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CERTIFICATE OF PARTICIPATION

This is to certify that

Toufik Roubache

has participated as **"Poster Presenter"** and presented the following paper entitled:

Comparison study of two FTCs strategies for double stator induction machines

during the

INTERNATIONAL CONFERENCE ON APPLIED ANALYSIS AND MATHEMATICAL MODELING, 2024

held on July 19-23, 2024
Biruni University
Istanbul-Turkey

ICAAMM 19-23, July 2024 Biruni Üniversitesi Istanbul

Prof. Dr. Mustafa Bayram
Chairman

Id: 10455	Dr.	Toufik	Roubache	FaceToFace-Poster Presentation	Algeria	Accepted (Participation confirmed by author)

BİRUNİ UNIVERSITY

12th INTERNATIONAL CONFERENCE ON APPLIED ANALYSIS AND MATHEMATICAL MODELING (ICAAMM24)

Abstract Book

July 19-23, 2024,

Istanbul-Turkey

Abstracts Book

Editors
Mustafa Bayram
Aydın Seçer

12th INTERNATIONAL CONFERENCE ON APPLIED ANALYSIS AND MATHEMATICAL MODELING (ICAAMM24) Abstract Book, July 19-23, 2024, Istanbul-Turkey

Abstracts Book

Prof. Dr. Mustafa Bayram
Prof. Dr. Aydın Seçer

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Participant Statistics

230 participants from 29 different countries attended the conference, 28 of them from Turkey and the others from abroad, so 88% participants are foreigners and 12% participants are Turkish.

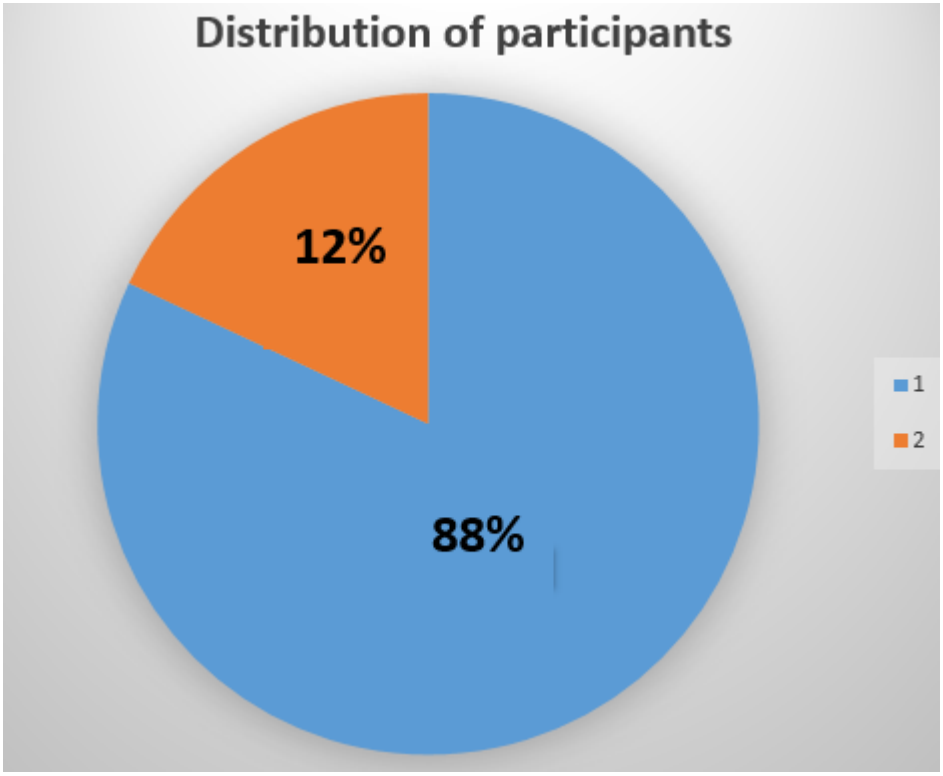

Figure 1: 1. Foreign participants, 2. Turkish participants

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MESSAGE FROM CHAIRMAN

It was with great pleasure that we welcomed you to the "12th International Conference On Applied Analysis And Mathematical Modeling. This conference, which took place in Istanbul, Turkey from July 19-23, 2024, was a hybrid event presented by Biruni University. With a significant turnout of scientists from 29 countries and a total of 230 papers presented, we gathered to discuss the most recent developments, discoveries, and progress in Applied Analysis.

We aimed to delve into the fundamental and frontier theories that act as the backbone of modern science and technology. We hoped to instigate further research interest and explorations into this exciting field. The conference placed a spotlight on the foundational theories and principles, analytical and symbolic approaches, and computational techniques in nonlinear physical science and mathematics. A diverse range of topics was addressed, from nonlinear dynamical systems, nonlinear electronic circuits, and classical and fractional differential equations to nonlinear dynamics in fields such as biology and engineering. We also explored complexity in areas like physics, chemistry, and biomedicine, neurodynamics, social dynamics, data-driven dynamical systems, and mathematical methods in artificial intelligence, among others.

As the number of applications from around the world increased, we faced the challenging task of selecting and categorizing abstracts from numerous participants. We did our utmost to accommodate a wide range of speakers, creating an environment conducive to rich, engaging interactions and exchanges.

We were also delighted to offer a range of social activities including an excursion boat trip and a city tour, providing an excellent opportunity for participants to engage in informal discussions and networking. We were particularly heartened by the robust participation from young researchers, whose presentations contributed significantly to the conference.

The talks covered a wide range of mathematics and its applications such as analysis, algebra, statistics, computer mathematics, discrete mathematics, geometry, and engineering, as well as their use in modeling. We believed that this richness provided the basis for interdisciplinary collaborations.

We want to express our sincere thanks to some key individuals who contributed significantly to the conference's success. Aydin Secer and Dumitru Baleanu, your participation and efforts were truly appreciated. The same goes for Ali Akgul, Yeliz Karaca, Tuğçem Partal, Neslihan Ozdemir, Melih Cinar, Handenur Esen, and Ismail Onder, along with all our colleagues who worked tirelessly for the organization of the conference. In addition, we acknowledged the support and guidance of the chairman of the board of trustees of Biruni University and Prof. Dr. Adnan Yüksel, the Rector of Biruni University, our host institution. We were also grateful to all the plenary speakers who kindly accepted our invitation and dedicated their time to sharing their ideas during the conference.

Our heartfelt appreciation extended to all members of the organizing committee. If any individual or contribution has been unintentionally overlooked or forgotten, we hope for their kind understanding. We sincerely thanked all who put their effort into making this occasion possible.

We were delighted to welcome each and every one of you to this conference. We hope it was an enjoyable and productive experience and look forward to meeting again on future occasions.

Sincerely Yours,
Prof. Dr. Mustafa Bayram,
Conference Chair

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Lamiche Chaabane, University of M'sila, Algeria
Luis Vazquez, Universidad Complutense de Madrid, Spain
Mahmoud Abdel-Aty, Sohag University, Egypt
Mustafa Bayram, Biruni University, Turkey
Michal Fečkan, Comenius University, Slovakia

Pleneary Speakers

Ravi P. Agarwal, USA
George Anastassiou, USA
Dumitru Baleanu , Lebanon
Mahmoud Abdel-Aty, Egypt
Jamal-Odysseas Maaita, Greece
Juan R. Torregrosa, Spain

Hossein Jafari, South Africa
Ali Akgul, Turkey
A. Cordero, Spain

Invited Speakers

Jordan Hristov, Bulgaria
Luis Vazquez, Spain
Yeliz Karaca, USA
Carla Pinto, Potugal
Mir Sajjad Hashemi, Iran
Sunil Dutt Purohit, India
Abdelsalam Gomaa Abdelsalam, Qatar
Jose Francisco Gomez Aguilar, Mexico
Zakia Hammouch, Morocco
Amin Jajarmi, Iran
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Nauman Ahmed, Pakistan
Zaid Odibat, Jordan
Shahram Rezapour, Iran
Carlo Grebogi, UK
Raoul Nigmatullin, Russia
Amar Debbouche, Algeria
Babak Shiri, China
Irina Perfilieva, Czech Republic
Mohammad Hossein Heydari, Iran
Praveen Agarwal, India
Jan Awrejcewicz, Poland
Valentina Emilia Balas, Romania

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ORAL and POSTER PRESENTATIONS

Analysis of Fractal, Fractional and Conformable Derivatives and Integral Transforms

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Abstract: In this work, we have investigated the fractal, fractional and conformable derivatives. We have considered many mathematical models with these derivatives. We have applied many integral transforms to these models. We have considered many new numerical methods to get the approximate solutions of the models. We compare the exact solutions with the approximate solutions. We demonstrate our results by some tables and figures. We prove the efficiency of the proposed techniques.

Possible breakthrough in fractional order modeling of epidemiological systems

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Abstract: In the last years a myriad of papers have been written in fractional epidemiological models. Most of them ae mere generalizations of integer-order models, without any relevant biological assumption, only based in the incorporation of a "memory effect". The ODes are replaced by fractional differential equations (DE). Unfortunately questions such as: What is the physical and biological interpretation of fractional models? are everywhere to be found. We will try to discuss this and other issues pertaining to the modeling of fractional order DE.

Keywords: Caputo derivative, epidemiology, breakthrough, modeling.

Parametrized Trigonometric derived Lp degree of approximation by various smooth singular integral operators

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Abstract: In this work we continue with the study of smooth Gauss-Weierstrass, Poisson-Cauchy and Trigonometric singular integral operators that started in 1997. This time the foundation of our research is a trigonometric Taylor's formula. We prove the parametrized univariate Lp convergence of our operators to the unit operator with rates via Jackson-type parametrized inequalities involving the first Lp modulus of continuity. Of interest here is a residual appearing term. Note that our operators are not in general positive.

Investigating the dynamical behavior of systems with a positive maximal Lyapunov Characteristic Exponent near zero

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Abstract: In this talk, we will try to answer the question: " What is the dynamical behavior when the proposed system has a positive maximal Lyapunov Exponent" near to zero?". To do so, we investigate many dynamical systems with the help of several numerical tools, such as Poincare sections and the Smaller Alignment Index.

Keywords: maximal Lyapunov Characteristic Exponent, Chaotic motion, Smaller Alignment Index

Cardinal basis functions for fractional problems involving the Hadamard derivative

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Abstract: The Hadamard type fractional derivatives are a generalization of the fractional operator $(t^d)^n dt$ (where $n \in Z^+$) with a logarithmic kernel function. Such derivatives play a vital role in physics and engineering problems. It is shown that the Hadamard fractional derivatives are more suitable for modeling very slow processes. Solving problems with the Hadamard's fractional derivatives is much more complicated, due to the logarithmic kernels of these derivatives. The structure of these fractional derivatives (due to logarithmic kernels) is such that many numerical methods used for problems with other fractional derivatives cannot be easily developed for fractional problems with the Hadamard's derivatives. in recent years, different numerical technique, such as the generalized Legendre functions method, finite difference technique, reduction method, generalized sine–cosine wavelets method, Galerkin finite element method, Legendre-spectral method, Krawtchouk wavelets method and Haar wavelets method have been developed to solve such problems. In this talk, we investigate the use of the cardinal basis functions to solve some classes of fractional problems involving the Hadamard's fraction derivatives. Some proper basis functions, such as the logarithmic Chebyshev cardinal functions, shifted Chebyshev polynomials and hat functions are employed to solve these problems. The methods established based on these functions turn solving the problem under consideration into solving an algebraic system of equations, which can be easily solved.

Keywords: Hadamard fractional derivative; Logarithmic Chebyshev cardinal functions; Coupled nonlinear Schrodinger-KdV equations; Coupled nonlinear Schrodinger-Hirota equations.

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Mathematical Modeling, Stochastic Processes and Computational Complexity in Precision Medicine: Medical and Clinical-related Applications with Fractional Calculus Operators, Bloch Torrey Partial Differential Equation, Hidden Markov and Artificial Intelligence

Yeliz Karaca

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Abstract: Mathematical models for uncertain phenomena are applicable for the purposes of description as well as computation of complex dynamical behaviors, which ensure the applicable mathematical formulations of neural dynamics across the temporal and spatial scales. Thus, the form of equations subsequently facilitating the comprehension of the subtleties of the original problem also help with the discovering of the new attributes concerning complex problems. Human brain, as one of the most complex networks of nature, manifests chaotic, stochastic and dynamic aspects entailed in its analysis considering the neurological configuration. Besides these, with its fractal structure, human brain demonstrates complex dynamics with fractals in the brain being marked by irregularity, singularity as well as self-similarity in terms of forms at different observation levels, which may render detection difficult due to the fact that observations in real-time occurrences can prove to be time-variant, discrete, continuous or noisy. Stochastic models, on the other hand, are characterized in applications with observations being probabilistic functions of the state, encompassing doubly stochastic process that ensures the inferring of the underlying stochastic process. Congruently, stochastic processes are mathematical models that are constructed through a family of random variables, and by reducing the problem to its fundamental characteristics and addressing the relationship with the flow of interacting elements, mathematical models are known to provide abstractions accordingly. Across this line, Hidden Markov Model (HMM), as a stochastic process, elicits that implicit or latent stochastic processes can be inferred indirectly through a sequence of observed states considering that observations are probabilistic functions of the state, and hence, HMM is proven to be beneficial for purposes of modeling, simulations and applications across a multitude of scientific disciplines. The computational complexity of all the models are calculated so that the complexity of equations can be measured based on the degrees to reduce computational time (time parameter) and make the most use of data storage (space parameter) to ultimately enhance compatibility with models. Apart from these points, advanced mathematical models are known to be employing multifaceted methods for extracting information from the images. Accordingly, Diffusion Magnetic Resonance Imaging (DMRI), as a noninvasive and experimental imaging technique, provides clinical and research applications, lending a measure concerned with the diffusion characteristics of water in biological tissues, particularly in the brain tissues. While delving into neuronal dynamics, the aforementioned techniques provide a reliable way to detect and generate accurate quantitative parametric instruments while reflecting the subtle properties of brain tissues, focusing on the precise connections between tissue microstructure and signals. For the evaluation of computational complexity pertaining to the finite difference method, Bloch–Torrey partial differential equation and fractional methods demonstrate the significance of applicable mathematical models to achieve an optimal level of accuracy to identify the total simulation time as well as the diffusion coefficient of the simulated tissue. Consequently, the critical manifolds of multifaceted mathematical modeling in conjunction with Artificial Intelligence (AI) as well as machine learning contribute to robust scientific understanding by validating the relevant multidisciplinary aspects to substantially enhance hyperparameter optimization based on complex data-based problems from the lens of solution-oriented schemes and systems.

Keywords: Mathematical Neuroscience; Stochastic Processes; Hidden Markov Model (HMM); Markovian processes; Bloch Torrey Partial Differential Equation; Fractional Calculus; Medical Imaging; Diffusion Magnetic Resonance Imaging (DMRI); Artificial Intelligence (AI); Computational Complexity; Neural Dynamics, Accurate Neuron Geometry Models; Optimal Predictive Dimension of Changes; Hyperparameter Optimization; Precision Medicine.

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Iterative processes for nonlinear problems: from Newton to nowadays

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Abstract: Solving nonlinear problems modeled by the expression $F(x) = 0$, where F is a nonlinear function between two Banach spaces, is both a classical and topical problem that numerous researchers have worked on throughout history and in recent years is being very prolific, in part thanks to the computational tools that are being developed.

In general, there are no analytical methods to solve these problems, so we must use iterative schemes that approximate the solution by starting from an initial estimate. Among these procedures, possibly the best known and most widely used is Newton's method, whose iterative expression is

$$x_{k+1} = x_k - [F'(x_k)]^{-1} F(x_k),\ k = 0, 1, \ldots,$$

where $F'(x_k)$ is the "derivative" of function F evaluated in the iterate x_k. This scheme has quadratic convergence under some conditions.

Throughout history, and especially in recent years, numerous new iterative methods have been designed trying to improve the convergence speed, without increasing too much the computational cost and smoothing the convergence conditions. In this paper we will present an overview of this development from different points of view.

One of these approaches is the use of complex dynamics or multidimensional real dynamics tools to analyze the stability of the different methods, selecting those with good properties and rejecting those with chaotic behavior.

Stability analysis and optimal control of variable-order fractional covid-19 dynamic discrete model

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Abstract: In this work, we introduce an improved class of covid-19 dynamics involving a discrete-time and fractional variable order. We investigate the well-posedness results under appropriate set of sufficient conditions. Then, we find the disease-free equilibrium point and endemic equilibrium point. Next, we investigate the local asymptotic stability of the considered model. Further, we formulate a new discrete fractional optimal control problem for covid-19 using a discrete mathematical model with a variable order fractional derivative. Finally, we give numerical simulations to clarify and confirm the obtained theory.

Keywords: Variable-order derivative; fractional discrete calculus; covid-19 model; optimal control; stability; numerical simulation.

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What is a generalized fractional operator?

Dumitru Baleanu

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Abstract: Fractional calculus is an interdisciplinary field, and it is deeply connected with complicated processes appearing in various areas of research. Recently the generalized fractional operators and the modified versions of non-singular fractional operators are considered some of the hot topics within fractional calculus area.In my talk I will concentrate on the basic definition of the generalized fractional operator and modification of fractional operators with Mittag-Leffler.

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Some Basic Properties of Harmonic Functions Defined by the Salagean Operator

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Abstract: The paper introduces a new subclass of harmonic functions within the unit disk, defined by the Salagean differential operator. It explores various properties, including close-to-convexity, coefficient bounds, and growth estimates. Furthermore, the study investigates convolution and convex combination properties for this specific class.

Keywords: Harmonic functions, Salagean derivative, close-to-convex functions, convolution.

Mathematics Subject Classification: 30C45, 30C50.

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Image denoising by anistropic nonlinear model and deep neural network architecture

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Abstract: The image's restoration is an essential step in image processing. Several filters have been developed to eliminate noise, the most interesting of which are those that allow image denoising while preserving semantically important structures. A recent class of adaptive denoising methods is the nonlinear partial differential equations, which is currently enjoying considerable success for images of acceptable size.

After the mathematical study of a nonlinear evolution partial differential equation proposed for image processing. The existence and uniqueness of the solution are established. Using a finite-difference method with the AOS scheme, we experiment the validity of the proposed model and illustrate the effectiveness of the method using a few specified images. Next, we propose another restoration technique based on deep neural networks, which has enabled us to overcome the problem of processing large images. The techniques presented in this article significantly improve the pre-processing of large images. We present some numerical experiments and compare the signal-to-noise ratio (SNR) and the RMSE error.

Keywords: Anistropic diffusion model, Deep Neural Network, image processing, Riemann boundary conditions, SNR.

Mathematics Subject Classification: 35K55, 35Q68, 68T01, 68U10

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Transformers for aircraft emergency landing sites semantic segmentation

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Abstract: A forced landing, which can occur unexpectedly due to factors like engine malfunctions, adverse weather conditions, or other emergencies, presents a critical challenge in aviation. So, emergency aircraft landing site detection is a critical task for ensuring the safety of passengers and crew in case of an emergency. Pilots are traditionally trained to visually identify suitable landing sites by assessing visible terrain from the cockpit, a fundamental skill in flight training. However, adverse environmental conditions such as fog, rain, or poor lighting along with the high stress conditions generated by such emergencies can significantly make this task harder, making the selection of an appropriate landing site highly dependent on the pilot's experience, which varies widely among individuals. Recognizing this challenge, there is potential for the development of a Deep Learning (DL) based automatic emergency landing site suggestion system. Surprisingly, research in this field appears to be relatively limited, leaving room for innovation. By leveraging advanced image segmentation techniques[2, 3, 4, 5], such a system could assist pilots in identifying safe and optimal emergency landing sites, ultimately enhancing the safety of the aircraft and the well-being of passengers and crew members during critical situations. We believe that our method can pave the way for more advanced and reliable emergency aircraft landing site recommendation systems in the future.

In this paper, we propose the usage of a vision transformer[1] based model tailored to identify safe landing areas. Furthermore, we make use of our own dataset specifically designed for emergency landing area segmentation. In this context of emergency landing site detection within the larger field of remote sensing, it is strikingly evident that there exists a noteworthy lack of comprehensive research dedicated to the critical domain of identifying suitable aircraft emergency landing zones. A substantial portion of the existing state-of-the-art research [6, 7, 8, 9], predominantly centers its attention on the relatively more straightforward task of pinpointing singular landing coordinates specifically tailored for unmanned aerial vehicles (UAVs). However, our primary research focus diverges from this mainstream goal, gravitating towards the considerably more intricate and consequential task of detecting secure and accessible landing strips that can be readily utilized as emergency runways for a diverse range of general-purpose aircraft, thereby addressing a pivotal gap in the existing literature. This nuanced shift in perspective underscores the significance of our research and its potential to significantly enhance the field of remote sensing for aviation safety.

Keywords: vision transformer, semantic segmentation, emergency landing site detection.

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Optimization of Path Loss Models in Urban Areas Using 4G-LTE Networks

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Abstract: The paper discusses the influence of propagation environment and optimization of path loss models in urban areas using 4G-LTE networks. It has made it possible to achieve high speeds while reducing latency; it is based on the transmission of data only, the latter at theoretical speeds of around 100 Mb/s. It considers the measurement and prediction results for a special case of propagation. Both theoretical and measurement-based propagation models indicate that average received signal power decreases logarithmically with distance. We will then compare the different results obtained depending on the distance between the mobile and the BTS and the parameters presented above show that the model microcell is optimal for urban areas compared to all other models and COST231, using Long Term Evolution networks.

Keywords: Studies, 4G-LTE, Evolved Paquet System network, wireless, path loss, model arc/harq, Cost 231.

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Finite difference implicit scheme for diagonal non-conservative hyperbolic systems

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Abstract: In this work we present a convergence result for an implicit Upwind scheme considering the framework of hyperbolic systems, which are not necessarily strictly hyperbolic [2]. Related to this work, it is worth noting that, in [3] the authors have proved a similar result for a semi-explicit scheme in the case of non-conservative strictly hyperbolic systems. Moreover, their result was only valid in the class of vanishing viscosity solutions, introduced by Bianchini and Bressan in [1]. Here, we show the convergence taking only Lipschitz continuous solutions, without any other restriction concerning the class of solutions.
An application of this result is done on a simplified one-dimensional model describing the dynamics of dislocations, where dislocations are microscopic defects present in materials, especially in metal alloys. The movement of these defects is the main explanation of plastic and viscoplastic deformations.
In a particular geometry, where dislocations are assumed to be punctual defects, depending on a single variable x and moving in two fixed directions, according to the vector $(1,0)$ (on the right) or according to the vector $-(1,0)$ (on the left), Groma and Balogh have modeled in [4] the dynamics of the dislocations densities by a (2×2) coupled system of non-local transport equations .

Keywords: Implicit upwind scheme, diagonal non-conservative hyperbolic systems, transport systems, discrete gradient estimates, Lipschitz discrete solutions. Error estimate

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Existence results for p(t)-Laplacian fractional differential equations

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Abstract: We explore the existence of solutions for a class of differential equation that include mixed-type fractional Caputo derivatives and the non-standard growth operator called the p(t)-Laplacian. Using various fixed point theorems, we prove that solutions exist for these equations. Furthermore, we investigate the Ulam-Hyers stability.

Keywords: Boundary value problem, Existence of solution, Fractional derivative, Stability

Mathematics Subject Classification: 34B40, 34B15.

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Fractional neutral differential equations involving $(k,\psi)-$Hilfer fractional derivative and control: Complete controllability exploration

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Abstract: The complete controllability of a new class of Sobolev type nonlinear $(k,\psi)-$Hilfer fractional system in Hilbert space are studied. The results are obtained by using ideas from semigroup theory, $(k,\psi)-$Hilfer fractional calculus, fractional power of operators and fixed point theorem under the assumption that the associated linear system is completely controllable.

Keywords: Complete controllability; Fractional differential equations; (k,ψ)-Hilfer fractional derivative; Mild solution; Fractional power; Fixed point theorem.

Mathematics Subject Classification: 93B05, 26A33, 34K37, 47H10

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Packing chromatic number for certain classes of graphs

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Abstract: Let $G = (V, E)$ be a simple graph with no isolated vertices. Given a positive integer i, an *i-packing* in G is a subset W of the vertices of G such that the distance between any two distinct vertices from this set is greater than i. This concept encompasses also the notion of an independent set, which is edentical to a 1-packing. The *packing chromatic number* of a graph G is the smallest integer k such that the vertex set of G can be partitioned into disjoint sets $W_1, W_2, \ldots, W_k$, where W_i is an i-packing for each $i \in \{1, 2, \ldots, k\}$. We denote this number by $\chi_\rho(G)$. The corresponding mapping $c : V(G) \to \{1, ..., k\}$, satisfying the property that $c(u) = c(v) = i$ implies $d_G(u, v) > i$, is called a *packing coloring* of order k. The packing coloring is considered to be optimal, when $k = \chi_\rho(G)$. It was introduced by Goddard et al. in [3] and study its properties. Also, they showed that it is NP-hard to determine if $\chi_p(G) \leq 4$. First, it was presented under the name broadcast chromatic number, and the current name was given by Brešar et al. in [1]. The packing chromatic number has been investigated in a number of papers (see [2, 4, 5, 6]). In this paper, we consider the packing chromatic number of the Mycielski of the $p-th$ power graph, with a special emphasis on the second power graph ($2-th$ power graph), for specific graphs such as the Mycielski graph of a path and a cycle.

Keywords: Packing chromatic number, Mycielski graph, Power graph.

Mathematics Subject Classification: 05C15, 05C12, 05C70

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Numerical development for an integro-diffirential equation depending in acceleration trem

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Abstract: The objective of this work is the analytical and numerical study of integro-differential equations by methods based on successive Picard methods. Our work is generalization other work of degrees 1 in the framework of non-linear Volterra. This kind of equations came from dynamic system especially the dynamic systems esume the seismic problems, the cases studied in the previous work depends only on the speed and my work depends on the speed and the acceleration, we obtain the existence and the uniqueness using the Nyström method adapt to solve our problem.

Keywords: Volterra integral equation, system of integral equations, integro-differential equations, Nystrom method.

Mathematics Subject Classification: 45J05, 47G20, 34K28, 45L05, 65R20

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An intelligent conditional integrator sliding mode controller for a two-degree-of-freedom robotic arm

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Abstract: In this study, we have designed a conditional integrator sliding mode controller for a two-degree-of-freedom robotic arm based on swarm intelligence (PSO). The main idea of the designed control is that the integral action only acts when the system state reaches the sliding surface; elsewhere, it is zero or close to zero. This controller allows for the avoidance of the degradation of the system's transient response regime resulting from conventional integral action. Additionally, it avoids chattering and ensures zero static error, even in parametric uncertainties and external disturbances. The system's response is improved by scheduling the controller's switching gains with a PSO algorithm. Several numerical simulations are carried out in the Matlab/Simulink environment. Compared with three other sliding mode controllers, the results demonstrate that our controller is better regarding time criteria such as rising time, settling time, max overshoot, and stationary error.

Keywords: Sliding mode control, Conditional integrator, Particle swarm optimisation, Manipulator robot

Mathematics Subject Classification: 70E60, 68T40

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Enhanced Restarting PINN with Functional Link Artificial Neural Network on the Solution of Thermal Partial Differential Equation

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Abstract: Breast cancer is a serious health concern for women globally, spanning both developed and developing countries. One potential approach is to monitor observing abnormal surface temperatures as an early diagnostic treatment. In this research, The PDE thermal analysis is employed in terms of investigating the thermal behavior of the human breast. Physics-Informed Neural Networks (PINN) with a restarting strategy (r-PINN) is utilized to generate the numerical approximation of the PDE thermal. The restarting process monitors loss values, and if no improvement occurs, the method restarts with the best weights from the previous cycle. This ensures the efficiency of the convergence obtaining the smallest loss value, avoiding wasteful iterations. In fact, we combined the idea of the r-PINN method with a Functional Link Artificial Neural Network (FLANN). FLANN extends the r-PINN structure by introducing additional nonlinear transformations using Legendre polynomials function after the input layer. With this combination, we aim to demonstrate the effectiveness of this approach in accurately observing abnormal surface temperatures of the human breast, even in scenarios with limited sample points availability. The proposed method was compared to the basic r-PINN and PINN in terms of accuracy and efficiency. The research highlights the robustness and superiority of this approach, positioning it as a valuable tool for studying temperature behavior related to breast cancer.

Keywords: Breast cancer, PDE thermal analysis, r-PINN, FLANN, Legendre

Some new results on the coalition number

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Abstract: Let $G = (V, E)$ be a simple graph of order n, and let V_1 and V_2 be two nonempty disjoint subsets of V. We say that V_1 and V_2 form a coalition in G if neither V_1 nor V_2 dominates G but their union $V_1 \cup V_2$ does dominate it. A vertex partition $\mathcal{P} = \{V_1, V_2, ..., V_k\}$ into $k \geq 2$ nonempty disjoint subsets of V is called a coalition partition, abbreviated c-partition, in G if every subset V_i in $\mathcal{P}$ is either a dominating set containing a single vertex of degree of $n - 1$, or it is not a dominating set but forms a coalition with another subset V_j. The coalition number of G, denoted $C(G)$, is the largest integer k for which G has a c-partition of cardinality k. This concept was introduced by Haynes et al. [1]. In this paper, we provide a new bound on the coalition number and we give exact values for some special graphs.
Keywords: Domination, vertex partition, coalition

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On independent [1,k]-set in graphs

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Abstract: For an integer $k \geq 1$, a subset $S \subseteq V$ in a graph $G = (V, E)$ is an independent $[1, k]$-set of G if S is independent and every vertex in $V - S$ is adjacent to one but no more than k vertices in S. The upper $[1, k]$-independence number noted $\alpha_{[1,k]}(G)$ is the maximum cardinality of an independent $[1, k]$-set of G. In this paper, we provide a constructive characterization of graphs having an independent $[1, k]$-set, while for split graphs, a necessary and sufficient condition is given for those having an independent $[1, k]$-set. Moreover, some upper bounds on $\alpha_{[1,k]}(G)$ are established for graphs having an independent $[1, k]$-set. We also establish a Nordhaus-Gaddum type result for the upper $[1, k]$-independence number, where in addition, a characterization of extremal graphs attaining each bound is provided. Finally, we show that the decision problem corresponding to the problem of computing the upper $[1, k]$-independence number is $\mathcal{NP}$-complete for bipartite and chordal graphs.

Keywords: Independent [1,k]-sets, upper [1,k]-independence number.

Mathematics Subject Classification: 05C69

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Analytical and Computational aspects on an Unreliable Retrial Queue with Two Distinct Customer Types

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Abstract: Retrial queues serve as effective representations of numerous real-world scenarios, spanning from computer networks to telephone switching systems, telecommunications networks, and computer systems. This research delves into the analysis of a single server retrial queue, accommodating two distinct customer types: persistent and impatient. The model intricately accounts for diverse aspects of customer behavior and system dynamics, encompassing service times, retrial times, repair times, as well as specific reserved times for impatient customers only.

In order to refine the authenticity of the modeling approach, the study introduces novel concepts such as a service orbit and service repairs, activated in the event of server breakdowns. This innovative model holds promising applications across a spectrum of fields. The establishment of Chapman-Kolmogorov equations anchors the theoretical framework, while the application of the supplementary variables method facilitates the presentation of steady-state solutions. Furthermore, the provision of explicit closed-form expressions for various performance metrics aids in constructing an anticipated total cost function.

Supplementing the theoretical underpinnings, numerical results are presented to elucidate the impact of system parameters on both performance metrics and the total cost function.

s **Keywords:** Retrial queues, Markov chain, Performance metrics, Steady-state solutions

Mathematics Subject Classification: 90B22, 60K25

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Combination of approximation and statistical methods for the ruin probability assessment in risk models

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Abstract: We discuss in this work the benefit of combining some approximation methods (stability method, Markov chain and regenerative possesses) and statistical techniques (boundary kernel method and transformation kernel method) to enhance the ruin probability assessment in classical models presenting large claims. Numerical results based on simulation and insurance real data as well as comparative studies are presented to show the performance of our combined approach.

Keywords: Approximation, Kernel estimation, Stability, Risk model, insurance

Mathematics Subject Classification: 91B30, 34K20, 62G07

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Solvability of a fractional boundary value problem involving Riesz fractional derivative

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Abstract: In this work, we study the solvability of a Riesz fractional boundary value problem. By reducing the considered problem to an equivalent singular integral equation, we provide the existence of solution via Krasnoselskii's fixed point theorem. Then, we give a new Lyapunov's inequality for the corresponding fractional boundary value problem.

Keywords: Riesz fractional derivative, existence of solution, fixed point theorem

Mathematics Subject Classification: 34A08, 26A33

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Optimizing a linear Fractional function over an integer efficient set of a Multi-Objective Linear Program

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Abstract: Optimizing a linear function over a discrete efficient set problem studied by Jorge (2009) is extended in this paper to a nonlinear case. An algorithm is developed that maximize a ratio of two linear functions over the integer set of a multi-objective linear program (MOILP) without explicitly having to enumerate all the efficient solutions. The proposed exact method is based on a simple selection technique that improves the main linear fractional objective function Φ at each iteration while reducing the feasible region and eliminating dominated points. The optimal value of the function Φ is obtained in a finite number of steps of the algorithm. A numerical example illustrates the method.

Keywords: multiple objective programming, integer programming, linear fractional programming, efficient solutions

Mathematics Subject Classification: 90C29, 90C10

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Optimal Embedding of some new classes of Balanced Binary Trees in Hypercube

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Abstract: The hypercube is a structure whose topology is used in different fields such as computer science, combinatorics, code theory, etc. The problem of embedding trees into the hypercube is much studied in the graph theory. In fact many efforts have been devoted to find sufficient conditions for which a tree T is a subgraph of the hypercube Q_n. The problem consists of giving the smallest dimension of the hypercube in which a given tree T is embeddable. In this paper, we introduced new classes of balanced binary trees and we determine their cubical dimension.
Keywords: Binary Tree, Cubical dimension, Embedding, Hypercube

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Modeling and fuzzy logic based nonlinear control of three-level grid-connected PV system with active filter functionality

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Abstract: This paper presents the modeling and fuzzy logic based nonlinear control of three-level single-stage PV system connected to the grid. The T-type inverter is used in this paper instead of conventional NPC one, which would increase the efficiency of system and ensure power quality. The control is designed for the inverter to act simultaneously as power converter and active power filter, if nonlinear loads are connected to the point of common coupling. To achieve these tasks with a good dynamic performance, a nonlinear control strategy based on the fuzzy logic controller is developed based, with a suggested adequate approach of setting the scaling factors, based on linear approximation to the proportional-integral controller, which considerably affect the system's response. The obtained results using numerical simulations confirmed the expected performances of the proposed control, in term of maximum power extracting, power quality and unity power factor. Furthermore, these performances are more highlighted when compared to the PI controller during the dynamic state.

Keywords: Grid-connected PV system modeling, Fuzzy logic control design, Active power filtering

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Using least-squares adjustments to analyse nuclear data from AME2020

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Abstract: In the present work, least-squares adjustments have been used to analyse nuclear data from the Atomic Mass Evaluation 2020 with the aim of determining the coefficients of the classical Bethe-Weizsäcker mass formula. The obtained set of formula coefficients allowed us to reproduce almost all the experimental values of the binding energies for each nucleus with $A > 50$. The comparison between the binding energies provided with the updated mass formula and those of AME2020 shows relative errors oscillating between 0.05% and 1.5%. The revisited Bethe-Weizsäcker formula is in very good agreement with experimental data.

Keywords: least-squares adjustments, AME2020, Binding Energy of atomic nuclei, Mass formula parameters.

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Enhancing the Remaining Useful Life Prediction of Lithium-Ion Batteries Using Deep Learning Approaches

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Abstract: Lithium-ion batteries occupy an important place in realm of renewable energy and e-mobility due to their unique advantages offering higher energy density and low self-discharge. Many well-known aging sources of Li-ion batteries contribute to their degradation impacting the reliability and safety of battery-powered systems. An effective way to indicate the health of lithium-ion batteries is to predict the remaining useful life (RUL) to schedule maintenance, optimize operating efficiency, and avoid unplanned downtime. The experimentation with aging Li-ion battery sources and their mathematical description for life-prediction models are still challenging issues. Data-driven methods have gained popularity due to their flexibility and ease of use. In this context, we have proposed a Transformer based neural network model benefiting from its good capture to long-time dependencies by an attention mechanism to improve the accuracy and performance of the RUL prediction and benchmarked the results to other existing deep learning models using a set of evaluation metrics. The proposed model gives better prediction results. These models are validated using publicly available datasets.

Keywords: Lithium-ion batteries, State of Health Estimation, Prognostic and Health Management, Data-driven Machine Learning, Artificial Neural Networks, Deep Learning, Long Short Term Memory Recurrent Neural Network, Transformer

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Existence results for a strongly nonlinear elliptic system in Sobolev spaces with variable exponent

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Abstract: In this work, we study the existence of a distributional solution for a strongly nonlinear $(p(x), q(x))$-elliptic system. By means of the Berkovits degree theory, with suitable assumptions on the nonlinearities, we establish the existence of a nontrivial solution to our problem.

Keywords: Topological degree, Strangly nonlinear elliptic system, p(x)-Laplacian.Sobolev spaces

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A Method for Solving a Multicriteria Bilinear Game

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Abstract: In this work, we present a procedure to find a Pareto-Nash equilibria in multicriteria bimatrix game corresponding to the Nash equilibria of a scalarized bimatrix game. For this, we used the method of "H. Benson" to solve a first multicriteria program and obtain an effective extreme point with the vector weight associated with this solution that we use to solve a second multicriteria linear program and obtain an extreme point effective with the associated weight vector. The two weight vectors are used to scalarize the original multicriteria game, that we solve by an algorithm for enumerating the extremes Nash equilibria. The resolution of the scalarized bimatrix game provides the set of Nash equilibria which corresponds to the set of Pareto-Nash equilibria in the original multicriteria bimatrix game.

Keywords: Multiobjective Linear Programming, Bimatrix Games, Benson's Procedure

Mathematics Subject Classification: 65Kxx, 91A05

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An Efficient Simplex Algorithm for Training SVM Classification Problems

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Abstract: Solving large-scale support vector machine (SVM) problems is a challenging task. Traditional classification SVM problems are formulated as a convex quadratic programming (QP) problem with bounded variables. We propose to tackle this QP using a novel Simplex algorithm, named SMQP-SVM. By introducing a new concept, called working-basis, the structure of an iteration of SMQP-SVM will be further simplified. It generates a decreasing sequence of basic feasible points that converges to the global optimal solution. SMQP-SVM algorithm has the particularity to avoid using the null-space matrix, which invokes the reduced Hessian matrix when the descent direction is calculated at each iteration. The proposed working-basis selection scheme employes the second-order information, prevents degeneracy cases, and guarantees the nonsingularity of the working-basis matrix throughout all iterations.
In order to evaluate the performance of our SMQP-SVM solver over the state-of-the-art solvers, like LIBSVM implementing the sequential minimal optimization (SMO) algorithm and the revised simplex method (SVM-RSQP), we have performed numerical experiments on several datasets. Comparison results show that our approach SMQP-SVM is efficient when solving large-scale SVM problems.

Keywords: Support vector machines, quadratic programming, simplex method, working-basis

Mathematics Subject Classification: 90C20, 68T09

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An inverse problem of determining a time-dependent coefficient in a time-fractional reaction-diffusion equation with involution and periodic boundary conditions

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Abstract: In this paper, we study an inverse problem of determining a time-dependent coefficient in one-dimensional time-fractional reaction-diffusion equation with involution. The time-fractional derivative is described in the conformable sense. The direct problem is the initial-boundary value problem for this equation with usual initial and periodic boundary conditions. To determine the unknown time-dependent coefficient, we consider with additional measurement condition at the point $x = 0$ of the reaction-diffusion process. Under some assumptions on the input data, the well-posedness of this inverse time-dependent coefficient problem is shown by using Fourier's method and Banach's fixed point theorem. Furthermore, we propose a numerical algorithm based on a collocation method and a finite-difference scheme to solve this inverse problem. Finally, some numerical examples are presented to confirm the reliability and effectiveness of this numerical algorithm.

Keywords: Inverse time-dependent coefficient problem, Fourier's method, Banach's fixed point theorem, Collocation method, Finite-difference scheme.

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On the existence of the Berge equilibrium in the non-cooperative Bayesian game

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Abstract: In this work, we study a class of static non-cooperative games with incomplete information introduced by Harsanyi [3], which is Bayesian games, we introduced the definition of the Berge equilibrium for a Bayesian game. By using Bayes' formula, we have simplified the definition initially introduced by Berge [1]. Based on the Shauder's fixed point theorem [5] used in the study of the problem of existence of the Bayesian Nash equilibrium and those used in the problem of existence of the Berge equilibrium for a game in normal form, we have established sufficient conditions for the existence of the Bayesian Berge equilibrium. To illustrate the obtained results some examples are given.

Keywords: Game theory, Bayesian game, Nash equilibrium, Berge equilibrium, Shauder fixed point theorem.

Mathematics Subject Classification: 91Axx, 91A10, 91A06

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A New Complex Number Definition: Distinct Imaginary Numbers

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Abstract: A new base complex number is defined. To distinguish it from the usual complex number i, the name "distinct imaginary number" is proposed with a shorter referral of "dimaginary number" and symbol j. The complex number with this new base included can be referred to as dicomplex numbers (distinct complex numbers) accordingly. Based on the new definition, the basic arithmetic operations are handled first. Taylor series expansions with the new complex number are given next. Application areas such as finding roots of polynomials, analytical geometry in three and higher dimensional spaces are discussed. The new definition extends the usual two-dimensional complex plane into three and higher dimensional spaces.

Keywords: complex numbers, roots of polynomials, Taylor series expansions, analytical geometry

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Estimation of the regression function using the asymmetric kernel method

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Abstract: In statistics, regression plays an important role in extracting the relationship between two random variables, *X* and *Y*. Generally, parametric regression is utilized to derive and evaluate this relationship. However, this type of estimation cannot be universally applied, leading to the use of nonparametric estimation in certain cases. The kernel method is one such nonparametric estimation method, initially defined for symmetric data, which presents challenges in its application to asymmetric data. This research aims to investigate nonparametric regression using associated kernel methods in cases involving positive real data. We applied this estimation using Gamma and Beta kernels, and for other kernels, we assessed the performance of the estimation through simulation studies. Finally, we applied the proposed estimators to real data.

Keywords: Non parametric regression, Asymmetric associated kernel, Continuous univariate kernel

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Augmented truncation approximations of discrete-time Markov chains

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Abstract: Calculating the stationary distribution for a stochastic infinite matrix is typically challenging and lacks closed-form solutions. Therefore, it's advantageous to have simple approximations that quickly converge to this distribution. Suppose P represents the transition matrix of a discrete Markov chain on $\mathcal{S}$ with an invariant distribution π. Consider a sequence $\mathcal{S}_k$ within $\mathcal{S}$. We aim to find methods for approximating π using P_k, where P_k is obtained from the linear augmentation of the $(k+1)\times(k+1)$ "northwest truncation" of P. Let $V : \mathcal{S} \to [1, +\infty)$. In this work, an explicit bounds are obtained for the distance between $\widehat{\pi}_k$ and π. Finding such computable bounds is of practical importance, which enables one to determine the needed truncation size. For this, we extend the result of Hervé and Ledoux [1]. For V-geometrically ergodic chains, computable upper bounds have been derived. These bounds seem a little complex for direct application, however, they are improved and become applicable even for stochastically monotone chains. We then establish a bound for $|\pi f - \widetilde{\pi} f|$ for any f integral performance measure. Finally, we give a random walk example to illustrate the application of these bounds.

Keywords: Truncation, Queuing System, Weak Stability, Markov chain and Algorithm.

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Econometric modeling of olive oil production in Bejaia from 2000 to 2021

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Abstract: Agriculture in Algeria has a large part of the land and it has an important role in the transformation of the environment by man who has shaped the landscape and natural ways of life over the centuries.
Algerian agriculture has seen the application of a new policy since the 2000s, with the aim of encouraging investment in production sectors.
Olive growing is one of the activities practiced in the Algerian mountains. It is characterized by a wide range of 36 varieties in the Willaya of Bejaia.
The production of olive oil depends on several factors, including the existence of olive plantations, the quality and quantities of the olives harvested, as well as the use of modern techniques.
The aim of this paper is to model the production of Bejaia olive oil according to different factors, namely the surface area and the number of trees. This is why we used econometric method of analysis. This article is divided in two parts.
In the first part we built the regression model for the independent variable by estimating the model parameters using the ordinary least squares method.
The second part will be devoted to testing the significance of different parameters and validating our model, using the Eviews software.

Keywords: Agriculture, olive oil, multiple linear regression, statistical tests.

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Reliability analysis of the unreliable server and impatient customers

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Abstract: Retrial queuing systems have been widely used to model many practical and real problem arising in telephone switching systems, telecommunication networks, computer systems, and production inventory systems, etc.
The main characteristic of these queues is that the customers who find the server busy upon arrival joins the retrial group called orbit in order to repeat this request for service after some random time.

In various domains ranging from customer service centers to transportation systems, queues are ubiquitous phenomena that significantly affect operational efficiency and customer satisfaction. Understanding the reliability of queues becomes paramount, particularly in scenarios where arrivals occur in groups and customers may become discouraged due to prolonged waiting times.
The main of this work is to investigate some reliability indices of the unreliable sever, bath arrival and impatient customers. We derive reliability indices from the queuing system under study, such as the availability Av and failure frequency Ff of the server. Which will provide the information required from the improvement of the system. To justify and validate the analytical results.

Keywords: Reliability, bath arrival, impatient customers, unreliable server.

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Boundary control of a viscoelastic flexible marine riser with nonlinear Terms

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Abstract: In this work, we investigate the boundary stabilization of a flexible marine riser problem with nonlinear Terms. We prove a stability result which depends on the properties of the riser. This is established through the judicious choice of a control acting on top of the riser. We use the multiplier technique to prove stability result.

In this work we stabilize the system by using a viscoelastic material and an appropriate boundary control. The model is

$$\begin{cases} \rho w_{tt} + EI(w_{xxxx} - \int_0^t h(t-s)w_{xxxx}(s)ds) - Tw_{xx} + |w|^p w = 0 \\ \forall (x,t) \in (0,L) \times [0,\infty), \\ w(0,t) = w_x(0,t) = w_{xx}(L,t) = 0,\ t \in [0,\infty), \\ w(x,0) = w_0(x),\ w_t(x,0) = w_1(x),\ x \in [0,L], \\ EI\left(-w_{xxx}(L,t) + \int_0^t h(t-s)\, w_{xxx}(L,s)\, ds\right) + Tw_x(L,t) \\ = u(t) - d_S w_t(L,t) - M_S w_{tt}(L,t),\ \forall t \in [0,\infty), \end{cases} \tag{0.1}$$

where $w(x,t)$, T, EI represent the displacement, the tension and the bending stiffness of the riser respectively, the parameters: d_s, M_S, $w_t(L,t)$ represent the damping, the mass and the velocity of the vessel respectively, the uniform mass per unit length of the riser is the parameter $\rho > 0$, $w(L,t)$ is the position of the vessel and L denotes the length of the riser.
The dynamics of the flexible riser is indicated by the partial differential equation of system (0.1) and the ordinary differential equation describes the vessel dynamics. At the top boundary of the riser, a boundary control is proposed. It is important to mention that due to the infinite dimensionality of the system (P.D.E), it is difficult to control the dynamics of a flexible mechanical system. If the diameter to the length of the riser is small, we can represent the marine riser as an Euler–Bernoulli beam structure. We refer the reader to [3]-[4] and [6]-[10] where the authors used this structure to study the dynamic of a flexible marine riser. Following the ideas introduced in [5], we prove a stability result for the system.

Keywords: Boundary control, multiplier technique, Euler- Bernoulli beam structure, viscoelasticity.

Mathematics Subject Classification: 35L20, 93D15, 93D20.

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Mann's stochastic approach for estimating parameters of the Black-Scholes model

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Abstract: A new fixed point method is proposed for estimating volatility in the Black-Scholes model. This approach incorporates Mann's stochastic algorithm, enabling efficient iteration to achieve precise estimations. In this work, we explore the use of this method to determine the implied volatility of options.

To demonstrate the effectiveness of our approach, we conduct an empirical study applying our method to real market data, particularly to the prices of European call options. This application showcases how Mann's algorithm can adapt to real market situations and provide reliable estimates of implied volatility.

Keywords: Black-Scholes model; Volatility; Mann's stochastic approach

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A Parametric Uncertainty Analysis Based on Bayesian Approach

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Abstract: A Bayesian approach for computing model output metrics under epistemic uncertainty in the model input parameters is proposed. Specifically, we compute the expected value and the variance of the stationary distribution associated with Markov reliability models. Numerical results are presented and compared to the corresponding Monte Carlo simulations ones.

Keywords: Epistemic uncertainty, Bayesian approach, Markov reliability model

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Bimodal Biometric Identification Based on the Fusion of Finger Veins and Finger Knuckle Print

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Abstract: Multimodal biometrics, which consists of combining several biometric indicators by personal identification systems, has received increasing research interesting for biometric recognition due to several advantages. In fact, this approach reduces certain limitations of unimodal biometric systems, such as the lack of data extracted from certain people or intentional fraud. At this level, the multimodal biometric systems can represent an efficient alternative by merging several biometric indicators. In this paper, we propose an automatic identification of people through their biometric data. To this end, we use two biometric modalities, the Finger Veins (FV) and the finger knuckle print (FKP), to perform our biometric system. A set of textural features, such as Local Binary Pattern (LBP), Binarized Statistical Image Features (BSIF), Radon and Gabor, are applied on the images of these two modalities in order to extract the feature vectors. Then, Support Vector Machines (SVM) is involved to classify the combined vectors into the right classes. Our system combines the advantages of each modality for getting a robust and an accurate recognition system. The experiments conducted on FKP and FV fingerprint datasets showed that our system provides excellent results in terms of recognition rate and precision. The comparison with the state-of-the-art-method demonstrates also the superiority of the proposed system.

Keywords: Multimodal Biometrics, Finger Veins, Finger Knuckle Print, Fusion, Support Vector Machines.

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Stochastic analysis of GI/M/s queue with negative arrivals

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Abstract: In this work, we consider the stochastic analysis of a multiserver $GI/M/s$ queue with negative arrivals under the RCE discipline using the embedded Markov chain. We carried out the existence of stationary regime of the embedded Markov chain. We also derived some performance measures.

Keywords: Queue with negative arrivals, Stochastic Analysis, embedded Markov chain.

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Stability and Almost-Periodic Solutions Of Beams Networks with Structural Damping

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Abstract: We study the stability of a semi-infinite network of Euler-Bernoulli beams with structural damping under some interesting conditions on the damping coefficient. Additionally, we investigate the existence of almost periodic solutions to our problem.

Keywords: Euler-Bernoulli equation, beams, infinite star-shaped network, almost periodicity, structural damping, stability

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Investigating the Dynamics of Positive Solutions of a Three-Dimensional System of Difference Equations with rational terms

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Abstract: Difference equations play a pivotal role in various fields of science and engineering, offering a powerful framework to model dynamic systems evolving over discrete time intervals. Researchers interested in dynamic systems, nonlinear dynamics, and applied mathematics are particularly drawn to the challenges and opportunities presented by difference equation systems. Understanding the asymptotic behavior of solutions, oscillatory patterns, and periodicity in these systems is crucial for predicting long-term dynamics and designing effective control strategies.
This presentation aims to contribute to this vibrant research area by delving into the study of asymptotic behavior, oscillation, and periodicity in a class of three-dimensional difference equation systems. By using the boundedness of solutions, we establish conditions for local and global stability, we also provide conditions for the existence of periodic solutions.

Keywords: Difference Equations, Global and Local Stability, Periodicity

Mathematics Subject Classification: 39A05,39A23, 39A30

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Preservation of homoclinic orbits after discretization in a degenerate system

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Abstract: If a differential equation has to be solved only over a finite time interval, numerical methods aim to get a precise discrete approximation of the solution. However, if behaviour of solutions over infinite time intervals is of high interest, then the errors may grow, and it could be impossible to prove that the numerical solution is close to the exact solution. Otherwise, convergence of a method over finite intervals does not guarantee persistence of long-term characteristics of solutions in the numerical approximation, which may take on many possible phenomena when applied to certain dynamical systems.
Dynamical behaviours in discrete equations are more complicated than those corresponding continuous-time differential equations. Furthermore, the difficulty is more stressed because a solution obtained by Euler's method tends to go outwards of the exact solution. In the hyperbolic case, it is shown that, subject to certain conditions, the phase portrait of the differential system is correctly reproduced in the associated discretization by a one step method, on an arbitrary time interval.
Knowing that after discretization by Euler's method the solution of a differential equation pulls outwards, contrary to the idea which consists in believing that homoclinic solutions, solutions tending to the equilibrium point when time tends to $+\infty$ and $-\infty$, do not persist in the associated discretized system, this work aims to show that in very degenerate systems, this is not necessarily the case. Our main interest in the present work is to study the homoclinic region in which any orbit started from this region is homoclinic, for a planar differential system, in the nonhyperbolic case, and for the discrete system associated by Euler's method; we describe this homoclinic region and show that the corresponding Euler discretized system has a homoclinic region converging to that of the continuous one when the step size of the discretization tends to zero.

Keywords: homoclinic orbit, discrete system, iterative method, periodic orbit

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The boundary value problem concerns a weighted fractional derivative involving a function of variable order

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Abstract: This study aims to address weighted fractional operators of variable order within specific spaces. We investigate a boundary value problem involving the weighted fractional derivative of one function with respect to another function of variable order. It's important to note that the symmetry of a transformation for differential equations is closely linked to local solvability, which indicates the existence of solutions. Consequently, establishing existence requirements for the weighted fractional derivative of a function with respect to another function of constant order becomes necessary. Additionally, we review stability within the Ulam–Hyers–Rassias sense. The findings are obtained through the application of the Kuratowski measure of non-compactness. A model is presented to demonstrate the reliability of the obtained results.

Keywords: Weighted fractional integrals; Weighted spaces of summable functions; Fixed point theorem; Derivatives and integrals of variable order; Boundary value problem; Measure of non-compactness.

Mathematics Subject Classification: 26A33; 47H08; 34B15; 34A08; 37C25

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Sensitivity analysis in genetic network models

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Abstract: Probabilistic Boolean Network (PBN), has a critical problem which is to study the steady-state probability distribution for network analysis. In this paper, we provide a perturbation analysis for Probabilistic Boolean Networks with gene perturbations models (PBNp), by introducing a new perturbation bound such stochastic models. Specifically, we establish efficient bound of the relative error between the disturbed model and the nominal one. Additionally, our new bound exploit more completely the stochastic features of the perturbation and which also applicable to a Markov transition matrix that has a large size. The efficiency of the proposed bound is shown with several numerical examples and obtained numerical results are compared with the known ones in the literature.

Keywords: Perturbation bound, Stochastic Boolean Network with gene perturbation, nominal model, perturbed model, Markov chains.

Mathematics Subject Classification: 30E; 37N; 65C

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The Autohomeomorphism Groups of Some Digital Lines

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Abstract: For a topological space X, the group of autohomeomorphisms is denoted by $\mathcal{H}(X)$. It is a well-established fact that even if two topological spaces X and Y have isomorphic autohomeomorphism groups, it does not necessarily imply that X and Y are homeomorphic. A space X is considered homogeneous if its autohomeomorphism group, $\mathcal{H}(X)$, acts transitively on X, via the action

$$\begin{array}{ccc} \mathcal{H}(X)\times X & \longrightarrow & X \\ (g,x) & \longmapsto & g(x). \end{array}$$

The degree of homogeneity of X, denoted as $d_h(X)$, is defined as the cardinality of the quotient set $X/\mathcal{H}(X)$ relative to the aforementioned action.
Regarding the Khalimsky topology defined on the set of integers, this topology, denoted by $\mathcal{K}$, is the topology generated by the family

$$\{\{x-1, x, x+1\} : x \text{ is an even integer}\}.$$

The space $(\mathbb{Z}, \mathcal{K})$, known as the Khalimsky line or digital line, is called the *Khalimsky line (or digital line)*, will be denote it by $\mathbf{KL}$ (or $\mathbf{KL}_1$). The digital line is notably influential in digital image processing and computer graphics. The aim of this paper is the construction of a sequence of Alexandroff topologies, $\{\mathcal{K}_p : p \in \mathbf{N}\}$, on the set of integers $\mathbb{Z}$. This provides new digital lines with the following properties:

- $\mathcal{H}(\mathbb{Z}, \mathcal{K}_p)$ is isomorphic to $\mathcal{H}(\mathbb{Z}, \mathcal{K})$.
- For each positive integer p, $(\mathbb{Z}, \mathcal{K}_p)$ is topologically embedded in $(\mathbb{Z}, \mathcal{K}_{p+1})$.
- $d_H(\mathbb{Z}, \mathcal{K}_p) = p + 1$.

Keywords: Alexandroff space, Degree of homogeneity, Group of autohomeomorphisms, Khalimsky line, Reversible space

Mathematics Subject Classification: 22F50, 20B27,54F65

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Finite Rings and Error Correcting Codes

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Abstract: One of the most active and important research areas in algebra is the investigation of finite rings. These rings have been successfully applied in various fields, especially in coding theory and cryptography.
Error-correcting codes were introduced by Claude Shannon in 1948 to the field of information theory to address noise added by communication channels. The primary aim of coding theory is to construct codes that are easy to encode and decode, can detect and correct many errors, and have a sufficiently large number of codewords.
Algebraic codes and rings are closely connected in at least two fundamental ways. Firstly, code alphabets often have a ring structure rather than just being a set. Secondly, the codes themselves can often be constructed and studied as modules over some ring.
LCD codes have been widely applied in data storage, communication systems, consumer electronics, and cryptography. Formally self-dual codes are another important class of codes that have generated significant interest because their weight enumerators are invariant under the MacWilliams transform and they sometimes have better parameters than self-dual codes.
In this work, we present new constructions of LCD and formally self-dual cyclic codes over certain finite rings.

Keywords: Finite Principal Ideal Rings,Finite Chain Rings,Error Correcting Codes

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On the multiplicity of non radial solutions for fractional p-Laplacian problems

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Abstract: In this work we are mainly concerned with the existence of non radial solutions for the following Dirichlet problem,

$$\begin{cases} (-\Delta)_p^s u = f(|x|, u) & x \in \Omega \\ u = 0 & x \in \partial\Omega \end{cases}, \tag{0.2}$$

where, Ω be the ball $B(0,R)$ in $\mathbb{R}^N$, centred at 0 and of radius R, with $N \geq 2$, $|x| := \sqrt{\sum_{i=1}^{N} x_i^2}$, is the Euclidean norm of x in $\mathbb{R}^N$, $(-\Delta)_p^s$ is the fractional p-Laplacian operator with $0 < s < 1 < p < +\infty$, $sp < N$, and f is radial function satisfying some conditions.
Our approach is based on a variational method.

Keywords: fractional p-Laplacian problems, minimization with constraints, periodic solution.

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A multi-server queue in a multi-phase random environment with waiting servers and customers' impatience under synchronous working vacation policy

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Abstract
In this work, we study an infinite-space multi-server queueing model in random environment with impatient customers (balking and reneging) and waiting servers at which the servers are subjected to single and multiple working vacation policies. Once the system is empty, the servers have to wait a random period of time before leaving, causing the system to move to vacation phase 0 at which new arrivals can be served at lower rate. We drive the steady-state probabilities for the system using the probability generation functions. Then, we develop a cost model and provide an appropriate optimization via a quadratic fit search model (QFSM) to get the optimum values of the service rates during the both vacation and operative phases.

Keywords: Queueing models, Random environment, Working vacation policies, Impatient customers, Optimization

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A second order BVP with time depending operator on the whole-line

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Abstract: This paper is concerned with existence results of a boundary value problem posed on the whole line with a nonlinear term and time depending derivative operator. We will use Schauder fixed theorem to prove existence of classical and weak solutions. Existence of weak solution consists also one implication of the Molchanov criterion for the non linear problem (0.3).

$$\begin{cases} y''(x) - q(x)y(x) + h(x,y) = 0, \quad -\infty < x < +\infty. \\ \lim\limits_{|x|\to+\infty} y(x) = 0. \end{cases} \tag{0.3}$$

Keywords: infinity interval, sign changing nonlinearity, differential equation, variable coefficient, weak solution, Molchanov.

Mathematics Subject Classification: 34B40. 34B27. 34B15

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Euler Bernoulli beam equation with two boundary fractional fedbacks

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Abstract: We consider an Euler Bernoulli beam equation with two boundary control condition of fractional derivative type. We study the existence of solution of the system using the semigroup theory of linear operators.

Keywords: Euler Bernoulli beam equation, boundary dissipation of fractional derivative type, Frequency domain method

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Euler Bernoulli beam equation with two boundary fractional fedbacks

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Abstract: We consider an Euler Bernoulli beam equation with two boundary control condition of fractional derivative type. We study the existence of solution of the system using the semigroup theory of linear operators.

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Strategic Pricing for Hazelnut Producers: MN-Method and Linear Programming Approaches

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Abstract: This study proposes a solution strategy to optimize the selling price and period for hazelnut producers amidst the uncertainties inherent in agricultural production and marketing. Employing linear programming and the MN method, the research begins by defining matrix games and introducing these techniques as effective tools for resolving decision-making challenges. Subsequently, it delves into the decision-making process under uncertainty, assessing the MN method's efficacy in navigating this complexity. The study outlines the sequential steps in addressing the hazelnut pricing problem, underscoring the utility of linear programming and the MN method. Finally, the effectiveness and accuracy of the MN method are evaluated through a comparison with alternative methodologies documented in the literature.

Keywords: Linear programming, MN-method, matrix games, decision-making under uncertainty

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Average Solutions of Differential Equations Containing Fractional Derivatives of Orders Governed by Probability Distributions with Bounded Support

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Abstract: In this study, various ordinary differential equations are transformed into non-integer ordered differential equations containing the Caputo fractional derivative. The orders or derivation have been selected from probability distributions with bounded supports and the resulting equations have been analyzed with fde12 algorithm to obtain the arithmetic mean of the solutions of the fractional differential equations. The mean solutions from each probability distribution are compared with each other and the solution of the ordinary differential equation to comment on the effects of the probability distributions and the order of derivation. Results show that the selection of non-integer ordered derivatives driven by a probability distribution provides a more generalized investigation for the differential equation.

Keywords: Caputo derivative, Beta distribution, fde12 algorithm, Simulation, Triangular distribution

Mathematics Subject Classification: 34A08, 34F05

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Soliton Dynamics in the Perturbed Dispersive Nonlinear Schrödinger Equation with Multiplicative White Noise by the F–Expansion Method

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Abstract: This paper investigates the soliton solutions of the perturbed dispersive nonlinear Schrödinger equation with multiplicative white noise. Nonlinear wave equations, particularly the nonlinear Schrödinger equation, are pivotal in describing a wide array of complex wave phenomena across various scientific fields. Solitons, as stable and localized wave packets, play a crucial role in understanding nonlinear wave behavior. However, in real-world scenarios, wave propagation is often subject to stochastic perturbations, which can significantly alter the dynamics predicted by deterministic models. By incorporating multiplicative white noise into the dispersive nonlinear Schrödinger equation, we develop a more realistic model that accounts for these stochastic effects. We employ the F-expansion procedure to derive exact soliton solutions, including dark soliton solutions, singular soliton solutions, bright soliton solutions, straddled singular-singular soliton solutions, complexiton solutions, and straddled dark-bright soliton solutions. Additionally, we explore the parametric restrictions necessary for the existence of these solutions, providing a comprehensive analysis of the conditions governing soliton formation and stability. Our findings contribute to the theoretical understanding of soliton dynamics under stochastic influences and have practical implications for physical systems where multiplicative white noise plays a crucial role.

Keywords: solitons, white noise, F–expansion

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Dark and Singular Soliton Solutions in Perturbed Fokas–Lenells Equation with Nonlinear Chromatic Dispersion and Quadratic Self-Phase Modulation

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Abstract: In this paper, we address the quiescent optical solitons to the perturbed Fokas–Lenells equation incorporating both nonlinear chromatic dispersion and quadratic self-phase modulation. Utilizing the Modified Extended Tanh-function Method, Generalized Kudryashov Method, Auxiliary Kudryashov Method, and Addendum to Kudryashov Method, we derive a variety of soliton solutions, including dark soliton solutions, singular soliton solutions, straddled soliton solutions, complexion solutions, and singular periodic solutions. Furthermore, we perform a comprehensive analysis of the parametric restrictions necessary for the existence of these solutions, elucidating the conditions under which these solutions are valid. Our findings contribute to a deeper understanding of the dynamics of optical solitons in nonlinear media, providing valuable insights into their stability and propagation characteristics.

Keywords: perturbed Fokas–Lenells equation, nonlinear chromatic dispersion, quadratic self–phase modulation

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Qualitative Analysis for Nonlinear Fractional Difference Equations

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Abstract: This research work is devoted to exploring new results for the solutions of fractional difference equations. We have focused on the properties of the solutions like oscillation, and nonoscillation. Firstly, we have built some hypotheses. Our results are presented based on these hypotheses. Finally, we provide some examples to illustrate the effectiveness of our theoretical findings.

Keywords: Fractional, Difference operator, Difference equations, Nonoscillation

Mathematics Subject Classification: 39A10,39A21,26A33,45M05,45M20

Application of Wavelet-Galerkin Approximation Techniques on the Partial Differential Equations via Maple

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Abstract: In this study, we consider the fractional SIR model and its stochastic equivalent based on fractional derivatives to model the spread of infectious diseases. The aim of the fractional SIR model is to describe disease dynamics more flexibly and realistically by incorporating uncertainties and random events. Maximum Likelihood Estimation (MLE) is used to improve the accuracy of parameter estimation. Our empirical results show that the fractional stochastic SIR model provides a more sensitive and realistic representation of disease dynamics by considering uncertainty and random events. Our simulation results show that the fractional SIR model is a powerful approach for modelling and analysing epidemic diseases.

Keywords: Dynamics of the Fractional Order SIR Model

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Derivation of optical solitons of dimensionless resonant nonlinear Schrödinger equation with the Kudryashov's law

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Abstract: The main target of this study is to derive optical soliton solutions of the (1+1)-dimensional resonant nonlinear Schrödinger equation (NLSE) with the Kudryashov's law in the presence of spatio-temporal and inter-modal dispersions. First of all, the analytical method is performed to generate the analytical soliton solutions of the equation under consideration. Therefore, dark and kink soliton solutions are obtained. To show the physical attitude of some of the acquired solutions, 3D, 2D, and contour graphics are demonstrated. In particular, to find out the influences of the Kudryashov's law, spatio-temporal dispersion, inter-modal dispersion terms of the traveling wave transformation on the soliton dynamics of the proposed equation, 2D graphs for several values of coefficients are depicted. The acquired consequences ensure us with the knowledge that the considered equation can be investigate from a physical perspective. It can be concluded that the applied method is effective technique to extract the analytical solutions for the resonant NLSE.

Keywords: Resonant nonlinear Schrödinger equation, Optical fibers, Kudryashov's law, Spatio-temporal dispersion.

Mathematics Subject Classification: 35R11

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Revealing optical soliton solutions of the perturbed Schrödinger-Hirota equation with generalized anti-cubic law of nonlinearity

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ABSTRACT In this study, we aimed to reveal the optical solitons of the perturbed nonlinear Schrödinger-Hirota equation with generalized anti-cubic law of nonlinearity. The relevant model is one of the phenomena that models soliton propagation in fiber optics. The model also includes a spatio-temporal dispersion term. It is known to be an inclusive model in that it includes nonlinearity, spatio-temporal dispersion and perturbation together. In this study, we obtained soliton solutions with a well-known and effective method called enhanced Kudryashov method. We also examined the effects of the parameters in the equation on the solutions we obtained and presented them with graphics.

Keywords: Optical solitons; Perturbed Schrödinger-Hirota equation; Enhanced Kudryashov method

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Producing soliton solutions for the nonlinear complex Ginzburg-Landau model including generalized quadratic-cubic law nonlinearity and chromatic dispersion

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Abstract: This paper focuses on producing soliton solutions for the nonlinear complex Ginzburg-Landau model having generalized quadratic-cubic law nonlinearity and chromatic dispersion [1]. The nonlinear complex Ginzburg-Landau model serves as a principle framework for modeling wave propagation in diverse nonlinear media, such as photonic systems and optical fibers [2]. Incorporating generalized quadratic-cubic nonlinearity and chromatic dispersion, the equation captures a broader range of physical phenomena, offering a more comprehensive depiction of nonlinear interactions. The wave transformation is utilized to reduce the main equation to a nonlinear ordinary differential equation. Besides, we enforce the unified Riccati equation expansion method [3, 4, 5] to retrieve the analytical solutions for the presented model. Moreover, we depict the 3D, contour, and 2D graphical representations of the acquired solutions to investigate the physical behavior of the obtained solutions.

Keywords: Ginzburg-Landau equation, unified riccati equation expansion method, soliton solutions.

Mathematics Subject Classification: 35A24, 35C07, 35R11

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Introduction of a model describing two zones with an interface

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Abstract: In this communication, we investigate the invasion of a village by the domestic species Triatoma Dimidiata. The village is located next to a forest, serving as the natural habitat for these vectors. They enter the village to feed, primarily consuming blood meals from the humans or mammals with whom they coexist. It is during this feeding phase that the primary transmission of Trypanosoma Cruzi from the vector to the host occurs.
The village is defined by the domain Ω, with the buffer zone identified as Ω_+ situated between Ω and the forest. An interface exists between Ω and Ω_+.
In our study, we examine a population of these triatomines structured both in terms of time and space. The demographic and spatial dispersion processes are described using reaction-diffusion equations in a two-dimensional space. By working within appropriate functional spaces, we convert this system of partial differential equations into an abstract differential equation. Our initial goal is to demonstrate that the operator generates an analytic semigroup. Subsequently, we establish the existence and uniqueness of a solution to the corresponding Cauchy problem.

Keywords: Transmission problem; reaction-diffusion; analytical semi-group; sector operator

Mathematics Subject Classification: 35K57, 47D06

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Solving the Generalized Chavy-Waddy–Kolokolnikov Model: Analytical Approaches to Bacterial Colonies

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Abstract: This study examines the analytical solutions of the Chavy-Waddy–Kolokolnikov model describing the behavior of bacterial colonies. The model is characterized by a nonlinear fourth-order partial differential equation. With the help of diverse analytical methods, the explicit solutions of the considered model are obtained. The derived analytical solutions are confirmed to satisfy the main equation through Mathematica. To demonstrate the behavior of bacteria, numerical simulations of the solutions are achieved using Matlab.

Keywords: Bacterial Colonies, Analytical Solutions, Nonlinear Partial Differential Equation, Mathematical Modeling

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How to Treat Gene Expression Data for Mathematical Modelling in Dynamical Sense

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Abstract:
In literature, several different approaches exist to collect, process and visualize gene expression data. Gene expression analysis requires detailed consideration of confounding biological factors. Gene expression data can be viewed as a matrix of rows and columns where the rows represent the genes and the columns show the specific conditions of the array measurement. In this work, a gene expression dataset in time series format is used illustratively which belongs to a yeast bacteria microarray chip experiment. Its characteristics are identified and the underlying dynamics of the biological process are modelled in a time-discrete manner using some advanced mathematical modelling tools.
Keywords: Mathematical modelling, differential equations, data processing

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Travelling Wave Solutions of the Benney-Roskes/Zakharov-Rubenchik System

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Abstract: This study presents the travelling wave solutions of the Benney-Roskes/Zakharov-Rubenchik system which was derived in the context of water waves. We apply the new Kudryashov method to obtain solutions effectively. This results in obtaining bright and singular solutions, and we also create graphical presentations to analyze the effects of problem parameters.

Keywords: Benney-Roskes system; Zakharov-Rubenchik system, The new Kudryashov method.

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Stochastic Analysis with Zili's Generalized fractional Brownian motion

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Abstract: We initiate a stochastic analysis theory with respect to the generalized fractional Brownian motion (gfBm) introduced by M. Zili in [1], which is a Gaussian process extending both fractional and sub-fractional Brownian motions. In fact, in the last decades, many extension kinds of fractional Brownian motion (fBm) and sub-fractional Brownian motion(sfBm) processes have been introduced such as the multifractional Brownian motion, the mixed fractional Brownian motion, the bifractional Brownian motion, the mixed sub-fractional Brownian motion and the generalized sub-fractional Brownian motion. But all these extensions do not generalize fBm and sfBm in the same time: each of them extends either only fBm or only sfBm. The Zili's Generalized fractional Brownian motion is completely different from all the above cited processes; in particular, it should allow researchers to deal with a larger class of modeled natural phenomena, including those with stationary or with non-stationary increments, whereas with fBm we can model only phenomena with stationary increments, and sfBm allows us to model only phenomena with non-stationary increments. Moreover, the gfBm depends on three parameters, that should allow us to construct more adequate models, allowing for example to control the level of correlation between the increments of the studied phenomena. This feature is not available with already known fractional and sub-fractional Brownian motions, and consequently it should overcome the deficiency of fBm and sfBm models due to their dependence on one single constant (the Hurst parameter). In this work, the main stochastic properties of the gfBm are established and its sample paths are simulated. Besides, Malliavin divergence operator and a Stochastic symmetric integral with respect to this process are defined, and sufficient integrability conditions are provided. Furthermore, corresponding Itô formulas are established, then applied to introduce a generalized version of the fractional Black–Scholes option pricing model.

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The Qualitative Properties of Integro-Delay Differential Equations

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Abstract: This work deals with behaviors of solutions of a DIDE. Four theorems, which have new sufficient conditions on the uniformly stability, asymptotic stability, exponential stability, instability of zero solution have been proved via the Lyapunov–Razumikhin method. Finally, an example is given to show applications of the given theorems.

Keywords: Integrability, exponentially stability, instability, asymptotically stability.

Mathematics Subject Classification: 34D05, 34K20, 45J05

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Flood Modeling Using Spatial Pair-Copula Construction

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Abstract: This paper presents a hydrological application of bivariate pair-copulas to model the spatial distribution of floods in Peninsular Malaysia. Accurate estimation of hydrological variables, such as average annual rainfall, rainfall severity, and duration, is crucial for the success of flood mitigation projects. Traditional spatial interpolation methods, such as kriging, rely on the assumption of linear spatial dependence and generate a single average value to reflect spatial correlation over a certain distance. However, this approach may not capture the non-linear dependence patterns present in the data. To overcome this limitation, the study proposes the use of spatial pair-copulas to model non-linear spatial dependence. Spatial pair-copula have the capability to capture complex spatial dependence structures more effectively than traditional methods. As a result, they provide greater accuracy in modeling relationships among hydrological variables. In the proposed spatial pair-copula model, the achieved results are promising in predicting annual maximum rainfall values at unobserved locations.

Keywords: Geostatistics Analysis, Hydrology, Spatial Copula, Multivariate Analysis

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Fractional order of differential inclusions with lipschitz perturbations of an inverse strongly monotone and maximal monotone operators

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Abstract:
We study the existence and uniqueness of solutions for a class of fractional differential inclusions with lipschitz perturbations of maximal monotone operators in a real space with initial condition. The primary findings concerning existence and uniqueness are derived through the application of theory of multivalued fixed points.

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Advanced Control Strategies and Energy Optimization for Hybrid Energy Storage in Electrified Vehicles

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Abstract: Hybrid electric vehicles (HEVs) have arisen as a significant technological innovation in the automobile industry, playing a novel and ecologically beneficial kind of transportation that is gaining popularity around the world. They are powered by electrical generators and provide a clean and sustainable alternative to traditional vehicles that use fossil fuels. Furthermore, HEVs, as symbols of the shift to more sustainable mobility, play an important role in mitigating climate change and safeguarding our planet for future generations; Direct Torque Control holds significant importance in the realm of electric vehicles. The DTC enables precise and responsive control of the motors by directly adjusting the torque produced, without the need for complex transmission systems. The incorporation of control mechanisms in HEV cars is critical for improving overall performance, efficiency, and safety. Sliding mode control (SMC) holds significant importance when applied to direct torque control (DTC) in electric vehicles. By implementing the SMC technique, the DTC system can enhance its ability to manage torque production of the electric motor, leading to improved performance and increased robustness. The control and energy management of a fuel cell-supercapacitor electric vehicle are the subject of this research. The energy management system employed in this study aims to harness the rapid charging and discharging capabilities of supercapacitors in order to mitigate the strain placed on fuel cells due to sudden power requirements. The HEV is controlled by a sliding mode controller with direct torque control. The simulation findings validate the efficacy of the provided energy management and sliding mode control solutions based on direct control.

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Mathematical Methods Safety Barrier Performance Assessment

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Abstract: Most well-designed systems have safety barriers against such circumstances to protect humans, the environment, and material assets. This makes it harder for any one initiating event to propagate through all the barriers culminating in a hazardous event or accident. Some barriers are set up to prevent accidents from occurring (prevention barriers). Others are in place to reduce the consequences of an event once it has already occurred (mitigation barriers). The purpose of this paper is evaluating the performance of the existing safety barriers and according to risk tolerable decides if more additional barriers should be implemented.

Keywords: Barrier, Failure, Lopa, Tolerable risk, Safety instrumented system

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On The Dynamics Of Time-Dependent Three Coupled Oscillators

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Abstract: Quantum dynamics of general time-dependent three coupled oscillators is investigated through an alternative approach based on decoupling of them using the unitary transformation method. From a first unitary transformation, the quantal Hamiltonian of the complicated original system is transformed to an equal but a simple one associated with the three coupled oscillators of which masses are unity. Finally, we diagonalize the matrix representation of the transformed hamiltonian by using a unitary matrix. The diagonalized Hamiltonian is just the same as the Hamiltonian of three simple oscillators.Through these procedures, the coupled oscillatory subsystems are completely decoupled. The importance of this decouplement is that it enables us to develop exact theory for mechanical treatment of the originally-coupled systems without any restriction in the form of time-varying parameters.

Keywords: Time-dependent three coupled oscillators; Unitary transformation; Hamiltonian; Wave function. unitary operators.

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Parallel Active Filter Analysis, Control, and Diagnosis

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Abstract: In this work we expose the problem of current degradation in electrical installations, which arises directly from the proliferation of non-linear loads, to solve it, we used a two-level inverter as a parallel active filter, which injects harmonic currents at the connection point with a compensation method called the instantaneous active and reactive power method. The second part in this work we are interested in the problems of detection and localization of some faults in a voltage inverter used as a parallel active filter which is intended for the filtering of harmonic currents with the compensation of reactive energy. To do this, a series of simulation tests, for the different defects considered, must be carried out in order to extract the different information contained in the electrical signals from the inverter.

Keywords: : Parallel Active Filter, Analysis, Control, Faults detection, Inverter.

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Comparative Analysis between Adaptive type-1 Fuzzy Field-Oriented Control and hybrid Sliding Mode-Backstepping Control of a Double Star Induction Machine (DSIM)

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Abstract: In this work we have opted for a comparative study between two different control strategies for the double star induction machine (DSIM). The DSIM is fed by two cascaded two-level voltage inverter using the pulse-width modulation (PWM) control strategy. The two hybrid nonlinear controls studied and applied are increasingly oriented towards the application of modern control techniques, the first is the Adaptive type-1 Fuzzy Field-Oriented Control based on PI regulators by rotor flux orientation and uses a rotor flux estimator and with a hybrid control on sliding mode control synthesized by backstepping, to regulate the speed of a dual star induction machine DSIM in order to compare the performances of the system using these two control methods.

Keywords: DSIM, Fuzzy Field-Oriented Control, sliding mode Control, backstepping, Inverter.

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Artificial Intelligence-Based Mathematical Analysis for Coupled Differential System Subject to Circular Obstacle in Corrugated Backward Facing Step

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Abstract: The backward-facing step (BFS) is considered as a computational domain. The two similar triangular ribs are introduced to make BFS corrugated. The flow is taken at the inlet with the parabolic pattern. The circular obstacle is installed in BFS at the end of upstream. The coupled differential system is constructed for the backward-facing step flow field. The domain is discretized by using hybrid meshing and the finite element method is used to report the solution. The artificial neural networking (ANN) model is constructed by considering fluid density, dynamic viscosity, mean inflow velocity, and characteristics length as inputs in the first layer while lift coefficient (LC) is treated as output in the last layer. For training, we select 67 (70%) values while for both validation and testing, we own 14 (15%) each. Carrying 10 neurons in the hidden layer, the ANN is trained by using the Levenberg-Marquardt algorithm. The model is validated by conducting mean square error and regression analysis. It is found that the constructed ANN is the best model to forecast the hydrodynamic force faced by circular obstacles in BFS up to a wide range of parameters where usual methods fail to report the solution.

Keywords: Coupled differential system, Backward facing step, Hydrodynamic force, Circular obstacle, Neural networking, Finite element method

Mathematics Subject Classification: 35Q35, 76B03

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Mathematical modeling of organism swimming through rough inclined passage

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Abstract: The self-propelling mechanism of spermatozoa at low Reynolds number is investigated using Stokes equations. These equations normally hold for bodies swimming with slow speed, having small scales, and interacting with highly viscous medium. In biomedicine, these artificial crawlers useful for drug delivery, diagnostic, or therapeutic purposes are controlled via electric and magnetic sensors. In addition to the fluid rheology, these external forces tend to reduce/enhance the speed of swimming cells. To investigate such effects on active spermatozoa we calculate the speed of an undulating sheet propelling through viscous fluid. After utilizing Galilean transformation, dimensionless variables, stream function, low Reynolds, and long wavelength approximation on momentum equation one arrives at the fourth-order ordinary differential equation with four boundary conditions involving two unknowns i.e. flow rate and organism speed. Unknowns satisfying the dynamic equilibrium conditions are simulated via the modified Newton-Raphson method. Consequently, work done by the microorganism is also computed.

Keywords: Swimming organism, Navier–Stokes equations, Galilean transformation, modified Newton-Raphson method

Mathematics Subject Classification: 76A05, 76-10

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Biological effects and chemical characterization of Ilex aquifolium L. extracts: A new source of bioactive constituents

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Abstract: This study gathers information about the effects of methanolic extracts from fruits and aerial parts of Ilex aquifolium L. on selected enzymes (cholinesterases, alpha-amylase and alpha-glucosidase and tyrosinase) as well as their antioxidant capacities in relation with their phenolic composition. The chemical composition was assessed by determining total phenolic and flavonoid content as well as individual phenolic compounds by HPLC-DAD. Moreover, antioxidant abilities of the investigated extracts were tested by using different assays including free radical scavenging (DPPH and ABTS), reducing power (CUPRAC and FRAP), phosphomolybdenum and metal chelating, overall fruits being indicated as a source of antioxidant compounds. Furthermore, interactions between dominant compounds from extracts and selected enzymes were investigated by molecular modeling studies in order to explain at a molecular level the interactions between selected compounds and active sites of the enzyme.

Keywords: Ilex aquifolium L.; bioactive compounds; enzyme inhibition; herbal extracts

Fractional Order Moment Parameter Estimator of Compound-Gaussian Clutter with Nakagami-Distributed Textures

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Abstract: This paper deals with parameter estimation of Compound-Gaussian Clutter with Nakagami-Distributed Textures (CGNG). CGNG was recently proposed to model sea clutter at medium/high grazing angles, where the parameters were estimated using the higher order moments estimator (HOME) and [zlog(z)] method. In order to improve the estimation performance, the fractional order moment estimator (FOME) is proposed in this paper. The obtained results show that the proposed FOME estimator provides the best estimation accuracy comparing to the HOME and the [zlog(z)] methods using both simulated and real data.

Keywords: Parameter estimation, Radar clutter, Compound Gaussian, Nakagami distribution.

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Structural, elastic, vibrational and thermal properties of quaternary Lithium based Alloys

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Abstract: Ab-initio calculations combined with the virtual crystal approximation (VCA) and the quasi-harmonic Debye model have been used to investigate the phase transition of the $LiBeAs_{1-x}Sb_x$ and $LiBeP_{1-x}Sb_x$. Phase transition has been predicted for both systems, i.e., $LiBeAs_{1-x}Sb_x$ and $LiBeP_{1-x}Sb_x$, from the Cu_2Sb (P4/nmm) phase to the polar LiGaGe (P63mc) one beyond antimony concentration of $x = 0.21$ and 0.36, respectively. These alloys are mechanically stable according to the calculated elastic constants. The phonon frequencies at the zone centre for the Raman-active and infrared-active modes are predicted for the Cu_2Sb and the LiGaGe structures for different antimony concentrations. The variations of thermal expansion coefficient, bulk modulus, Debye temperature, heat capacities at constant volume and the Grüneisen parameter as a function of pressure and temperature were all obtained and analysed.

Keywords: Abinitio methods, phase transition, elastic constants, phonon spectra

Study of the influence of cutting parameters on technological parameters in the turning process of titanium alloy

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Abstract: Manufacturers' goals today are to reduce machining costs as much as possible by reducing technological parameters. Titanium alloys are widely used in several fields of engineering. Ti-6Al-4V may be considered one of the more difficult titanium alloys to machine and is known for damaging cutting tools due to its aggressiveness This work consists of studying the influence of cutting parameters (cutting speed, depth of cut and feed per revolution) on technological parameters (surface roughness, cutting force, vibrations and rate of material removed). the finishing turning operation was carried out on a part of titanium alloy Ti-6Al-4V using two different types of cutting materials, one is PVD coated carbide (GC1125) and the other uncoated (H13A). To carry out this study, we used Multi objective optimization methods (MCDM) such as the CODAS, ARAS, TOPSIS method for the purpose of determining the optimal regime to obtain the desired results.

Keywords: Ti-6Al-4V- surface roughness - Cutting force- vibrations- H13A- GC1125

Fractional Order Moment Parameter Estimator of Compound-Gaussian Clutter with Nakagami-Distributed Textures

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Abstract: This paper deals with parameter estimation of Compound-Gaussian Clutter with Nakagami-Distributed Textures (CGNG). CGNG was recently proposed to model sea clutter at medium/high grazing angles, where the parameters were estimated using the higher order moments estimator (HOME) and [zlog(z)] method. In order to improve the estimation performance, the fractional order moment estimator (FOME) is proposed in this paper. The obtained results show that the proposed FOME estimator provides the best estimation accuracy comparing to the HOME and the [zlog(z)] methods using both simulated and real data.

Keywords: Parameter estimation, Radar clutter, Compound Gaussian, Nakagami distribution.

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Correlations between the Nusslet and the Reynolds Numbers: a Statistical Approach Ahsene Lanani and Rahima Benchabi

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Abstract: This paper presents a new statistical approach to study correlations between the Nusselt and Reynolds numbers. Also, the work is devoted to the study of the laminar fluid flow in corrugated channel and to determine the influence of certain parameters on the heat transfer. The governing equations of flow and energy were solved numerically by using volume finite method (SIMPLE algorithm and CFD code).

Keywords: Correlations, Finite volume method, Numerical study

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Long-Term Dynamics of the Wave Equation under Mixed Boundary Conditions

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Abstract: This work focuses on analyzing the damped wave equation subject to mixed boundary conditions within a finite domain. Specifically, a Ventcel-type boundary condition characterized by the significant density function f(x) is applied to a portion of the boundary, while the remainder is governed by a homogeneous Dirichlet boundary condition. The decay of solutions to the wave equation is demonstrated to be logarithmic, predicated on the behavior of the resolving operator along the imaginary axis. This decay rate is substantiated through resolving estimations that leverage interpolation inequalities pertinent to an elliptic equation under Steklov-type boundary conditions.

Keywords: Semi-groups, Polynomial stability, Multiplier method, Geometric condition, Fourier Analysis

Mathematics Subject Classification: 35L05, 35B35, 35B40.

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DFT calculations of two azo-palladium (II) complexes

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Abstract: The transition metal-azo dye complexes are related to the possibility to obtain new compounds with various biological activities. This class of complexes is important in the progress of metalbased anticancer agents. These different areas of interest fostered inorganic chemists to develop novel approaches to the preparation of non-covalently bound anticancer drugs. Recently, Pd-arylazo complexes have found application in C–C coupling reactions interacting strongly with CT DNA and exhibiting photochromic activity , where most of their electronic and photochromic efficiency have been explained by DFT calculations. We report two novel Pd(II) coordination complexes obtained using (E)-1-((2-methoxyphenyl)diazenyl)naphthalen-2-ol [1] and (E)-1 ((3methoxyphenyl)diazenyl) naphthalen-2-ol [2] azo-ligands. These two bidentate ligand precursors are isomers differing from the ortho versus meta position of their methoxyphenyl group. In both Pd(II) complexes(I) and (II), respectively, the metal is coordinated to two N atoms and two O atoms. The DFT-optimized structures of (I) and (II) reproduce well the structural properties of their experimentally determined X-ray counterparts. Complexes (I) and (II) display large HOMO–LUMO gaps, in line with the strong metal–ligand interactions. Complex (I) is computed to be less stable by 12.0 and 11.5 kcal/mol than (II) and (III), respectively, showing the impact of the methoxy position on the molecular structures, which are planar in (II) and (III), but distorted in (I) The simulated UV–Vis spectra obtained by TD-DFT calculations are comparable to the experimental spectra, putting emphasis on the ILCT and MLCT electronic transitions involving several of the frontier molecular orbitals in the complexes.

Keywords: DFT calculations, Transition metal, Azo compounds, TD-DFT and AIM.

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Some particular nonlinear partial differential equations solution by the Adomian and modified decompositions methods

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Abstract: In this work, we aim to obtain the exact analytical solution of some particular partial differential equations of order 2 which are nonlinear and nonhomogeneous in space-time by the Adomian and modified decompositions methods accompanied by a series of Taylor expansions. The solutions of these equations are given in the form of a polynomial series which converges to their own exact solution by the two methods. It is easy to see that each method gives exactly the same solution. The comparison of exact solutions to numerical solutions is given in the form of tables including the error rate between the two solutions. The graphs presented in this work using Matlab also show the behavior and differences of this two solutions. This demonstrated the accuracy of the two cited methods for solving nonlinear partial differential equation.

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Physical Properties of Mg-doped Co_3O_4 Nanocrystalline Thin Films Elaborated Using Spray Pyrolysis

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Abstract: In this study, we elaborated and characterized thin films of undoped and magnesium-doped (1%, 2%, and 3%) cobalt oxide. These films were deposited on ordinary glass substrates at a temperature of 400 °C, with a deposition time of 5 min, using the spray pyrolysis technique. The main objective of this work was to investigate the influence of magnesium doping on the structural, optical, and electrical properties of Co_3O_4. X-ray diffraction (XRD) results showed that all films were polycrystalline with a cubic spinel structure [1-4], and there was a decrease in the crystallite size (D) with increasing doping. The optical transmission spectra of the Mg-doped Co_3O_4 film exhibited high transmittance in the 400 to 500 nm range. Specifically, the electrical resistivity showed a significant decrease, from 8.031 Ω·cm to 0.807 Ω·cm for undoped and 2% Mg-doped films, respectively. However, for Mg concentrations of 3%, the electrical resistivity increased to 0.8217 Ω·cm.

Keywords: Thin films, Mg-doped Co_3O_4, Spray pyrolysis, XRD, Electrical resistivity.

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Impact of Fluorine Doping on the Structural, Optical and Electrical Characteristics of Spray Deposited SnO2 Thin Films

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Abstract: In this study, we conducted a thorough analysis of the impact of fluorine doping at concentrations of 2%, 4%, and 6% on the structural, optical, and electrical characteristics of undoped SnO_2 films deposited using the spray pyrolysis technique. Various analytical methods were employed to assess these properties: X-ray diffraction (XRD) for structural examination, UV-visible spectrophotometry for optical evaluations, and the four-point probe method for electrical measurements. The XRD analysis revealed that the films deposited via spray pyrolysis exhibited a polycrystalline structure with a tetragonal rutile-type phase [1-4]. The pure SnO_2 and SnO_2:2%F films displayed a preferential orientation along the (110) plane, as indicated by the peak at $2\theta = 26.84°$. However, the films doped with 4%F and 6%F showed a change in orientation from (110) to (200). The addition of fluorine dopant resulted in increased transmittance, reaching a maximum of 83% for the SnO_2:6%F film. Electrical analysis demonstrated that fluorine doping enhanced the electrical resistivity of the pure SnO_2 film deposited via spray pyrolysis, achieving a low resistivity value of 7.11×10^{-2} Ω·cm. Based on these findings, it can be concluded that SnO_2:6%F holds potential for use as a conductive transparent electrode in thin-film solar cells.

Keywords: Thin films, F-doped SnO_2, Spray pyrolysis, XRD, Electrical resistivity.

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Study of the behaviour of a hydrodynamic contact using the homogenization method

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Abstract: A study of combined effects of surface roughness and lubricant rheology on the hydrodynamic contact behavior using the homogenization method. The combined effects of surface roughness and lubricant rheology on the performance characteristics of a hydrodynamic inclined slider bearing are investigated by means of the homogenized method. The pad surface is rough and stationary while the lower surface is assumed to be smooth and moving. The V.K. Stokes couple stress fluid model is adopted to describe the rheological behavior of the lubricant flowing between the two surfaces. The numerical simulations are performed by considering three roughness patterns (transverse, longitudinal and anisotropic), and various values of the couple stress parameter. It is found that the homogenization method is rigorous and efficient for the three roughness patterns considered. It is also found that the combined effects of the surface roughness as well as the couple stress due to the presence of polymer additives on the hydrodynamic performance characteristics such as pressure field, load carrying capacity, friction factor and power loss are significant.

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An Efficient Numerical Solution for Nonlinear Poro-Elasto-Hydrodynamic (PEHD) Lubrication Problem in Dynamically Loaded Journal Bearings Lubricated with Nanofluids

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Abstract: The thrust of this paper is to present an efficient numerical method to solve the strongly nonlinear PEHD lubrication problem encountered in internal combustion engine journal bearings using nanofluids as lubricants and subject to an arbitrary force torsor. Under isothermal conditions, this problem is described by a set of differential equations, namely: the nonlinear Reynolds partial differential equation, the modified Darcy law, and the nonlinear motion ordinary differential equations of the crankshaft which are the second Newton's law. The Reynolds equation is derived from the momentum and mass conserving laws of the V. K. Stokes micro-continuum theory which takes into account the characteristic size of nanoparticles or agglomerates of nanoparticles dispersed in the base lubricant. This equation is then modified to account for the concentration and the bearing-liner permeability property using the Krieger-Dougherty viscosity model and the Morgan-Cameron approximation. For an arbitrary force torsor, the fluid-film pressure, the lubricating film geometry, the squeeze film velocities, and the misalignment angular velocities are determined simultaneously by solving the discrete form of Reynolds equation coupled with the film geometry equation and the nonlinear rotor (crankshaft) dynamic equations by means of the powerful damped Newton-Raphson iterative method at each crankshaft angle step. The main journal axis trajectories in the bearing's mid-plane, rear, and front sections as well as the misalignment angles are easily deduced from squeeze film velocities and misalignment angular velocities using a second order Runge-Kutta scheme. The numerical results obtained with the proposed PEHD model are compared with the theoretical published results since there are no benchmark results available for engine bearings operating with non-Newtonian nanolubricants. Finally, some relevant results of parametric study carried out with the PEHD model are graphically presented and discussed.

Keywords: Numerical modelling, Nonlinear differential equations, Finite difference method, Newton-Raphson algorithm, Runge-Kutta scheme, Poro-Elasto-Hydrodynamic Lubrication, Engine bearings, Nanolubricants, Lubricating nanoparticles, Non-Newtonian Fluid.

Periodic-Soliton Solutions by a New Perspective

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Abstract: This study brings a new perspective to implementation of a periodic-soliton solution approach [1,2]. This new viewpoint arises from usage of different parameters. Some restrictions are given to specify classes of obtained solutions.

Keywords: Periodic-soliton solutions, Combined solutions, Bilinear form

Mathematics Subject Classification: 35C07, 35C08, 74J30

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Explicit Formulas for Algebraic and Non-Algebraic Limit Cycles of a Family of Planar Differential Systems

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Abstract: In this work, we study a family of multi-parameter polynomial differential systems of degree eleven. We prove that the considered family has an invariant algebraic curve, which is given explicitly. Subsequently, we demonstrate the integrability of these systems and derive an explicit expression for a first integral. Moreover, we provide sufficient conditions for the systems to possess two limit cycles explicitly given: one is algebraic, and the other is shown to be non-algebraic. The applicability of our results is illustrated by concrete examples.

Keywords: Planar polynomial differential system; First integral; Limit cycle.

Mathematics Subject Classification: 34C05, 34C07

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Application of Response Surface Methodology for Parametric Optimization of Natural Convection in Trapezoidal Cavity containing Hybrid Nanofluid

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Abstract: This work presents a numerical analysis for exploring heat transfer phenomena in a trapezoidal cavity using natural convection. Because of the numerous real-world applications of nanofluids in engineering development, hybrid nanofluids are used as fluid mediums in the fluid field. The copper (Cu) and alumina (Al_2O_3) nanoparticles are suspended in water to make a hybrid nanofluid. A trapezoidal is taken with the left heated wall, and right cold wall and filled with hybrid nanofluid, and the remaining walls of the cavity are kept at adiabatic. The governing equations have been solved by the finite element method (FEM). The graphical computation of the effective parameters is precisely scrutinized on the profiles of velocity, isotherms, and average Nusselt number. As a novelty, the response surface method (RSM) has been applied to achieve the optimum value of the involved parameters. It provided a correlation for the average Nusselt number based on the investigated determinants due to the conflicting influence of the study factors.

Keywords: Hybrid Nanofluid, Natural Convection, Trapezoidal Cavity, Response Surface Methodology.

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Effect of natural and artificial aging on the mechanical properties of high density polyethylene HDPE 100

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Abstract: High-density polyethylene (HDPE100) has recently emerged as the material of choice for the economical and public health-safe distribution and transportation of drinking water. For this reason, a study of the effect of natural and artificial aging was conducted on HDPE100 to verify the mechanical robustness of this material against climate change. Firstly, HDPE100 specimens were artificially irradiated using a UV lamp with a wavelength of 254 nm, with three aging durations studied: 10 hours, 20 hours, and 30 hours. Subsequently, aging under climatic stresses (natural) involved exposing various specimens directly to solar radiation and weathering for 125 days. To highlight the aging effects through the wall of the HDPE100 tube, which was cut into three layers (outer, middle, and inner), tensile tests were conducted to study the mechanical behavior of HDPE100. We observed a hardening effect of aging on the material and differences between non-irradiated and irradiated samples. Artificial irradiation leads to a cross-linking phenomenon, a higher crystallinity compared to natural aging; these effects impact the physical and mechanical properties of HDPE100. The results of the tensile tests led to a decrease in elongation at break depending on the type of aging, however, the Young's modulus varies from one case to another. DSC analysis showed that for natural aging, the fusion and crystallization enthalpies, fusion temperatures, and crystallization temperatures increase progressively with exposure time.

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First Principales Calculations of the Electronic, Magnetic, and Elastic Properties of FeVYSb (Y= Sc, Y) Heusler Alloys

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Abstract: The study of Heusler alloys has attracted more attention from the scientific community since Groot's discovery of the first half metallic material, NiMnSb, in 1983[1]. These materials have attracted a lot of attention because of their unusual and interesting structural features, magnetic properties, and several traits, such as metallic, insulating, semiconducting, half-metallic, and spin gapless semiconducting[2]. These materials are used for spintronics and magnetoelectronics applications such as spin filters, spininjection, magnetic tunnel junctions, giant magnetoresistance, spin transfer torque, memory devices, spin caloritronics, magnetic sensors, and neuromorphic and stochastic computing [3-5].
Based on the density functional theory, we have studied the electrical, magnetic, structural, and elastic properties of the FeVYSb(Y=Sc, Y) Heuslers compound in this work. The most stable structure has been found to be energetically favorable in face-centered cubic (FCC) structure with space group F43m, in which Fe, V, Y and Sb atoms are located at 4d, 4c, 4b and 4a Wyckoff positions respectively. In the stable state, FeVScSb is ferromagnetic while FeVYSb is ferrimagnetic. The determined elastic constants (C_{ij}) show that FeVYSb(Y=Sc, Y) is mechanically stable and ductile, and exhibit a notable elastic anisotropy. Electronic calculations indicate that FeVYSb(Y=Sc, Y) are semiconductors with band gap of 0.37 eV and 0.30 eV respectively. The total magnetic moment of these alloys is found to be equal to 3 μ_B which follows the Slater-Pauling rule. The magnetic moment remains equal to 3 μ_B under strain, which makes it hopeful in spintronic applications.

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Enhancement Multi-interest U-Net for Medical Image Segmentation

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Abstract: In recent years, state-of-the-art performance has been attained using deep learning (DL) techniques for image segmentation. Image segmentation has been effectively applied to the U-Net model, particularly in deep learning. On the other hand, conventional U-Net techniques use up sampling, convolution, and pooling blocks to extract features, gather remote data, and rebuild images. Because of the stacked local operators, the traditional method is incredibly inefficient. In this work, we offer the multi-interest U-Net for image segmentation, which is endowed with non-local blocks based self-attention, channel-attention, and spatial-attention. By inserting these blocks into U-Net, information on the plane and spatial scales may be flexibly aggregated. The multi-interest U-Net can enhance the outcomes of medical image segmentation.

Keywords: Medical image segmentation, multi-interest U-Net, non-local blocks based self-attention

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Refined descriptive sampling with dependent variables

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Abstract: We propose an algorithm to generate refined descriptive samples [3]from dependent random variables for estimation of expectations of functions of output variables using the Iman and Conover algorithm [2] to transform the dependent variables to independent ones. Hence, the asymptotic variance of such an estimate in case of dependent input random variables is proved, using a result from [1], to be less than that obtained using simple random sampling.

Keywords: Simulation, Monte Carlo Methods, Sampling Theory, Variance Reduction

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Analysis of the structure and behaviour of odonate populations in a number of wetlands likely to be impacted by thermal springs in the Bejaia region (north-central Algeria).

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Abstract: The Odonata survey and of upstream and downstream in three geothermal springs in the Bejaia region has enabled us to draw up a report on the impact they may have on aquatic biodiversity, using odonata as a biological model. The various discharges from these thermal springs modify the chemistry and quality of the water downstream, which has repercussions on the structure and composition of the dragonflies populations between upstream and downstream. Some species can tolerate a wide range of conditions, while others are highly sensitive to their environment. A group of four ubiquitous taxa (Ischnura graellsii, Anax imperator, Orthetrum chrysostigma, and Trithemis annulata), seem indifferent to the state and conditions prevailing in the different biotopes. However, a group of seven species (Platycnemis subdilatata, Ceriagrion tenellum, Coenagrions citullum, Erythromma lindenii, Calopteryx exul, Onychogomphus uncatus and Gomphus lucasii) appear to be sensitive to water quality.

Keywords: Biodiversity analysis - Odonata - Thermal springs - Anthropization - Bejaia

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Study of Spatial Conformation of Anomeric Xylose Esters by Density Functional Theory

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Abstract: Gaussian 09 software and DFT modeling method were investigated to determine the spatial conformation of synthesized anomeric xylose esters. Two basis sets 3.21 G and 6.31 G of B3LYP were tested. The most stable optimized geometry was obtained from B3LYP/6-31G with the basis set combination 6-31 G (d, p) and 6-31 G (d) method.
The frontier molecular orbitals HOMO and LUMO are the orbitals that are involved in the reactivity. The lowest unoccupied molecular orbital (LUMO) and the highest occupied molecular orbital (HOMO) are located over the whole skeleton of the molecule except the methyl groups of the hydrophobic chain. Their energy value and their energy gaps reflect the reactivity of the molecule. A molecule having a small frontier orbitals gap is a soft molecule with a high chemical reactivity. While a large HOMO-LUMO gap indicates a hard molecule more stable /less reactive molecule. The compound which has the lowest energetic gap is octadecanoyl-α-D-xylopyranose (ΔE_{gap} = 0.26237 eV). The results of energy gap indicate that the α-anomers of the two studied products 1α (ΔE_{gap} = 0.26294 eV) and 2α (ΔE_{gap} = 0.26237 eV) are the softest compounds compared to their β-anomers 2β (ΔE_{gap} = 0.26315) and 2β (ΔE_{gap} = 0.26311). According to these results (Table 1), the α-compounds are more reactive than the β ones.

Table 1: Calculated energy values using B3LYP/6-31G basis set.

Compound & **HOMO** & **LUMO** & **Energy gap (eV)**
1α & -0.25801 & 0.00493 & 0.26294
1β & -0.25548 & 0.00767 & 0.26315
2α & -0.25866 & 0.00371 & 0.26237
2β & -0.25548 & 0.00763 & 0.26311

Keywords: Xylose ester, anomers, molecular modeling.

Thermal performance enhancement of LHTES using enhanced PCMs with fins

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Abstract: In this work, the application of enhanced PCMs and different geometry of fins is used to numerically study the performance enhancement of an LHTES setup. Through several fins, the paraffin wax RT35 phase change material (PCM) fills the annular area of the cylinder and absorbs heat from hot water. The influence of fin numbers and shape geometry on the heat transfer properties of PCM during the melting process is investigated, with the constant total cross-section area of all tubes and fins serving as the constraint condition. It is suggested that the geometrical shape of heat transfer tubes be changed from circular to petal to enhance the thermal performance of LHTES. An increase in the number of fins helps improve the heat capacity by a large ratio. When compared to the base case, which has a single circular HTF tube and straight fins, the storage capacity increases drastically.

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Application of the Maud program to monitor the microstructural evolution of nanosized Cr50Ni50 alloy

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Abstract: Nanocsized Cr50Ni50 material was obtained by high energy ball milling from pure Cr and Ni powders in a planetary ball-mill P7 under argon atmosphere at ambient temperature. Microstructural, structural, morphological, magnetic were studied by X-ray diffraction, scanning electron microscopy and magnetic measurements . The Maud program which is based on the Rietveld method combined with Fourier analysis was used to monitor the microstructural evolution Rietveld refinement of the X-ray diffraction pattern reveals after 1 h of milling, the formation of the disorderd fcc- Ni(Cr) solid solution in addition to pure Cr and Ni. After 25 h of milling, the interdiffusion between Cr and Ni atoms leads to the formation of a mixture of disordered fcc-Ni(Cr) and bcc-Cr(Ni) solid solutions. The average thickness of the grains boundaries <EJ>, of bcc-Cr(Ni) and fcc-Ni(Cr) are of about 3.5 and 2.3 nm, respectively. The morphological observations reveals the fragile aspect of the powder particles which is explained by their fragmentation at different stages of milling process. The existence of small magnetic particles which are typically single domains is evidenced by Mr/Ms (0.1-0.5) v

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Modeling of discharge currents and dielectric losses in electrically aged cable insulation by filamentary trees

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Abstract: This paper presents a model of a filamentary treeing structure expanding in an insulating polymer used as cables protection. By likening the tree to a cylindrical channel with a hyperboloidal front and by considering the polymer /tree interface without charge, we establish a mathematical expression describing the dynamics of the tree propagation. This shows the relationship between the treeing length, the current and the loss factor and their dependency on many parameters such as the amplitude, the duration and the shape of the applied voltage, the frequency, the electrode geometry (thickness of the polymer sample, the electrode gap and radius), the density of the polymer, the permittivities and conductivities of both polymer and tree.

Keywords: Modeling, cable insulation, ageing, filamentary trees, discharge currents and dielectric losses

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Statistical analysis of COVID-19 Monthly Pandemic Evolution in Algeria

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Abstract: Our study's objective was to retrospectively evaluate the pandemic Coronavirus Infection Disease first appeared in 2019 (COVID-19) in Algeria from July 2020 until February 2022 by studying the evolution and relationship between three variables: the number of new cases, the number of new deaths, and the number of cases hospitalized in intensive care. Data were obtained from "Our world in Data Organisation" (https://ourworldindata.org/coronavirus) on 01 March 2022. They were proceeded by descriptive and multivariate analysis. The correlation between the three variables and the analysis of individual principal components (PCA) were conducted. The number of new cases shot up the month of January 2022 with 33685 cases, the peak number of cases in intensive care was recorded in July 2021 with 1261 cases whereas the number of new deaths reached its peak in the month of August 2021 with 1015 cases. A significant linear dependence has been identified between the number of new cases and the number of cases in intensive care (R^2>0.5). The PCA analysis allowed us to distinguish the months of August 2020, November 2020, July 2021, August 2021, September 2021, and January 2022. They were characterized by high levels of new confirmed cases, new deaths and/or cases in intensive care. Algeria passed by three waves characterized by peaks in the number of new cases and new deaths

Keywords: Correlation, COVI-19, New cases, New deaths, Intensive care, PCA

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Dynamic insights into vitamin E and cholesterol encapsulation for enhanced ovine sperm cryopreservation: A semi-empirical modelization approach

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Abstract: In the realm of ovine sperm cryopreservation, the encapsulation of vitamin E and cholesterol stands out as a promising strategy. This study delves into the intricate dynamics of these compounds within innovative encapsulation systems, shedding light on their release kinetics and antioxidant activities. Utilizing a semi-empirical modelization approach, we explored the in vitro release profiles of vitamin E and cholesterol encapsulated in cyclodextrins and liposomes. The results unveiled a Fickian diffusion mechanism, emphasizing the role of concentration gradients in the release process. Notably, cyclodextrin encapsulation significantly improved solubility, enhancing vitamin E and cholesterol release. Our findings provide valuable insights into controlled release strategies, with implications for improving sperm viability and motility during cryopreservation.

Keywords: Ovine sperm cryopreservation, vitamin E, cholesterol, encapsulation, in vitro release, semi-empirical modelization.

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Statistical Analysis of Wear in Contaminated Dry Rolling Contacts

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Abstract: It is well-established that the presence of solid particles between contacting surfaces can significantly degrade the lifetime of machine components. This study focuses on investigating the failure of dry rolling contacts under the influence of solid contaminants. To achieve this, the researchers conducted experiments using a custom experimental setup that closely represents the real operating conditions of gears or roller bearings. Specifically, the dry rolling contact tests were carried out using the contact between two steel disks. In order to examine the influence of three operating variables - particle size (S), rotational speed (V), and load (Q) - on the studied response, which was wear (W), the Taguchi L9 orthogonal array was utilized. The analysis of the obtained experimental results was performed using both response surface methodology (RSM) and analysis of variance (ANOVA) techniques. The results revealed that particle size (S) was the dominant factor affecting the wear of the contaminated dry rolling contact, contributing 59.93% to the observed wear. Furthermore, the developed RSM models for wear demonstrated a strong correlation between the predicted and experimental data, with determination coefficients exceeding 75

Keywords: dry rolling contact, solid particles, Taguchi technique, wear, Statistical Analysis

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Oscillatory Solutions of a new Class of Fredhom Type Integrodifferential Equations

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Abstract: The main objective of this work is to study the existence uniqueness and other properties of the solution of a new class of integrodifferential equation. The well-known Banach fixed point theorem coupled with Bielecki type norm and integral inequalities with explicit and suitable estimate are used to establish the desired results. Also, the invariance and the stability of the solutions under a perturbation of the kernel is studied.

Keywords: Fixed point Theorem, Kernel, Differential equations

Mathematics Subject Classification: 34K45, 35B15

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High Gain Reconfigurable Trapezoidal Patch Antenna On Thick YIG Substrate

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Abstract: Currently, passive components made of magnetic materials are widely used in microwave applications. Ferrites, or metal oxides, are among the most commonly employed magnetic materials in the microwave range, in order to guarantee optimal efficiency and gain for an electronic frequency agility device. The principal objective of this study was to introduce a simple and efficient ferromagnetic material-based reconfigurable microstrip antenna construction. On a ferrite material YIG (Iron and Yttrium Garnet), a trapezoidal patch shape with two circular slots was selected for implantation. The use of YIG offers significant agility of resonant frequencies in the frequency range from 10.4GHz to 14.1GHz, through external excitation by magnetic fields applied to the antenna. Note that the adjustment range narrows slightly with higher frequencies and weaker magnetic fields. At greater magnetic fields, stable radiation was seen with a high gain of 8.85dB. The results verify that YIG provides greater radiation characteristics in terms of gain, directivity, and radiation efficiency which can reach 94% on the antenna while providing frequency agility when compared to FR4.

Keywords: Microstrip antenna, Ferrite substrate, YIG (Yttrium Iron Garnet)

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Mathematical Modeling and an Adaptive PID Control of Quadrotor

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Abstract: The objective of this paper is to develop an adaptive proportional-integral-derivative control for a nonlinear quadrotor system. we start by modeling of this system with state space and presenting the idea of this adaptive control. We presented the theory of the type 2 fuzzy logic, in order to use in the adaptation of the gains parameters of the PID control. The adaptive PID (T2FAPID) technique are applied to the unmanned aerial vehicle (UAV) system, their performance results are compared to a designed non adaptive PID controller. The effectiveness of the suggested adaptive methods is demonstrated in simulations with a quaternion-based nonlinear dynamic model of a quadrotor derived in this work. The results of the study prove the higher performance of the T2FAPID technique in regulating the attitude stabilization of the quadrotor.

Keywords: Interval type 2 fuzzy logic technique, Adaptive PID control, PID control, state space system, quadrotor.

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Modeling and interval type 2 fuzzy logic controller of manipulator robot

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Abstract: This paper presents the interval type 2 fuzzy logic controller (IT2FLC) for a manipulator robot system. After dynamic modeling and system state modeling, we presented the method of the fuzzy logic control, the efficient interval type-2 fuzzy controller is designed for trajectory tracking of two DOF robotic manipulator. A comparative study is made between the proposed interval type 2 fuzzy logic control technique in the presence of variation of parameters. The results obtained show that the proposed IT2FLC has a superior robustness against difference of parameters where the two DOF robotic manipulator system functions with satisfactory performance.

Keywords: Interval type 2 fuzzy logic technique, PID control, state space system, two DOF robotic manipulator.

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Approximation method for performance analysis of a retrial queuing system with collisions and transmission errors for wireless networks

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Abstract: In many situations, involving data transmission from diverse sources there can be conflict for a limited number of channels or other facilities. Uncoordinated attempts by several Sources to use a single server facility can result in 'Collision' leading to the loss of the transmission. Several protocols are developed to try to solve the problem of collisions in wireless networks and each time the authors try to obtain a negligible collision rate. We use an approximate approach, here the strong stability method, to answer the question: under which conditions (the parameters of the network) can one say that the collisions are negligible?. The purpose is to determine the conditions under which the performance of an M/M/1 retrial queuing system with collision and transmission errors, modeling the operation of a wireless channel access method, can be approached by those of an M/M/1 retrial queuing system with transmission errors (without collisions). In this work, we have calculated the error bound made during this approximation, and it is noted that we were interested much more in the conditions of application of the approximation than in the calculation of the performances themselves.

Keywords: Retrial queue, Collisions, Transmission errors, Strong stability, Inequalities of stability.

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Stochastic Modelling of Rumour Spreading with the Adjusting Control Mechanism Attitude in Homogeneous Network

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Abstract: Rumour spreading in social media networks has emerged as a pervasive phenomenon, profoundly impacting information dissemination, public opinion formation, and societal behaviour. This paper presents a stochastic modelling approach to analyze the dynamics of rumour spreading in homogeneous networks, integrating an adjusting control mechanism attitude. We introduce stochasticity into the epidemic deterministic compartmental model, distinguishing susceptible (S), ignorant (I), propagation (P), and hesitant (H) individuals. The characteristic of this model is examined to investigate its stability properties, equilibrium states, and sensitivity to parameter variations. Numerical simulation is performed to validate its efficacy. This research contributes to the understanding of rumour spreading processes in homogeneous networks and provides insights into designing effective control strategies to mitigate the spread of misinformation and rumours.

Keywords: Stochastic modelling, Rumour spreading, Homogeneous network

Mathematics Subject Classification: 60H10

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Statistical Optimization of Culture Media of Lipolytic Enzyme from a Thermophilic Actinomycete Isolated from Local Poultry Compost

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Abstract: Microorganisms are essential sources for enzyme production for industrial applications. In the last few years, there has been an increasing interest in the use of enzymes for the biosynthesis of molecules in organic media [1]. Among enzymes, lipases were considered as a great biotechnological and industrial catalyst after carbohydrases and proteases [2]. Lipases are prevalent in nature and are produced by plants, animals, and microorganisms including actinomycetes, fungi, and bacteria [3]. This work describes the production of a new lipase from a thermophilic Actinomycete strain Cpt29 isolated from local poultry compost in North East of Algeria, for industrial applications. This study aims to improve the lipase production by strain Cpt29, through mathematical modeling and optimization of culture media components using statistical approaches. For this purpose, eleven culture parameters were considered using lipase activity as production reference parameter. Plackett-Burman design used for screening step, selected three significant variables (incubation temperature, cultivation time, and Tween 80) for optimization using a response surface method (RSM) generated by a Box-Behnken design. Increase in these three parameters markedly increased the production of lipase from strain Cpt29. A 4.1-fold increase in the lipase production was obtained in the optimized medium. A maximum lipase activity of 185 U/mL was recorded under the following optimal condition. RSM shows that the observed values of lipase activity with predicted ones, obtained with high correlation coefficient (R^2 = 0.995 with P-value< 0.0001) confirmed the validity of the statistical mathematical model of optimization.

Keywords: Statistical optimization; Lipase; Actinomycete; RSM; Plackett-Burman design

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Predicting Stock Volatility: Machine Learning versus Classical Approaches

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Abstract: In this work, our objective is to predict the monthly rolling volatility of Repsol's stocks. To do this, we considered several models, namely: Artificial Neural Networks (ANN), three Machine Learning models: XGBoost, LightGBM, and CatBoost. We also used the GARCH model: Generalized Autoregressive Conditional Heteroskedasticity, which is widely used for forecasting the variance of financial time series and is particularly useful for modeling stock volatility. We adapted these models and used them to make short-term forecasts on stock volatility. Additionally, we compared the performance of the different models. Our results show that the three Machine Learning models (XGBoost, LightGBM, and CatBoost) are capable of accurately predicting Repsol's monthly rolling stock volatility and outperform the GARCH model and ANN in out-of-sample forecasting. This work demonstrates the usefulness and power of Machine Learning models in predicting stock volatility.

Keywords: Prediction, stock Volatility, Machine learning models, GARCH model, Artificial Neural Networks model

Mathematics Subject Classification: 62M10; 62M86; 62F12; 62J12

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Thermal properties of $Fe_{0.6}Al_{1-x}Co_x$ alloys in Magnetic Induction Melted

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Abstract: In contrast to the abundance of studies in Fe-Al and Fe-Co, those in the Fe-Al-Co ternary system are scarce. Consequently, the phase separation and phase diagram of this system remain still ambiguous. Ternary $Fe_{0.6}Al_{1-x}Co_x$ (x values in a molar ratio of 0.05, 0.1, 0.15, and 0.2) have been elaborated by high frequency magnetic induction fusion, in order to study the effect of cobalt ternary addition on the structural behaviour such as phase separation, thermal and mechanical properties of Fe-based alloy system, by means of x-ray diffraction, thermal analysis (DSC) and Vickers microhardness. An unexpected allotropic phase transformation from stable HCP to metastable FCC Cobalt has been observed in all alloys.

Keywords: Fe-Al-Co, phase transformation, phase separation, lattice parameter

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Investigating an algorithmic solution for a two person game problem

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Abstract: In this study, we present a numerical investigation of an algorithm designed to address a specific class of two-person game problems [1]. Initially, we reframe the game formulation into a linear complementarity problem (LCP) [2]. Notably, the LCP does not inherently represent an optimization problem, lacking an explicit objective function. Consequently, we formulate an equivalent optimization problem derived from the resulting LCP. Subsequently, we develop an algorithm rooted in a nonconvex methodology [3]to tackle the optimization task. We conduct a numerical analysis on randomly generated game instances to assess the efficacy of the proposed approach. Furthermore, we perform a comparative analysis with a widely recognized method from the existing literature to provide further insights into our results.

Keywords: two person game, nonconvex technique, LCP.

Mathematics Subject Classification: 91A05, 91A10, 90C26.

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Abamectin induced renal injuries and the protective effect of Ajuga iva in domestic pigeon (Columba livia domestica)

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Abstract: This study was performed to investigate the effects of Abamectin an insecticide of the avermectin family, as well as the protective effect of "Ajuga iva" (Chendgoura) a medecinal plant , on the kidney function of domestics pigeons (Columba livia domestica). The study was conducted on 24 pigeons, divided into 4 groups; the 1st one was the negative control, the 2nd was treated by the insecticide with a dose of 20mg/Kg/D, the 3rd was treated with 0.1mg / ml of the infusion of the plant, the 4th goup was treated with a mixture of abamectin and Ajuga iva for 45th day of the experiment. the biochemical profile was determined and the animals were sacrificed, and the histopathological studies were done. The obtained results showed that abamectin causes a significant increase in albumin and uric acid, a non-significant increase in calcium and total proteins with a significant decrease in kidney weight. However, pigeons treated by Ajuga shows a significant decrease in uric acid, an increase in potassium, as well as a significant decrease in albumin in the abamectin / plant mixture group, and decreased. uric acid level in the combined group, which explains the protective and detoxifying effect of the plant. The histological examination revealed a structural degradations of renal parenchyma, glomeruli wall and tubules which confirms the toxic effect of abamectin.

Keywords: Ajuga iva, abamectin, pigeons, biochemical parameters, ionogram, kidneys,

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Application of Artificial Neural Networks (ANN) and Response Surface Method (RSM) for enhancing the Immobilization Conditions for Lipase on Ion-Exchange Resin

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Abstract: In recent years, artificial neural network (ANN) has been used as a very powerful and flexible method in various processes [1]. ANN constitutes a central element and a main key tool used in the field of artificial intelligence. It could be considered as a main developed variant of response surface methodology (RSM) for several chemistry processes. This approach facilitates the learning of data models, leading to precise decision-making based on exploratory data [2]. It is an effective statistical technique for developing, improving, and optimizing complex processes [3]. In this study, ANN-RSM approach is used for enhancing immobilization conditions for *Candida rugosa* lipase (CRL) as an important industrial enzyme that is successfully utilized in a variety of organic reactions, on the anionic resin Amberjet®4200-Cl. This work mainly describes the optimization of immobilization conditions (enzyme/support ratio, immobilization temperature, and buffer concentration), using the lipase enantioselectivity parameter (E) as the response (y) of the calculated mathematical models. The results show that both models performed by ANN and RSM gave stable responses in the prediction of the response (y), with a coefficient of determination (R^2) and the root mean square error (RMSE) values between the calculated and estimated responses. R^2 and RMSE values were equal to 0.99 and 0.06 for the ANN training set, 0.97 and 0.2 for the ANN testing set, and 0.94 and 0.4 for the RSM training set, respectively. The fitted plots between the observed values of response (y) and predicted ones calculated by RSM and ANN models show the goodness of fit for the obtained mathematical models (R^2 = 94% and 97.1%, respectively). These models provided good quality predictions, yet the ANN showed a clear superiority over RSM for both data fitting and estimation capabilities.

Keywords: Optimization; Mathematical model; Artificial Neural Network (ANN); Response Surface Methodology (RSM); Lipase; Enantioselectivity; Immobilization.

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Crystal Structure and Hirshfeld Surface Analysis of E-1-(3-nitrophenylazo)-2-naphtol

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Abstract: In the title compound, the molecule $C_{16}H_{11}N_3O_3$ belongs to the family of azo dyes, and the asymmetric unit displays an intramolecular N—H$\cdots$O hydrogen bond. In the light of a single crystal X-ray study, it is evident that of the tautomeric forms (Azo-hydrazone), the hydrazone form is the predominant form in the solid state. The naphthol and benzene fragments attached to the -N=N- moiety adopt the s-trans conformation. Furthermore, the molecules are nearly coplanar, implying a dihedral angle of 2.63 (5)°. There are only two types of intermolecular interactions in the crystal structure: strong hydrogen-bonding C—H$\cdots$O interactions and π-π stacking interactions. The importance of C—H$\cdots$O interactions in the molecular packing is reflected in the relatively high contributions made by O$\cdots$H/H$\cdots$O contacts to the Hirshfeld surface, i.e., 28.5%.

Keywords: azo dyes, X-ray diffraction, crystal structure, intermolecular interactions, Hirshfeld surface.

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Analysis of Sub-Synchronous Resonance in a wind farm with Thyristor-controlled series capacitor

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Abstract: Renewable energies play a crucial role in the economic development of countries. Recently, wind power has been the most widely used energy source, due to its advantages. One of the economically viable generation systems in the wind energy market is the doubly fed induction generator (DFIG), but it poses several problems. One of the main problems is system instability and control when a large number of turbines are connected to the grid in the form of a wind farm. Scientists have developed numerous articles to control wind energy systems, guarantee system stability and reliability, and increase the power available to the grid. Implementation of a fixed series capacitor in a transmission line increases transmissible power but can cause a significant negative effect known as sub-synchronous resonance (SSR). The phenomenon of sub-synchronous resonance (SSR) causes significant damage and degrades the performance of wind farms. Power systems research is currently focusing on mitigating and limiting the effects of this phenomenon in wind power installations. Thyristor-controlled series capacitors (TCSC) are one technique for improving system stability and damping the SSR. A 66-turbine wind farm powered by a double-fed induction generator (DFIG) connected to a TCSC with P controllers was used to study the SSR phenomenon. The results were presented in MATLAB.

Keywords: Renewable energy, Wind turbine, Doubly fed induction generator, sub-synchronous resonance, Thyristor-controlled series capacitors.

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Maximizing Efficiency: Simulation-Based Modeling of Hybrid Power Systems with MPPT Technology

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Abstract: The paper introduces a study focused on the behavior analysis and performance control of a hybrid power system (HPS) comprising two renewable energy sources: photovoltaic and wind systems connected to a continuous bus. The investigation encompasses two main aspects: control strategies and maximizing the utilization of renewable resources.
Given the inherent fluctuation of renewable resources, there exists a risk of compromising energy efficiency concerning specific demand requirements. Therefore, in pursuit of maximizing the efficiency of the renewable energy system, it becomes imperative to implement methods for tracking the maximum power point of the input sources, a task undertaken within the MATLAB/Simulink platform.
To enhance the efficiency of photovoltaic energy conversion, a Maximum Power Point Tracker (MPPT) utilizing perturb and observe set theory is proposed. This approach is grounded in linguistic rules applied to control the step-up converter for MPPT purposes.In the case of the wind system, optimization is achieved by considering the optimal power curve as the load characteristic, incorporating knowledge of the turbine characteristic Cp (λ).

Keywords: MPPT, Hybrid Power Systems, Simulation, wind power system

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Sub-synchronous oscillation in a wind park with series compensation

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Abstract: In wind power systems based on the doubly-fed generator (DFIG), sub-synchronous oscillations (SSO) are becoming increasingly frequent in weak areas of power grids with high levels of energy production, affecting their operation. This effect can damage the turbine-generator shaft system and could be a potential point of origin for generator failure and subsequent power system instability. The grid-controlled series compensator (GCSC) is one of the techniques that have been used to solve the problem of sub-synchronous oscillations (SSO). In this article, the GCSC was used in the electrical network to improve power transfer and system stability. The results have been demonstrated with MATLAB/SIMULINK.

Keywords: Wind power system, Doubley-fed induction generator, sub-synchronous oscillations, Grid-controlled series compensator

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Nonlinear Wavelet Estimators of Spatially varying coefficients

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Abstract: In this paper, we propose nonlinear wavelet estimators of spatially varying coefficients of a linear system based on kernel and wavelet estimators of the evolutionary spectrum and cross-spectrum. We obtain large sample properties of these estimators.

Keywords: Evolutionary spectrum, Kernel estimator, wavelet.

Mathematics Subject Classification: 60G60, 60G20

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The role of modeling with statistical structural equations in psychology

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Abstract: Psychological characteristics are among the most important factors that affect human behavior and his interaction with the surrounding environment. To accurately assess these characteristics, many tools and methods are used, including psychometrics and tests. However, these tools may suffer from some limitations that affect the accuracy of the assessment, such as the combined effect of factors, measurement errors, and biases. To remedy this problem, structural equation modeling came to improve the accuracy of assessing psychological characteristics, to control common effects, estimate measurement errors, and test biases. What is statistical structural equation modeling?

A Numerical Study of Mixed Convection Ternary Hybrid Nanofluid Flow in a Duct Subjected to a Fluctuating Temperature

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Abstract: Numerical investigation of the mixed convection of ternary hybrid nanofluid is carried out in a duct subjected to a fluctuating temperature. The governing equations with boundary conditions are discretized using finite volume method (FVM). A code is developed based on SIMPLER and TDMA algorithms. Computations are carried out for both aiding and opposing flows, different Richardson numbers, different nanoparticle mean diameter and different nanoparticle volume fraction .

Keywords: Finite Volume Method, Differential Equations, Mixed Convection, Ternary Hybrid Nanofluid.

Modeling of fatigue crack growth by special mathematical function: Exponential function

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Abstract: In the present study an attempt has been made to evaluate the fatigue crack growth in V-notch Charpy specimens in four point bending tests of 2024 T351 Al-alloy. For this reason, new fatigue crack growth model is developed based on "Exponential function" under constant amplitude loading. The exponential model depends principally on physical parameters and materials properties in non-dimensional form. The validation of the performance of the mathematical model of fatigue crack growth is ensured by evaluation of deviation percentage, band error and prediction ratio. The fatigue crack growth rates results determined from exponential model are in good agreement with experimental fatigue crack growth rates and those obtained by Paris law. Also fatigue lives curves show that fatigue life depends on stress ratio and the amplitude of the applied stress.

Keywords: Special function, exponential function, fatigue crack growth model

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Maintenance efficiency assessment in virtual age reduction models

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Abstract: When we aim to avoid failures and improve the performance of industrial systems, we usually use preventive maintenance (PM). To establish appropriate PM models well describing the operational behavior of repairable systems, we need to know and integrate the imperfect maintenance parameters, which express the impact of the maintenance actions on the system state (reliability) [1, 2]. However, it is hard to quantify this impact, this difficulty is due to several facts such as unavailability or/and imprecision data, hardness and/or time-consuming computation procedures [3]. In the present work, to take into account the effect of preventive and corrective maintenance on the system reliability, we used the virtual age concept [4], and several assumptions are investigated to assess the imperfect maintenance parameters using the software tool MARS [5]. Among all the hypotheses explored, the most realistic is chosen. A numerical example is provided to illustrate the effectiveness of the approach.

Keywords: Repairable systems, Imperfect maintenance, Virtual age, Assessment.

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Study of The Impact of Lubricating Oil Additives on The Reduction The Effects of Solid Pollution on The Stability of The Rotor-Bearing System

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Abstract: The theoretical and numerical study proposed, aims to predict the effects of additives (polymers) improving the quality of lubricant oils on the linear dynamic behavior of hydrodynamic bearings lubricated by oils polluted by solid particles (lubricant polluted or contaminated by solid particles due to wear of the contact surfaces). The presence of the additives in lubricant oils makes the rheological behavior of the lubricant non-Newtonian. The study of the flow of these types of fluids is based on the application of the theory of continuum theory of Vijay Kumar Stokes. Ball and Richmond's simple model is retained to take into account the presence of pollution due to the existence of solid particles in lubricating oils. The perturbation method is used for prediction of the eight dynamic coefficients of stiffness and damping of the rotor-bearing system. The modified Reynolds equation is transformed into a system of three second-order partial differential equations. The equations of the system are discretized by the method of centered finite differences. The system of algebraic equations obtained is solved using an iterative Gauss-Seidel process with over-relaxation coefficient. The parametric study showed in evidence on the one hand the presence of solid pollution in lubricant oil makes it to increase the pressure peak in the lubricating film of the journal bearing and to significantly reduce the stability of the rotor-bearing system compared to the journal bearing lubricated by clean fluid no additive (no polluted). On the other hand, the addition of additives improving the quality of lubricant oils significantly reduces the effects of the presence of solid pollution on the stability of the rotor-bearing system of rotating machines.

Keywords: Polluted lubricant oils, Additives oils, Hydrodynamic journal bearings, V.K Stokes Theory, Modified Reynolds Equation.

Application of Three Exact Solution Methods on the (3+1)-dimensional Boiti-Leon-Manna-Pempinelli Equation

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Abstract: In this study, we consider the following (3+1)-dimensional Boiti-Leon-Manna-Pempinelli (BLMP) equation via three diverse exact solution methods. The mathematical form of the BLMP equation as a class of KdV-type equation is given as follows:

$$u_{yt} + u_{zt} + u_{xxxy} + u_{xxxz} - 3u_x(u_{xy} + u_{xz}) - 3u_{xx}(u_y + u_{(z)}) = 0,$$

which models wave propagations in compressible fluid. The BLMP equation and its various forms have attracted great interest in recent years due to its emerging applications in fluid dynamics. The main goal of this study is to obtain new exact solutions in more general forms with free parameters including hyperbolic, trigonometric and rational function solutions. Besides, considering applications of the BLMP equation on real world problems in compressible fluid, some 2D and 3D graphs are plotted to show the dynamical characteristics of some selected exact solutions.

Keywords: Boiti-Leon-Manna-Pempinelli equation, The Generalized Unified Method, The Modified Extended tanh Method, The G'/G-expansion Method, Exact Solution Method.

Mathematics Subject Classification: 35B08, 76B15

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A Review of Stochastic Population Dynamics Models

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Abstract: The dynamics of a population and its response to environmental change depend on the balance of birth, death and age-at-maturity, and there have been many attempts to mathematically model populations based on these characteristics. Stochastic population dynamics studies the evolution of a given population in time under the effect of randomness. Recently, there has been great interest in studying the stochastic Population Dynamics Models , one of the reasons for this is a necessity for some techniques which can be used in investigating equations arising in mathematical models describing real life situations in population biology, genetics, psychology and so forth. The goal of this paper is to review about the dynamical behavior of the positive solutions of the systems of difference equations. The present study gives review of recent studies and developments to this subject will be provided, in particular about the long term behaviour of such models such as the probability of extinction or stability of the population.

Keywords: – differential equations –stochastic perturbation, asymptotic behavior, approximation, Population dynamics.

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Access to valuable building blocks by the regio-and enantioselective ring opening of itaconic anhydride by lipase catalysis

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Abstract: Herein, we report for the first time the highly regio- and enantioselective ring opening of a biobased itaconic anhydride catalyzed by the Pseudomonas cepacia lipase (PCL) in tert-butyl methyl ether (TBME) at room temperature. This method is easy, efficient and eco-friendly and can be performed in one step with a series of highly valuable monoester itaconates using various alcohols as nucleophiles with 100% atom economy. In all cases, the β-monoester isomer was the predominant product of the reaction. Using achiral primary alcohols as substrates, a variety of novel itaconates were obtained in moderate to excellent yields (50–90%). For select examples, product characterization was carried out using X-ray diffraction, in addition to the standard techniques.

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Study and tribological analysis of the mechanical behavior of a hydrodynamic bearing

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Abstract: The hydrodynamic bearings are organs supporting and guiding in rotation the most used in many industrial machines. Their main role is to support a radial or axial load. They allow to reduce the friction, increase efficiency and improve the durability of mechanical equipment. Severe conditions applied to the level of operating temperature, the thickness of the fluid film, serves to the birth of probable problems at an early stage which become by the time major failures. In order to understand the origin of defects in these bearings, tribological analysis is one of the techniques followed wich inables to study and solve problems related to friction, wear and lubrication of the surfaces in contact. It plays a crucial role in ensuring their proper functioning and improving their performance. In this context, the objective of this work is focused on the tribological analysis of the mechanical behavior of a hydrodynamic thrust bearing with oscillating pads. Different parameters are studied such as: the flash point of the lubricant, the viscosity, the rotation velocity and the applied load. The results obtained illustrate that these parameters are important factors in the analysis of the faults of these thrust bearings to ensure the conditions of correct operation.

Keywords: Tribological analysis, Wear, Friction, Hydrodynamic bearing with oscillating pads , Flash point of lubricant.

Study of the tribological behavior of a plain bearing

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Abstract: Bearings are tribological components that support a load and allow relative movement between two elements. Their performance is directly linked to the quality of the materials, the geometric design and the tribological conditions, which govern their mechanical behavior. Increasing the rotational speed can generate more heat due to friction between the shaft and the bearing. This can cause an increase in local temperature, which in turn can reduce lubricant viscosity and increase friction torque. In this context, the present work is interested in studying the influence of tribological parameters on the mechanical behavior of a plain bearing in order to quickly and accurately detect possible defects.

Keywords: Tribology, wear, friction, lubricant, bearing.

Study and analysis of diesel engine performance

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Abstract: The main objective of this work is to study and analyze the effect of certain technical and geometric parameters (injection advance and duration, engine speed and piston crown design) on the performance of diesel engines, in particular the 1.9 TDI ALH diesel engine, using a Diesel-RK calculation code. It is essential to know the dimensional characteristics, geometric properties of the combustion chamber, injector design, orientation and diameter of the holes and the composition of PM particles and NOx nitrogen oxides under different conditions, so that they can be used safely and effectively in practical installations. However, numerical calculation may be the most suitable solution, given the progress made in the field of computing and modeling. The results obtained show that the above-mentioned parameters have a significant influence on engine behavior, and had a noticeable effect on performance and the reduction of pollutant emissions.

Keywords: Diesel engine, Performance, Diesel-RK software, Injection advance, Injection duration, Engine speed, Piston crown design, Pollutant emissions, Combustion chamber.

Data analysis of the contribution of the spark plasma sintering (SPS) technique into the optimization of the mechanical properties of certain titanium alloys

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Abstract: The aim of this study is to investigate and evaluate the impact of the spark plasma sintering (SPS) technique on enhancing the mechanical properties of specific titanium alloys (such as Ti-Al, Ti-Mo, etc.). This will be achieved by employing data mining and multivariate analysis techniques to identify correlations and similarities among the mechanical properties of these alloys. The ultimate goal is to demonstrate the role of the SPS technique in optimizing the properties of these alloys.

Keywords: Data mining; multivariate analysis techniques; Spark plasma sintering (SPS); Titanium alloys.

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Modeling Wheat Evapotranspiration in Semi-Arid Regions Using Satellite Remote Sensing

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Abstract: Recent research has highlighted the potential of remote sensing for retrieving crop water requirements through mathematical modeling and analysis of vegetation indices. This study investigates the application of linear regression models to estimate wheat evapotranspiration in the semi-arid Setif region of Algeria, contributing to the understanding of data-driven dynamical systems in agricultural contexts. Utilizing Sentinel 2 data, we derived vegetation indices (NDVI, NDRE, MSAVI, ReCI, NDMI) and analyzed their relationship with evapotranspiration values obtained from a smartphone application through linear regression analysis. Results revealed strong correlations between the indices and crop water requirements, particularly during the January-March period (R^2 values exceeding 0.9 for several indices), with corresponding root mean square error (RMSE) values as low as 1.68 mm/decade. These findings demonstrate the efficacy of satellite remote sensing and vegetation indices, coupled with linear regression techniques, for modeling and estimating crop water needs in semi-arid environments.

Keywords: Remote sensing, semi-arid, linear regression, wheat, evapotranspiration, vegetation indices

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On the solutions of an abstract system of difference equations

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Abstract: Our main objective in this work is to give and study the solutions of a rational system of difference equations on the complex domain. Then, we present some results for an abstract system of difference equations defined by one-to-one continuous functions.

Keywords: Systems of difference equations, closed form, periodicity.

Mathematics Subject Classification: 39A05, 39A06, 39A10, 39A23, 39A45.

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Influence of glass addition on the crystallization kinetics of spinel in porcelain insulators prepared from economic raw materials

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Abstract: In this work, we studied the kinetics of spinel (Al-Si) crystallization from Algerian kaolinite (DD2) in different mixtures under non-isothermal conditions using DTA. Although many mathematical equations were proposed for the calculation, the Johnson-Mehl-Avrami (JMA) equation and Kissinger method are the most commonly used. Four compositions marked as N00, G10, G20, and G30, corresponding to 0, 10, 20, and 30 wt% of glass, were fabricated and studied. Recycled waste glass was added to kaolin and quartz to partially replace potash feldspar for the prepared white porcelain. The DTA conducted at heating rates of 2, 5, 10, and 15 °C/min showed an exothermic peak in all compositions at about 950 °C associated with spinel crystallization. This crystallization temperature decreased slightly with increasing glass content. The activation energies measured from non-isothermal treatments for four compositions: 00, 10, 20, and 30 wt% of glass, were, 694, 684, 615, and 498 kJ/mol, respectively. The activation energy decreases with the increase in glass percentage. The n values (Avrami parameter) obtained for all compositions are about 2, the spinel crystallization of these composites is followed by three-dimensional growth (controlled by diffusion).

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Synthesis and characterization of GNP/Fe3O4 catalyst: Application for the removal of Crystal Violet dye

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Abstract: The aim of this work is to synthesize and characterize a composite material based on graphene nanoplatelets and magnetite (GNP/Fe_3O_4), for application in the photocatalytic degradation of the basic crystal violet (CV) dye. The GNP/Fe_3O_4 nanocomposites were prepared by the co-precipitation method. Then GNP/Fe_3O_4 catalyst was characterized by x-ray diffraction and Raman spectroscopy. The results confirm the success of the synthesis and the functionalization of the surface of GNP by iron oxide (Fe_3O_4).
The effect of the GNP/Fe_3O_4 catalyst on the degradation of the crystal violet dye by the heterogeneous photo-Fenton process was investigated. The influence of certain systems was verified and compared, according to the degradation and the rate constant.
Compared to the other systems, the CV/GNP/Fe_3O_4/H_2O_2 system showed a very high degradation rate (Over 70%) and rate constant was 6.71×10^{-3} min^{-1}, during 180 min at room temperature and an acidic pH (2.5). These results reveal the importance of the GNP/Fe_3O_4 catalyst in the treatment of water by the heterogeneous photo-Fenton process, and show the possibility of its use even at industrial scale.

Keywords: Nanocomposite; Crystal violet; heterogeneous photo-Fenton;degradation.

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Some classical theorems of factorizations in the sublinear case

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Abstract: This participation is part of the development of some theorems of factorizations in the sublinear case. Many problems in commutative analysis involve the principle of factorization, in other word summing operators in all its dimensions. The tudies in this field have given rise to a rich and vast literature that will be cited in our work as we go along.

Keywords: Banach space, Factorization theorem, sublinear operator.

Mathematics Subject Classification: 46B25, 46B28, 46B42

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Computational studies of Electronic, optical and elastic properties of half-Heusler SrMgA (A= Si, Sn) Compounds for optoelectronic applications

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Abstract: The development and optimization of optoelectronic devices depends on the availability of suitable semiconductor materials. During the last years, many researches have been devoted to multinary compounds such as Half-Heusler that comprise a large number of semiconductors characterized by a large variation in the energy interval of their bandgap. This variation in energy bandgap allows for many applications in optoelectronics.
In general, the half-Heusler materials with eight valence electrons can be II-VI, I-II-V, I-III-IV, II-II-IV, and III-II-III type.
Among these materials, we have studied SrMgA (A= Si, Sn) compounds to highlight their physical properties. SrMgA (A= Si, Sn) are II-II-IV compounds that crystallize in a structure space group F-43m (no. 216), and the structure is made up of 4 distinct face-centered cubic (fcc) sublattice where the Sr atom is located at (0, 0, 0), the Mg atom at (½, ½, ½) and the A atom at (¼, ¼, ¼).
In order to perform the structural optimization, we used the generalized gradient approximation (GGA) of DFT introduced by Perdew, Burke, and Ernzerhof (PBE). With the optimized lattice constant, the electronic, optical and elastic properties were subsequently determined.

Keywords: DFT, Half-Heusler, semiconductors, optical properties, elastic properties.

Smart control of photovoltaic system with batteries in a standalone area

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Abstract: The subject of our study is the optimization and smart control of an isolated photovoltaic system. To achieve this, a power management control (PMC) is used. It is based on fuzzy logic control with specific decision criteria aided in the control of the studied system. The key decision factors for a PMC strategy are the power level provided by the PV generator and the state of charge of the batteries (SOC). The use of the management allows producing maximum power from the PV generator, protecting the batteries against overcharge, and deep discharge and satisfying the energy needs [14-24]. Depending on the different tests, the system operates in one of the following modes. The principle of the fuzzy logic controller is to generate four control signals, K_1, K_2, and K_3, from four inputs: charging power P_{Load}, ΔP: excess power, battery state of charge SOC, and photovoltaic generator power PPV. Hence the output signals are: K_1: Control signal for the switch supplying the load with PV power, K_2: control signal for the switch that charges the battery with phototovoltaic power, K_3: control signal for the switch that supplies the load, and battery. Through the application of the PMC, the batteries were protected from deep discharges and overloads, ensuring uninterrupted power supply to the load. The studied system is composed of PV panels and batteries interconnected with a bidirectional converter enabling the bi-directional flow of current. This feature facilitates the charging and discharging of the batteries various under meteorological conditions. Two different algorithms have been used for power optimization. The simulation results demonstrate the superior performance of the proposed power management approach utilizing the fuzzy logic control method. These findings were consistent across two diverse profiles, underscoring the efficacy of our approach in diverse operating conditions.

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The effect of Covid-19 vaccination on case and mortality rates in Türkiye

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Abstract: The aim is to evaluate the effect of Covid-19 vaccination on case and mortality rates in Turkey. Average case per day before vaccination is 5241. After vaccination, it is 28440. Mortality rate is %1.53 before vaccination, but it is only %0.57 after vaccination. As a result, it can be said that although the huge increase in case numbers because of the mutation of the virus and the increase in the rate of transmission, the mortality number did not increase at the same rate after vaccination. This is the success of the vaccination. If there was no vaccination in Türkiye, and the same mortality rate (%1.53) was valid during the whole dataset period, the total number of mortalities was calculated. In this case, the mortality per day would be 436. In other words, the number of saved people per day due to the vaccination is 273. The total number of saved people during the vaccination period (from 12 February 2021 to 25 April 2022) was 119639. This is a huge number, and this is an enormous success of vaccination.

Keywords: Covid-19, Vaccination, Case rates, Mortality rates, Türkiye

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Multi-criteria Decision Support for Intelligent Management of Traffic Lights in an Isolated Intersection

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Abstract: This paper introduces a novel application of two polling systems with non-exhaustive services for traffic light management, namely: the M/M/1 (Binomial Gated Service, Multiple Vacation) and the M/M/1 (Gated Service, Single Vacation). These models are used to simulate traffic signal control at an isolated signalized intersection. The objective of the system controller is to minimize the number of waiting vehicles in each queue for every phase by extending the green light duration for the most congested road. After defining key performance measures for both models, we formulate a corresponding bi-criteria optimization problem for each model to select the most efficient one and determine an optimal traffic light duration plan. To tackle this problem, we employ a genetic algorithm approach, considering various traffic scenarios. This study provides promising insights into smarter and more efficient traffic light management by integrating polling models and multi-objective optimization techniques. These findings contribute to enhancing traffic flow and reducing waiting times at intersections, offering innovative solutions for urban mobility challenges.

Keywords: Polling System, Performance Measures, Multi-objective Optimization, Genetic Algorithm, Smart Traffic Light Management.

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Comparison study of two FTCs strategies for double stator induction machines

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Abstract: This study aims to apply the two strategies of active fault tolerant control (FTC) by the sliding mode observer (SMO) and the extended kalman filter (EKF) for direct torque control (DTC) of the double stator induction motor (DSIM) to improve the performance of the machine. To demonstrate the efficacy of the proposed approaches, a comparative analysis was conducted between the two suggested strategies in this paper. Several results prove that the two strategies applied with faults, SMO-FTC and EKF-FTC, improve the robustness and the quality of dynamic responses of the DSIM in closed loop system.

Keywords: Double stator induction motor (DSIM), Direct torque control (DTC), Fault Tolerant Control (FTC), Sliding mode observer (SMO), Extended kalman filter (EKF).

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Diagnostic of Dual stator winding Induction machine (DSWIM) Based on Mechanical Signatures of Stray Magnetic Flux

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Abstract: Dual stator winding Induction machine (DSWIM) is widely used in industrial and transportation applications which are essential to industrial processes. However, the unreliability and unpredictable life cycles of these machines still present opportunities and challenges for condition monitoring research. A machine breakdown leads to costly repairs and high losses due to downtime. The motivation of this research is to improve the reliability of DSWIM through non-invasive methods for condition monitoring. To monitor and detect these faults at the initial stage, this thesis proposes condition monitoring based on the magnetic stray flux. By studying the interaction between stray flux variations and machine failure, different types of faults can be classified and distinguished through numerical simulation by Finite Element Method simulations (FEM) and Signal Processing Technique (FFT).

Keywords: Induction machine, Finite Element, Stray Flux, DSWIM, FFT, diagnostic.

Multi-coupled circuit modelling to study generator's defects impacts on the power quality in wind energy conversion systems connected to the grid

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Abstract: This paper presents a method to study the effect of the broken bars defects of an induction generator used in a wind conversion system. The conventional three-phase model can't be applied to the induction generator's rotor in the case of defect because it can't determine the instantaneous properties of rotor bars. Thus, for introducing the broken information, we apply the Magnetically Coupled Circuits Approach (MCCA) which allows us to show the broken bars effects on the wind conversion performances in order to decide about protecting the system.

Keywords: Induction generator; Broken bars; Rotor defects; Magnetically Coupled Multiple Circuits Approach

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Mathematical model of a solar photovoltaic system optimized by artificial neural networks

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Abstract: Solar energy is a widely used renewable energy source, particularly through photovoltaic (PV) systems for clean electricity generation. This article presents a simplified single-diode mathematical model of photovoltaic cells (PV). This model is built based on nominal specifications provided by manufacturers, such as open-circuit voltage, short-circuit current, as well as voltage and current at the maximum power point. It allows for a more precise representation of the impact of physical variables such as temperature and irradiation. After modeling the photovoltaic panel, the paper explores the application of a robust intelligent technique based on artificial neural networks (ANN) to improve the Maximum Power Point Tracker (MPPT) algorithm of a photovoltaic generator. Simulation results obtained with Matlab/Simulink highlight the importance of this technique in terms of efficiency, robustness, and response time.

Keywords: Galerkin approximation, Photovoltaic, Mathematical Model, MPPT, Artificial Neural Networks.

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Eco-friendly synthesis of bi-phase iron oxide nanoparticles: Effect of Geranium Rosat plant extract concentration and their antibacterial activity

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Abstract: Iron oxides nanoparticles (IO-Nps) were synthesized through an environmentally friendly and simple process utilizing varying concentrations of Pelargonium graveolens (Geranium rosat) hydrodistilled plant extract as a reducing and capping agent, and iron trichloride hexahydrate as a precursor. The nanoparticles were characterized using X-ray diffraction (XRD), scanning electron microscopy (SEM), energy dispersive X-ray analysis (EDX), Fourier transform infrared spectroscopy (FT-IR), Raman spectroscopy, and ultraviolet-visible analysis (UV-Vis). X-ray diffraction shows the existence of two phases, the stable rhombohedral phase of hematite and the metastable orthorhombic phase of goethite. Heat treatment at 300°C transforms goethite into the more stable hematite phase. The revealed results showed that the crystallite size varied between 12 and 108 nm with an increase in extract plant concentration. Scanning electron microscopy reveals that the nanoparticles exhibit a uniform, agglomerated structure at higher concentrations and a spherical shape at lower concentrations. Quantitative EDX analysis confirms the chemical composition of iron oxide. Chemical analysis using infrared spectroscopy reveals the presence of the Fe-O bond as well as the -OH and C-H bonds of the biomolecules in the extract. Raman spectra show the existence of vibration modes A_1g and E_g of the hematite phase. UV-visible spectroscopy shows two transitions: an indirect one at approximately 1.9 eV and a direct one at around 2.34 eV. The band gap energy is influenced by the size of the grains. The antimicrobial activity was evaluated against Gram-negative (Escherichia coli) and Gram-positive (Staphylococcus aureus) bacteria. The inhibition zone was 16 mm for Escherichia coli and 7 mm for Staphylococcus aureus.

Keywords: Eco-friendly synthesis, geranium rosat, nanoparticles, hematite, goethite, antimicrobial activity.

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Ecological synthesis of copper oxides nanoparticles using Geranium Rosat leaf extract and their antibacterial activity

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Abstract: Green synthesis of nanoparticles has become more common in recent years due to its numerous benefits, including simple use, low cost, non-toxic products, friendly to the environment, and easy scaling up for large-scale synthesis. In this study, copper oxide (CuO) NPs were synthesized using a Copper (II) sulfate pentahydrate ($CuSO_4$ $5H_2O$) as a precursor and Geranium Rosat leaves extract as a biosolvent agent. CuO NPs were investigated using several kinds of characterization techniques, including x-ray diffraction (XRD), scanning electron microscopy (SEM), energy-dispersive x-ray spectroscopy (EDX), Raman spectroscopy, Fourier-transform infrared spectroscopy (FTIR) and ultraviolet-visible spectroscopy (UV-Vis). The anti-microbial activity was performed on the gram-positive and gram-negative bacteria. XRD analysis confirms that all biosynthesized copper oxide NPs have a monoclinic crystalline structure of cupric oxide CuO. However, for the very low concentration of plant extract, copper hydroxide Cu(OH)2 appear as a metastable phase. The average crystallite sizes estimated by the Scherrer formula vary between (9.92 and 16.3 nm). In addition, the morphological properties of CuO nanoparticles revealed by SEM characterization shows a flake (like-flakes) and rice (nanorize) shapes. EDX data showed that the product consisted of very pure CuO NPs. The Raman spectra shows the existence of the three optical phonon modes Ag (278 cm-1) and 2Bg (321 and 597.4 cm-1) of the CuO phase. FTIR analysis shows the existence of the Cu-O bond (metal –oxide) additionally to the -OH, aromatic C=C and C-O bonds characteristics of extract biomolecules. The band gap energy changes with the extract concentration variation and has been observed to range between approximately 1.23 and 1.29 eV. The antimicrobial activity of the synthesized nanopowders showed the highest zone of inhibitions for CuO NPs synthesized using 0.025M precursor concentration at 0.1 g/ml leaves extract. The observed values were 1.75 ± 0.01 mm for Gram-negative (Escherichia coli) and 1.5 ± 0.02 mm for Gram-positive (Staphylococcus aureus) bacterial strains.

Keywords: Green synthesis, geranium Rosat, nanoparticles, copper oxides, antibacterial activity.

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Generalization of the Method Based on Parameterization Developed for Solving Integer Linear Programming Problems

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Abstract: This study presents the generalization of methods based on parameterization proposed for solving integer programming problems with linear objectives and linear constraints. Initially, the method based on parameterization, proposed for solving 2, 3, and 4-variable integer linear programming problems, is generalized to n-variable integer linear programming problems. The proposed method relies on the parameterization obtained from Diophantine equations. Using this parameterization, the original problem is reformulated as another integer linear programming problem that can be solved more efficiently using simple mathematical programming. The method can be used regardless of the number of constraints of the problem and also provides all alternative solutions to the decision maker. It is demonstrated with some examples that this method provides an efficient algorithm.
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A Novel and Efficient Method for Integer Linear Programming Problems

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Abstract: In this study, an iterative method based on parameterization is developed to solve linear integer programming problems with linear constraints and a linear objective function, and a new efficient and reliable algorithm is presented. There are several methods used for solving LIP problems; however, most of these methods encounter difficulties in terms of computation and timing. In the proposed method, such computational and timing challenges are absent, providing significant advantages for the user. In our method, first, the original LIP problem is transformed into a new LIP problem using parameterization. Then, it is solved sequentially using interval arithmetic, graphical method, and Cartesian product. In this method, which is more better than the branch-and-bound and cutting plane methods, alternative solutions are also defined and presented to the decision-maker.
Numerical examples are provided to demonstrate how the method is implemented and its effectiveness.

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A Numerical Study of Forced Vibration Analysis of Sandwich Plates with Viscoelastic Core in the Thermal Environment Subjected to Moving Load

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Abstract: The paper focuses on the vibrations responses of sandwich panels constituted of different types of viscoelastic core materials under the effect of a moving load in a thermal environment. The present approach is based on the finite element method using the variationnelle formulation of Hamilton's principle with the virtual displacement principle. However, the complexity of constructing the model basis by solving the eigenvalue problem, mainly due to the frequency dependence of the viscoelastic properties and the stiffness matrix, requires the use of the asymptotic numerical method "ANM" combined with the automatic differentiation "AD" algorithm. This numerical approach presented here is considered a typical approach well suited to solve the vibration problem of sandwich structures with viscoelastic core. First, an evaluation of the state of stress in the different layers constituting the sandwich are discussed. However, the response of sandwich structures with viscoelastic cores considered frequency and temperature dependent under the action of a moving load are deeply investigated. The effect of the variation of the viscoelastic damping and the temperature is very significant on the stress state of the viscoelastic layer and forced vibration responses.

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Nonlinear Dynamic Analysis of PCLD Sandwich Beams in the Thermal Environment with Frequency and Temperature Dependent Viscoelastic Cores

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Abstract: The aim of this paper is to present a simpliied numerical approach to study the vibro-acoustic responses of structures with PCLD "Passive Constrained Layer Damping" treatment in the thermal environment, taking into account the frequency and temperature dependence of the diferent viscoelastic behavior laws. The modal stability procedure MSP is based on the finite element method in order to discretize and formulate the equation of motion. The asymptotic numerical method "ANM" is applied to approximate the solution of complex eigenvalue problems and construct the modal basis. The variability of the frequency responses is evaluated by a Monte Carlo simulation (MCS) combined with MSP and ANM to evaluate the stochastic behavior of a sandwich beam with random properties. The comparison with the direct frequency responses (DFR) demonstrates that the results are highly satisfactory in terms of the validity of the present MSP approach. A comparative study of viscoelastic behavior models was carried out to evaluate their damping properties provided to the structure. The viscoelastic materials provide signiicant damping particularly for amplitudes corresponding to the high frequencies. This is in contrast to the responses obtained without the viscoelastic layer. The obtained results show the importance of viscoelastic damping, which has a signiicant efect on the vibroacoustic behavior, implying the improvement of the damping of the structure, especially for large frequencies and high temperatures.

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Solution of Markov Reward Games Using Convolutional Neural Networks

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Abstract: In this paper, we present a convolutional neural network architecture designed to solve Markov reward games. This architecture takes the rewards and transition matrix as inputs and provides the optimal strategy for the game. The proposed neural network architecture is trained using 80% of 3000 and 5000 Markov reward games, each featuring 3 actions and 3 states, and is tested utilizing 20% of 3000 and 5000 Markov reward games. The results reveal that the developed architecture can achieve errors of less than 3% in terms of mean square error in the final rewards.

Keywords: Game theory, Markov reward games, Convolutional neural network, Artificial intelligence

Mathematics Subject Classification: 91A80, 68T01

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Application of 3D Decision Criteria for the Selection of an Ally

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Abstract: In this paper, we use the 3-dimensional decision criteria under uncertainty to evaluate potential allies for NATO. In this context, we focus on the recent member of NATO, Finland and Sweden. We investigate Türkiye's behavior towards these countries based on three main factors such as political, economic and military, each with three subfactors. We generate 3D payoff matrix by evaluating the effect of these factors on Türkiye's decision and apply 3D Laplace, 3D Wald, 3D Hurwicz and 3D Savage criteria on the 3D payoff matrix. The findings suggest that Turkey should give priority to approve Finland's accession, in line with Türkiye's current pattern of decision-making.

Keywords: Game theory, 3D decision criteria, 3D matrices, International relations

Mathematics Subject Classification: 91A35, 91A80

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A Matrix Norm-Based Solution for Zero Sum Fuzzy Matrix Games: Fuzzy Matrix Norm Method

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Abstract: This paper introduces novel methodology for addressing two-person zero-sum matrix games with fuzzy payoffs of triangular fuzzy numbers. Apart from traditional approaches, the proposed method aims to directly solve the game by utilizing the norms of the payoff matrix comprehensively, without the need for solving linear programming problems or dealing with sub-games created by considering the components of a fuzzy number individually. Initially, we introduce fuzzy versions of the 1-norm and ∞-norm using a ranking function and then develop the fuzzy matrix norm method to obtain approximate solutions for zero-sum fuzzy matrix games based on the matrix norm (MN) method for matrix games with real values. To demonstrate the effectiveness of the fuzzy matrix norm method, we provide illustrative examples.

Keywords: Game theory, Matrix norm method, Fuzzy matrix games, Zero-sum games

Mathematics Subject Classification: 91AXX, 15B15

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Statistical modelling of the effect of cutting parameters on the roughness of the machined surface when drilling C22 steel in the annealed and hardened state

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Abstract: This article is dedicated to the statistical modelling of the effect of cutting parameters on the roughness of the machined surface when drilling C22 steel using HSS twist drills in the annealed and hardened condition. The tests were carried out in accordance with the experimental design methodology (L8). Cutting speed, feed rate and drill diameter are the main elements of the cutting regime representing the input parameters of the test, while the roughness of the machined surface is considered as the response criterion. The results show that the metallurgical aspect of the steel and the cutting parameters have a remarkable influence on the good finish of the machined surface; increasing the cutting speed improves the roughness, while it deteriorates with increasing feed speed and drill diameter. Increasing the feed speed increases the height of asperities on the machined surface, and large diameters require high cutting forces that affect the stability of the machining system. On the other hand, increasing the cutting speed stabilises the system by reducing the cutting forces, which favours chip flow. The roughness obtained after heat treatment is significantly better than that of annealed parts; the steel after quenching has a finer microstructure, which reduces deburring of the material during cutting. The same applies to low rates of elastic deformation, which allow clean, burr-free breakage. In addition, hard materials with fine microstructures mean that chip shear is accompanied by much finer particles being torn off, contributing to improved surface finish. This study has produced predictive mathematical models that correlate well with the experimental results and can be used as tools for industrial applications.

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Bending and free vibration analysis of functionally graded carbon nanotube-reinforced composite beams by finite element method (FEM)

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Abstract: This article presents the bending and free vibration of functionally graded (FG) beams made of carbon nanotube (CNT) reinforced composites. Three distributions of the carbon nanotube are considered; two functionally graded which are FGA-CNT and FGX-CNT and one uniform UD-CNT.The micromechanics properties are determined by using Eshelby-Mori-Tanaka approach. The Hamilton's principle isused fordetermined the motion equations of the functionally graded of carbon nanotube-reinforced composite beams. The motion equations of beams are numericalapproximated by finite element method.We developed a MATLAB code for a parametric study to evaluate the effect of CNT reinforcement on the deflection and frequency of the functionally graded carbon nanotube reinforced composite beams.The results show that the FGX-CNT model gives the minimum dynamic deflection of the beam; therefore, this model has better dynamic resistance.The numerical results also showed that the fraction of CNTs has a significant effect on the deflection and natural frequency of the beam.

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The importance of statistical tools for understanding the smoking behaviour of Algerian smokers: a decision-making aid for the effectiveness of tobacco control measures

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Abstract:
Position of the problem: Tobacco control offers sustainable development gains in its economic, social, environmental and health dimensions. Following the globalisation of tobacco control, a convention outlining a coordinated global response has been in place since 2005, under the name of the Framework Convention on Tobacco Control and under the leadership of the WHO. Algeria ratified the Convention in 2006, thereby fulfilling its promise to develop a national tobacco control policy based on its rules, provisions and priorities, by acting to reduce tobacco supply and demand.
Methods: in this work, we carried out two studies. The first was a macroeconomic study in which we analysed the conditions for the effectiveness of the anti-smoking tax policy and its viability by means of an econometric study (multivariate modelling) of the price elasticity of demand for cigarettes, the income elasticity of demand for cigarettes and the elasticity of affordable demand for tobacco. In the second microeconomic study based on individual survey data, our work consisted in analysing, using modelling (an ordinal logistic model), the effectiveness of demand-side tobacco control measures in accordance with the provisions of the FCTC.
Results: The econometric results cast doubt on the effectiveness, in the case of Algeria, of some of the provisions of the WHO FCTC relating to anti-smoking tax policy, the placing of health warning labels on cigarette packets and the ban on the sale of single units of tobacco. Our contribution will prove, in fine, that the results of statistical modelling are essential in order to make effective decisions and guide anti-smoking policies.

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Extraction Process of Algerian Rosmarinus Officinalis L. Essential Oil by Hydrodistillation-Statistical Approach

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Abstract: The medicinal plants represent a very important source of active compounds; they are used in several fields: in cosmetics, in food and especially in the pharmaceutical field. These active compounds can be extracted by different extraction techniques, Among these plants, Rosmarinus officinalis L. This medicinal herb contains an essential oil to which it owes its interesting properties. The oil possesses tonic stimulating qualities, it is used as a pulmonary antiseptic, a choleretic, and a colagoguic, and also has stomachic, antidiarrheal, and antirheumatic characteristics [1]in addition to being a natural effective antioxidant [2]. The improvement of the essential oil yield becomes a main priority. Hence, the application of statistical techniques such as design of experiments makes this improvement increasingly possible. These methods optimize the operating conditions to achieve the maximum possible result with a minimum number of experiments [3]. Numerous researchers have referred to the application of experimental designs in the analysis and optimization of the extraction essential oil method. Others have passed directly to the optimization by employing the response surface approach, while others have applied other types of designs including the complete factorial design [4-6]. A study by surface response plan type Box Behnken was conducted; after an appropriate choice of three variables: Ratio (Volume/Plant matter), Heating temperature, and Extracting time. The effects of all factors examined and the statistical values of Student's t-test and the observed probability (p value) are employed to establish the significance of the coefficients of each parameter. The statistical mathematical model that represents the response in terms of the most influential variables according to the results of the minitab 13 software is: $Y = 0,80333 - 0,10500X_1$ˇ$0,13000X_2 + 0,19000X_3 - 0,19000X_1X_3 + 0,08500X_2X_3$. According to the postulated and validated mathematical model, the yield depends on the linear terms relating to the ratio factors (v/m); the heating temperature and the hydrodistillation time, respectively; and the interaction terms which relate to the heating temperature/hydrodistillation time interactions; and the ratio (v/m)/hydrodistillation time interactions. The statistical compilation establishes, in an interdependent way, the behavior of our system with respect to several variables. Indeed, the mathematical correlation deduced shows that the mass yield of essential oil is proportional to the extraction time and the heating temperature and inversely proportional to the ratio (v/m). A very good agreement between the model and the experimental results was observed with a correlation factor of $R^2 = 0.9761$. The results of this study demonstrated the high efficiency of employing the experiment design method to optimize the operational factors impacting the extraction yield.

Keywords: Extraction yield; Algerian Rosmarinus officinalis; Box Behnken Desig; Design of experiments; Essential Oil

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Contribution to the Application of Condition Maintenance for Followed and Diagnostic Of a Rotating Machine

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Abstract: The appropriate type of maintenance (corrective, preventive or predictive) is chosen for each rotating machine based on certain criteria, including: the cost of replacing equipment and the frequency of breakdowns, is one of the main causes of machine breakdown rotating. Which are monitored and diagnosed in real time to increase their lifespan and ensure their suitability.The objective of this work is to study bearing fault diagnosis tools. We carried out precise and reliable machine condition measurements, based on vibration analysis, wear index tracking and thermal imaging, to discover faults and find suitable solutions to ensure. the proper functioning of the machine.

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Using Calculus of Variations to Mathematically Model a Durable Tent Design

Using Calculus of Variations to Mathematically Model a Durable Tent Design

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Abstract:
Natural disasters and emergencies cause many people in our country and around the world to be homeless and forced to live in tents. Especially in earthquake-prone regions like Turkey, it is imperative to find fast and safe solutions in emergencies. In the February 6 earthquake in Turkey, many people lost their homes and in this process, there was an urgent need for shelter and therefore a large number of tents were needed. In this presentation, the authors will share a tent model, namely the CaTent

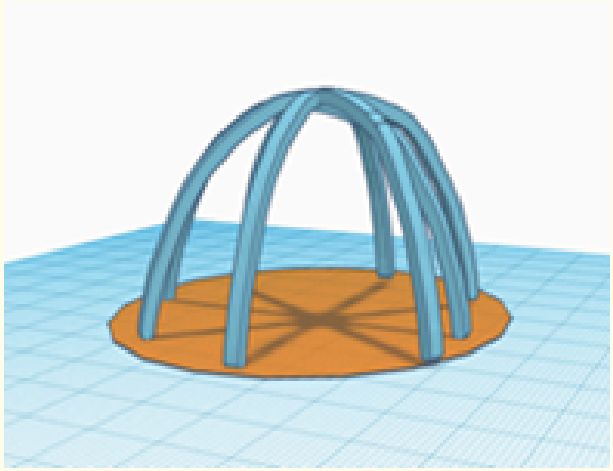

Figure 2: CaTent Design

(Figure 1) that is designed to provide fast, safe and sustainable shelter for people who have lost their homes during natural disasters and emergencies. Mathematical modeling and biomimicry principles are used in the process. In addition, by using physics and mathematics disciplines together, it is aimed to design the tent in a way that is far from aesthetic concerns and suitable for different climatic and living conditions. The main component of a tent is the poles which are designed based on calculus of variations, specifically by using the Euler-Lagrange equation.

$$\frac{\partial f}{\partial y} - \frac{d}{dx}\left(\frac{\partial f}{\partial y'}\right) = 0$$

The following Functional is used for solving the Euler-Lagrange equation:

$$f = 2\pi y\sqrt{1 + (y')^2}$$

The result is as follows:

$$y = K\cosh\left(\frac{x - C}{K}\right)$$

$$y = 3.8752 - 1.3252\cosh\left(\frac{x}{1.3252}\right)$$

By using this equation the authors determined the length of a pole. The length of a pole is found to be 7.2832 meters. Considering the biomimicry approach in the research, the tent was designed in harmony with nature. Thus, a sustainable and environmentally friendly solution was presented. As a result, this research combines mathematical modeling and biomimicry

principles to design an effective, fast and safe tent for emergency situations. This tent is more practical than the traditional earthquake tent and requires fewer people to set up. It is also an example of how mathematical modeling can be applied to tent design.

Keywords: Catenary Curve, Calculus of Variation, Mathematical Modelling, Biomimicry

Mathematics Subject Classification: 49-01

Comparison of software tools for calculating maximum tsunami wave heights

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Abstract: Destructive tsunami flood waves still pose a significant hazard both for the population of a number of coastal territories and for the corresponding industrial and infrastructural facilities. Correct determination of the distribution of the expected maximum wave heights along the coast before tsunami arrival can save lives, minimize the consequences for engineering structures, and avoid costly evacuation measures if they are not necessary. The paper compares the maximum tsunami wave amplitude values obtained by different numerical methods [1]. It is shown that the methods used to solve the wave propagation problem for model source give similar values of maximum heights practically in the entire computational domain except for points close to the boundary. This can be explained by different ways of realizing the conditions of total reflection from the boundary. However, the discussed methods have different performance, which differs by orders of magnitude. In order to obtaining results faster, it is recommended to use hardware acceleration of the calculations [2]. The results will be useful for warning services in decision making.

Keywords: Tsunami wave propagation, Maximal heights, Numerical Scheme

Mathematics Subject Classification: 65N06, 76D33

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Transoceanic tsunami modeling on a 1-minute grid

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Abstract: Tsunami waves can propagate over a distance of several thousand kilometers without losing their destructive power. For modeling the process of transoceanic wave propagation, it is customary to use the resources of supercomputers. In order to limit the processing time by 1-2 hours, grids with a step of 3-4 geographic minutes are used for such calculations. The use of more detailed grids requires even more significant computational costs. Due to the use of hardware acceleration (previously proposed [1]co-processor based on Field Programmable Gates Array - FPGA), a personal computer can also be used for calculations, which can significantly increase the number of studies in the field of tsunami warning. Obtained precision is the same then using alternative simulation tools, while performance is similar to those of supercomputers [2]. The paper presents the results of numerical solution of the system of shallow water equations modeling the propagation of a tsunami wave across the Pacific Ocean water area using a computational grid with a resolution of 1 minute. It is shown that due to the achieved fast performance it is possible to adjust the source parameters as new information on the amplitude and profile of the wave passing over deep-sea pressure sensors becomes available.

Keywords: Transoceanic tsunami wave propagation, Hardware acceleration

Mathematics Subject Classification: 65N06, 76D33

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Realizing Multiple Optical Bifurcation using a Micoring Resonator with Triple-Coupler

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Abstract: In this study, a novel triple-coupler add-drop microring resonator (TCADMR) was presented and the nonlinear behavior of light through a system of GaAsInP core waveguide on a substrate layer of InP was investigated. The light behavior via TCADMR system was studied using optical transfer matrix and coupled-mode theory. Three sets of optical bright solitons with an increasing amplitude ratio were simultaneously entered in to the TCADMR and multiple bifurcate areas were realized. A nonlinear ultra-fast on-off switching time with a minimum threshold input power was realized that makes the TCADMR as a promising device for study of cell signaling networks, quantum systems, classical analogues, and analysis impacts areas systems like hamiltonian and stochastic systems.

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Modelling and optimisation of the maximum power of a wind turbine using fuzzy logic

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Abstract: In this article we will apply a method based on artificial intelligence (fuzzy logic), with the aim of tracking and extracting the maximum power produced by the wind turbine. To do this we first modelled our system using mathematical equations, then developed an algorithm based on fuzzy logic which consists of finding an optimal operating relationship corresponding to dv/dp=0, this method has the advantage of being able to be integrated without any knowledge of the characteristics of the canopy. The results obtained show the effectiveness and robustness of fuzzy MPPT. The performance validity of this proposed technique is confirmed by simulation on MATLAB. Simulink, and compared with other classical methods such as P&O, TCR... etc.

Keywords: Turbine, MPPT, Wind, Fuzzy Logic

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Bound state solutions of the Dirac equation with the Eckart potential including Coulomb-like tensor potential by Feynman path integral

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Abstract: We solve the Dirac equation with the Eckart potential including a Coulomb-like tensor interaction under pseudospin symmetry condition with arbitrary spin-orbit coupling quantum number κ by using the Feynman path integral method. We calculated the wave function and energy eigenvalues and compared our results with other data.

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On Generalized Metric Spaces and their Topological and Fixed Point Theoretic Applications

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Abstract: This is a survey on the genesis and development of one of the most important notions in mathematical analysis, namely the notion of metric space and mainly for its own sake. It also surveys the topological properties and fixed point theoretic applications of notable metric space variants, as its subsidiary general goal. In particular, the survey article attempts to accomplish the following three specific objectives. Firstly, it attempts to uncover a moderately comprehensive list of generalizations or extensions of metric space that exist in the contemporary literature and classify them into logical categories that could be pedagogically significant. Secondly, it assesses the impacts of selected variants of metric spaces in the realm of fixed point theory vis-a-vis the motivations that necessitated their introduction into fixed point theory: Are fixed point theorems obtained via metric space generalizations genuine generalizations of existing results, as per their claims, or are they mere duplications of previous results? Lastly, the article explores some basic topological properties of selected "generalized" metric spaces and generalized metric characterizations of some topologies.

Generation of Multiple Nonlinear Optical Bistability using GaAsInP Microring Resonator with Three Input Port

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Abstract: A novel triple-coupler add-drop GaAsInP microring resonator (TCADMR) was introduced and the nonlinear behavior of light through this system was investigated. The optical transfer matrix was derived for a 2×2 asymmetric waveguide coupler using coupled-mode theory. Then the relationships between the light fields propagating inside the ring are calculated. Three sets of optical bright solitons with an increasing amplitude ratio were simultaneously entered in to the TCADMR and a nonlinear ultra-fast on-off switching time of 14.4 ps was realized for a minimum threshold input power as small as 0.37 μW. Achieving a pico-scale optical switching time via a microscale optical track beside, realizing nonlinearity in a microscale input power make the TCADMR as a promising device for future low cost and compact optical switches applicable in biological and photonics systems.

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Load and distance-based sink movement algorithm for network performance improvement in mobile wireless sensor networks with a mobile sink

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Abstract: Using sink mobility in wireless sensor networks significantly improves network performance by dynamically adjusting the position of the sink to optimize data collection. By strategically moving the sink according to specific objectives, the network can reduce latency, balance the load, and extend the lifetime of sensor nodes, resulting in more efficient and reliable data transmission. In this work, we propose a load and distance-based sink movement algorithm to determine the trajectory of the sink in a wireless sensor network with a mobile sink. The proposed algorithm uses a matrix distance to guide it to the nearest sojourning points from the most loaded nodes, then uses a function to determine the optimal visiting order between sojourning points. Indeed, our algorithm aims to minimize the hop distance between heavily loaded nodes and the sink, minimize the geometric distance between sojourning points, and prioritize visiting nodes with high packet numbers to deliver. By reducing the number of hops between the burdened nodes and the sink, the energy consumed in transmitting data packets is reduced, the risk of error is minimized, and the probability of successful transmission is maximized. The simulation results show that our algorithm significantly outperforms comparative approaches in terms of network lifetime and packet delivery ratio.

Keywords: 68M10, 94A05, 78M40.

Mathematics Subject Classification: Mobile wireless sensor networks (MWSN), controlled mobility, sink trajectory optimization, load balancing, energy efficiency.

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Solution of Markov Reward Games Using Convolutional Neural Networks

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Abstract: In this paper, we present a convolutional neural network architecture designed to solve Markov reward games. This architecture takes the rewards and transition matrix as inputs and provides the optimal strategy for the game. The proposed neural network architecture is trained using 80% of 3000 and 5000 Markov reward games, each featuring 3 actions and 3 states, and is tested utilizing 20% of 3000 and 5000 Markov reward games. The results reveal that the developed architecture can achieve errors of less than 3% in terms of mean square error in the final rewards

Keywords: Game theory; Markov reward games; Artificial neural network; Convolutional neural network

Mathematics Subject Classification: 91Axx, 91A80, 97R40

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Statistical Proprieties and Modeling of Lifetime Data under Exponential Geometric Pareto Distribution

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Abstract: Statistical distributions plays a vital role in modeling lifetime data that arise in different fields of science such as in Survival analysis, Economics, Biology, Engineering, and in some other applied field of sciences. There are many lifetime probability distributions that can be used to model the data under exponential family distributions, for example, Exponential-Geometric –Pareto distribution are among others. The main objective of this work is to achieve maximum flexibility while modeling the lifetime data. We firstly evaluate the Akaike and Bayesian information criteria for our distributions and different statistical properties. The maximum-likelihood estimators of the models parameters are obtained. Then we will try to apply our proposed distributions to real data sets for comparative study.

Keywords: Exponential- Poisson -Weibull distribution, Bayesian information criteria, maximum likelihood, lifetime data.

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Nonlocal and Nonclassical Properties of a System of Four-Level Atom Interacting with Parity Deformed field

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Abstract: In this article, we present a model of a four-level atom (F–LA) interacting with a field mode initially defined in a parity deformed field (PD-F). We consider for-level atom initially in the upper states and display the quantum dynamics of the mathematical system with the solution of the motion equation. We display the dynamical behavior of fundamental quantum resources that are considered in different tasks of quantum optics and information including the atomic population inversion, F–LA with PD-F entanglement, P–BF photon statistics with respect to the parameter values of the proposed model. In this context, we show how the quantum resources are influenced by the different parameters of the PD-F and time-dependent coupling. Finally, we illustrate the dynamical relationship among the quantum resources of the quantum mathematical system.

Keywords: Four-Level Atom, Parity Deformed field, Quantum properties, Entanglement, Photon Statistics.

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Using Machine Learning Intelligence for analyzing Insights in Blood diseases Medical Data

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Abstract: The objective of this research is to examine the notable challenges related to the profiling of Blood diseases, a globally prevalent disease with substantial health consequences. The relevance of the problem we are addressing becomes more apparent when considering the limitations of current diagnostic methods, which often suffer from deficiencies in terms of accuracy, speed, and customization. Given the aforementioned knowledge, there is a reconsideration of the Blood disease profiling process, aided by the utilization of a machine learning approach called artificial intelligence. The objective of our study is to have a significant impact on the diagnosis of Blood diseases, the selection of treatment modalities, and the delivery of patient care. In order to accomplish this objective, our approach entails leveraging diverse and extensive datasets, employing computational techniques, and scrutinizing intricate patterns. The importance of this program extends beyond the realm of Blood diseases research, with broader implications for healthcare methodology, patient well-being, and the utilization of advanced technologies to tackle pressing healthcare concerns. With the aim of showcasing a strong commitment to enhancing healthcare and the quantifiable influence it exerts on those affected by Blood diseases.The objective of this research endeavor is to establish the foundation for a prospective future wherein innovative technical advancements facilitate a transformative change in the domain of Blood diseases research, ultimately resulting in enhanced patient outcomes.

Keywords: Blood diseases, analyzing, Medical Data, Machine Learning, enhancing healthcare,scrutinizing intricate patterns.

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