9TH INTERNATIONAL CONFERENCE ON COMPUTATIONAL MATHEMATICS AND ENGINEERING SCIENCES

17 – 19 May 2025,
Diyarbakır – Türkiye

BOOK OF ABSTRACTS

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THE NINETH INTERNATIONAL CONFERENCE ON COMPUTATIONAL MATHEMATICS AND ENGINEERING SCIENCES (CMES-2025), DiYARBAKIR/TÜRKİYE, MAY 17-19, 2025

The **Nineth International Conference on Computational Mathematics and Engineering Sciences (CMES-2025)** will be held in Dicle University from **17- to 19 May 2025 in Dicle, Türkiye.** It provides an ideal academic platform for researchers and professionals to discuss recent developments in both theoretical, applied mathematics and engineering sciences. This event also aims to initiate interactions among researchers in the field of computational mathematics and their applications in science and engineering, to present recent developments in these areas, and to share the computational experiences of our invited speakers and participants.

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MESSAGE FROM THE GENERAL CHAIRS

Dear Conference Attendees,

We are honored to welcome you to the **Nineth International Conference on Computational Mathematics and Engineering Sciences (CMES-2025)** at Dicle University from 17 to 19 May 2025 in Diyarbakır City, Türkiye.

CMES, founded in 2016 at Faculty of Science and Techniques Errachidia Moulay Ismail University Morocco is an annual intarnational conference, which was very successful in the past years by providing opportunities to the participants in sharing their knowledge and informations and promoting excellent networking among different international universities. This year, the conference includes 200 extended abstracts, several submissions were received in response to the call for papers, selected by the Program Committee. The program features keynote talks by distinguished speakers such as:

Dumitru Baleanu from Lebanese American University, Beirut, Lebanon; **Baver Okutmustur** from Middle East Technical University, Türkiye; **Mehrdad Lakestani** from Tabriz University, Iran, **Ekrem Savas** from Usak University, Türkiye; **Ozlem Defterli** from Çankaya University, Türkiye; **Sedaghat Shahmorad** from Tabriz University, Iran. The conference also comprises contributed sessions, posters sessions and various research highlights.

We would like to thank the Program Committee members and external reviewers for volunteering their time to review and discuss submitted abstracts. We would like to extend special thanks to the Honorary, Scientific and Organizing Committees for their efforts in making CMES-2025 a successful event. We would like to thank all the authors for presenting their research studies during our conference. We are grateful to DUBAP(ZGEF.25.003) for research funds. We hope that you will find CMES-2025 interesting and intellectually stimulating, and that you will enjoy meeting and interacting with researchers around the world.

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Game Theory,
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Analysis and Its Applications,
Statistics and Its Applications,
Algebra and Its Applications,
Topology and Its Application,
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Cryptography and its Applications,
Fractional Calculus and Applications,
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PLENARY & INVITED TALKS

MODIFIED FRACTIONAL OPERATORS: THEORY AND APPLICATIONS

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Abstract

Fractional Calculus deals with the study of so-called fractional order integral and derivative operators over real or complex domains, and their applications. In this talk I will discuss the modified ABC operator and I will explain the related properties and its real world applications.

Keywords: Fractional calculus;General kernel; Modified ABC operator.

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A COMPARATIVE STUDY OF ADAPTIVE GRID METHODS FOR BURGERS MODELS

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Abstract

This work presents comparative numerical study of shock solutions in classical and relativistic a Burgers models using two finite volume-based adaptive mesh refinement (AMR) strategies: *h*-adaptivity (local grid refinement) and *r*-adaptivity (mesh redistribution). The *h*-method dynamically adjusts resolution by adding/removing cells in shock regions, while the *r*-method maintains a fixed cell count but optimally redistributes points to sharpen shock resolution. We compare both approaches in terms of accuracy and efficiency, demonstrating their effectiveness for handling shocks and nonlinear waves in both classical and relativistic cases. This work is based on the joint work [4].

Keywords: Adaptive grid; h-refinement; r-refinement; Monitor function; Finite volume method; Relativistic Burgers equation

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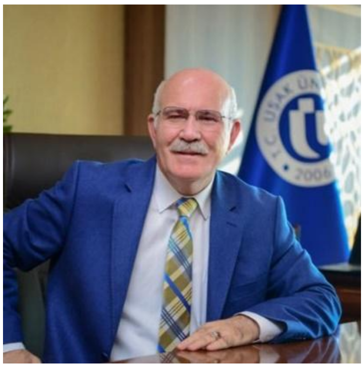

The development adventure of mathematics

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Abstract:

Mathematics has always existed since the first steps of culturel history of the living creatures called human beings. It has always been a part of culture with numbers, figures, characteristics and with their applications according to the technical levels of the day. In this study, a general knowledge will be given concerning how math began and what phases it went through up to now. In getting the data, books and articles dealing with the issue have been studied. The findings we have show that it is not possible to say exactly where and when mathematics began. However, we can say, on the basis of findings, that math began in Epypt and Mesopotamia between 3000-2000 B.C. and then spread to other countries.

ADVANCED MATHEMATICAL MODELLING AND INFERENCE OF GENE REGULATORY NETWORKS WITH REAL DATA

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Abstract

Systems biology addresses the challenge of understanding living systems in their entirety, as opposed to concentrating on individual biological elements.One approach to describing biological systems is through networks which are the graphical representations in which nodes denote entities of the system and edges signify the relationships between them.Given that the underlying structure of many networks remains partially or entirely unknown, a key objective of systems biology is to predict the complex and dynamic interactions among genes.This is called *network inference (NI) that* focuses on deducing network structures by leveraging high-throughput data in combination with reverse engineering methods. A fundamental challenge in network inference is the high dimensionality—often involving thousands of genes—contrasted with the relatively small number of available samples. Consequently, gene regulatory network (GRN) inference is inherently under-determined [1,2]. In this study, a time-series gene expression data-set derived from a micro-array chip experiment involving a model eukaryotic organism is used for illustrative purposes. The dataset's key characteristics are analyzed to gain insights into the structure and behavior of the underlying biological process. Subsequently, the temporal dynamics of the system are modeled in a discrete-time framework, employing advanced mathematical modeling techniques to capture the complexity and regulatory mechanisms of gene interactions [3,4].

Keywords: Network inference, Mathematical modelling, Data processing.

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SOME EFFECTIVE NUMERICAL METHODS FOR FRACTIONAL DIFFERENTIAL EQUATIONS

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Abstract

Some efficient numerical methods such as block-by-block, fuzzy transform and interpolation based methods are studied for solving linear and nonlinear single term and multi-term frac- tional differential equations (MFDEs). The approaches involve converting the given linear and nonlinear MFDEs with some initial conditions into equivalent Volterra integral equa- tions (VIE), and applying the mentioned numerical approaches to the obtained VIES. Error bounds and convergence theorems are discussed for each case, separately. Finally, illustra- tive and comparative examples are provided to demonstrate the applications of the proposed methods and verify the theoretical results.

Keywords: Multi-term fractional initial value problem, Block-by-block method, Fuzzy tarnsform, Nonlinear Volterra integral equation, weak singularity.

NUMERICAL SOLUTION OF SINGULARLY PERTURBED INITIAL VALUE PROBLEMS WITH DELAY USING B-SPLINE WAVELETS

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ABSTRACT

In this paper, we solve a singularly perturbed initial value problem with delay by using c B-Spline wavelets. The properties of these functions are provided, and by employing the operational matrix of differentiation, a numerical method is genereted over some subintervals that reformulates the problem into a system of algebraic equations. This system can be solved to find the approximate solution. Numerical results demonstrate the efficiency of the method.

Keywords: Singularly perturbed problem; B-Spline wavelets; Delay differential equation.

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Mathematical modeling and control analysis for the Whooping Cough using SVEITR compartmental Model

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Abstract

Whooping cough, or pertussis, is a highly contagious disease that poses serious health risks to people of all ages, particularly infants and young children worldwide [1,2]. Given its significant impact, there is a need for a mathematical model to predict the disease's future dynamics and provide strategies for the best controls and elimination [1,3]. In this study, we developed a new susceptible-vaccinated-exposed-infected-treatment-recovered (SVEITR) model for whooping cough to predict its spread and recommend effective strategies for disease control. We demonstrate that the model is well-posed, with positive and bounded solutions within a feasible region. Using the Next-Generation Matrix approach, we computed the basic reproduction number and analyzed the stability of equilibrium points.

Our research also aimed to evaluate the effectiveness of different pharmaceutical and non-pharmaceutical interventions for controlling disease. We expanded the standard SEIR model by incorporating vaccination and treatment compartments, allowing us to assess pharmaceutical (vaccination and treatment) and non-pharmaceutical (self-precaution and transmission reduction) measures. Numerical simulations revealed that all control strategies significantly influence the disease dynamics. Increasing the vaccination and treatment rates led to a reduction in exposed and infected individuals. Notably, combining pharmaceutical and non-pharmaceutical controls proved to be the most effective strategy for managing whooping cough. All the theoretical results and control analysis are validated through numerical simulations.

Keywords: Whooping cough; SVEITR model; Stability and sensitivity analysis;

Pharmaceutical and non-pharmaceutical; Control strategies.

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ON A HEAT EQUATION AND NEWTON- RAPHSON METHOD

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Abstract

In this paper, we study a heat conduction problem in a rod that a boundary condition, which involves a linear combination of dependent variable and its derivative, arises when heat is lost from the end of the rod due to radiation into the surrounding medium. When we apply the seperation of variables method to solve the problem, Newton- Raphson method is used to calculate the eigenvalues of the equations we encounter.

Keywords: Heat equation; Eigenvalue problem; Newton- Raphson method.

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EIGENVALUES OF COMPLEX SKEW-SYMMETRIC CIRCULANT MATRICES

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Abstract

Skew circulant matrix, which is a family of circulant matrices, has many applications such as in graph theory, mechanics, mathematical chemistry, signal processing, coding theory and image processing, etc. They arise in applications involving the discrete Fourier transform and the study of cyclic codes for error correction. They also play a crucial role for solving various differential equations. Numerical solutions of certain types of elliptic and parabolic partial differential equations with periodic boundary conditions often involve linear systems associated with circulant matrices

In this paper, we derive the eigenvalues of any complex skew-symmetric circulant matrix, depending on the Chebyshev polynomials of the first kind. Then, some illustrative examples are given by using maple software, one of computer algebra systems (CAS).

Keywords: Skew circulant matrix; Eigenvalues; Chebyshev polynomial.

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INVESTIGATION OF DYNAMICS OF MAGNETS THROUGH THE HEISENBERG FERROMAGNETIC SPIN CHAIN EQUATION

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Abstract

This paper is related with the Heisenberg ferromagnetic spin chain equation (HFSCE) that has a significant task in theory of magnets, spintronics, plasma physics, and condensed matter physics. The $(m + 1/G')$-expansion method has been successfully utilized to investigate novel wave structures of the aforementioned equation. This approach has provided a series of new exact wave solutions with diverse physical structures. Various wave patterns have been also observed through the 3D graphs and contour plots. This search into the wave propagation may encourage to examine the nonlinear properties of magnetic materials.

Keywords: $(m + 1/G')$-expansion method; Heisenberg ferromagnetic spin chain.

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Lower Bound Estimates for the Blow-up Time of the p-Laplacian Equation

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Abstract

In this presentation, we deal with the p-Laplacian wave equation with damping terms in a bounded domain**.** The study investigates the behavior of solutions and focuses on obtaining lower bounds for the blow-up time under suitable conditions. These conditions are derived based on the nonlinearity of the equation and the properties of the damping terms. Our result extends the recent results obtained by Baghaei (2017) and Zhou (2015), specifically for $p>2$, and provides new insights into the blow-up dynamics of the p-Laplacian wave equation with damping.

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

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Nonexistence of Global Solutions for the Hyperbolic Type Equation

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Abstract

In this presentation, we consider the Kirchhoff-type equation with a variable exponent, a significant equation in the context of evolution problems. The Kirchhoff-type equation belongs to the broader class of evolution equations, which are partial differential equations with time t as one of the independent variables. These types of equations are crucial in modeling various dynamic processes over time. The Kirchhoff equation, in particular, has found wide applications in many areas of applied science, such as the modeling of electrorheological fluid flows, thin liquid films, and other complex systems that exhibit time-dependent behavior. In this work, we focus on proving the upper bound for the blow-up time under suitable conditions, providing a deeper understanding of the time evolution of such systems. This result has important implications for the analysis of stability and the prevention of catastrophic blow-up phenomena in these models.

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

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INVESTIGATION of MIDDLE SCHOOL STUDENTS' REAL-LIFE PROBLEM POSING PROCESSES

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Abstract

This study aimed to examine the problem-posing processes of middle school students within real-life contexts. The research analyzes students' ability to relate problems to real-life situations and how they integrate real-life elements into their problem-posing processes (Chen & Cai, 2020; Palm, 2006). A teaching experiment was employed as a qualitative research method, and the study was conducted with four eighth-grade students (Cobb, 2000). During the data collection process, students posed a total of four problems-two during the problem-posing phase and two during the lesson extension phase of two problem-posing-based learning task. A two-stage analysis process was carried out. In the first stage, the problems were examined in terms of contextuality, solvability, data quantity, and grammar, to determine their status as valid problems (Kwek, 2015; Nedaei et al., 2022; Özgen et al., 2017; Silver & Cai, 1996; Ulusoy, 2023). In the second stage, the problems were analyzed based on components such as event, question, information/data, presentation, solution strategies, circumstances, solution requirements, and purpose (Palm, 2006). The findings revealed how students incorporate authenticity components into their problem-posing processes and highlight areas requiring further development. The evaluation of four tasks showed that three were classified as fully authentic, while one was classified as partially authentic. These results indicated that although students generally construct problems based on real-life contexts, certain deficiencies prevent them from achieving full authenticity. According to the study's results, students' problem-posing performance was at a satisfactory level. Consequently, their ability to connect real-life contexts with problem-posing was generally positive, except for a few components. Additionally, the analysis of the posed problems indicated that this process contributes positively to students' overall learning experiences. In this regard, it was recommended that problem-posing activities be integrated into the mathematics curriculum. Furthermore, students should be encouraged to connect mathematical concepts with real-life situations by drawing on their own experiences or real-world scenarios.

Keywords: Connection with real life, Problem posing, Problem posing tasks.

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NUMERICAL SOLUTIONS OF THE GENERALIZED REGULAR LONG WAVE (GRLW) EQUATION USING FOUR DIFFERENT OPERATOR SPLITTING ALGORITHMS COMBINED WITH THE FINITE ELEMENT METHOD

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Abstract

The one-dimensional nonlinear generalized regular wave (GRLW) equation with physical boundary conditions will be taken into consideration in this article. This study will employ operator splitting algorithms in conjunction with the finite element-based Galerkin method, which is a practical and highly adaptable method for the numerical solution of the equation. The study's goal is to generate more precise and appealing results. B-splines serve as the foundation for the application of Galerkin methods in this study. Four distinct numerical schemes—Lie-Trotter splitting techniques $L_{\Delta t} = A - B,\ L_{\Delta t} = B - A$ and Strang splitting techniques $S_{\Delta t} = A - B - A$, $S_{\Delta t} = B - A - B$ are utilized for the numerical results obtained throughout the article and it is be evaluated which of these methods yields more accurate results. The work take into consideration the algorithm's output that yields the best results. Using the suggested techniques, the study has been put into practice to solve the single solitary wave problem. Error norms have been calculated in this article, and the results have been compared with the solutions discovered by some researchers in the literature to show the precision and appeal of the numerical techniques employed. Furthermore, The current method is shown to be unconditionally stable through the use of the Von Neumann analysis. This study, which will be carried out after the literature review, will create a new and more effective solution method for the (GRLW) equation.

Keywords: Generalized regularized long wave; B-splines; Galerkin method; Operator splitting.

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THE NEWEST NUMERICAL INVESTIGATION OF THE EQUAL-WIDTH WAVE EQUATION WITH QUINTIC HERMITE B-SPLINE BASIS FUNCTIONS

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ABSTRACT

In this paper, a numerical investigation of the equal-width wave equation by collocation finite element method using Rubin-Graves type linearization based on quintic Hermite B-spline basis functions under homogeneous boundary conditions will be presented. In order to investigate the effectiveness and reliability of the scheme obtained by the present method, five test problems are selected and the results are presented and evaluated. Only one of the test problems has an analytical solution. In the simulation results of this test problem for which an analytical solution is available, the values of the error norms L_2 and L_∞ will be calculated at the same mesh points available in the literature. Since the other four test problems do not have analytical solutions, the results will be tabulated by giving the values of the conservation constants. Another observation in comparing the results is to examine the graphs of the simulation results at certain times. Graphs will be drawn at certain times and presented in the study. The obtained results show the efficiency and accuracy of the presented method and gives a sight for its further usage for other problems.

Keywords: Equal Width Wave Equation; Quintic Hermite B-spline; Finite Element Method.

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A Robust numerical investigation of the MEW equation with FEM based on Hermite B-spline basis functions

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ABSTRACT

The problem considered in the paper is the modified equal-width wave equation with Dirichlet-type boundary conditions. A numerical investigation of the considered problem will be presented by means of a powerful new numerical approach based on quintic Hermite B-spline basis functions and collocation finite element method. First, the solution domain will be divided into sub-regions of equal length. A typical element will be selected from these sub-regions and the element equation will be derived on this typical element. Then the scheme of the problem over the whole region will be found and a solvable system of algebraic equations will be obtained by applying the boundary conditions given together with the problem. The program code of the scheme will be written with the help of symbolic programming language MATLAB. In order to investigate the efficiency and reliability of the scheme obtained by applying the numerical method, four test problems will be examined. The results obtained as a result of simulations for various values of spatial and temporal sizes will be presented in the study with the help of tables and graphs. When the results are analyzed, one can clearly see that the method can be easily applied to other ordinary, partial and fractional differential equations.

Keywords: Finite Element Method; Modified Equal-Width Wave Equation; Linearization.

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This study is supported by Inonu University Scientific Research Project with project number FDK-2023-3402.

ON NEW PARANORMED SEQUENCE SPACES

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Abstract

In general, since paranormed spaces are a generalization of normed spaces, they offer the possibility of using classical functional analysis methods in a broader context. In the present study, it is aimed to introduce certain paranormed sequence spaces as the domain of a newly derived matrix in the Maddox spaces. Further, α, β, γ-duals of the resulting spaces are computed and the characterization of some matrix classes are given.

Keywords: Paranormed sequence space; Matrix domain; Dual spaces.

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WAVE DYNAMICS IN THE LONNGREN EQUATION: EXACT SOLUTIONS AND ANALYSIS

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Abstract

In this study, we investigate the Lonngren wave equation using the generalized $(m + 1/G')$-expansion method to obtain exact travelling wave solutions under different parameter conditions. The method is applied to derive new exact solutions, providing insights into the dynamic behavior of the equation. The obtained solutions are verified by direct substitution into the original equation. Additionally, graphical representations, including three-dimensional and contour, plots, illustrate the physical properties of the derived waveforms. The results demonstrate the effectiveness of the generalized expansion method in solving nonlinear partial differential equations and contribute to the theoretical understanding of wave propagation in applied fields.

Keywords: Lonngren wave equation; generalized expansion method; travelling wave solution.

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EXPLORING NONLINEAR WAVE BEHAVIOR IN THE STRAIN EQUATION

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Abstract

In this study, we analyze the Strain equation and obtain its travelling wave solutions under various parameter conditions using a generalized analytical approach. Exact solutions are derived in different functional forms, including hyperbolic, trigonometric, and rational expressions, providing deeper insights into the nonlinear wave dynamics of the system. To visualize the wave behavior, three-dimensional surface plots and contour diagrams are generated. The results confirm the effectiveness of the proposed method in solving nonlinear partial differential equations and contribute to the understanding of wave propagation phenomena in applied mathematical models.

Keywords: train equation; travelling wave solutions; nonlinear partial differential equations; wave propagation; exact solutions; graphical analysis.

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INTUITIONISTIC FUZZY BE-ALGEBRAS w.r.t. (T, S_T)-NORM

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Abstract

In this study introduces the concept of intuitionistic fuzzy BE-algebra as a generalization of BCK-algebra, with respect to t-norms and t-conorms. It thoroughly investigates the algebraic properties of triangular norm-based intuitionistic fuzzy BE-algebras and explores the characteristics of norm-based α-cuts. The paper also defines and analyzes the notion of intuitionistic fuzzy filters in the context of triangular BE-algebras. A novel concept of t-norm-based intuitionistic fuzzy BE-algebra is introduced and provides a distinct example to illustrate the structure. It examines the algebraic properties of this new framework and analyzes the role of triangular norms in shaping its behavior. Additionally, the concept of a t-norm-based intuitionistic fuzzy filter is formally defined and explored, with theoretical results supported by concrete examples, highlighting the key characteristics of the proposed algebraic structure.

Keywords: Intuitionistic fuzzy sets, intuitionistic fuzzy BE-algebra, t-norms, intuitionistic fuzzy filter.

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Migrating Birds Optimization-Based Radial Basis Function Method To Find the Optimal Surface from a Given Data Set

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Abstract

In this study, we propose a method to determine the optimal surface from a given set of data points using the Radial Basis Function (RBF) method. The accuracy of the RBF interpolating surface largely depends on the choice of its shape parameter, which controls the smoothness and generalization of the surface. To efficiently determine the optimal shape parameter, we apply the Migrating Birds Optimization (MBO) algorithm, a metaheuristic inspired by the V-shaped flight formations of migratory birds. By utilizing MBO, we minimize the error between the original data and the interpolated surface. Our experiments demonstrate that MBO achieves superior performance in determining the optimal parameters when compared to traditional methods.

Keywords: Radial Basis Function; Migrating Birds Optimization; Surface Fitting

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M−TRUNCATED DERIVATIVE APPLIED TO THE NONLINEAR MODEL WITH (n+1)−DIMENSION

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Abstract

In this paper, the optical solitons with M-truncated derivative and other solutions to the $(n+1)-$dimensional nonlinear Schrodinger equation (NLSE) with Kerr and power laws nonlinearities are obtained. We apply the undetermined coefficient method to achieve such novel solutions. Study on the new soliton control structure has been found to explain specific physical problems. These findings have been usefully extended to transmitting long-wave and high-power telecommunication systems. The necessary conditions for the existence of these solutions are presented.

Keywords: $(n+1)$-dimensional nonlinear Schrodinger equation; Optical solitons; Undetermined coefficient; Kerr law; Power law; M-truncated derivative.

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Chaotic Dynamics of the Fractional Improved mKdV Equation via Atangana Conformable Derivative

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Abstract

This study examines the chaotic dynamics and bifurcation structures of the fractional improved modified Korteweg–de Vries equation, which includes a space-time dispersion term and a conformable fractional derivative of the Atangana type in time. The dynamics of the system are analyzed using phase portraits, bifurcation diagrams, and Lyapunov exponents. The investigation reveals that changes in key parameters can shift the system from periodic regimes to chaotic behavior. This highlights the nonlinear characteristics and memory effects introduced by the fractional derivative operator. The results show that the system displays complex and sensitive behaviors, such as period-doubling cascades and chaotic attractors, which are typical of nonlinear systems of fractional order. These findings enhance our understanding of complex dynamical processes in dispersive media governed by time-fractional models.

Keywords: Bifurcation analysis; Chaos; Lyapunov exponents; Fractional derivative.

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NOVEL TEMPERED FRACTIONAL INTEGRAL INEQUALITIES OF HERMITE-HADAMARD-MERCER TYPE IN THE FRAME OF MULTIPLICATIVE CALCULUS

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Abstract

In this paper, authors generalize Hermite-Hadamard-Mercer type inequalities using tempered fractional integrals within the framework of multiplicative calculus. Some new multiplicative tempered fractional integral inequalities are established via Jensen-Mercer inequality and several special cases are obtained. Moreover, for suitable choices of parameters some known results are recaptured.

Keywords: Hermite-Hadamard inequality; Hermite-Hadamard-Mercer inequality; Jensen-Mercer inequality; Tempered fractional integral operators; Multiplicatively convex function.

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NUMERICAL SOLUTION OF SINGULARLY PERTURBED INITIAL VALUE PROBLEMS WITH DELAY USING B-SPLINE WAVELETS

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Abstract

In this paper, we solve a singularly perturbed initial value problem with delay by using c B-Spline wavelets. The properties of these functions are provided, and by employing the operational matrix of differentiation, a numerical method is genereted over some subintervals that reformulates the problem into a system of algebraic equations. This system can be solved to find the approximate solution. Numerical results demonstrate the efficiency of the method.

Keywords: Singularly perturbed problem; B-Spline wavelets; Delay differential equation.

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WELL-POSEDNESS AND DECAY OF SOLUTIONS FOR THE POROUS SYSTEM WITH TIME DELAY

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Abstract

In this paper, we study the Porous system with time delay. First, we prove the well-posedness results. Then, 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: Well-posedness, Decay, Porous system, Time delay.

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BLOW UP OF SOLUTIONS FOR THE DELAYED BEAM EQUATION

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Abstract

Time delay effects arise in many applications and practical problems such as physical, chemical, biological, thermal and economic phenomena. 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. In this paper, we study the beam equation with time delay. Under suitable conditions, we prove the blow up results for the beam equation.

Keywords: Blow up, Beam equation, Delay.

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MACHINE LEARNING AND CLASSICAL ESTIMATION METHODS FOR EXTREME-VALUE GENERATED LOG-LOGISTIC DISTRIBUTIONS: PROPERTIES AND PERFORMANCE ANALYSIS

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Abstract

The development of new probability distribution models is essential for statistical modeling, as it enhances the accuracy of reproducing real-world data patterns. In this study, the Extreme Value Generated (EVG) familyderived from the cumulative distribution function (CDF) of the Extreme Value distributionis introduced. This family includes a key distribution referred to as EVGLLog, characterized by four distribution parameters. A comprehensive statistical evaluation of the EVGLLog distribution is conducted, including derivations of its survival functions and moments, as well as methods for generating random samples.This paper investigates two approaches for parameter estimation of the EVGLLog model: Maximum Likelihood Estimation (MLE) and Long Short-Term Memory (LSTM), a machine learning technique, to determine the most effective and stable estimation method. The proposed EVGLLog model is applied to real-world datasets, including: (1) queue times observed in a banking system, and (2) failure data from accelerated life tests on 59 conductors assessed for electromigration failure.The goodness-of-fit of the EVGLLog distribution is evaluated using several statistical metrics, including chi-square test statistics, negative log-likelihood, Akaike Information Criterion (AIC), and Bayesian Information Criterion (BIC). Results show that the EVGLLog distribution provides a superior fit compared to traditional probability distribution models when analyzing real-world data.

Keywords: Reliability function; Extreme value, waiting time; Long Short-Term Memory; Simulation; Maximum Likelihood Estimations.

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THE NOVEL NUMERICAL SOLUTIONS FOR TIME-FRACTIONAL FISHERS EQUATION

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Abstract

A new method for solving time-fractional partial differential equations (TFPDEs) is proposed in the paper. It is known as the fractional Kamal transform decomposition method. Time-fractional PDEs are approximated using the fractional Kamal transform decomposition method. The Caputo sense is used to define fractional derivatives. Also, MAPLE software displays the 2D and 3D graphs of the solutions to a few nonlinear TFPDEs. FKTDM is a highly effective method, as evidenced by the numerous applications.

Keywords: Fishers Equation, Fractional Kamal Transform, Adomian Polynomial.

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A NEW TOPOLOGICAL INDEX FOR SUPPLIER SELECTION IN PROCUREMENT PLANS

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Abstract

Supplier selection is one of the challenging operations for the procurement plans when there exist several alternative markets to be selected. Moreover, planning the order of the markets to be visited makes the planning decisions more complex when the transportation cost is additionally considerable for the decision-maker. In this context, the traveling purchaser problem (TPP) as one of the well-known routing problems that fits with the supplier selection problem and routing decision. The TPP involves satisfying a set of product demands from a set of markets. In TPP, the purchaser selects a number of markets from a set of available markets to buy a number of products. In addition to the procurement plan, the purchaser has to decide on the route to visit selected markets. The aim of the problem is to minimize the total procurement and transportation cost of the purchaser. Since TPP has been shown as an NP-Hard problem, several heuristic and exact methods have been introduced in the literature. To solve the problem, one of the critical issues is the selection of the markets to be visited. When the markets to be visited are known, the procurement plan and route plan can be efficiently obtained by either an exact or heuristic approach. Based on the aforementioned motivation, this study introduces a new topological index that presents the affordability of each market regarding the available products at the market and their prices. After the affordability index of each market is determined, the markets with high index value are selected one by one until all demands are satisfied. The performance of the proposed topological index is tested on a well-known TPP problem set by comparing the selection made by the affordability index and the optimum solution of the problem. The results show that the introduced topological index has the potential to make supplier selection near to optimal solution.

Keywords: Graph theory; Topological indices; Traveling purchaser problem.

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AN OPTIMAL COEFFICIENT CONTROL PROBLEM FOR A LINEAR ORDINARY DIFFERANTIAL EQUATION

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Abstract

Optimal control theory plays a crucial role in various fields of science and technology. Inverse problems and control problems related to ordinary differential equations have been extensively studied due to their wide range of applications [1–4]. In this paper, we address an optimal control problem for the Euler-Bernoulli beam equation. Our main objective is to establish the optimal controllability of a coefficient in the equation using a given boundary data. We provide a theoretical framework and establish the conditions under which optimal controllability can be achieved. The results contribute to the broader understanding of structural control and inverse problems in beam dynamics.

Keywords: Differential equations; Optimal control; Euler-Bernoulli beam.

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ANALYSIS OF WIN-PROBABILITES IN TURKISH-STYLE RUMMIKUB TILE GAME FROM A STATISTICAL PERSPECTIVE

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Abstract

In this paper, the Turkish version of the tile game Rummikub is investigated from a probabilistic approach using simulations of the game in MATLAB. Several scenarios for winning the game, such as winning through doubles only or normal wins with sets of tiles, are simulated using an original algorithm and the outcomes are further studied with different ability levels for the program. The results of the simulations are analyzed statistically in terms of the goodness of fit and comparison of win probabilities for different players in each scenario. Chi-squared and Kolmogrov-Smirnov tests, Monte-Carlo simulations and probabilistic analysis of game scenarios are used to perform an in-depth investigation of the simulation results.

Keywords: Goodness of fit; Simulation; Tile game; Estimation; Win ratio; Chi-Squared Test.

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Numerical Solution of the Buckley-Leverett Equation with β −Conformable Fractional Derivative Using Artificial Neural Networks

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Abstract

In this paper, the classical Buckley-Leverett equation, widely used for modeling two-phase flow in porous media, is reformulated using the β-conformable fractional derivative. Replacing the traditional time derivative with a β-conformable derivative introduces a more flexible and generalized modeling framework. The resulting fractional model is approximately solved using a Physics-Informed Neural Network (PINN) approach, which does not require observational data but instead learns the solution based on the underlying physical law. Implemented in PyTorch, the model is trained over randomly sampled collocation points, and the saturation distribution at $t = 0.5$ is successfully visualized. The proposed method offers an effective and extendable alternative for solving a broader class of physical problems involving fractional-order dynamics.

Keywords: Buckley-Leverett equation, β −conformable derivative, fractional calculus, artificial neural network, physics-informed neural network (PINN)

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ON THE STRUCTURES OF SOFT IDEALS OVER DIRINGS

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Abstract

Molodtsov introduced the theory of soft sets, which serves as a powerful mathematical tool for addressing uncertainties, as it avoids many of the challenges associated with traditional theoretical methods. In this study, we apply the de notion of ideals over dirings to the concept of soft sets, and introduce the concept of soft ideals over dirings. Also, we explore the properties of soft ideals and demonstrate that the structure is preserved under diring epimorphisms. The main objective of this study is to further the theoretical study of soft ideals over dirings.

Keywords: Soft set; Diring; Ideal; Soft Ideal.

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COEFFICIENT INEQUALITIES FOR A NEW SUBCLASS OF BI-UNIVALENT FUNCTIONS DEFINED BY GEGENBAUER POLYNOMIALS

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Abstract

The study of bi-univalent functions has recently attracted considerable attention due to their rich geometric structure and applications in complex analysis. In this paper, we introduce and investigate a novel subclass of bi-univalent functions that are defined via Gegenbauer polynomials in the open unit disk U. The primary objective of this study is to obtain estimates for the initial coefficients a_2 and a_3 in the Taylor-Maclaurin expansion of functions belonging to this new subclass. In addition to the coefficient bounds, we also examine the Fekete-Szegö problem concerning this subclass.

Keywords: Analytic functions; Bi-univalent functions; Coefficient estimates; Gegenbauer polynomials; Fekete-Szegö problem.

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AN INTRODUCTION TO SOFT EPIGROUPS

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Abstract

This study investigates the intersection of soft set theory and epigroups, proposing the concept of soft epigroups and examining its foundational properties. Additionally, it obtains characterisations related to the family of soft epigroups and establishes the category of soft epigroups. Finally, it describes the concept of soft subepigroups and studies several structural features.

Keywords: Soft set; Epigroup; Subepigroup; Soft Epigroup; Soft Subepigroup.

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PROPORTIONAL TUMOR GROWTH MODEL ON TIME SCALES

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Abstract

In this study, tumor growth model is constructed on some common time scales. Tumor growth model is a mathematical framework used to describe and predict the growth behavior of tumors over time. These models help researchers and medical professionals understand how tumors develop, spread, and respond to treatments. Because of this importance, the tumor growth model was solved on a time scale by including proportional derivatives and some numerical examples were concretized and comparisons were made.

Keywords: Time scales; Proportional derivative; Tumor growth model.

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Exact solutions and modulation instability analysis of the (3+1)-dimensional Gross-Pitaevskii equation with periodic potential

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Abstract

In this paper we examine the 3D-Gross-Pitaevskii equation, which describes phenomena such as wave propagation. The solitonic wave solutions of the underlying problem are examined using two efficient techniques: the modified auxiliary equation approach and the $exp(w(\xi))-$ method. This approach yields solutions that are stated as exponential, rational, trigonometric, and hyperbolic functions. To have a better understanding of their dynamic behavior, several of the distinct types of solitons, including dark waves, have also been shown using 3D visuals for varying parameter values. The stability of the obtained results is confirmed by investigating the modulation instability for the governing model.

Keywords: Exponential method; Modified auxiliary equation method; Gross-Pitaevskii equation.

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THE NEW MODIFIED SABAN FRAME AND THE EVOLUTION OF CURVES BASED ON MODIFIED SABAN FRAME ON S_1^2 AND H_0^2

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Abstract

In this paper, we define a new modified orthogonal Saban frame for timelike and spacelike curves with geodesic curvature on S_1^2 and the Saban frame for hyperbolic curves with geodesic curvature on H_0^2. We study the evolution of curves depending on the modified orthogonal Sabban frame and we obtain the necessary conditions for the inextensible flow of curves on modified orthogonal Saban frame. Thus this study presents theoretical examples using a modified orthogonal Saban frame based on the intrinsic property of time.

Keywords: Evolution of curve; Inextensible flow; Modified Saban Frame.

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SOME PROBLEMS FOR THE EIGENVALUES OF THE ELLIPTIC OPERATORS

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Abstract

We consider some minimization problems for the eigenvalues of the elliptic operators relatively domains. Finding the optimal domain for the considered functionals is reduced to the solution of the variational problem. The equivalency classes of these problems are defined. Consider the following eigenvalue problem

$$-Au = \lambda u, \quad x \in D, \tag{1}$$

$$u(x) = 0, \quad x \in S_D, \tag{2}$$

where A is some elliptic operator, $D \subset R^n$ is a convex bounded domain with smooth boundary S_D

Keywords: Eigenvalue Problem; Elliptic operator; variational problem.

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Some new numerical methods for solving fracrtional stochastic differential equations

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Abstract

In this presentation, we introduce some new numerical works to solve fractional stochastic differential equations(FSDE). Most of these methods are based on the construction of operetional stochastic, fractional matrices which the FSDEs convert to the salgebaic systems that can be solved easily. Additionally, the approach employs thresholding to significantly reduce the computational workload in linear problems. Thresholding involves setting a threshold value to differentiate between relevant and irrelevant data. Then, the method can avoid unnecessary calculations and focus only on the relevant data. Thresholding can help filter out noise or unwanted elements in a matrices, improving the quality of the data. This results in significantly faster and highly efficient problem-solving. The recently developed approaches have revealed remarkable results in terms of both accuracy and efficiency, following a rigorous assessment of its error bounds and convergence analyses. A thorough analyses show that the schemes perform well demonstrates significant potential as a reliable and efficient methods. The findings indicate that the produced methods provide exceptional precision and operates with remarkable efficiency. These results are promising and suggest that these are an effective solutions.

Keywords: B-spline wavelets, flatlet oblique multiwavelets; fractional differential equation.

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GENERALIZED λ-STATISTICAL CONVERGENCE OF ORDER α

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Abstract

In this study, using the generalized difference operator Δ^m, we generalize the concepts of λ-statistical convergence of order α and p-Cesàro summability of order α by a non-decreasing sequence (λ_n) tending to infinity and give some properties of λ-statistical convergence of order α.

Keywords: Statistical convergence; Difference sequence; Cesaro summability.

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SOME PROPERTIES OF THE SEQUENCE CLASS $S_\theta^f(\Delta_F, b)$

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Abstract

Lacunary statistical boundedness, which is mostly used to study the general behavior of sequences and operators, is a subject with wide applications in fields such as statistical analysis, functional analysis and summability theory. In the present paper, we generalize the concept of lacunary statistical boundedness of order β using a difference operator Δ for sequences of fuzzy numbers and give some inclusion relations with the help of many examples and figures. Furthermore, we study some properties like solidity, symmetricity, etc.

Keywords: Fuzzy sequence; Statistical boundedness; Lacunary sequence.

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Numerical Comparisons for solving systems of equation of Emden–Fowler type

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Abstract

In this paper, we obtain some new numerical solutions to the linear and nonlinear systems of equation of Emden–Fowler type which seems in the fluid mechanics, relativistic mechanics and in the study of chemically reacting systems by using variational iteration method and Padé approximation.

Keywords: systems of equations; Emden–Fowler equation; variational iteration method, Padé approximation.

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Numerical Solution of One-Dimensional Wave Equation Using Artificial Neural Networks

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Abstract

In this study, the authors developed an efficient solution to find the numerical solution of the 1D wave equation with the help of Artificial Neural Networks (ANN). Numerical solution of the wave equation by this method is a complex and computationally intensive process. The ANN method separates from all these processes and provides a faster numerical solution with very little error. In addition, the ANN method visualizes the solution. In ANN method, activation functions are used to increase the capabilities of the model and systematize the learning processes. Fibonacci polynomials are used as activation functions in the learning process of the network since they have a continuous and complex structure in themselves. Thus, the numerical solution of the one-dimensional wave equation with certain initial and boundary values is obtained by ANN method.

Keywords: Wave Equation; Fibonacci Polynomial; Artificial Neural Networks.

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Parametric Extension of New Generalization of Szász-Mirakjan Operators

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Abstract

In this paper, we introduce a new extension of the generalized Kantorovich Type of Szász-Mirakjan operators based on a new parameter $\alpha > 0$ and $\eta \in \mathbb{R}^{+}$, as follows:

$$K_{m,\eta}^{\alpha}\left(h;y\right)=\sum_{J=0}^{\infty}S_{m,j}\left(y\right)\int_{0}^{1}h\left(\frac{j+s^{\eta}}{m+\alpha}\right)ds \tag{1.1}$$

$$S_{m,j}\left(y\right)=e^{-ny}\frac{\left(ny\right)^{k}}{k!}, \tag{1.2}$$

and new operators are positive for arbitrary functions defined on the interval $[0,1]$.

We obtain an essential auxiliary result for these new operators. Our subsequent study focuses on their qualitative aspects, including uniform convergence and asymptotic behavior. For $m \in \mathbb{N}$, $\alpha > 0$ and $\eta \in \mathbb{R}^{+}$, we have the following

$$\left(K_{m,\eta}^{\alpha}\left(t-y,y\right)\right)^{2}\leq\frac{2}{\left(m+\alpha\right)^{2}}\gamma_{\eta,\alpha}^{1}\left(1+y^{2}\right),\quad \gamma_{\eta,\alpha}^{1}>0 \text{ for } y\in[0,\infty) \tag{1.3}$$

$$K_{m,\eta}^{\alpha}\left(\left(t-y\right)^{2},y\right)\leq\gamma_{\alpha,\eta}^{2}\left(m\right)\left(1+y\right)^{2},\quad \gamma_{\alpha,\eta}^{2}\left(m\right)>0 \text{ for } y\in[0,\infty) \tag{1.4}$$

$$K_{m,\eta}^{\alpha}\left(\left(t-y\right)^{4},y\right)\leq\varphi^{*}\left(\eta\right)\frac{A}{\left(m+\alpha\right)^{2}},\quad \varphi^{*}\left(\eta\right)>0, \text{ for } y\in[0,A]. \tag{1.5}$$

Keywords: Szász-Mirakjan operators; Linear positive operators; modulus of continuity.

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Numerical Solution of Time-Space Fractional-Order Elliptic Partial Differential Equations Using Artificial Neural Network

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Abstract

Classical numerical methods have been widely used for solving the heat equation. However, in order to obtain more accurate representations of complex physical phenomena, fractional order differential equations have received increasing attention in recent years. In this study, the solution of fractional heat equation is addressed through the application of artificial neural networks (ANN). A feed-forward neural network architecture is used, where the training process is driven by a composite loss function that imposes both the governing differential equation and associated initial and boundary conditions. The accuracy and efficiency of the proposed method are evaluated through comparisons with analytical and traditional numerical solutions.

Keywords: Fractional-Order Elliptic Partial Differential Equations; Heat equation; Artificial neural networks (ANNs); Numerical methods

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DEGREE OF APPROXIMATION BY MATRIX MEANS OF HEXAGONAL FOURIER SERIES

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Abstract

The degree of approximation of the function *f*, which is periodic with respect to the hexagon lattice is estimated by matrix means $T_n^{(A)}(f)$ of its hexagonal Fourier series in the generalized Hölder metric where **A** is a lower triangular infinite matrix of nonnegative real numbers with nonincreasing row in this paper.

Keywords: Hexagonal domain, hexagonal Fourier series, generalized Hölder class, matrix mean

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Fractional Model of Human Metapneumovirus (HMPV)

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Abstract

Human Metapneumovirus (HMPV) is a major cause of acute respiratory infections, particularly affecting infants and young children, and often resulting in hospitalization. It also poses a considerable risk to elderly individuals and those with weakened immune systems. Gaining a deeper understanding of how this virus spreads is essential, and mathematical modeling proves to be an effective approach for this purpose. In this study, we introduce a novel model that uses fractional differential equations to examine the dynamics of HMPV transmission. These equations allow us to incorporate memory and non-local effects into the framework, offering a more realistic representation of disease progression. The model also reflects the delayed immune response and intricate interactions between the virus and the host. We conduct a thorough stability analysis and perform numerical simulations to explore how different parameters impact the spread of the infection. The findings offer valuable insights for refining public health strategies, including vaccination plans and antiviral treatment schedules, to better manage and contain HMPV outbreaks.

Keywords: Fractional calculus; Human Metapneumovirus (HMPV); Fractional differential equations; Disease modeling; Non-local effects; Epidemiology; Numerical simulations.

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STABILITY ANALYSIS OF A THREE-DIMENSIONAL SYSTEM OF DIFFERENCE EQUATIONS WITH QUADRATIC TERMS

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Abstract

In this study, we analyze the dynamics of a nonlinear three-dimensional system of second-order difference equations involving quadratic terms. We establish the existence of fixed points and explore the properties of positive solutions such as boundedness, persistence, and invariance. We also investigate the local and global asymptotic stability of the equilibrium point and provide the rate of convergence of the solutions. Finally, numerical simulations are given to support and illustrate the theoretical findings.

Keywords: Difference equations; Asymptotic stability; Boundedness; Rate of convergence.

SUPPLY AND DEMAND MODEL WITH PROPORTIONAL DERIVATIVES ON TIME SCALES

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Abstract

In this study, supply and demand model, which explains how markets in the economy seek balance with their own internal dynamics and how the price mechanism directs resource allocation, will be defined and solved using proportional derivatives on time scales. Some comparisons will also be made with numerical examples.

Keywords: Time Scales, Supply and Demand Model, Proportional Derivative.

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ON THE SPECIAL SURFACES IN SEMI-EUCLIDEAN 4-SPACE

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Abstract

In this work, the special surfaces, in which the surfaces that can be chosen to be tubular surface generated by normal curve in semi-Euclidean 4-space, are examined. Moreover, by using the Gaussian curvatures and mean curvatures of tube surfaces with normal curves generated by Frenet frame in semi-Euclidean 4-space, the conditions being Weingarten surface and HK-quadric surface, minimal surface, at, ... etc are examined in detail.

Keywords: Tubular surfaces, HK-quadric surface, weingarten surfaces, normal curves.

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GROWTH OF SOLUTIONS FOR THE KIRCHHOFF TYPE EQUATION

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Abstract

In this presentation, we consider the Kirchhoff type equation with initial and boundary conditions. We prove the growth of solutions under suitable conditions.

Keywords: Growth, Kirchhoff type equation, Parabolic type equation.

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EXISTENCE OF SOLUTIONS FOR THE HYPERBOLIC TYPE EQUATION

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Abstract

In this presentation, we consider the hyperbolic type equation with initial and boundary conditions. We prove the existence of solutions under suitable conditions by using the potential well method.

Keywords: Existence, Hyperbolic type equation, Potential well metdod.

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LOCAL EXISTENCE OF SOLUTIONS FOR A DELAYED LOGARITHMIC WAVE EQUATION

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Abstract

In this work, we study a logarithmic viscoelastic wave equation with a time-dependent delay term in a bounded domain. We establish the local existence of solutions using the Faedo-Galerkin method.

Keywords: Existence, Delay, Faedo-Galerkin.

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NONEXISTENCE OF GLOBAL SOLUTIONS FOR THE LOGARITHMIC KIRCHHOFF-TYPE HYPERBOLIC EQUATION WITH VARIABLE EXPONENT

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Abstract

In this work, we investigate the nonexistence of global solutions to a logarithmic Kirchhoff-type hyperbolic equation with variable exponents. We prove that, under appropriate conditions on the initial data, there is nonexistence of global solution.

Keywords: Hyperbolic type equation, Nonexistence, Variable exponent.

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Error and Erasure Correction Using Parikh Matrices of Uniformly Parikh-Friendly Words

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Abstract

The Parikh matrix mapping, a generalization of the Parikh mapping, was introduced by Mateescu et al. [2]. A word's Parikh matrix is an upper triangular matrix that represents the number of occurrences of specific subwords within that word. It's important to note that the Parikh matrix of a word doesn't usually identify that word uniquely. Words that share a common Parikh matrix M are classified as M-equivalent. In [3], the concept of uniformly Parikh-friendly words was introduced. Atanasiu et al. [1] suggested the use of M-equivalent words as codewords. Their results indicated that the associated Parikh matrix allows for the correction of received words containing up to a certain level of erasures and errors.

In this talk, we will consider the uniformly Parikh-friendly words as codewords. We will examine the erasure and error correction capabilities of the relevant Parikh matrix.

Keywords: M-equivalent word; Parikh matrix; uniformly Parikh-friendly word.

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A NEW APPROACH TO THE l_p $(0 < p \leq 1)$ MINIMIZATION PROBLEM WITH TIGHT FRAME AND IT IS IMAGE PROCESSING APPLICATION

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Amidst advancements in signal and image processing, achieving high-quality restorations from limited measurement data has become a significant research topic. Particularly, the need for irregular and non-convex optimization techniques is increasing, highlighting the demand for new and effective algorithms. In this context, studies focusing on sparsification and advanced enhancement methods contribute substantially to the development of signal processing technologies.In this study, the goal is to sparsify a given signal using the concepts of Tight Frame (TF) and Discrete Fourier Transform (DFT), and subsequently restore it through a novel approach developed for the $l_p(0 < p \leq 1)$ norm minimization problem. The work specifically addresses the restoration of sparsified black-and-white images. In image restoration, irregular and non-convex regularization techniques offer significant advantages, often transforming restoration problems into large-scale, irregular, and non-convex optimization problems. However, existing minimization approaches have been observed to be ineffective in handling such challenges.To overcome this issue, a Smoothing Conjugate Gradient Method (SCGM) is proposed, combining the classical nonlinear conjugate gradient method with two new-generation smoothing techniques. The proposed method has been formulated as a numerical algorithm and applied to test images with different types of noise. Experimental results demonstrate that the proposed SCGM algorithm outperforms existing methods in terms of restoration performance.

Keywords: Tight Frame, Discrete Fourier Transform, Non-Smooth Optimization, Image Restoration, Conjugate Gradient Method.

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On Pell Calculus

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Abstract

In this paper, we introduce a new mathematical structure called "Pell calculus". This original calculus contains establishment of Pell calculus and presentation of fundamental teorems related to derivatives, exponential and some trigonometric functions, binomial, Taylor expansion, integrals and their operational features within this mathematical structure. Our work make contribution to scientific discourse by providing extensive study of presented Pell calculus, introducing strong foundation for further examination in this specific mathematical framework.

Keywords: Pell number; Pell-Lucas Number.

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The Element-Free Galerkin Method for Solving the Fractional Schrödinger Equation

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Abstract

In this paper, the fractional Schrödinger equation with Caputo-type derivatives was numerically solved using the Element-Free Galerkin method. The L_1 method was used to discretize the Caputo fractional derivative, and the Rubin-Graves approach was used to linearize the nonlinear terms. It has been observed that the approximate solutions are consistent with the exact solutions.

Keywords: Caputo fractional derivative, Schröndinger equation, Element free Galerkin method.

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SOME NEW SEQUENCE SPACES DERIVED BY THE COMPOSITION OF BINOMIAL MATRIX AND QUINTET BAND MATRIX

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Abstract

In this paper, we define three new sequence spaces by using the matrix domain of composition matrix of the Binomial and Quintet band matrices. Also, we examine some inclusion relations between existing sequence spaces and newly defined ones. Moreover, we determine Schauder bases and α-, β- and γ-duals of those sequence spaces. Lastly, we characterize some matrix classes related to new sequence spaces.

Keywords: Matrix Transformations; Matrix Domain; Schauder Basis; Sequence Spaces.

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NEW SEQUENCE SPACES DEFINED BY THE DOMAIN OF SEXTUPLE BAND MATRIX

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Abstract

In this work, we construct new sequence spaces by using the domain of sextuple band matrix $S(r,s,t,u,v,y)$ which is the general form of difference, double band, triple band, quadruple band and quintet band matrices. Furthermore, we study some inclusion relations and topological properties related to those spaces. Also, we define Schauder bases and α-, β- and γ-duals some of those spaces. Finally, we determine some matrix classes belonging to new sequence spaces.

Keywords: Matrix Domain; Matrix Transformations; Schauder Basis; Sequence Spaces.

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SOME SPECIAL CONDITION FOR PSEUDOSYMMETRIC KENMOTSU MANIFOLDS

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Abstract

In this paper pseudosymmetric and Ricci pseudosymmetric of a Kenmotsu manifolds are researched. We have achieved the necessary and sufficient conditions for a Kenmotsu manifold, W_8-pseudosymmetric, W_8-Ricci pseudosymmetric, W_9-pseudosymmetric and W_9-Ricci pseudosymmetric. Additionally, some interesting results on Kenmotsu manifolds are obtained.

Keywords: Kenmotsu Manifold; Pseudosymmetric Manifold; Ricci pseudosymmetric Manifold.

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Increasing Fruit Productivity with Modern Modeling Methods

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Agricultural productivity in fruit production varies depending on environmental factors such as temperature, precipitation, humidity, and wind, which often involve uncertainty. This uncertainty limits the accuracy of predictions made using classical mathematical methods. In this study, a fuzzy logic modeling approach, one of the modern optimization tools, was used. The model was developed using historical data on temperature, precipitation, and olive yield published by the Turkish Statistical Institute (TURKSTAT). It can produce successful predictions not only based on this data but also on untested datasets. As a result of regression analysis, a prediction accuracy of over 80% was observed with untested data. Due to its ability to represent nonlinear relationships and offer flexible interpretations, the model demonstrated strong performance in terms of generalizability. The results indicate that fuzzy logic can be used as an effective decision support tool in agricultural productivity analysis.

Keywords: Olive Productivity, Fuzzy Logic, Temperature, Precipitation, Agricultural Modeling.

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Fractional Solutions to the *k*-Hypergeometric Differential Equation

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Abstract

In this study, the fractional calculus operator was used to examine both homogeneous and non-homogeneous situations of the *k*-hypergeometric differential equation. We apply certain classical transformations to solve the equation and at the same time constrain the parameters required to determine their value. The major benefit of the fractional operator is that it implements singular differential equations and transforms them into fractional order equations. As a result, several new exact fractional solutions of the given equation were created.

Keywords: k-hypergeometric differential equation; Fractional calculus; Differential equations.

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THE GAUSSIAN PELL NUMBERS VIA PERMANENTS AND DETERMINANT OF TRIDIAGONAL MATRICES

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Abstract

Gaussian number means representation as Complex numbers. Our goal in this work is to give the Gaussian Pell numbers by using permanent and determinant of some tridiagonal matrices.

Keywords: Permanent, Gaussian Pell number, Tridiagonal matrix.

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THE APPROXİMATİON OF FİXED POİNT OF ENDRİCHED ϕ-CONTRACTİON MAPPİNGS

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Abstract

We introduce the class of enriched ϕ-contractions in Banach spaces as a natural generaliza tion of ϕ-contractions and study the existence and approximation of the fixed points of mappings in this new class, which is shown to be an unsaturated class of mappings in the setting of a Banach space. Weillustrated the usefulness of our fixed point results by studying the existence and uniqueness of the solutions of some second order (p,q)-difference equations with integral boundary value conditions.

Keywords: Banach space; enriched ϕ-contraction; enriched cyclic ϕ-contraction; fixed point; Maia type fixed point theorem; (p,q)-difference equation; integral boundary value condition

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ESTIMATING THE AIR POLLUTION VALUE OF BISHKEK CITY WITH ARIMA USING TIME SERIES METHOD

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Abstract

This study aims to estimate the air pollution levels in Bishkek, the capital of Kyrgyzstan, using the ARIMA (AutoRegressive Integrated Moving Average) time series model. Air pollution poses a significant threat to public health and environmental sustainability, especially in rapidly developing urban areas like Bishkek. The research utilizes daily PM10 data for the year 2021, along with meteorological variables such as temperature, humidity, wind speed, and precipitation. After conducting data cleaning, outlier detection, and seasonal decomposition, the ARIMA(1,0,1) model was selected as the best-fitting model based on AIC and residual analysis. The results indicate that the model provides reliable short-term forecasts for PM10 concentration levels and effectively captures seasonal pollution trends. This research offers a valuable tool for policymakers and urban planners to implement timely and data-driven interventions to improve air quality in Bishkek.

***Keywords**:* Air Pollution, Time Series Analysis, ARIMA Model, PM10 Forecasting, Bishkek, Environmental Monitoring

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Numerical Investigations of the Sawada-Kotera Eqaution with Septic B-spline Functions

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Abstract

This study uses the B-spline functions as approximate functions to offer a finite element scheme for numerical solutions of the Sawada Kotera (S-K) equation. Additionally, an investigation of the algorithm's Von-Neumann stability has been done [1]. Furthermore, the method's practicality and dependability are illustrated through an analysis of a single soliton's behavior. To regulate the efficiency and conservation features of the proposed algorithm, the I_2 L_2 and L_∞ error norms as well as the two lowest invariants, I_1 and I_2, of the equation have been calculated [2]. The aspects of the problem modelled are easily visualized thanks to the tables and images that accompany the obtained numerical results. The outcomes also show that our approach is effective .

Keywords: Sawada Kotera Equation; Finite Element Method; Collocation; Septic B-Spline;

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New soliton solutions with modified generalized exponential rational function method

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Abstract

In this study, the fractional Kairat-II equation is studied. The modified generalized exponential rational function method is applied to this equation. Thus, various soliton solutions of this equation are obtained. Various values are given to the obtained solutions and graphical drawings are made.

Keywords: Modified generalized exponential rational function method; Fractional Kairat-II equation; Soliton solutions.

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APPLICATION OF EXTENDED WEIERSTRASS TRANSFORM METHOD TO BETA TIME DIFFERENTIAL EQUATIONS

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Abstract

In this paper, the exact solutions of beta-conformable fractional equations are constructed by using the extended Weierstrass transformation method. This method is applied to the equations widely used in engineering and mathematical physics, providing exact solutions involving trigonometric, Weierstrass elliptic, and rational functions. By applying a traveling wave transformation, the beta-conformable fractional equations are reduced to a nonlinear ordinary differential equation, and the solution function is determined by expanding it into a finite series using the Weierstrass function solutions of the corresponding elliptic differential equation.

Keywords: Beta derivative; The extended Weierstrass transformation method; Weierstrass elliptic function.

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Dynamical behavior of analytical soliton solutions for nonlinear partial differential equation

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Abstract

In this paper, we obtain some new analytical soliton solutions to the nonlinear partial differential equation (PDF) arising in nonlinear sciences ocean physics, fluid dynamics, plasma physics, scientific applications, and marine engineering. By employing powerful analytical methods such as the sine-Gordon Expansion method, we derive exact soliton solutions, including bright, dark, and singular solitons. There is no prior publication of these determined solutions. By giving appropriate values to free parameters, three-dimensional images are used to illustrate the dynamical wave structures of specific analytical solutions. The soliton solutions of other well-known equations in fluid dynamics, engineering physics, and other nonlinear science domains can also be obtained using this method.

Keywords: sine-Gordon Expansion method; nonlinear partial differential equation; analytical soliton solutions.

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LORENTZ MATRIX MULTIPLICATION: EXPLORING ITS RELATIONSHIP WITH FIBONACCI AND LUCAS NUMBERS

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Abstract

This paper introduces new matrix representations of Fibonacci and Lucas numbers by using Lorentz matrix multiplication. We present novel identities, characteristic equations, and quadratic properties derived from Lorentzian transformations applied to traditional matrix formulations of these sequences.

Keywords: Matrix multiplication, Fibonacci numbers, Lucas numbers.

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DECAY AND BLOW UP OF SOLUTIONS FOR A WEIGHTED BIHARMONIC EQUATION

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Abstract

Inthispresentation, weinvestigatetheweightedbiharmonicequationwithnonlineardampingandsourceterms. Thedecay of theenergy is establishedusingNakao'sinequality. Furthermore, weprovethatsolutionsblowup in finite time

Keywords:Blowup, Decay, weightedbiharmonicequation.

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MODIFIED EXPONENTIAL FUNCTION METHOD FOR TRAVELING WAVE SOLUTIONS OF THE NONLINEAR MATHEMATICAL MODEL

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ABSTRACT

In this paper, the traveling wave solutions of the Oskolkov equation, a model describing the dynamics of incompressible viscoelastic Kelvin-Voigt fluid, are investigated using the modified exponential function method. This method is used to find analytical traveling wave solutions of the Oskolkov equation. Different traveling wave solutions are obtained by giving appropriate values to the parameters of the nonlinear mathematical model. In this way, two and three-dimensional graphs of the different wave solutions found are drawn according to the appropriate parameters..

Keywords: Modified Exponential Function method; Wave solutions: Oskolkov equation; Nonlinear partial differential equation;

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SOLUTIONS OF TWO EXPONENTIAL TYPE POTENTIALS FOR DIATOMIC MOLECULES

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Abstract

In this study, we consider the Schrödinger equation with the Manning-Rosen and Deng-Fan molecular potentials over the positive half line. First, we obtain their closed form solutions when the angular quantum number $\ell = 0$. Then, we show that the two potentials are the same. Hence, by taking one of them, we obtain numerical solutions by using the Laguerre pseudospectral method, in the presence of the centrifugal term ($\ell \neq 0$) for which the solutions can not be expressed in closed form. Comparison with the exact solution for $\ell = 0$ and numerical literature results when $\ell \neq 0$ reveals that the Laguerre pseudospectral method produces highly accurate numerical results for the Schrödinger equation with the Manning-Rosen and Deng-Fan molecular potentials.

Keywords: Schrödinger equation, Manning-Rosen potential, Deng-Fan potential, Laguerre pseudospectral methods.

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EXPLICIT REPRESENTATIONS FOR A CLASS OF GAUSS HYPERGEOMETRIC FUNCTIONS

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Abstract

In this study, we derive explicit elementary formulas for the Gauss hypergeometric functions which are the solutions of the Gauss hypergeometric equation with characteristic exponent differences $\{\frac{1}{2}, \mathrm{n}+\frac{1}{2}, \alpha\}$ and $\{\mathrm{n}+\frac{1}{2}, \mathrm{n}+\frac{1}{2}, \alpha\}$ up to permutations and sign changes where n is a non negative integer. To this end, we obtain two different sets of linearly independent solutions of the specific second order ordinary differential equation where the first set contains the aforementioned Gauss hypergeometric functions and the second one consists of elementary functions. Then the identities will be obtained by expressing the hypergeometric solutions as the linear combinations of the elementary ones.

Keywords: Gauss hypergeometric equation, Gauss hypergeometric functions.

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TOOL FRAME OF ROBOT END-EFFECTOR USİNG TWO RULED SURFACES CORRESPONDİNG TO THE HYPER-DUAL CURVE

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Abstract

Hyper-dual numbers are a new number systems developed at the beginning of the twenty-first century as extension of dual numbers. A hyper-dual number is constituted of two dual numbers, similarly, a hyper-dual curve constituted of two dual curves. If the dual curves of the hyper-dual curve are on the unit dual sphere, then this hyper-dual curve represents two ruled surfaces in Euclidean 3-space which intersect perpendicular along a common base curve. In this paper, we show that these ruled surfaces can be expressed by a same tool frame of the trajectory of the motion of a robot end-effector. Moreover, we give examples of tool frame of robot end-effector of two ruled surfaces corresponding to the hyper-dual curve.

Keywords: Hyper-dual numbers; Unit hyper-dual sphere; Hyper-dual curves; Ruled surfaces; Robot end-effector; Tool frame.

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Generalized Lacunary Statistical Convergence of Modulus Function Sequences

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Abstract

In this paper, we propose a generalized structure for statistical convergence by adapting the concept of density functions using sequences of modulus functions $f_{\{t\}}$) and an order parameter $a \in (0,1]$. This method introduces a new density framework designed specifically for lacunary sequences, facilitating the definitions of strong ($f_{\{t\}}$) -lacunary summability of order a and ($f_{\{t\}}$)-lacunary statistical convergence of order a. These newly defined concepts serve as a bridge between traditional convergence and statistical convergence in the context of lacunary sequences, providing a middle ground that enhances analytical versatility. Furthermore, we establish inclusion results and investigate the interconnections between these notions, offering a thorough exploration of their implications. This study extends the reach of statistical convergence theory and advances the field by presenting a more generalized analytical approach.

Keywords: Lacunary statistical convergence, Lacunary summability, Modulus function, Difference sequence space.

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MULTIPLICATIVE EQUIAFFINE CURVES AND THEIR PROPERTIES

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Abstract

This study introduces a multiplicative calculus framework for analyzing curves in equiaffine space. It defines multiplicative arc length, curvature, and torsion, and derives the corresponding Frenet equations. Curves with constant multiplicative curvature and torsion are characterized, accompanied by illustrative examples.

Keywords: Equiaffine space; Multiplicative calculus; Curves; Curvatures; Frenet Equations

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CHARACTERIZATION OF PLANE CURVES WITH CONSTANT MULTIPLICATIVE EQUIAFFINE CURVATURE

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Abstract

This study presents a multiplicative calculus approach to the differential geometry of plane curves within equiaffine geometry. By introducing multiplicative arc length and curvature, the research derives the corresponding Frenet formulas and establishes an analog of the fundamental theorem. The classification of plane curves with constant multiplicative curvature is also provided, supported by illustrative examples.

Keywords: Equiaffine plane; Plane curves; Multiplicative Equiaffine curves

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FRACTIONAL DERIVATIVES: DEFINITIONS AND PROPERTIES

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Abstract

Fractional derivatives are the extension of the concept of derivative to fractional (rational or irrational) degrees and have an important place in mathematical analysis. It extends the process of differentiation to rational or irrational degrees. In this presentation, different fractional derivative definitions and properties will be expressed.

Keywords: Fractional derivatives, Fractional degrees, Mathematical analysis

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ON BRIEF NOTE REGARDING F-CONTRACTIONS IN COMPLETE S-METRIC SPACES

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Abstract

In this writing, we investigate fixed points of F-contraction in an abstract space. Additionally, the effectiveness of our work is confirmed through appropriate examples

Keywords: Fixed point, S-metric, F-contraction

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A STUDY ON WARDOWSKI CONTRACTION IN A−METRIC SPACES

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Abstract

In this writing, we explore Wardowski's contraction principle for F-contraction mappings and demonstrate the existence and uniqueness of fixed points in A-Metric Spaces.

Keywords: Fixed point, A-metric, F-contraction

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INVESTIGATION OF APPLICATIONS OF FIXED POINT ITERATION METHODS WITH THE AID OF GREEN'S FUNCTION

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Abstract

In this paper, a new fixed point iteration scheme is introduced. The strong convergence of the scheme to the fixed point of a contractive mapping is demonstrated. It is also proved that the defined scheme converges faster to the fixed point compared to the Modified-JK iteration scheme existing in the literature. Moreover, the iteration scheme is shown to be faster than some existing methods by means of examples and illustrated with tables and graphs. Then data dependency is proved for the scheme in question. Then the defined iteration scheme is extended by embedding it in the Green's function. It is shown that the extended iteration scheme converges strongly to the fixed point of the transformation and is weakly$-\omega^2$stable. Finally, it is shown on an example that the extended iteration scheme converges to the fixed point faster than the Modified-JK-Green iteration scheme.

Keywords: Fixed Point Theory; Iteration Scheme; Convergence Analysis, Strong Convergence; Speed Comparison; Efficiency; Green's Function; Weak$-\omega^2$ Stability; Boundary Value Problem.

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EXISTENCE RESULT OF WEAK SOLUTION FOR A SİNGULAR KIRCHHOFF TYPE PROBLEM WITH STEKLOV BOUNDARY CONDITION

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Abstract.

In this paper, we study the existence of solutions for a singular p(x)-Kirchhoff type problem with Steklov boundary value in variable exponent Sobolev spaces. Using the variational approach, we prove the existence a nontrivial weak solution on variable exponent Sobolev spaces under appropriate conditions.

We study the following problem involving singular p(x)-Kirchhoff type equation with Hardy type term

$$\begin{cases} -M\left(\int_\Omega \frac{|\nabla u|^{p(x)}}{p(x)}dx\right)\Delta_{p(x)}u = \frac{|u|^{q(x)-2}}{|x|^{q(x)}}, & x \in \Omega \\ |\nabla u|^{p(x)}\frac{\partial u}{\partial \vartheta} = \lambda f(x,u), & x \in \partial\Omega \end{cases} \qquad \text{(E)}$$

where $\Omega \subset R^N$ $(N \geq 2)$ is a bounded with smooth boundary, $p(x)$is continuous functions on $\overline{\Omega}$ such that $p^- := \inf p(x)$, $f: \partial\Omega x R \to R$ is a Carathéodory condition, λ is a positive parameter,

$\frac{\partial u}{\partial \vartheta}$ is the outer unit normal derivative on $\partial\Omega$, $M: (0,\infty) \to (0,\infty)$ is a continuous and $\Delta_{p(x)}u = div\left(|\nabla u|^{p(x)-2}\nabla u\right)$ is $p(x)-$Laplacian type operatör.

Keywords: $p(x)-$Laplacian operator,Variational methods, Weak solutions. Singular problem.

Theorem 1.1. The problem (E) has a nontrivial weak solution for all $\lambda > 0$.

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USE OF ROUGH SET THEORY IN DATA MINING

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Abstract

Rough set theory, presented by Pawlak, has been studied in many disciplines along with mathematics. Especially in data mining, rough set theory makes a great contribution as it enables the storage of large data and the reduction of unimportant data.

In this study, general information about rough set theory, its usage areas and its importance in data mining are emphasized.

Keywords: Rough set theory; Data mining; Data reduction.

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SOLUTION OF AN OPTIMIZATION PROBLEM USING GROVER'S ALGORITHM FOR QUTRIT SYSTEMS

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Abstract

In this study, we investigate the acceleration of solving an optimization problem using Grover's algorithm implemented on qutrit systems.Unlike conventional qubit-based approaches, qutrit-three level quantum systems offer a richer Hilbert space, potentially enabling more efficient quantum search processes.The proposed approach aims to lay the groundwork for addressing more complex and larger-scale problems by leveraging the advantages of higher-dimensional quantum systems.This work serves a preliminary study toward extending quantum algorithm applications beyond binary quantum architectures.

Keywords: Quantum computing , Qubit systems, Qutrit systems, Grover's Algorithm ,Superposition, Quantum Fourier Transform(QFT).

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Oscillation results of second-order noncanonical neutral differential equations with distributed deviating arguments

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Abstract

Sufficient conditions for the oscillation of solutions to a class of second-order noncanonical differential equations with bounded and unbounded neutral coefficients are established. The results obtained improve and simplify existing ones in the literature.

Keywords: Oscillation; neutral; second-order; noncanonical.

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CURVES AND THEIR PROPERTIES IN DYNAMIC GEOMETRY

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Abstract

In this study, Frenet curves on time scales are considered within a unified framework that connects discrete and continuous analysis. Fundamental geometric concepts such as tangent lines, normal planes, osculating planes, and curvature are presented for plane and space curves in R^n. The Frenet frame and its corresponding equations are given in the context of time scale calculus, offering a generalized geometric approach over varying time domains.

Keywords: Time Scale; Curves; Curvatures; Frenet Equations

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ON THE MANGENETIC CURVES ACCORDING TO THE RIBBON FRAME IN MINKOWSKI SPACE

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Abstract

Curves in Minkowaski space have been examined in many studies according to different frame works. While examining curves, researchers studied frameworks such as the Frenet frame, Bishop frame and Ribbon frame. These frame help us with characterizations of curves.

The aim of this paper is to investigate magnetic curves according to ribbon frame in 3-dimensional Minkowski space. For this purpose, an ribbon frame was first defined. Then, magentic curves were given depending on this frame and various characterizations were obtained.

Keywords: Frenet frame, magnetic curves, ribbon frame, Minkowski space

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FIXED POINT THEOREMS FOR FOUR-POINT CONTRACTIONS

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Abstract

In this paper, we give a novel type of mappings that are four-point instead of two or three-point. Some fixed point theorems in metric spaces are proved using four-point contractions, and an example is also given related to four-point contractions.

Keywords: metric space; Fixed point theorems; four-point contractions; mappings contracting perimeters of triangles.

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SOFT SET THEORY AND VARIOUS APPLICATION AREAS

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Abstract

Soft set theory, defined by Molodtsov, has found a wide place in contemporary mathematics [1]. After the soft set theory, which gave a new perspective to the concepts of completeness and precision in mathematics, was introduced, it was studied by many mathematicians from topological, categorical and algebraic perspectives [2-22]. In this study, the development process and various application areas of soft set theory, which has been studied by many mathematicians from topological, categorical and algebraic perspectives, are discussed.

Keywords: Soft set, Development process, Application areas.

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ELASTIC ANALYSIS OF ROTATING FG PRESSURE VESSELS USING THE POWER SERIES METHOD

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Abstract

In this paper, stresses in rotating thick walled functionally graded cylindrical and spherical pressure vessels are investigated using elasticity theory. It is assumed that the material properties except Poisson's ratio vary in the radial direction with the Voigt model. Under these conditions, the analytical solution of the Navier equation is obtained by the power series solution method. The solutions available in the literature are used to verify the results obtained in this study. The effect of the rotaion and pressure on the radial displacement, radial and circumferential stress are discussed for a randomly selected material pair consisting of metal and light metal.

Keywords: Elastic analysis, Cylindrical and spherical pressure vessels, Rotation, Functionally graded materials.

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OSTROWSKI-GRÜSS TYPE INEQUALITIES VIA KATUGAMPULA FRACTIONAL INTEGRALS

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Abstract

In this study, the authors obtained new integral inequalities of Ostrowski and Ostrowski-Grüss type by using Katugampola fractional integral definition. It was shown that the obtained results support the results in the literature with special selection of parameters.

Let the space $X_c^p(a,b),(c\in\mathbb{R},\ 1\leq p\leq\infty)$ of those complex-valued Lebesque measurable functions on for which $\|f\|_{x_c^p}<\infty$, where the norm is defined by (Kilbas, 2006):

$$\|f\|_{x_c^p}=\left(\int_a^b\left|t^c f(t)\right|^p\frac{dt}{t}\right)^{\frac{1}{p}}<\infty,$$

for $1\leq p\leq\infty,\ c\in\mathbb{R}$ and for the case ,

$$\|f\|_{x_c^p}=\underset{a\leq t\leq b}{\text{ess sup}}\left[t^c\left|f(t)\right|\right].$$

Let $[a,b]\subset\mathbb{R}$ be a bounded interval. Then, for any function and any order , the Katugampola fractional integrals defined on the left and right are given by (Katugampola, 2011):

$${}^{\rho}I_{a+}^{\alpha}f(x)=\frac{\rho^{1-\alpha}}{\Gamma(\alpha)}\int_a^x\frac{t^{\rho-1}}{\left(x^{\rho}-t^{\rho}\right)^{1-a}}f\left(t\right)dt,$$

and,

$${}_{\rho}I_{b-}^{\alpha}f(x)=\frac{\rho^{1-\alpha}}{\Gamma(\alpha)}\int_x^b\frac{t^{\rho-1}}{\left(t^{\rho}-x^{\rho}\right)^{1-\alpha}}f\left(t\right)dt.$$

with $a<t<b$ and if the integral exists.

Keywords: Katugampola Fractional Integral, Integral Inequalities, Ostrowski inequality.

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A STUDY ON OSCILLATION OF NEUTRAL DIFFERENTIAL EQUATIONS WITH DAMPING TERM

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Abstract

In this work, it has been concerned that the oscillatory behavior of solutions to damped second-order linear functional differential equations with a mixed neutral term. It is presented a new oscillation criteria that improve and extend some existing ones in the literature. Example to illustrate the result is included.

Keywords: Oscillation, Neutral Differential Equations of Mixed Type, Second Order, Damping Term.

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Unital Designs Admitting Blocking Sets

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Abstract

A unital design of order q is a combinatorial structure consisting of q^3+1 points, in which each block contains exactly q+1 points, and every distinct pair of points is contained in precisely one block. A blocking set in such a design is defined as a subset of the point set that intersects every block in at least one point, yet does not fully contain any block. In this study, we address the classification of unital designs that contain a blocking set for small values of q, presenting both our methodology and computational results.

Keywords: Blocking Sets; Discrepancy; Unital design.

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ON THE OSCILLATION OF FOURTH-ORDER NEUTRAL DIFFERENTIAL EQUATIONS

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Abstract

In this talk, we consider a class of fourth--order functional differential equations with a mixed neutral term and establish some new criteria related to the oscillation of all solutions of that class of equations. The applicability and significance of the results are demonstrated with several examples.

Keywords: Oscillation; Fourth--order; Neutral differential equations.

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ON FINITE FAMILIES OF HEMICONTRACTIVE MAPPINGS

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Abstract

This work explores hemicontractive mappings, which are significant in fixed point theory, a core area of functional analysis. The research focuses on the definition and properties of these mappings in Hilbert spaces.In this study, firstly, we will introduce an implicit iteration process for two finite families of hemicontractive mappings in Hilbert spaces. After, we will give a main fixed point result for such mapping under suitable conditions. Finally, we will prove our second result using a projection operator.

Keywords: Fixed Point Theory; Hemicontractive Mappings; Hilbert Space; Convergence Analysis; Iteration Method.

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Some Applications of Fuzzy Logic Using Fuzzy Data

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Abstract

In this study, applications using fuzzy and intuitionistic data will be introduced. In line with recent developments such as artificial intelligence, we will examine the problems of managing and making decisions using fuzzy, intuitionistic fuzzy data in some areas such as regulating traffic flow and improving production in greenhouses.

Keywords: Artificial intelligence, fuzzy logic, intuitionistic fuzzy, traffic control, greenhouse.

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A COMPARATIVE ANALYSIS OF THE PROBLEM-SOLVING PROCESSES OF PROSPECTIVE ELEMENTARY MATHEMATICS AND SCIENCE TEACHERS IN THE CONTEXT OF A REAL-LIFE PROBLEM

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Abstract

The aim of this study is to examine and compare the problem-solving processes of prospective elementary mathematics and science teachers when dealing with a context-based real-life problem. In recent years, there has been a growing interest in and emphasis on the use of real-life problem situations in teaching and learning processes. It has been stated that encouraging students to produce individual or group-based solutions to problems grounded in real-life numerical data significantly supports conceptual understanding and internalization of mathematical and scientific concepts (Tan & Nie, 2015; Mebert et al., 2020). From this perspective, identifying the approaches adopted by prospective mathematics and science teachers in solving real-life problems, as well as revealing potential similarities and differences, is expected to provide valuable insights into the cognitive processes of teacher candidates with a background in quantitative disciplines.

This study adopted a qualitative research design, specifically a comparative case study approach. The participants consisted of 27 third-year prospective elementary mathematics teachers and 22 prospective science teachers enrolled in the Faculty of Education at a public university located in the Black Sea Region of Turkey. Data were collected through solution papers, audio recordings of group work, and observations. The collected data were analyzed using descriptive and content analysis methods.

Keywords: Pre-service mathematics teachers; Pre-service science teachers; Real-life problem.

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A COLLECTION OF SOLITARY WAVES FOR THE FRACTIONAL KADOMTSEV-PETVIASHVILI-MODIFIED-EQUAL-WIDTH EQUATION

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Abstract

In this research, diverse wave samples of (2+1)-dimensional fractional Kadomtsev-Petviashvili-modified-equal-width (KPmEW) equation have been examined. The new version of trial equation method (NVTEM) has been handled to establish the wave solutions of the governing nonlinear model in frame of M-truncated derivative. Plentiful rational, trigonometric, exponential, hyperbolic and Jacobi elliptic type functions have been attained and these new solutions have been observed in two and three dimesions to highlight the physical demeanors. The software system Mathematica has been utilized to validate the evaluated waves. This research is marked by the novel results considering the former studies.

Keywords: Kadomtsev-Petviashvili-modified-equal-width (KPmEW) equation; The new version trial equation method; Traveling wave solutions

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Various Optical Soliton Solutions for Combined Model Using Analytical Technique

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Abstract

In this paper, various exact wave solutions of the concatenation model which combines the nonlinear Schrödinger equation, the Lakshmanan-Porsezian-Daniel model, and the Sasa-Satsuma model are investigated. Using the unified method, different types of wave structures such as optical soliton, elliptic wave, and rational soliton solutions are obtained. These solutions are visualized through two- and three-dimensional plots based on appropriate parameter selections to demonstrate their physical relevance. The soliton solutions are anticipated to yield effective results, particularly in long-distance optical communication systems. The employed method provides an effective, reliable, and systematic approach for computing soliton solutions in nonlinear models. The results are expected to contribute significantly to applications in optical fiber systems, plasma physics, telecommunications, engineering, and related fields.

Keywords: Soliton; Optical Soliton; The Nonlinear Schrödinger Equation; The Lakshmanan-Porsezian-Daniel Model; The Sasa-Satsuma Model; The Unified Method.

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PSEUDO NULL AND NULL SMARANDACHE CURVES IN $\mathbf{E}_1^3$ AND THEIR CHARACTERIZATIONS

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Abstract

In this paper, we define pseudo null and null smarandache curves E_1^3 and examine some curvature and torsion characterizations for these curves.

***Keywords*:** Smarandache curve, Pseudo null curve , Null curve.

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GENERALIZED V-MANNHEIM CURVES IN E^4 AND THEIR CHARACTERIZATIONS

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Abstract

In this paper we define generalized V-Mannheım curves in E^4 and also obtain some characterizations for these curves

Keywords: Mannheim curve; Frenet frame; Curvature furctions.

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ANALYSIS OF THE TRIANGLES IN THE CONTEXT OF PROTOTYPICALITY IN THE TÜRKİYE CENTURY MAARİF MODEL MATHEMATICS TEXTBOOKS

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Abstract

Utilizing real-life contexts or concrete representations is regarded as an effective strategy for enhancing the understanding and teaching of mathematical concepts. Prototypical examples that are easily recalled and support cognitive processing can be especially effective in facilitating learning during the early phases of instruction (Tapan Broutin, 2014). However, the unconscious or uncritical use of such examples may lead to misconceptions about mathematical concepts (Akkoç, 2006; Ayaz, 2016; Aydın Karaca, 2014; Özkan, 2019; Sarı Arıkan, 2019; Zembat, 2014). The aim of this study is to analyze the triangle examples in the mathematics textbooks prepared in accordance with the Türkiye Century Maarif Model, which came into effect in 2024 and has been implemented for the first time in grades 1, 5, preparatory, and 9, in terms of whether they are prototypical or not. The scope of the study includes seven mathematics textbooks used in the 2024–2025 academic year. In this research, the document analysis method was utilized, and data were gathered through the use of a "Mathematics Textbook Analysis Form" specifically designed for this study. The collected data were analyzed using the descriptive analysis method. The findings indicate that the highest proportion of non-prototypical triangle usage (21.1%) was observed at the 5th grade level in the 2024-2025 mathematics textbooks, all of which were published by the Ministry of National Education (MoNE). In the preparatory grade mathematics textbooks, it was found that only 1 out of the 44 triangle examples used was non-prototypical.

Keywords: Prototypical examples; Prototype; Mathematics textbook; Triangles; Türkiye Century Maarif Model.

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A NOTE ON DEMİ WEAK ALMOST LİMİTED OPERATORS

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Abstract

In this study, we introduce the class of demi-weak almost limited operators on a Banach lattice as a generalization of weak almost limited operators defined by Elbour A., Machrafi N., and Moussa M. in 2015. Let E be a Banach lattice, an operator $\mathrm{T}: \mathrm{E} \rightarrow \mathrm{E}$ is called a demi-weak almost limited operator if for every sequence $(\mathrm{x_n}) \subset \mathrm{E}$ and every pairwise disjoint sequence $(\mathrm{f_n}) \subset E'$ whenever $\mathrm{x_n} \xrightarrow{w} 0$, $\mathrm{f_n} \xrightarrow{w^*} 0$ and $(\mathrm{f_n}(\mathrm{x_n}) - \mathrm{f_n}(T(\mathrm{x_n}))) \rightarrow 0$ implies $\mathrm{f_n}(\mathrm{x_n}) \rightarrow 0$. We examine the relationship between weak almost limited operators and demi-weak almost limited operators. In addition, we establish a characterization of demi-weak almost limited operators. Finally, we obtain some properties of the class of demi-weak almost limited operators.

Keywords: Weak almost limited operators; Demi-weak almost limited operators; Limited operators; Banach lattice.

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Synthesis and Characterization of a Series of Poly(2-hydroxypropyl acrylate)-based Copolymers

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Abstract

Poly(2-hydroxypropyl acrylate) (PHPA) is a water-soluble and thermo-responsive polymer that exhibits a lower critical dissolution temperature [1]. In this study, poly-β-alanine oligomer with vinyl end-group was synthesized using acrylamide as a monomer, sodium tert-butoxide as an initiator, and hydroquinone as a radical polymerization inhibitor via hydrogen-transfer polymerization [2]. The macromonomer and HPA were polymerized using the "grafting through" strategy via free-radical polymerization to obtain graft copolymers P(HPA-g-BA) with various degrees of grafting [3]. Similarly, N-isobutoxymethyl acrylamide (IBMAAm) and N-methoxypropyl acrylamide (MPAAm) were used as co-monomers to obtain poly(HPA-co-IBMAAm and poly(HPA-co-MPAAm random copolymers, respectively. The structural and thermal characterization of the products was achieved using basic polymer characterization methods such as elemental analysis, FTIR, ^{1}H-NMR, GPC, DSC, and TGA.

Keywords: Poly(2-hydroxypropyl acrylate), copolymer, free-radical polymerization, thermo-responsive polymer.

This study was supported by the Scientific Research Projects Coordination Unit of Kafkas University (project number: 2024-FM-33).

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THE PERFORMANCE ADVANTAGE OF THE LEVY-GTO HYBRID ALGORITHM COMPARED TO GTO

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Abstract

The aim of this study is to experimentally evaluate the performance of swarm-based heuristic algorithms, which are used for problem optimization within the scope of machine learning models. In this context, the Gorilla Troops Optimizer (GTO) is examined in detail. To overcome the algorithm's fundamental limitation of getting trapped in local optima, a hybrid approach incorporating the Levy flight strategy is proposed. The effectiveness of the proposed method is demonstrated through experimental studies conducted on five test functions with varying characteristics. The results show that the hybrid approach provides a performance improvement ranging between 3% and 5%. The findings are also visually supported using box plots.

Keywords: Artificial learning; Metaheuristic algorithm; Gorilla troops algorithm; Levy flight.

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MATHEMATICAL MODELING OF CRIMEAN-CONGO HEMORRHAGIC FEVER SPREAD: AN APPROACH BASED ON THE SIRD MODEL

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Abstract

Crimean-Congo Haemorrhagic Fever (CCHF) is a serious zoonotic disease transmitted to humans through tick bites and characterised by a high case fatality rate. As an endemic disease in Turkey, it constitutes an important public health problem. In this study, a compartmental SIRD (Susceptible-Infectious-Recovered-Dead) model was used to investigate the transmission dynamics of CCHF. The model was used to analyse epidemiological data reported at Sivas Cumhuriyet University Research Hospital between 2010 and 2024.The model is formulated as a system of ordinary differential equations (ODEs) with parameters such as transmission rate (β), recovery rate (γ) and mortality attributable to disease (μ) estimated using real-world data. The basic reproductive number (R_0) was analytically derived to serve as a threshold indicator for potential outbreak or eradication of the disease. Local stability analyses of both disease-free and endemic equilibrium points were performed by linearisation techniques using the Jacobian matrix.All simulations, parameter estimates and stability analyses were performed using MATLAB. The numerical results show the temporal progression of the disease under different initial conditions and parameter scenarios. The inclusion of the deceased in the SIRD framework facilitates a more realistic portrayal of diseases characterised by significant mortality.This study demonstrates that mathematical modelling, supported by computational tools such as MATLAB, offers valuable insights into the spread of infectious diseases and provides a quantitative basis for public health intervention planning.

Keywords: Crimean-Congo Hemorrhagic Fever; SIRD model; infectious disease modeling, MATLAB; Basic reproduction number (R_0); Stability analysis; Epidemiology

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A NEUTRAL SYSTEM APPROACH TO ASYMPTOTIC STABILITY OF Q-FRACTIONAL SINGULAR DELAY SYSTEMS

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Abstract

This study is concerned with the problem of asymptotic stability in q-fractional singular delay systems. By representing the singular system in a neutral form and using an augmented Lyapunov–Krasovskii functional method, we obtain a new stability criterion in terms of a linear matrix inequality (LMI). The criterion is applicable for the stability test of both singular time-delay systems and neutral systems with constant time delays. The approach used in this study relies on directly calculating the quantum derivatives of the Lyapunov–Krasovskii functionals. Illustrative examples demonstrate the applicability of the theoretical results, the effectiveness of the method, and its merits.

Keywords: Asymptotic stability; Lyapunov–Krasovskii functional; LMI; q-fractional singular delay systems.

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GLOBAL STABILITY OF AN EXPONENTIAL DIFFERENCE EQUATION SYSTEM

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Abstract

In this study, we investigate the qualitative behavior of solutions to a discrete system of exponential-type difference equations:

$$\begin{cases} u_{n+1} = \dfrac{a_1 + b_1 e^{-v_n} + c_1 e^{-v_{n-1}}}{d_1 + p_1 v_n + q_1 v_{n-1}}, \\ v_{n+1} = \dfrac{a_2 + b_2 e^{-wn} + c_2 e^{-w_{n-1}}}{d_2 + p_2 w_n q_2 w_{n-1}}, \\ w_{n+1} = \dfrac{a_3 + b_3 e^{-un} + c_3 e^{-u_{n-1}}}{d_3 + p_3 u_n q_3 u_{n-1}}, \end{cases}$$

for $n \in N_0$, where the coefficients a_j, b_j, c_j, d_j, p_j, q_j, $j \in \{1,2,3\}$ are non-negative real numbers such that $a^2{}_j + b^2{}_j + c^2{}_j \neq 0$ and $d^2{}_j + p^2{}_j + q^2{}_j \neq 0$, $j \in \{1,2,3\}$. The initial contidions u_{-s}, v_{-s}, w_{-s}, $s \in \{-1,0\}$ are assumed to be positive real numbers. More specifically, we study the boundedness and persistence of positive solutions, the existence and uniqueness of a positive equilibrium point, the local and global behavior of this equilibrium, and the convergence rate of the positive solutions. Finally, several numerical examples are provided to support the theoretical findings.

Keywords: Boundedness, system of difference equations, local and global stabilty

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IDEALS AND GRÖBNER BASES OF SOME PSEUDO-SYMMETRIC NUMERICAL SEMIGROUP FAMILIES

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Abstract

In this work, we give the ideals of some pseudo-symmetric numerical semigroup families with multiplicity 4 and embedding dimension 3, and the Gröbner bases of these ideals.

Keywords: Gröbner basis; Ideals; Numerical semigroups; Pseudo-symmetric numerical semigroups.

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*Abstract Submission should be prepared only **1 page**.

THE ANALYSIS OF LGS SUCCESS VIA ROUGH SET THEORY: THE CASE OF SİVEREK AND SAVUR

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Abstract

The aim of this presentation is to analyze the placement results of the 2025 High School Entrance Exam (LGS) candidates into various types of high schools using Rough Set Theory, considering both environmental and hereditary factors. In this context, personal, familial, and academic data were collected from 8th grade students in the Siverek and Savur districts. Based on the collected data, the most discriminative combinations of factors affecting students' LGS scores will be identified and analyzed within the framework of Rough Set Theory. As a result, the main factors influencing students' exam success will be examined in greater depth and presented to relevant governmental and academic stakeholders.

Keywords: Rough Set Theory; Success of LGS.

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*Abstract Submission should be prepared only **1 page**.

GLOBAL EXISTENCE, DECAY AND NONEXISTENCE OF SOLUTIONS FOR LAMÉ TYPE EQUATION WITH A FRACTIONAL TIME DELAY TERM

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Abstract In this presentation, we consider the Lamé equation with a fractional type time delay term and a nonlinear source terms. We show the global existence and decay of the solutions under suitable conditions. Also, we prove the nonexistence of global solutions.

Keywords: Global existence, decay, nonexistence

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FRACTIONAL HADAMARD'S TYPE INEQUALITIES FOR EXPONENTIALLY CO-ORDINATED CONVEX FUNCTIONS

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Abstract

In this study, we introduce a novel definition of convexity in the context of exponential coordinates. Utilizing this new framework, we establish a series of fractional Hermite-Hadamard type inequalities. Furthermore, we provide several remarks to elucidate the connections between our findings and previously established results in the literature.

Keywords: Convex functions; co-ordinated convex mapping; Hermite-Hadamard inequality; fractional integral.

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Evaluation of Biomechanical and Physiological Effects of Vehicle Vibrations on Pregnant Drivers

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Abstract

The human body, which is highly sensitive to vibrations, can react differently to these effects according to different population groups (pregnant women, children, elderly people, etc.). In this study, a biodynamic model of a pregnant woman, a highly sensitive user group, was developed, and the vibrations affecting the targeted body parts were analyzed. While extant research in this field has predominantly focused on the effects of vibration on the dynamic systems of non-pregnant individuals, studies examining the impact of vertical vibrations on pregnant women, particularly in the sitting position under driving conditions, are severely limited. In this study, a biodynamic model of a pregnant woman, a highly sensitive user group, was developed and the vibrations affecting the targeted body parts were analyzed. In this context, the study investigates the impact of vibrations induced by speed bumps on highway safety, employing a half-vehicle model with a pregnant woman driver's seat as a case study. The analysis evaluated the forces acting upon the pregnant woman's lumbar region and the vertical accelerations experienced by the driver's head and fetus. The physical model of a pregnant woman is represented using mechanical system elements (spring, mass and damper). The model has eleven degrees of freedom and is mathematically expressed in terms of Newton-Euler and moment equations. The second-order linear ordinary differential equations with constant coefficients were transformed into state-space form and solved using MATLAB software. The results of the study are presented in graphical form, and the dynamic effects on the pregnant driver and the fetus are assessed in detail.

Keywords: Biodynamic model; Pregnant woman; Vibration analysis.

ON SOME PERFECT NUMERICAL SEMIGROUPS

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Abstract

A numerical semigroup consists of linear combinations of some natural numbers that are prime to each other. Numerical semigroups are particularly prominent with their applications in commutative algebra. However, perfect numerical semigroups are a subject worth examining. It is particularly important to express numerical semigroups in terms of type sequence elements. In previous studies, the structure of numerical semigroups with determine number four or less than four has been expressed in terms of elements of their type sequence. In this study, we will examine the structures of some perfect numerical semigroups with a number of determinants of five. Firstly, we will give the necessary and sufficient conditions for the type sequences of these numerical semigroups. Secondly, we will show that these numerical semigroups are perfect.

Keywords: Numerical semigroup, Frobenius number, isolated gaps, type sequence, perfect numerical semigroup, genus.

A COMPARATIVE STUDY OF ITERATIVE AND NON-ITERATIVE OPTIMIZATION METHODS FOR NONLINEAR LEAST SQUARES PROBLEMS

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Abstract

In this study, the numerical characteristics of classical iterative methods such as Newton-Raphson, Gradient Descent, Gauss-Newton and Levenberg-Marquardt, which are widely used in solving nonlinear least squares problems, have been examined. These gradient-based methods are sensitive to initial values. In this regard, the logarithmic transformation method, used for determining initial parameter estimates is presented in detail. The performance of the classical methods has been compared with alternative optimization algorithms that do not require derivative information, including deterministic, heuristic, and evolutionary approaches. To support the comparison, a application involving the Gompertz function was conducted, and each method was analyzed in terms of convergence behavior, solution accuracy, and sensitivity to initial values.

Keywords: Newton-Raphson; Gradient Descent; Gauss-Newton; Levenberg-Marquardt; Deterministic; Heuristic; Evolutionary.

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Strength Performance of Alkali Activated Mortars Produced with Waste Brick Powder Depending on NS/NH Ratio and Curing Temperature

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Abstract

This study investigates the effects of waste brick powder (BP) use in alkali-activated composites (AAC) on mechanical performance and strength behavior under the sulfate effect. Sodium silicate/sodium hydroxide (NS/NH) ratios of 1.5, 2.0, 2.5 and 3.0 were determined and curing temperatures were applied at 40°C and 80°C in mixtures prepared by substituting 15% BP in GBFS-based binder system. Waste marble powder (WMP) was used as fine aggregate. Experimental findings revealed that the NS/NH ratio and curing temperature strongly affected the compressive strength. In particular, under the NS/NH=2.5 ratio and 80°C curing condition, the BP-based mixtures reached the highest compressive strength of 44.58 MPa. This was explained by the acceleration of geopolymerisation reactions and the formation of a denser C-A-S-H/N-A-S-H gel matrix. Under normal curing conditions (40°C), the compressive strength of the mixture with an NS/NH ratio of 2.5 was measured as 30.32 MPa, which is about 47% lower than the 80°C curing condition. This finding indicates high-temperature curing significantly increases reactivity and binder phase formation in BP-containing systems. Furthermore, regarding sulfate resistance, the compressive strength of the mixtures with BP exposed to $MgSO_4$ solution for 60 days decreased by less than 15% for the mixture with NS/NH = 2.5. This indicates that BP provides physical stability in the binder matrix formed after alkaline activation and develops resistance to sulfate ions. As a result, using BP offers significant potential for both sustainable building material production and durability. NS/NH=2.5 ratio and 80°C curing condition are recommended to achieve optimum performance in such systems.

Keywords: Sustainability, brick powder, Heat cure, Sulfate effect, NS/NH ratio

On Asymptotically Equivalent Sequences in Probability

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Abstract. In this study, we give some results related with asymptotically equivalent sequences in probability.

Keywords: Sequence of random variables, Asymptotical statistical equivalence.

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k-Lauricella Hypergeometric Functions

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Abstract

The Pochhammer k-symbol, introduced by Diaz and Pariguan in 2007, has become one of the important symbols of the theory of special functions. There are many special functions defined using this symbol. In this study, k-Lauricella hypergeometric functions are defined by means of Pochhammer k-symbol. Also, some Euler type integral formulas are given.

Keywords: Pochhammer symbol; Integral representation; Lauricella hypergeometric functions.

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AN ANALYSIS OF 9th GRADE MATHEMATICS TEXTBOOK PREPARED IN ACCORDANCE WITH TÜRKİYE CENTURY MAARİF MODEL CURRICULUM IN THE CONTEXT OF CONGRUENCE AND SIMILARITY

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Abstract

Coxford (1991) highlights congruence and similarity as fundamental elements of Euclidean geometry. Çevik (2006) notes that congruence and similarity axioms and theorems are employed in the proofs of several theorems in plane geometry, such as the basic proportionality theorem, the sine theorem, and the angle bisector theorem, among others. As also emphasized by Çıldır (2007), despite the importance of the theme of congruence and similarity within the discipline of mathematics, inconsistencies in the terminology used to describe these concepts in textbooks and scholarly works are evident. In an effort to address these inconsistencies, mathematicians like Hilbert have sought to establish alternative axiom systems. This controversial situation in the history of mathematics, along with the differences between Hilbert and Euclid, has been reflected in scientific literature, textbooks, teachers, and, consequently, students as well. The aim of this study is to analyze the theme of congruence and similarity in terms of content structure, the terminology used, and the instructional approach as presented in the 9th grade mathematics textbook prepared in accordance with the Türkiye Century Maarif Model and implemented during the 2024–2025 academic year. The study adopts the document analysis method. As research material, the 9th grade mathematics textbook published within the scope of the Türkiye Century Maarif Model and introduced into the curriculum as of the 2024–2025 academic year was used. The data obtained were analyzed using content analysis methodology.

Keywords: Türkiye Century Maarif Model; Congruence and similarity; 9th grade mathematics textbook, Document analysis.

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EXISTENCE AND UNIQUENESS OF SOLUTIONS FOR FRACTIONAL BOUNDARY VALUE PROBLEMS INVOLVING CAPUTO-HADAMARD FRACTIONAL DERIVATIVES

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Abstract: Fractional-order derivative models are gaining popularity over ordinary derivatives because they provide more accurate results in real-world applications. Researchers are increasingly studying fractional differential equations due to their effectiveness in fields like engineering, mathematics, physics, bioengineering, and applied sciences [1]. Nonlinear fractional boundary value problems are particularly important, as they better model complex phenomena. This study focuses on analyzing such nonlinear fractional boundary value problems. In this work, the following nonlinear fractional boundary value problem is considered with the help of Caputo-Hadamard fractional derivative operator.

$$-D^{\alpha}u(t) = f(t, u(t)), t \in (1, e), u'(1) = 0, \beta D^{\alpha-1}u(e) + u(\eta) = 0.$$

Here $f \in C([1,e] \times [0,\infty),[0,\infty))$, $1 < \alpha \leq 2$, $\beta > 0$, $1 < \eta < e$, D^{α} and $D^{\alpha-1}$ are Caputo-Hadamard fractional derivatives of order α and α−1 respectively. Under some assumptions on the nonlinear term, the existence and uniqueness of positive solutions are obtained by certain fixed point theorems.

Keywords: Banach fixed point theorem, Caputo-Hadamard fractional derivative, fractional differential equations.

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An Experimental Study on the Durability of One-Part Geopolymer Foam Concrete Under NaCl Effect

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Abstract

In this study, the strength performance of geopolymer foam concretes produced for the development of environmentally friendly building materials was investigated under saline conditions (NaCl solution). Composites containing lime and pumice powder in different ratios (0%, 25%, 50%, 75%) were used as binder system and 10% and 20% sodium bicarbonate was preferred for activation. All samples were immersed in 5% NaCl solution after the 90-day curing period was completed and kept in this environment for 3 months. At the end of the curing period, the specimens were dried and their compressive strength was determined in accordance with ASTM C109 standard. According to the experimental results obtained under normal curing conditions, a significant improvement in compressive strength was observed as the pumice content increased. The highest strength was obtained in P50NC20 specimen with 10.22 MPa after 90 days of standard curing, which indicates that pumice increases the pozzolanic contribution and matrix integrity in the binder system. It was observed that contact with NaCl solution caused significant deterioration in the mechanical properties of geopolymer foam concretes. Mixtures containing only lime (P0NC10 and P0NC20) experienced strength losses of 76.24% and 73.05%, respectively, and very low residual strengths of 0.24-0.45 MPa were recorded. This was attributed to insufficient geopolymeric network formation and high porosity. In contrast, mixtures containing 25% and 50% pumice showed significantly better strength. In particular, the P50NC20 mix was the most resistant to NaCl environment, reaching a value of 7.89 MPa. In terms of relative strength losses, P50NC10 and P50NC20 mixtures retained 74.49% and 77.20% of their initial strength, respectively. These findings show that pumice powder provides significant contributions to the stabilization of the geopolymer matrix and that mechanical strength can be maintained under aggressive environmental conditions such as NaCl, especially with moderate pumice substitution. In this respect, the study offers a potential alternative for applications requiring chemical resistance such as infrastructure elements or structural elements that may be exposed to seawater.

Keywords: NaCl effect, Foam concrete, Sustainability, Pumice powder, Slaked lime.

Conceptual Perceptions of Prospective Teachers Regarding the Concept of "Unit" in Mathematics

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Abstract

Meaningful learning and internalization of the concept of measurement is largely associated with understanding the concept of unit.This concept establishes a direct bridge between the object or phenomenon to be measured and the measurement. It can be said that the knowledge of prospective teachers of the future regarding this concept, which is at the basis of many mathematical subjects such as arithmetic, algebra and measurement, is quite important. It has been claimed that when an understanding is carefully sought in a wrong answer given by a person, the logical side of that answer can be discovered. In this case, the ways in which a person learns mathematics and the obstacles that block these ways can be understood, and this can be a guide on how mathematical knowledge is produced, encoded in the mind and used. In this sense, it can be said that determining the mathematical understanding of the individual is an important guide for conceptual learning. The aim of this study is to determine the understanding of prospective mathematics teachers regarding the concept of “unit”. The participants of this descriptive survey study were prospective teachers receiving education at a state university in the south of Turkey. Data were collected through documents and document analysis was used in its analysis. As a result of the findings, it was seen that the prospective teachers explained the concept of unit with different concepts such as "measurement", "the essence of the subject", "each part of the whole", "the smallest part of the multitude".

Keywords: Unit; Conception; Math Prospective Teachers

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ON THE BOUNDEDNESS AND STABILITY PROPERTIES OF SOLUTIONS FOR FOURTH ORDER NONLINEAR STOCHASTIC DIFFERENTIAL EQUATIONS WITH VARIABLE DELAYS

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Abstract

This study addresses the analysis of fourth-order stochastic differential equations with variable delays. Two novel results are established, providing sufficient conditions for the stochastic asymptotic stability and stochastic boundedness of solutions. The proofs are developed through the application of the Lyapunov–Krasovskii functional technique. To substantiate the theoretical contributions, two illustrative examples are presented. In comparison with existing studies, the results obtained herein are original and offer a significant contribution to the qualitative theory of stochastic differential equations.

Keywords: Bounded variable delay, Fourth-order, LK-F, Nonlinear stochastic differential equation (SDE), Stability

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ON THE STABILITY OF FIFTH-ORDER NONLINEAR STOCHASTIC DELAY DIFFERENTIAL EQUATIONS

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Abstract

In this work, we examine the stochastic asymptotic stability of solutions to fifth-order non-autonomous stochastic delay differential equations with multiple variable delays, utilizing the Lyapunov–Krasovskii functional method. A new theorem is established to characterize this qualitative property. To illustrate the effectiveness of the proposed approach, a detailed example is presented. The result obtained in this work offers a broader generalization compared to several existing findings in the current literature.

Keywords: Stochastic delay differential equations, asymptotically stability in probability, multiple variable delay, fifth-order, Lyapunov-Krasovskii functional

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Pell Statistical Convergence

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Abstract

The Pell matrix $P = (P_{nk})$ is used in this paper to introduce the concepts of Pell summability, Pell density function, and Pell statistical convergence. Additionally, we provide some inclusion relations regarding these concepts and strongly $P[p]$-Cesaro summability.

Keywords: Pell analog; Pell numbers; Statistical Convergences.

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NUMERICAL CALCULATIONS USING NEWMARK'S METHOD TO SOLVE A HYPERBOLIC PROBLEM

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Abstract

In this study, the Newmark method is preferred for the solution of the differential equation that occurs together with the Galerkin method in the solution of hyperbolic problems. The weak solution of the hyperbolic equation is examined using the Galerkin and Newmark methods under different boundary conditions. This study is prepared to obtain numerical solutions for the weak solution of a hyperbolic problem with variable coefficient homogeneous boundary conditions.

Keywords: Newmark method, Hyperbolic equation, Galerkin Methods

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ON THE SEPARATION AXIOM OF TOPOLOGICAL SPACEN M-SPACE AND T_M-SPACE

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Abstract

In the study of topology, spaces are often classified based on their structural properties and the types of functions they support. One such interesting class is the **M-space**, which presents unique characteristics that differentiate it from more conventional topological spaces. A **M**-space is defined by a set of axioms that impose specific conditions on the space's topology, focusing on continuity, separation, and compactness properties. The **T_M-space**, a specific type of **M**-space, further refines these properties by introducing additional constraints that influence the relationships between points and open sets. This paper explores the fundamental aspects of both M-spaces and T_M-spaces, providing detailed examples and comparing them with more widely studied spaces such as Hausdorff spaces (T_2) and regular spaces (T_3). The study also highlights the relevance of M-spaces and T_M spaces in both theoretical and applied contexts, including their potential applications in modern fields such as quantum topology, data science, and network theory. The goal of this research is to advance the understanding of these spaces and their potential impact on the broader landscape of topology.

Keywords: Topology, Separated Axiom, M-Space, T_M-space

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ANALYZING A NONLINEAR SCHRÖDINGER TYPE EQUATION: DYNAMICAL ANALYSIS AND SOLITARY WAVE FEATURES

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Abstract

This study explores exact soliton solutions of a nonlinear Schrödinger type equation, which governs femtosecond pulse propagation in optical fibers with higher-order dispersive and nonlinear effects. Using an advanced analytical approach, we derive bright and dark soliton solutions that exhibit amplitude and width variations under different nonlinear parameter regimes. The obtained solutions demonstrate how third-order dispersion and nonlinear terms influence pulse dynamics, offering potential applications in ultrafast optics and signal processing. Physical interpretations of these solitons are discussed and propagation characteristics in nonlinear media. The results complement existing theories on optical solitons [1-3] while providing new insights into ultrashort pulse control.

Keywords: a nonlinear Schrödinger type equation, soliton.

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EULER METHOD IN NUMERICAL SOLUTION OF FRACTIONAL DIFFERENTIAL EQUATIONS

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Abstract

In this study, an approach based on Euler method is presented for the numerical solution of fractional order differential equations. In the study, fractional derivatives formulated under Caputo definition are taken into consideration, and how the classical Euler method is adapted and its applicability is detailed in this framework. In addition, the accuracy of the method are analyzed through sample problems. The findings show that Euler method can provide an effective starting point in solving fractional systems despite its simple structure.

Keywords: Fractional Differential Equations; Caputo Derivative; Euler Method**.**

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SECOND HANKEL DETERMINANT FOR A SUBCLASS OF BI-UNIVALENT FUNCTIONS ASSOCIATED WITH GEGENBAUER POLYNOMIALS AND SUBORDINATION

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Abstract

Recently, many upper bounds of second Hankel determinant $|a_2a_4 - a_3^2|$ have been investigated for various subclasses of bi-univalent functions. The main object of this work is to evaluate an upper bound for a novel subclass of bi-univalent functions associated with the Gegenbauer polynomials that satisfy subordination conditions on the open unit disk U. Some relevant remarks and observations are also presented.

Keywords: Analytic functions; Bi-univalent functions; Subordination; Gegenbauer polynomials; Second Hankel determinant.

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Production of Foam Concrete with Hasankale Pumice and Expanded Micronized Perlite

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Abstract

In this study, the mechanical and physical properties of foam concrete, a type of lightweight concrete, were investigated. For this purpose, cement, pumice, expanded micronized perlite aggregates and foaming agent were used for foam concrete production. A total of 4 different concrete mixes were produced. In all 4 groups, the amount of foaming agent was kept constant. In the first group, cement, water and foaming agent were used. In the second group, cement, water, pumice and foaming agent were used. In the third group, cement, water, perlite and foaming agent were used. In the last group, cement, water, pumice, perlite and foaming agent were used. Density, compressive and flexural tests were performed on the produced samples. The unit weight of the fresh concrete mixtures was measured. After 28 days of curing under laboratory conditions, compressive and flexural strength tests were performed on the samples. As a result of the unit volume weight test, foam concrete samples between 720 kg/m3 and 1400 kg/m3 were produced. The lowest unit volume weight was obtained in the samples produced with perlite and the highest unit volume weight was obtained in the samples where pumice and perlite aggregates were used together. As a result of the 28-day compressive strength test, the lowest value was obtained in the mixture containing perlite with 6,33 MPa and the highest value was obtained in the normal foam concrete mixture without aggregates with 12,47 MPa. This is due to the fact that the compressive strength of cement is higher than the other aggregates. As a result of the 28-day flexural strength test, the lowest value was obtained with 2,04 MPa in the mixture where pumice and perlite were used together and the highest value was obtained with 3,0 MPa in the mixture containing pumice. As a result, the use of pumice and expanded perlite aggregates in foam concrete is used for a structure that is both lighter and has better thermal insulation properties rather than improving the mechanical properties of foam concrete.

Keywords: Foam Concrete; Pumice; Expanded Micronized Perlite; Compressive and Flexural Strength

ON GENERALIZED PROPORTIONAL FRACTIONAL INTEGRAL

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Abstract

Fractional calculus operators deal with investigatin and applications of integrals and derivatives of arbitrary (real or complex) order. There are many definitions of fractional integral and fractional derivatives of different types. Object of this talk is to present an introductory overview of the theory of an integral operator of fractional calculus known as generalized proportional fractional integral. We also show a fractional integral inequality whose proof based on techniques to the existing literature.

Keywords: Generalized proportional fractional integral; Inequality; Operator.

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STRESS ANALYSIS OF A ROTATING FG POLAR ORTHOTROPIC DISK

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Abstract

In this paper, the elastic analysis of a functionally graded polar orthotropic disk rotating with time-dependent angular velocity is considered. The material properties of the disk and thickness are exponentially graded in the radial direction. Under these conditions, a linear partial differential equation is obtained. The time dependence in the partial differential equation is eliminated by using the Laplace transform. Then, the boundary value problem in the radial direction is solved by the pseudospectral Chebyshev Method in the Laplace domain. The stresses in physical space are obtained by using the modified Durbin method. The effects of thickness, rotation and material properties on the stresses are analyzed.

Keywords: Elastic stresses, Polar orthotropic disk, Functionally graded materials, Rotation..

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DEFORMATION ANALYSIS OF FG LONGITUDINAL RODS BY PSEUDOSPECTRAL CHEBYSHEV METHOD

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Abstract

Deformation analysis of functionally graded longitudinal vibrated rod with variable cross-sectional area in axial direction is considered. It is assumed that the rod subjected to external harmonic excitation and material properties such as elastic modulus and density are graded in the axial direction by the Halpin-Tsai homogenization model. These conditions result in a partial differential equation with variable coefficients that is difficult to solve with conventional analytical methods. Under the Laplace transform, the partial differential equation is transformed into a time-independent boundary value problem in the longitudinal direction and solved by the pseudospectral Chebyshev Method. The displacements in physical space are obtained inverse modified Durbin Method. The effects of time dependent sinüzoidal force on displacement distributions are discussed.

Keywords: Deformation analysis; Tip mass; Functionlly greded materials; pseudospectral Chebyshev Method; Laplace transform, modified Durbin Method.

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THERMAL EFFICIENCY OF FGM ANNULAR FINS

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Abstract

The annular fins, which are used to enhance heat transfer from the cylindrical surface to the surrounding, are widely used too many applications such as heat exchangers and electronic cooling systems. The efficiency of annular fins is defined as the ratio of the heat transferred from a cylindrical surface through the fin to the heat transferred from the same fin with infinite thermal conductivity (the temperature everywhere on the fin being equal to the fin base temperature). The efficiency of annular fins varies depending on the fin material and geometry (shape, cross-section of the fin, and whether the fin is perpendicular or parallel to the surface to which the heat will be transferred). In this situation, fin efficiency can be increased not only with the fin material but also with changes in its geometry. The pseudospectral Chebyshev method is used in this study to numerically analyze the thermal efficiency of functionally graded variable cross-section annular fins. The material properties have been assumed to gradually vary in the radial direction in the fins, which is thought to have reached thermal equilibrium. The validation of the method has been ensured by comparing it with the results of an analytical study in the literature.

Keywords: Variable cross-section annular fin; Functionally graded material; Pseudospectral Chebyshev method

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THERMAL ANALYSIS OF FG POROUS FIN BY ADOMIAN DECOMPOSITION METHOD

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Abstract

In this paper, nonlinear thermal analysis of functionally graded convective-radiative porous longitudinal fins using Adomian decomposition method is discussed. The variation of material properties, which are generally neglected in functionally graded materials, with temperature is taken into account. The effects of the axial variation of the heat transfer coefficient as well as its dependence on temperature on the temperature distribution is discussed.

Keywords: Longitudinal porous fin, Heat conduction, Functionally graded materials, Adomian decomposition method.

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APPLICATION OF INVERSE LAPLACE TRANSFORM METHODS ON HEAT CONDUCTION EQUATION

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Abstract

In this study, the one-dimensional heat conduction equation of the plate is solved using the combined method. The time dependence of the equation is eliminated using the Laplace transform. Then, the pseudospectral Chebyshev method is used to solve the boundary value problem in the Lapalce space. The temperature distribution of the plate in the physical space is obtained by different inverse Laplace transform methods. A numerical simulation is performed to check the accuracy of the inverse Laplace transform methods.

Keywords: Inverse Laplace transform methos, Heat conduction, Pseudospectral Chebyshev method.

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PFAFFIAN FORMULATION OF NONLINEAR DIFFERENTIAL EQUATIONS

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Abstract

Nonlinear differential equations are fundamental in mathematically describing a diverse range of physical processes occurring in nature. Due to their intrinsic difficulty, the derivation of solutions for these equations remains a significant and actively investigated research area. Determinant-based methods [1-3] represent a prominent technique for deriving soliton solutions of nonlinear evolution equations. In this talk, we introduce the Pfaffian formulation [4] for nonlinear differential equations and discuss some recent applications of this approach.

Keywords: Soliton solutions; Pfaffian formulation; Nonlinear evolution equations.

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*Abstract Submission should be prepared only **1 page**.

ROBUSTNESS 2.0: A TRANSFORMATIONAL STORY BETWEEN ARTIFICIAL INTELLIGENCE AND STATISTICS

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Abstract

Robust statistics has been a significant research area since the 1960s, offering methods designed to address challenges such as outliers, model misspecifications, and small sample sizes. Robust approaches developed by pioneers like Tukey, Huber, and Hampel have substantially enhanced the reliability of statistical analyses for decades. However, with the rise of machine learning and artificial intelligence, the advantages of big data and powerful algorithms overshadowed the popularity of robust methods. During this period, handling outliers became largely limited to data cleaning and regularization techniques.

Today, new challenges—including adversarial attacks, explainable artificial intelligence (XAI) requirements, and model reliability—have brought the concept of "robustness" back into focus. Nevertheless, existing literature often discusses "adversarial robustness" without connecting it to classical robust statistics, while statisticians have shown limited engagement with artificial intelligence applications. This situation has created an interdisciplinary methodological gap.

This study presents an exploratory review of the historical development of robust statistical approaches (Robustness 1.0), their transformation during the machine learning era (Robustness 1.5), and their new definitions and applications in the age of artificial intelligence (Robustness 2.0). This classification and the historical framework describing the evolution of robustness are, for the first time, introduced with these specific terms and conceptualized to contribute to the literature. Additionally, the future roles of robustness and proposed methodological directions for researchers will be discussed. The study aims to bridge the disciplines of statistics and artificial intelligence through a methodological framework grounded in the philosophy of robust thinking, offering a new conceptual perspective.

Keywords: Robustness; Artificial Intelligence; Statistics

ON GAUSSIAN CURVATURE OF THE CYCLIC SURFACES

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Abstract

In this talk, we analyze equations of Gauss curvature type for cyclic surfaces using the Mathematica program. In particular, we study such equations in the case of constant curvature.

Keywords: Gauss curvature; cyclic surface; rotational surface.

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NUMERICAL SOLUTION of GRLW EQUATION by CUBIC HERMITE B-SPLINE COLLOCATION METHOD

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Abstract

This study involves the numerical solution of the Generalized Regularized Long Wave (GRLW) equation, which has an important place in fluid dynamics. For this purpose, the Crank-Nicolson scheme is used for time discretization. The Rubin-Graves type linearization technique is used to deal with nonlinear terms. The space discretization is performed by cubic Hermite B-spline collocation method. To verify the accuracy of the proposed method, it is applied to some well-known test problems, the error norms and the conservation constants are calculated. The calculated error norms and conservation constants are presented in tables and compared with the work of previous researchers using the same parameters. In addition, the problem is presented visually by drawing graphs of the numerical results obtained. The tables and graphs show that the proposed method agrees with the analytical solutions of the test problems and preserves the conservation constants.

Keywords: GRLW equation; Collocation method; Cubic Hermite B-spline.

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DEVELOPMENT OF A DOMAIN-SPECIFIC AI PLATFORM BASED ON SMALL LANGUAGE MODELS

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Abstract

Large Language Models (LLM) have demonstrated remarkable success in natural language processing (NLP) tasks. However, their high computational requirements, prolonged training durations and data privacy concerns cause significant limitations for organizational adoption. These limitations are especially critical in regulated sectors such as finance, healthcare and government, where local data processing, compliance and customizability are essential. This study presents an AI platform based on domain-specific Small Language Models (SLM), enhanced with Retrieval-Augmented Generation (RAG) and optimized for Turkish NLP tasks. The proposed solution enables low-cost deployment, fast fine-tuning and high accuracy while reducing the need for technical expertise through a natural language query interface. The models are optimized using quantization, pruning, knowledge distillation techniques and include a custom tokenizer designed for Turkish morphological structures. Moreover, the platform's on-premise deployment capability, along with advanced data privacy techniques such as homomorphic encryption and differential privacy, ensures secure processing of sensitive data.

Keywords: Natural Language Processing (NLP); Small language models (SLM); Retrieval-augmented generation (RAG).

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INVESTIGATION OF WIND DIRECTIONS BY CIRCULAR DATA ANALYSIS

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Abstract

In this study, the wind directions in Yozgat Basin were analyses with the circular data analysis method using daily wind direction data between 1969-2018. Unlike classical statistics methods, circular approaches take into account the angular nature of directional variables such as wind direction. The data set was divided into ten five-year periods and descriptive circular statistics (mean direction, resultant length, mean resultant length, circular variance, circular standard deviation and Von Mises concentration parameter (κ)) were calculated for each period. The findings show that wind directions are not randomly distributed throughout the year, but tend to cluster in certain directions during certain periods. Especially in the period 2009-2018, there is a strong directional concentration evidenced by increases in the mean resultant length and κ. Statistical tests such as Watson-Williams F, Concentration Homogeneity and Likelihood Ratio confirm that there are significant differences in mean direction and concentration parameter between periods ($p<0.05$). These long-term changes in wind direction affect not only meteorological aspects, but also critical environmental and economic processes such as soil erosion, seeding, transport of air pollution, spread of forest fires and renewable energy potentials. This study highlights the value of circular statistics in environmental research and provides insights for regional planning and resource management.

Keywords: Environmental planning; Circular data analysis; Wind direction; Von Mises

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FINITE DIFFERENCE METHOD FOR LINEAR VOLTERRA INTEGRO-DIFFERENTIAL EQUATIONS

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Abstract

We study a useful numerical method for the linear Volterra integro-differential equations with non-local conditions. The implicit difference principles for the differential component and the composite right-sided rectangle approach for the integral component are used to model the numerical solutions of the problem across a uniform mesh. The numerical approach's convergence and stability are next examined. The accuracy of the suggested approach is confirmed by the presented numerical experiments.

Keywords: Numerical method; Stability; Uniform mesh.

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Multi-layer Artificial Neural Networks in Optimization of Predictive Maintenance Processes

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Abstract

The prevention of breakdown and the optimization of maintenance processes are crucial for operational efficiency and cost effectiveness in industrial systems. This study proposes an Artificial Neural Network (ANN) based approach to model the complex and non-linear relationships within equipment sensor data, in contrast to classical predictive maintenance approaches. The proposed methodology is supported by a multi-layer ANN architecture. This architecture is designed to process time series data from the automotive industry for parameters that are fundamental to monitoring the health of industrial equipment, such as vibration, temperature and oil analysis. The ANN model provides high accuracy in failure prediction and flexibility in maintenance scheduling by learning the deterioration signals of the equipment. Preliminary results suggest the model outperforms conventional techniques in early-stage failure detection sensitivity and may substantially reduce maintenance costs. The results show that the ANN approach plays a critical role in the shift to reliable and predictable production systems by improving maintenance strategies.

Keywords: Predictive Maintenance; Artificial Neural Network; Artificial Intelligence; Industrial Engineering.

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Analytical Solution of a Caputo Fractional-Order Computer Virus Propagation Model

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Abstract

In this study, a proposed model describing the propagation of a computer virus in the network with antidote in a vulnerable system is analyzed. Using the Laplace Adomian Decomposition Method (LADM), the model's analytical and approximate-analytical solutions are determined. These solutions are found in the form of fast converging series that portray the system dynamics accurately. The efficiency of the method was tested and the validity of the introduced fractional-order model was proved through the numerical simulations.

Keywords: Caputo fractional derivative; Computer Virus Propagation; Laplace Adomian decomposition; Nonlinear system.

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NUMERICAL APPROACH OF SINGULARLY PERTURBED DELAY DIFFERENTIAL EQUATIONS WITH NONLOCAL CONDITIONS

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Abstract

The numerical solution of singularly perturbed delay differential equations with nonlocal conditions is presented in this study. The method's stability and convergence analysis are examined. The presented method is used to solve several numerical instances, display the problem solution graphs, and compare the calculated result with the exact solution.

Keywords: Singularly Perturbed Problem; Delay differential equations; Nonlocal Conditions.

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On the Domain of 4-dimensional Catalan Matrix in the Space of Absolutely Summable Double Sequences

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Abstract

The aim of this study is to obtain a new double sequence space as the domain of the 4-dimensional Catalan matrix obtained by using Catalan numbers on the space $\mathcal{L}_u$ of absolutely summable double sequences, to investigate some algebraic and topological properties of this space, to calculate its α-, β(bp)- and λ-duals and to characterize matrix transformations from the newly obtained space to classical sequence spaces and vice versa.

Keywords: Catalan numbers; 4-dimensional Catalan matrix; Double sequence spaces.

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An Analytical Study of a Fractional Differential Model for COVID-19

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Abstract

This study investigates a nonlinear SITR system that models the dynamics of COVID-19 by incorporating fractional-order derivatives in the sense of the Caputo definition. The model categorizes the population into four compartments: susceptible (S1), infected (I), under treatment (T), and recovered (R). To analyze the fractional-order SITR system, the Laplace Adomian Decomposition Method (LADM) is employed. Approximate analytical solutions are obtained, demonstrating rapid convergence and effectively capturing the system's behavior. The accuracy and applicability of the method are assessed, confirming the validity of the proposed fractional-order model.

Keywords: Caputo fractional derivative; Laplace Adomian decomposition; Zika virus; Nonlinear system.

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Analytical Solution of a Mathematical Model for the Spread of the Zika Virus

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Abstract

In this study, a nonlinear SEIR system is analyzed to model the spread of the Zika virus, using a modified form of the Caputo fractional derivative. Analytical and approximate-analytical solutions of the proposed model are derived using the Laplace Adomian Decomposition Method (LADM). The solutions are presented as rapidly converging series. Approximate analytical solutions are obtained, demonstrating rapid convergence and accurately capturing the system's dynamics. The reliability of the method is verified, and the validity of the proposed fractional-order model is substantiated.

Keywords: Caputo fractional derivative; Laplace Adomian decomposition; Zika virus; Nonlinear system.

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Applications of bifurcation analysis, sensitivity analysis and modified Kudryashov method

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Abstract

In this paper, we obtain the exact solution to a nonlinear differential equation that plays a crucial role in analyzing signal transmission and exploring nonlinear effects, making it indispensable for advancing various technological domains. Its significance spans optical communications, nonlinear phenomena, and other related fields, driving innovation and enhancing our ability to harness light for diverse applications. Then, we handled the bifurcations of the model and were interested in the sensitivity analysis.

Keywords: Modified Kudryashov method; Bifurcations; Sensitivity analysis.

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An artificial neural network procedure for the nonlinear typhoid fever disease system

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Abstract

The current investigations provide the numerical solutions of the nonlinear typhoid fever disease system by using an artificial neural network procedure. The model is categorized into four dynamics susceptible, exposed, infected, and recovered. The use of one class into another category makes the model nonlinear and numerical solutions of the model are achieved through the stochastic computing procedure, while the optimization is performed by using the Levenberg-Marquardt backpropagation (LMQBP) neural network.

Keywords: Typhoid fever disease; Neural network; Transfer function; Levenberg-Marquardt; numerical outputs.

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Prediction of Concrete Compressive Strength Using Mamdani-Type Fuzzy Inference System

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Abstract

As technology progresses, artificial intelligence (AI) techniques, which offer the potential for faster and more reliable results, have superseded conventional methodologies. Nowadays, AI techniques are commonly utilized for the prediction of concrete compressive strength. Predicting concrete compressive strength as accurately as possible by leveraging various parameters is of vital importance for numerous aspects, including primarily the construction of safe structures, as well as cost and time savings, and the support of sustainable building practices. Through AI-based prediction models, insights into concrete compressive strength can be obtained at very early stages, enabling the early detection of potential issues in material quality or mix design. As with many real-world problems, modelling and controlling concrete compressive strength to achieve the most accurate representation with experimental results is a very challenging and complex task. In this study, fuzzy logic approach is utilized to predict the 28-day concrete compressive strength. In the fuzzy logic model designed in Python, input parameters are determined as CaO, MgO, NaEq, LOI (Loss on Ignition), Blaine, 1-day, 2-day and 7-day compressive strengths. Trapezoidal and triangular membership functions are used to model the input and output parameters. Additionally, the Mamdani inference mechanism is used to evaluate the generated rule base. The centroid method is employed for defuzzification. The results demonstrate that the fuzzy logic approach can be effectively used to predict concrete compressive strength.

Keywords: Compressive Strength; Forecasting; Time Series; Piecewise Linear Fuzzy Number; Fuzzy Logic.

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Topp-Leone Power Garima Distribution: Properties and Applications

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Abstract

This article introduces the Topp-Leone Power Garima Distribution (TLPGD), a novel continuous probability distribution derived by integrating the Topp-Leone generator with the Power Garima distribution**.** The proposed model enhances flexibility in modeling skewed and complex data across various domains. In this study, we explore the mathematical properties of the TLPG distribution, including its probability density function (PDF), cumulative distribution function (CDF), moments, and entropy measures**.** Additionally, we discuss parameter estimation using maximum likelihood estimation (MLE) and demonstrate its applications through real-world datasets. The results indicate that the TLPG distribution provides a superior fit compared to traditional models, making it a valuable tool for statisticians and data analyse. The TLPGD's probability density function (PDF) and cumulative distribution function (CDF) are derived, showcasing its ability to generalize the Power Garima distribution via the Topp-Leone transformation. Analytical expressions for moments, quantiles, entropy, and order statistics are provided. The TLPGD exhibits right-skewed**,** unimodal**, and** bathtub-shaped hazard rates, making it suitable for diverse real-world scenarios. The TLPGD offers a robust tool for modeling lifetime data in engineering, medicine, and environmental sciences, with potential extensions to bivariate and regression frameworks suggested for future research.

Keywords: Topp-Leone distribution, Power Garima distribution, hazard function, maximum likelihood estimation, reliability analysis

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Travelling-wave Solutions of Evolution Equations

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Abstract: Integrable systems and evolution equations are closely linked, especially in mathematical physics. Evolution equations describe how systems change over time, often appearing as partial differential equations (PDEs) or ordinary differential equations (ODEs). When an equation is integrable, it means that it can be solved exactly.

Many famous integrable systems are governed by evolution equations, such as the Korteweg–de Vries (KdV) equation and the nonlinear Schrödinger (NLS) equation. These equations often produce solitons—stable wave-like structures that maintain their shape over time due to the integrability of the system. Methods such as the inverse scattering technique, Hirota method, and Darboux transformations are commonly used to solve these equations and reveal their underlying structure.

Motivated by this, we present explicit traveling-wave solutions for the general KdV and NLS equations.

Keywords: Integrable systems; travelling-wave solutions; solitons.

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SOME SPECTRAL PROBLEMS OF DIFFUSION OPERATOR WITH HIGH ORDER APPROXIMATIONS

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Abstract

In this work, we obtain some spectral results of Diffusion operator with high order approximations. Also, we focus on the theorems which include the solution functions belong to the Paley-Wiener Space.

Keywords: Diffusion operator; Sampling theory.

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New Lindley Distribution and Applications

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Abstract

In this paper, we investigated the new Lindley distribution a new, flexible statistical model for positively skewed and heavy-tailed data offering closed-form formulas, moment analysis, and strong real-world applicability across survival, reliability, and biomedical datasets.

Keywords: Lindley family; survival analysis; reliability data; hazard function.

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COMPARISON OF SOLUTION METHODS IN NON-LINEAR EQUATIONS WITH ONE UNKNOWN

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Abstract

In cases where solutions cannot be made with analytical methods, numerical methods are used to find the approximate roots of the equation. In this study, from the nonlinear equation solution methods with one unknown;   closed interval and Open methods. These methods (strengths and weaknesses) were examined and compared.

Keywords: Numerical methods; Closed; Open approximate solutions.

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INVESTIGATION OF ITERATIVE APPROXIMATE SOLUTIONS OF LINEAR EQUATION SYSTEMS

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Abstract

Solutions of problems encountered in engineering and applied science fields may not always be found with direct solution methods. The lack of analytical methods to solve the encountered problem has led to the use of numerical methods. Iterative methods are generally preferred for large linear equation systems. Among these are the “Jacobi iteration method”, the Gauss-Seidel iteration method” and the “(Succesive Over Relaxation – SOR) method”. In this study, these methods are examined and their strengths are emphasized.

Keywords: Numerical Method, Iterative Approach, Error in Approximate

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Regime-Based Modeling of USD/TL via Stochastic Differential Equations and Change Point Estimation

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Abstract

This study examines the USD/TRY exchange rate over the period from April 30, 2015, to April 30, 2025, through a regime-based stochastic differential equation (SDE) modeling framework. Using change point estimation, we identify two structural breaks on November 10, 2021, and March 23, 2022, partitioning the data into three distinct regimes. For each regime, we apply tailored SDEs reflecting their unique statistical characteristics. In Regime 1 (pre-November 2021), a Cox-Ingersoll-Ross (CIR) process is adopted due to its suitability for modeling mean-reverting and strictly positive series with heteroskedasticity. Regime 2 spans a short and turbulent period with limited data, requiring the use of 4-hour interval GBM simulations to enhance sample density for valid calibration. This enriched data enables the application of the Heston stochastic volatility model. In Regime 3 (post-March 2022), characterized by moderately declining volatility, the Heston model continues to provide a flexible structure. The CIR model and Heston models are calibrated using Maximum Likelihood Estimation (MLE), which enables direct parameter inference under each regime's stochastic structure. By integrating regime-dependent dynamics and simulation-assisted calibration in short regimes, the approach achieves higher fidelity in capturing the evolving behavior of the exchange rate. Overall, the methodology emphasizes the significance of data-driven regime segmentation and stochastic modeling for financial time series in emerging markets.

Keywords: change point, Cox-Ingersoll-Rose model, exchange rate modeling, Heston model, stochastic differential equations, stochastic volatility, regime switching, simulation.

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BLOW UP OF SOLUTIONS FOR A FRACTIONAL PETROVSKY EQUATION

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Abstract

This presentation focuses on the fourth-order wave equation incorporating a fractional time delay. We provide preliminary details about the equation to establish the blow-up of its solutions.

Keywords: Blow up, Fractional, Fourth-order equation.

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MATHEMATICAL FOUNDATIONS OF TECHNICAL INDICATORS USED IN FINANCIAL TIME SERIES

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Abstract

In this study, the mathematical background and models behind technical analysis indicators, which are widely used in crypto and stock exchange markets, will be analysed and their links with financial time series data, which are generally stochastic in nature, noisy and high volatility sequences, will be investigated. In addition, in this study, the effects of indicators on the decision-making process of buying or selling in money markets will be analysed.

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THE CURVES WITH MODIFIED ORTHOGONAL FRAME OF IN THE MINKOWSKI 3-SPACE

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Abstract

In this study, the modified frames with both the non-zero curvature and the torsion of the non-unit speed timelike and spacelike curves in Minkowski 3-space E_1^3 are investigated. The relationships between the derivative vectors of the modified frames and the Frenet vectors or the vectors of the modified frames of the timelike and spacelike curves are given.

Keywords:; Minkowski Space; Modified Frame.

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A Look at The Analysis of Coefficients of Univalent Functions with Artificial Intelligence

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Abstract

With artificial intelligence, the information on some subjects can be accessed very easily. We will investigate the effectiveness of the artificial intelligence when the subjects become complex. For this purpose, we examined the competence of artificial intelligence on the subject of estimating the coefficients of the univalent functions.

Keywords: Univalent Functions; The coefficients of Univalent Functions; the artificial intelligence

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DETERMINING THE SHORTEST ROUTE FOR AIR TRANSPORT AFTER A POSSIBLE FIRE IN MUĞLA PROVINCE USING ARTIFICIAL BEE COLONY ALGORITHM

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Abstract

According to the official information on the OGM page, 360,556.20 hectares of land were burned and 54,201 fires broke out in Türkiye between 2000-2023. Of these fires, 4,622 were intentional, 25,183 were accident-negligence, 6,692 were natural, and the cause of 18,835 was unknown (OGM, 2023). In line with this data, it was aimed to determine the possible routes to be used during a fire in Muğla, the province with the highest probability of a fire. Reaching and responding to a fire in a short time reduces the amount of damage that may occur after the fire. In this study, it is considered to use the ABC Algorithm, which is an artificial bee colony algorithm, in the event of a possible Muğla fire. In the proposed study, the ABC algorithm was applied to reach the fire in the shortest time by air and the shortest route was determined.

Keywords: Artificial bee colony algorithm, Shortest Path, Optimization

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Optical solutions for Fokas system in optical fiber

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Abstract

The Modified Generalized Riccati Equation Mapping Method (M-G-REMM) is used in this work to examine the Fokas system, which models the distribution of unpredictable pulse in optical fibers. The equation that defines the system is transformed into a nonlinear ordinary differential equation (N-ODE) using a traveling wave transformation. Consequently, novel complex hiperbolic travelling wave solutions are obtained in multitude. As far as we are aware, no prior literature has reported on these solutions. Regarding the Fokas System, all of our findings have been confirmed using Mathematica and Maple.To enhance comprehension of the dynamic behavior of the current optical solutions with different time parameter values, graphical simulations of many graphs are provided. This makes (M-G-REMM) useful and practical for comprehending nonlinear issues in optic fiber, plasma physics, applied sciences.

Keywords: Modified Generalized Riccati Equation Mapping Method; Fokas system; Optical soliton solutions.

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Hybrid Jump-Heston and Bidirectional LSTM Model with Attraction Mechanism for S&P 500 Forecasting

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Abstract

This study introduces a novel hybrid model for S&P 500 forecasting, integrating the Jump-diffusion Heston stochastic volatility model with an attention-enhanced Bidirectional LSTM (Bi-LSTM). The model leverages Jump-Heston for capturing stochastic volatility and market jumps alongside the Bi-LSTM with attention for temporal pattern learning and feature focus. Trained on daily S&P 500 data (2000-2024), preliminary results demonstrate superior forecasting performance over traditional models by effectively capturing market dynamics like volatility clustering and jump risks. This highlights its potential for risk management and algorithmic trading (Ge, 2025; Ouyang et al., 2024).

Keywords: LSTM, Heston, Jump-Diffusion, S&P500.

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On a solvable difference equations system of second order its solutions are related to a generalized Mersenne sequence

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Abstract

In this paper, we consider a class of two-dimensional nonlinear difference equations system of second order, which is a considerably extension of some recent results in the literature. Our main results show that class of system of difference equations is solvable in closed form theoretically. It is noteworthy that the solutions of aforementioned system are associated with generalized Mersenne numbers. The asymptotic behaviour of solution to aforementioned system of difference equations when a=b and p=0 are also given. Finally, numerical examples are given to support the theoretical results presented in this paper.

Keywords: System of difference equations, solvable system, periodicity.

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THE APPROXİMATİON OF FİXED POİNT OF ENDRİCHED ϕ-CONTRACTİON MAPPİNGS

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Abstract

We introduce the class of enriched ϕ-contractions in Banach spaces as a natural generaliza tion of ϕ-contractions and study the existence and approximation of the fixed points of mappings in this new class, which is shown to be an unsaturated class of mappings in the setting of a Banach space. Weillustrated the usefulness of our fixed point results by studying the existence and uniqueness of the solutions of some second order (p,q)-difference equations with integral boundary value conditions.

Keywords: Banach space; enriched ϕ-contraction; enriched cyclic ϕ-contraction; fixed point; Maia type fixed point theorem; (p,q)-difference equation; integral boundary value condition

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ON ASYMPTOTICALLY EQUIVALENT SEQUENCES IN PROBABILITY

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Abstract

In this study, we give some results related with asymptotically equivalent sequences in probabilitiy.

Keywords: Sequence of random variables; Asymptotical statistical equivalence.

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GENERALIZED BIVARIATE FIBONACCI AND LUCAS POLYNOMIALS BY HESSENBERG MATRICES

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Abstract

In this paper, we give some Hessenberg matrices associated with generalized bivariate Fibonacci and Lucas polynomials, and then investigate the relationships between these matrices and polynomials. We show that determinants and permanents of these Hessenberg matrices are generalized bivariate Fibonacci and Lucas polynomials, which generalize the known results for Fibonacci, Lucas, Pell, Jacobsthal, Fermat, Chebyshev, Morgan-Voyce and Vieta polynomials in both univariate and bivariate forms.

Keywords: Bivariate Fibonacci Polynomial; Bivariate Lucas Polynomial; Determinant; Hessenberg Matrix; Permanent.

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BI-PERIODIC GENERALIZED BIVARIATE FIBONACCI POLYNOMIALS

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Abstract

In this paper, we define bi-periodic generalized bivariate Fibonacci polynomials, which generalize Fibonacci, Pell, Jacobsthal polynomials and bi-periodic generalized Fibonacci polynomials that include bi-periodic Fibonacci, Pell and Jacobsthal polynomials, and other well-known generalized polynomials, in both univariate and bivariate forms. We obtain Binet formulas and generating functions of these polynomials, and then investigate their convergence properties. Also, we prove some new identities that are consistent with the known results of generalized bivariate Fibonacci polynomials.

Keywords: Bi-periodic Fibonacci polynomials; Bivariate Fibonacci polynomial, Generalized Fibonacci polynomial.

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Epidemiological Modeling with Seasonal Environmental Effects

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Abstract

This study deal with a fractional-order epidemiological model incorporating fractional derivatives to capture memory effects inherent in disease transmission. To reflect environmental seasonality, almost periodic functions are introduced, allowing key parameters to vary over time. The existence and uniqueness of solutions are rigorously established. Numerical simulations are presented to illustrate the influence of fractional dynamics and seasonal fluctuations on disease behavior. The results highlight the significant impact of these factors on disease progression, providing a more realistic framework for understanding and managing epidemic outbreaks.

Keywords: Epidemiological modeling, fractional calculus, existence and uniqueness.

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INVESTIGATING CROSSOVER BEHAVIORS IN CHAOTIC SYSTEMS

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Abstract

This work examines the concept of hybrid chaos, characterized by the integration of deterministic order and chaotic behavior within a unified framework. Employing a piecewise modeling approach, distinct chaotic systems are combined over defined intervals, with stochastic elements incorporated to enhance dynamical richness and adaptability. The proposed methodology offers a foundation for advancing hybrid chaotic system design, with potential applications in complex systems across various scientific domains.

Keywords: Crossover behaviors, hybrid chaotic attarctors, stochastic approach.

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EXAMINING THE GOLDEN RATIO-AESTHETIC RELATIONSHIP IN HISTORICAL BRIDGES IN DIYARBAKIR

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Abstract

The golden ratio is a special numerical proportion that is considered aesthetically pleasing and harmonious in both mathematics and art. The golden ratio, approximately equal to 1.618, appears widely in nature and everyday life, ranging from art to sculpture and graphic design. Throughout history, it has often been used in architecture to ensure aesthetic integrity and visual harmony. This research aims to examine the arches of historical bridges based on the concept of the golden ratio and evaluate these structures aesthetically. This study is significant in revealing the aesthetic balance in the design of historical bridges through the use of the golden ratio, thereby contributing to the preservation and evaluation of cultural heritage. The study was carried out on three historical bridges located in Diyarbakır, a city rich in historical and cultural heritage, hosting numerous civilizations throughout history. The presence of the golden ratio in the arches of the examined bridges was analyzed using span-to-height ratios. Deviations from the golden ratio were calculated, and these values were evaluated in terms of the golden ratio-aesthetic relationship. The results showed that the design principles used in bridge construction could be related to the golden ratio and aesthetic criteria. Thus, the importance of examining the aesthetic values of historical structures from a mathematical perspective was highlighted. Additionally, this study makes a significant contribution to the field by combining the aesthetic aspect of historical structures with mathematical analysis.

Keywords: Golden ratio; Aesthetic evaluation; Historic bridges.

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Some effective numerical methods for fractional differential equations

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Abstract

Some efficient numerical methods such as block-by-block, fuzzy transform and interpolation based methods are studied for solving linear and nonlinear single term and multi-term fractional differential equations (MFDEs). The approaches involve converting the given linear and nonlinear MFDEs with some initial conditions into equivalent Volterra integral equations (VIE), and applying the mentioned numerical approaches to the obtained VIES. Error bounds and convergence theorems are discussed for each case, separately. Finally, illustrative and comparative examples are provided to demonstrate the applications of the proposed methods and verify the theoretical results.

Keywords: Multi-term fractional initial value problem, Block-by-block method, Fuzzy tarnsform, Nonlinear Volterra integral equation, weak singularity.

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NHPP SOFTWARE RELIABILITY MODEL INCORPORATING UNCERTAINTY IN OPERATING ENVIRONMENTS WITH PARAMETER ESTIMATION VIA PARTICLE SWARM OPTIMIZATION (PSO)

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Abstract

In this paper introduces a novel Software Reliability Growth Model (SRGM) that integrates imperfect error correction and the stochastic characteristics of operating environments, based on the Non-Homogeneous Poisson Process (NHPP). Unlike traditional models, which assume that testing and operational environments are identical, the proposed model addresses the discrepancies caused by diverse, unpredictable user environments. These environmental variabilities often result in reliability outcomes differing from theoretical predictions. The model accounts for fault detection rates influenced by test coverage and uncertainties in operating conditions. To evaluate its effectiveness, the proposed model was compared against benchmark NHPP SRGMs using real-world software failure data and multiple performance metrics. Parameters were optimized using Particle Swarm Optimization (PSO), demonstrating the model's superior goodness of fit and predictive capabilities. Additionally, the paper discusses the trade-offs involved in determining the optimal software release time, considering cost, reliability, and sensitivity assessments.

Keywords: Non-homogeneous Poisson process (NHPP); Software Reliability Growth Models (SRGMs); New process; Particle Swarm Optimization (PSO); Uncertainty; Simulation.

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