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(Deemed to be University under section 3 of UGC Act, 1956)
CHENNAI

SOUVENIR

International Conference on Emerging Frontiers in Nonlinear Complex Systems, Computational Intelligence and their Applications

07-09 February 2024

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The Innovation Engine of India

Division of Mathematics
School of Advanced Sciences
Vellore Institute of Technology, Chennai, INDIA

VIT - A place to Learn; A chance to Grow

Message from Chancellor

It is with great pleasure that I extend a warm welcome to the participants of the International Conference on Emerging Frontiers in Nonlinear Complex Systems, Computational Intelligence and their Applications. This occasion brings together the finest minds in the field of mathematics from around the world.

The Conference will serve as a platform for the exchange of groundbreaking ideas, methodologies, and discoveries. It is a testament to our commitment to promoting excellence in mathematical research and fostering a global community of scholars who strive to expand the boundaries of knowledge.

I appreciate the Organizing Committee for its untiring efforts in ensuring the success of the event. The dedication and hard work of the team have played a pivotal role in bringing together this gathering of brilliant minds. I thank the sponsors for graciously supporting the event.

I believe that the Conference will enrich the knowledge of the participants, in addition to providing a memorable experience.

I wish the conference all success.

With best wishes,

Dr. G. Viswanathan

Founder & Chancellor

Message from Vice President

A very heartfelt welcome to all participants of the International Conference on Emerging Frontiers in Nonlinear Complex Systems, Computational Intelligence and their Applications.

This conference serves as a vibrant meeting ground for scholars, researchers, and professionals who share a common passion for advancing the frontiers of mathematical knowledge. Mathematics, as a language of universal significance, has the power to transcend borders and unite us in our pursuit of understanding the intricacies of the world around us.

Our college is honored to be the host of this prestigious event, and I believe that the next few days will be marked by stimulating discussions, insightful presentations, and the forging of meaningful connections. The diversity of perspectives and experiences represented here reflects our commitment to fostering a global community that thrives on collaboration and the exchange of ideas.

I extend my heartfelt appreciation to the organizing committee for their meticulous planning and dedication in bringing together this exceptional event. To our esteemed speakers and presenters, your expertise and insights are the driving force behind the success of this conference.

Let us make the most of this time together, leveraging the diversity of thought and experience present in this room. May the bonds formed and the knowledge shared during this conference lay the foundation for future advancements in the field of mathematics.

With warm regards,

Dr. Sekar Viswanathan

Vice President

Vellore Institute of Technology

Message from Vice Chancellor (In-charge) and Pro-Vice Chancellor

It is my distinct privilege to address this gathering of brilliant minds that transcends borders and unites us in the pursuit of mathematical excellence. This conference stands as a testament to our collective commitment to advancing the frontiers of knowledge, fostering international collaboration, and celebrating the richness of mathematics. We are honored to host such a distinguished audience representing diverse cultures, perspectives, and mathematical traditions.

As we embark on this intellectual journey over the coming days, I encourage you to immerse yourselves fully in the spirit of collaboration and exploration. Engage in discussions that challenge assumptions, seek connections that transcend disciplines, and forge relationships that extend beyond the confines of this conference room.

To our distinguished speakers and presenters, your presence enriches our academic landscape, and your contributions are the catalysts for the intellectual fire that burns within our institution. The School of Advanced Sciences is not just a venue for this conference; it is a crucible for the synthesis of diverse perspectives, a place where mathematical ideas converge, collide, and give birth to new paradigms.

With warm regards,

Dr. V S. Kanchana Bhaaskaran

Vice Chancellor (In-charge) and Pro Vice-Chancellor

Vellore Institute of Technology, Chennai

Message from Dean

With a profound sense of enthusiasm and scholarly participation, I extend a warm welcome to all of you at the International Conference on Emerging Frontiers in Nonlinear Complex Systems, Computational Intelligence and their Applications. As the Dean of the School of Advanced Sciences, I am honoured to welcome the architects of tomorrow's mathematical landscapes to this hub of intellectual dynamism.

Our School is not merely a venue for this conference; it is a sanctuary where the pursuit of knowledge and the spirit of inquiry meets the canvas of boundless possibilities. Each one of you represents a brushstroke, contributing to the masterpiece that is the collective intelligence of this diverse and esteemed assembly.

The theme of this conference, like a mathematical equation awaiting its solution, beckons us to unravel new patterns, explore uncharted territories, and seek the elegance that lies within the complexity of mathematical thought. It is not just a meeting of minds; it is a symphony of intellects converging to compose the future of mathematical exploration.

To our distinguished speakers, your expertise is the beacon light guiding us through the uncharted waters of mathematical discovery. To our participants, you are the collaborators, the co-creators of knowledge, and the architects of a shared mathematical destiny.

In the days ahead, let this conference be a crucial one where ideas are forged, assumptions are challenged, and collaborations are sparked. Embrace the intellectual currents that flow through our School, and may the connections you make here transcend geographical boundaries and inspire future collaborations that redefine the landscape of mathematical inquiry.

With anticipation and warm regards,

Dr. Mahalakshmi S

Dean, SAS

Vellore Institute of Technology, Chennai

Contents

Preface

On behalf of entire organizing team, Division of Mathematics and School of advanced Sciences, we heartly welcome all the speakers and participants of the ICNCS-2024. The ICNCS-2024 serves as a dynamic platform for researchers, scholars, and experts to converge and explore cutting-edge developments in the fields of nonlinear complex systems and computational intelligence. This conference provides a unique opportunity to showcase novel mathematical methods, discuss groundbreaking research, and share insights into the multifaceted applications of these techniques. Attendees can look forward to engaging discussions, keynote addresses from leading experts, and a collaborative environment that fosters innovation. This conference will focus on:

- Nonlinear systems and their complex nature
- Chaos and synchronization
- Numerical analysis and the development of algorithms for simulation
- Scientific computing and their applications
- Machine and deep learning
- Data driven model
- Fluid dynamics
- Fuzzy inference system
- Mathematical biological model

For ICNCS-2024, we are grateful to have received financial support from SERB-Assistance to Professional Bodies and Seminar Symposia for ₹3,50,000, as well as the CSIR Symposia/ Conference Grant for ₹50,000, also we have received over ₹3,00,000 from the participants as the registration fee. Our call for abstracts attracted submissions from both national and international researchers, totalling more than 200 abstracts. We are pleased to announce that we have invited over 150 abstracts to present their research findings at the conference. Additionally, we are honoured to have renowned international speakers joining us from esteemed institutions such as Humboldt University (Germany), University of Pisa (Italy), Deakin University (Australia) and the UAE University (United Arab Emirates). Moreover, we have extended invitations to esteemed Indian senior and young professors from institutions such as IITs, IISER Mohali, IIST Thiruvananthapuram, Bharathidasan University, Bharathiar University, The Gandhigram Rural Institute (Deemed to be University), and Gauhati University.

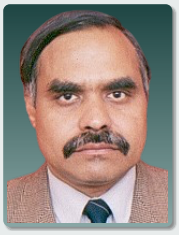
Finally, the conference can lead to new research directions between nonlinear systems and computational intelligent approaches. Also, participants can gain new insights from keynote speakers and research discussions. In addition to the wealth of information shared through presentations and research discussions, attendees have the unique opportunity to acquire valuable insights from distinguished keynote speakers. These experts, renowned in their respective fields, provide stimulating viewpoints that can significantly influence the way participants approach their own research and contribute to the advancement of these disciplines. The knowledge exchange facilitated by these keynote addresses adds a layer of depth to the conference experience, enriching the intellectual landscape. We express our gratitude to the Dean of SAS, the Division Chair, and all faculty members for their support.

Additionally, a special acknowledgment is extended to our organizing team and all research scholars for their exceptional efforts in ensuring the success of this conference. Finally, our heartfelt thanks go out to all our participants, and we extend our best wishes to them for continued success and prosperity.

Dr. S. Lakshmanan
Convener, ICNCS 2024
Associate Professor
School of Advanced Sciences
Vellore Institute of Technology, Chennai

Our Speakers

Keynote Speaker



Dr. Maithili Sharan
INSA Senior Scientist
Center for Atmospheric Sciences, Indian Institute of Technology Delhi, New Delhi, India

Keynote Speaker

Dr. P. Kandaswamy
Professor
Bharathiar University, Coimbatore,
Tamil Nadu, India

Keynote Speaker

Dr. Hemen Dutta
Associate Professor
Department of Mathematics, Gauhati University,
Assam, India

Invited Speaker

Prof. Dr. Dr. h.c. mult. Jürgen Kurths
Professor & Senior Scientist
Potsdam Institute for Climate Impact Research,
Potsdam, Germany

Institute of Physics, Humboldt University of Berlin,
Berlin, Germany

Invited Speaker

Dr. Fathalla Ali Rihan
Professor
Department of Mathematical Sciences
College of Science UAE University, Al-Ain
United Arab Emirates

Invited Speaker

Dr. Chee Peng Lim
Professor
Institute for Intelligent Systems Research and Innovation, Deakin University
Australia

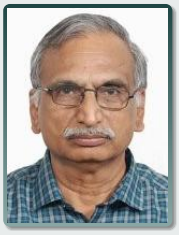
Invited Speaker

Dr. Stefano Galatolo
Associate Professor, University of Pisa, Italy

Invited Speaker

Dr. M. Lakshmanan
Professor of Eminence
Centre for Nonlinear Dynamics
Bharathidasan University, Tiruchirappalli, Tamil Nadu, India

Invited Speaker



Dr. K. Balachandran
Mentor Professor
Department of Mathematics
Bharathiar University, Coimbatore,
Tamil Nadu, India

Invited Speaker

Dr. Raju K. George
Professor
Department of Mathematics
Indian Institute of Space Science and Technology,
Thiruvananthapuram, Kerala, India

Invited Speaker

Dr. P. Balasubramanian
Professor
Department of Mathematics
The Gandhigram Rural Institute - Deemed
University, Dindigul, Tamil Nadu, India

Invited Speaker

Dr. Malay Banerjee
Professor
Department of Mathematics and Statistics
Indian Institute of Technology Kanpur, Uttar
Pradesh, India

Invited Speaker

Dr. Sudeshna Sinha
Professor
Department of Physics
Indian Institutes of Science Education and
Research Mohali, Punjab, India

Invited Speaker

Dr. Pratibhamoy Das
Assistant Professor
Department of Mathematics
Indian Institute of Technology Patna, Bihar, India

Program Schedules

Inaugural Function (07 February 2024)

Time		Program
09:15	:	**Invocation - Tamil Thai Vazhthu**
09:20	:	**Lighting the Kuthu Vilakku**
09:25	:	**Welcome Address** Dr. S. Lakshmanan, Convener, ICNCS 2024
09:30	:	**Inaugural Address** Dr. S. Mahalakshmi, Dean SAS, VIT, Chennai
09:35	:	**Dynamics of the Conference** Dr. Kalyani Desikan, VIT, Chennai
09:45	:	**Felicitation Address** Dr. V. S. Kanchana Bhaaskaran Vice-Chancellor (i/c) and Pro Vice Chancellor, VIT, Chennai
09:50	:	**Release of Souvenir**
09:55	:	**Address by Chief Guest** Dr. Fathalla Ali Rihan, UAE University, UAE
10:00	:	**Keynote Address** Dr. P. Kandaswamy, Bharathiar University, Coimbatore
10:15	:	**Keynote Address** Dr. Maithili Sharan, IIT Delhi, India.
10:30	:	**Vote of Thanks** Dr. S. Dhanasekar, Co-Convener, ICNCS 2024

Valedictory Function (09 February 2024)

Time		Program
14:45	:	**Welcome Address** Dr. A. Manivannan, VIT, Chennai
14:47	:	**Impression of the Conference** Dr. B. Srutha Keerthi, VIT, Chennai
14:52	:	**Valedictory Address** Dr. Hemen Dutta, Gauhati University, Assam
15:00	:	**Feedback from Participants**
15:05	:	**Distribution of Certificates**
15:10	:	**Vote of Thanks** Dr. V. Parthiban, VIT, Chennai
15:12	:	**National Anthem**
15:15	:	**High Tea**

DAY 01 (07 FEB, 2024)

08:00–09:15 **Registration**

09:15–10:30 **Inauguration & Keynote Addresses**

10:30–10:35 **Group Photo Session**

10:35–11:00 **Tea Break**

Invited Talks (11:00 – 12:30)

Chair Person: Fathalla Ali Rihan, UAE University, UAE

11:00–11:45 Malay Banerjee, IIT Kanpur, India
Analytical detection of spatial and spatio-temporal pattern

11:45–12:30 Pratibhamoy Das, IIT Patna, India
Higher order numerical analysis for multi-term time fractional partial integro differential equations on graded meshes

12:30–14:00 **Lunch Break**

Invited Talks

Chair Person: Malay Banerjee, IIT Kanpur, India

14:00–15:15 Jürgen Kurths, Humboldt University, Berlin, Germany
Stability of power grids concerning strong perturbations - tropical cyclones and increasing resilience ***(Virtual Mode)***

15:15–16:00 Fathalla Ali Rihan, UAE University, UAE
Continuous Runge-Kutta methods of delay differential equations of Pantograph type

16:00–16:15 **Tea Break**

16:15–17:30 **Contributory Talks (AB1, 7&8 Floors)**

DAY 02 (08 FEB, 2024)

Invited Talks

Chair Person: Pratibhamoy Das, IIT Patna, India

09:30–10:15 Chee Peng Lim, IISRI, Deakin University, Australia
Development and application of intelligent learning systems ***(Virtual Mode)***

10:15–11:00 Sudeshna Sinha, IISER Mohali, India
Disorder in aid of order

11:00–11:30 **Tea Break**

Invited Talk

Chair Person: Lakshmanan M, Bharathidasan University, India

11:30–12:15 Balasubramaniam P, The Gandhigram Rural Institute, India
Quantum control systems

12:15–14:00 **Lunch Break**

14:00–16:30 **Contributory Talks (Delta Block, 4th Floor)**

16:30–17:00 **Tea (Delta Block, 4th Floor)**

18:00–19:00 **Cultural Programme (Nethaji Auditorium, AB1 7th Floor)**

19:00–20:30 **Conference Special Dinner**

DAY 03 (09 FEB, 2024)

Invited Talk

Chair Person: Sudeshna Sinha, IISER Mohali, India

09:15–10:00 Lakshmanan M, Bharathidasan University, India
Collective dynamical states in simple and complex nonlinear systems

10:00–10:45 Raju. K. George, IIST, Thiruvananthapuram, India
Controllability of nonlinear networked systems

10:45–11:00 **Tea Break**

Invited Talk

Chair Person: Raju. K. George, IIST, Thiruvananthapuram, India

11:00–11:45 Stefano Galatolo , University of Pisa, Italy
Self consistent transfer operators in a weak and not so weak coupling regime. Invariant measures, convergence to equilibrium, linear response ***(Virtual Mode)***

11:50–13:00 **Contributory Talks (AB2, 2nd Floor)**

13:00–14:00 **Lunch Break**

Invited Talk

Chair Person: Hemen Dutta, Gauhati University, India

14:00–14:45 Balachandran K, Bharathiar University, Coimbatore
Controllability of fractional dynamical systems

14:45–15:15 **Valedictory**

15:15–15:45 **High Tea**

*Classroom details for the contributory talks will be shared separately.

Program Committee

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Mr. Vignesh Ravi

Call for Papers

The authors are requested to submit their original research works through online submission in one of the SCI journals by registering themselves after the notification. Please note that the submitted papers will be accepted only after thorough scrutiny and three peer reviews.
Topics chosen could be related to the following topics of interest but not limited to:

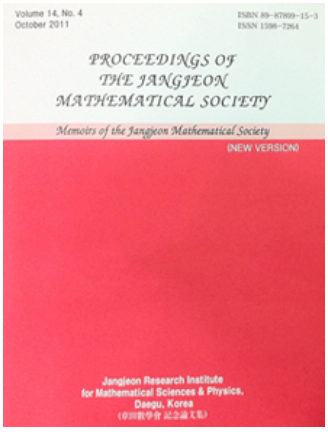
- Nonlinear complex systems
- Nonlinear classical and fractional differential equations and their applications
- Numerical analysis and the development of algorithms for simulation
- Scientific computing and their applications
- Numerical simulation and modeling
- Mathematical methods in artificial intelligence
- Machine and deep learning
- Neural networks
- Intelligent control scheme
- Multi-agent system with deep learning approach
- Computational intelligent models for health care application
- Stability and stabilization issues
- Fuzzy set theory and their applications
- Fractal theory
- Graph theory and their applications
- Discontinuous dynamical systems and control
- Synchronization and chaos problem
- Fluid dynamics and computational fluid dynamics
- Time-delays / uncertainties
- Data-driven dynamical systems

The submitted research papers will undergo rigorous peer review, and those selected will have the privilege of being published in the following journals:

1. **The European Physical Journal Special Topics (EPJ ST)**

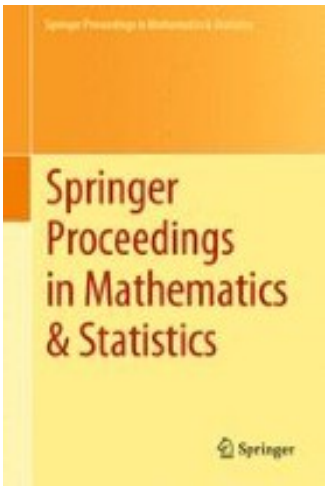
Index in	:	SCOPUS, Science Citation Index, Science Citation Index Expanded
Impact Factor	:	2.8(2022)
Publisher	:	Springer Verlag
Electronic ISSN	:	1951 – 6401
Print ISSN	:	1951 – 6355

2. **Proceedings of the JANGJEON Mathematical Society**



Index in	:	UGC CARE
Publisher	:	Jangjeon Mathematical Society
ISSN	:	1598-7264

3. **Springer Proceedings in Mathematics and Statistics**



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Publisher	:	Springer Publishing Company
Electronic ISSN	:	2194-1017
Print ISSN	:	2194-1009

Abstracts

ICNCS2024_04

State estimate intervals for a class of fractional-order interconnected systems

Dao Thi Hai Yen[1] and Dinh Cong Huong[2]

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[2]Faculty of Automotive Engineering Technology, Industrial University of Ho Chi Minh City, Vietnam. dinhconghuong@iuh.edu.vn

Abstract

This paper addresses the problem of designing estimate intervals for linear functions of state vectors of each subsystem of fractional-order time-varying interconnected systems subject to time delays and external disturbances. Unlike the existing methods for designing interval observers for linear time-varying systems, which only dealt with integer-order time-varying systems or fractional-order invariant systems, the one in this paper can be applied to a wide class of fractional-order time-varying interconnected systems subject to time-varying delays and external disturbances. First, we propose novel observers that provide upper and lower bounds of the unknown linear functions of the state vectors. Then, we provide existence conditions and algorithms for determining such state observers. Finally, we propose two examples to verify the validity of the proposed approaches.

Keywords: Fractional-order systems, state observers, time delays, interval observers, interconnected systems, disturbances.

AMS subject classifications. 34H05; 93B07; 93B51; 93B40

ICNCS2024_05

State estimation for the permanent magnet synchronous motor using a recurrent neural network learning algorithm and an event-triggered state observer

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Abstract

In this paper, we propose a novel method to estimate the electrical angular velocity, the electrical angle, and the currents of the permanent magnet synchronous motor. A recurrent neural network learning algorithm is first developed to estimate the permanent magnet synchronous motor. Then, an event-triggered state observer is designed for the recurrent neural network. This state observer robustly estimates state variables of the permanent magnet synchronous motor. A sufficient condition in terms of a convex optimization problem for the existence of the event-triggered state observer is established. In contrast with the abundance of state estimation methods based on time-triggered state observers where the measurements are always continuously available, the ones in this paper are updated when an event-triggered condition holds. Therefore, it lessens the stress on communication resources while can still maintain an estimation performance. Simulation results are provided to demonstrate the merit of the proposed method.

Keywords: Permanent magnet synchronous motor (PMSM), event-triggered mehanism (ETM), event-triggered state obervers, linear matrix inequality (LMI).

AMS subject classifications. 34H05; 93B07; 93B51

ICNCS2024_06

Impact of Magnetic Field at the Entrance Region of Porous Filled Duct under the LTNE Model with Viscous Dissipation and Axial Conduction*

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Abstract

Convective flow problems often involve porous materials, where the solid skeleton temperature can deviate from the fluid temperature. The situation characterised as local thermal non-equilibrium (LTNE) is widely recognised. Researchers have demonstrated significant interest in exploring these intriguing problems, likely motivated by the tremendous and thrilling prospects of applying such equations in realtime applications. The effect of the magnetic field at the entrance region of a porous filled duct under the local thermal non-equilibrium (LTNE) with viscous dissipation and axial conduction is examined in the present analysis. Channel walls are subjected to heat flux. The unidirectional flow in the porous region corresponds to the Darcy Brinkman model. A successive accelerated replacement (SAR) approach has been used to obtain numerical solutions. The investigations further quantify the impact of the Hartmann number, Brinkman number, Peclet number, Biot number and thermal conductivity ratio on heat transfer enhancement. For fluid-solid phases, dimensionless temperatures, and local Nusselt number profiles are given in the present investigation.

Keywords: Darcy Brinkman model; Hartmann number; Viscous dissipation; LTNE model

*Nitish Gupta thanks the MoE, Government of India for his Doctoral Scholarship.

ICNCS2024_07

Revolutionizing Wind Energy: A Novel Approach to Site Selection Employing L_{q^*} q-Rung Orthopair Multi-Fuzzy Soft Matrix

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Abstract

The selection of an ideal location is a critical milestone in wind energy projects to generate electricity, and it presents an effective multi-criteria decision-making (MCDM) framework for accomplishing this objective. This paper offers a comprehensive analysis for assessing the optimal site selection for wind turbines through the utilization of an $\mathscr{L}_{q^*}$ $q-\mathscr{R}ung\ \mathscr{O}rthopair\ \widehat{\mathscr{M}}ulti-\widehat{\mathscr{F}}uzzy\ \widehat{\mathscr{S}}oft$ information. The primary aim of this research is to embark on the development of a novel matrix called $\mathscr{L}_{q^*}$ $q-\mathscr{R}ung\ \mathscr{O}rthopair\ \widehat{\mathscr{M}}ulti-\widehat{\mathscr{F}}uzzy\ \widehat{\mathscr{S}}oft$ matrix and determine its binary operations and properties. Next, the established framework is used to evaluate a case study of wind turbine site selection to elucidate the usefulness and practicability of the suggested technique. The results indicate that this approach provides a broader scope for displaying data, increases adaptability in its implementation, and generates more reliable evaluation results.

Keywords: Wind Turbine; Site Selection; $q-\widehat{\mathscr{ROMFS}}\ \mathscr{S}et$; $\mathscr{L}_{q^*}$ $q-\widehat{\mathscr{ROMFS}}\ \mathscr{S}et$; $\mathscr{L}_{q^*}$ $q-\widehat{\mathscr{ROMFS}}\ \mathscr{M}atrix$.

ICNCS2024_08

Study of fractals generated by $\sin(z^{k+1} + c)$ using Picard-Mann Iteration[†]

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Abstract

The combinatorial structures of the fractals of Mandelbrot and Julia sets for the transcendental function $\sin(z^l) + c$, in the complex plane with $c \in \mathbb{C}, l \geq 2$ is investigated here. We have set up an escaping criteria for the set of points in the dynamical plane to generate the fractals of Julia and to generate the Mandelbrot set in the parameter plane. Fractals geometry is investigated through figures.

Keywords: Fatou set, Julia set, periodic points, singular values, Fixed points, critical values

AMS subject classifications. Primary 37F10 , Secondary 30D05

ICNCS2024_09

Binary Multiset Separation Axioms in Binary Multiset Topology Space

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Abstract

In this paper, initate a separation axioms in binary multiset(bms) topological space also we define bms T_o space, bms T_1 space, bms T_2 space, bms T_3 space and their properties, characterization are studied. Furthe, the interrealtionship between these bms space are invesigated.

Keywords: bms T_o space, bms T_1 space, bms hausdorff sapce, bms regular space, bms normal space.

AMS subject classifications. 00A05, 03E70, 54B10, 54G20.

[†]The authors thanks the support of VIT-AP funding

ICNCS2024_11

Analysis of Entropy Generation on MHD Oscillatory Jeffrey Fluid Flow in a Tapered Wavy Channel

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Abstract

The entropy generation analysis on time-dependent MHD oscillatory flow of Jeffrey fluid in a wavy channel subjected to Lorentz force and thermal radiation parameter is discussed in the present study. It has diverse applications in a range of disciplines: automotive elastomers in the material selection process, soft tissue mechanics modeling in biomechanics, extrusion and injection molding optimization in polymer processing, rheological test design and data interpretation in rheology. The governing equations are transformed into a system of nonlinear differential equations using non-similarity transformations. The transient system of dimensionless partial differential equations (PDEs) is solved using the Crank–Nicolson implicit finite difference method. Incorporating relevant parameters, the exact behavior of the flow with respect to velocity, temperature, volumetric rate of entropy generation and Bejan number is graphically depicted and these graphs exhibit a parabolic nature. In conclusion, the results obtained in this study have been compared with those of previous research, revealing a notable level of agreement between them.

Keywords: Entropy analysis; Oscillatory flow; MHD; Jeffrey fluid; Crank–Nicolson method.

AMS subject classifications. 76D05; 76S05; 76R50; 76W05.

ICNCS2024_12

Investigation of Hybrid Nanofluid Flow with Thermal Radiation and MHD Effects: Using different ratios of Base Fluid Mixture Water-EG (H_2O–$C_2H_6O_2$)

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Abstract

Nanofluids hold great promise in revolutionizing heat transfer applications and offer many advantages compared to conventional heat transfer fluids. Their superior thermal properties, adjustability, stability, and potential for energy conservation make them an appealing option for various engineering and industrial processes. This, in turn, paves the way for the development of more efficient and sustainable technologies in the future. Flow formulation is developed in this study by considering the effect of magnetic field, thermal radiation and oscillatory flow in a porous medium through asymmetric wavy channel. The primary objective of this research is to determine the thermal and physical characteristics of a hybrid (Iron Oxide-Silica) nanofluid composed of three cases involving water, ethylene glycol (EG), and mixtures of water and EG in different ratios. Specifically, six different volume ratios of EG to water were considered: 0:100%, 20:80%, 40:60%, 60:40%, 80:20%, and 100:0%. To describe this system mathematically, the governing equations are transformed into non-linear partial differential equations using appropriate dimensionless transformations. These equations are subsequently solved analytically. As a result of these calculations, graphical representations of velocity, temperature, and concentration profiles, Skin Friction Coefficient, Heat and Mass transfer rate are generated.

Keywords: Thermal radiation; Oscillatory flow; Nanofluid; MHD, Hybrid base fluid.

AMS subject classifications. 76W05; 76R50 ; 76D05; 76S05

ICNCS2024_13

On reciprocal distance spectrum of neighbourhood corona of graphs

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Abstract

Let G be a connected graph with $V(G) = \{v_1, v_2, \ldots, v_n\}$. The reciprocal distance matrix [O. Ivanciuc et al. *Design of topological indices. Part 4. Reciprocal distance matrix, related local vertex invariants and topological indices*. J. Math. Chem., 12: 309–318, 1993] of G, also known as Harary matrix [D. Plavšić et al. *On the Harary index for the characterization of chemical graphs*. J. Math. Chem., 12: 235–250, 1993], is a square matrix of order n defined as $RD(G) = [h_{ij}]$, where $h_{ij} = \begin{cases} \frac{1}{d_{ij}} & i \neq j \\ 0 & \text{otherwise,} \end{cases}$ where d_{ij} is the distance between vertices v_i and v_j. The reciprocal distance matrix is applicable in molecular chemistry to study the quantitative structure - property relationships ($QSPR$) and quantitative structure - activity relationships ($QSAR$) of molecular graphs. The reciprocal distance spectrum of G is the set of all eigenvalues of its reciprocal distance matrix. Spectral properties of reciprocal distance matrix provide insights into various graph characteristics, such as connectivity and structural properties. The neighbourhood corona $G \star H$ of two graphs G and H is obtained by taking one copy of G and $|V(G)|$ copies of H and making all the vertices in the i^{th} copy of H adjacent with all the neighbours of the i^{th} vertex of G [G. Indulal. *The spectrum of neighborhood corona of graphs*. Kragujevac J. Math., 35(3): 493–500, 2011]. In this paper we describe the reciprocal distance eigenvalues and corresponding eigenvectors of $G \star H$ in terms of the adjacency eigenvalues of G and H when both G and H are regular with diameter of G at most 2. We also construct infinitely many reciprocal distance non cospectral pairs of reciprocal distance equienergetic graphs and non isomorphic pairs of reciprocal distance cospectral graphs of the same order and size using some graph operators namely line graphs, iterated line graphs, double graphs, strong double graphs and complement graphs.

Keywords: Reciprocal distance spectrum; neighbourhood corona; reciprocal distance equienergetic graphs; reciprocal distance cospectral graphs

AMS subject classifications. 05C50; 05C76

ICNCS2024_14

Scattering of Water Waves by Thick Porous Breakwater in the Presence of Ocean Current‡

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Abstract

In this study, an investigation is conducted into the interaction between water waves and porous breakwater under the influence of ocean current. This investigation has been conducted using some physical and structural parameters such as the friction coefficient and porosity of the breakwater, and ocean currents to comprehend various phenomena related to wave-current interaction. The boundary element method based numerical technique is used to solve the associated boundary value problem. The porosity of the breakwater structure is modelled using the Sollit and cross model [Sollitt et al. *"Wave reflection and transmission at permeable breakwaters."* (1972)] of water wave passes through thick porous structures. The results demonstrate that the ocean current shift the frequencies for which optima in wave characteristics occurs.

Keywords: Breakwater; Porosity; Uniform current; Boundary Element Method

AMS subject classifications. Numerical simulation and modeling, Fluid dynamics and computational fluid dynamics

‡Kailash Chand Swami acknowledges the support received as a junior research fellow (File no: 09/1026(13600)/2022-EMR-I) from the Council of Scientific and Industrial Research, New Delhi. Santanu Koley acknowledges the financial support received through the DST Project: DST/INSPIRE/04/2017/002460 and the SERB Project: CRG/2021/001550.

ICNCS2024_15

Iterative boundary element method for modeling an inverted T-type porous barrier in presence of ocean currents[§]

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Abstract

The utilisation of lightweight and cost-effective thin porous structures to safeguard marine infrastructure from the impact of high amplitude wave-current interaction has been a great concern in recent years [Feichtner et al. *Using a porous-media approach for CFD modelling of wave interaction with thin perforated structures*. Journal of Ocean Engineering and Marine Energy, 7:1–23, 2021]. In this context, the present study investigates the scattering of ocean wave-current by an inverted T-type lightweight surface-piercing wave barrier placed over an uniform sea bottom. To model the aforementioned boundary value problem, the classical linear water wave theory is used. To analyze the complex wave-current interaction on the wave barrier, an iterative boundary element method is used [Nishad et al. *Dual boundary element analysis for a pair of inverted T-type porous barriers having nonlinear pressure drop*. Waves in Random and Complex Media:1–25, 2021][Dash et al. *Boundary Element Method for Water Wave Interaction with Semicircular Porous Wave Barriers Placed over Stepped Seabed*. International Conference on Mathematical Modeling and Computational Science: 95–105, 2023]. To analyze the efficacy of employing thin wave barriers, the impact of porosity, relative submergence depth and width of the barrier on the hydrodynamic properties (like wave force, wave reflection, dissipation, and transmission) are investigated in presence of ocean currents [Chen et al. *Numerical and experimental investigation of nonlinear wave-current propagation over a submerged breakwater* 143(9). Journal of Engineering Mechanics:04017061, 2017][Ryu et al. *Fully nonlinear wave-current interactions and kinematics by a BEM-based numerical wave tank* 32. Computational mechanics:336–346, 2003]. These simulated results demonstrates that the use of lightweight wave barriers provides a better wave energy dissipation compare to the bulky submerged structures.

Keywords: ocean currents; Dissipation; wave barrier

AMS subject classifications. Numerical simulation and modeling; Fluid dynamics and computational fluid dynamics

[§]Santanu Kumar Dash acknowledges DST, Government of India, New Delhi, for the financial support received through the DST INSPIRE Fellowship (DST/INSPIRE Fellowship/ IF200487). Further, Santanu Koley acknowledges the financial support received through the DST Project: DST/INSPIRE/04/2017/002460 and SERB-CRG project: CRG/2021/001550 to pursue this research work.

ICNCS2024_18

Problems on the radius of convexity for the class of analytic functions correlated with Legendre polynomials of odd degree

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Abstract

This research investigates radii problems within the class $k-\mathscr{SSC}(\alpha,\rho)$, defined by a complex inequality involving derivatives of a function $f(z)$ and parameters $k, \alpha,$ and ρ. Specifically, a function belongs to this class if a certain condition is met. The expression involves the real part of a ratio of derivatives, and the paper aims to explore the implications of this condition on the properties of functions within the specified class. The study extends to functions associated with the normalized form of Legendre polynomials of odd degree. Examples are provided to illustrate the application of the defined class and to highlight specific cases. The findings presented in this paper offer insights into the intricate relationships between the defined class of functions and their radii properties. Additionally, the exploration of normalized Legendre polynomials provides concrete instances of the theoretical results. This research lays the groundwork for further investigations into the broader implications of these mathematical concepts.

Keywords: Legendre polynomials; Analytic functions; Radii problems; Convex functions.
AMS subject classifications. 30C45; 30C50

ICNCS2024_20

Detection of Corn leaf gray spots using coefficient bounds obtained for a subclass of Analytic Functions

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Abstract

One of the most important and productive crops in the world is corn. It is widely grown for biofuel, human and animal food, and as a raw material for industrial uses. In order to effectively manage diseases, minimise financial losses, ensure food security, and support sustainable agricultural practices, it is essential to detect corn leaf gray spot. For farmers to execute appropriate control techniques and stop the disease from seriously harming maize harvests, early and precise detection is essential. In [Harakannanavar et al. 2022. Plant leaf disease detection using computer vision and machine learning algorithms. Global Transitions Proceedings, 3(1), pp.305-310], the dataspace is partitioned using K-means clustering, and then the informative characteristics of the leaf samples are extracted using the Discrete wavelet transform, Principal Component Analysis, and Grey Level Co-occurrence Matrix. In [Jung, M et al. 2023. Construction of deep learning-based disease detection model in plants. Scientific Reports, 13(1), p.7331], multiple crop diseases were detected with a deep learning algorithm. The disease detection model consists of three steps: identifying crops, determining where diseases exist and sorting the disease type. In [Rajeena PP et al. 2023. Detecting Plant Disease in Corn Leaf Using EfficientNet Architecture—An Analytical Approach. Electronics, 12(8), p.1938], the authors proposed an EfficientNet-based deep learning framework for identifying illnesses in corn leaves.

Inspired by the previously mentioned works, we focus on detecting gray leaf spots in Corn, botanically called as Zea Mays using one of the most essential computer vision applications called Edge detection. Edge detection techniques can locate the borders of objects and regions in a picture by looking for pixels with high gradient values. In order to locate the borders of unhealthy regions in plant tissues, edge detection can also be used to detect plant diseases. The severity and course of the disease can be assessed by examining the size and form of these spots. The proposed method includes convolution of coefficient bounds obtained for a subclass $\mathscr{R}(t,\delta)$ [Aarthy et al. 2023. Estimation of coefficient bounds for a subclass of Sakaguchi kind functions mapped onto various domains. Concrete Operators, 10(1), p.20220140] of Sakaguchi type functions with the image pixels to detect the gray spots in the Corn leaves. The edge detection operators Sobel, Canny, Prewitt, Roberts and Laplacian of Gaussian are compared

with the proposed method to conclude that the proposed method yields satisfactory results. The quality metrics Entropy, Contrast, Correlation, Energy and Homogeneity are taken into account to check the validity of the proposed method which is tested on a Corn gray leaf spot dataset which consists of 574 images.

Keywords: Analytic function; Edge detection; Corn disease

AMS subject classifications. 30C45; 30C50

ICNCS2024_21

Enhancing the image quality by varying the coefficients of analytical functions using quality assessment analysis

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Abstract

The purpose of this study is to process the image for enhancing its quality of it by the method of convolution to the newly generalized subclass of an analytic function $k-\Omega S^*(\alpha,\beta)$ involving the concept of $\mathscr{M}$ittag-Leffer type $\mathscr{P}$oisson distribution co-related with the starlike functions.The process of adjusting digital images like removing noise, sharpening, or brightening a picture improves its suitability for display or subsequent image analysis.. The image quality factors PSNR (Peak signal -to- noise ratio) and NIQE (Natural image quality evaluator) have been measured here for the better visual perception of the enhanced image. To demonstrate that the image enhancement algorithm that has been suggested is flawless and able to withstand significant shifts in quality, it is tested on a variety of photos that have varying degrees of quality. The quantitative values of PSNR and NIQE for the two photos were 24,8956 and 5.8037 correspondingly for the first image and 24,2888 and 5.3930 for the second image. Based on the findings of the comparisons, it seems that the picture enhancement model that was presented achieves the highest ratings for image quality. In general, this model makes considerable improvements to the specifics of the datasets that are provided, and it has the ability to assist individuals throughout the process of diagnosis. A piece of MATLAB code that may be used for the purpose of applying and evaluating various picture quality metrics. About the visual return, a comparison with other picture methods is provided as an example.

Keywords: Enhancement; Mittag - Leffler type poisson distribution; PSNR; NIQE; Analytic function.

AMS subject classifications. 30C45; 30C50

ICNCS2024_22

On the Spectra of Graphs Resulting from a New Graph Operation

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Abstract

Consider a graph G with n vertices and q edges of diameter d. Let $S \subset V(G)$ with $|S| = m$. In this paper, we introduce a new operation on G called $S-N$ Partial Cartesian Product of G, denoted by $H_S^N(G)$. The $S-N$ Partial Cartesian Product of G is defined as the Partial Cartesian product of G taken N times i.e., $\underbrace{G\square_S G\square_S ...\square_S G}_{[N-times]}$ with respect to the subset S and obtain the spectrum of certain connected graphs. We consider a new class of graphs called dumbbell graphs denoted as $\mathbf{DB}(W_{m,n})$. Dumbbell graph is the graph obtained from two copies of generalized wheel graph $W_{m,n}, m \geq 2, n \geq 3$. It is a graph on $2(m+n)$ vertices obtained by connecting m - vertices in one copy with the corresponding vertices in the other copy. Using $S-N$ Partial Cartesian Product we extend the dumbbell graph to form the Hyper-Dumbbell graph $H_S^N(\mathbf{DB}(W_{m,n}))$. Also we obtain the spectrum, Laplacian spectrum and signless Laplacian spectrum of $H_S^N(\mathbf{DB}(W_{m,n}))$.

Keywords: Partial Cartesian product; Laplacian spectrum;Signless Laplacian Spectrum; Hyper-Dumbell **AMS subject classifications.** 05C50

ICNCS2024_23

Meta-Optimization for Sustainable Pharma: An Integrated Approach with Two-Level Trade Credit Strategies in Inventory Management

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Abstract

The pharmaceutical industry's significance in providing crucial healthcare services necessitates an efficient and strategic approach to inventory management. Efficient management of pharmaceutical inventory is key to minimize wastage and storage issues, and ensuring timely access to treatments for diverse healthcare needs. Economic order quantity is used by retailers to determine the optimal order quantity to minimize the deterioration rate. Consequently, retailers have introduced trade credit as a means to attract more customers and reduce the impact of deterioration. Traditional EOQ models mandated that retailers make immediate payments upon receiving orders. Conversely, in the trade credit model, suppliers grant retailers a designated timeframe to settle accounts without accruing interest. In 2017, [Uthayakumar et al.*A Deterministic Pharmaceutical Inventory Model for Variable Deteriorating Items with Time-Dependent Demand and Time-Dependent Holding Cost in Healthcare Industries*.Innovations in Computational Intelligence. Studies in Computational Intelligence, 713. https://doi.org/10.1007/978-981-10-4555-4_13] introduced a groundbreaking pharmaceutical inventory model addressing time-dependent demand under trade credit. This foundation has been extended by introducing a two-level trade credit inventory model to pharmaceutical products.

The design of this study is to maximise total profits by minimising the deterioration rate of medicine and drugs by calculating the optimal order quantity and the optimal replenishment cycle. The model incorporates the complexities of the pharmaceutical industry, where non-linear time-dependent demand and the deterioration of expiry-date items pose significant challenges. The optimal order quantity, replenishment period, and credit period for pharmaceutical inventory management are determined based on the interdependence of these factors. This inventory system is mathematically modelled by governing differential equations, the total profit of the proposed model is achieved as a non-linear maximizing problem by solving these equations. An

optimal solution for the proposed inventory model is derived using metaheuristic optimization algorithms. This innovative approach establishes a symbiotic relationship involving suppliers, retailers, and hospitals. This model is universally applicable to all pharmaceutical items, including medications, vaccines, and other healthcare products, especially those with expiration dates.

Implementing a two-level trade credit system in the pharmaceutical industry helps streamline payments, foster collaboration among suppliers, retailers, and hospitals patients, reduce financial risks, and ensure consistent access to medications, ultimately contributing to improved profitability. It can be a valuable tool for managing cash flow and building relationships within the business ecosystem.

Keywords: Expiry date; Inventory; Metaheuristic; Pharmaceuticals; Time-dependent; Trade-credit

AMS subject classifications. 90B05.

ICNCS2024_24

Greening Inventory Management: Leveraging Rebates and Preservation Technology for Sustainable Amelioration and Deterioration Control.

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Abstract

In today's fiercely competitive business environment, the demand for adaptable inventory management models is rising, emphasizing the strategic importance of inventory control beyond storage. Companies aim for financial equilibrium by maintaining optimal inventory levels to meet customer demand while minimizing carrying costs. A notable shift in inventory management focuses on handling ameliorating items like meat and seafood, which improve over time, presenting unique challenges and opportunities. For a business to succeed, inventory management is critical, addressing items that gradually enhance over time. Resilient approaches thwart deterioration and exploit sales prospects (featured) as highlighted by research emphasizing the efficient management of perishable items. This model's primary objective is to reduce the impact of deteriorating inventory items by exploring strategies and methodologies, particularly in industries dealing with perishable goods. This paper probes into rebates in an inventory model for instantaneous deteriorating items, enriched by preservation technology. Rebate

inventory involves products eligible for volume-based discounts, incentivizing sales and cost savings for retailers. Static and dynamic rebate types are considered, with static rebates being fixed predetermined discounts and dynamic rebates adjusting based on factors like purchase volume, providing supplier flexibility. The collaboration with preservation technology aims to extend shelf life, addressing immediate concerns like food waste and resource conservation and aligning with broader sustainability objectives. This study examines the impact of advertising, advance booking, and rebates on demand based on price-dependent demand. The model employs a Weibull distribution to enhance its accuracy, ensuring a consistent pace of deterioration while sustaining a constant rate. In addition to this, the study explores other relevant factors. A sales analysis model is developed to examine product sales at different pricing levels, with a focus on both static and dynamic rebates, while considering capital constraints. By incorporating genetic algorithms, numerical analysis is fortified and generates consistently trustworthy quantitative evaluations. This cutting-edge approach ensures that results are reliable and can be confidently relied upon. This paper provides strategic insights, practical advice, and valuable suggestions for optimizing the worth of ameliorating items, maximizing profits, and mitigating risks in inventory management.

Keywords: Amelioration; Advance Booking; Capital Constraints; Deterioration; Preservation Technology; Rebate

AMS subject classifications. 90B05; 90B30

ICNCS2024_25

Optimizing Dairy Inventory Management: Integrating ramp-type demand and lost sales strategies for operational efficiency

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Abstract

Inventory management is the strategic control and oversight of goods and materials, aiming to optimize inventory levels, minimize costs, and meet customer demand. The evolving consumer landscape has transformed expectations for product quality, particularly in everyday staples like dairy products. The proposed research contributes to the field of dairy product retailers

by addressing the complex challenge of managing inventories of dairy products with expiration dates. The objective is to find the optimal order quantity and minimize the overall inventory cost.

Considering the deterioration effect of the product and preservation technology, an inventory model of non-instantaneous deteriorating items with an expiration date is developed, in a ramp-type demand pattern. Shortages are allowed with two different partially backlogging rates to provide a realistic representation of customer demand satisfaction. The excess demand which is not satisfied through partial backlogging, leads to lost sales. To reduce this adverse effect, An innovative approach is introduced to balance the fulfillment of past unmet demand while ensuring adequate inventory for future demand. A signature algorithm is developed to find the optimal order quantity and minimization of total inventory cost. The algorithm is illustrated by considering a numerical example for each case. A sensitivity analysis is performed to study the effect of changes in key parameters of the model on the optimal policy. The findings have practical implications for dairy industry professionals seeking to enhance their inventory management strategies in a competitive and dynamic market environment.

Keywords: Dairy; Expiration date; Lost sales; Non-instantaneous deterioration; Partial backlogging; Preservation technology; Ramp type demand

AMS subject classifications. 90B05

ICNCS2024_26

Application of Mohand Transform in Solving Fractional Difference Equations

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Abstract

This paper introduces and examines the nabla discrete Mohand transform, focusing on its properties and application in solving fractional difference equations. It explores how this transform can efficiently evaluate fractional sums and differences while solving initial value problems within this context. Moreover, the study establishes a significant relationship by showcasing the discrete Mittag-Leffler function as the eigenfunction of the Caputo type fractional difference operator ∇_α through Mohand transforms. By demonstrating its utility in solving real-world problems involving discrete systems, this research not only contributes to advancing the

understanding of fractional calculus but also highlights the practical implications of the nabla discrete Mohand transform across various fields such as engineering, physics, and biology. This exploration emphasizes the transformative potential of this mathematical framework in addressing complex problems in fractional calculus, underscoring its relevance in both theoretical and practical applications.

Keywords: Difference equation; fractional difference; Caputo type; initial value problem; Mohand transform.

AMS subject classifications. 39A10; 39A99

ICNCS2024_27

A memory state-feedback controller scheme for multi-agent systems on time scale and its application to circuit network

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Abstract

This manuscript addresses a memory state-feedback control (MSFC) strategy for multi-agent systems (MASs) on a time scale. The communication between all agents is solved from a collection of directed graphs with switching edges. For error systems, the complexity of exponential stability analysis is converted into the form of a leader-following synchronization of the necessary MASs. Utilizing the linear matrix inequality (LMI) method and the Lyapunov-Krasovskii functional (LKF), we construct many requirements to guarantee global exponential for the systems under consideration. On different time scales, it is shown that the conditions for the synchronization of MASs are distinct from those for discrete or continuous MASs. In addition, the outcomes of this paper show that combining discrete-time and continuous-time global synchronization problems could be derived in a single framework. At last, a simulation study based on the neural network (NN)-based circuit model is implemented to illustrate the utility of the proposed control design approach.

Keywords: Transmission delay; Exponential synchronization; Multi-Agent Systems; Time scale

ICNCS2024_29

Application of Genetic Matrix via bms Topological Spaces

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Abstract

The purpose of this paper is to introduce the genetic matrix representation by Kronecker family of genetic matrices are investigated, which is based on genetic matrix $[AG : CT]$, where C,T,A,G are the letters of the genetic alphabet. The matrix of $P^n = [CT : AG]^n$ contains the complete set of n-plets as its matrix element in 64 triplets. Also, we use theory binary multiset(bms) to initiate the DNA and RNA mutation to discover the mutation occurrence. Further, AND and OR operations on a collection of such matrices and apply the genetic coding in 64 amino acids for finding reducts and core of attributes in a binary multiset information system. Finally, genetic algorthim based on binary vlaue structure of bms topological space.

Keywords: G-bms topolgy, G-bms matrix, G-bms algorthim, G-bms mutation.
AMS subject classifications. 00A05, 03E70, 54B10, 54G20.

ICNCS2024_30

Enhancing the quality of low light images via the coefficient bounds derived for a subclass of Sakaguchi type function

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Abstract

Low-light conditions often result in dark, noisy, and hazy images, which makes it difficult for computer vision systems to identify important details. Image enhancement plays a important role in addressing the problems caused by insufficient illumination. The enhanced images helps in better monitoring, detection, object recognition. etc. Real-life applications, including surveillance systems, medical imaging, and search and rescue operations, benefit from enhanced images. Numerous algorithms have been proposed to address the challenge of

enhancing low-light images, [Dong et al. (2010). Fast efficient algorithm for enhancement of low lighting video. In ACM SIGGRAPH 2010 Posters (pp. 1-1)] proposed a method for dehazing low-visibility input images in which image inversion is performed to obtain illuminated images. [Ancuti et al. (2016, September). Night-time dehazing by fusion. In 2016 IEEE International Conference on Image Processing (ICIP) (pp. 2256-2260). IEEE] presented a fusion-based dehazing approach. [Unnikrishnan et al. (2022). Non-Local Retinex Based Dehazing and Low Light Enhancement of Images. Traitement du Signal, 39(3)] implemented a Non-Local Retinex Based low light image enhancement. Although these methods yield satisfactory results, they may not fully capture the true illumination and contrast of the scene. Additionally, some of these approaches do not account for the impact of noise in resulting images, potentially leading to varying results under different lighting conditions.

This study introduces an innovative method for enhancing low-light images, with a primary focus on elevating image quality and preserving important details. Unlike previous approaches, this paper presents a new methodology by making use of coefficient bounds from a particular subclass of analytic function [Amourah et al. (2021). Gegenbauer polynomials and bi-univalent functions. Palestine Journal of Mathematics, 10(2), 625-632], a concept from Geometric Function Theory. Extensive tests on the LOL dataset demonstrate that our method effectively yields high-fidelity improvements for images taken in low light. Both quantitative and qualitative analysis, distinctly demonstrate the effectiveness of our approach compared to current state-of-the-art techniques.

Keywords: Analytic functions; Computer vision; Convolution; Gegenbauer polynomial; LOL dataset; Low light image enhancement.

AMS subject classifications. 30C45; 30C50.

ICNCS2024_31

Predictive Ability of Degree and Neighbourhood Degree Sum-Based Topological Descriptors of Breast Cancer Drugs

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Abstract

Graph theoretical molecular descriptors alias topological indices are a convenient means for expressing in numerical form the chemical structure encoded in a molecular graph. Topological

indices are numerical parameters of a molecular graph that characterise the bonding topology of a molecule and are necessarily structure invariants. The main goal of studying topological indices is to capture and transform the information contained in a chemical structure and develop a mathematical relationship between the structures and physico-chemical properties, bio-activities, and other experimental properties of the chemicals. Topological indices are used in the development of Quantitative Structure-Property. Relationships (QSPRs) in which a large number of molecular properties ranging from physico-chemical and thermodynamic properties to chemical activity and biological activity are correlated with their chemical structures.
Cancer is a disease that causes uncontrolled cell development, spreads through the surrounding tissues, and harms various body organs. Every year, this illness affects millions of people worldwide. Out of the several forms, breast cancer is the most prevalent. Breast cancer affects women either because of hormonal changes or genetic alterations that take place in the DNA. Further research is required to ramp up efforts to combat the worst disease because breast cancer is a condition that poses a serious risk to life.
In chemical graph theory, the degree and neighbourhood degree sum-based indices have been explored a lot in the last ten years. ”New indices are proposed and studied so that predictions of target features of molecules under consideration that are better than predictions made with already-known indices can be made. In this study, we perform the quantitative structure-property relationship (QSPR) analysis for 21 breast cancer treatment drugs. Molecular graphs of these 21 breast cancer drugs are modelled, and 10 reduced reverse degree based indices, 28 neighbourhood degree sum based topological indices are computed. For these drugs, the QSPR analysis is performed using the Single Variate Regression and Multi-Variate Linear Regression techniques, and conclusions are obtained from the analysis.

Keywords: Reduced Reverse Degree; Open and Closed Neighbourhood Indices; QSPR Analysis; Breast Cancer Drugs

AMS subject classifications. 05C35; 05C07; 05C40; 05C92

ICNCS2024_32

Optimizing Skin Cancer Prediction: An Efficient Deep Learning Approach

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Abstract

Skin cancer is a prevalent and possibly fatal disease that needs to be appropriately diagnosed and treated in its early stages. The International Skin Imaging Collaboration (ISIC) provided training and testing images of benign and malignant skin lesions. We have employed a multi-layer convolutional neural network to classify skin cancer and compared the results with other models, such as random forests, support vector machines, and ResNets. Data augmentation and rescaling are two data preparation methods employed to improve the model's performance and generalization. Batch normalization and dropout regularization were used to prevent overfitting and stabilize the training process. On the held-out test set, the proposed model achieved an accuracy of 94.9%, surpassing the accuracy of other models like ResNets (90.51%), random forests (90.51%), and support vector machines (85.3%). The proposed system aims to provide dermatologists with an automated tool to assist in early skin cancer detection and classification to improve patient outcomes and speed up the diagnosis process with high accuracy.

Keywords: Skin cancer; Convolutional neural network; Learning algorithms; disease classification

AMS subject classifications. 68T01; 68T07

ICNCS2024_35

Continuous Archimedean Triangular Norms based Intuitionistic Fuzzy Hamy Mean Operator[†]

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Abstract

The continuous Archimedean t-norm provides the advantage of being represented by an additive generator, which reduces the calculation process from a multivariate function (t-norm) to its univariate generator [Gleb Beliakov et al. *Aggregation functions: A guide for practitioners* 2007: Springer]. In this work, we have introduced two general aggregation operators (AOs): (i) intuitionistic fuzzy Archimedean Hamy mean (IFAHM) operator; (ii) intuitionistic fuzzy Archimedean weighted Hamy mean (IFAWHM) operator. These two AOs are based on the continuous and Archimedean class of t-norms, which comprise various well-known t-norms, including Hamacher $(T^H)_{\lambda\in[0,\infty)}$, Frank $(T^F)_{\lambda\in(0,\infty]}$, Dombi $(T^D)_{\lambda\in(0,\infty)}$, Aczél-Alsina $(T^{AA})_{\lambda\in(0,\infty)}$, etc. Moreover, the illustration and results of the IFAWHM operator are shown through a multi-attribute decision making (MADM) problem.

Keywords: Aggregation operators; Archimedean t-norms; Hamy mean; Intuitionistic fuzzy set

AMS subject classifications. 03E72; 26E60

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ICNCS2024_36

An Enhanced Delay-Dependent Criterion and H-Infinity Filters for Continuous-Time Systems with Time-Varying Delays

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Abstract

This paper addresses the challenge of designing H-infinity filters for continuous-time systems with time-varying delays. The filter design incorporates potential variations in gain due to implementation inaccuracies. The new delay-dependent H-infinity performance is derived by using a novel Lyapunov-krasovskii functional and by employing novel free weighting matrices. The paper establishes sufficient conditions for the existence of such filters, expressed as linear matrix inequalities (LMIs). Numerical examples are presented to demonstrate the effectiveness of the proposed method.

Keywords: Lyapunov-krasovskii function; Asymptotic stability; Time varying delay; H infinity filter; Non linear system

AMS subject classifications. 93D05; 93D20

ICNCS2024_37

IIoT-Driven Cross-matching Substitution for the Blood Bank to the End-User-Driven Demand in A_1A_2BO System

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Abstract

The purpose of this article is to point out the must-have need for advancements in blood inventory management(BIM) within the clinical sector. The focus is specifically on leveraging the capabilities of the Industrial Internet of Things (IIoT) to revolutionise the existing blood bank inventory systems. The IIoT, characterised by intelligent device networks, facilitates real-time monitoring, data collection, exchange, and analysis. IIoT can play an important role in developing sophisticated yet low-risk impact machines in the healthcare field, especially in high-stakes scenarios. This system is not only safe and secure, but it is also robust in terms of risk mitigation. In addition to ensuring interoperability with legacy systems, scalability on large networks, and fostering economic growth, these are the outputs of the system. The maintenance of the IIOT infrastructure is scheduled and organised.

Within the medical context, the article specifically addresses the indispensable upgrades required for blood typing and offers insights into compatible substitutions for enhanced BIM. A proposed inventory management system incorporates three key parameters: 1) Analysis of patient demand by incorporating detailed treatment information into the IIoT system; 2) Upgrading the inventory to encompass 12 blood group types; and 3) Integrating a compatible substitution table for the A1A2BO system in RBC and platelets. Using this model, incompatibilities in inventory management will be mitigated, and inventory precision will be enhanced. By incorporating cross-matching substitutions for RBCs and platelets, this model seeks to minimise discrepancies in resource allocation, thereby optimising the services provided to patients within the healthcare industry.

Keywords: A_1A_2BO system; Cross-matching; Healthcare; IIOT; Substitution

AMS subject classifications. 90B05, 90B99

ICNCS2024_39

Machine Learning Models for Recommending Crops to Farmers in the Face of Unbalanced Data

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Abstract

In machine learning, oversampling is a technique used to balance out unbalanced datasets. This technique reduces bias and improves model accuracy by making duplicates of the minority class occurrences. The discipline of crop analysis and prediction is expanding quickly and is essential to improving agricultural operations. Crop suggestion is essential to agriculture because it gives farmers the knowledge and ability to choose the best crops for their particular climate and area. This research presents a machine learning model-based approach for crop recommendation based on many parameters. Farmers can no longer select the most suitable crop based on the properties of the soil and other factors. In this work, we suggest using machine learning techniques after pretreatment with the Synthetic Minor Oversampling technique (SMOTE). By assessing the ROC receiver's operational characteristic, the method put forth here increases learning accuracy and enables improved test outcomes. This work focuses also on accuracy, precision, recall, and F1-Score to analyze the machine learning model.

Keywords: Classification; Machine Learning; Crop Prediction; SMOTE, Smart Agriculture

ICNCS2024_42

Memory Sampled-data Control for Fuzzy Chaotic Systems: An Extended Looped Functional Approach

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Abstract

This study considers a memory sampled-data control for Takagi– Sugeno (T–S) fuzzy chaotic system [Lian et al. *Secure communications of chaotic systems with robust performance via fuzzy observer-based design*. IEEE Transactions on fuzzy systems, 9(1): 212–220, 2001]. A memory sampled-data control technique, which includes a constant signal transmission delay stabilizes the considered T–S fuzzy system. The new method extends and improves the previous looped-functional method. First, a looped-functional is constructed corresponding to the chaotic system. Then, Free-Matrix-Based integral inequality [Zeng et al. *Sampled-data synchronization control for chaotic neural networks subject to actuator saturation*. Neurocomputing, 260:25–31, 2017] is applied to solve the integral term in the derivative of the looped-functional. The sufficient conditions are obtained in terms of linear matrix inequalities (LMIs) to guarantee the asymptotic stability of T–S fuzzy systems and the existence of memory sampled-data control law. With a numerical example, the performance and importance of the proposed method are illustrated.

Keywords: Chaotic system; Extended Looped-functional; Memory sampled-data control; T–S fuzzy model

ICNCS2024_44

Planarity of combination of graphs in Commutative Ring

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Abstract

In this paper we find minimum planarity for Rectilinear crossing number of $\Gamma(Z_{p^n})$ by decomposing into complete and complete bipartite graphs by forming a conjecture.

Keywords: Zero divisor graph; Crossing number; Rectilinear crossing number.

AMS subject classifications. 05C25; 05C10; 52C35

ICNCS2024_46

Fractional-order dynamics and fear-induced bifurcation in delayed food chain model

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Abstract

This paper investigates the bifurcation problem in a fractional-order delayed food chain model that incorporates a fear effect. We observe that the fractional order significantly impacts the delayed system, influencing its stability in the presence of fear. Both the fractional order and the fear effect play crucial roles in determining the system's stability. Furthermore, we observe stability switching induced by the fear effect while keeping the delay fixed. We identify the stability domains of the proposed model and precisely establish bifurcation points by utilizing delay as a bifurcation parameter. The system exhibits robust stability performance with smaller control parameters, and Hopf bifurcation arises as the control parameter surpasses critical values. Additionally, through theoretical analysis and numerical simulations, we investigate the effects of fractional order, the fear effect, and time delay on the system's stability.

Keywords: Fear effect; Fractional-order; Hopf-bifurcation; Local stability; Time delay;
AMS subject classifications. 37G10; 34D20; 92D25; 34A08

ICNCS2024_47

A Novel H-Infinity Filtering Design for Continuous-Time T-S Fuzzy Systems With Time Delays

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Abstract

This paper is devoted to design and analysis of H-infinity filtering for continuous-time T-S fuzzy systems with time-varying delays. An appropriate Lyapunov-Krasovskii functional (LKF) is established. Then, based on the free-weighting matrix technique and some improved integral inequality are employed, without ignoring any useful terms. Novel delay dependent conditions are obtained in terms of linear matrix inequality (LMIs), which can be solved by using the Matlab LMI toolbox, to achieve the desired H-infinity performance. Finally numerical examples are given to demonstrate the effectiveness of the proposed results.

Keywords: H-infinity filtering; T-S fuzzy systems; linear matrix inequality (LMIs); H-infinity performance.

AMS subject classifications. 93D05; 93D20; 39A26

ICNCS2024_50

Stability of stochastic systems driven by Poisson process

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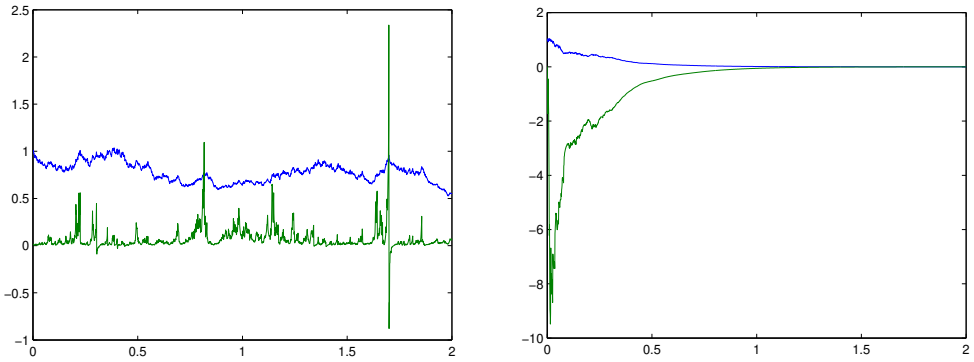
Abstract

In this paper, control function is designed to achieve asymptotic stability in probability for the strict-feedback nonlinear continuous time stochastic differential system with randomness and fluctuation in the form of Weiner and Poisson processes [D. Applebaum *Lévy Processes and Stochastic Calculus*: Second Edition, 2009.]. A suitable Lyapunov functional is constructed and the stability is obtained using the method of backstepping [H. Deng and M. Kristic *Stochastic nonlinear stabilization-I: A backstepping design* Systems and Control Letters, 32:143-150, 1997]. The stability of the system is then validated by a numerical example. The graphical results are presented in $\mathbb{R}^2$ which exhibits the effect of control function in stabilizing the trajectories of the unstable system[refer Figure 1].

Keywords: Strict feedback system; Backstepping; Weiner and Poisson processes; Asymptotic stability.

AMS subject classifications. 37H30; 60G65; 93D15.



(a) Without control (b) With control

Figure 1

ICNCS2024_51

Passivity based boundary control design for reaction-diffusion equations with delays

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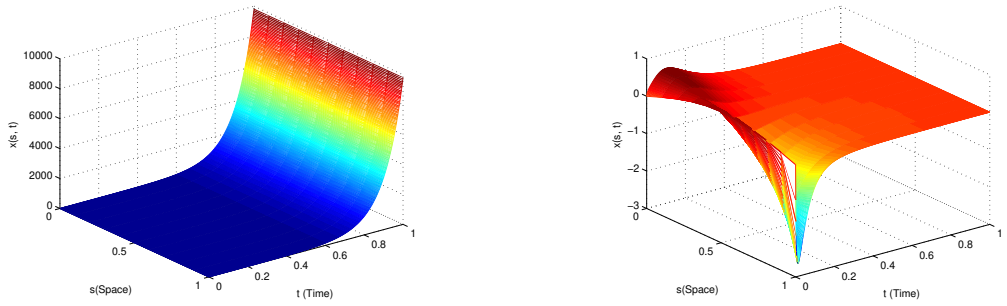
Abstract

This paper deals with designing of boundary control to stabilize the unstable reaction-diffusion equation with state delay. The backstepping method using Volterra integral transformation is used for designing the boundary control [M. Kristic and A. Smyshlyaev *Boundary control of PDEs, A course on backstepping designs* Advances in design and control]. Stabilization of the chosen target system is proved by using passivity theory which is the main novelty of this paper. By constructing an appropriate Lyapunov function for the target system, the conditions for proving the decreasing nature of Lyapunov function are established in terms of linear matrix inequality. The result ensures the asymptotical stability and passivity of the given system with Neumann boundary conditions without and with disturbance, respectively.

A numerical example has been illustrated in detail which shows the passivity and internal stability of the target system are guaranteed. Since, the chosen transformation is invertible, the stability of the target system proves the stability for our original system. By using the finite difference approach, the effectiveness of the controller in eliminating the instability of the system were shown by the simulation results for both with and without control cases [refer Figure 2].

Keywords: Boundary control; Delays; Backstepping; Passivity; PDEs.

AMS subject classifications. 35B35; 93D20



(a) $x(s,t)$ without control (b) $x(s,t)$ with control

Figure 2

ICNCS2024_53

Heat transfer Effects of Thermal Radiation on a Parabolic Nanofluid flow Past a vertical plate with variable Temperature in the presence of rotation

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Abstract

Thermal radiation's impact on the flow of a parabolic nanofluid and its heat transfer effects. The study focused on the effects of rotation on a vertical plate with varying temperature. Analytical solutions are obtained for water-based nanofluids including CuO, ZnO, and TiO2. The dimensionless governing equations are resolved with the Laplace transform method. The study investigates the impact of velocity profiles on several physical parameters, including the radiation parameter, rotation parameter, thermal Grashof number, Prandtl number, and time. Graphs are used to display the obtained results.

Keywords: Parabolic; Radiation; Rotation; Nanofluid

AMS subject classifications. 74F05; 76U05; 80A21; 82D80

ICNCS2024_55

Neutrosophic $\alpha\psi$ supra compactness in neutrosophic supra topological space

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Abstract

Neutrosophic $\alpha\psi$ open set was introduced on neutrosophic supra topological space. This motives to study further the same open set and its complement. In this paper, neutrosophic $\alpha\psi$ supra open cover, neutrosophic $\alpha\psi$ supra closed cover and neutrosophic $\alpha\psi$ supra compactness in neutrosophic supra topological space. Some properties of neutrosophic $\alpha\psi$ supra compactness is studied.

Keywords: Neutrosophic set; compactness; neutrosophic supra topological space

AMS subject classifications. 54A05; 54A40

ICNCS2024_56

Elastic Waves in a Layered Medium

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Abstract

The S-waves engendering in an anisotropic, non-homogeneous, incompressible, layered medium with couple stress is examined. In order to calculate the phase velocity of S-waves, linear inhomogeneities are used to derive the accurate solution to the frequency expression for the issue. With the aid of MATLAB, it is explored how alternative values of the density parameter, anisotropy factor, rigidity parameter, and wave number affect the current scenario, and numerical computation is carried out with graphical representations of the results.

Keywords: incompressible; anisotropic; velocity; layered media; shear wave

AMS subject classifications. 74E05; 74E10

ICNCS2024_58

Handwritten Text Recognition with Deep Learning and Data Augmentation[‡]

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Abstract

This paper presents the process of converting the handwritten document into a digital document. To achieve this, deep learning algorithms are implemented to identify the letters from their digital form. The output obtained using deep learning algorithms yields better performance and good accuracy too. In this model, we use convolutional recurrent neural network to recognize the handwritten text image without pre-segmentation of the document into words or characters. CTC Loss function is then used to train that model. Existing systems use the simple OCR model to recognize the handwritten text and yield a high-level error rate. By using the simple OCR model it is complicated to extract information from the low quality blurred or shaky images. To overcome these issues, deep learning techniques are used. For more accuracy, data augmentation is also used. In this model for experimental purposes, the well-known IAM dataset is used.

Keywords: Handwriting Text Recognition, Deep Learning, Data Augmentation, Text Recognition.

ICNCS2024_59

Controllability of impulsive fractional damped integrodifferential systems with distributed delays[§]

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Abstract

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[§]The work of G. Arthi was supported by the Science and Engineering Research Board (SERB) POWER Grant (No.: SPG/2022/001970) funded by the Government of India.

This paper deals with the controllability criteria for impulsive fractional damped dynamical systems with distributed delays using caputo derivatives for both linear and nonlinear cases. Further, we study the controllability of impulsive fractinal damped integrodifferential systems with distributed delays. Controllability results are established by using the Mittag-Leffer function and fixed point theorem. An example is given to illustrate the theory.

Keywords: Fractional differential equations; Damped systems; Fixed point theorem; Distributed delay

AMS subject classifications. 93B05; 34A08

ICNCS2024_60

Deepfake Detection: Examining Algorithmic Synergies for Image Similarity

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Abstract

The rise in the deepfake media – digitally altered media (images, audio files, videos, etc.) has posed a moral threat to the human race. As the deepfake generators continue to rise at a very alarming rate, the detection methods are unable to keep up with the pace. Our project aims to use the similarity between two images to find the presence of deepfake in the targeted image. The project was worked on a small dataset of 600+ images with a limited cloud GPU, which is a limitation of this project. Deepfake and Deepswap images were generated by using packages available on GitHub. Different similarity parameters such as Structural Similarity Index (SSIM), Multiscale Structural Similarity Index (MS-SSIM), Mean Square Error (MSE), and Euclidian Distance are used along with a Convolutional neural network (CNN)-based feature extraction method, Conv2D. The study compared two different algorithms, decision tree and random forest, to find our dataset's accuracy and best-fit model. Evaluation metrics such as accuracy, ROC curve, and F1 score were used to find the best fit. The Random Forest model achieved an accuracy of 84.65% and 80.78%, while the Logistic model achieved 78.96% and 74.98% accuracy for Roop-generated and face-recognition-generated deepfakes, respectively.

Keywords: Deepfake Detection; Convolution Neural Network; Image Processing; Similarity Indice; OpenCV

AMS subject classifications. 68T01; 68T07

ICNCS2024_62

Bifurcation Analysis and Chaos Control of a Discrete-Time Coral Reef Model with Growth Rate on Macroalgae

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Abstract

The reduction in coral reef densities, characterized by the proliferation of macroalgae, has emerged as a global threat. Here, we consider a discrete-time coral reef model under the assumption that a particular region of the seabed is covered entirely by macroalgae (M), coral (C), and algal turfs (T). We explore all ecologically possible equilibrium points and analyze the conditions for their local stability. Subsequently, we investigate the model's behavior using the center manifold theorem and bifurcation theory. Our analysis reveals that the model undergoes codimension-two bifurcations, specifically period-doubling and Neimark-Sacker bifurcations. To address the chaos resulting from the emergence of the Neimark-Sacker bifurcation, we apply the OGY feedback control method and a hybrid control methodology. Finally, we provide numerical simulations to validate the results and demonstrate the complex dynamic behaviors that arise, including reversal period-doubling bifurcation, period-4, 8, and 24 bubble bifurcations, and chaotic behavior.

Keywords: Bubble bifurcation; Coral reef model; Discrete population model; OGY control; Period-doubling and Neimark-Sacker bifurcation; Stability

AMS subject classifications. 37G10; 37G35; 86A08; 92D25

ICNCS2024_63

Reachable Set Estimation of Multi-agent Systems under Packet Losses and Deception Attacks†

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Abstract

This paper considers the problem of estimating reachable set in leaderless consensus for multi-agent systems with Lipschitz nonlinear dynamics and bounded external disturbances. Initially, a sampled-data control is introduced to address the consensus of nonlinear multi-agent systems vulnerable to deception attacks and packet dropouts, which occur randomly during sampling intervals. Then, aperiodic sampling in various degrees is taken into account in the primary Lyapunov term. Sufficient conditions to guarantee that all the actual states of the multi-agent, starting from the initial state, can be bounded within a given ellipsoid set are established by designing a suitable controller. Moreover, the consensus control design is established as linear matrix inequalities, utilizing a two-sided looped functional and Wirtinger's inequality-based discontinuous Lyapunov-Krasovskii functional. Finally, the numerical section validates the applicability of the proposed control method.

Keywords: Multiagent systems; Sampled-data control; Reachable set estimation; Packet losses; Deception attacks.

AMS subject classifications. 93A16; 93C57; 93D15; 93D20; 93B03.

†The first author in this article was supported by the University Grants Commission (UGC) under the scheme of Savitribai Jyotirao Phule Single Girl Child Fellowship (SJSGC) 2022-2023, UGC Award Letter - F. No. 82-7/2022(SA-III) dated 07th February 2023 and UGC-Ref.No. UGCES-22-OB-TAMF-SJSGC-2920.

ICNCS2024_64

The Steiner Global Domination Number of a Graph

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Abstract

An Steiner set S of a connected graph G is said to be an Steiner global dominating set of G if S is both Steiner and a global dominating set of G. The minimum cardinality of an Steiner global dominating set is the Steiner global domination number of G is denoted by $\bar{\gamma}_s(G)$. Connected graphs of order $n \geq 2$ with Steiner global domination number 2 or n are characterized. Connected graphs of order $n \geq 4$ with Steiner global domination number $n-1$ is given. It is shown that for every pair of positive integers a and b with $2 \leq a \leq b$, there exists a connected graph G such that $S(G) = a$ and $\bar{\gamma}_s(G) = b$, where $\bar{\gamma}_s(G)$ is the Steiner global domination number of a graph. Also the Steiner global domination number of join of graphs is studied.

Keywords: Steiner global domination number, Steiner domination number, Steiner number.

AMS subject classifications. 05C12.

ICNCS2024_65

Application of Butcher's Seventh Order RK Methods in MAGDM Using ITrFS

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Abstract

MAGDM is the best solution that comes into play, compared to other solutions. From Intuitionistic triangular fuzzy number matrices, the data set is taken. The values shall be determined in accordance with some order of Runge Kutta methods. By using decision making, we have used Intuitionistic Triangular Fuzzy Weighted Geometric ITrFWG Operator and Intuitionistic Triangular Hybrid Geometric ITrFHG operator solutions. The values shall be determined in accordance with some order of Runge Kutta methods. By using decision making, we have used Intuitionistic Triangular Fuzzy Weighted Geometric ITrFWG Operator and Intuitionistic Triangular Hybrid Geometric ITrFHG operator solutions. For ranking alternatives, a new extended Normalized Hamming Distance formula is used. This paper presents the numerical illustration of elasticity and effectiveness.

Keywords: Intuitionistic Triangular Fuzzy Set(ITrFs); Intuitionistic Triangular Fuzzy Weighted Geometric(ITrFWG); Intuitionistic Triangular Fuzzy Hybrid Geometric(ITrFHG); Butcher's Seventh Order Runge-Kutta Method

ICNCS2024_66

Detour simplicial graphs

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Abstract

A vertex v of a connected graph G is said to be a *detour simplicial vertex* of G if v is not an internal vertex of any x-y detour for all $x, y \in G$. The *detour simplicial order* $ds(G)$ is the number of detour simplicial vertices of G. A graph G is said to be a *detour simplicial graph* if $dn(G) = ds(G)$, that is, if G has a unique minimum detour set consisting of the detour simplicial vertices of G, where $dn(G)$ is the detour number of G. Detour simplicial graphs of order p with detour number p or $p-1$ or $p-2$ or $p-3$ are characterized. It is shown that for every pair a, b of integers with $0 \leq a \leq b$ and $b \geq 2$, there exists a connected graph G with $ds(G) = a$ and $dn(G) = b$. Also, it is shown that for every pair p, k of positive integers with $2 \leq k \leq p-4$, there exists a connected graph of order p and $dn(G) = k$ such that G is not a detour simplicial graph. A graph G is an *extreme geodesic graph* if $g(G) = ex(G)$, where $ex(G)$ is the number of extreme vertices of G and $g(G)$ is the geodetic number of G. Some realization results regarding detour simplicial graphs and extreme geodesic graphs are given.

Keywords: Detour number; Detour simplicial graphs; Geodetic number; Extreme geodesic graphs.

AMS subject classifications. 05C12

ICNCS2024_68

Automated Detection of Breast Lump or Masses through Mammogram Image Analysis

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Abstract

Current technology has a major role in the health care system in every hospital and laboratory. As everything is getting automated, this proposed system is an attempt to automate the identification of lumps in the breast. A lump in the breast can function as a sign of breast cancer. The uncontrolled growth of breast cells is the cause of lumps or breast cancer. Not all lumps in the breasts are cancer. Still, early identification and staging of the illnesses is critical in organizing a breast cancer treatment program. In the late stages, malignancy can extend beyond the breast and impact adjacent anatomical areas. Mammogram is the gold standard procedure in the diagnosis of carcinoma of breast cancer. In this article, we have attempted to spot the breast lump that uses technology. We have also attempted to extend our work to identify the cancer stage.

Keywords: breast lump, Mammogram, screening, tumor

ICNCS2024_69

Fixed points of Additive Cellular Automata in General Systems

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Abstract

Dynamical System [Kurka, Petr. *Topological and symbolic dynamics* Société mathématique de France, 2003] is a pair (X, f) where X is a compact metric space and $f : X \to X$ is a continuous map. The orbit of any $x \in X$ is $\{x, f(x), f^2(x), f^3(x), \ldots f^n(x), \ldots\}$. Here every element depends upon the previous element only.

In General system [Mihail and Alexandru. *Recurrent iterated function systems* Revue Roumaine de Mathematiques Pures et Appliquees 53.1 (2008): 43-54.] and [NIA, M. FATEHI and A. ZAMANI BAHABADI. *CHAOS AND SHADOWING IN GENERAL SYSTEMS* .] which is the new modification of Dynamical systems is a continuous map $f : X \times X \to X$ and the orbit for any x is $\{x_n\}_{n\geq 0}$ and

$$x_0 = x_1 = x, x_n = f(x_{(n-2)}, x_{(n-1)}), n \geq 2.$$

Here every element depends upon previous two elements makes stronger conditions. In this paper we are going to define additive cellular Automata in the general systems and finding the fixed points for it in the simplified form. We define cellular automata in general systems as continuous map

$$f : A^{\mathbb{Z}} \times A^{\mathbb{Z}} \to A^{\mathbb{Z}}$$

where $A^{\mathbb{Z}}$ is infinite two sided sequence of symbols from the set $A = \{0, 1, 2, 3 \ldots . m - 1\}$(mod m) for Integer $m \geq 1$.

The fixed points are those $x \in A^{\mathbb{Z}}$ satisfying

$$f(x, x) = x$$

Keywords: Keywords:Dynamical Systems,Fixed point,Cellular Automata

AMS subject classifications. Classification:37C25;37B15

ICNCS2024_71

Convergence of Newton-Steffensen method under Lipschitz continuous second derivative[‡]

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Abstract

In this paper, we have used recurrence relation to study the semilocal convergence of Newton-Steffensen method. Under Lipschitz continuous second derivative, the convergence analysis of the method is given. We have given a family of recurrence relations and proved that R-order of the method is 3. Also to show the efficiency of our result we have given a numerical example.

Keywords: Newton-Steffensen method; Cubic convergence; R-order Convergence; Recurrence Relation; Lipschitz Condition.

AMS subject classifications. 47H10; 41A25; 65Q05

[‡]The work is supported by financial grant F.No. 16-6(DEC. 2018)/2019(NET/CSIR)

ICNCS2024_72

Improving Chemical-Induced Pulmonary Toxicity Prediction with Ensemble Learning and Explainable AI

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Abstract

Chemical-induced pulmonary toxicity, involving adverse respiratory effects from drugs or chemicals on the respiratory system, is a growing concern for the pharmaceutical and chemical industries, as well as public health. Conventional methods are costly and demand significant time and effort. In response to these challenges, we focus on computational models for identifying the potential pulmonary-toxic drugs or compounds. Early identification during drug development not only enhances safety and efficiency of drugs or chemicals but also helps avoid late-stage withdrawals. In this study, we systematically employ various feature selection techniques to identify the key molecular and structural features that significantly impact the model's performance. Moreover, to build the proposed model, ensemble machine learning methods are used to enhance the performance of the pulmonary toxicity prediction. Subsequently, we evaluated the model performance using a 5-fold cross validation methodology.In addition, we apply the SHapley Additive exPlanations (SHAP) approach to gain deeper insights into the crucial molecular features influencing pulmonary toxicity predictions. Thus, the proposed model emerges as a promising tool for the early screening of potential pulmonary toxic compounds, enhances chemical safety while providing interpretability for the predictions.

Keywords: Ensemble Learning; Pulmonary Toxicity; Molecular Features; Explainable AI

ICNCS2024_75

A Study on the Number of Fuzzy Subgroups of Groups of Units Modulo 20 and 21

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Abstract

In today's age of digital data interchange, safeguarding the security and privacy of visual information has emerged as a critical and immediate priority. This study introduces a novel approach to image encryption leveraging the combined strength of 2D Henon chaotic mapping and evolutionary algorithms, specifically Genetic Algorithms (GA). The proposed method aims to enhance the security of image data through a multi-step encryption process. Initially, the plain image is transformed into a cipher image using the 2D Henon chaotic map, which introduces a high level of randomness and complexity. Subsequently, an evolutionary algorithm, particularly the Genetic Algorithm, is employed to further optimize and strengthen the encryption by iteratively refining the cipher image. The evolutionary process enhances the scrambling of image pixels, ensuring robustness against attacks and increasing the encryption's complexity. The synergy between the Henon chaotic map and Genetic Algorithm offers a potent encryption framework capable of securing image data efficiently while preserving its integrity during transmission and storage. Experimental evaluations and analyses showcase the effectiveness and resilience of the proposed encryption scheme against various cryptographic attacks, establishing its potential for secure image communication applications.

Keywords: Henon Chaotic Map; Image Encryption; Genetic Algorithm

ICNCS2024_76

Analysis of Stochastic Tuberculosis Model with Mixed-strain

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Abstract

Tuberculosis (TB) is one of the most dangerous diseases that affects millions of people worldwide. TB causes substantial morbidity, with symptoms ranging from persistent coughing to severe respiratory distress. In this work, we have proposed a stochastic model for studying the dynamics of tuberculosis with mixed-strain. The main objective of this study is to include randomness in the model to simulate the real-world dynamics of tuberculosis and improve understanding of its spread and transmission patterns. First, the existence and uniqueness of the global positive solution are discussed. Then, using suitable Lyapunov functions, a unique stationary distribution was proven to exist. Model analysis indicated that increasing the noise intensity could benefit and accelerate the extinction of the disease while decreasing the intensity of the white noise can ensure the existence of a unique stationary distribution, which implies the persistence of the disease. Finally, several numerical simulations are carried out to illustrate the main results of this contribution.

Keywords: Stochastic model; Stationary distribution; Tuberculosis;
White noise

AMS subject classifications. 92B05; 60H30; 92D30; 60H10

ICNCS2024_77

Dynamical Analysis of Fractional Order Delayed Hepatitis C Virus Model

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Abstract

Hepatitis C Virus (HCV) infection remains a global health challenge, affecting millions of individuals in worldwide. It make cause cirrhosis, hepatocellular cancer, progressive liver failure, and even death. In this work, we develop a fractional order model to study the dynamics of Hepatitis C virus along with the antibodies. We establish the well-posedness of considered model in terms of proving the existence and positivity of the solutions. The dynamical analysis reveals that the disease-free steady state is asymptotically stable if the basic reproductive number is less than one. On the other hand, if the reproduction number is greater than one, the disease is dynamically unstable. The sufficient condition for the stability analysis for the endemic steady state are investigated. We construct an optimal control model, using the control parameter as drug efficiencies Ribavirin and awareness program. We examine the optimality in terms of its necessary and sufficient conditions. In numerical section, we discussed the time series behaviour of infected and uninfected cells for the certain range of parameters, which results in understanding and control the spread of diseases dynamics.

Keywords: Fractional-order; HCV model; optimal control; stability; time-delay;

AMS subject classifications. 37N25; 37N35; 34A08; 26A33

ICNCS2024_78

Note on "Edge geodesic number of a fuzzy graph"

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Abstract

For a connected fuzzy graph $G : (V, \sigma, \mu)$, a strong path P from u to v is called geodesic if there is no shorter strong path from u to v and the length of a u-v geodesic is the geodesic distance from u to v. Let S be a collection of vertices in the connected non-trivial fuzzy graph $G : (V, \sigma, \mu)$. The collection of all edges lying on the geodesic between $S's$ vertices is then known as the edge geodesic closure of S, denoted by $(S)_e$. If $(S)_e = E(G)$, the edge set of G, then a set S of vertices in a connected non-trivial fuzzy graph $G : (V, \sigma, \mu)$ is said to be an edge geodesic set of G. An edge geodesic basis of G is an edge geodesic set with least cardinality, and the edge geodesic number of G, indicated by $gn_e(G)$, is the cardinality of an edge geodesic basis in G. In the article [Sameeha Rehmani and M. S. Sunitha *Edge geodesic number of a fuzzy graph* Journal of Intelligent & fuzzy systems, 37(3), 4273-4286, 2019.], the section 4.5, 4.6 and 4.7 contains some errors. In this note, we have pointed out the errors of these sections and the updated versions of these sections have been presented in this paper.

Keywords: fuzzy graph, geodesic, strong arcs, geodesic number, edge geodesic number

AMS subject classifications. 05C72, 05C12, 90C35.

ICNCS2024_79

Solvability Of Stochastic Fractional Differential Equations with Deviating Arguments

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Abstract

In this paper, the existence and uniqueness of the solutions of stochastic fractional differential equations with deviating arguments are investigated. The Picard-Lindelöf successive approximation scheme is used to establish the existence of solutions. The uniqueness of the solution is also studied under suitable conditions. Further the numerical example of stochastic fractional differential equations are discussed.

Keywords: Existence, Uniqueness, Successive Approximation, Stability, Mittag Leffler Function Solvability.

AMS subject classifications. 34A08, 60H10, 34A12, 93D20

ICNCS2024_80

Analysis of Thermophoretic and Brownian Motion along with Casson Micropolar Fluid Flow over an Inclined Surface

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Abstract

The casson micropolar nanofluid flow along with thermophoretic and Brownian motion over an inclined surface is analyzed. The systems of Partial differential equations with various parameters converted to Ordinary differential equation and clarify numerically adopting by MATLAB bvp4c procedure. The outcome velocity, Magnetic, Micro polar, Porous medium, Temperature and Concentration profiles portrayed through graphs and the consequences on the friction drag, nusselt and sherwood numerals represent through table form. An excellent agreement is found when the computational strategy is compared to the results that are already available in the existing research.

Keywords: Chemical reaction, Micro polar, Nano fluid flow, Soret, Thermophoretic

ICNCS2024_81

Integrating Fuzzy Promethee 2 Language Modelling Method for Detecting Intrinsic Plagiarism

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Abstract

Plagiarism detection is crucial in upholding academic integrity, especially with the growing digital content. The method of extrinsic plagiarism has improved, while that of internal plagiarism has not. The use of a different word with the same meaning and the jumbled structure confuse the system that detects intrinsic plagiarism. This research provides novel approach of Integrating Fuzzy Promethee 2 Language Modelling Method (IFP2LMM) for enhanced intrinsic plagiarism detection. The proposed method was divided in two categories: first, identify the plagiarism-checking methods that centred on textual characteristics, semantic structures, organizational characteristics, context of sentences grammatically, are used as criteria and alternatives, then the Promethee method facilitates decision-making by assigning weights to diverse criteria, resulting in a comprehensive ranking of potential plagiarism cases. The incorporation of fuzzy promethee decision variables and linguistic variables, the system adeptly captures language ambiguity, enabling a more precise and context-aware evaluation of text similarities. Integrating Fuzzy Promethee 2 Language Modelling Method (IFP2LMM) provides a robust and efficient solution for addressing the complexities of plagiarism in the era of expanding digital content

Keywords: Fuzzy-Promethee; Language Model; Plagiarism

AMS subject classifications. 68T50; 68U35; 91B06; 90C70

ICNCS2024_82

Optimal Control System of Multi-Term Fractional Stochastic Inclusion with Clarke's Subdifferential

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Abstract

This article examines the optimal control of multi-term fractional stochastic inclusion with Clarke's subdifferential driven by mixed fractional Brownian motion in Hilbert space. The existence of the mild solution for the considered system is explored by utilizing multivalued functions, stochastic analysis, fractional calculus, and fixed point technique. Further, the optimal control of the proposed system is provided by using Balder's theorem. Finally, an example is provided that illustrates the developed theory.

Keywords: Clarke's subdifferential; Existence of mild solution; Fractional Brownian motion; Multi-term fractional inclusion; Optimal control.

AMS subject classifications. 34A08; 34K50; 47J22; 60G22; 93E20.

ICNCS2024_84

Optimal intervention strategies for Visceral Leishmaniasis model -A case study in South Sudan[§]

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Abstract

In this article, we formulate and analyze a compartmental model of visceral leishmaniasis (VL). We validate our model by calibrating it to monthly VL incidence data from South Sudan. The proposed model's basic reproduction number (R_0) has been derived and estimated. We have discussed about the possible existence of backward bifurcation in our system. We study the effects of popular control strategies namely, the use of treated bed nets, vaccination, culling effect for reservoirs, and possible treatment of infected humans, using optimal control theory. The numerical result suggests that combining the mass treatment, vaccination, bed net, and culling effect give superior and proficient outcomes for diminishing VL prevalence. However, the mass treatment is critical in contrast to alternate controls during the outbreak of VL and the optimal use of only culling effect to the reservoirs is not helpful to the community.

Keywords: Visceral Leishmaniasis; Backward bifurcation; Basic reproduction number; Control Strategies.

[§]Research of Santanu Biswas is supported by Dr. D. S. Kothari Postdoctoral Fellowship under University Grants Commission scheme (Ref. No. F.4-2/2006 (BSR)/MA/19-20/0057). Special thanks to Prof. Sudeshna Banerjee for useful discussions.

ICNCS2024_85

On Nano Soft $^{s}(I)$ Topological Space and its Application in Decision Making for Medical Diagonsis in the Risk Factors for Cancer

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Abstract

In this paper, we present an application of nano soft ideal topological space in decision making problems. That is based on the reduction of parameters to keep the optimal choice objects. Further we analyze the real life problem and we obtain the decision in soft information patterns. Finally, an algorithm for multiple choice selection problem based on risk factors for cancer data is also provided. .

Keywords:

Soft set, Soft ideal reducts, Nano soft ideal topological space, Decision Making, Choice value .

AMS subject classifications. 06D72, 54A40, 54A10, 54C50, 54G20

ICNCS2024_86

A Hybrid Approach of Neutrosophic TOPSIS and LINMAP Method for Developing Enterprise Selection Criteria

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Abstract

Two well-known approaches for handling the multi attribute decision making (MADM) problems are the standard linear programming technique for multidimensional analysis of preference (LINMAP) and the technique for order preference by similarity to ideal solution (TOPSIS). The LINMAP approach was created by numerous researchers in a fuzzy, intuitionistic context. In this research, a new hybrid strategy for addressing the MADM issues with single valued

trapezoidal neutrosophic numbers is proposed, and LINMAP is extended to handle the neutrosophic environment. To handle MADM challenges a hybrid method combining the neutrosophic LINMAP and TOPSIS is developed. In order to determine the weights of attributes and the best solutions for achieving the objective of becoming a successful enterprise, this research integrates the neutrosophic LINMAP and TOPSIS with traditional techniques of enterprise selection. Lastly, a real-world example is given to demonstrate how the developed approach is implemented. A suggested hybrid method for resolving issues related to medical diagnosis, personnel selection, supplier selection, and other MADM concerns.
Keywords: Single valued trapezoidal neutrosophic number; Multi attribute decision making; Neutrosophic Linear programming technique for multidimensional analysis of preference; TOPSIS; Hamming distanc

ICNCS2024_88

Encryption and Decryption through Even-Odd Harmonious Graphs

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Abstract

Cryptography[Neal koblitz *A course in number theory and cryptography* 1994: Springer New York.] plays a vital role in today's digitally connected world, which is serving as a foundational pillar in ensuring the confidentiality, integrity, and authenticity of data. It involves the use of mathematical algorithms and cryptographic keys to encode (encrypt) data in a way that can only be decoded (decrypted) by individuals or systems with appropriate keys. Encryption is a fundamental technique for safeguarding sensitive data, and its effectiveness relies on innovative approaches to protect against evolving threats. Graph labeling [Gallian J A. *A Dynamic Survey of Graph Labeling*. Electronic Journal of Combinatorics, 17, DS6, 2022.] is crucial in cryptography, playing a pivotal role in the broad field of techniques designed to ensure the confidentiality and security of information. This article explores the application of even-odd harmonious labeling[Adalin Beatress N and Sarasija P.B. *Even–odd harmonious graphs*. International Journal of Mathematics and Soft Computing, 5(1): 23–29, 2015.] in the field of cryptography, with a specific focus on encryption and decryption processes. The article presents an encryption algorithm that employs RSA algorithm and even-odd harmonious labeling to convert plaintext

data into ciphertext, making it resistant to unauthorized access. This encryption system aims to enhance data security and efficiency of data protection.

Keywords: Ciphertext; Encryption; Decryption; Labeling; Even-odd harmonious graphs
AMS subject classifications. 05C78; 94A60

ICNCS2024_89

Exhaustive Study on Chebyshev Pseudo Spectral Method, Runge-Kutta Fourth Order Method, and Ode45 in MATLAB for forced oscillators

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Abstract

This paper undertakes a meticulous examination of three numerical methods applied in solving a range of force-driven oscillators, specifically, the Chebyshev pseudo-spectral method, classical Runge-Kutta fourth-order method, and MATLAB's ode45 incorporating the Runge-Kutta (4,5) algorithm. The study evaluates the efficiency and accuracy of these methods through error analysis in numerical solutions, considering various initial conditions. It centers on resolving force-driven oscillators, emphasizing damped, driven oscillators, Van der Pol oscillators, Duffing oscillators, and other pertinent nonlinear models. This research provides valuable insights into the nuanced performance of numerical methods across diverse nonlinear systems.

Keywords: Numerical methods; Forced oscillators; Chebyshev pseudo-spectral method; Runge-Kutta fourth-order method; Nonlinear systems; Performance evaluation
AMS subject classifications. 65L05; 65L70; 65D99; 65N35; 65M70

ICNCS2024_90

Sigma coloring of graphs obtained through Mycielski transformation

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Abstract

Let $G(V,E)$ be a non-trivial simple connected graph with vertex set $V(G)$ and edge set $E(G)$. Let $c : V(G) \to \mathbb{N}$ be a vertex coloring function of G. For a vertex v of G, the color sum $\sigma(v)$ of v is the sum of the colors of the vertices in $N(v)$ where $N(v)$ is the neighborhood vertices of v. If $\sigma(u) \neq \sigma(v)$ for every two adjacent vertices u and v of G, then c is called a sigma coloring of G [Chartrand G, Okamoto F and Zhang P,*The sigma chromatic number of a graph*, Graphs and Combinatorics 26:755-733, 2010.]. The minimum number of colors required for such a coloring is called as sigma chromatic number of G and it is denoted by $\sigma(G)$. In this article, the sigma coloring of Mycielski transformation [Mycielski Jan, *Sur le coloriage des graphes*, Colloq. Math., 3(2): 161-162, 1955.] of the graphs viz., star graph, bi-star graph, sunlet graph, tadpole graph and ladder graph have been investigated.

Keywords: Graph; Sigma coloring; Sigma chromatic number; Mycielski graph.

AMS subject classifications. 05C15, 05A18

ICNCS2024_91

A Public Key Exchange Protocol using Tropical Upper Triangular Matrices for Medical IoT Environment

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Abstract

This paper introduces a public key exchange protocol grounded in the tropical upper triangular matrices within the tropical algebra framework, designed for deployment in Medical IoT environments to bolster security measures. We have given a proof and an example to illustrate our protocol. We have also discussed the security of our key exchange protocol and how our protocol is not vulnerable to standard attacks. The paper concludes by outlining the advantages of incorporating tropical semirings in cryptographic applications.

Keywords: Key exchange; Tropical algebra; Upper triangular matrices; Medical Internet of Things

AMS subject classifications. 94A60; 14G50; 68W30

ICNCS2024_93

A novel TOPSIS method approach for neutrosophic Aczel-Alsina power geometric aggregation operator for green supplier selection problem

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Abstract

In the current scenario, due to increased awareness and concerns for the environment have led to the prominence of the green supplier selection (GSS) process, showcasing the prevailing trend of businesses incorporating environmental considerations. Managing and mitigating various uncertainties present in GSS is crucial for the effective operation of a green supply chain

management achieving sustainability goals. This paper concentrates on developing innovative single-valued neutrosophic (SVN) power aggregation operators (PAO) by applying Aczel-Alsina(AA) operational laws. This approach expands the operators and captures interrelationships using power geometric techniques among SVNs. Secondly, we exploit the newly proposed operators to TOPSIS method that helps deal with GSS decision making problems. Additionally, a distinct test has been conducted by employing the proposed operators to reinforce the suggested approach. To validate the effectiveness of our approach, we compare the obtained results with existing methods from the literature. The results demonstrates the proposed model's ability to successfully address the challenge of GSS in unpredictable circumstances.

Keywords: Single valued Neutrosophic set(SVN); Green supplier selection(GSS); Power aggregation operator; Aczel-Alsina T-norms and T-conorms; TOPSIS method

AMS subject classifications. 90B50; 90C70

ICNCS2024_94

QSPR Graph Model for Physicochemical Poperties of some Polycyclic Aromatic Hydrocarbons through Reverse Sum Revan Topological Descriptors and Artificial Neural Network

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Abstract

Polycyclic aromatic hydrocarbons (PAHs) are a broad range of chemical molecules containing two or more benzene rings and are listed under the organic pollutant group [Wang et al. Source apportionment of polycyclic aromatic hydrocarbons (PAHs) in the air of Dalian, China: Correlations with six criteria air pollutants and meteorological conditions. Chemosphere 2019, 216, 516–523.] The prediction of the destiny of PAHs in the environment is largely depending on their physical and chemical properties[Alves de Lima Ribeiro, F.; Ferreira, M.M.C. QSPR Models of Boiling Point, Octanol–Water Partition Coefficient and Retention Time Index of Polycyclic Aromatic Hydrocarbons. Theochem 2003, 663, 109–126 and Ferreira, M.M.C. Polycyclic Aromatic Hydrocarbons: A QSPR Study. Chemosphere 2001, 44, 125–146.] In theoretical chemistry, a chemical molecule is converted into a molecular graph G(V,E) by considering atoms set V

as vertices and bonds set E as edges. The topological indices of molecular graphs are employed to predict physicochemical and other properties of chemical compounds. The investigation of relationship between the chemical structures and their physicochemical and ADMET properties are known as the quantitative structure property relationship (QSPR).In this article a new topological index namely reverse sum Revan index is introduced to predict physicochemical properties of some PAHs. The QSPR analysis is carried out through artificial neural network (ANN) and it exhibits good prediction of PAHs properties.

Keywords: Polycyclic aromatic hydrocarbons; Artificial neural network; QSPR analysis; Reverse sum Revan index.

AMS subject classifications. 05C92; 05C07

ICNCS2024_95

Independent Domination Numbers for Co-Splitting Graphs

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Abstract

Let $G(V,E)$ be a graph with vertex set V and edge set E. A subset $S \subseteq V$ is an independent dominating set [W. Goddard and M. Henning, Independent domination in graphs: A survey and recent results, Discrete Mathematics, 313(7):839-854, 2013.] if every vertex in S is adjacent to a vertex in $V - S$ and no two vertices within S are adjacent. The cardinality of the smallest independent dominating set in G is the independent domination number $i(G)$. The co-splitting graph [Selvam Avadayappan, M. Bhuvaneshwari, Cosplitting and Co-regular graphs, International Journal of Mathematics and Soft Computing, 5(1): 57-64, 2015.] denoted by $CS(G)$, is a graph obtained from G by adding a new vertex v' for each vertex $v \in V$ and joining v' to those vertices of G which are not adjacent to v in G. In this article, we compute the independent domination numbers for co-splitting graphs associated with different graphs, including the path, cycle, complete graph, star graph, bistar graph and comb graph.

Keywords: Independent dominating set; Minimum independent dominating set; Independent domination number; Co-Splitting graph

AMS subject classifications. 05C69; 05C76

ICNCS2024_96

On the solutions of coupled system of time-fractional reaction-diffusion equations with time delays[†]

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Abstract

In this article, we systematically explain how to apply the analytical technique called the invariant subspace method to find various types of exact solutions for a coupled system of nonlinear time-fractional partial differential equations with time delays. Also, the present work explicitly studies a systematic way to obtain various kinds of finite-dimensional linear invariant subspaces for the coupled system of nonlinear time-fractional reaction-diffusion equations with time delays under the two fractional derivatives that are (a) the Riemann-Liouville fractional derivative and (b) the Caputo fractional derivative. Additionally, we provide details of deriving exact solutions in the generalized separable form for the initial and boundary value problems of the coupled system of generalized nonlinear time-fractional reaction-diffusion equations with multiple time delays through the obtained linear invariant subspaces under the considered two time-fractional derivatives.

Keywords: Invariant subspace method; exact solutions; fractional reaction-diffusion system; time delay nonlinear PDEs; initial and boundary value problems; Laplace transformation technique

AMS subject classifications. 35R11; 35Bxx; 35-XX; 35Cxx

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ICNCS2024_99

Partial Petri Net Languages and their Properties

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Abstract

The languages derived from Petri Net provides a efficient technique for verification, validation, and synthesis for the system. Partial words have wide usage in bioinformatics, pattern matching and text searching. In this paper, we introduce a Partial Petri Net and then define its associated languages. Further, we discuss the closure properties that hold over these derived languages.

Keywords: Partial words, Partial languages, Partial Petri Net, Closure properties.

AMS subject classifications. 68Q45, 68Q70, 68Q85

ICNCS2024_103

On Grundy Number of Ladder Graph Families

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Abstract

The Grundy number of a graph G, denoted by $\Gamma(G)$, is the maximum number required for proper grundy coloring. This Grundy Coloring(also known as First-Fit Coloring) is defined as $f : V(G) \to \{C_t : t \in \mathcal{N}\}$ such that $\forall\ f(m) = C_t$ is adjacent with all C_{t-1} colors where $m \in V(G)$. In this, we obtained the grundy number of some graphs from ladder graph family such as Ladder graph$[L_n]$, Open Ladder graph$[O(L_n)]$, Slanting Ladder graph$[S(L_n)]$, Triangular Ladder graph$[T(L_n)]$, Open Triangular Ladder graph$[O(TL_n)]$, Circular Ladder graph$[C(L_n)]$, Mobius Ladder graph$[M_n]$, Diagonal Ladder graph$[D(L_n)]$, Open Diagonal Ladder graph$[O(DL_n)]$.

Keywords: Proper Coloring; Grundy Coloring; Greedy Algorithm

AMS subject classifications. 05C15

ICNCS2024_104

Dynamics of MHD Blood Flow With Iron Oxide Nanoparticles

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Abstract

Magnetite (Fe_3O_4) exhibits superparamagnetism as it reduces in size to about 20 nm within the single-domain range, making it highly useful in drug delivery systems, MRI, and hyperthermia reagents. Taking this into account, the effect of Fe_3O_4 on blood flow with varying viscosity over a stenotic artery with magnetic and thermal radiation is numerically analysed in this current work. The governing equations of blood flow over a cylindrical artery immersed in a porous medium of tissues and cells are represented by a system of partial differential equations (PDE). Using Similarity transformations, the PDEs are scaled down to Ordinary differential equations (ODE), which are then numerically solved using the fourth-order Runge-Kutta method with the shooting technique. The results, comprising the velocity and temperature profiles for varying values of different physical parameters, are plotted in the form of graphs. The values of skin friction coefficient and heat transfer coefficient are tabulated. It is found that the velocity distribution of blood is reduced and the heat transfer of blood is enhanced under the effect of iron oxide nanoparticles. The findings of this research contribute valuable insights into the role of iron oxide in drug delivery techniques, elucidating its mechanisms and highlighting its potential as a versatile and effective component in enhancing drug delivery systems.

Keywords: Blood flow; Iron oxide nanoparticles; Runge Kutta method; Drug delivery; Heat transfer

AMS subject classifications. 76S05; 76W05; 74F10;

ICNCS2024_105

On Some Bounds of Fuzzy Secure Domination Number[‡]

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Abstract

A set $D \subseteq V$ of a fuzzy graph $G(\sigma, \mu)$ is a dominating set of G if every vertex outside D is a strong neighbor of at least one vertex in D.Secure Domination in Graphs was introduced in 2005 as method to protect vertices and fuzzified in 2017. A secure dominating set S of a fuzzy graph G is a dominating set with the property that every vertex u outside S is a strong neighbor of some vertex v in S and $(S - \{v\}) \cup \{u\}$ is a dominating set.The secure domination number in fuzzy graph is the minimum fuzzy cardinality of secure dominating sets. Here we present the some bounds of fuzzy secure domination number $\gamma_{sc}(G)$ and its relation to domination number, independence number and the matching number.

Keywords: Fuzzy Graphs, Secure domination, Secure domination number, Independence number, Matching number

AMS subject classifications. 03E72, 05C72

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ICNCS2024_106

SafeCare: Smart IoT Device for Gas and Dust Detection in Medical Environments

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Abstract

This study provides a hardware solution that combines cutting-edge sensor technologies with an Arduino microcontroller to provide a portable and flexible real-time monitoring system for hazardous settings. The apparatus combines specialist gas sensors, an integrated dust sensor, and a high-precision flame detection element to identify flames quickly, detect harmful gases, and measure airborne particles to evaluate air quality. After analyzing sensor data, the Arduino microcontroller notifies people promptly of dangerous gas concentrations, flame incidents, or high dust concentrations. By guaranteeing prompt action via SMS or a mobile app, the notification system promotes proactive danger management. This cutting-edge tool provides a thorough method of environmental monitoring, improving flexibility and efficacy in a range of contexts for immediate risk reduction.

Keywords: Flame detection, Dust detection, Gas detection, Arduino microcontroller, portable safety device, real-time monitoring, and notification system

ICNCS2024_107

SHEild: A Smart Hat for Women Safety Integrating IOT Technology

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Abstract

The goal of the smart hat for ladies with a panic button is to enhance non-public safety with the help of IOT Technology through discreet and proactive generation. This wearable tool pursuits to offer a seamless combo of style and safety by means of incorporating a panic button for fast distress indicators to predefined contacts or authorities. The hat will feature location tracking for rapid reaction, an intuitive person interface for ease of use, and connectivity options for seamless verbal exchange. With a focal point on network assistance, customizable alerts, and affordability, the venture aims to empower girls with a reliable and handy protection solution, fostering self-belief and peace of mind in their everyday lives. Expanding on the concept, the smart hat for ladies with a panic button integrates a comprehensive social media platform to facilitate the expression of perspectives and provide a further layer of safety functions. In addition to the panic button and location tracking, the smart hat connects customers to a dedicated social community, permitting them to percentage actual-time updates, express issues, and broadcast SOS alerts to a wider community. This integrated platform allows users to post their area, making sure that during emergency situations, not most effective predefined contacts but also the wider social community is alerted. The social media component is designed to encourage the experience of network help, fostering a collaborative environment in which customers can obtain assistance from nearby individuals or authorities, the smart hat endeavours to redefine private protection in a digitally related global, empowering girls to navigate their environments with self-belief and a sense of collective protection.

Keywords: Smart hat, Women Safety, IoT technology, Discreet panic button, Real-time monitoring, SOS signal, Panic Button, Social media platform.

ICNCS2024_109

Analysis of Radiative Hybrid Nanofluid Flow over a Two-Way Stretching Sheet with Variable Viscosity and Inclined Magnetic Field

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Abstract

Radiation, an inclined magnetic field, and variable viscosity play vital roles in heat transfer industries. These physical variables control the fluid flow where the high temperature difference takes place. Here, the current work analyses the three-dimensional hybrid nanofluid flow with variable viscosity past a stretching sheet with the effect of an inclined magnetic field and radiation. With the help of a physical model, the governing equations are formulated. The systems of nonlinear partial differential equations are transformed into systems of nonlinear ordinary differential equations by using dimensionless variables. The system of ordinary differential equations is reduced to a first-order system and solved numerically using MATLAB. The physical effects of an inclined magnetic field, the volume fraction of nanogranules, and radiation on the three-dimensional engineered fluid flow are represented by figures and tables. The results of the present problem are in good agreement when compared with previous works. Also, the sensitivity is carried out using the Response Surface Method (RSM) for analysing the impact of various physical factors on the skin friction coefficient and heat transfer rate. It is found that the force of the magnetic field controls the velocity of the fluid when the inclined magnetic field acts against the designed fluid flow. The variable viscosity helps to enhance the heat transfer rate. The contributions of a linear parameter as an input variable on the output function of skin friction coefficient and heat transfer rate are 74.92%, 99.8% and 83.05% respectively.

Keywords: Hybrid nanofluids; Heat transfer; Similarity transformation; Numerical analysis; Sensitivity analysis

AMS subject classifications. 80A21; 65K05; 65L10; 65L06

ICNCS2024_111

Deep Learning based Imputation and Prediction Model for Vehicle Traffic Congestion

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Abstract

Efficient traffic management system is important for traffic congestion mitigation and urban planning in both developing and developed countries. Traffic control systems works based on the idea of eliminating uncertainties and avoid accidents to reduce the traffic flow and increase the vehicle flow. Because of issues in vehicle traffic data collection and instability in short term periods, it is hard to predict the traffic congestion accurately. To manage the congestion, it is essential to predict the forthcoming traffic flow and it will be beneficial for Advanced Traffic Management Systems (ATMS) , Advanced Traffic Information Systems (ATIS) and traffic analytics. Traffic data plays a key role in all transport-oriented applications. The problem of missing data has greatly affected the process of Intelligent Transportation Systems (ITS). Hence imputation is needed to find the missing values. Spatio-temporal factors are important to impute the missing values and also predict the vehicle traffic congestion effectively. Deep learning algorithms play a major role in both prediction and imputation. Non–linear historical data and uncertain features influence the vehicle congestion at peak hours which are not considered in existing algorithms. This study proposes stacked denoise auto encoder with ELU activation to impute the missing values and Long short term memory network is proposed to predict the vehicle traffic congestion with uncertain factors. Broadly referred datasets Performance Measurement Systems (PEMS) and Mesowest have been used to assess this model. Experiment results shows that SDAE-LSTM imputation prediction model achieves high accuracy compared with other models.

Keywords: Vehicle; Traffic; Deep Learning

ICNCS2024_112

Exponential Function Projective Synchronization of Delayed Discrete-Time Neural Networks via Saturation-based Feedback Controller[§]

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Abstract

In this paper, the problem of exponential function projective synchronization (EFPS) of delayed discrete-time neural networks (DT-NNs) under saturation-based feedback controller is analyzed. Inequality techniques have been implemented to linearize the quadratic summation terms induced through the forward difference of the constructed Lyapunov-Krasovskii functional. Further, to achieve less conservative results the sufficient conditions are derived in the absence of zero-equation in terms of linear matrix inequalities which ensures EFPS. To demonstrate the efficiency of the proposed theoretical results, a numerical example is carried out via simulation outcomes through MATLAB software. Finally, complete synchronization is further verified for the master-slave DT-NNs with the same parameters.

Keywords: Projective Synchronization; Saturation-based Feedback Controller; Lyapunov-Krasovskii Functional; Linear Matrix Inequalities.

AMS subject classifications. 93D23; 39A30

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ICNCS2024_113

Solving fuzzy non-linear fixed charge transportation problems using modified gauss elimination technique

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Abstract

In real-world scenarios, transportation costs may exhibit non-linearities, particularly when uncertainty is present in the relevant factors. The primary objective of this paper is to determine optimal shipment quantities to the Fuzzy Nonlinear Fixed Charges Transportation Problem (FNFCTP) that minimize overall costs, considering non-linear fuzzy variable expenses and fixed charges. To effectively address the complexities of the FNFCTP, the proposed modified Gauss elimination techniques overcomes the limitations associated with the existing approaches to provide adaptable solutions capable of accommodating vague and imprecise data, making them well-suited for modelling and solving FNFCTP-related issues in practical settings. Also the proposed approach contribute to computing an approximate solution for the FNFCTP, reducing computational costs and addressing problems with local optimal solutions often encountered with standard approaches. The proposed procedure is illustrated through a numerical example, and a comparison study with existing methods is provided, by demonstrating the effectiveness of the proposed methodology.

Keywords: Fuzzy non-linear variable; Fixed charge transportation problem; Ranking; Trapezoidal fuzzy number; Gauss elimination method

AMS subject classifications. 90B50; 90C70

ICNCS2024_114

Modeling SEIR Epidemics with a Finite Automaton

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Abstract

Epidemics is very important area of concern for most our living being family in the world. Any epidemic situation when properly not controlled could lead to a disaster when large amount of human population is involved. Here we propose a fundamental model of computation in terms of non-deterministic finite automata (NFA) for the Susceptible-Exposed-Infectives-Recovered (SEIR) model.Through this model we could prove there could be certain languages which are epidemic regular since it could be compared with the normal regular languages for which we can have NFA or regular grammar. If we could classify how the epidemic model could behave then we could better develop strategies that could tackle a similar epidemic situation in future.

Keywords: epidemics, SEIR model, epidemic NFA

AMS subject classifications. 68Q45

ICNCS2024_115

Forecasting stock price index using multiple linear regression model

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Abstract

One of the most popular methods for managing finances is the stock market, which has attracted more participants. Investing in stocks carries a comparatively significant risk. One of the most pressing issues in the stock market is how to lower risks while increasing returns for investors. The main aim of this paper is used to forecast the closing stock market price of various companies. Multiple linear regression is the basis for the prediction [Hegazy, O *Soliman, O. S., & Salam, M. A.(2014)* A machine learning model for stock market prediction. arXiv

preprint arXiv:1402.7351.] of the price value of the closing stock price index. In this study, the short-term prediction of the stock price is achieved by the use of multiple linear regression and correlation analysis[Nobi A *Lee S, Kim DH, Lee JW(2014)* . Correlation and network topologies in global and local stock indices" Physics Letters,378(34), 2482–2489.]. The outcome shows that the multiple regression model works well and is capable of more accurately forecasting changes in the stock market index. The result also demonstrates the improved predicted accuracy of the model.

Keywords: Closing Stock Price Index, Multiple regression model, Accuracy and Prediction.

ICNCS2024_116

MetaOptiRice: A Metaheuristic Approach to Elevate Imaging Precision in Paddy Disease Detection[†]

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Abstract

Paddy fields, vital for global agriculture, face persistent threats from diseases that compromise crop yield and food security. This study introduces "MetaOptiRice," a pioneering mathematical approach designed to enhance imaging precision in paddy disease detection. By integrating metaheuristic algorithms, specifically Genetic Algorithms and Particle Swarm Optimization, our methodology focuses on the mathematical fine-tuning of imaging parameters. This dynamic adaptation of settings maximizes discriminatory features relevant to paddy disease patterns, resulting in a significant elevation of disease detection precision. Extensive experimentation on a diverse dataset of paddy field images demonstrates MetaOptiRice's superiority over traditional imaging methods and non-optimized deep learning models. The iterative optimization process, rooted in mathematical principles, ensures convergence towards an optimal configuration, markedly improving disease detection rates. This heightened mathematical precision not only advances disease detection capabilities but also contributes substantively to the overall health monitoring of paddy crops. The study emphasizes MetaOptiRice's mathematical foundation and explores its generalizability across various paddy disease types and environmental conditions. This underscores its adaptability, making it a robust solution for precise imaging in diverse scenarios. As a mathematical approach, MetaOptiRice represents a significant

[†]The authors express their gratitude to the Thiagarajar College of Engineering (TCE) for supporting us to carry out this research work. Also, the financial support from TCE under Thiagarajar Research Fellowship scheme (File.no: TRF/Jul-2023/01) is gratefully acknowledged.

leap forward in precision agriculture, providing a nuanced, efficient, and adaptable method for imaging in paddy disease detection, thereby contributing to global initiatives for sustainable food production.

Keywords: Precision Agriculture; Paddy Disease Detection; Metaheuristic Algorithms; Imaging Optimization; Crop Health Monitoring; Sustainable Food Production

ICNCS2024_117

Comparison of homotopy perturbation method and new analytical method for solving nonlinear equations in the enzymatic reaction of glucose in a Spherical matrix

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Abstract

The theory of glucose responsive composite membranes for the planar diffusion and reaction process is extended to a microsphere membrane. The theoretical model of glucose - oxidation and hydrogen peroxide production in the chitosan-aliginate microsphere is discussed in the manuscript for the first time. We have successfully reported an analytical derived methodology utilizing homotopy perturbation to perform the numerical simulation.The effect of various parameters on the concentration of gluconic acid and hydrogen peroxide release as well as the influence and sensitive analysis are also discussed. The theoretical results enable to predict and optimize the performance of enzyme kinetics are compared with new Analytical method .

Keywords: Enzyme-encapsulated polymer microspheres; Enzyme reaction mechanism;Mathematical modeling; New approach of homotopy perturbation method.

ICNCS2024_118

Generative power of Hyper-edge replacement graph P system

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Abstract

Graph grammar is a formalism used to describe and manipulate graphs, which are mathematical structures consisting of nodes and edges. Graphs are versatile representations that model relationships between entities, and graph grammar provides a set of rules for transforming and generating graphs. Hyper-edge replacement graph grammar is considered a kernel in generating graphs and hypergraphs, and it has stood out enough to be noticed in recent years. In this paper, using the hyper-edge replacement graph rewriting P system, the set of all Pan, Tadpole, Sunlet, Web, and Prism graphs are generated with hyper-edge rules of minimum order.

Keywords: Graph grammar, Hyper-edge, Hyper-edge replacement graph grammar (HRG), Graph P system, Hyper-edge replacement graph rewriting P system (HRGRPS).

AMS subject classifications. 68Q42, 68R10, 68Q10

ICNCS2024_121

Adomian Decomposition Method and Homotopy Analysis Method for Fuzzy Fractional Differential Equations through 1-cut and 0-cut equations

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Abstract

Fuzzy fractional differential equations (FFDEs) are important tool for expressing complicated scientific phenomena that involve heritable features and uncertainty and Obtaining accurate or approximate analytical solutions for these equationscan be difficult, especially for nonlinear problems[R. P.Agarwal, V.Lakshmikantham, & J. J.Nieto, "On the concept of solution for fractional differential equations with uncertainty", Nonlinear Analysis: Theory, Methods & Applications, 72.6 (2010) 2859-2862]. In order to overcome these difficulties, Adomian decomposition method and Homotopy analysis method have been studied and developed in a new manner. In this research, an effective numerical approach is utilized to deal with fractional-order differential equations with fuzzy initial conditions involving Hukuhara Caputo's derivate. In this regard, a fuzzy fractional differential equation is interpreted as two equations via 1-cut and 0-cut cases[T.Allahviranloo, S. Abbasbandy, O.Sedaghgatfar, & P. Darabi, "A new method for solving fuzzy integro-differential equation under generalized differentiability", Neural Computing and Applications, 21.1 (2012) 191-196 , O.Sedaghatfar, P.Darabi, & S.Moloudzadeh, "A method for solving first order fuzzy differential equation", International Journal of Industrial Mathematics 5.3 (2013) 251-257.], then using Adomian Decomposition Method (ADM) and Homotopy Analysis Method (HAM) to solve these equations. A convex combination of 1-cut and 0-cut solutions is utilized to obtain the solution of the original FFDE. Numerical examples are carried out to confirm the ability and simplicity of the proposed methods. The MATLAB software is used to simulate the results for various fractional orders.

Keywords: Fuzzy differential equation; Fuzzy fractional differential equation; Adomian Decomposition Method; Homotopy Analysis Method; Interval-valued fractional differential equation

ICNCS2024_123

Moduli Space of Projective Sheaves on Smooth Projective Surfaces[‡]

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Abstract

We introduce the notion of moduli spaces of projective sheaves on a projective smooth complex surface and their application to classifying algebraic objects, particularly in the context of vector bundles on algebraic curves. The construction of a moduli space for semi-stable bundles is detailed, emphasizing stability conditions and the existence of a coarse moduli space. The Hilbert scheme is explored, linking it to the moduli space through a bijective map. Theorems and results regarding smoothness, stability, and geometric quotients are presented, demonstrating the application of algebraic geometry in diverse fields such as bifurcation analysis, numerical simulations, and mathematical modeling, with a specific example in fluid dynamics simulations and mesh parameterization.

Keywords: Moduli Space; Hilbert scheme; Semi-stable bundles; Smoothness

AMS subject classifications. 14D20; 14D22

[‡]The authors express their sincere appreciation to the Ramanujan Institute for Advanced Study in Mathematics for offering invaluable resources, academic guidance, and a supportive environment, which significantly contributed to the successful completion of this research.

ICNCS2024_124

Numerical Study on Maxwell Fluid on Perpendicular Plate with the impact of Heat Mass Transfer

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Abstract

This simulation shows how heat and mass transfer is analyzed when Maxwell fluid flows across a vertical plate. The conservative energy transport equation and relaxation effect is considered. Using appropriate similarity transformations, the governing equations such as continuity, conservation of momentum, energy transport and mass transport were transformed into ordinary differential equations. Runge – Kutta method uses these differential equations with shooting technique and the corresponding boundary conditions. The numerical method has compared to previously published work and found to be accurate. As an example, buoyancy ratio (Nr), Grashof number (Gr), Prandtl (Pr), Rayleigh (Ra) and Lewis number (Le) are all essential parameters that are commonly studied through graphs.

Keywords: Fluid dynamics, Heat Mass Transfer

AMS subject classifications. 76N10, 76N25

ICNCS2024_125

Exploring Tumor-Induced Immunosuppression dynamics by Myeloid-Derived Suppressor Cells: Insights via a fractional order mathematical model with time delay[§]

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Abstract

This research addresses the challenge of tumor-induced immunosuppression in cancer disease by employing fractional-order delay differential equations. Our study further investigates the intricate interplay of myeloid-derived suppressor cells (MDSCs) within the immune system and tumor progression, due to their pivotal role in immune response modulation. The proposed mathematical model encompasses tumor cells, cytotoxic T cells (CTLs), macrophages, dendritic cells, and MDSCs within a comprehensive five-dimensional deterministic system. To validate the model, we investigate the steady state stability and the non-negativity of solutions. Through rigorous numerical simulations, we observe that the system undergoes Hopf-bifurcation concerning tumor time-delay τ as the bifurcation parameter. Additionally, our study presents the influence exerted by fractional-order, α over the dynamics of immunosuppression. **Keywords:** Mathematical model; Dynamical systems; Time-delay; Hopf-bifurcation; stability; Fractional calculus

AMS subject classifications. 93A30; 37M05; 34A34; 34C23; 26A33

[§]The research work of P. Tamilalagan and B. Krithika is supported by National Board for Higher Mathematics, Department of Atomic Energy, Mumbai, India under the grant no. 02011/8/2020/NBHM/R&D-II/8071.

ICNCS2024_126

Free Ternary Semigroup

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Abstract

We introduce the notion of Free Ternary Semigroup and some elementary properties are studied. Necessary and Sufficient condition for the External direct product of 2 free ternary semigroup to be finitely generated is proved.

Keywords: Free Ternary Semigroup; Generating Set; Finely Generated.

AMS subject classifications. 20M05; 20M30; 20M35.

ICNCS2024_127

Synchronization for uncertain neural networks with randomly occurring uncertainties and time-delay based on the sliding mode control[†]

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Abstract

This paper investigated the master-slave synchronization for uncertain neural networks with randomly occurring uncertainties [V. Vembarasan, P. Balasubramaniam, C. S. Chan, *Robust synchronization of uncertain chaotic neural networks with randomly occurring uncertainties and non-fragile output coupling delayed feedback controllers*. Nonlinear Dynamics, 78: 2031–2047, 2014] and time-delay by using the sliding mode control method [W. You, T. Wang, *Master-slave synchornization for uncertain Markov jump neural networks with time-delay based on the sliding mode control*. AIMS Mathematics, 9(1):257–269, 2023]. An integral sliding mode surface and sliding mode controller were designed such that the state trajectories of the neural networks could reach the sliding mode surface in a finite time. By introducing an improved Lyapunov-Krasovskii functional and employing reciprocally convex approach [P. Park, J. W. Ko, C. Jeong, *Reciprocally convex approach to stability of systems with time-varying delays*. Automatica, 47(1):235–238, 2011], it's designed to achieve synchronization with the help of linear matrix inequalities. Finally, a numerical example was shown to demonstrate the efficacy of the acquired results.

Keywords: neural network; sliding mode control; randomly occuring uncertainties

AMS subject classifications. 37H30; 34D06

[†]The research work of S. Priyanka is supported by SNUC-JRF, Shiv Nadar University, Chennai.

ICNCS2024_128

An Integrated Framework for Glioma Chemotherapy employing Mathematical Modeling & Deep Learning[‡]

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Abstract

Low-grade gliomas are infiltrative, incurable primary brain tumours that usually grow slowly and cause death. This study presents a unique low-grade glioma mathematical model and pattern prediction using deep learning. We combine the advantages of a deterministic and stochastic model with deep learning features to provide results with precise solutions and high-performance prediction. We also investigate the impact of a time delay parameter on the rate of drug concentration. The global stability at treatment success and failure equilibrium is effectively analysed using Routh-Haurwitz criteria and the Lyapunov method. Next, the effectiveness of chemotherapy on the rate of proliferation of low-grade glioma is predicted using an efficient deep-learning model by employing the long-term dependencies in sequential data. Thus make the prediction more accurate.

Keywords: Glioma; Chemotherapy; Stochastic Perturbation; LSTM; Bifurcation

AMS subject classifications. 92B10; 68T07

[‡]S. K. Mohanty thanks Vellore Institute of Technology, Vellore, for providing the VIT SEED Grant-RGEMS Fund (**SG20220069**) for carrying out this research work.

ICNCS2024_129

Synchronization of Fractional Order Time Delayed Neural Networks using Matrix Measure Approach

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Abstract

This paper presents an innovative model designed to achieve the synchronization of fractional order time-delayed neural networks by utilizing the matrix measure approach (MMA). The aim is to fill the existing research gap related to the application of MMA in fractional-order neural network systems (FONNs). To attain coupling control in the slave system of FONNs, several criteria are introduced. If synchronization occurs, the proposed criteria should exhibit asymptotic stability between the slave and master systems. Finally, numerical results are provided to showcase the effectiveness of using MMA for achieving synchronization in FONNs.

Keywords: Fractional order;Matrix Measure; Synchronization; Time-Delay

ICNCS2024_130

Optical soliton propagation for nonlinear Schrödinger equation with higher order dispersion and linearity

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Abstract

Optical solitons have earned great significance due to their ability to maintain the shape while travelling great distances [Z. Chen et al. *Optical spatial solitons: historical overview and recent advances*Reports on Progress in Physics, 75(8) (2012) 086401]. It holds important role in the telecommunications with optical fiber. Non-Linear Schrodinger (NLS) equation have been used to find the soliton solution. Solitons with higher order dispersion, inter-modal dispersion have been explored and reported by many researchers [A. Biswas et al. *Highly dispersive optical solitons with Kerr law nonlinearity by F-expansion*, Optik, 181 (2019) 1028–1038, A. Biswas, A. Sonmezoglu, M. Ekici, A. S. Alshomrani, *Highly dispersive singular optical solitons having Kerr law nonlinearity by Jacobi's elliptic cs function expansion*, Optik, 192 (2019) 162931]. This paper contains the study of optical solitons propagation in fiber for NLS equation with higher order dispersion and non-linearity. We use the new extended auxiliary method to find the soliton solutions. We explore the role of higher order dispersion and non-linearity and plot graphs varying the respective coefficients.

Keywords: Solitons; nonlinear Schrödinger equation; new extended auxiliary method.

ICNCS2024_131

Optimizing Edge Coloring in Undirected Graphs through Efficient Adjacency Matrix Representation

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Abstract

Graph edge coloring is a fundamental problem in combinatorial optimization with applications in various domains. This paper presents an algorithm for efficiently edge coloring of undirected graphs using a stack-based approach on incidence matrix. The algorithm initializes a stack with a unique color for each edge, starting the traversal from a specified vertex. Coloring is performed by considering the topmost color of the stack, ensuring that adjacent edges do not share the same color. The algorithm employs a horizontal traversal in the incidence matrix and backtracking strategies to handle conflicts. The proposed method is evaluated through extensive experimentation on diverse graph types, revealing insights into its performance, strengths, and limitations. The analysis includes considerations of parameter sensitivity, optimization impact, backtracking behavior, and scalability. The results offer valuable guidance for understanding the algorithm's applicability in different scenarios and provide a foundation for further refinements and optimizations. The algorithm demonstrates effectiveness in preserving graph structure and optimizing the allocation of colors, providing a valuable tool for various applications such as scheduling, network optimization, and resource allocation. Theoretical analyses and experimental results showcase the algorithm's efficiency and applicability across diverse graph structures, establishing it as a practical solution for edge coloring in undirected graphs represented by adjacency matrices..

Keywords: Adjacency matrix; Undirected graph; Edge coloring

ICNCS2024_132

Revolutionizing Video Encoding: An Innovative Non-linear Approach for Enhanced Security

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Abstract

Combining video encoding and encryption streamlines the decryption and decoding processes, simplifying the playback of encrypted videos. This integration enables simultaneous or seamless decryption and decoding, eliminating the need for additional steps, and allowing authorized users to view the video effortlessly. By employing data randomization and generating unique random keys for each point, the proposed algorithm maps video data to various points on a $2D$ plane. This approach ensures improved speed and enhanced security compared to existing encryption algorithms currently in use. In the context of video file encryption, the presented paper introduces a symmetric block algorithm with a 128-bit key size. This algorithm efficiently encrypts video files, ensuring both security and transmission/storage speed. By treating the video file as a sequence of bytes and mapping them to specific points on a two-dimensional plane, the algorithm enables swift decryption using the shared key from the Code Book, facilitating efficient decryption for the involved parties. Furthermore, as the algorithm follows a Fully Layered Encryption approach, it does not affect the MPEG format. The combination of video encoding and encryption offers benefits such as reduced file size for easier and faster transmission over networks or storage on devices. This integration saves time and effort by merging encoding and encryption into a single operation, resulting in more efficient video transmission and storage

ICNCS2024_134

An analogue of Schur's theorem on integer colouring to algebraic groups

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Abstract

Schur's theorem on integer colouring states that a colouring of integers using finitely many colours yields at least one monochromatic solution to the equation $x+y=z$[I. Schur et al. (mod. p.). *Jahresbericht der Deutschen Mathematiker-Vereinigung*, 25:114–116, 1917]. An extension of Schur's theorem on integer lattices is explored by the authors[Vishal Balaji et al. Schur's theorem in integer lattices. *arXiv preprint arXiv:21*, 2021]. We find an analogue of this theorem to algebraic groups and we classify groups which admits a colouring which yields a monochromatic solution to $xy=z$(not all are equal.) when coloured using finitely many colours.

Keywords: Algebraic groups; Group colouring.

AMS subject classifications. 05C25; 05E16.

ICNCS2024_135

Investigation of Melting Heat Transfer in Viscous Nanofluid Flow including Micro-Organisms and Entropy Generation due to an Inclined Exponentially Stretching Sheet

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Abstract

This study investigates melting heat transfer and entropy production in viscous nanofluid flow consisting of micro-organisms over an inclined exponentially stretching permeable sheet. The flow is considered via porous medium. Impacts of heat transport characteristics are invoked in the energy equation. In concentration equation we have included chemical reaction impact. The regulating PDEs are transformed into nonlinear ODEs in non-dimensional form using adequate similarity transformation relations. The analytical solution of the problem is obtained utilizing HAM. Various plots are drawn to exhibit impacts of the regulating parameters (Prandtl number, Porous medium parameter, Thermal Grashof number, Mass Grashof number, Micro-organism Grashof number, Thermophoresis parameter, Radiation parameter, Bio-convection Levis number, Brownian motion parameter, Chemical reaction parameter, Suction parameter, Peclet number, and Melting parameter) occurred in the problem on relevant fields (flow, temperature and concentration distribution) and entropy production and discussed. Further values of significant physical quantities skin friction coefficient, Nusselt number, Sherwood number, and motile microbes density computed using MATLAB based bvp4c function and HAM are displayed in tabular mode and found in excellent agreement. For validity of the results skin friction coefficient and Nusselt number values are compared to prior research, apparently good agreement is found. The effect of melting surface parameter is found to reduce the fluid flow and temperature field. Entropy production lessens with rising values of slip parameters but effects of radiation and porous medium parameters are found to upsurge it. It is also noticed that bioconvection Lewis number and Peclet number reduce the micro-organism density profile. Inclusion of entropy analysis is a novel feature of the study. The solution methodology also enriched the novelty of the investigation. The results of the study may be applied to improve the efficiency of thermal, fluid flow and energy systems. This study may also find applications in bio-nano-coolant systems and heat transfer devices.

Keywords: Nanofluid, Microorganisms, Exponentially stretching inclined sheet, Slip conditions, Entropy generation, Chemical Reaction, Porous medium, Suction/Injection.

ICNCS2024_136

Effect of ocean current on interaction of water waves with perforated barriers placed over undulated seabed.[§]

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Abstract

This study examines the dispersion of water waves by perforated surface piercing wave barriers installed over the undulated seabed under the influence of ocean current. The "Boundary element method" is applied to handle the present "Boundary value problem". In addition to this, the energy identity is derived to evaluate the dispersion of wave energy by the perforated wave barriers. In addition, the influence of porosity, geometrical configurations of the perforated barriers and the undulation of the seabed on the energy dissipation are investigated. The results demonstrate that the ocean current and Keulegan-Carpenter (KC) numbers play a significant role in wave energy reflection and dissipation.

Keywords: Wave barrier; KC number; Ocean current; Boundary value problem; Boundary element method

[§]Santanu Koley acknowledges the financial support received through the DST Project: DST/INSPIRE/04/2017/002460 and the SERB Project: CRG/2021/001550.

ICNCS2024_137

Entry Analysis in Second Grade Non-Newtonian Fluid Flow and Heat Transport in a Channel with Thermal Radiation

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Abstract

The study of entropy formation in second-grade non-Newtonian fluid flow through the channel is the purpose of this article. It is assumed that the top wall is permeable and that the bottom wall is impervious. Additionally taken into account are the effects of radiation, porous material, and heat production. The similarity transformations are utilized to change the dimensional governing equations into non-dimensional ordinary differential equations, which are then analytically solved in the MAPLE software using the homotopy perturbation approach and differential transform method. The effects of various parameters likes slip parameters, radiation, heat source, Reynolds number, Prandtl number, porous media etc. on velocity, energy, entropy production, and bejan number are discussed.

Keywords: Heat Source; Second grade fluid; Radiation; Slip Conditions; Porous Media; Entropy; HPM; DTM

ICNCS2024_138

Distribution of Fractal and Multifractal Analysis in the Dynamics of Commodities Markets

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Abstract

This research investigates the probability distribution with fractal dimension within the context of fluctuations in oil and gold prices. The distribution model illustrates the constantly changing relationships and connections between these two vital commodities within the framework of oil price fluctuations. The interaction between the scale factor of probability distribution and fractal dimension is employed to analyze the temporal dynamics of oil and gold prices. The study aims to uncover patterns, irregularities, and potential correlations in the price movements of these two crucial commodities. Utilizing advanced statistical techniques and fractal analysis, the research explores the multi-fractal nature of oil and gold price time series and the underlying structure and complexity of these financial markets. The findings contribute to a deeper understanding of the inherent patterns in oil and gold price fluctuations, providing insights into potential market behavior and aiding risk assessment for investors and financial analysts.

Keywords: Stable Distribution; Fractal Dimension; Scale Factors; Hurst Exponent

AMS subject classifications. 60E07; 28A80

ICNCS2024_140

Bragg resonance in the presence of elastic bottom†

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Abstract

This paper explores Bragg scattering in a homogeneous fluid, focusing on the interaction between oblique waves and an undulated elastic bottom in the presence of uniform current. It uses linear wave theory to analyze the effects of a uniform current and flexible floor on wave interaction, where the fluid propagates in two modes (free-surface and flexural mode). The study uses analytical derivation and numerical exploration of Bragg resonance conditions for various physical parameters, including perturbation and Fourier transform methods. The study computes Bragg transmission and reflection for various physical parameters and verifies the energy relation, assuring the accuracy of the results. The findings reveal that the amplitude of Bragg reflection increases when the flexural rigidity of the elastic bottom increases and decreases when the current speed increases. Furthermore, wave blocking resulting from an elastic bottom and ocean current is discussed, which affects Bragg reflection significantly.

Keywords: Elastic bottom; Perturbation method; Fourier transform technique; Blocking resonance; Bragg resonance

AMS subject classifications. 76B15

†S. K. Mohanty gratefully acknowledges the financial support from SERB, Department of Science and Technology, Government of India through CRG project, Award No. **CRG/2021/002821** for carrying out this research work.…

ICNCS2024_141

Passivity Based Sampled-Data Controller for T-S Fuzzy System with the Refined Fractional Delayed-State

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Abstract

The paper is concerned with the development of a sampled-data controller designed for Takagi-Sugeno (T-S) fuzzy systems. A key highlight is the incorporation of a refined fractional delayed-state into this control approach. The primary aim is to establish criteria for system stabilization, thereby ensuring the asymptotic stability of T-S fuzzy systems. This objective is pursued within the framework of the newly designed control methodology. The core contribution of the paper lies in the introduction of an innovative Lyapunov-Krasovskii functional (LKF) tailored to T-S fuzzy systems. This novel approach capitalizes on the efficacy of sampling intervals. The LKF design takes advantage of variable attributes tied to the real sampling pattern, effectively reducing the conservatism of the outcomes. Moreover, the paper introduces a sophisticated fractional delayed-state concept, which plays a pivotal role in shaping a modified looped functional-based LKF. The stability criteria are then formulated through the utilization of linear matrix inequalities (LMIs) and integral inequalities. These criteria play a vital role in establishing the asymptotic stability of considered systems when subjected to the designed control approach.

Keywords: Asynchronous constraints, sampled-data control, refined fractional delayed-state, T-S fuzzy system.

ICNCS2024_142

Enhancing Image Security: A Two-Stage Encryption Approach using Chaotic Map and RSA Algorithm

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Abstract

With the escalating volume of digital images transmitted over various communication channels, the need for robust and secure image encryption techniques has become paramount. This paper introduces a novel approach to image encryption using Logistic Sine maps and RSA algorithm. The proposed encryption scheme transforms to create a highly secure and efficient algorithm for safeguarding visual information. This research delves into fortifying image security through a dual-layered approach. Firstly, employing the Logistic Sine Map for scrambling the initial image enhances its confidentiality and integrity. Secondly, utilizing the RSA algorithm for encryption provides an added layer of protection, ensuring a robust shield against unauthorized access. One major advantage of logistic sine map is that it can easily control the amount of encryption just by varying the value of the threshold value. RSA on the other hand is a highly secure and reliable algorithm for encryption. The combination of these methods augments the security measures, safeguarding sensitive visual data from potential threats and ensuring heightened confidentiality in data transmission and storage.

Keywords: Encryption; Chaotic Map; RSA Algortihm

ICNCS2024_143

Unsteady fractional time derivative of nanofluid past a stretching sheet with time varying temperature and concentration

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Abstract

In the present study we carry out the investigation of flow of nanofluids past a vertical inclined plates. The nanofluids in consideration are Carboxy-methyl-cellulose-molybdenum disulfide and Carboxy-methyl-cellulose-graphene oxide nanofluid. Guiding equations for the flow are written obeying no slip condition, time varying temperature and concentration effect. Obtained results through series solutions are presented and interpreted with graphs for different parameters namely, Magnetic parameter, porosity parameter, and angle of inclination. Results and discussion comparing the CMC/MOS2 nanofluid and CMC/GO nanofluid are made.

Keywords: Fractional unsteady fluid flow; Laplace equation; Two plates

AMS subject classifications. 76-10; 34A08; 80A19

ICNCS2024_144

gsl-Groups and some of its properties

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Abstract

The most basic tools of universal algebra are lattices and groups. Through the analysis of appropriate lattices with binary operations, we can study more interesting applications of lattice theory. The concept of soft set is applicable to represent real life problems with uncertainties in a simple form. In this paper, we introduce the concepts of gs-poset groups and gsl-groups and study their major properties in terms of soft elements.

Keywords: gs-poset group, gsl-group

AMS subject classifications. 03E72,06D72,06A06,20B05

ICNCS2024_147

A Comprehensive Survey on Methodologies for Automatic Essay Scoring

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Abstract

In the field of educational endeavors, assignments and assessments play an essential position since they allow us to examine student's performance. As of the present moment, evaluation has to be performed by hand, and which requires direct, one-on-one assessment, which is affordable when working with a small class size. But manual grading becomes an overwhelming chore when the number of students grows. Furthermore, prejudice can affect human graders, leading to irregularities and mistakes in the grading process. Numerous scholars have established automated essay grading systems in an effort to overcome these issues. These algorithms take into account various factors such as syntax, semantic coherence, and the contextual use of sentiment-related terms in the text, going beyond conventional keyword-based techniques. Hence, this article suggests conducting a thorough analysis of Automated Essay Scoring (AES) models. The primary goal is to elucidate the numerous approaches, datasets, similarity metric tools, and performance metrics that can be utilized in developing AES systems. Additionally, it discusses the challenges, ethical issues, research outcomes to be considered while developing the AES system.

Keywords: Computer-based assessment system, Essay scoring, Natural Language Processing (NLP), Text Processing, Semantics, Linguistics.

ICNCS2024_148

The geodetic and the Steiner numbers of a hollow coronoid $HC(C_1, C_2, C_3)$

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Abstract

Benzenoids are arranged into hexagons with six sides by mathematical configuration to form coronoid structures. By their definition they are organic chemical structure. Primitive and catacondensed coronoids are the two types of hollow coronoids. Another name for them is polycyclic conjugated hydrocarbons. There is a lot of interest in studying chemical mathematics by the researchers from various fields. While graph theory has always been an important for creating chemical structures that they are easy to understand and have many uses. Once the chemical structure has been changed into a graph, they can be used to carry out various theoretical and investigative research of structures. A broad area of graph theory called distance in graphs has both scientific and practical uses. We examined various distance-based parameters for the hollow coronoid structure in this paper.

Keywords: Hollow coronoid, distance, Steiner distance, geodetic number, total geodetic number, connected geodetic number, vertex geodetic number, Steiner number, total Steiner number.

AMS subject classifications. 05C12.

ICNCS2024_149

Numerical Scheme for Attractors of Dynamical Systems with Fractal Fractional Derivatives

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Abstract

This study proposes a novel numerical approach for solving the attractors of dynamical systems with fractal fractional derivatives. Its combination of fractal geometry and fractional calculus creates a novel and complicated dynamical behaviour, which contributes to a better understanding of non linear systems. The results show that the method can handle the complexities introduced by both the fractal and fractional components, providing insights into the underlying dynamics. Furthermore, the study explores the sensitivity of the attractors to initial conditions and system parameters, shedding light on the intricate interplay between fractal geometry and fractional calculus.

Keywords: Chaotic dynamical system; Fractal- fractional derivatives; Fractal-fractional integral Self- similar attractors

ICNCS2024_150

Transmission dynamics and stability of fractional order derivative model for Covid-19 epidemic with optimal control analysis

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Abstract

In this study, we examine a non-linear mathematical model for COVID-19 with Caputo fractional derivative. We prove the results of the solution existence and uniqueness via fixed point theory. We compute the basic reproduction number through the next-generation matrix. We derive the stability results based on the basic reproduction number. In numerical simulation, we obtained the approximate solution by using fractional Adam-Bashforth method, Euler and Runge Kutta Method of the fourth order to enumerate numerical results. A comprehensive exploration of optimal control is performed, utilizing two control parameters to investigate the fluctuations in the infected population under conditions with and without the implementation of control measures. The numerical approach applied in this study exhibits resilience and effectiveness, showcasing its versatility for addressing diverse real-world challenges.
Keywords: Fractional-order Model; Caputo Derivative; Fixed point theory; Approximate solution; Numerical simulations.
AMS subject classifications. 34D20; 65L70; 92B05; 93B20.

ICNCS2024_151

Interval type-2 fuzzy control design for nonlinear time-delay systems using convex relaxation technique

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Abstract

In this article, the stabilization problem of interval type-2 fuzzy systems in the presence of time-varying delays is addressed. In detail, the non-parallel distributed compensation approach is utilized to address non-parallelism issues within fuzzy rule bases. This improvement is achieved by incorporating a Lyapunov stability theory and linear matrix inequalities. Additionally, this paper employs a specialized convex relaxation method to reduce computational complexities with less conservativeness. Finally, two illustrative examples are presented to underscore the efficacy of the proposed approach.
Keywords: Interval type-2 fuzzy systems; Time-varying delay; Convex relaxation techniques; Stabilization.
AMS subject classifications. 93C42, 94D05, 93C43, 93D15

ICNCS2024_152

Cancer classification based on Single cell RNA Sequence

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Abstract

Cancer classification via Single-Cell RNA Sequencing (scRNA-seq) has become pivotal in identifying distinct cell populations within tumors. This study presents the application of the Efficient Net Convolutional Neural Network (CNN) model for accurate and efficient classification of cancer subtypes based on scRNA-seq data.

Previous research in cancer classification has utilized diverse methodologies, including traditional machine learning algorithms, clustering techniques, and other deep learning architectures. However, these methods often face challenges in handling high-dimensional scRNA-seq data, extracting relevant features, and accurately discerning complex cellular subtypes, limiting their efficacy in comprehensive cancer characterization.

The study begins by gathering RNA sequencing data from diverse cancer tissues and corresponding labels defining specific cancer types. The data is processed, organized, and transformed into a database suitable for training a deep learning model. This involves structuring the data into images, utilizing the RNA sequencing features as image pixels, and associating these images with their respective cancer subtype labels.

Accurate cancer classification is important for tailoring treatment to individual patient, and it allows researchers to maximize the treatment based on the molecular profiles. In this approach, we propose a system to identify the cancer cells using transfer learning approach, specifically using the efficient net model with 5.3m parameters and 7 layers. The images are taken from a csv file and resized. We were able to achieve an accuracy of 86.97%

The results demonstrate the effectiveness of the EfficientNet B0 architecture in classifying various cancer subtypes based on RNA sequencing data transformed into image representations. The model achieves significant accuracy in differentiating between multiple cancer types, highlighting its potential for accurate and efficient cancer classification.

Keywords: Cancer classification; Single cell RNA; Deep Learning

ICNCS2024_153

Numerical analysis on the stability and controllability of fuzzy fractional singular dynamical systems under granular computing

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Abstract

The goal of this research is to investigate fuzzy fractional singular dynamical system's (FFSDS) controllability and stability. We find the fuzzy solutions of FFSDS by presenting various theorems proved in this study. Additionally, a few novel hypothesis about the examination of FFSDS stability are presented. Furthermore, we use Gronwall delay inequality to prove the system's finite-time stability. The concept of granular controllability of the fuzzy fractional singular dynamical system is explored. Finally, a numerical example is provided to justify the findings that were obtained.

Keywords: Horizontal membership function, Triangular fuzzy number, Fuzzy granular Laplace transform, Fuzzy fractional differential equations, Granular differentiability, Granular fuzzy fractional derivative, Fuzzy fractional granular controllability/Stability

ICNCS2024_154

Functional-observer-based feedback control design for stabilization of time-delayed systems

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Abstract

This paper focuses on the stabilization problem of continuous-time delayed systems by virtue of functionalobserver (FO)-based feedback controller. However, the fundamental benefit of a FO is that it may be easier to estimate a given function than the traditional technique and thus it can be considered as a generalization of classical state observers. In addition to that, the aim is then to design minimal order functional observer. Whilst, the design and analysis of FO is based on Lyapunov stability theory and applying the inequality analysis technique, the sufficient stability conditions are established in the forms of matrix inequality. Eventually, the numerical examples with simulation results are provided to validate the practicability and efficacy of the developed control strategy .
Keywords: Functional observer ; Continuous-time delayed systems; Lyapunov stability theory.
AMS subject classifications. 93C43, 93B52, 93D05

ICNCS2024_156

Fractal fractional unsteady time derived Casson fluid flow past the parallel plates with top plate oscillating in the direction of flow

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Abstract

The present investigation addresses the use of fractal fractional operators and power law kernel in simulation of unsteady Casson fluid flow subject to magnetic field through the parallel plate. Out of the top and bottom plate the top plate is made to oscillate along its plate thereby affecting the flow under it. The flow then becomes unsteady and follows certain patterns. The study has in it the time derivative being fractal-fractional. The oscillation is of the plate is an sinusoidal function of time with certain fixed frequency. The equations governing this flow is consolidated and solutions are obtained through series solution. Closed form solutions is obtained to certain reduced cases where parameter effects are eliminated. The results obtained through such solutions are compared with the available results in literature for authentification[I. A. Imran. *Application of fractal fractional derivative of power law kernel* (${}_0^{FFF}D_x^{\alpha,\beta}$) *to MHD viscous fluid flow between two plates*. Chaos, Solitons and Fractals, 124:109691, 2020. doi:https://doi.org/10.1016/j.chaos.2020.109691],[N. A. Sheikh et al. A

Fractal-Fractional Model for the MHD Flow of Casson Fluid in a Channel. Computers, Materials & Continua *62(20,) 1385-1398* 2021:Tech Science Press. doi:10.32604/cmc.2021.011986]. Extended observations are then plotted for interpretation and understanding .

Keywords: Fractal fractional unsteady Casson fluid flow; Oscillating parallel plates; Magnetic field;

AMS subject classifications. 76-10; 34A08; 80A19

ICNCS2024_157

Transfer Learning in Thyroid Malignancy Prediction Explained with Grad-CAM

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Abstract

Thyroid cancer poses a substantial worldwide health challenge, requiring accurate and timely interventions. According to the American Cancer Society Cancer Statistics [American Cancer Society. Cancer Statistics Center. Available online: *https://cancerstatisticscenter.cancer.org*], the projected number of new thyroid cancer cases in 2023 is 43,720, with an estimated 2,120 deaths. This paper explores the application of transfer learning techniques in the context of thyroid cancer prediction using deep neural networks. Thyroid cancer diagnosis, particularly from ultrasound images, is a challenging task, demanding both high predictive accuracy and interpretability in clinical scenario. This paper proposes a pre-trained VGG-16 network topped with customised dense classification layers in classification and prediction of thyroid ultrasound images. Our study achieves state-of-the-art predictive performance and also addresses the need for model interpretability. Gradient-weighted Class Activation Mapping (Grad-CAM), an interpretability tool, is employed to explain the decision-making process of the model. By generating heatmaps that highlight the regions and features in the ultrasound images which contribute to the predictions, Grad-CAM provides insights into the features crucial for cancer prediction. The Grad-CAM visualisations thus enhances the trust on the deep learning model predictions and also assist clinicians in identifying patterns indicative of thyroid cancer. This research work represents a significant step towards bridging the gap between advanced deep learning models and their practical utility in real-world medical diagnostics, particularly in the domain of thyroid cancer prediction.

Keywords: Transfer Learning; VGG-16, Thyroid Cancer; Thyroid ultrasound; Grad-CAM; Classification and Prediction; Explainability

ICNCS2024_158

On Numerical Approximation of initial and boundary value problem of Caputo fuzzy fractional Volterra integro differential equations

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Abstract

The objective of this study to examine, the existence and uniqueness of solutions for the nonlinear fuzzy fractional Volterra Fredholm integro-differential equations. We first provide the parametric interval form of the fractional derivative of Caputo on fuzzy set valued functions. The existence and uniqueness of solutions for proposed equation with the Caputo fractional operator investigated using the fixed point theorems of Schaefer and Banach. Furthermore, a novel Adomian decomposition method is used to get a numerical solution. The outcome is derived from Adomian polynomials and organised according to the acquired recursive relation. The suggested approach reduces numerical calculations by eliminating the requirement for discretization and assumptions. The results show a significant convergence with series solutions generated by the fuzzy Adomian decomposition method. Finally, the numerical result shows the symmetry between the upper-cut and lower-cut representations of the fuzzy solutions using MATLAB.

Keywords: Fuzzy fractional differential equations; Leibniz rule; fixed point theorem; initial and boundary value problem; existence and uniqueness; Adomian decomposition method.

AMS subject classifications. 03E72;34A07;34A08.

ICNCS2024_160

Modeling of COVID-19 with Vaccination and Optimal Control

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Abstract

COVID-19 is a respiratory disease caused by the virus SARS-CoV-2. So far, Millions of people have died as a result of the devastating COVID-19 outbreak. As of December 31, 2023, COVID-19 has killed almost 7 million people worldwide. Vaccination can lessen the severity of COVID-19. Here, we develop and examine a seven-component COVID-19 epidemiological model that takes vaccination into account. We find different equilibria of our proposed model and compute the basic reproduction number (R_0). We also perform the sensitivity analysis to visualize the impact of different parameters mainly associated with vaccination. By varying several parameters, we have discovered how they affect the infection prevalence. It has been shown that by increasing the rate of treatment and vaccination, the transmission of COVID-19 can be reduced significantly. By taking into account two control parameters—namely, those related to the disease's rate of diagnosis and transmission—the proposed model is extended to an optimal control problem. It is observed that both the control parameters have a significant impact on limiting the spread of COVID-19. The main goal of this study is to find out how vaccination, when compared to no vaccination, can reduce the spread of disease.

Keywords: COVID-19, Vaccination, Stability, Sensitivity analysis, Optimal control.

AMS subject classifications. 34D20; 34C60; 93A30.

ICNCS2024_161

Qualitative Analysis of Inverter Fed Induction Motor Modeled by Caputo Fractional Derivative

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Abstract

In this paper, the Caputo derivative is used to explore the fractional order differential equations of the inverter fed induction motor drive. It is the most appropriate fractional operator for modeling real world systems such as power electronic converters, electric motors etc. The mathematical state space model of the induction motor is presented in which the stator currents and rotor fluxes are considered as the state variables. The performance of the drive system is tested on simulink environment with PI speed controller for different running conditions. The simulation results are presented for integer order and different fractional order. The results are compared and the most effective fractional order is identified with respect to the response of speed, torque, stator currents and rotor fluxes.

Keywords: Caputo fractional derivative, induction motor model, matlab/simulink.

AMS subject classifications. 26A33; 97N40.

ICNCS2024_162

Pair Mean Cordial Labeling in the Context of Vertex Switching of Path, Cycle, Shell and Wheel Graphs

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Abstract

Let a graph $G = (V, E)$ be a (p, q) graph. Define

$$\rho = \begin{cases} \frac{p}{2} & p \text{ is even} \\ \frac{p-1}{2} & p \text{ is odd,} \end{cases}$$

and $M = \{\pm 1, \pm 2, \cdots \pm \rho\}$ called the set of labels. Consider a mapping $\lambda : V \to M$ by assigning different labels in M to the different elements of V when p is even and different labels in M to $p-1$ elements of V and repeating a label for the remaining one vertex when p is odd. The labeling as defined above is said to be a pair mean cordial labeling if for each edge uv of G, there exists a labeling $\frac{\lambda(u)+\lambda(v)}{2}$ if $\lambda(u) + \lambda(v)$ is even and $\frac{\lambda(u)+\lambda(v)+1}{2}$ if $\lambda(u) + \lambda(v)$ is odd such that $|\bar{\mathbb{S}}_{\lambda_1} - \bar{\mathbb{S}}_{\lambda_1^c}| \leq 1$ where $\bar{\mathbb{S}}_{\lambda_1}$ and $\bar{\mathbb{S}}_{\lambda_1^c}$ respectively denote the number of edges labeled with 1 and the number of edges not labeled with 1. A graph G with a pair mean cordial labeling is called a pair mean cordial graph. In this paper, we investigate the pair mean cordial labeling behavior of vertex switching of path, cycle, shell and wheel graphs.

Keywords: path; cycle; shell graph; wheel graph; pair mean cordial labeling

AMS subject classifications. 05C78

ICNCS2024_163

$\mathscr{H}_\infty$ control for discrete-time coupled interconnected systems with stochastic disturbances and time-varying delay

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Abstract

This article presents an approach to design a $\mathscr{H}_\infty$ control for a class of discrete-time interconnected systems with stochastic noise and time-varying delays. The interconnected system under consideration is subjected to time-varying delays and stochastic noises. Precisely, a state feedback control is designed to guarantee that the addressed interconnected system is asymptotically stable. Moreover, stochastic disturbances are susceptible at any time and occur randomly, so the well-known Bernoulli random variable is taken into account in stochastic disturbance behaviour. Using an appropriate Lyapunov-Krasovskii functional, an assortment of sufficient conditions are obtained to ensure the asymptotic tracking performances and appropriate disturbance attenuation to the model. Owing to this viewpoint, the required controller gains are computed through the linear matrix inequality. Finally, the potential of the theoretical outcomes in this paper is ensured by numerical simulation.

Keywords: Coupled interconnected system; Stochastic disturbance; State feedback controller; Lyapunov-Krasovski Functional; Time-varying delay.

ICNCS2024_164

The upper and the forcing geodetic hop domination numbers of a graph

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Abstract

A geodetic hop dominating set S in a connected graph G is called a minimal geodetic hop dominating set of G if no proper subset of S is a geodetic hop dominating set of G. The upper geodetic hop domination number $\gamma^+_{hg}(G)$ is the maximum cardinality of a minimal geodetic hop dominating set of G. Some general properties satisfied by this concept are studied. It is shown that for every two positive integers a and b where $2 \leq a \leq b$, there exists a connected graph G such that $\gamma_{hg}(G) = a$ and $\gamma^+_{hg}(G) = b$. Let S be a γ_{hg}-set of G. A subset T of S is called a forcing subset T of S if S is the unique γ_{hg}-set containing T. The minimum cardinality of T is the forcing geodetic hop domination number of S and is denoted by $f_{\gamma_{hg}}(S)$. The forcing geodetic hop domination number of G is $f_{\gamma_{hg}}(G) = min f_{\gamma_{hg}}(S)$, where the minimum is taken over all γ_{hg}-sets of G. Some general properties satisfied by this concept are studied. It is shown for every pair of positive integers a, b with $0 \leq a \leq b$ and $b > a + 3$, there exists a connected graph G such that $f_{\gamma_{hg}}(G) = a$ and $\gamma_{hg}(G) = b$.

Keywords: Hop dominating set; geodetic hop domination number; upper geodetic hop domination number; forcing geodetic hop domination number.

AMS subject classifications. 05C12; 05C69

ICNCS2024_165

LRS Bianchi II in higher order teleparallel gravity

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Abstract

In this paper we discuss Bianch II model universe in the backdrop of higher order teleparallel gravity. We made efforts to comprehend this particular anisotropic model involded in $f(T, B)$ gravity. We construct the minisuperspace Lagrangian for this model to see the dynamical system aspect of the problem. We also study the phase portraits and Poinacare section for this cosmology.

Keywords: Bianchi model; teleparallel gravity; dynamical system

ICNCS2024_168

Complex probabilistic intuitionistic fuzzy set and their aggregation operators in multi criteria decision making extended to VIKOR

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Abstract

Randomness and fuzziness generate uncertainty [Zadeh *Fuzzy sets, fuzzy logic, and fuzzy systems: selected papers* World scientific, 1996.] in the structure at the same time. To combine randomness and analytical uncertainty with intuition into a solitary model and integrate more data, this work defined on developing complex probabilistic intuitionistic fuzzy set. The main objective of this work is to proceed a technique that can solve the pair of uncertainty with statistical and non statistical values. Statistical and intuitionistic fuzzy represents the type of uncertainty regarding the perception of a future event happening and intuitionistic fuzzy uncertainties [Atanassov, Krassimir T. *Intuitionistic fuzzy sets*. Springer, 1999.] denote the opinion of partial truth and indistinct cause. Here statistical uncertainty is provided through probability and intuitionistic fuzzy is indicated via the complex fuzzy sets and formed together to form the complex probabilistic intuitionistic fuzzy set. This amalgamation condenses the significance of this work as they could characterize the real situations more exactly. Suggesting the complex probabilistic intuitionistic fuzzy set and studying its fundamental operations are the work's main benefaction. Also, different aggregation operators are evolved for the same and their important properties are properly explained. Additionally, these operators are extended to VIKOR which is employed for multi criteria decision making problem with data acquired in the form of complex probabilistic intuitionistic fuzzy number to estimate the correct risk factor of the disease jaundice in a human body. The main cause for considering TOPSIS here is because it is a conception that produce a scalar value catching into consideration both the best and worst alternatives and it takes less computational time.

Keywords: Complex probabilistic fuzzy set; Complex probabilistic fuzzy intutionistic set; Multi attribute decision making; Aggregation operators; AHP and VIKOR

ICNCS2024_169

A Novel Optimal Eight-Order Three-Point Iterative Method for Solving Non-Linear Equations with Applications

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Abstract

The primary focus of this study is to introduce a new three-step iterative method without memory for root-finding by merging two different existing techniques. Based on the computational cost, the proposed method acquires optimal eight-order convergence with four functional evaluations (three evaluations for the function and one computation of first derivative). Furthermore, the suggested scheme supports the Kung Traub's Conjecture with efficiency index of $8^{\frac{1}{4}} = 1.682$. The utilization of finite difference is applied for the estimation of derivatives, and simultaneously, the incorporation of a weight function on the opposite side is employed to enhance both convergence and efficiency. We also established the convergence criteria developed for the root-finding technique and demonstrate the fact that the proposed approach is eighth-order convergent. In order to demonstrate the efficacy as well as application of the constructed root-finding technique, we addressed a few practical engineering as well as biological- based application problems. In contrast to several existing approaches, this particular method converges more quickly.

Keywords: Non Linear Equations; Order of Convergence; Computational Efficiency; Finite Difference, Weight Function Approach

AMS subject classifications. 65H05; 41A25

ICNCS2024_170

Controllability of Stochastic Non-Instantaneous Impulsive Hilfer Fractional Switched Dynamic Systems with Deviated Arguments and fBm[‡]

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Abstract

This paper deals with the study of solvability and the controllability results of stochastic non-instantaneous impulsive Hilfer fractional switched differential equations with deviated arguments and fractional Brownian motion (fBm) in finite dimensional space. Mainly, this paper can be divided into two parts. In the first part, we analyse the existence and uniqueness of solution using Banach fixed point theorem for the proposed system. In the second part, the controllability results are established for the considered system. We introduce a novel category of control functions designed to govern the system both at the termination of the time-interval and at each impulsive event with stochastic noise. This leads to the establishment of comprehensive controllability outcomes, often referred to as total controllability results. These results are primarily established using the fixed point theorem, fractional calculus, Laplace transformation, stochastic dynamics and Mittag Leffler function. A numerical example is provided to verify the outcomes of the developed theoretical results.

Keywords: Deviated Arguments; Hilfer Fractional Switched System; Non-Instantaneous Impulses; Stochastic Differential Equations with fBm; Total Controllability.

AMS subject classifications. 60H10; 34K37; 60G22; 93B05.

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ICNCS2024_171

Improving Contrast in Low-Light Color Images through a New Intuitionistic Fuzzy Filter-Histogram Technique

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Abstract

This paper introduced a new algorithm based on intuitionistic fuzzy in association with the filter-histogram method to improve the quality of color images captured in low-light conditions. First, the input image is converted into a fuzzy image and then into an intuitionistic fuzzy image (IFI). Utilizing IFI in image enhancement prevents image quality from challenges like low-light circumstances and noise by incorporating considerations for both belonging and non-belonging aspects within the image. The evaluation of performance and a comparative study indicate that the proposed technique outperforms other existing enhancement algorithms.

Keywords: Histogram; Intuitionistic fuzzy image; Image enhancement;
AMS subject classifications. 94A08; 03B52 ; 94D05;

ICNCS2024_172

Design of event-triggered extended dissipative state estimator for neural networks with multiple time-varying delays

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Abstract

This article investigates the problem of extended dissipative state estimator design for a class of neural networks featuring multiple time-varying delays. The novelty of this problem lies in assuming distinct time-varying delays for each node to represent the network's behavior, showcasing its generalization and complexity. We have proposed an event-triggered state estimator with known output measurement to facilitate these targeted network responses by saving the limited communication bandwidth resources and maintaining the sequential feedback loop. Consequently, the sufficient condition for extended dissipative estimator analysis has been achieved by constructing an augmented Lyapunov-Krasovskii functional and limiting its derivative. As a result, generalized free-weighting matrix inequality and improved reciprocally convex inequality have been utilized to attain the less conservative sufficient condition in the form of linear matrix inequality constraints. Finally, a numerical example is provided to check the merits and effectiveness of the proposed results.

Keywords: Neural networks; Multiple time-varying delays; Event-triggered mechanism; State estimation; Extended dissipavity

AMS subject classifications. 34K35; 93D05

ICNCS2024_174

On Half range Fourier Cosine and sine series of Octagonal Fuzzy number

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Abstract

The application of Fourier series is enormous in the Engineering World. The utilization of Fourier series technique is even needed in uncertainty case too. So in this paper we have proposed the half range Fourier Cosine and Sine series for Octagonal fuzzy number in the interval $[0, \pi]$. Also, we have explicit the Half Range Fourier Cosine and Sine series of OFN in suitable examples.

Keywords: Fourier Series; Level Sets; Octagonal Fuzzy Number; Uncertainty; Half Range Cosine Series.

ICNCS2024_175

On various Zagreb indices of the drug Trimethoprim

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Abstract

In this paper, we have ascertained the exact values of valency-based molecular descriptors of a chemical compound Trimethoprim.In order to treat a variety of infections, such as urinary tract, respiratory tract, and digestive tract, trimethoprim [Ritter J et al. Rang and Dale's Pharmacology (9th ed.). Edinburgh: Elsevier. 2020 (ISBN 9780702080609)] an antifolate antibiotic, is frequently used with sulfamethoxazole. It is related to pyrimethamine, another antibiotic used to treat plasmodial infections, both structurally and chemically. We discussed various Zagreb indices encompassing the hyper-Zagreb, the leap Zagreb, the modified Zagreb, the entire Zagreb, the redefined Zagreb, the eccentric Zagreb for the compound Trimethoprim.
Keywords: degree based topological indices; Zagreb index; leap zagreb; trimethoprim
AMS subject classifications. 05C07, 05C35, 05C90

ICNCS2024_176

T2FP_UNet: a U-Shaped Convolutional Neural Network with Type-2 Fuzzy Pooling Layer for Biomedical Applications

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Abstract

This study aims to propose Type-2 Fuzzy Pooling in a U-Shaped Convolutional Neural Network (CNN) architecture (T2FP_UNet). CNN consists of convolutional, pooling, a fully connected layer, and activation functions. A fuzzy pooling operation with a Type 2 fuzzy membership function in the pooling layer is performed. Compared to traditional approaches (max and average pooling), in the fuzzy pooling operation, pixels have been given membership values, and

then fuzzy value is calculated which prevents from losing features. This approach helps in enhancing the robustness and uncertainty handling of semantic image segmentation tasks with a modified U-Net architecture with a type-2 fuzzy pooling layer. This approach combines the advantages of the feature fused U-Net architecture for accurate semantic segmentation and Type-2 fuzzy logic for handling complex uncertainties in image data, which helps in feature extraction. Comparative results are tabulated.

Keywords: Type-2 fuzzy, U-Net architecture, Convolutional Neural Network, Image segmentation.

AMS subject classifications. 68T10; 68T37; 94D05; 68U10

ICNCS2024_177

Optimal Tracking Control for Chaotic Grid-connected PMSM model

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Abstract

This study aims to propose a model predictive control (MPC) approach for solving the optimal tracking control problem for grid-connected permanent magnet synchronous motor (PMSM) in wind energy conversion systems (WECSs). Grid-connected PMSM is modeled as ordinary differential equations (ODEs) with nonlinear characteristics. The system is linearized using Takagi-Sugeno (T-S) linearization and discretized to reduce the complexities while implementing MPC and enhance computational accuracy. Choosing the stator voltages as control parameters to control the stator currents in the $d-q$ reference frame. The cost function is designed for the set point tracking control problem and the constraint sets for state and control are defined. The error state and control are defined to transfer the tracking problem into the stabilization problem. The constraints are rewritten for the error states and control vectors and a new optimization problem is designed. By solving the optimization problem using the MPC approach, the required optimal control input is obtained. Numerical simulations are performed to show the results.

Keywords: Optimal tracking control, Takagi-Sugeno fuzzy, Grid-connected PMSM, Model Predictive control.

AMS subject classifications. 93C15; 93C55; 93C10; 90C30

ICNCS2024_178

A Novel Fuzzy Generator Handling Video in a Dimly Light Space

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Abstract

Low-light enhancement involves the processes that aim to increase the quality of images or videos acquired in low-light circumstances. Due to lower available light in low-light conditions, such as poorly lit areas or nighttime, cameras may need help to take crisp, detailed images. Low-light enhancement refers to techniques or tools used to improve the quality of images or videos shot in poorly lit areas. Our concerns regarding the new intuitionistic fuzzy generator for the intuitionistic fuzzy image have been addressed in this study. Images for videos are created from the dark video samples. The suggested generator identifies the improved frames using histogram equalization (HE). The video has been converted to frames after this procedure. Moreover, all of the frames have been successfully enhanced, turning each into a video. The exceptionally elevated degree of confidentiality of the proposed research is ensured by the analysis of numerous metrics, including entropy, peak signal-to-noise ratio (PSNR), structural similarity index measure (SSIM), contrast, correlation, energy, and homogeneity, and numerical simulations.

Keywords: Fuzzy Image, Intuitionistic Fuzzy Image, Histogram Equalization, Image Enhancement, Video Enhancement.

ICNCS2024_179

A low-light color image enhancement technique using new interval-valued intuitionistic fuzzy generator

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Abstract

Fuzzy logic systems greatly benefit digital image processing in dealing with various important issues. Improving the contrast of low-illumination images is one of the critical issues as they contain a higher degree of uncertain information. To address this challenge, the present study innovates a new interval-valued intuitionistic fuzzy generator for enhancing the contrast of low-illumination color images. Initially, a low-contrast crisp image is fuzzified using a fuzzification method. The contrast of the fuzzified image is then improved by converting it into an interval-valued intuitionistic fuzzy image using the new generator. The image is further enhanced with the help of the histogram equalization technique. Subsequently, the image is defuzzified to obtain the proposed new enhanced image. Moreover, experimental investigations are conducted with benchmarking datasets and the results of the proposed technique are compared with certain existing techniques. Finally, performance measures such as entropy, contrast improvement index, peak signal-to-noise ratio, and absolute mean brightness error are examined. From the outcomes, it is demonstrated that the proposed technique provides superior results compared to existing techniques.

Keywords: Image enhancement; Interval-valued intuitionistic fuzzy generator; Interval-valued intuitionistic fuzzy image; Histogram equalization; Entropy measure.

AMS subject classifications. 03E72; 68U10

ICNCS2024_180

Soliton solutions in (2+1)-dimensional ferromagnetic spin chain using new extended auxiliary method

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Abstract

Over the span of ten years, research on soliton-like spin excitation in ferromagnetic systems has been thriving, and studies of these self-reinforcing wave packets aid in the analysis of the nonlinear aspects of magnetic materials. Heisenberg ferromagnetic models describe the dynamics of magnets that are nonlinear [M. H. Bashar, S. M. R Islam, *Exact solutions to the (2+ 1)-Dimensional Heisenberg ferromagnetic spin chain equation by using modified simple equation and improve F-expansion methods*, Physics Open, 5 (2020) 100027][E. H. M. Zahran and A. Bekir, *Enormous soliton solutions to a (2+ 1)-dimensional Heisenberg ferromagnetic spin chain equation*, Chinese Journal of Physics, 77 (2022) 1236–1252]. In this paper, we consider a (2+1)-dimensional Heisenberg ferromagnetic spin chain equation with bilinear and anisotropic interaction. The (2+1)-dimensional Heisenberg ferromagnetic spin chain equation is in the form of Nonlinear Schrödinger (NLS) equation. NLS equation has been widely used to simulate the spread of beats in different fields such as nonlinear optics, water waves, Bose-Einstein condensate, earth science, plasma physics, biological molecules, chemical systems and so on [S. Islam et al. *Optical and rogue type soliton solutions of the (2+ 1) dimensional nonlinear Heisenberg ferromagnetic spin chains equation*, Scientific Reports, 13(1) (2023) 9906][S. Altun et al. *Soliton solutions of Heisenberg spin chain equation with parabolic law nonlinearity*, Optical and Quantum Electronics, 55(8) (2023) 710]. Using graphical plots we analyse the parameters such as exchange interaction in X and Y axes, and also the adjacent interaction in slanting. In addition, we study the stability of soliton in ferromagnets by Fourier collacation method.

Keywords: The (2+1)-dimensional Heisenberg ferromagnetic spin chain equation; new extended auxiliary method; soliton solutions; stability analysis.

ICNCS2024_181

Coupling memory sampled data control for PMSM model with stochastic disturbances

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Abstract

This study aims to design a coupling memory sampled data control (CMSDC) for Permanent Magnet Synchronous Motors (PMSM) model with stochastic disturbances. PMSM is modeled using stochastic differential equations with nonlinear characteristics. By applying Takagi-Sugeno (TS) fuzzy membership rules, the nonlinear PMSM model is converted into linear sub models. Moreover, Lyapunov stability theory is employed to derive sufficient conditions in terms of solvable linear matrix inequalities (LMIs) to guarantee global stability of stochastic PMSM model. Numerical simulations are performed to validate the theoretical sufficient conditions by choosing the experimental range of parameters in PMSM model.

Keywords: PMSM, Takagi-Sugeno (T-S) fuzzy, Coupling memory sampled data control, Lyapunov Stability, Stochastic disturbances.

AMS subject classifications. 93E03; 93C42; 93C10; 15A39

ICNCS2024_182

Dynamic Feature Weight Selection and Residue Aware Correlation Filter Learning for Object Tracking

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Abstract

Visual object tracking continues to combat the issues in choosing important features for tracking and struggles with the pace of learning filters. Currently, the majority of discriminative correlation Filter (DCF) trackers use the fixed weight for feature selection and the L_2 norm for regularization. L_2 norm regularization does not encourage sparsity during optimization. Sparsity in regularization will provide a balance between model complexity and simplicity. So the proposed method uses the $L_{2,1}$-norm on the loss term which encourages the group sparsity and is less sensitive to outliers. The fixed weight approach will treat all features equally irrespective of their impact on detection. For more robust handling we are using dynamic feature weight selection, which will assign different weights for different features. It helps to highlight the salient features for tracking. For this, we define a weight matrix containing different weights. Also inspired by the residue representation, we used residue-aware correlation filters to speed up the filter learning. Extensive experiments are conducted on the proposed DWRACF (Dynamic Feature Weight Selection and Residue Aware Correlation) tracker using a few benchmark datasets. The results indicate that our method outperforms the state of art approaches. **Keywords:** Object tracking, Correlation filter, Dynamic feature weight, Residue aware correlation filter

AMS subject classifications. 93E24; 68T05; 90C26; 68T10

ICNCS2024_184

Application of Caputo fractional operator to investigate the fractional Klein-Gordon equation with Laplace transform

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Abstract

In this article, we investigate the fractional Klein-Gordon equation via Caputo fractional operator. The fractional Klein-Gordon equation has been studied extensively in the fields of solitary waves and condensed matter physics, as well as the contact of solitary waves in a collision less plasma, the recurrence of starting states, and wave propagation equations. A hybrid computational technique, which is combination of Laplace transform and a numerical technique, is applied for getting the numerical solution. The maximum absolute error of the proposed technique is also analysed. Finally, the efficiency of the proposed technique is shown by solving two examples and computing the absolute error.

Keywords: Fractional Klein-Gordon equation (FKGE); Caputo derivative; Laplace transform; Homotopy perturbation method; Error analysis.

ICNCS2024_185

Finite-Time Sampled-Data-based Synchronization Criteria for Variable-Order Fractional Neural Networks

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Abstract

In this article, the finite-time sampled-data synchronization of variable-order fractional neural networks (VOFNNs) with time-varying delay is investigated. In particular, a new inequality is derived for the finite-time stability conditions, providing an explicit formula for settling time based on the definition of a variable-order fractional derivative. Then sufficient criteria is obtained to guarantee the asymptotic stability in finite time by utilizing Lyapunov function theory, inequality technique and a sampled-data control. The obtained conditions for the VOFNNs are derived in the form of linear matrix inequality. Finally, a numerical simulation is given to demonstrate the superiority of the proposed control method.

Keywords: Variable-order fractional derivative; Neural networks; Synchronization; Linear matrix inequality; Sampled-data control.

ICNCS2024_186

Solving Travelling Salesman Problem using Dynamic Programming under extended fuzzy environment

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Abstract

The main intention of this article is to solve travelling salesman problem (TSP) under extended fuzzy environment. Uncertainty of a TSP can occur due to factors like variable travel duration, unpredictable road conditions etc. In this article, these uncertainties are handled using intuitionistic and interval valued intuitionistic fuzzy parameters. Moreover, dynamic programming technique is applied to get the best optimal solution. In addition, numerical examples are formulated that contain cost parameters are triangular intuitionistic fuzzy numbers and interval valued intuitionistic fuzzy numbers. The results of the proposed dynamic approach are compared with algorithms including Brute- force and branch and bound methods.

Keywords: Travelling salesman problem, Dynamic programming, Intuitionistic fuzzy number, Interval valued intuitionistic fuzzy number, Optimal solution

ICNCS2024_188

Convergence of BDF2-Galerkin Finite Element Scheme for Cancer Invasion Model

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Abstract

The aim of this article is to establish the convergence and error bounds for the fully discrete solutions of a class of parabolic equations using Two step backward difference scheme(BDF2) in time and Galerkin finite element approximation in space.The existence of a solution is affirmed and the initial data is drawn from the space $L^2(\Omega)$. Error estimates with optimal order convergence rates are established for a finite element spatial discretization. The problem is further addressed through the proposal and analysis of a time discretization technique based on linear extrapolation, specifically the BDF2 scheme. Some numerical experiments are used to validate the scheme competency and accuracy.

Keywords: Galerkin Finite Element Scheme; Reaction Diffusion System; Weak Solution

AMS subject classifications. 65M60; 35K57; 35D30

ICNCS2024_189

Convergence of L1-Galerkin Finite Element Scheme for Time-Fractional Cancer Invasion Model

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Abstract

This article examines the L1-Galerkin finite element analysis of a time-fractional nonlinear diffusion system. The investigation extensively delves into the existence and uniqueness of solutions, covering both continuous and discrete. To subdue the highly nonlinear discrete problems, the prominent Picard iteration methodologies for linearization to be applied. Additionally, the article provides apriori error and convergence estimates within the $L^2(\Omega)$ norm for fully discrete scheme. Numerical experiments are conducted to validate the scheme's competence and accuracy.

Keywords: fractionl differential equations, reaction diffusion system,finite element methods,weak solution, numerical solution.

AMS subject classifications. 34K37;65M60;35K57

ICNCS2024_190

Performance assessment of Fuzzy Inference System on Medical data

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Abstract

Fuzzy sets have been used in the medical field where uncertainty is prevalent. Medicine, which frequently straddles the line between science and art, is an excellent example of a field where ambiguity, hesitation, linguistic uncertainty, evaluation inaccuracy, natural diversity and subjectivity are prominent. Medical diagnosis is a complex problem that requires the use of all of a person's abilities, including intuition and the subconscious [Umoh Uduak and Ntekop Mfon *A Proposed Fuzzy Framework for Cholera Diagnosis and Monitoring* International Journal of Computer Applications, 82(17):1–10, 2013]. A fuzzy inference system is a linguistic framework that can be used to model human thought processes. An extensive study is conducted in this investigation through an evaluation of fuzzy inference system. The datasets used in this investigation are PIMA Indian diabetics dataset [Smith et al.(1988).*Using the ADAP learning algorithm to forecast the onset of diabetes mellitus* In Proceedings of the Symposium on Computer Applications and Medical Care (pp. 261–265). IEEE Computer Society Press] [**?**], cancer dataset, Parkinson disease dataset and heart attack analysis dataset. These datasets were downloaded from Kaggle, world's largest data science community. In this research work, the dataset used were reduced into fewer dimension using domain knowledge of the particular disease. Using this transformed data, a fuzzy inference system is established and the performs of the system is evaluated using the performance evaluation measures such as precision, recall and F1-score.

Keywords: Obesity; Heart Rate; Body Mass Index; Fuzzy Inference System (FIS)

ICNCS2024_191

Adaptive control for switching stochastic neural networks

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Abstract

The author investigates the synchronization problem of stochastic neural networks (SNNs) via an adaptive feedback controller approach. The main significant feature of an adaptive feedback controller is that dynamically adjusts its parameters based on feedback signals from the system. The main contribution of this work is the synchronization of SNNs with Markovian jump, time-varying delay, and adaptive feedback controller. Compared to previous studies this study involves a delay in the stochastic phenomenon. In general, synchronization is achieved only if the error system derived from the master and slave will converge to the origin. Theoretically due to nonlinearities, the Lyapunov stability theory is utilized to derive sufficient stability conditions that ensure the global asymptotic stability of closed-loop error dynamics. In this regard, Lypanouv Krasvoskii Functionals (LKFs) are considered and the derivative of LKFs are derived using Ito's formula. The sufficient conditions are derived through linear matrix inequalities (LMIs). Finally, numerical simulations are performed to validate the performance of the proposed results.

Keywords: Synchronization, time-varying delays, Neural networks.

AMS subject classifications. 34D06; 34K20; 92B20

ICNCS2024_192

Data driven inference to study the relationship between FDI and GDP using multiple mediation model with special reference to leather sector

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Abstract

Indian leather occupies a prominent place in the world market, exporting approximately US$ 4.87 billion during the period 2021-2022. India's leather export plays a vital role in Indian economy. This manuscript investigated the mediating effect of Export of leather and the RCA values on the relationship between Foreign Direct Investment (FDI) made to India and the Gross Domestic Product (GDP). India's leather trade data between 2001 and 2021 (International Trade Center, 2023) has been utilized for this manuscript. The results indicated that FDI and GDP are positively strong correlation. Multiple mediation model results show that Exports of Leather and RCA values have mediating effect.

Keywords: Multiple Mediation models, Exports, Foreign Direct Investment, Gross Domestic Product, RCA, Leather and Leather products.

ICNCS2024_193

Fixed time synchronization of neural networks with parameter uncertainties

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Abstract

In this paper, the problem of fixed time synchronization of neural networks stochastic disturbances via quantified control with stochastic disturbances. In addition, this problem has uncertainties in the proposed model. Solving a problem with stochastic disturbance and uncertainties is a challenging task. Based on the quantified rules, sufficient conditions are established to achieve the synchronization in a fixed time. By constructing the Lyapunov function to ensure the global stability performance for the proposed model. Numerical results are performed to demonstrate the effectiveness of the theoretical results.

Keywords: Fixed time synchronization, time-varying delays, stochastic disturbances, uncertainties.

AMS subject classifications. 93C15; 93C55; 93C10; 90C30

ICNCS2024_194

Numerical investigation of Arrhenius Energy on boundary layer flow of Micropolar Hybrid Nanofluid

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Abstract

Buoyancy forces from continual cooling or heating a vertical plate induce a change. Thermal fields affect heat transport behaviour in areas such as nuclear energy, electronics, and space technology. The present study aims to Study the impact of micro polar fluid flows on surface and buoyancy-induced thermo-physical properties, as well as heat flux variation, in an electro Magnetohydrodynamic boundary layer flow with Joule heating and an external magnetic field. The governing boundary layered equations are non-dimensionalized using suitable non-similar transformations and linearized using Quasilinearization technique. The linearised dimensionless partial differential equations are solved using implicit finite difference scheme and iterative Varga's algorithm. Graphs are plotted for varying values of buoyancy parameter (λ), micropolar parameter(Δ), Casson parameter(β) and inertial force parameter Reynold's number (Re) for velocity, temperature, and micropolar profiles. The present numerical results are compared with previously existing results available in the literature found to be in good agreement.

Keywords: Casson hybrid nanofluid, micro rotation, micro inertia, Joule heating, Finite difference method and Varga's algorithm.

ICNCS2024_195

Numerical Investigation of Capillary Instability in Walter's B viscoelastic Fluid via Heat and Mass Transfer

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Abstract

The purpose of this numerical study is to determine the heat and mass transfer phenomenones at the fluid interface of Capillary Instability using Walter's B viscoelastic. The significance of this research to a range of industries, including biomedical engineering, microfluidics, and material processing, where understanding and managing capillary instability is critical, acts as its driving force. The finite element methods have been used to solve the system of goverening equation in order to get the more efficient and accurate numerical results. Examining the whirling effect on the capillary instability that results from heat and mass transfer at the interface between a viscous and a Walter's B viscoelastic fluid is the focus of this study. Two rigid cylinders make up the configuration, which creates an annular zone with Walter's B viscoelastic fluid on the outside side and viscous fluid on the inner. The inner cylinder stays still while the outer cylinder revolves at a steady angular speed. The viscoelastic model used in the study, Walter's B, is compliant with the potential flow theory for viscoelastic fluids.

Keywords: Walter's B viscoelastic fluid, Heat and Mass Transfer, Annular region, Finite element.

ICNCS2024_196

Solutions of Differential Equations in Bicomplex Space using Sadik Transforms

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Abstract

Integral transforms are powerful tools used to solve differential and integral equations. Integral transforms act as mappings between two domains. They take the differential or integral equations from the original domain into target domain where obtaining the solutions would be much easier when compared to the original domain. The solution is then traced back to the original domain with the help of the inverse integral transform. Though there exist many integral transforms, we were interested in Sadik transform as it is the generalizes many existing transforms. In this article, we have defined Sadik transform in Bicomplex space and discussed its properties. We have also solved ordinary differential equations and matrix integral equations using Sadik transforms and convolution theorem in Bicomplex space.

Keywords: Bicomplex Sadik Transform; Bicomplex Laplace Transform; Bicomplex Convolution theorem and Differential equations.

AMS subject classifications. 44A05; 34B05; 44A10.

ICNCS2024_197

Dynamical and computational analysis of HIV infection model with intracellular time-delay

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Abstract

The paper aims to provide deterministic HIV model including logistic growth rate of uninfected T-cells and nonlinear incidence rate of virions and infected cells. The existence and stability of the equilibrium such as (i) infection free (ii) infection equilibrium can be performed for different situations of the model including intra-cellular delay. The infection spread rate is identified using the basic reproduction number R_0. The qualitative changes in the system can be identified by bifurcation analysis approach at different equilibrium points with parametric restrictions. The behaviors of the HIV model dynamics are shown using the numerical simulations. To find the effective control strategies for the infection model optimal control strategies are performed using Pontryagin's maximum principle. From data-driven approach the efficacy of the model is validated by comparing with the existing models.
Keywords: Stability;time delay; optimal control
AMS subject classifications. 37N25;49K15;34K20

ICNCS2024_198

Exploring the Dynamics of Van der Pol equation: A Physics-Informed Neural Network Approach

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Abstract

The Van der Pol oscillator equation represents a second-order ordinary differential equation characterized by non-linear damping. The equation manifests a notable level of stiffness due to its fast and slow-varying temporal components. Due to the requirement of small time steps, traditional numerical methods encounter challenges in accurately capturing the intricate dynamics of the solution. To address this, a deep learning-based approach called physics-informed neural network (PINNs) along with an adaptive learning rate strategy is employed for solving the Van der Pol equation. The methodology is tested for several stiffness parameter values of the Van der Pol equation, showcasing its robustness. Comparative analysis with the traditional Runge-Kutta method highlights the effectiveness of the proposed PINN approach in efficiently and accurately solving the Van der Pol equation.
Keywords: PINNs, Van der Pol oscilator equation, Adaptive learning rate

ICNCS2024_199

A Comprehensive Analysis on Regularisation Techniques in Image Denoising Autoencoder

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Abstract

Image denoising through autoencoder has emerged as a powerful and versatile tool in the domain of image denoising. However, overfitting and capturing unnecessary noise-related features remain significant hurdles. Regularisation techniques are essential for guiding the learning process and boosting desirable qualities in the denoised output to overcome these challenges. This comprehensive study explores the various regularisation techniques used in image denoising autoencoders and looks at how they affect the resilience, performance, and overall denoising abilities of the model. We explore traditional regularization methods such as L_1 and L_2 regularization on different denoising autoencoder architectures. Furthermore, this study delves into the impact of various activation functions when applied to gaussian noise during the denoising process. The findings of this extensive study offer insightful information on how autoencoder architectures, activation functions, and regularisation strategies work together to enhance image denoising. This information aids in the creation of more resilient and flexible models, which may find use in several fields such as computer vision, satellite imaging, and medical imaging.

Keywords: Image denoising; autoencoders; overfitting; L_1 and L_2 regularisation; activation functions; gaussian noise.

AMS subject classifications. 68U10

ICNCS2024_201

Fixed-time Synchronization of hyperchaotic Fuzzy PMSM Model with Stochastic Disturbances

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Abstract

The objective of this research is to analyze and model the dynamic characteristics of a hyperchaotic permanent magnet synchronous motor (PMSM) by incorporating the randomness effect resulting from the aerodynamics of the PMSM. Randomness can be conceptualized as stochastic disturbances and represented mathematically as Brownian motion, which is a white noise derivative. The majority of previous research focuses on stabilization analyses of chaotic PMSM models; however, this investigation explores the effect of DC-link capacitor factor integration in voltage equations, which could cause hyper-chaotic solution behavior. Instead of a randomness-free three-dimensional PMSM model, this study proposes a four-dimensional hyperchaotic model. Furthermore, the model beneath consideration exhibits nonlinear characteristics that can be approximated by employing the Takagi-Sugeno (T-S) fuzzy approach. This method utilizes fuzzy-inference rules to describe the nonlinear model as linear sub-models. Moreover, the issue of stabilization is addressed through the utilization of a synchronization approach, which attempts to replicate the dynamic characteristics of a controlled system from an uncontrolled one. A controlled system retains the dynamical characteristics of a stochastic PMSM model while incorporating external control inputs specified by the user. In addition, the research attempts to synchronize the drive-response stochastic fuzzy PMSM model within the specified time period. To validate the theoretical frameworks, numerical simulations are performed.

Keywords: PMSM, Hyperchaos, Adaptive control, Lyapunov Stability, Stochastic disturbances.

AMS subject classifications. 93E03; 93C42; 93C10; 15A39

ICNCS2024_202

Oblique wave scattering of water waves by a moored finite elastic plate in the presence of current

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Abstract

This study investigates the impact of ocean currents on the oblique wave scattering by a finite elastic plate floating horizontally and attached to mooring lines at its edges under lateral pressure load over a rigid ocean bottom in the case of finite and shallow water depth. The eigenfunction expansion method is used to investigate the solution of oblique wave incidence by moored finite floating elastic plate while considering the continuity of velocity and pressure and the edge condition. Due to incident waves, the study examines the bending moment, shear force, strain on the floating plate, free surface elevations, the deflection of a floating plate, and the wave reflection and transmission coefficients under ocean current and rigid bottom. Additionally, the study explores the impact of flexural rigidity, mooring stiffness, compressive force, Froude number, and wave incidence angle on the wave reflection and transmission coefficients. Notably, higher Froude numbers and mooring lines lead to a decrease in wave energy propagation in the form of reflection coefficients. The amplitude of plate deflection also increases with a higher Froude number. Overall, this research provides valuable insights into the effects of ocean current, mooring stiffness, and structural parameters on oblique wave scattering by a moored finite flexible plate over a rigid ocean bottom.

Keywords: Oblique wave, Ocean current, Moored finite elastic plate, Eigenfunction expansion method, Reflection and transmission coefficients

AMS subject classifications. 74K20, 76B15.

ICNCS2024_203

QGA based Reliable sampled data control for T-S fuzzy systems with applications

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Abstract

This research focuses on enhancing the stabilization of the fuzzy sampled data control system (FSDCS) through the implementation of a quantum genetic algorithm (QGA)-based reliable control scheme. It introduces a robust set of two-sided looped Lyapunov functionals to reinforce the efficacy of the proposed control technique. The study derives sufficient conditions to guarantee the asymptotic stability of the FSDCS. Furthermore, the QGA-based reliable control integrates larger sampling intervals, substantially boosting the practicality and efficiency of the control scheme while expanding the stability region of the FSDCS. The findings of this study are notably less conservative and demonstrate superiority over previous studies. Lastly, the research conducts numerical simulations using a widely recognized Lorentz sys- tem and wing chaotic system, to illustrate the exceptional performance of the derived results when compared to existing approaches.

Keywords: Quantum genetic algorithm, sampled data control, TS fuzzy, actuator faults.

AMS subject classifications. 68Q12, 93C43, 93C57

ICNCS2024_204

Finite time stability of non-instantaneous impulsive large-scale neutral fractional stochastic system[§]

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Abstract

This manuscript presents a study on finite time stability of non- instantaneous impulsive large-scale neutral fractional stochastic sys- tems in finite dimensional space. Based on the solution of representa- tion on m non-instantaneous impulsive intervals, sufficient conditions for finite time stability results of proposed system are derived by em- ploying fixed point theorem, suitable hypothesis on nonlinear terms and stochastic inequalities. Finally, an example is provided to check all the necessary assumptions of the derived theoretical result.

Keywords: Stability; Fractional derivative; Non-instantaneous impulse; Stochastic differential equations.

AMS subject classifications. 93B05; 26A33; 93E03; 31A30

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ICNCS2024_206

Enumeration of Multi-Variate Independence Polynomial for Iterations of Sierpinski Triangle Graph

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Abstract

In dynamical systems, Fractals and their features have been proven for a wide range of applications in graphical structures. In particular self-similar graphs, as well as graph polynomials play a vital role. This paper explores the characteristics of the family of well-known self-similar graphs, namely Sierpinski triangle graph ST_n and propose an algorithm to compute the multivariate independence polynomials of these graphs. We employ iterative patterns from the Sierpinski triangle graph and for iterative values of n=1, 2, 3, we employ our approach to explicitly compute the independent sets and multi-variate independence polynomials of ST_n. In addition, the inverse of these polynomials have been computed using SAGE software.

Keywords: Fractal Analysis, Self-similar Graph, Sierpinski Triangle Graph, Independent Sets, Multivariate Independence Polynomial.

AMS subject classifications. 28A80, 05C31, 05C69

ICNCS2024_208

Real-Time Twitter Spam Detection: A Comparative Study of Machine Learning Models Utilizing Natural Language Processing Techniques

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Abstract

In today's world, the rise of social networking apps like Facebook, Instagram, WhatsApp, Twitter, Snapchat, and YouTube has largely replaced in-person interactions, conversations, and information sharing. Spamming through messages has been rising in this segment where people find misleading messages which could overall affect the performance of trust in social media. Spammers are using social networking applications to send spam messages. Twitter, which has become one of the critical sources of communication and news propagation, is becoming a base for spammers to post misleading and deceptive content to distract users. Twitter spam frequently includes false information, such as "free coupons" and "weight loss adverts," to entice users into casting several votes for the same item. Opening unnecessary links and sending unwanted answers or remarks can offer spammers or hackers access to a person's phone or another device. This will increase the security risks for Twitter as well as the users using Twitter. Due to this people fall into the trap or get cheated by spammers through spam messages. To overcome this problem, researchers came up with different techniques to enhance the spam detection performance. So here, we are conducting various Natural Language Processing (NLP) techniques that could preprocess the data and with the help of Classifying Machine Learning (ML) algorithms, we would fetch the best algorithm for detecting spam messages on Twitter and classifying them into spam and non-spam tweets or spam and non-spam accounts.

Keywords: Spam Detection, Twitter, Natural Language Processing, Machine Learning

ICNCS2024_209

LSTM-CNN Ensemble for Efficient Toxic Comment Detection

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Abstract

In this research, we study the difficulty of correctly identifying toxic remarks by employing models based on deep learning. Long Short-Term Memory (LSTM) and Gated Recurrent Unit are two widely used models for identifying and classifying potentially harmful messages. In this investigation, we compare and contrast these two models (GRU). We found that despite the fact that both models are capable of good performance, they both fall short when it comes to dealing with longer passages of text and recognizing minor language subtleties. This was something that we noticed. We propose an updated architecture that makes use of a combination of LSTM and Convolutional Neural Network (CNN) layers as a means of overcoming these constraints. Our LSTM-CNN model can accurately capture both short-term and long-term dependencies in the text with the assistance of the spatial information acquired by the CNN layers. Using a dataset of abusive comments that is open to the public, we evaluate how well our model performs in comparison to the most recent and cutting-edge methodologies. In addition, we conduct exhaustive tests to discover how modifying the model's hyperparameters affects the performance of the model and how this may be accomplished. Our findings, when taken as a whole, demonstrate that the LSTM-CNN model is superior to normal LSTM and GRU models when it comes to the classification of harmful comments, and also call attention to the deficiencies of these other models when it comes to the processing of lengthy text sequences. This paper sets the door for additional research into the possible applications of hybrid models in Natural Language Processing (NLP).

Keywords: Toxic comment classification; Long-short-Term Memory (LSTM); Gated Recurrent Unit (GRU); LSTM-CNN

ICNCS2024_210

A study on $\delta g\alpha$ closed sets in Topological space

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Abstract

The aim of this paper is to introduce a new class of sets called $\delta g\alpha$-closed sets and a new class of set called $\delta g\alpha$-closed sets in topological spaces. This new class of sets lies between the class of all different closed sets. Several examples are provided to illustrate the behavior of new sets. Some of their properties and characterizations are studied.

Keywords: open sets , closed sets , α-closed sets , δ-closed sets , g-closed sets, $\alpha\delta$g-closed sets.

ICNCS2024_211

Fault-tolerant T-S Fuzzy synchronization control for complex dynamical networks with coupling delay

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Abstract

This paper addresses the challenge of fault-tolerant T-S Fuzzy synchronization control in complex dynamic networks with coupling delay. Based on Lyapunov theory, a fault-tolerant controller is presented to ensure that the resulting closed-loop system is synchronous in the presence of actuator failures. Using these conditions for the fault-tolerant controller, the study also derives the synchronization of the fuzzy network, which are presented in the form of linear matrix inequalities. Finally, a simulation example is given to demonstrate the effectiveness of the proposed method.

Keywords: Complex dynamical networks; T-S Fuzzy, Synchronization; Fault-tolerant control; Linear matrix inequalites

AMS subject classifications. 93D20, 92C10

ICNCS2024_212

Synchronization analysis of switched neural networks with time-delays

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Abstract

This study is concerned with the synchronization analysis of switched delayed neural networks (SDNNs). To achieve synchronization between master and slave SDNNs, a sampled data control is designed in the master system. The looped-Lyapunov functional sampled data-based synchronization condition is derived in the form of linear matrix inequality. The sufficient conditions ensure that the error system is asymptotically stable, which means the master and slave SDNNs are synchronized with each other under the sampled data control. Finally, a numerical example and their simulation results are demonstrated to ensure the superiority of the proposed problem.

Keywords: Synchronization; Asymptotic stability Analysis; Delays ; Switched Neural networks

AMS subject classifications. 34E05; 34H05; 34K24

ICNCS2024_213

s*p* connected spaces and s*p*compact spaces in topological spaces

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Abstract

The Goal of this research paper is to present and explore the two new concepts of topological spaces is termed as s*p*connected and s*p* compact using s*p*closed set and s*p*open set. And we study some fundamental properties of these topological spaces and also examine its relationship with existing spaces with suitable examples.

Keywords: s*p* open set; s*p* closed set; s*p* closure; s*p* connected spaces; s*p*compact spaces

ICNCS2024_214

Compactness and connectedness in Beta weakly semi –closed sets in Topological spaces

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Abstract

In this paper, a new class of Beta weakly semi-closed sets namely compactness and connectedness in Beta weakly semi-closed sets in Topological spaces. We investigate the basic facts in the Beta weakly semi–closed sets in terms of compactness and connectedness in Beta weakly semi-closed sets, and we get several characterizations and some of their properties. Also, we investigate its relationship with other types of functions.

Keywords: Weakly semi – closed sets (ws –closed); Weakly semi – open sets (ws – open); closed set; open set; Beta weakly semi – closed sets (βws- closed); Beta weakly semi – open sets (βws –open); Beta weakly semi closed sets – compactness (βws – compactness); Beta weakly semi closed sets – connectedness (βws – connectedness).

ICNCS2024_216

Predictive Modelling for Life Expectancy Classification: A Comprehensive Comparative Analysis of Ensemble Learning and Neural Network Approach

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Abstract

The research paper aims to showcase an in-depth investigation into predictive modelling for life expectancy classification, using advanced machine learning techniques. The research studies a comprehensive dataset consisting a wide range of socio-economic, health, and demographic indicators from various countries. Including diverse factors such as vaccination coverage, disease prevalence, lifestyle choices, and economic parameters, the dataset offers a rich pool of information for understanding the determinants of life expectancy. With features ranging from immunization rates and disease incidence to GDP per capita and education metrics, this dataset provides a holistic view of the multifaceted factors influencing public health outcomes. The study covers a broad spectrum of algorithms, including traditional models like Support Vector Machine, K-Nearest Neighbours, Naive Bayes, Logistic Regression, Decision Tree, as well as sophisticated ensemble techniques such as Random Forest, AdaBoost, and XGBoost. The investigation further incorporates Neural Networks, specifically Multilayer Perceptron (MLP), leveraging the sequential model provided by Keras. With careful hyperparameter tuning and feature engineering, the models have been optimized to achieve the highest accuracy.

Starting with a pre-processing phase, and then moving down to enclosing data down sampling, feature selection, and standardization the research aims to provide the best classification model on the dataset. Subsequently, a suite of ensemble learning algorithms is applied, each fine-tuned through grid search and cross-validation. The investigation extends to the integration of neural networks, exploring different architectures and activation functions to enhance predictive accuracy. Outcome highlights the efficacy of AdaBoost as the best-performing ensemble model, and the MLP neural network gives competitive accuracy. The study also reveals insights into the impact of hyperparameter tuning on model performance. Furthermore, an exploration of the dataset structure prompts the incorporation of additional layers and activation functions in the MLP, achieving noteworthy improvements in accuracy.

The study is concluded by presenting a comprehensive analysis of model performance, evaluating precision, recall, confusion matrices, and Receiver Operating Characteristic (ROC) curves. The findings contribute valuable insights into the selection of optimal predictive models for life expectancy classification, paving the way for enhanced healthcare analytics and decision-making.

ICNCS2024_217

Enhancing Disease Identification Through Machine Learning and Swarm Intelligence-Based Feature Selection

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Abstract

The relentless growth of healthcare data has spurred the integration of machine learning techniques in disease identification and diagnosis. Leveraging swarm intelligence algorithms for feature selection in this context presents a novel approach to optimize machine learning models. This paper explores the application of swarm intelligence algorithms, including Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), and Bee Colony Optimization (BCO), to streamline the feature selection process for improved disease identification. We delve into the methodology, encompassing data preprocessing, feature engineering, algorithm selection, fitness function design, and performance evaluation. By striking a balance between computational efficiency and diagnostic accuracy, our research aims to contribute to the advancement of medical diagnosis systems, enhancing their effectiveness and reliability in real-world healthcare scenarios.

Keywords: Disease Identification; Feature Selection; Swarm Optimization Algorithms; Machine Learning

ICNCS2024_218

Finite-Time Synchronization of Fractional Order Neural Networks via Sampled Data Control with Time Delay

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Abstract

This paper investigates the problem of finite-time synchronization (FTS) of fractional-order neural networks (FONNs) with time-delay via sampled data control (SDC) scheme. To achieve FTS criteria, a sampled-data control (SDC) scheme is implemented in the slave model of FONNs. And, this investigation is based on the solution of the time-delayed NNs by using Laplace transform, Mittag-Leffler function (MLF), and the generalized Grown-wall's inequality. Furthermore, under the proposed SDC scheme, the FTS conditions are derived for two cases of fractional order α, such as $0 < \alpha < 1$ and $1 < \alpha < 2$. The derived conditions ensure that the slave FONNs is asymptotically synchronized with master FONNs. Finally, two numerical examples are given to show the effectiveness of derived FTS criteria, and their fractional order derivative lies between $0 < \alpha < 1$ and $1 < \alpha < 2$.

Keywords: Fractional-order Derivative; Neural networks; Finite-time Synchronization; Time-delay; Mittag-leffler function

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