3]
1,2 Department of Algebra and geometry, L. N. Gumilev Eurasian National University, Kazakhstan
3M. Kozybayev North Kazakhstan University, Petropavlovsk, Kazakhstan
meruertarapbay@gmail.com
basheyeva3006@gmail.com
sveta_lutsak@mail.ru

Abstract

There are two fundamental and interconnected problems in lattice theory: identifying which finite lattices generate finitely based quasivarieties and which generate standard quasivarieties. These questions are pivotal in understanding the structural and logical characteristics of lattices and their impact on the quasivarieties they produce.

In this work, we establish a sufficient condition for a locally finite quasivariety of lattices that ensures it is neither finitely axiomatizable nor profinite.

Our findings include multiple examples of finite lattices that generate quasivarieties lacking these properties. These examples highlight the complex interplay between the internal structure of finite lattices and the resulting properties of the quasivarieties they define.

Keywords: lattice, quasivariety, topological quasivariety.

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On two problems of quasivarieties of modular lattices

Meruert Arapbay[1], Amantay Asanbekov[2], Ainur Basheyeva[3] and Anvar Nurakunov[4]
[1,3]L.~Gumilev Eurasian National University, Astana, Kazakhstan,
[2,4]Institute of Mathematics, National Academy of Sciences, Bishkek, Kyrgyzstan
meruertarapbay@gmail.com,
asanbekov.amantai.1@gmail.com,
basheyeva3006@gmail.com,
a.nurakunov@gmail.com.

Abstract

A quasivariety is a class K of algebras closed under subalgebras, direct products an ultraproducts. Ftriple $\langle A, \sigma, \tau \rangle$ is called a topological algebra if $\langle A, \sigma \rangle$ is an algebra of the signature σ, $\langle A, \tau \rangle$ is a topological space and every operation from σ is continuous with respect to topology τ . A topology τ on a set A is Boolean if the topological space $\langle A, \tau \rangle$ is compact, Hausdorff and totally disconnected. A topological algebra $\langle A, \sigma, \tau \rangle$ is Boolean if it's topology τ is Boolean. A finite algebra A equipped with discrete topology τ generates a topological quasivariety $Q_\tau(A)$ consisting of all topologically closed subalgebras of non-zero direct powers of A endowed with the product topology. A topological quasivariety $Q_\tau(A)$ is standard if every Boolean topological algebra with the algebraic reduct in $Q(A)$ is homeomorphic to inverse limits of finite algebras from $Q(A)$ endowed with the product topology.

There are two well-known and closely related problems: Which finite lattices generate finitely based quasivarieties? and Which finite lattices generate standard topological quasivarieties? The first problem is attributed to V. A. Gorbunov and D. M. Smirnov (1978), while the second is due to D. M. Clark, B. A. Davey, M. G. Jackson, and J. G. Pitkethly (2008).

The main goal of this talk is to discuss both problems and present some new results. In particular, let $M_{3,3}$ be an 8-element modular lattice with 3 atoms and 3 coatoms, and let M_{3-3} be a 10-element lattice with 3 atoms and 3 coatoms, which is the subdirect product of $M_{3,3}$ and a two-element lattice. We denote by $Q(L)$ ($V(L)$) the least quasivariety (variety) containing L.

Theorem. Let L be a finite modular lattice. If $Q(M_{3-3}) \subseteq Q(L) \subset V(M_{3,3})$, then $Q(L)$ is not finitely axiomatizable, and $Q_\tau(L)$ is not standard. Corollary. Let L be a finite lattice. If $M_{3-3} \leq L$ and $M_{3,3} \nleq L$, then $Q(L)$ is not finitely axiomatizable, and $Q_\tau(L)$ is not standard.

Keywords: Lattice, quasivariety, finitely axiomatisable class, standard quasivariety

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On the Dynamics and Hopf Bifurcation Analysis of an Immigration Model with Time Delay

Aleyna Akin[1], M. Taylan Sengul[2]
[1,2]Department of Mathematics, Marmara University,
aleynaakin@marun.edu.tr
taylan.sengul@marmara.edu.tr

Abstract

Immigration is considered a global issue as it takes place in many countries for different reasons. The causes of migration include political and economic instability, human rights violations by governments, authoritarian regimes and geographical conditions. Since the causes of immigration fall within the research area of many different disciplines, studies on immigration increase their importance.

In this study, a dynamic population model will be constructed by examining the relationships between the immigrants and the native population. This model is constructed with two systems of nonlinear ordinary differential equations describing the dynamics of the immigrant and native population. In the model created within the scope of the study, it is thought that the immigrant population migrating to the country increases the native population by assimilating over time.

The model will first show the existence of an internal equilibrium point and analyze its stability and bifurcation. In the model, the existence and stability of Hopf bifurcation will be analyzed. We also introduce time delay in the model and analyze how this time delay effects the Hopf bifurcation phenomenon.

Keywords: Hopf bifurcation, stability, delay, stability analysis, equilibrium points, native and immigrant population, central manifold theorem, normal form.

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Idempotent Total Graphs: Structure, Properties and Python-Based Analysis

Ali Berkan Bektas[1], Yeliz Kara[2], Ismail Naci Cangul[3]
[1,2,3]Department of Mathematics, Bursa Uludag University,
berkanbektas@hotmail.com
yelizkara@uludag.edu.tr
cangul@uludag.edu.tr

Abstract

Let R be a commutative ring with unity. In this study, we introduce the concept of the idempotent total graph of R, constructed using the zero-divisor and idempotent elements of the ring. We focus our investigation on the ring of integers modulo n for selected values of n, analyzing key properties of the corresponding graphs. Furthermore, we implement computational algorithms in Python to construct, visualize, and verify the structure of these graphs, offering numerical evidence and graphical representations to support our theoretical findings.

Keywords: Commutative Rings, Idempotent Element, Zero Divisors, Zero-Divisor Graphs, Python.

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Existence Analysis for a Class of Conformable Fractional Boundary Value Problem

Asghar Ahmadkhanlu[1]
[1]*Department of Mathematics, Azarbaijan Shahid Madani University, Tabriz, Iran*
ahmadkhanlu@azaruniv.ac.ir

Abstract

Fractional calculus is used to model complex systems that exhibit memory effects, but finding analytical solutions to fractional boundary value problems (FBVPs) is difficult because of nonlocal operators such as Caputo derivatives. Conformable fractional calculus offers a solution by introducing localized derivatives, which allows for more manageable solutions to conformable fractional boundary value problems (CFBVPs). However, CFBVPs lack specific numerical methods despite their potential, which restricts their use in areas like anomalous diffusion and control theory. It is essential to develop effective numerical techniques to fully utilize their capabilities, filling a gap in existing research and enhancing real-world modeling.
In this work we investigate the fractional boundary value problem

$$T_\zeta \varkappa(\sigma) = \sigma^\xi \mu(\sigma, \varkappa(\sigma)), \quad 0 \leq \sigma \leq A, \qquad (1.1)$$

$$\varkappa'(0) = 0, \varpi\varkappa(0) + \varsigma\varkappa(A) = \gamma, \qquad (1.2)$$

where T_ζ is the conformable fractional derivative of order $1 < \zeta < 2$,, $\xi > (2-\zeta) \in R$ and $\mu: [0,1] \times R^+ \to R^+$ is a continuous function. Firstly, we compute the Green function of the above problem by transforming it into an integral equation. Then, using the properties of the Green function and applying some fixed-point theorems, like the Banach fixed point theorem and some *α-ψ-* contractions, we will prove the existence and uniqueness of the solution for the problem. Finally, a numerical method to solve the problem will be examined using Bernstein polynomials.

Keywords: Fixed point theorems, Existence and uniqueness, Green function.

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Blow Up Of Solutions For A P-Triharmonic Equation With Positive Initial Energy

Ayşe Fidan[1], Erhan Pişkin[2]
[1]Dicle University, Institute of Natural and Applied Sciences, Department of Mathematics, Diyarbakır, Turkey,
[2]Dicle University, Department of Mathematics, Diyarbakır, Turkey,

afidanmat@gmail.com
episkin@dicle.edu.tr

Abstract

In this article, we consider a p-triharmonic equation. Under suitable conditions on the initial datum, we prove that the solution blow up in finite with positive initial energy.

Keywords: Blow up, p-triharmonic, variable coefficient.

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Blow Up Of Solutions For A P-Triharmonic Equation With Negative Initial Energy

Ayşe Fidan[1], Erhan Pişkin[2]

[1]Dicle University, Institute of Natural and Applied Sciences, Department of Mathematics, Diyarbakır, Turkey,
[2]Dicle University, Department of Mathematics, Diyarbakır, Turkey,
afidanmat@gmail.com
episkin@dicle.edu.tr

Abstract

In this article, we consider a p-triharmonic equation. Under suitable conditions on the initial datum, we prove that the solution blow up in finite with negative initial energy.

Keywords: Blow up, p-triharmonic, variable coefficient.

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On Eigenvalues of the Sturm-Liouville Problems with Boundary Conditions Polynomially Dependent on the Eigenparameter

Ayşe Kabataş[1]
[1]*Department of Mathematics, Karadeniz Technical University,*
akabatas@ktu.edu.tr

Abstract

In this paper, we consider the eigenvalues of the Sturm-Liouville boundary value problem

$$-y" + qy = \lambda y$$

$$P_{\xi 1}(\lambda) y'(\pi\xi) + P_{\xi 0}(\lambda) y(\pi\xi) = 0, (\xi = 0,1)$$

where λ is the real spectral parameter, q is a real-valued, its derivative exists and is an integrable function. Also,

$$P_{\xi k}(\lambda) = \sum_{j=0}^{r_{\xi k}} P_{\xi k j} \lambda^{r_{\xi k} - j}, \xi, k = 0,1, \ r_{\xi k} \geq 0$$

are arbitrary polynomials of degree $r_{\xi k}$ with real coefficients such that $P_{\xi 0}(\lambda)$ and $P_{\xi 1}(\lambda)$ have no common zeros.

Keywords: Sturm-Liouville problem, Eigenvalues, Eigenparameter-dependent boundary condition.

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Finite Time Blow-up Analysis for a Semilinear Damped Wave Equation

Begüm Çalışkan Desova[1]
[1] Department of Information Security Technology, Yeditepe University,
begum.caliskan@yeditepe.edu.tr

Abstract

In this paper, we study the finite time blow-up behavior of solutions to a fourth-order semilinear damped wave equation of the form $u_{tt} + \Delta^2 u + g(u_t) = f(u)$, with $g(s) = s$ and appropriate boundary and initial conditions. We use an energy method and Levine's concavity argument to prove that blow-up can occur even with positive initial energy. A simplified one-dimensional model is used to numerically illustrate the blow-up behavior, confirming the theoretical results and highlighting the impact of nonlinearity.

Keywords: Finite-time blow-up, semilinear damped wave equation, energy method.

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On Weighted Dynamic Inequalities With Diamond Alpha

Beyza Karagöz[1], Lütfi Akın[2], Zeynep Bilge Alperen[3]
[1]The Institute for Graduate Educational Studies, Mardin Artuklu University, Mardin, Türkiye
[2]Department of Business Administration, Mardin Artuklu University, Türkiye
[3]The Institute for Graduate Educational Studies, Mardin Artuklu University, Mardin, Türkiye
byzaakrgz137@gmail.com
lutfiakin@artuklu.edu.tr
zeynepbilgealperen@gmail.com

Abstract

In this work, we establish weighted dynamic inequalities of Hilbert type with diamond alpha by applying reversed Hölder's inequality, chain rule on time scales, and the mean inequality. When $T = N$ and $T = R$, we get the reversed form of discrete and continuous inequalities.

Keywords: Hilbert-type inequalities, Diamond alpha, Reverse Hölder's inequality.

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Automorphisms of three generated free metabelian Lie algebras

Bibinur Duisengaliyeva[1], Altyngul Naurazbekova[2]
[1,2]Department of Algebra and Geometry, L.N. Gumilyov Eurasian National University,
bibinur959@gmail.com
altyngul.82@mail.ru

Abstract

Let M_3 be a free metabelian Lie algebra of rank 3 over a field K. We represent the group of almost tame automorphism of M_3 as an amalgamated free product of its subgroups. Using this structure, we prove that every non-linear almost tame automorphism of M_3 is almost elementary reducible. As a consequence, we show that almost tame automorphisms of this algebra over a constructive field are algorithmically recognizable. We also show that the group generated by all almost tame and all exponential automorphisms has a seni-direct product structure.

Keywords: Free metabelian Lie algebras, Chein automorphisms, almost tame automorphisms, amalgamated free product, semi-direct product.

Acknowledgements: The authors has been supported by the grant AP23487886 of MSHE RK.

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An Asymptotic Approach for Variance-Based Computation of the Parameters s and S in the Semi-Markov Model of type (s, S)

Tahir KHANIYEV[1,2]*, Bilgesu Ozden EFE*[1]
[1]*Department of Industrial Engineering, TOBB University of Economics and Technology, Turkey;*
[2]*The Center of Dijital Economics, Azerbaijan State University of Economics, Azerbaijan.*
tahirkhaniyev@etu.edu.tr
b.efe@etu.edu.tr

Abstract

Determination of s and S parameters is a critical issue in (s,S) type semi-Markov inventory models. In this study, we investigate the (s,S) policy in the case where there is lead time and the system is observed for long periods of time to calculate the optimal s and S parameters.
The parameter s, which expresses the reorder level, is formulated in terms of renewal reward process and residual waiting time process, and an asymptotic expansion for the parameter is obtained. On the other hand, the parameter S, which is the order-up-to-level, is calculated by minimizing the average cost function since it is related to the cost components. The average cost function takes the parameter s as input. By including variance in the calculation of the parameter s, the parameter S is similarly calculated in a way that takes into account the variance value.
In this study, for the first time, the variance is included in the calculation of the s and S parameters and formulas that give more comprehensive results than existing solutions are obtained. In addition, concrete algorithms have been developed for the s and S parameters in the case of Exponential and Erlang distributions.

Keywords: Semi-Markov model of type (s, S), Renewal reward process, Residual waiting time process, Asymptotic analysis, Variance-Based Computation.

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Self adjoint operator in the context of weak topology for DKP particles

Boutheïna Boutabia-Chéraitia[1]
[1]*Faculty of Medicine, Badji-Mokhtar University*
bboutheïna@hotmail.com

Abstract
For each quantum mechanical system, one defines a Hilbert space *H*. Every measurable quantity is called an "observable" (e.g. energy, momentum, angular momentum, etc.), and must to be represented by a self-adjoint operator acting on *H*. In particular, the Hamiltonian *H* which is a very special observable because it generates the time evolution of the states, and its spectrum represents the energy of the system. As we are inerested in DKP particles in a one dimensional box, we will follow the machinery of Von Neumann's theory for self-adjoint extensions of operators which concerns symmetric operators, i.e., operators with dense domains. However we cannot speak about density of the domain of *H*, since the norm is not positive defined. To address this, we introduce the notion of weak density, defined through y a weak topology.

Keywords: Boundary conditions, DKP equation, Von-neumann theory, Self-adjoint extrension of opereators.

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An Alternative Method for Edge Detection Using Schwarzian Derivatives

Büşra Köksal[1], R. Murat Demirer[2], Burcu Tunga[3]
[1,3]Department of Mathematics Engineering, Istanbul Technical University,
[2]Department of Electrical and Electronics Engineering, Işık University,
koksalb17@itu.edu.tr
murat.demirer@isikun.edu.tr
tungab@itu.edu.tr

Abstract

The performance of edge detection techniques plays a crucial role in various image processing applications. In this study, a new perspective on traditional filters is introduced by utilizing Schwarzian derivatives, representing the first application of an edge detection filter based on Schwarzian derivatives [1]. Experimental results show that the quantitative performance of the proposed algorithm does not create a significant difference compared to traditional methods such as Sobel [2], Prewitt [3] and Canny [4]; however, it has been observed that it produces visual results with higher contrast and more distinct edges. The evaluation uses PSNR, SSIM, and MSE, confirming the effectiveness of the proposed approach.

Keywords: Edge detection, Schwarzian derivatives, image processing, Sobel operator, Prewitt operator, Canny operator, Otsu thresholding.

Acknowledgment: This work has been filed for a patent application with the application number 2025/002384, ensuring the protection of all rights.

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Matrix mappings on series spaces of generalized means

Canan Hazar Güleç[1]
[1]*Department of Mathematics, Pamukkale University,*
gchazar@pau.edu.tr

Abstract
In the present study, we characterize certain classes of matrix mappings on series spaces derived by absolute generalized means summability which includes some most known absolute summability methods such as generalized Nörlund, Nörlund, Cesàro, Euler, generalized weighted and weighted means. So, we extend some well-known results.

Keywords: Absolute generalized means summability, Summability methods, Matrix mappings.

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Exploring Optimal Polygons within Polygons

Cemil Karaçam[1], Ahmet Çağdaş Girit[2], Eralp Akay[3]
[1,3] Department of Mathematic Muğla Science and Art Center Mugla- TURKEY
[2,] Department of Computer Engineering Bogaziçi University Istanbul-TURKEY
cemil-karacam@hotmail.com
ahmetcagdasgirit@gmail.com
eralpakay2009@gmail.com

Abstract

This study examines the geometric and mathematical properties of the maximum-area m-sided regular polygon that can be inscribed within an n-sided regular polygon. By modeling vertex coordinates in the complex plane, it analyzes optimal placement and symmetry relations. The vertex coordinates of regular polygons are represented using complex numbers, enabling analytical expression of geometric transformations such as rotation and scaling.
Keywords: Regular polygon, Maximum area, Optimal placement

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Weak Solution of High Order of Accuracy Difference Scheme for the Nonlinear System of sine-Gordon Equations

Özgür YILDIRIM[1], Çağlanur YILDIZ[2]
[1,2]Department of Mathematics, Yildiz Technical University
ozgury@yildiz.edu.tr
caglanur.yildiz@std.yildiz.edu.tr

Abstract

The Sine-Gordon equation is a well-known nonlinear hyperbolic partial differential equation that arises in various physical applications, including nonlinear optics, field theory, and crystal dislocation dynamics. In this study an unconditionally stable fourth-order of accuracy difference scheme that corresponds to the nonlinear system of sine-Gordon equations within the framework of Sobolev spaces is considered. Our primary objective is to investigate the existence and uniqueness of the weak solution by employing variational analysis techniques. We establish the necessary mathematical foundation and derive the corresponding a priori estimates to ensure the well-posedness of the proposed scheme. The results contribute to the theoretical development of high-accuracy numerical methods for solving nonlinear wave equations and provide valuable insights into the stability and convergence properties of difference schemes in variational settings.

Keywords: sine-Gordon equation, partial differential equations, Sobolev space, weak solution.

Acknowledgements: The authors were supported in part by the Research Fund of the Yildiz Technical University. Project Number: FYL-2024-6281

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Variation of Parameters and Hölder Stability of Differential Systems

Coşkun Yakar[1], *Dilara Karslıoğlu*[2]
[1]*Department of Mathematics, Gebze Technical University,*
[2]*Department of Mathematics, Yeditepe University,*
cyakar@gtu.edu.tr
dilara.karslioglu@yeditepe.edu.tr

Abstract

This study explores the relationship between an unperturbed differential equation and a perturbed differential system with different initial conditions by employing variation-of-parameter techniques to derive integral formulae. To ensure Hölder stability in nonlinear differential systems, it is essential to utilize the variational system corresponding to the unperturbed differential system.

Keywords: differential equations, hölder stability, variation of parameters

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Effect of Varying Edge Constraints on Delamination in Laminated Glass Shell Structures

Ebru Dural[1], Gözde Başak Öztürk[2], Muaz Ibrahim[3]
[1,2,3]Department of Civil Engineerings, Adnan Menderes University,
ebru.dural@adu.edu.tr
gbozturk@adu.edu.tr
muazibrahim3@gmail.com

Abstract

Laminated glass shell structures are widely used in architectural and structural applications for their transparency, strength, and safety. However, delamination—defined as the interfacial separation between glass layers due to interlayer failure—remains a critical concern under mechanical and environmental loading. This study investigates the delamination behavior of laminated glass shells subjected to various edge constraints. The governing equations and boundary conditions are systematically derived using the principle of minimum potential energy within a variational framework, considering the interlayer as a shear-transmitting medium. The resulting equations are discretized and solved using the finite difference method to evaluate the stress fields and displacement distributions. To validate the proposed model, the numerical results are compared against simulations performed using the finite element method (FEM). The comparison confirms the accuracy of the finite difference approach and highlights the sensitivity of delamination to boundary conditions, particularly at free and partially supported edges. The findings offer important insights for the reliable design of laminated glass shells, especially in structures with complex geometries and variable support conditions.

Keywords: Laminated Glass, Shell Structures, Delamination, Boundary Conditions.

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A Note on Open Jacobi Diagrams

Elif Altınay Özaslan[1]
[1]*Department of Mathematics, Kastamonu University*
eaozaslan@kastamonu.edu.tr

Abstract

An open Jacobi diagram is a graph with univalent and trivalent vertices, cyclic order of three edges around each trivalent vertex and with at least one univalent vertex in every connected component. Diagrams with loops and multiple edges are allowed. The degree of an open Jacobi diagram is half the number of vertices (trivalent and univalent). The space of open Jacobi diagrams is the vector space over $\mathbb{Q}$ spanned by Jacobi diagrams modulo to the AS (Anti–Symmetry) and IHX relations. Some of the Jacobi diagrams vanish in the space of open diagrams due to the AS relation. For example, any open Jacobi diagram with a loop vanishes. The space of open Jacobi diagrams is graded by degree.

We call an edge adjacent to a univalent vertex of an open Jacobi diagram a leg. In this study we are motivated by the following important conjecture: Any open Jacobi diagram with an odd number of legs is zero in the space of open Jacobi diagrams. This conjecture is equivalent to the conjecture that Vassiliev invariants do not distinguish the orientation of knots.

In this talk, we will cover some properties of vanishing open Jacobi diagrams with an odd number of legs and give examples. In the literature, open diagrams are also referred to as 1-3-valent diagrams, Jacobi diagrams, web diagrams and Chinese characters.

Keywords: Open Jacobi diagrams, Vassiliev invariants.

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The Eigenvalues of the Sturm-Liouville Problems with Boundary Condition Rationally Dependent on the Eigenvalue

Ayşe KABATAŞ[1], Elif BAŞKAYA[2]
[1,2]Department of Mathematics, Karadeniz Technical University
akabatas@ktu.edu.tr
elifbekar@ktu.edu.tr

Abstract

In this paper, we study a Sturm-Liouville boundary value problem $-y'' + qy = \lambda y \, ; y(0)cos\alpha = y'(0)sin\alpha, y'(1) = f(\lambda)y(1)$, provided that f is a rational function and q is a real-valued, its derivative exists and is an integrable function. The eigenvalues for the boundary value problem are calculated, asymptotically.

Keywords: Sturm-Liouville problem, Eigenvalue asymptotics, Differentiable potential, Eigenparameter-dependent boundary condition.

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On the Sturm-Liouville Problems with Integrable Potential and Boundary Conditions Rationally Dependent on the Eigenparameter

Elif Başkaya[1]
[1]*Department of Mathematics, Karadeniz Technical University,*
elifbekar@ktu.edu.tr

Abstract

We consider the Sturm-Liouville equation $-y'' + qy = \lambda y$ with boundary conditions $y(0)cos\theta = y'(0)sin\theta,\ \theta \in [0,\pi)$; $\frac{y'}{y}(1) = s(\lambda)$ that $s(\lambda) := \frac{m(\lambda)}{v(\lambda)}$ where m and v are polynomials with real coefficients and no common zeros, in this work. We accept that our potential q is integrable and we find asymptotic eigenvalues for the problem.

Keywords: Sturm-Liouville equation, Asymptotic eigenvalues, Integrable potential, Boundary conditions rationally dependent on the eigenparameter.

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Numerical Solution of Fractional Langevin Differential Equations Using the Grey Wolf Optimization Algorithm

Elif Demir[1], Yusuf Zeren[1], Mohammad Mursaleen[2], Alpaslan Demirci[3]
[1]Department of Mathematics, Yildiz Technical University,
[2]Department of Mathematics, Aligarh Muslim University
[3]Department of Electrical Engineering, Yildiz Technical University
elifdemir1317@gmail.com
ademirci@yildiz.edu.tr
mursaleenm@gmail.com
yzeren@yildiz.edu.tr

Abstract

In this study, the Grey Wolf Optimization Algorithm (GWO) is proposed for the numerical solution of fractional Langevin differential equations with given initial and boundary conditions. The considered differential equation is expressed as follows:

$$\mu_n cD^{\gamma_n}(\ \mu_n cD^{\nu_n} + \ \xi_n)w_n(s) = g_n(s, w(s), \varphi(\ \mu_n cD^{\rho} w(s)), s \in [0,1], n \in IN$$

Here, $w(s) = \{w_n(s)\}_{n=1}^{\infty} \in l_p^{\alpha}$ and $\varphi(\mu_n cD^{\rho} w(s)) = \{\varphi_n(\mu_n cD^{\rho} w_n(s))\}_{n=1}^{\infty} \in l_p^{\alpha}$ are continuous functions, while $g_n: [0,1] \times l_p^{\alpha} \times l_p^{\alpha}$ are differentiable functions. The system is solved with the following initial and boundary conditions:

$$w_n(0) = 0, \qquad \mu_n cD^{\nu_n} w_n(0) = 0, \ \ w_n(1) = \sigma w_n(\lambda_n)$$

The solution of this complex fractional differential equation system is obtained using the GWO. GWO is a natural optimization algorithm that mimics the behavior of wolf packs and is proposed as an effective method for the numerical solution of fractional differential equations. This study provides an innovative approach for solving fractional differential equations and contributes to the advancement of numerical methods for such problems.

Keywords: Fractional derivative, Langevin fractional differential equation, Grey Wolf Optimization Algorithm

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Solving Infinite Fractional Differential Equations using Grey Wolf Optimization Algorithm

Elif Demir[1] , Yusuf Zeren[1] , Mohammad Mursaleen[2], Alpaslan Demirci[3]
[1]Department of Mathematics, Yildiz Technical University,
[2]Department of Mathematics, Aligarh Muslim University,
[3]Department of Electrical Engineering, Yildiz Technical University
elifdemir1317@gmail.com
ademirci@yildiz.edu.tr
mursaleenm@gmail.com
yzeren@yildiz.edu.tr

Abstract

This paper investigates the implementation of the Grey Wolf Optimization (GWO) algorithm as an efficient method for addressing infinite fractional differential equation systems. The equations involve the p-Laplacian operator and Caputo generalized fractional derivatives, and an appropriate numerical method is developed to solve the system. The equation is given as follows:

$$c\mu_n D^{\gamma_n}\Phi_p\big(\ c\mu_n\, D^{\rho_n} w_n(s)\big) = g_n(s, w(s), c\mu_n D^{\beta} w(s)), s \in [0,1], n \in IN$$

Where $\Phi_p(r) = |r|^{p-2}, p > 1$, p-Laplacian operator, $w(s) = \{w_n(s)\}_{n=1}^{\infty} \in l_p^{\alpha}$ and $g_n: [0,1] \times l_p^{\alpha} \times l_p^{\alpha}$ are differentiable functions. The equation is solved under the following boundary conditions:

$$w_n(0) = 0, \qquad c\mu_n\, D^{\nu_n} w_n(0) = 0, s^{1-\mu_n} w_n'\ (1) = 0$$

In the study, the GWO algorithm is proposed as an effective method for solving these complex fractional differential equations. The aim is to obtain more efficient and accurate solutions through the integration of both analytical and numerical methods.

Keywords: Fractional derivative, p-Laplacian operator, Grey Wolf Optimization Algorithm

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Reidemeister-Franz Torsion as a Homomorphism

Esma Dirican Erdal[1]
[1]*Department of Mathematics, Işık University*
esma.diricanerdal@isikun.edu.tr

Abstract

Let us denote the Diff-isomorphism classes of n-dimensional non-empty, closed, connected, oriented differentiable manifolds by M_n^{Diff}. An n-manifold M^n is called highly connected if $\pi_1(M^n)=0$ for i=0,…, $\lfloor n/2 \rfloor$-1. So the Diff-isomorphism classes of n-dimensional highly connected differentiable manifolds is given as $M_n^{Diff,hc}$ = $\{M^n \epsilon\ M^{Diff} \mid M^n$ is highly con-nected$\}$. Hence by [1], M_n^{Diff} and $M_n^{Diff,hc}$ are abelian monoids under the connected sum. By [1]-[3], the monoid $M_{2n}^{Diff,hc}$ is a unique factorisation monoid provided that n ≡ 3,5,7 mod 8 except for n=15 or n=31. Suppose that $W^{2n} \epsilon\ M_{2n}^{Diff,hc}$ .Then W^{2n} admits a unique connected sum decomposition into 2n-manifolds that can not be decomposed any further, $W^{2n}=M_1\#M_2\#\cdots\#M_j$. By using such a connected sum decomposition, we prove that Rei- demeister-Franz torsion can be seen as a monoid homomorphism

$$|T_{RF} - |: M_{2n}^{Diff,hc} \to R^+$$

given by

$$|T_{RF}(W^{2n})| = |T_{RF}(M_1)| \times |T_{RF}(M_2)| \times \cdots \times |T_{RF}(M_j)|.$$

Acknowledgements: This work was partially supported by TÜBİTAK under the project number 124F247.

Keywords: Reidemeister-Franz torsion, unique factorization monoid, differentiable manifolds.

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Multi-Objective Optimization Techniques for Solving Energy-Efficient Permutation Flowshop Scheduling Problem

Eyüp Ensar Işık[1]
[1]*Department of Industrial Engineering, Yildiz Technical University,*
eeisik@yildiz.edu.tr

Abstract

Scheduling problems are one of the most crucial problems in the production processes. Therefore, they extensively studied in the literature. Although the main goal for these problems is the minimization of the total cost or related production time objectives, there are other objectives that need to be considered in real-world applications. For example, with the high effort of the United Nations on the Sustainable Development Goals, energy consumption-related objectives have also started to be taken into account. However, most of the studies in the literature still focus on the single-objective version of the problems. This study focuses on the energy-efficient permutation flow shop scheduling that has many real-world applications. The problem studied by Öztop et al. (2020) and Yükesl et al. (2020), the authors determined the objectives as total flowtime and total energy consumption, and used the augmented ε-constraint method to handle the multiple objectives. Since the technique used to handle significantly affects the quality of the solution, this study proposes various multi-objective optimization techniques, like the standard ε-constraint method, the lexicographic method, and fuzzy goal programming, to solve the problem. This study also proposes a new constraint programming model and uses the default feature of the solver to consider multiple objectives. The techniques are compared using the benchmark instances provided by Taillard (1993) using CPLEX and CP optimizer solvers. The results show that standard ε-constraint method solutions are dominated by augmented ε-constraint method solutions. Although they provide Pareto optimal solutions, since the ε level is chosen arbitrarily, the solutions are not exact. Therefore, this study also uses single solution techniques, and the results also show that single solution techniques provide competitive results.

Keywords: Permutation flowshop scheduling problem, Energy-efficient scheduling, Multi-objective optimization, ε-constraint method, Fuzzy goal programming.

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Convergence and Computational Analysis of Generalized Bernstein Operators

Faruk Özger[1]
[1]Department of Computer Engineering, Iğdır University,
farukozger@gmail.com

Abstract

This study focuses on the approximation properties of generalization of Bernstein operators. A comprehensive analysis of moment estimates is conducted, alongside an investigation into various local direct approximation theorems. Further approximation characteristics of the newly introduced operators are examined, including a Voronovskaya-type asymptotic result and pointwise estimates. To assess their performance, the proposed operators are compared—both graphically and numerically—with several classical linear positive operators from the literature. The findings demonstrate superior approximation capabilities in terms of convergence rate, computational efficiency, and stability. As a practical application, the operators are employed to derive a numerical solution for a specific instance of the fractional Volterra integral equation of the second kind.

Keywords: Bersntein operators, rate of convergence, numerical results.

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Generalized Szász Operators with Shape Control and Convergence Analysis in Some Spaces

Faruk Özger[1]
[1]*Department of Computer Engineering, Iğdır University,*
farukozger@gmail.com

Abstract
This paper introduces two novel classes of positive linear operators—extensions of the Szász operators—each incorporating parametric modifications to enhance approximation capabilities and shape-preserving behavior. Motivated by classical contributions such as Bernstein's polynomial approach to the Weierstrass theorem, we construct generalized operators with a shape parameter α\alphaα, enabling control over features like monotonicity and convexity through the analysis of first and second derivatives. We establish key approximation results, including Korovkin-type theorems, Grüss-Voronovskaya-type asymptotics, and statistical rates of convergence. Special attention is given to weighted function spaces to address functions with non-uniform behavior or those defined on unbounded intervals. The theoretical findings are substantiated with graphical illustrations and numerical experiments conducted in Mathematica, underscoring the practical relevance of the proposed operators in computational fields such as computer graphics and robotic control. Furthermore, we demonstrate that classical operators emerge as special cases within our broader frameworks, thus providing a unified and flexible foundation for approximation theory.

Keywords: Grüss-Voronovskaya, Szasz operators, rate of convergence, numerical results.

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On Solving Some Fractional Cauchy Problems Via Almost Sectorial Operators

Faten H. Damag[1,2] *and Amin Saif*[1]
[2 1]*Department of Mathematics, Faculty of Sciences, Ha'il University, Hail 2440, Saudi Arabia.*
[2]*Department of Mathematics, Faculty of Applied Sciences, Taiz University, Taiz 6803, Yemen.*
fat.qaaed@uoh.edu.sa (F.H.D.),
aminsaif.sanawy@taiz.edu.ye (A.S.)

Abstract

In this paper, we study the existence property for the mild solutions of fractional Cauchy equations involving the Lie bracket operator, the almost sectorial operator, and the ϕ−Hilfer derivative operator by using the Schauder fixed-point theorem. We have two types of non-compact associated semigroups and compact associated semigroups to prove some properties of the existence of these mild solutions by using Hausdorff measure of noncompact associated semigroup in the collection of bounded sets. We got the existence property of mild solutions when the semigroup associated with an almost sectorial operator is compact as well as noncompact. Some examples are introduced as applications for our results in the commutative real Banach algebra R and the commutative Banach algebra of the collection of continuous functions in R.

Keywords: Banach algebra; Compact; Almost sectorial operator; Hilfer fractional derivative; Lie bracket operator.

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Generalized Fuzzy Set Theory: Applications in Algebraic Structures

G. Muhiuddin[1]
[1]*Department of Mathematics University of Tabuk*
Tabuk 71491, Saudi Arabia
chishtygm@gmail.com

Abstract

In this talk, we apply the notion of fuzzy set theory to the BCK/BCI-algebras. Firstly, we will talk about the historical background of BCK/BCI-algebras and their key notions and properties. Then, we present some concepts and results on fuzzy set theory. Finally, we apply the notion of fuzzy sets to the ideal theory of BCK/BCI-algebras and study the related concepts of fuzzy ideals in BCK/BCI-algebras, and derive their basic properties and results based on their general forms.

In future work, these notions can be applied to several kinds of subalgebras and ideals in BCK/BCI algebras, including other algebraic structures such as MV algebras, R0-algebras, EQ algebras, MTL algebras, BL algebras, etc.

Keywords: Fuzzy set, BCK/BCI-algebras, BCK-Ideal, Fuzzy BCK-algebras, Fuzzy BCK-ideal.

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On Mean Field Stochastic Differential Equations Driven by G-Brownian Motion with Averaging Principle

Hacène Boutabia[1]
[1]*Department of Mathematics, Badji Mokhtar-Annaba University,*
boutabiah@yahoo.fr

Abstract

In this study, we prove existence and uniqueness of the solution of Mean Field stochastic differential equation driven by a G-Brownian motion (G-MFSDEs in short), by using the fixed point theorem. These equations called also G-McKean-Vlasov stochastic equations, are SDEs where coefficients depend not only on the state of the unknown process but also on its law. To this end, we introduce a new type Kantorovich metric between subsets of laws and adapt Lipchitz and linear growth conditions. Furthermore, we prove the validity of the averaging principle and obtain convergence theorem where the solution of the averaged G-MFSDE converges to that of the standard one in the mean square sense.

Keywords: mean-field SDE, G-browniam motion, sublinear expectation, averaging principle.

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The Hub Number of Subdivision Graphs

Haifa Ahmed[1], Mohammed Alsharafi[2], Saad Tobaili[3]
[1]Department of Mathematics, Aden University, Yemen
[2]Department of Mathematics, Yildiz Technical University, Turkey
[3]Department of Mathematics, Hadhramout University, Mukalla, Yemen
haifaahmed010@gmail.com
alsharafi205010@gmail.com
saadaltobaili@yahoo.com

Abstract

The hub number, a graph-theoretic parameter measuring the smallest vertex subset (hub set) required to maintain network connectivity, is examined for subdivision graphs structures formed by replacing edges with paths. This study establishes analytical bounds and exact values for the hub number across key graph classes (trees, cycles, complete graphs) and explores relationships between base graphs and their subdivisions. Using combinatorial and inductive methods, we prove that the hub number of a subdivision graph depends critically on the base graph's vertex degrees and cyclicity. Notably, subdividing edges in cycles preserves the hub number, while subdivisions of complete graphs exhibit logarithmic growth relative to vertex count. For arbitrary graphs, we derive bounds proportional to edge density and connectivity. Additionally, planar subdivisions adhere to constraints linked to Euler's characteristic. These results advance theoretical understanding of domination in edge-augmented graphs and have practical applications in infrastructure design, such as optimizing hub placement in resilient transportation or communication networks. By unifying combinatorial principles with structural analysis, this work provides a framework for future research on fault-tolerant network architectures and algorithmic graph modifications.

Keywords: Hub number, Subdivision graphs, Graph connectivity, Domination parameters, Networks.

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Berezin radius inequalities with the help of generalized forms of mixed Cauchy-Schwarz inequality

Hamdullah Başaran[1]
[1]*Antalya/Tırkey*
07hamdullahbasaran@gmail.com

Abstract

The mixed Cauchy-Schwarz inequality is improved to prove several Berezin radius inequalities. By increasing the doubly convex function, Berezin radius inequalities are demonstrated. Furuta's inequality, a generalization of mixed Cauchy-Schwarz inequality, obtains Berezin radius inequalities.

Keywords: Berezin symbol, mixed Cauchy-Schwarz inequality, convex function, partial isometry, arithmetic-geometric mean inequality.

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Arithmetic Entire Function

Harrat Chahrazed[1]

[1]*University of Sciences and Technology "M B"of Oran,Department of Mathematics,*
Faculty of Mathematics and computer sciences, Bp 1505 El M'naouar Oran 31000, Algeria,
harratchahrazed@gmail.com

Abstract

The aim of this paper is solved the following problem: Let *Pn* be a sequence of distinct polynomials (of bounded degree) with some arithmetic properties, what can be said of an entire function *f*, the Lagrange interpolation polynomial Pn of *f* with respect to roots of *Pn* is in Z[X] for all *n*?.

Keywords: Divided Differences, Lagrange interpolation polynomial, Entire function, Holomorphic function, Arithmetic function, Integral of Cauchy,

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Integer powers of certain complex 2−Tridiagonal 2−Toeplitz matrices

Hatice Kübra Geçör[1] *and Gürsel Yeşilot*[2]
[1,2]*Department of Mathematics, Yildiz TechnicalUniversity,*
gyesilot@yildiz.edu.tr
gecorhaticekubra@gmail.com

Abstract

In this study, we get a general expression for the entries of the s-th power of even-order 2−Tridiagonal 2−Toeplitz matrices. The investigation is based on the use of Jordan's form, eigenvalues and eigenvectors of the 2−Tridiagonal 2−Toeplitz matrices.

Keywords: Chebyshev polynomials, Eigenvalues, Eigenvectors, Polynomial sequence, 2-Toeplitz matrices

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Existence and Decay of Solutions For An Integro-Differential System With Time Delay

Hazal Yüksekkaya[1]

[1]Department of Mathematics, Hakkari University,
hazalyuksekkaya@hakkari.edu.tr

Abstract

In this work, we study the integro-differential system with time delay. Firstly, we prove the existence results utilizing Fadeo-Galerkin approximations. Later, by using energy method and by constructing a suitable Lyapunov functional, we establish the decay of solutions under suitable conditions. Time delay effects arise in many applications and practical problems such as physical, chemical, biological, thermal and economic phenomena.

Keywords: Existence, Decay, Integro-differential system, Time delay.

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Nonexistence of Global Solutions For The Beam Equation With Delay Term

Hazal Yüksekkaya[1]

[1]*Department of Mathematics, Hakkari University,*
hazalyuksekkaya@hakkari.edu.tr

Abstract

In this paper, we consider the beam equation with delay term. Under suitable conditions, we prove the blow up of solutions for the beam equation. In the eighteenth century, the first equations with delay were considered by brothers Leonard Euler and Bernoulli. By A. Myshkis and R. Bellman, systematical study started at the 1940s. Since 1960, there have been appeared many surveys on the subject. In the middle of 1990s, robust control of systems with uncertain delay was started and led to the `'delay bloom" in the begining of the twenty-first century. Time-delay systems are also named systems with aftereffect or dead-time, equations with deviating argument, hereditary systems, or differential-difference equations. They belong to the class of functional differential equations which are infinite-dimensional, as opposed to ordinary differential equations.

Keywords: Blow up, Beam equation, Delay term.

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Analytical Solutions of Nonlinear Conformable Time-Fractional CDGKS Equation via Modified Sardar Sub-Equation Method

Hicran Arzu DENİZ[1], Erdoğan Mehmet ÖZKAN[2]

[1,2]Department of Mathematics, Yildiz Technical University,

arzu.deniz@std.yildiz.edu.tr

mozkan@yildiz.edu.tr

Abstract

In this study, the nonlinear fractional integro-differential Caudrey–Dodd–Gibbon–Kotera–Sawada (CDGKS) equation with the conformable time-fractional derivative is analytically solved using the modified Sardar sub-equation method. The modified Sardar sub-equation method is an effective and practical analytical tool for obtaining exact solutions of nonlinear fractional equations, which frequently arise in mathematical physics and applied sciences. This method provides a systematic approach to derive various types of exact solutions, including solitary wave solutions and other forms. All calculations and derivations have been performed with the aid of a symbolic computation software, which facilitates the complex algebraic manipulations involved in the process. The obtained solutions contribute to the existing solution pool of the CDGKS equation and demonstrate the applicability and efficiency of the proposed method in handling nonlinear fractional integro-differential equations.

Keywords: Conformable derivative, CDGKS equation, Sardar sub-equation method, integro-differential equation.

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A Modern Approach To Hardy-Type Inequalıtıes Vıa Nabla Calculus

Hilal Orhan[1], *Lütfi Akın*[2]

[1,2,3]*Department of Mathematics, Yildiz Technical University,*

h_sndg@hotmail.com

lutfiakin@artuklu.edu.tr

Abstract

In this study, a generalization of the classical Hardy inequality is presented in the form of a nabla integral, encompassing both its continuous and discrete forms. The newly derived inequality is examined in detail on specific time scale subsets such as $T = R$, $T = Z$ and $T = hZ$, and its integral representations are expressed in summation form within these domains. Furthermore, the validity of the inequality under monotonicity and positivity conditions on the involved functions is proven, supported by fundamental analytical tools such as the chain rule, Hölder's inequality, and integration by parts. In this respect, the study offers a novel and systematic perspective on the Hardy inequality, an important result in classical analysis within the framework of time scales. It demonstrates how this inequality can be applied to sets with different structures using the nabla integral approach.

Keywords: Hardy inequality, Time scale, Nabla integral, Chain rule.

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Asymptotic Approximation Formulas of the Eigenfunctions and the Green Function of a Problem of Sturm-Liouville Type in Which the Potential Has Discontinuities at Two Interior Points

Seda KIZILBUDAK ÇALIŞKAN[1], Hilal ÖZDEMİR[2]

[1,2]Department of Mathematics, Yildiz Technical University,
skizilb@yildiz.edu.tr
hilal.ozdemir2@std.yildiz.edu.tr

Abstract

In this study, we are interested in the operator formulation of the boundary value problem in which the potential in the differential expression of a Sturm-Liouville type problem has discontinuity at two interior points, the asymptotic behavior of the eigenfunctions and the asymptotic approximation formulas of the Green function we created for the problem.

Keywords: Green function, Eigenfunctions, Discontinuous Sturm-Liouville Type Problems

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Efficient Numerical Solution of Coupled Fractional Systems Using Vieta-Lucas Operational Matrices

Imran Talib[1]

[1]*Department of Mathematics, Virtual University of Pakistan*
imrantaalib@gmail.com

Abstract

Coupled systems of fractional-order differential equations (FODEs) play a crucial role in modeling intricate phenomena in physics, engineering, and biology. However, obtaining their analytical solutions is often intractable. This talk presents an innovative numerical approach leveraging Vieta-Lucas polynomials and operational matrices to efficiently solve such systems. By exploiting the properties of shifted Vieta-Lucas polynomials, we derive operational matrices for integration and fractional differentiation, thereby reducing the coupled FODEs to a solvable system of algebraic equations.
The proposed method exhibits exceptional accuracy and accelerated convergence relative to conventional techniques, as confirmed through comprehensive error analysis using root mean square error (RMSE) and absolute error measures. Extensive numerical simulations—including stiff sinusoidal systems and periodic orbit dynamics—demonstrate the method's robustness in addressing computationally demanding problems with high precision. Our findings underscore the method's broad applicability for computational modeling of fractional-order systems characterized by memory effects and anomalous dynamics.

Keywords: Fractional coupled system, Orthogonal polynomials, Operational matrices

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Hawking Radiation and Entropy in Three Dimensional Space Time

İremi Kevser Kurt[1], *Reyhan Kaya*[2]
[1,2]*Department of Physics, Yildiz Technical University*
iremi.kurt@std.yildiz.edu.tr
rkaya@yildiz.edu.tr

Abstract

We examine thermodynamical properties of black holes in three dimensional Einstein gravity. Our results are presented for both nonrotating and rotating cases. We calculate the entropy, temperature and the emission probabilities for these cases.

Keywords: Black hole, the Kraus, Keski-Vakkuri and Wilczek (KKW) analysis, Hawking temperature, Thermodynamics.

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Mathematical Decision Algorithms in Intrafamilial Communication

Cemil Karacam[1], İbrahim Kızılel [2] Nursena Karakan[3]
[1,3]Department of Mathematics, Mugla Science and Art Center , Mugla Turkey
[2]Robert College, İstanbul Turkey
cemil-karacam@hotmail.com
nursenakarakan9889@gmail.com
kizibr.29@robcol.k12.tr

Abstract

Utilizing quantitative methodologies to explore the intricate dynamics of familial relationships, this study investigates the foundational elements of intrafamilial harmony and the potential for predictive modeling in marital stability**.** Fundamental prerequisites for intrafamilial harmony include marital cohesion and the feeling of individual worth. A newly developed attitude scale was administered to a total of 147 individuals, comprising 121 married, 12 single, and 14 divorced participants. The collected data were analyzed using SPSS software, and the variance, mean values, and frequencies of the questions were calculated. In the first part of the study, the causes of divorce and spousal harmony were examined through mathematical modeling from the perspectives of men, women, and societal norms. The societal viewpoint was derived from the statistical analysis of the participants' scores. The second part evaluated the compatibility levels of individuals considering marriage using the Sanchez Algorithm within the framework of Fuzzy Set Theory. This innovative approach was implemented with a modeling where both parties are selective. The ultimate aim of the research is to develop an artificial intelligence-supported software system capable of assessing divorce statistics for individuals with similar characteristics, akin to tests that measure genetic disease risks in pregnant individuals.

Keywords: Relationship Analysis, Sanchez Algorithm ,İntrafamilial Communication

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Fuzzy Regression Analysis

İrem Demir[1], Reşit Çelik[2]
[1,2]Department of Mathematics, Yildiz Technical University
demirirem000@gmail.com
rcelik@yildiz.edu.tr

Abstract

The problems encountered in real life have a complex and uncertain structure. Fuzzy logic and related methods offer more suitable perspectives to life and are among the methods developed to quantify uncertainly. Regression analysis based on the concept of fuzzy logic is a subject on which much research has been done. In our work, the fuzzy regression approach suggested by fuzzy logic, which is a succesfull method in modelling uncertainly, for uncertainties in forward-looking predictions was examined. A numerical example was presented for a better understanding of the method. Results are given by table and graphically.

Keywords: Fuzzy logic, fuzzy regression, fuzzy data, regression models.

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Quality of non-compactness for some non-compact maps

Jan Lang[1,2]

[1,] Department of Mathematics, The Ohio State University, 231 West 18th Avenue, Columbus, OH 43210, USA
[2] Czech Technical University in Prague, Faculty of Electrical Engineering, Department of Mathematics, Technická 2, 166 27 Praha 6, Czech Republic
lang@math.osu.edu

Abstract

In this talk, we explore the structure of some non-compact linear operators and embeddings between function spaces.

While traditional tools such as approximation, Kolmogorov, and entropy numbers effectively describe compact operators, they fail to provide insights into the finer structural properties of non-compact maps. We discuss the necessity of employing more refined notions, notably strict singularity, finite strict singularity, and Bernstein numbers, to characterize the degree of non-compactness adequately.

Focusing specifically on embeddings between Besov and Sobolev spaces, as well as the Fourier and Hilbert transformations, we highlight recent advancements in understanding these mappings through the lens of Bernstein numbers and using concepts of maximal non-compactness and strict singular operators. Our results demonstrate that Bernstein numbers, initially introduced and later neglected, are indispensable for revealing detailed structural differences between non-compact maps. In particular, we provide conditions under which embeddings are strictly singular, finitely strictly singular, or fail to exhibit strict singularity entirely, thus enriching the classical theory of functional analysis.

Lecter is based on series of joint results with Chian Yeong Chuah, Liding Yao, David E Edmunds and others.

Keywords: Non-compact maps, measure of non-compactness, s-numbers, Bernstein numbers, strictly singular maps, Sobolev spaces, Besov spaces, sequence spaces.

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Comparative Performance Analysis of Machine Learning Algorithms for Early Detection of Heart

Kadriye Şimşek Alan[1]*, Büşra Şenel Kahyaoğlu*[2]

[1,2]*Mathematical Engineering Department, Yildiz Technical University, İstanbul, Turkey*
ksimsek@yildiz.edu.tr
bysrasenel@gmail.com

Abstract

Cardiovascular disease is one of the leading causes of death worldwide, and early diagnosis plays a crucial role. In recent years, machine learning algorithms have been effectively used for early detection of heart diseases. This study presents an analysis conducted using the publicly available UCI heart disease dataset to detect heart diseases early and determine individuals' risk levels. The dataset includes 920 patients and 14 clinical features. In this study, the performance of various machine learning algorithms, including SVM, Random Forest, LightGBM, XGBoost, KNN, and Logistic Regression, was evaluated using metrics such as accuracy, AUC, precision, recall, and F1-score. According to the results, the SVM model achieved the highest performance with an accuracy rate of 83.15%. The findings highlight the significant potential of machine learning-based approaches in the early diagnosis of heart disease and determining disease risk.

Keywords: Heart Disease, early Detection, Machine Learning, Support Vector Machine (SVM).

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Mathematical Modeling of Algal Blooms: Mechanisms, Prediction, and Control

Kalyan Das[1]
[1]*Department of Interdisciplinary Sciences National Institute of Food Technology Entrepreneurship and Management, HSIIDC Industrial Estate, Kundli, Haryana, India.*
daskalyan27@gmail.com

Abstract

Algal blooms are rapid proliferations of algae in aquatic ecosystems, often driven by excess nutrients, climatic variations, and hydrodynamic conditions. These blooms can have severe ecological, economic, and health consequences, including oxygen depletion, toxin production, and biodiversity loss. Mathematical modeling provides a systematic approach to understanding bloom dynamics, predicting their occurrence, and designing effective mitigation strategies. This study reviews and develops various mathematical models, including deterministic, stochastic, and machine learning-based approaches, to simulate algal bloom formation and progression. Key environmental factors such as nutrient loading, temperature, light availability, and water flow are incorporated into these models to enhance predictive accuracy. The models are validated using real-world data to assess their reliability in forecasting bloom events. By integrating mathematical techniques with ecological insights, this study aims to improve early warning systems and inform sustainable management practices for mitigating the adverse effects of algal blooms.

Keywords: Algal Blooms, Eutrophication, Mathematical Modeling , Phytoplankton Growth, Trophic Interactions

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Strong Convergence Using Hybrid Method with Kirk Iteration in the Cesàro Mean

Lale Cona[1], Deniz Simsek[2]
[1]*Faculty of Engineering and Natural Sciences, Mathematical Engineering, Gumushane University,*
[2]*Mathematical, Institute of Graduate Education, Gumushane University,*
lalecona@gumushane.edu.tr
furtana95@hotmail.com

Abstract

In this work, a hybrid approach is made using the Cesàro mean of the Kirk iteration of an asymptotically nonexpansive mapping on Hilbert spaces. It is shown that under suitable conditions, the iteration sequence converges strongly to the fixed point of an asymptotically nonexpansive mapping.

Keywords: Asymptotically nonexpansive mappings, Hybrid method, Kirk iteration in the meaning of Cesaro, Strong convergence.

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Hybrid method with Kirk Iterations in the Cesàro mean for equilibrium problems

Lale Cona[1]*, Deniz Simsek*[2]

[1]*Faculty of Engineering and Natural Sciences, Mathematical Engineering, Gumushane University,*
[2]*Mathematical, Institute of Graduate Education, Gumushane University,*
lalecona@gumushane.edu.tr
furtana95@hotmail.com

Abstract

In this work, a hybrid approach is made using the Cesàro mean of the Kirk iteration of an asymptotically nonexpansive mapping on Hilbert spaces. A new hybrid iteration method is introduced to find a common element at the intersection of the set of fixed points of asymptotically nonexpansive mappings on Hilbert spaces and the solution set of an equilibrium problem.

Keywords: Asymptotically nonexpansive mappings, Hybrid method, Kirk iteration in the Cesaro mean, Equilibrium problem.

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Quasi-idempotents in Certain Subsemigroups of I_n

Leyla Bugay[1]

[1]*Department of Mathematics, Çukurova University*

ltanguler@cu.edu.tr

Abstract

Let I_n be the symmetric inverse semigroup on a finite chain $X_n = \{1, \ldots, n\}$ and, for $1 \leq r \leq n-1$, let $I_{n,r} = \{\alpha \in I_n : |\operatorname{im}(\alpha)| \leq r\}$ which is a subsemigroup of I_n where $\operatorname{im}(\alpha)$ denotes the image set of $\alpha \in I_n$. For any $\alpha \in I_n$, if $\alpha \neq \alpha^2 = \alpha^4$ then α is called a quasi-idempotent. I will present some important results obtained in some studies that investigated the structure of quasi-idempotents and quasi-idempotent generating sets in $I_{n,r}$ (both as a semigroup and as an inverse semigroup), and also calculated their quasi-idempotent ranks.

Keywords: Symmetric inverse semigroup, quasi-idempotent, generating set, rank.

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Approximation Properties of Complex Shepard Operators in the Sense of Power Series Method

Emre TAŞ[1], Leyla Meymankulyyeva[2]
[1,2]Department of Mathematics, Kırşehir Ahi Evran University,
emretas86@hotmail.com
l.meymankulyyeva@gmail.com

Abstract

In the talk, we give some approximation results of the Complex Shepard operators by using power series method. Obtained results have generalized the classical ones. By using Abel and Borel methods which are special power series methods, we give some examples.

Keywords: Complex Shepard operators, Power series method, Approximation theory.

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On New Developments of Nabla Dynamic Inequalities

Lütfi AKIN[1]

[1]*Department of Business Administration, Mardin Artuklu University, Türkiye*
lutfiakin@artuklu.edu.tr

Abstract

In this work, we present new developments and applications of dynamic-type inequalities with nabla calculus. The results are proved using Hölder's inequality, the chain rule, the nabla calculus on time scales.

Keywords: Hardy-type inequalities, Nabla Calculus, Hölder’s inequality.

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Isomorphism and stable isomorphism in “real” and “quaternionic” K-theory

Malkhaz Bakuradze[1], Ralf Meyer[2]
[1]*Faculty of Exact and Natural Sciences, Tbilisi State University*
[2] *Mathematisches Institut, Universität Göttingen,*
malkhaz.bakuradze@tsu.ge
rmeyer2@uni-goettingen.de

Abstract

We find lower bounds on the rank of a “real” vector bundle over an involutive space, such that “real” vector bundles of higher rank have a trivial summand and such that a stable isomorphism for such bundles implies ordinary isomorphism. We prove similar lower bounds also for “quaternionic” bundles. These estimates have consequences for the lassification of topological insulators with time-reversal symmetry.

Keywords: Vector Bundle, Topological Insulators.

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Generating functions of numbers of the fourth order with numbers of the third order

Manel Zermani[1], Ali Boussayoud[2]

[1,2] LMAM Laboratory Department of Mathematics, Mohamed Seddik Ben Yahia University,
manelzermani00@gmail.com
aboussayoud@yahoo

Abstract

In this paper , we define a new symmetrizing operator ,and we base on some assumptions that helps us in building some main results and theorems by applying the previous theorems , we give the generating function of the product of some numbers and polynomials of the fourth and third order such as the new generating function of Tetranacci and 2-orthogonal chebychev polynomials of thr first kind .

Keywords: Tetranacci numbers, 2-orthogonal chebychev polynomials, generating function,

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Novel methods for exploring fractional solitary waves in the improved mKdV equation with time-fractional derivative and time-space dispersion

Marwan Alquran[1]

[1]*Department of Mathematics, College of Integrative Studies, Abdullah Al-Salem University, Kuwait*
marwan.alquran@aasu.edu.kw

Abstract

This talk introduces a new approach for extracting solitary wave solutions, specifically periodic or kink types, for nonlinear evolutionary problems. The proposed method formulates solutions in a rational form, with the numerator and denominator being linear combinations of either sine and cosine functions or sinh and cosh functions. The effectiveness of this innovative method is evaluated through examining solutions to the improved mKdV equation, which includes a space-time dispersion term and Atangana-conformable fractional derivative. Graphical analysis, including 2D and 3D plots, is conducted to understand the propagation of the obtained solutions and how it is affected by changing the value of the fractional derivative.

Keywords: Improved mKdV, New rational sine-cosine methods, New rational sinh-cosh methods

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The Predictive Utility of Novel Entire Irregular Topological Indices

Anwar Saleh[1], Samirah Alsulami[2], Maryam Alsulami[3]
[1,2,3]*Department of Mathematics and Statistics, Jeddah University, Saudia Aribia*
Saleh1@uj.edu.sa
shalsulami@uj.edu.sa
malsulami0656.stu@uj.edu.sa

Abstract

Topological indices are numerical descriptors derived from molecular graphs and are widely used to predict physicochemical properties of chemical compounds. These indices play a vital role in QSAR/QSPR studies, offering efficient alternatives to experimental approaches. This research introduces novel entire irregular topological indices and investigates their predictive capabilities for the physical and chemical properties of molecular graphs. This study contributes to the ongoing development of topological tools in chemical graph theory and opens new avenues for structure–property modeling in computational chemistry and material science.

Keywords: Entire Albertson index, entire sigma index, wheel graph, helm graph, tadpole graph.

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Approximation by Stancu variant of λ-Bernstein shifted knots operators associated by Bézier basis function

Md. Nasiruzzaman[1]

[1]*Department of Mathematics, Faculty of Science, University of Tabuk, Tabuk 7149, Saudi Arabia*
nasir3489@gmail.comr

Abstract

The current paper presents the λ-Bernstein operators through the use of newly developed variant of Stancu-type shifted knots polynomials associated by B\'{e}zier basis functions. Initially, we design the proposed Stancu generated λ-Bernstein operators by means of B\'{e}zier basis functions then investigate the local and global approximation results by using the Ditzian-Totik uniform modulus of smoothness of step weight function. Finally we establish convergence theorem for Lipschitz generated maximal continuous functions and obtain some direct theorems of Peetre's K-functional. In addition, we establish a quantitative Voronovskaja-type approximation theorem.

Keywords: Bernstein basis polynomial; B\'{e}zier basis function; λ-Bernstein-polynomial; shifted knots; Stancu operators, Ditzian-Totik uniform modulus of smoothness; Lipschitz maximal functions; Peetre's K-functional.

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SOC Estimation for Lithium-Ion Batteries Using ANN: Enhancing Battery Performance and Efficiency

Mehmet Akif Kacar[1] , Zeynep Ozturkgil[1], Abdulsamed Celik[1], Musa Terkes[1], Alpaslan Demirci[1],

[1]Department of Electrical Engineering, Yildiz Technical University
akif.kacar@std.yildiz.edu.tr,
zeynep.ozturkgil@std.yildiz.edu.tr,
abdulsamed.celik@std.yildiz.edu.tr,
ademirci@yildiz.edu.tr

Abstract

Accurate estimation of the state of charge (SoC) is critical for optimizing the performance, safety, and lifespan of lithium-ion batteries, which are widely used in electric vehicles (EVs) and portable electronic devices. The development of reliable models for SoC estimation is essential for enhancing the efficiency of battery management systems. In this study, an artificial neural network (ANN)-based model has been developed using SoC data obtained from analytical methods as labels for estimating the SoC in lithium-ion batteries. The model uses voltage (V) and charge (q) data from battery cells as input, and its accuracy is evaluated using performance metrics such as Mean Absolute Error (MAE) and Mean Squared Error (MSE). The results show that the model provides high accuracy in SoC estimation and offers an effective solution to issues such as charge-discharge imbalances. During the training process, continuous improvement in MSE values has been observed due to adaptive learning mechanisms that enhance the model's accuracy. In the future, the integration of heuristic optimization techniques and further development using diverse datasets under different environmental conditions are planned to improve the model's accuracy.

Keywords: artificial neural networks, state of charge, coulomb counting, estimation, Oxford aging dataset.

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Weighted multiple testing procedure for graph neural networks with ordinary differential equations for single cell data

Mehmet Ali Kaygusuz[1], Vilda Purutçuoğlu[2]
[1]Department of Economics, Anadolu University, Turkey
[2]Department of Statistics, Middle Eat Technical University, Turkey
makaygusuz1988@gmail.com
vpurutcu@metu.edu.tr

Abstract

More recently, modern technologies have provided great opportunities for the measurement of gene expression at the single-cell level, enabling the identification of distinct cell types, states, and developmental trajectories within a heterogeneous population. Furthermore, data scientists and geneticts may explore complex biological questions that were previously difficult to address using traditional bulk analysis methods. Nevertheless, single cell technlogies have still limited ability for continious depth under high throutput genetic sequential data. Accordingly, Ordinary differetial equations (ODEs) are favarable tools in single-cell biology for modeling dynamic processes specifically, for understanding the behavior of individual cells over time. On the other hand, multiple testing procedure also can be computationally difficult for high throutput single cell data. Herein, weighted false discovery rate control might be an appropiate and effective statistical approach in the context of single-cell technologies. As a result, we proposed weighted multiple testing procedure to detect significant single cell data to apply these results in modelling of the data via graph neural networkswith ODEs. By this way, we aim to improve the accuracy of inferring genomic information. We evaluated the performance of suggested procedure in mouse ES cells from endoderm pritimitive cells data sets.

Keywords: single cell, multiple testing, ordinary differential equation, graph neural networks

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Efficient multiple testing procedure for survival instrumental variables and nonparametric additive instrumental variables

Mehmet Ali Kaygusuz[1], Vilda Purutçuoğlu[2]
[1]Department of Economics, Anadolu University, Turkey
[2]Department of Statistics, Middle East Technical University, Turkey
makaygusuz1988@gmail.com
vpurutcu@metu.edu.tr

Abstract

Traditionally, Instrumental variable (IV) approach is a statistical technique used mainly in econometrics and other fields to estimate causal relationships when controlled experiments are not feasible and when there is concern about endogeneity. In general, endogeneity can arise from omitted variable bias, measurement error, or simultaneous causality, which can lead to biased and inconsistent estimates in regression analysis. To overcome this problem, we propose instrumental variables which can help to address endogeneity. But in the calculation, detection of valid instrumenrs can be challenging. If the instrument is weak or invalid, it can lead to biased estimates and incorrect inferences. Here, we consider that survival instrumental variable (SIV) can be an effective solution since it has a specific application of IV method in the context of survival analysis, particularly, when dealing with time-to-event data. More explicitly, this method can be particularly useful in medical and epidemiological research, where researchers often want to understand the effect of a treatment or exposure on the time until an event occurs. Furthermore, in the second part of the study, from nonparametric Additive instrumental variable (AIV) models perspective, these methods are a specific type of econometric model that combines the concepts of instrumental variables with additive structures in the context of regression analysis. These models are particularly useful when dealing with endogeneity issues in regression settings. In summary, nonparametric additive instrumental variable models provide a flexible framework for addressing endogeneity in regression analysis while allowing for complex, non-linear relationships between variables. On the other hand, to suggest efficient and faster conditional independence testing can be computationally difficult for additive survival IV and nonparametric additive IV. Consequently, in this study, we propose knockoff testing procedure for SIV and nonparametric additive IV. We examine suggested multiple testing procedure with real data analysis, namely, d-vitamine and growth datasets in the sense that the former is applied for survival additive IV models and the latter is performed for nonparametric additive IV models.

Keywords: instrumental variables, nonparametric additive models, cox proportional models time-to-event data, multiple testing procedure, knockoff testing

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On Basicity of The Exponential Systems In Weighted Grand Variable Exponent Lebesgue Spaces

Mehmet Özükanar[1], Yusuf Zeren[2], Fatih Şirin[3]
[1,2]Department of Mathematics, Yildiz Technical University,
[3]Department of Mathematics, Halic University
mehmet.ozknr13@gmail.com
yzeren@yildiz.edu.tr
fatihsirin@halic.edu.tr

Abstract

In this study, we consider the basicity of exponential systems in the weighted grand variable exponent Lebesgue space $L_w^{p(.),\theta}$. This space, introduced by Kokilashvili and Meskhi in 2014, combines two non-standard function spaces: the variable exponent Lebesgue space and the grand Lebesgue space. However, this space is not reflexive, separable, or invariant under rearrangements and translations. Because of these limitations, we focus on finding a suitable separable subspace using a shift operator. We then study the basicity properties of the exponential system within this subspace.

Keywords: weighted grand variable exponent Lebesgue, basicity, exponential system

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Analysis of Lower Bounds for Blow-Up Time in the p-Laplacian Equation with Damping

Yavuz Dinç[1], Mehmet Selim Çiçek[2]
[1]Department of Business Faculty of Economic and Administrative Sciences,
Mardin Artuklu University, Mardin, Turkey,
[2]The Institute for Graduate Educational studies, Department of Mathematics,
Mardin Artuklu University, Mardin, Turkey.
yavuzdinc@artuklu.edu.tr
meselci87@gmail.com

Abstract

In this presentation, the p-Laplacian wave equation with damping terms in a bounded domain is investigated. Under suitable conditions, lower bounds for the blow-up time are obtained. Additionally, analyses of how the solution of this equation evolves over time and the likelihood of blow-up provide a deeper understanding of the system's dynamics. As a result, an in-depth examination of the effects of different parameters on the p-Laplacian wave equation has been conducted.

Keywords: Blow-up, Damping term, p-Laplacian equation.

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Dirac Type Normal Differential Operators

Meltem Sertbaş[1]

[1]*Department of Mathematics, Karadeniz Technical University,*
m.erolsertbas@gmail.com

Abstract

In this study, we take into consideration some classes of degenerate conformable α-order differential operators with innovation. It is given formally normality condition of these operator and normal extensions domains. Moreover, we determine the spectrum set of these normal operators on $L^2_{,+}(H,(0,1)$.

Keywords: Degenerate differential operator, Innovation, Conformable fractional; Normal operator, Spectrum.

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Using the Autoregressive Model and Integrated Moving Averages (ARIMA) to predict cereal yield production in Abyan Governorate during the period (1993-2018)

Mervat Abdullah Awad Al-Sheikh[1]
[1]*Statistics and Informatics, College of Administration and Economics, Abyan University, Yemen,*
maalshek321@gmail.com

Abstract

This study deals with the using of the autoregressive integrated moving average (ARIMA) model as a modern statistical style to study and analysis the annual data of the cereal crop production in Abyan Governorate during the period of (1993-2016). Through the revealing of the nature time series (under the study). It became clear that time series was non-stationary but after taking the first difference it was stationary time series. The findings of the appropriate and best model to represent the time series data it the model ARIMA (10, 1, 10) through the differentiation criteria (Akaike, Schwarz, R-Sqared). According to the estimation model it has been forecasted of the productivity of the cereal crop in Abyan Governorate until the year of (2030) where the results showed the convergence of the forecasted value with the original time series.

Keywords: time series, ARIMA models, unit root testing, Augmented Dickey Fuller.

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Characterization of Compact Operators on Certain Sequence Spaces

Merve İlkhan Kara[1]
[1]*Department of Mathematics, Düzce University,*
merveilkhan@duzce.edu.tr

Abstract

One of the most interesting application for the concept of Hausdorff measure of noncompactness in the theory of sequence spaces is to obtain the necessary and sufficient conditions for compactness of a matrix operator between complete normed spaces. In this presentation, it is aimed to characterize some classes of compact operators on newly defined sequence spaces.

Keywords: Sequence spaces, Hausdorff measure of noncompactness, Compact operators.

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On rough parametric Marcinkiewicz integrals along certain surfaces

Mohammed Ali[1], Hussain Al-Qassem[2]
[1]*Department of Mathematics, College of Integrative Studies, Abdullah Al-Salem University, Kuwait*
[2] *Department of Mathematics and Statistics, Qatar University, Doha, Qatar*
mohammed .ali@aasu.edu.kw
husseink@qu.edu.qa

Abstract

In this work, we prove L^p boundedness of rough Marcinkiewicz integrals along certain surfaces related to surfaces of revolution via Yano's extrapolation technique. The findings of this work improve and generalize several previously known results on Marcinkiewicz integrals.

Keywords: Parabolic Marcinkiewcz integral, mixed homogeneity space, Grafakos-Stefanov class, Triebel–Lizorkin space

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Yemen-Sombor Index and Coindex of Graphs

Yusuf Zeren[1], Mohammed Alsharafi[1,2]
[1]Department of Mathematics, Yildiz Technical University, Turkey
[2]Department of Mathematics, Sana'a University, Yemen
yzeren@yildiz.edu.tr
alsharafi205010@gmail.com

Abstract

This study introduces and investigates the Yemen-Sombor index, a novel topological descriptor defined for a graph G as $YS(G) = \sum_{vivj\in E(G)} \sqrt{d_G^3(vi) + d_G^3(vj)}$, where $d_G(v)$ represents the degree of vertex v. Originally proposed by Zeren et al. in 2023 to model chain biphenylene structures. Our research extends the analysis of these indices to general graphs and derives exact expressions for key classes. Rigorous mathematical derivations and computational analyses are employed to establish upper and lower bounds and to explore the behavior of these indices under various graph operations. The findings have significant implications in fields such as chemistry, where these descriptors can enhance quantitative structure–activity and structure–property relationships, and in network science, by offering a nuanced understanding of complex systems. Notably, the dual perspective provided by the index and coindex reveals hidden structural properties that may be crucial for both molecular design and network optimization.

Keywords: Yemen-Sombor index and coindex, quantitative structure–activity and structure–property, special graphs.

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Probabilistic Hesitant Fuzzy-type Decision-Making Method based on Entropy with Its Application

Murat Kirişci[1]
[3]*Department of Biostatistics and Medical Informatics, Istanbul University-Cerrahpaşa, Istanbul, Türkiye*
murat.kirisci@iuc.edu.tr

Abstract

The hesitant fuzzy set has been widely applied in practical decision-making processes in recent years. It describes the thoughts of experts better because of a better tolerance. However, its applications have a significant defect—the severe loss of information. To improve the hesitant fuzzy set, the probabilistic hesitant fuzzy set has been put forward. It adds probability to the hesitant fuzzy set and retains more information than the hesitant fuzzy set. By utilizing the hesitant fuzzy elements to represent the fuzziness of the objects and the probabilistic hesitant thoughts of the experts, this paper introduces the negative exponential function into the prospect theory to portray the psychological behaviors of the experts, which transforms the probabilistic hesitant fuzzy decision matrix into the probabilistic hesitant fuzzy prospect decision matrix according to the expectation-levels. Then, this paper applies the energy and entropy in thermodynamics to consider the quantity and quality of the decision values and defines the thermodynamic decision-making parameters based on the probabilistic hesitant fuzzy prospect decision matrix.

Keywords: Probabilistic hesitant fuzzy set, decision-making, thermodynamics, prospect theory.

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Cloud model with an interval-valued probabilistic hesitant fuzzy set for decision-making

Murat Kirişci[1]
[1]*Department of Biostattistics and Medical Informatics, Istanbul University-Cerrahpaşa, Istanbul, Türkiye,*
murat.kirisci@iuc.edu.tr

Abstract

In this paper, the interval-valued probabilistic hesitant fuzzy set is used to express the uncertainty of information adequately, and the cloud model serves as a tool for dealing with the randomness of information. Therefore, a decision-making method is proposed based on an interval-valued probabilistic hesitant fuzzy set and cloud model. We will start by giving an interval-valued probabilistic hesitant fuzzy cloud that can subjectively resolve decision uncertainty and objectively address the randomness of decision-making. Then, a hybrid correlation coefficient based on an interval-valued probabilistic hesitant fuzzy set will be advanced to reduce the complexity of decision-making through hierarchical clustering. Thirdly, a bi-directional trust model based on an interval-valued probabilistic hesitant fuzzy integrated cloud is put forward to solve information conflict.

Keywords: Interval-valued probabilistic hesitant fuzzy set, cloud model, decision-making, hybrid correlation coefficient, hierarchical clustering, conflict resolution

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Enhancing Hourly Photovoltaic Power Forecasting with a Hybrid Statistical-Deep Learning Model

Musa Terkes[1], Alpaslan Demirci[2] , Erdin Gökalp[3]
[1,2,3]Department of Electrical Engineering, Yildiz Technical University,
musa.terkes@yildiz.edu.tr
ademirci@yildiz.edu.tr
gokalp@yildiz.edu.tr

Abstract

In this study, a hybrid ensemble machine learning model integrating statistical learning and time series modeling is proposed for hourly forecasting of power generation from photovoltaic (PV) systems. The model architecture combines the high-accuracy regression capabilities of the Extreme Gradient Boosting (XGBoost) algorithm with the temporal dependency learning capacity of Long Short-Term Memory (LSTM) networks. The final prediction is obtained by dynamically aggregating the outputs of both models using a weighted averaging technique. The modeling process utilizes hourly meteorological variables collected over one year, including solar irradiance, ambient temperature, relative humidity, and cloud cover. In addition, domain-specific feature engineering based on solar physics is applied to enhance the explanatory power of the input variables. Hyperparameter optimization for both XGBoost and LSTM models is conducted using a parametric grid search algorithm and cross-validation techniques. The performance of the model is evaluated using statistical metrics such as Mean Absolute Error (MAE), Root Mean Square Error (RMSE), Mean Absolute Percentage Error (MAPE), and the Coefficient of Determination (R^2). The hybrid model demonstrated a high prediction accuracy with an RMSE of 0.0057 and an R^2 of 0.9994. For comparative analysis, conventional methods including Support Vector Machines (SVM), k-Nearest Neighbors (k-NN), Random Forest (RF), and ARIMA were also implemented, and the proposed hybrid approach outperformed all these traditional techniques. The results obtained indicate that statistical learning-based hybrid models possess significant potential for smart decision support systems in distributed energy applications and contribute to the more efficient and predictable management of renewable energy resources.

Keywords: XGBoost, LSTM, Ensemble learning, Machine learning, PV forecasting.

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The Numerical Solutions of The Second Order Fredholm Integro-Differential Equations Using Residual Method

Mustafa Kemal Altınbaş[1], Meltem Evrenosoğlu Adıyaman[2], Gülter Budakçı[3]

[1]The Graduate School of Natural and Applied Sciences, Dokuz Eylül University,
[2,3]Department of Mathematics, Dokuz Eylül University
mustafakemal.altinbas@ogr.deu.edu.tr
meltem.evrenosoglu@deu.edu.tr
gulter.budakci@deu.edu.tr

Abstract

This study aims to find highly accurate numerical solutions for Fredholm integro-differential equations (FIDE) using the residual method. In this approach, the solution is approximated with Bézier curves. We determine the unknown control points by minimizing the Taylor series of the residual function. After adapting the residual method in [1] to our problem, error analysis is given for FIDE. The stability is also examined. Finally, the numerical results are presented in tables for comparison with other methods from the literature, highlighting the effectiveness and accuracy of the approach.

Keywords: Residual Method, Fredholm integro-differential equations, Bézier curve, Bernstein polynomials, error and stability analysis.

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Resolvability Parameters of Young Wheel Graph with degree 180

Natasha Shahid[1], Muhammad Kamran Jamil[2], Sidra Bukhari[3]
[1,2,3]Department of Mathematics, Riphah International University, Pakistan
natashashahid546@gmail.com
kamran.jamil@riphah.edu.pk
bintebatool777@gmail.com

Abstract

This paper explores the concepts of metric dimension and edge metric dimensions for the young wheel graph represented by YWG, constructed at an angle of 180^0. The young wheel graph(YWG), a variation of the classical wheel graph, is derived from integer partitioning, in which its unique structure is analyzed to compute and characterize these dimensions. We have a look at the vertex and edge resolvability of YWG to determine the metric dimension, which measures the minimal wide variety of vertices required to uniquely pick out all others via distance metrics. Similarly, the edge metric measurement is investigated, focusing on the minimum set of vertices required to differentiate all edges. Analytical consequences monitor tremendous relationships between the graph's structural specifications and its metric-based dimensions, offering insights into its geometric symmetry and combinatorial traits. The take a look contributes to a broader know-how of graph parameters in wheel-like structures with angular constraints.

Keywords: Resolving set, Metric dimension, Edge metric dimension, Edge resolving set

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Symmetric Polynomials in a Certain Variety

Nazan Akdoğan[1]
[1]*Department of Industrial Engineering, Haliç University,*
nazanakdogan@halic.edu.tr

Abstract

In this work, the free associative algebra F_3 of rank 3 in the variety generated by the Grassmann algebra is considered. The algebra of invariants of symmetric group S_3 is obtained by the action of symmetric group on the algebra F_3. A finite set of free generators for the algebra of symmetric polynomials in the commutator ideal of the algebra F_3 is given.

Keywords: Grassmann algebras, symmetric polynomials.

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A New chaos based generating function of the product of (p,q) Fibonacci numbers with Mersenne Lucas numbers

Noura Louzzani[1], Rania Debieche[2], Aya Kedja[3] and Ali Boussayoud[4]

[1]LAOTI Laboratory, Department of Computer Science, Mohamed Seddik Ben Yahia University, Jijel
[2,3] Department of Computer Science, Mohamed Seddik Ben Yahia University, Jijel
[4]LMAM Laboratory, Department of mathematics, Mohamed Seddik Ben Yahia University, Jijel, Algeria
nlouzzani@gmail.com
ayakdj@gmail.com
aboussayoud@yahoo.fr

Abstract

In this paper, we use (*p,q*)-Fibonacci numbers and Mersenne-Lucas numbers to define a new chaotic map. This map is constructed by multiplying the (*p,q*)-Fibonacci numbers with the Mersenne Lucas numbers, and its chaotic properties are verified using bifurcation diagrams and Lyapunov exponents. Then, the confusion and diffusion steps of the cryptographic process are carried out using this map. Experimental results confirm that the histogram, information entropy, and pixel correlation of the encrypted images are satisfactory, and the method provides a very large key space.

Keywords: (p,q)-Fibonacci numbers, Mersenne-Lucas numbers, Cryptographic process, Bifurcation diagrams.

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Numerical Solution of One-Dimensional Heat Equation Using Artificial Neural Network

Nuray Altınöz[1], Aslıhan Dilek[2], Faruk Düşünceli[3]
1,2 Department of Mathematics, The Institute for Graduate Educational Studies, Mardin Artuklu University,Türkiye
3Department of Economics, Mardin Artuklu University, Türkiye
nuray.altnz29@gmail.com
asliihandlk@gmail.com
farukdusunceli@artuklu.edu.tr

Abstract

This study presents a numerical solution to the one-dimensional heat equation using an artificial neural network (ANN). As a widely used parabolic partial differential equation, the heat equation models temperature distribution in physical systems. The proposed ANN employs Legendre polynomials as activation functions, offering a novel approach to function approximation. Training data are derived from the equation's initial and boundary conditions. Implemented in Python, the model's performance is assessed by comparing its results with those of classical numerical methods, demonstrating the accuracy and reliability of the ANN-based solution.

Keywords: Heat Equation, Artificial Neural Network, Legendre Polynomial, Numerical Comparison

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Newton-Raphson and Related Methods for Root-Finding: A Study with Circle Approximation

Mitat Uysal[1], Nurdanur Pehlivan[2]
[1,2]Department of Engineering, Dogus University,
muysal@dogus.edu.tr
npehlivan@dogus.edu.tr

Abstract

Root-finding algorithms are fundamental in numerical analysis, providing solutions for nonlinear equations. The Newton-Raphson method is widely used due to its simplicity and quadratic convergence. However, it requires the computation of derivatives, which is not always feasible. This paper presents the Newton-Raphson method and related techniques, including Secant and Bisection methods, as well as a new approximation method called the Circle Approximation, introduced by Mitat Uysal. We use the equation x3−2x+1=0 as an example, implement each method in Python, and compare their performance in terms of accuracy and convergence speed.

Keywords: Circle Approximation Method, Newton-Raphson, Secant Method, Bisection Method, Root Finding.

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Limit Properties of Certain Infinite-Dimensional Functional Conditional Models

Bouanani OUSSAMA[1]

[1]*Department of Mathematics,Faculty of Exact Sciences and Computer Science,*
University Abdelhamid Ibn Badis Mostaganem, ALGERIA
oussama.bouanani@univ-mostadz

Abstract

In this paper, we present an alternative method for kernel estimation, specifically local linear estimation (LLE), applied to estimating the conditional. This approach is examined in a scenario where the response variable is real-valued, and the explanatory variable resides in an infinite-dimensional space. The primary objective of this research is to establish the asymptotic normality of the proposed estimator and to derive explicit convergence rates . Additionally, we demonstrate the practical performance of our method with a simulation study, showcasing its effectiveness in real-world scenarios.

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A Comprehensive Analysis of Stability and Existence for Generalized Fractional Boundary Value Problems

Özlem Batıt Özen[1]
[1]*Department of Mathematics, Ege University,*
ozlem.ozen@ege.edu.tr

Abstract

In this study, we investigate a class of boundary value problems involving nonlinear fractional differential equations. By employing fixed point techniques, we establish sufficient conditions for the existence of solutions. Additionally, we examine the Ulam–Hyers stability of the problem within an appropriate functional framework. These results contribute to the ongoing development of the theory of fractional differential equations and offer potential for further applications in mathematical modeling. An illustrative example is presented to demonstrate the applicability of the main results.

Keywords: Fractional derivative, Boundary value problems, Existence of solutions.

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Nonexistence of Global Solutions for the Kirchhoff- Type Equation

Yavuz Dinç[1], Özlem Karaca[2]
[1]*Department of Business Faculty of Economic and Administrative Sciences, Mardin Artuklu University, Mardin, Turkey,*
[2]*The Institute for Graduate Educational studies, Department of Mathematics, Mardin Artuklu University, Mardin, Turkey*
yavuzdinc@artuklu.edu.tr
karacaozle@gmail.com

Abstract

In this presentation, we analyze the Kirchhoff-type equation with a variable exponent. The Kirchhoff-type equation is a type of evolution equation, where evolution equations refer to partial differential equations with time t as one of the independent variables. This type of problem has been extensively applied in various mathematical models in fields such as electrorheological fluid flows, thin liquid films, and more. We demonstrate the upper bound for the blow-up time under appropriate conditions.

Keywords: Blow up, Kirchhoff-type equation, Variable exponent.

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Modeling Post-Earthquake Housing Allocation with Time Delays

Özlem Yılmaz[1], Rukiye Kara[2] , Gülay İlona Telsiz Kayaoğlu[3]
[1,2,3]Department of Mathematics, Mimar Sinan Fine Arts University
ozlem.yilmaz@msgsu.edu.tr
rukiye.kara@msgsu.edu.tr
gulay.telsiz@msgsu.edu.tr

Abstract

In this study, we develop and analyze a mathematical model to investigate the post-disaster housing allocation process for families rendered homeless by an earthquake. The model incorporates two distinct time delays, representing the lag in relocating homeless families to tents and prefabricated housing units, respectively. These delays reflect realistic logistical and administrative constraints following such disasters. The system is formulated as a set of nonlinear delay differential equations, and a detailed stability analysis is carried out. In particular, we examine the existence of Hopf bifurcation induced by the delays, shedding light on the dynamic transitions that may arise in the system behavior over time. Numerical simulations are presented to illustrate the theoretical results and to explore the effects of delay parameters on the evolution of housing needs.

Keywords: Post-Disaster Housing, Time Delay, Delay Differential Equations, Hopf Bifurcation, Earthquake Response Modeling.

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Generalized Gamma-Wright Integral Operators: Approximation Properties

Prashantkumar Patel[1]
[1]*Department of Mathematics, Sardar Patel University, Vallabh Vidyanagar-388 120, Gujarat, India,*
Prashant225@spuvvn.edu

Abstract

This study presents a new category of integral-type positive linear operators constructed using the generalized gamma function and the Wright function, therefore extending traditional approximation frameworks into fractional and special function contexts. We ascertain essential characteristics of these operators, encompassing moment estimates and convergence analysis, using the classical modulus of continuity to produce error limits and uniform approximation outcomes. Furthermore, we provide an asymptotic formula that delineates the behavior of the operators and furnish pointwise convergence estimates in Lipschitz spaces, therefore augmenting their applicability to non-smooth functions. The research also examines weighted approximation characteristics in polynomial-weighted spaces and measures the convergence rate under different smoothness criteria. This study integrates approaches from fractional calculus, special function theory, and approximation theory, therefore expanding the range of operator-based approximation methods and providing tools for addressing issues in fractional differential equations and related areas. The findings enhance the theoretical framework of operator approximation, with possible applications in numerical analysis, signal processing, and mathematical physics.

Keywords: Wright function; Gamma function; rate of convergence; positive linear operators.

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On Fuzzy Total graph from commutative rings

Qussai Haj HUSSEIN[1], Serkan ONAR[2]
[1]Department of Mathematics, Idlib University, Idlib, Syria
[2]Department of Mathematical Engineering, Yildiz Technical University, Turkey
nasemalrouh20@gmail.com
sonar@yildiz.edu.tr

Abstract

This research investigates fuzzy total graphs derived from commutative rings, expanding on the concepts of zero-divisor graphs and total graphs. We explore the construction of fuzzy total graphs, where vertices represent ring elements and edges connect elements whose sum is a zero-divisor. The novelty lies in the introduction of fuzzy set theory, assigning membership degrees to vertices and edges within the [0, 1] interval. This study defines essential graph-theoretic and algebraic concepts, detailing the methodology for constructing fuzzy zero-divisor graphs and extending it to fuzzy total graphs. Furthermore, Key findings include the characterization of fuzzy star zero-divisor graphs and a theorem establishing conditions for non-empty fuzzy total graphs. This research contributes to the broader understanding of algebraic structures through graph theory, with potential implications in areas such as network analysis and fuzzy modeling.

Keywords: Fuzzy Total Graph, Commutative Ring, Zero-Divisor Graph, Fuzzy Graph Theory, Algebraic Graph Theory.

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A Study on Lucas Difference Sequence Spaces in 2-Normed Spaces

Ravi Kumar[1], Sunil K. Sharma[2]
[1]Department of Mathematics, Central University of Jammu,
Rahya Suchani (Bagla), Samba- 181143, Jammu and Kashmir, India
[2]School of Mathematics, Shri Mata Vaishno Devi University, kakryal,
Katra-182320, Jammu and Kashmir, India
Ravikumar13849@gmail.com
Sunilksharma42@gmail.com

Abstract

The study of sequence spaces in 2-normed structures has yet to fully integrate Orlicz functions and difference operators, limiting their analytical scope. To address this, we introduce new sequence spaces incorporating the Lucas difference matrix within a 2-normed space framework. We investigate their topological and geometric properties, establish inclusion relations and analyze their structural characteristics. This study advances sequence space theory in functional analysis, providing a foundation for further theoretical and applied research.

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

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A mathematical modeling approach of Cancer Invasion and its resolution by radiation therapy

Ravi Kumar[1]
[1]*Department of Mathematics, Patna Women's College, Autonomous,*
Patna University,
ravi.math@patnawomenscollege.in

Abstract

In this paper, Cancer is still one of the world's most serious public health problems. Mathematical modeling of cancer invasion investigates tumor growth, cell proliferation, migration, and interactions with the microenvironment. These models incorporate variables like drug resistance, immune response, and tumor heterogeneity to simulate metastatic progression. Mathematical model was developed and validated to optimize radiation therapy for cancer treatment. We begin by performing qualitative assessments of the model's dynamical behaviours, such as the presence and positivity of solutions The model considers factors such as tumor biology, radiation dose, and fractionation schedule. Results show the model can accurately predict tumor response and normal tissue toxicity, leading to improved tumor control and reduced side effects. This study highlights the potential of mathematical modelling to personalize and optimize radiation therapy, improving treatment efficiency and minimizing side effects.

Keywords: Mathematical Modelling, Radiation Therapy, Cancer Treatment, Tumor Growth, Treatment Optimization, cell migration, immune response.

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Automorphisms of Free Braided Nonassociative Algebras in Two Variables

Riza Mutalip[1], Altyngul Naurazbekova[2], Daniyar Kozybayev[3]
[1,2,3] Department of Algebra and Geometry, L.N. Gumilyov Eurasian National University,
mutalipriza@yahoo.com
altyngul.82@mail.ru
kozybayev@gmail.com

Abstract

We describe the automorphism groups of two generated free braided nonassociative algebras with involutive diagonal braidings over a field K of characteristic $\neq 2$. Depending on the form of the diagonal involutive braiding, five different automorphism groups arise as automorphism groups of two generated free braided nonassociative algebras. This list covers all three automorphism groups that arise in the case of quantum planes [1]. As a consequence, using similar results by R. Mutalip, A. Naurazbekova, and U. Umirbaev [2] for two generated free braided associative algebras, we obtain that the automorphism groups of the two generated free braided nonassociative algebra $(K\{x_1, x_2\}, \tau)$ and the two generated free braided associative algebras $(K\langle x_1, x_2\rangle, \tau)$ with involutive diagonal braiding τ are isomorphic.

Keywords: Yang-Baxter equation, braiding, free nonassociative algebra, automorphism.

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α-Suchrer Durrmeyer Operators And Their Approximation Properties

Ruchi Singh Rajawat[1]

[1,]Department of Mathematics, Institute of Applied Sciences and Humanities, GLA University, Mathura- 281406, Uttar Pradesh, India

ruchirajawat6795@gmail.com

Abstract

The key goal of the present research article is to introduce a new sequence of linear positive operators, i.e.,α-Schurer Durrmeyer operator, and their approximation behaviour based on the function $\eta(z)$, where η infinitely differentiable on [0,1], $\eta(z)$ = 0, $\eta(1)$ = 1and $\eta'(z)$ > 0, for all $z \in$ [0,1]. Further, we calculate central moments and basic estimates for the sequence of operators. Moreover, we discuss the rate of convergence and order of approximation in terms of modulus of continuity, smoothness, Korovkin theorem, and Peeter's K-functional. The subsequent sections study local, global, and A-statistical results.

Keywords: Suchrer-Durrmeyer type operators, local and global approximation, Peeter's K- functional, rate of convergence, Korovkin theorem.

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Berwald Covariant Derivative and Lie Derivative of Conharmonic Curvature Tensors in Generalized Fifth Recurrent Finsler Space

Adel M. Al-Qashbari[1], Alaa A. Abdallah[2], Saeedah M. Baleedi[3]
[1]*Department. of Mathematatices, Education Faculty -Aden, University of Aden, Yemen*
[2]*Department of Engineering, Faculty of Engineering and Computing, University of Science & Technology, Aden, Yemen*
[3]*Department of Mathematics, Education Faculty, University of Abyan, Zanjibar, Yemen*
a.alqashbari@ust.edu
ala733.ala00@gmail.com
saeedahbaleedi@gmail.com

Abstract

This paper builds upon new define for the conharmonice curvature tensor in generaralized fifth recurrent Finsler space that Cartan's fourth curvature tensor K^i_{jkh} in sense of Berwald ($GBK-5RF_n$) via Lie derivative. We define a new conharmonic curvature tensor and explore its relationships with other established curvature tensors. Through various mathematical operations, including the Berwald covariant derivative and the Lie derivative, we derive new expressions for the conharmonic tensor and its interactions with other curvature tensors. The main results include the commutativity of the Berwald covariant derivative of the fifth order with the Lie derivative, as well as the distributivity of the Lie derivative over the addition of curvature tensors. Additionally, we establish several theorems and corollaries that enhance the understanding of the behavior of curvature tensors in $GBK-5RF_n$.

Keywords: Generalized $\mathcal{BK}$-fifth recurrent Finsler space, Conharmonic curvature tensor L^i_{jkh} , Conformal curvature tensor C_{ijkh}, Lie-derivative L_v.

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Practical Stability Criterias of Perturbed Impulsive Differential Equations with respect to Its Unperturbed System with Initial Time Difference

Saliha Demirbüken[1], Coşkun Yakar[2]
[1,2,3]Department of Mathematics, Gebze Technical University,
sdemirbuken@gtu.edu.tr
cyakar@gtu.edu.tr

Abstract

In this study, we examine stability and (strongly) practical stability criterias of perturbed impulsive differential equations with respect to its unperturbed ones with an initial time difference via employing comparison theorems using Lyapunov functions.

Keywords: impulsive differential equations, initial time difference, practical stability, Lyapunov functions.

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The Sum Rule for Clarke Directionally Differentiable Functions

Samet Bila[1], Refail Kasımbeyli[2], Ali Farajzadeh[3]
[1]Department of Mathematics, Eskişehir Technical University,
[2]Department of Industrial Engineering, Eskişehir Technical University,
[3]Department of Mathematics, Razi University, Kermanshah, Iran.
sametbila@eskisehir.edu.tr
rkasimbeyli@eskisehir.edu.tr
farajzadehali@gmail.com

Abstract

In this study, we prove that the "sup relation" for the weak subdifferential, can be formulated as a "max relation" for the class of Clarke directionally differentiable function. Based on this formulation, we then show that the weak subdifferentials of the Clarke directionally differentiable functions satisfy the sum rule property in the form of equality. Additionally, we investigate a relation between the weak subdifferential of the indicator function and the augmented normal cone to a nonconvex set. We then applied this relation to establish some additional properties of nonconvex sets.

Keywords: Weak subdifferential, Sum rule, Augmented normal cones, Optimization.

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A Study on Certain Classes of Weakly Subdifferentiable Functions

Samet Bila[1], Refail Kasımbeyli[2]
[1]Department of Mathematics, Eskişehir Technical University,
[2]Department of Industrial Engineering, Eskişehir Technical University,
sametbila@eskisehir.edu.tr
rkasimbeyli@eskisehir.edu.tr

Abstract

This work presents a theorem stating that any Lipschitz function is weakly subdifferentiable, and the $\boldsymbol{x}^*$ component of its weak subgradient is nonzero (i.e., $\boldsymbol{x}^* \neq \boldsymbol{0}_{\mathbb{R}^n}$). The theorem is based on Kasimbeyli's nonlinear cone separation theorem. Furthermore, we demonstrate that any positively homogeneous and continuous function is both upper and lower Lipschitz. We also show that positively homogeneous and lower semicontinuous functions are weakly subdifferentiable, and in this case, the weak subgradient $(\boldsymbol{x}^*,c)$ satisfies $(\boldsymbol{x}^*,c) \neq (\boldsymbol{0}_{\mathbb{R}^n}, \boldsymbol{0})$.

Keywords: Weak subdifferential, Cone Seperation, Lipschitz Functions, Nonlinear Optimization.

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Geometric Analysis of Darboux Osculating Curves on Smooth Surfaces Under Isometric Transformations

Sandeep Sharma[1]
[1]*School of Mathematics, Shri Mata Vaishno Devi University, Kakryal, Katra-182320, Jammu and Kashmir, India*
sandeep.greater123@gmail.com

Abstract

Osculating curves play a significant role in analyzing the invariance of geometric features, such as curvature and position vector components, under isometric transformations. This paper presents a geometric characterization of Darboux osculating curves on a smooth surface in Euclidean 3-space. First, we establish a condition that ensures the invariance of these curves under surface isometries. Additionally, we examine how the position vector components of these curves deviate along both the tangent vector and the principal normal to the surface in response to a given isometry. Furthermore, we derive a sufficient condition for the conformal invariance of Darboux osculating curves on a smoothly immersed surface in Euclidean space.

Keywords: Darboux osculating curve; isometry of surfaces; conformal map; normal curvature.

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Milstein-Type Schemes for McKean-Vlasov SDEs Driven by Brownian Motion and Poisson Random Measure (with Super-Linear Coefficients)

Sani Biswas[1], Chaman Kumar[2], Christoph Reisinger[3], Verena Schwarz[4]
[1]*Centro de Modelamiento Matemático, Universidad de Chile, Chile*
[2]*Department of Mathematics, Indian Institute of Technology Roorkee, India*
[3]*Mathematical Institute, University of Oxford, United Kingdom*
[4]*Department of Statistics, University of Klagenfurt, Austria*
sbiswas@cmm.uchile.cl
chaman.kumar@ma.iitr.ac.in
christoph.reisinger@maths.ox.ac.uk
verena.schwarz@aau.at

Abstract

We present a general Milstein-type scheme for McKean--Vlasov stochastic differential equations (SDEs) driven by Brownian motion and Poisson random measure and the associated system of interacting particles where drift, diffusion and jump coefficients may grow super-linearly in the state variable and linearly in the measure component. The strong rate of L^2-convergence of the proposed scheme is shown to be arbitrarily close to one under appropriate regularity assumptions on the coefficients. For the derivation of the Milstein scheme and to show its strong rate of convergence, we provide an Itô formula for the interacting particle system connected with the McKean--Vlasov SDE driven by Brownian motion and Poisson random measure. The two-fold challenges arising due to the presence of the empirical measure and super-linearity of the jump coefficient are resolved by identifying and exploiting an appropriate coercivity-type condition.

Keywords: McKean--Vlasov equation, Lévy noise, super-linear coefficient, interacting particle system, Lions derivatives.

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The Investigation of Perturbed Gerdjikov-Ivanov Equation with M-fractional Derivative Used in Optical Fiber

Seçil DEMIRKAYA[1], Ayten ÖZKAN[2]
[1,2]Department of Mathematics, Yildiz Technical University,
secil.demirkaya@std.yildiz.edu.tr
uayten@yildiz.edu.tr

Abstract

The perturbed Gerdjikov-Ivanov equation with M-fractional is investigated in this study. This equation is used to understand and analyze complex physical phenomena, especially encountered in nonlinear optical and fiber optic communication systems. This equation has a wide range of uses in both theoretical physics and applied engineering. Sardar-sub equation method is used for solving this equation which have an important place in nonlinear optics. Solutions are obtained with Maple software.

Keywords: Perturbed Gerdjikov-Ivanov Equation, M-fractional Derivative, Sardar-sub equation.

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Trainable Half-Hyperbolic Tangent Function-Activated Complex-Valued Symmetrized Neural Network (SNN) Approximation

Seda Karateke[1]
[1]*Department of Software Engineering, Faculty of Engineering and Natural Sciences, Istanbul Atlas University, 34408 Istanbul, Türkiye*
seda.karateke@atlas.edu.tr

Abstract

This work deals with the approximation theories connected with the univariate symmetrized neural network (SNN) operators. Unlike classical neural network (NN) operators, the complex valued SNN operators we work with here are symmetrized. SNN operators have advantageous results in practice. However, the author here focuses only on the theoretical results. In addition, interesting approximation results of these complex valued operators are highlighted with trigonometric and hyperbolic connections. Here, the function activating the symmetrized complex valued NN operators is selected as the half-hyperbolic function, which is trainable. Moreover, we mention the advantages of this activation function compared to the classical one covering the related literature.

Keywords: complex valued symmetrized neural network approximation, complex valued quasi-interpolation operator, modulus of continuity, trigonometric and hyperbolic approximation, activation function, half-hyperbolic function.

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Some innovations of Opial-type inequalities with diamond$-\propto$ calculus

Selahattin AL[1], Lütfi AKIN[2]
[1]The Institute for Graduate Educational Studies, Mardin Artuklu University, Mardin, Türkiye
[2]Department of Business Administration, Mardin Artuklu University, Mardin, Türkiye
selahattinal47@gmail.com
lutfiakin@artuklu.edu.tr

Abstract

The studies of dynamic inequalities on time scales have attracted great attention in the literature and have become an important area in pure and applied mathematics. In particular, intensive studies have been conducted on inequalities. In this study, we will focus on some innovations of Opial type inequalities in the diamond$-\propto$ calculation of time scales.

Keywords: Opial type inequalities, Diamond alpha, Time Scales

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Analytical Solutions Of Fractional Heat Equations Using Fractional Fourier Transform

Senanur Benli[1], Şuayip Toprakseven[2], Yusuf Zeren[3]
[1,3]Department of Mathematics, Yildiz Technical University
[2] Artvin Vocational School, Accounting and Tax Applications Program Artvin Coruh University
senabenli77@gmail.com
topraksp@artvin.edu.tr
yzeren@yildiz.edu.tr

Abstract

This study addresses the analytical solutions of the fractional diffusion equations by employing methodologies derived from the classical heat equation and its fractional-order counterpart. The primary analytical approach involves the application of the fractional Fourier transform, a generalization of the conventional Fourier transform, which facilitates the treatment of diffusion processes governed by fractional order derivatives. By leveraging properties of fractional calculus, the solution framework captures anomalous diffusion behaviors that cannot be adequately described by classical integer-order models. The results illustrate the efficiency and applicability of the fractional Fourier transform in solving space-time fractional partial differential equations, thereby providing a robust tool for modeling complex transport phenomena in heterogeneous and memory-dependent media.

Keywords: Fourier transform, fractional fourier transform, heat equation, fractional diffusion equation

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On Reverse Minkowski Inequality for Power Weighted and Monotone Functions on Time Scales

Serkan Inaltekin[1], Yusuf Zeren[1], Lütfi Akın[2]
[1,2]Department of Mathematics, Yildiz Technical University,
[3]Department of Business Administration, Mardin Artuklu University
yzeren@yildiz.edu.tr
seyymacetin@gmail.com
lutfiakin@artuklu.edu.tr

Abstract

This paper establishes a novel power weighted reverse Minkowski inequality for monotone functions within the framework of diamond- α calculus on time scales. By incorporating a positive power weight function w^m and two parameters p, q we extend classical inequalities to dynamic systems, unifying continuous and discrete cases. Under the condition $0 < \propto < n \leq \frac{\gamma f(\vartheta)}{\phi(\vartheta)} \leq K$, we prove:

$$\frac{K+\gamma}{\gamma(K-\propto)}\left(\int_x^y \quad (\gamma f - \propto \phi)^p w^m(\vartheta) \diamond_\alpha \vartheta\right)^{\frac{1}{p}} \leq \left(\int_x^y \quad f^p w^m(\vartheta) \diamond_\alpha \vartheta\right)^{\frac{1}{p}} + \left(D_{(p,q)} \int_x^y \quad \phi^p w^m(\vartheta) \diamond_\alpha \vartheta\right)^{\frac{1}{q}},$$

where $D_{(p,q)} = \left(\int_x^y \quad w^m(\vartheta) \diamond_\alpha \vartheta\right)^{\frac{q-p}{p}}$. Our results generalize existing inequalities for $T = R$ (continuous) and $T = R$ (discrete), with applications in dynamic optimization and stability analys.

Keywords: Weighted inequalities, Reverse Minkowski inequality, Diamond$-\alpha$ calculus.

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Relation-theoretic F-contractions in Symmetric Spaces with an Application

Shahbaz Ali[1]
[1,2,3]*Department of Mathematics, Aligarh Muslim University, Aligarh*
shahbazali4786@gmail.com

Abstract

In this paper, we considered the relation-theoretic analogue of F-contraction in suitably equipped symmetric spaces. In doing so, we adopt suitable examples to establish the need of our results. We also utilize one of our main results to prove an existence theorem involving Volterra-type integral equations.

Keywords: Binary relation, F-contraction, Regular spaces, Volterra-type integral equation.

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Some results on partial order metric spaces using rational type contraction

Shiv Kant Tiwari[1]
[1]*Department of Mathematics, Lukhdhirji Engineering College,*
Morbi, Gujarat-363642, India
shivkant.math@gmail.com

Abstract

In this study, we have proved certain common fixed point theorems for rational type contractions in partial order metric space, which are connected to integral type equations. In addition, we provided an example for verifying our key findings.

Keywords: Contraction, continues, compatible, weakly compatible mapping, common fixed point.

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Optimized Retail Outlet Placement and Metropolitan Navigation for Enhanced Urban Logistics Efficiency

Sikander Ali[1]
[1]*Department of Mathematics, Riphah International University, Lahore, Pakistan.*
sikanderalicui@gmail.com

Abstract

Graph theory plays a fundamental role in modeling and optimizing real-world networks, including urban logistics and networking. In the rapidly evolving landscape of urban commerce, efficient retail outlet placement and seamless navigation are crucial for optimizing logistics and enhancing customer experience. This study explores the application of metric, fault-tolerant metric, and face metric dimension in determining optimal store locations and ensuring uninterrupted accessibility. The exchange property is utilized to dynamically reassign store locations while preserving the efficiency of the navigation system. A strategic approach is proposed where retail outlets are positioned such that each household in a metropolitan area has a unique identification code based on its shortest distance from the nearest store. This ensures precise location tracking and efficient delivery systems. Furthermore, if a store temporarily closes, the identification codes remain valid, maintaining uninterrupted service. These mathematical properties provide a robust framework for urban logistics, supporting businesses in improving supply chain operations, optimizing distribution networks, and enhancing last-mile delivery services. The findings of this research contribute to the development of smart city infrastructure by integrating graph theoretical resolvability concepts into real-world urban planning and navigation systems.

Keywords: Metric dimension, Fault-tolerant metric dimension, Exchange property, Retail outlets, Urban logistics, Real-world applications

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A Short Proof Of The Infinitude Of Primes

Siyabend TURGUT[1]
[1]*Department of Computer Engineering, Istanbul University - Cerrahpasa,*
siyabend.turgut@ogr.iuc.edu.tr

Abstract
This paper aims to provide a short proof of the infinitude of prime numbers. Prime numbers, which form the foundation of number theory, have attracted the interest of mathematicians since ancient times. Many proofs have been made to show that there are infinitely many prime numbers. In this study, a short proof is presented using the proof by contradiction.

Keywords: Infinitude of primes, Euclid's proof of primes infinitude.

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Enhancing Self-Organizing Maps for Non-Gaussian Data: An Adaptive Normalization Approach

Soumia Kharfouchi[1], Faiza Saadi[2]
[1]Department of Medecine, Salah Boubnider University,
[2]Department of Medecine, Salah Boubnider University,
soumia.kharfouchi@univ-constantine3.dz
fifasaadi@hotmail.com

Abstract

The Self-Organizing Map (SOM) is a specialized type of artificial neural network (ANN) designed for data visualization, facilitating the understanding of high-dimensional data and illustrating clustering mechanisms by grouping similar data points together. The conventional SOM is particularly effective when applied to data that follows a Gaussian distribution. However, when confronted with non-Gaussian characteristics, the initial placement of SOM nodes may not be optimal, resulting in slower convergence and less effective clustering.
To address this issue, we propose a novel approach aimed at enhancing the performance of the SOM by integrating a learning-by-epoch strategy. This strategy introduces a step within the SOM algorithm that evaluates the kurtosis and skewness of input vectors. When significant deviations from normality are identified, normalization is applied to ensure that the input data falls within an appropriate range. This adaptive normalization technique effectively addresses data distributions that exhibit non-Gaussian kurtosis or skewness, thereby making the SOM more versatile and robust.

Keywords: Self-Organizing-Map, Higher-order statistics, Learning by epoch, Satellite image segmentation, Iris data.

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Initial Time Difference Strict Practical Stability Of Nonlinear Perturbed Systems With Respect To Its Unperturbed Systems

Coşkun YAKAR[1], Sultan TOY YELKOVAN[2]
[1]Department of Mathematics, Gebze Technical University, [2]Department of Mathematics, Bingöl University
cyakar@gtu.edu.tr
stoy@bingol.edu.tr

Abstract

In this paper, the initial time difference strict practical stability of perturbed systems with respect to its unperturbed systems have been investigated and proved that the theorems and a comparison result with sufficient conditions for nonlinear differential equations.

Keywords: Strict practical stability criteria, perturbed and unperturbed systems, initial time difference, comparison results, Lyapunov second method.

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A Shortest-Path-Based Measure of Convexity for Planar Domains with Obstacles

Suman Sanyal[1], AdlinoAfonso[2]
[1,2]Big Data Analytics, Goa Institute of Management, Goa, India,
sanyal@gim.ac.in
adlino@gim.ac.in

Abstract

We propose a novel, shortest-path-based measure of convexity that captures how much a planar domain (with or without internal obstacles) deviates from being convex. The measure compares Euclidean distances between pairs of points to the feasible shortest-path distances contained entirely within the domain. By construction, it equals one if the domain is convex and obstacle-free and strictly decreases otherwise. We establish several key geometric properties, including monotonicity with respect to obstacle expansions, invariance under rigid motions and uniform scalings, and robust detection of boundary concavities. A discrete sampling procedure approximates the measure in practice, and we prove that this approximation converges (in probability) to the continuous definition as the sample size grows.

Keywords: Convexity Measure, Shortest-Path Metric, Non-convex Domains, Obstacle Avoidance, Shape Analysis.

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Analysis of Convergence Properties in (α, β)-Order Set Sequences

Sunil K. Sharma[1]
[1]*School of Mathematics, Shri Mata Vaishno Devi University, kakryal,*
Katra-182320, Jammu and Kashmir, India
Sunilksharma42@gmail.com

Abstract

In this paper, we investigate the convergence properties of set sequences within the framework of (α, β)-order. We begin by examining statistical convergence for (α, β)-order set sequences, establishing fundamental results that extend classical convergence concepts to a more generalized setting. Subsequently, we introduce and analyze asymptotic lacunary statistical equivalence in the context of (α, β)-order set sequences, highlighting its role in understanding the behavior of sequences with varying density constraints. Furthermore, we explore Wijsman asymptotic lacunary sequences of order (α, β), providing insights into their structural properties and interrelations with other modes of convergence. The results presented herein contribute to the broader study of set-valued convergence and its applications in functional analysis and topology.

Keywords: Statistical convergence, asymptotic lacunary statistical equivalence, Wijsman convergence, set-valued analysis, lacunary sequence.

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Existence And Boundedness Of Solutions To Degenerate Elliptic Equations

Sunnet Avezov[1]*, Scott Rodney*[2] *, Yusuf Zeren*[3]
[1]*Department of Mathematics, Cape Breton University,*
[1]*Department of Mathematics, Yildiz Technical University,*
[1]*Department of Mathematics, Yildiz Technical University,*
awezowsunnet@gmail.com
scott_rodney@cbu.ca
yzeren@ytu.edu.tr

Abstract

In this paper we extend the results in [1] to a more general elliptic partial differential operator. We study the existence of solutions with rough coefficients and establish boundedness of the possible solutions using notions of Orlicz spaces.

Keywords: Degenerate elliptic equations, Orlicz spaces, Weighted Sobolev Spaces.

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Generalized Quasilinearization Method with Initial Time Difference on Time Scale

Şahap Çetin[1],Yalçın Yılmaz[2] , Coşkun Yakar[3]
[1,2,]Department of Mathematics, Sakarya University,
[3]Department of Mathematics, Gebze Technical University,
sahapcetin1425@gmail.com
yalciny@sakarya.edu.tr
cyakar@gtu.edu.tr

Abstract

In this study, the generalized quasilinearization method is used to obtain upper and lower bounds for the solution of given nonlinear initial value problem of dynamic equations on time scales. These bounds are sequences created by solutions of linear differential equations starting from different initial times. Under some conditions, we observed that the solutions converged to the unique solution of the problem uniformly and monotonically, and the convergence is quadratic.

Keywords: The method of quasilinearization, initial time differences, time scale,comparison theorems

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Analytical Solutions Of Conformable Fractional Differential Equations

Şuayip Toprakseven[1] , *Yusuf Zeren*[2]
[1] *Artvin Vocational School, Accounting and Tax Applications Program Artvin Coruh University*
[2]*Department of Mathematics, Yildiz Technical University*
topraksp@artvin.edu.tr

yzeren@yildiz.edu.tr

Abstract

This work introduces a new technique to solve conformable fractional differential equations using conformable Fourier transofmation method. We obtain the analytical solutions of the conformable fractional differential equations by making use of this newly defined fractional Fourier transformation. This conformable fractional Fourier transformation has been further applied to find the analytical solutions of the conformable fractional heat and conformable fractional wave equations. We show that this technique is more effective than the standard Fourier transformation for solving fractional partial differential equation.

Keywords: Conformable fractional derivative, Fractional Fourier Transform, Fractional heat equation, Fractional wave equation

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Intersections of Linear Codes over F_q+vF_q and their properties

Taher Abualrub[1], Nasreddine Benbelkacem[2], Kenza Guenda[2]
[1]Department of Mathematics, American University of Sharjah
[2]Faculty of Mathematics, University of Science and Technology Houari Boumediene
Algebra and Number Theory Department, Algiers, Algeria,
abualrub@aus.edu@yildiz.edu.tr
nasreddine.benbelkacem@usthb.edu.dz
ken.guenda@gmail.com

Abstract

Let F_q be the finite fields of $q=p^r$ elements, where r is any positive integer and p is a prime integer. The ring $R= F_q+vF_q$ is a commutative non-chain ring with two maximal ideals $I=<v>$ and $J=<1-v>$ and has p^{2r} elements. A subset C of R^n is called a linear code over R if C is an R-submodule of R^n. If C is a linear code over R, then the dual of C is the linear code over R given by $C^{\perp}=\{v \text{ in } R^n: u.v=0$ in R for all u in $C\}$, where $u.v$ is the Euclidean inner product. Let C and D be two linear codes over R with $|C \cap D|=p^r$. In this case, we say that the rank of $C \cap D$ is r. In this abstract, we are interested to study the rank of the linear code $C \cap D$ and its properties. We will provide conditions when a pair of linear codes *(C,d)* is a linear complementary linear pair (LCP) of codes. We also provide conditions for a linear code to be a linear complementary dual (LCD) code. We will provide examples of LCP and LCD codes of different lengths over the ring *R.*

Keywords: Linear codes, linear complementary pair (LCP) of codes, linear complementary dual (LCD) codes.

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Pentadiagonal And Tridiagonal Systems With Gauss Elimination And Boundary-Value Linear Ordinary Differential Equations

Tefaruk Haktanır[1]
[1]*Department of Civil Engineering, Erciyes University*
thaktan@erciyes.edu.tr

Abstract

Here, an n by n pentadiagonal matrix, whose ($n*n$ – $5*n$ + 6) elements are zeros, is configured as an n by 5 matrix, as commonly done saving a huge space from computer's memory. Algorithms for pentadiagonal and tridiagonal systems based on a Gauss elimination with pivoting scheme are presented. The finite differences method when applied to a 3rd or a 4th order linear ordinary differential equation using the first order central differentiation formulas yields a system of linear equations with a pentadiagonal coefficient matrix while it is tridiagonal for a 2nd order equation. A main program is coded which solves any boundary-value linear ordinary differential equation up to the 4th order. The statements for the coefficients of the linear equations having three blocks for a 2nd order differential equation and five blocks for higher orders are typed in a subprogram, which will be linked to the fixed main program. 16-digit real arithmetic is executed. Computations are repeated as many as 29 times for the step sizes of Δx = 0.11, 0.10, 0.09, …, 0.01, 0.009, …, 0.001, 0.0009, …, 0.0001, and they terminate when either the average of n absolute relative differences of two successive series of the dependent variable become smaller than $1*10^{-6}$ or Δx = 0.0001. The programs are applied to a 3rd order and a 2nd order linear ordinary differential equations from two renowned books, whose analytical solutions exist, and their numerical results are equal to the exact values with 6 significant digits.

Keywords: Pentadiagonal linear systems, tridiagonal linear systems, boundary-value linear ordinary differential equations.

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On Gauss Hyper-Fibonacci and Gauss Hyper-Lucas Numbers

Mustafa Asci[1], *Tevfik Kalan*[2]
[1,2] *Department of Mathematics, Pamukkale University,*
mustafa.asci@yahoo.com
kalantevfik35@gmail.com

Abstract

In this study, a generalization was made regarding the Gauss Fibonacci and Gaussian Lucas numbers. A new definition of Gaussian Fibonacci and Gaussian Lucas numbers was made by using Hyper-Fibonacci and Hyper-Lucas numbers. Gaussian Hyper-Fibonacci and Gaussian Hyper-Lucas numbers were introduced and studies were carried out on these numbers.

Keywords: Fibonacci Numbers, Lucas Numbers, Hyper Fibonacci Numbers, Hyper Lucas Numbers, Gaussian Lucas Numbers,

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Variation Of Parameters And Lipschitz Stability Of Set Valued Differential Systems With Initial Time Difference

Coşkun YAKAR[1], Tuba SATILMIŞ[2]
[1,2]Department of Mathematics, Gebze Technical University,
cyakar@gtu.edu.tr
t.satilmis2022@gtu.edu.tr

Abstract

In this paper, we examine the connection between an unperturbed set valued differential system and a perturbed one, where the systems differ in their initial conditions and initial times. By applying variation of parameters techniques, we derive integral representations and establish Lipschitz stability criteria for nonlinear set-valued differential systems. Additionally, we utilize the variational system corresponding to the unperturbed system to support our analysis.

Keywords: Lipschitz stability criteria, variation of parameters, set valued differential equations, perturbed and unperturbed systems, initial time difference.

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Structurally identifiability analysis of a COVID-19 model

Tuğba Akman[1]
[1]Department of Computer Engineering, University of Turkish Aeronautical Association
06790 Etimesgut, Ankara, Türkiye
takman@thk.edu.tr

Abstract

The construction of a mathematical model consists of several steps. Model development is followed by structural identifiability analysis. Some mathematical models suffer from structural nonidentifiability, meaning that a unique parametrization of the model using the available observations cannot be achieved [1]. This can result in unrealistic model behavior. In this study, we develop a structurally identifiable mathematical model for the first wave of COVID-19 by splitting the total population of Türkiye at time t into nine mutually exclusive compartments of individuals for the period of March 11, 2020 - May 31, 2020. For parameter estimation, some parameters are fixed while the remaining parameters are estimated [2]. Our results align well with the observations. In addition, we investigate the variability of the parameters based on the profile likelihood method for parameter identifiability. However, we observe that some of the model parameters are not practically identifiable [3]. It means that we must be careful while planning interventions using this model.

Keywords: COVID-19, structural identifiability, parameter estimation, mathematical model.

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A Computational Approach for Projecting Spaces of a Projective Variety

Uğur Ustaoğlu[1], Erol Yılmaz[2]
[1,2]Department of Mathematics, Bolu Abant İzzet Baysal University,
ugur.ustaoglu@ibu.edu.tr
yilmaz_e2@ibu.edu.tr

Abstract

Let $W \subseteq P^n$ be a projective variety and $p \in P^n \backslash W$ be a point. The projection of W from the point p onto P^{n-1} is defined by the map $\pi_p: P^n \backslash \{p\} \to P^{n-1}$, where $\pi_p(q)$ is the point of intersection between the line $\underline{pq}$ and P^{n-1} for $q \neq p$. In this presentation, we compute a generating set for the ideal $I(\pi_p(W))$ when W is given as the variety of zeroes of certain homogeneous polynomials.

Keywords: Elimination theory, Gröbner bases, Projection, Projective space

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On the Suborbital Graphs and Fibonacci Polynomials

Ümmügülsün ÇAĞLAYAN[1]
[1]*Department of Mathematics, Karadeniz Technical University,*
ummugulsun.akbaba@gmail.com

Abstract

The relation between Fibonacci sequences and suborbital graphs is studied by many mathematicians. In this paper, the vertices on the minimal length path of the suborbital graph $F_{u,N}$ are given by a new polynomial representation of Fibonacci numbers.

Keywords: Suborbital Graphs, Fibonacci sequences, Polynomials.

References:

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COVID-19 Spread Prediction via an SCIRS Epidemic Model Containing Insurance Parameter

Vahid Roomi[1]
[1]*Department of Mathematics, Azarbaijan Shahid Madani University, Tabriz, Iran*
[2]*Insurance Research Center, Tehran, Iran*
roomi@azaruniv.ac.ir

Abstract

In this paper, an SCIRS epidemic model will be presented that takes into account immunity to the spread of COVID-19 and insurance parameter. We will investigate how the immune system affects the speed of disease spread by calculating the equilibrium points of the system and checking their local and global stability. Additionally, the occurrence of a Hopf bifurcation will be demonstrated. Also, the effect of insurance parameter on the incidence of the diseases will be considered. To predict the transmission of Covid-19, we will present a numerical simulation based on real data.

Keywords: Epidemiological modeling, COVID-19, Equilibrium point, Hopf bifurcation.

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Difference Cesaro Function Space on Rooted Tree

Vivek Kumar[1], *Sunil K Sharma*[2]
[1,2]*School of Mathematics, Shri Mata Vaishno Devi University, kakryal, Katra-182320, Jammu and Kashmir, India*
Vivakkumar072@gmail.com
sunilksharma42@gmail.com

Abstract

In this paper, we introduce difference Cesaro function spaces on rooted tree defined by Musielak-Orlicz function. This paper aims to investigate the algebraic and topological properties of a newly constructed function space on rooted tree.

Keywords: Cesaro function space, difference operator, Musielak-Orlicz function.

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The Modified Generalized K-Sylvester Polynomials

Yahya ÇİN[1], Nejla ÖZMEN[2]
[1,2]Department of Mathematics, Düzce University,
yahyacin2525@gmail.com
nejlaozmen06@gmail.com

Abstract

The present study deals with some now properties for the k-modified generalized k-Sylvester polynomials. The results obtained here include various families of multilinear and multilateral generating functions, miscellaneous properties and also some special cases for these polynomials. Finally, we get several interesting results of this theorem.

Keywords: Generalized k-Sylvester polynomials, Generating functions, Multilinear and multilateral generating functions

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Some Operations for the Almost-Riordan Arrays

Yasemin Alp[1]
[1]*Department of Education of Mathematics and Science, Selcuk University,*
yaseminalp66@gmail.com

Abstract

In this study, the derivative and flip operations of almost-Riordan arrays are investigated. The generating functions are obtained for the A, Z, and w- sequences of these operations. There are also some relationships among the generating functions of these sequences provided. Finally, relationships between the derivative operation and the flip operation are found.

Keywords: Almost-Riordan arrays, A-sequence, Z-sequence, w-sequence.

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Fuzzy Modeling of Musical Events Using Triangular Membership Functions for Pitch, Loudness, and Timing

Yusuf Yeşilyurt[1], *Serkan Onar*[2]
[1]*Department of Mathematics, Yildiz Technical University,*
[2]*Department of Mathematical Engineering, Yildiz Technical University,*
yusuf.yesilyurt@std.yildiz.edu.tr
serkan10ar@gmail.com

Abstract

This study presents a fuzzy logic-based model for analyzing and interpreting musical events using pitch, loudness, and timing as input variables. Each input is characterized by five linguistic terms defined using triangular membership functions to effectively capture the imprecision and expressive nature of musical perception. The output variable, musical event, reflects a synthesized evaluation of the input parameters and is similarly described using five linguistic categories. The model is developed and implemented using the MATLAB Fuzzy Logic Toolbox, allowing for intuitive rule definition, simulation, and visualization. By structuring the mapping from continuous audio features to qualitative musical interpretations, the system offers a computationally intelligent approach for music analysis, expression modeling, and potential applications in music education, composition, and interactive sound systems. The results demonstrate that fuzzy inference systems can effectively bridge numerical input data and human-level musical understanding.

Keywords: Fuzzy Logic, Musical Event Modeling, Triangular Membership Functions, Linguistic Variable Modeling.

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Optimizing Flat Minima via Sharpness-Aware Minimization: A Min–Max Transfer-Learning Framework for Breast Ultrasound Cancer Detection

Zaied Al-Haj[1,2]*, Mahmut Ozturk*[1]*, and Mohammed Alsharafi*[2]
[1]*Department of Biomedical Engineering, Istanbul University- Cerrahpasa, Turkey,*
[2]*Department of Biomedical Engineering, University of Science and Technology, Yemen,*
Zalhaj@ogr.iuc.edu.tr
mahmutoz@iuc.edu.tr
alsharafi205010@gmail.com

Abstract

Convolutional neural network transfer learning to breast cancer classification using ultrasound is likely to suffer from overfitting and domain shift when there is limited and noisy data. Sharpness-Aware Minimization (SAM) is a novel optimization method that is designed to seek parameter settings residing on wide, flat local optima of the loss surface, and thereby improve the robustness and generalization of the models. In this paper, we apply SAM to fine-tune ImageNet-pretrained backbones on a gathered breast ultrasound dataset. SAM fine-tuning of ResNet-50 and EfficientNet-B0 backbones results in a best 4% increase in accuracy and a 0.05 area under the ROC curve improvement compared to Adam and SGD optimizers with their default configurations. SAM also results in lower variability in performance over cross-validation folds than default optimizers. We further examine an adaptive SAM variant (ASAM) and a gradient-centralized extension (GCSAM) and demonstrate both maintain or exceed vanilla SAM benefits at the expense of various computational trade-offs. Qualitative inspection of feature activation maps is consistent with the observation that SAM-based models focus on lesion regions more consistently in the presence of ultrasound artifacts. These findings render SAM and its variants effective at enhancing the reliability of transfer learning for application in medical imaging tasks and provide actionable insights on optimizer choice in clinical-grade classification pipelines.

Keywords: Sharpness-Aware Minimization (SAM), Min–Max Optimization, Transfer Learning, Flat Minima, Breast Ultrasound, Cancer Detection.

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Identities in Generalized derivations Related to Quotient Rings

Zakia Al-Amery[1]
[1]*Department of Mathematics, Aden University, Aden, Yemen*
alameryzakia@gmail.com

Abstract

The primary aim of the current paper is to explore the behavior of the quotient ring R/P when the ring R is equipped with generalized derivations F and G associated with derivations d and g, respectively. These generalized derivations, denoted as (F, d) and (G, g), satisfy certain identities connecting a non-zero ideal to prime ideal P such that $P \subsetneq I$. Furthermore, the paper delves into several important consequences related to algebraic identities. Finally, to clarify the relevance of the assumption that P is prime, several examples are provided.

Keywords: prime ideal; ideal; integral domain; derivation; generalized derivations and quotient ring.

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A Note on q-Vietoris' number Sequence

Serpil Halıcı[1], Zehra Betül Gür[2]
[1,2]Department of Mathematics, Pamukkale University,
shalici@pau.edu.tr
gurbetul35@gmail.com

Abstract

The aim of this study is to present the q-Vietoris' numbers as a generalization of Vietoris' sequence and investigate some properties of this new number sequence. For this purpose, we define the q-Vietoris' numbers, and we derive related recurrence-like identities by using some combinatorial operations. Furthermore, we give some finite summation formulas involving the q-harmonic numbers.

Keywords: Vietoris' numbers, central binomial coefficients, q-identities, harmonic numbers

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Mathematical Modeling and Analysis of Singularly Perturbed Problems

Zelal Temel[1]
[1,]*Department of Mathematics, Van Yuzuncu Yil*
drzelaltemel@hotmail.com.tr

Abstract

In the present work, we describe a numerical approach for solving the singularly perturbed problems with an efficient non-local boundary condition. This approach is demonstrated by combining exponential basis functions into integral identities and employing integral-type quadrature types through the weight and remainder terms. We then confirm that the numerical approximations are uniformly convergent in the discrete norm, independent of the perturbation value ε. The theoretical analysis is finally supported by numerical results, and examples are provided to demonstrate the effectiveness of the procedure.

Keywords: Singularly perturbed problem, non-local boundary condition, uniform mesh, uniform convergence.

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On Diamond Alpha Weighted Dynamic Inequalities Of Hilbert-Type

Zeynep Alpsoy[1], Lütfi Akın[2], Beyza Karagöz[3]
[1]The Institute for Graduate Educational Studies, Mardin Artuklu University, Mardin, Türkiye
[2]Department of Business Administration, Mardin Artuklu University, Türkiye
[3]The Institute for Graduate Educational Studies, Mardin Artuklu University, Mardin, Türkiye
alpsoy987@gmail.com
lutfiakin@artuklu.edu.tr
byzaakrgz137@gmail.com

Abstract

In this work, we establish weighted diamond alpha dynamic inequalities of Hilbert type by applying reversed Hölder's inequality, chain rule on time scales, and the mean inequality. As particular cases of our results (when $T = N$ and $T = R$), we get the reversed form of discrete and continuous inequalities.

Keywords: Hilbert-type inequalities, Diamond alpha calculus, Hölder's inequality

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A Study On Diamond$-\propto$ Inequalies Of Dynamic Type

Zeynep Bilge Alperen[1], Lütfi Akın[2], Zeynep Alpsoy[3]
[1]*The Institute for Graduate Educational Studies, Mardin Artuklu University, Mardin, Türkiye*
[2]*Department of Business Administration, Mardin Artuklu University, Türkiye*
[3]*The Institute for Graduate Educational Studies, Mardin Artuklu University, Mardin, Türkiye*
zeynepbilgealperen@gmail.com
lutfiakin@artuklu.edu.tr
alpsoy987@gmail.com

Abstract

In this work, we prove diamond$-\propto$ inequalities of dynamic type by applying reversed Hölder's inequality, chain rule with diamond$-\propto$ calculus on time scales. As particular cases of our results (when $T = N$ and $T = R$), we get the reversed form of discrete and continuous inequalities.

Keywords: Hilbert-type inequalities, Diamond alpha calculus, Hölder's inequality

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