MAULANA AZAD NATIONAL INSTITUTE OF TECHNOLOGY, BHOPAL

2025 FRONTSCI CONFERENCE

February 27-28, 2025

(Hybrid Mode)

NATIONAL CONFERENCE ON FRONTIER RESEARCH IN SCIENCES (FRONTSCI 2025)

Department of Mathematics, Bioinformatics & Computer Applications

About MANIT

Maulana Azad National Institute of Technology (MANIT) is an Institution of National Importance and was formerly known as Maulana Azad College of Technology (MACT). In 1960, Govt. of India and Govt. of Madhya Pradesh jointly sponsored the institute and named it after the great scholar and first Education Minister of Govt. of India, Maulana Abul Kalam Azad. Institute is producing highly skilled, talented and qualified manpower in the field of engineering since its inception. The institute is offering under graduate and post graduate programs in different discipline along with doctoral program.

For more information, one may visit: https://www.manit.ac.in/

About the Department

It is one of the pioneering departments of the institution, came into existence in the year 1961.The department since its inception, and catered to the needs of under graduate and post graduate engineering departments. The department launched Master of Computer Applications (M.C.A.) program in 1987 and Master of Technology (M.Tech.) program in Bioinformatics in 2006. Recently, it has introduced dual degree program B. Tech. and M. Tech. in Mathematics and Data Science. The department comprises of well qualified and research-oriented faculty members working in various areas of Mathematics, Bioinformatics and Computer Applications. It also runs doctorate programs in Mathematics, Bioinformatics and Computer Applications and has so far produced a good number of Ph.Ds.

For more information, one may visit:
https://www.manit.ac.in/content/mathematics-0

About the Conference

The National Conference on Frontier Research in Sciences (FrontSci 2025) is an academic event organized by the Department of Mathematics, Bioinformatics, and Computer Applications (MBC), Maulana Azad National Institute of Technology (MANIT), Bhopal, to celebrate National Science Day 2025. The conference provides a platform for researchers, academicians, and industry professionals to exchange ideas, collaborate, and contribute to scientific advancements.

This conference focuses on promoting research in Mathematics, Physics, Chemistry, and Biological Sciences. In today's world, many scientific discoveries come from the intersection of different fields. FrontSci 2025 encourages discussions and collaboration across disciplines, addressing global challenges such as quantum computing, artificial intelligence, sustainable energy, computational biology, and biomedical advancements.

This year, the conference received more than 75 research contributions from various academic and research institutions across the country. A total of 77 research presentations will be delivered, covering different subject areas:

Mathematical Sciences – 54 presentations

Physics – 10 presentations

Biological Sciences – 11 presentations

Chemistry – 2 presentations

The conference follows a hybrid format, allowing both in-person and virtual participation to ensure broader engagement and accessibility.

We are honored to have Prof. Suresh Kumar Jain, Vice Chancellor of Barkatullah University, Bhopal, as the Chief Guest, and Prof. K. K. Shukla, Director of MANIT Bhopal, as the Guest of Honor. Their presence highlights the importance of platforms like this in encouraging scientific research and innovation.

About the Conference

In addition, the conference features distinguished keynote speakers who have made significant contributions to their respective fields:

Prof. Vineet Kumar Sharma, IISER Bhopal

Prof. Debasis Kundu, IIT Kanpur

Dr. Kamal Das, IBM Research, Bangalore

Prof. Hari Narayan Bhargava, CSIR-AMPRI, Bhopal

Their expertise and insights will provide valuable knowledge on the latest developments in science, inspiring researchers and students alike.

FrontSci 2025 aims to encourage meaningful discussions, foster interdisciplinary collaborations, and shape the future of scientific research. The event is not only about presenting research but also about building connections, sharing knowledge, and exploring innovative ideas. Participants will have opportunities to engage in discussions, learn about emerging trends, and form collaborations that contribute to real-world scientific advancements.

We sincerely thank our esteemed guests, keynote speakers, session chairs, organizing committee members, and all participants for their valuable contributions. We are also grateful to the institute authorities for their continuous support and guidance. Special appreciation goes to the organizing team and volunteers for their dedicated efforts in making this event successful.

We warmly welcome everyone to FrontSci 2025 and look forward to an inspiring and intellectually enriching conference that contributes to the progress of science and society

For more information, one may visit:
https://sites.google.com/view/frontsci-2025?usp=sharing

Mathematics

A study on time-fractional Black-Scholes jump-diffusion model via exponential B- spline approach

Presented By

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Abstract

This article examines a time-fractional Black-Scholes model with a Caputo differential operator under jump-diffusion. The numerical approach uses the composite trapezoidal rule for the discretisation of the integral component, exponential B-spline collocation for the discretisation in space, and discretisation to approximate the temporal derivative on graded mesh. Analysis of convergence and stability has been completed. It is shown that the method is of second order in space and order in time, where is the order of the fractional derivative. To validate the theoretical estimations, the current numerical method is applied to a number of numerical cases. Furthermore, as an application, the current numerical technique is used on the jump-diffusion model for European option pricing developed by Merton and Kou.

Complementary Distance Spectra and Energy of Certain Classes of Graphs

Presented By

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Abstract

For a graph G which is connected, CD-eigenvalues are the eigenvalues of its complementary distance matrix CD(G). The sum of the absolute values of CD-eigenvalues gives the CD-energy ECD(G) of G. Two graphs of same order, which are connected and having equal CD-energies are called CD-equienergetic. This study focuses on l-fold and strong l-fold graphs, where we investigate their CD-spectra. Moreover, the relationships between the CD-energies of the l-fold graphs and strong l-fold graphs concerning the CD-energy of the original graph G are established. Notably, the CD-energy of these graph types exhibits dependence on the diameter of original graph involved. Also, explore the connection between the CD-energy of extended bipartite double cover graphs derived from certain regular graphs and their adjacency energy. Furthermore, the instances of graphs that demonstrate equienergetic properties concerning the adjacency and complementary distance matrices are presented.

Keywords: Complementary distance matrix, Complementary distance eigenvalues, Complementary distance energy, Complementary distance equienergetic graphs, Energy of graph, Equienergetic graphs.

Enhanced SEAPIRD Model for Analysing Infectious Disease Dynamics and Public Health Response

Presented By

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Abstract

This study introduces the Susceptible-Exposed-Asymptomatic-Presymptomatic-Infected-Recovered-Dead (SEAPIRD) model, a deterministic compartmental framework designed to understand the transmission dynamics of infectious diseases with complex incubation periods and asymptomatic carriers, such as COVID-19. This model extends the traditional SIR, SEIR, and SEAIR models by incorporating a presymptomatic period. We begin with an in-depth review of the fundamental SEAPIRD model, emphasizing the intricacies of each compartment and their transitions. The model's realism is enhanced by integrating natural death across all compartments except the Dead (D), reducing the threshold for disease extinction and determining whether a disease becomes endemic or dies out. Cure rates for asymptomatic, presymptomatic, and infected individuals are included to reflect medical interventions that shorten the infectious period and reduce secondary infections, impacting the reproduction number. Furthermore, the article explores a SEAPIRD model with a saturated incidence rate to account for psychological factors affecting contact opportunities as more people become infected. This addition provides a more realistic scenario of infection risk dynamics. We also discuss equilibrium points and stability analysis in these models, identifying potential disease spread through the estimation of reproduction numbers. These enhanced models support better-informed public health decisions and interventions, aiding in the control and mitigation of infectious disease outbreaks.

Keywords: Reproduction Number, Equilibrium Points, Asymptomatic, Presymptomatic.

Modelling Bivariate dependance using the odd lindley half-logistic distribution with the Farlie Gumbel - Morgenstern Copula

Presented By

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Abstract

In this study, we introduce a new bivariate distribution, referred to as the Farlie-Gumbel-Morgenstern (FGM) type bivariate odd Lindley half-logistic distribution. This model integrates the FGM copula with the odd Lindley half-logistic marginal distribution, making it suitable for analyzing correlated lifetime data or events influenced by shared underlying factors. The proposed distribution offers a compelling alternative to existing bivariate lifetime models for handling real-valued data in diverse applications. We investigate several key properties of this distribution, including its conditional distribution, survival function, and hazard rate function, while also examining its dependence structure. To estimate the parameters of the proposed bivariate model, we employ the maximum likelihood estimation (MLE) method. The efficiency of these estimators is further assessed through a Monte Carlo simulation study. Additionally, we apply the model to a real dataset to demonstrate its practical utility and gain meaningful insights from real-world applications.

Keywords: Bivariate distribution, Maximum likelihood estimation, FGM Copula, Odd Lindley distribution, Hazard rate function.

Numerical Insights into Mixed convective Casson-Williamson SWCNT/MWCNT-EG Nanofluid Flow with Heat Source Effect over a Vertical Cone

Presented By

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Abstract

This work examines the mixed convection flow of a Casson-Williamson hybrid nanofluid over a vertical cone while taking activation energy and heat source effects into account. By dispersing single-walled carbon nanotubes (SWCNT) and multi-walled carbon nanotubes (MWCNT) in ethylene glycol as the base fluid, the hybrid nanofluid is developed. Using similarity transformations, the governing equations are converted, and the fifth-order Runge-Kutta-Fehlberg method with the shooting approach is used to solve them numerically. Key parameters that affect velocity, temperature, and concentration profiles are examined, including the activation energy, heat source parameter, and Casson and Williamson fluid parameters. The findings suggest that while the heat source parameter considerably raises the temperature distribution, boosting the Casson and Williamson fluid parameters increases fluid resistance and decreases velocity. Raising the nanoparticle volume fraction enhances heat and mass transmission by 62.9% and 66.9%, respectively, in SWCNT+MWCNT+EG compared to SWCNT+EG. The activation energy parameter is essential for improving mass transfer characteristics. The results offer significant insights into optimising hybrid nanofluids for advanced thermal management applications in a variety of domains where improved heat dissipation and thermal conductivity are essential for performance and efficiency, including nuclear reactor cooling, electronic cooling systems, automotive and aerospace cooling, solar thermal systems, biomedical applications, and industrial heat exchangers.

Keywords: Casson-Williamson Hybrid Nanofluid; Mixed Convection; Heat Source; Activation Energy; Vertical Cone.

Multidimensional Analysis of Principal Component Interactions in High-Variance Data Points for Online fraud transaction detection

Presented By

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Abstract

For financial institutions, detecting credit card fraud is essential in order to spot fraudulent transactions and reduce client losses. The goal of this project is to model credit card transaction data for fraud detection by utilizing machine learning and data science methodologies. We seek to effectively identify fraudulent transactions while reducing false positives by investigating anomaly detection methods like Local Outlier Factor and Isolation Forest and employing Principal Component Analysis (PCA) for dimensionality reduction. In order to address class imbalance and enhance model performance, we also look into preprocessing methods including feature extraction and data sampling (Random Undersampling, SMOTE, SMOTE Tomek). The classification accuracy of ensemble classifiers, such as Random Forest, CatBoost, LightGBM, and XGBoost, is assessed using metrics like F1 score and AUC. This approach is particularly suitable for online applications with computational constraints.

Keywords: Machine learning; Fraudulent transactions; Principal component analysis.

Virus Transmission Modeling in Computer Networks: Findings from an Expanded SEIR Epidemic Model

Presented By

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Abstract

The expanded epidemic model of SEIR in a computer network is illustrated in this research. Here, we ascertain the model's basic reproduction number, which sheds light on how viruses propagate within a network. In order to help control the propagation of viruses within the network, we show that the model is stable at its equilibrium locations. Using MATLAB, we analyze the long-term behavior of the model and use numerical techniques to get graphical answers. This research helps protect against viral attacks.

Keywords: E-epidemic model, Symptomatic nodes, Asymptomatic nodes, Basic reproduction number RO , Stability of the model.

Construction of Post Quantum Secure Single Sign-on Protocol

Presented By

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Abstract

Multi-server authentication, commonly referred to as single sign-on (SSO), enables users to seamlessly access multiple servers with a single registration. This method facilitates fast and secure service access over public channels. The primary goal of this research is to develop a quantum-secure authenticated key exchange (AKE) scheme suitable for multi-server environments. Traditional AKE schemes that rely on integer factorization and discrete logarithm problems are vulnerable to quantum attacks, particularly through Shor's algorithm. To address this vulnerability, we propose an AKE scheme based on the ring learning with errors (RLWE) problem, ensuring resistance to quantum threats. The implementation was conducted using a Dell desktop running Windows 11 Pro as a server and a Lenovo desktop with Windows 11 as the user's device. Our scheme allows users to establish secure connections with multiple servers without requiring multiple registrations, enhancing data security in the quantum computing era. The central authority and servers have distinct roles: the central authority manages user registration privacy, while the server verifies users before granting access to services. This separation of responsibilities enhances the scalability of the multi-server framework. The proposed scheme provides strong mutual authentication and meets essential security requirements, as confirmed by a rigorous security analysis within the random oracle model (ROM). The analysis shows that even if an attacker compromises the credential database, they cannot extract any sensitive user information, even with repeated probabilistic polynomial time (PPT) attacks exceeding a predefined threshold. The scheme ensures resistance against various attacks while maintaining perfect forward secrecy and key freshness. Furthermore, a comprehensive comparative analysis with existing AKE schemes in multi-server environments highlights the superior efficiency of our proposed approach.

Keywords: Lattice based cryptography, Multi-Server authentication, Ring Learning with Error Problem, Authenticated Key Exchange.

Quantum-Resistant Decentralized Authentication for VANETs: An RLWE-Based Approach

Presented By

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Abstract

Recent road accidents, which account for nearly 3% of global GDP losses and incur significant human casualties, underscore the urgent need for advanced vehicular safety systems. Vehicular Ad Hoc Networks (VANETs) offer a promising solution by enabling real-time communications between vehicles and traffic management centres, thus facilitating the timely dissemination of critical safety warnings. However, the inherent openness of VANET communications renders them susceptible to various security threats. Existing authenticated key agreement (AKA) protocols primarily rely on classical number-theoretic assumptions, which are increasingly vulnerable to quantum attacks (e.g., via Shor's algorithm), and centralized authentication models in high-density networks suffer from scalability issues and present single points of failure. In this paper, we propose a quantum-secure authentication scheme for VANETs that removes the dependency on a Trusted Third Party (T3A) by harnessing the hardness of the ring learning with errors (RLWE) problem. Our protocol is implemented using the Lattice Crypto Library, and we conduct a comprehensive evaluation of its execution and communication costs. Comparative analysis demonstrates that our scheme not only significantly improves efficiency but also enhances security relative to state-of-the-art approaches. Furthermore, we provide rigorous security proofs under the random oracle model based on the RLWE assumption, thereby ensuring robustness against classical and quantum adversaries.

Keyword:VANETs, Quantum Security, Ring Learning with Errors (RLWE), Authenticated Key Agreement, Security.

IoT Frameworks, Requirements, and Architectures for Smart Buildings: Enhancing Energy Efficiency and Next-Generation Building Management

Presented By

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Abstract

The Internet of Things (IoT) is increasingly integrating into the daily operations of various industries, with applications spanning smart cities, smart grids, smart homes, physical security, e-health, asset management, and logistics. For instance, the concept of smart cities is gaining traction across multiple continents, enabling large-scale deployment of enhanced street lighting controls, infrastructure monitoring, public safety and surveillance, gunshot detection, meter reading, and transportation optimization systems. A closely related and cost-effective IoT application is the implementation of smart buildings, particularly in commercial spaces that require high standards of comfort, usability, security, and energy management. IoT-based systems can seamlessly address these demands. In particular, power over Ethernet (PoE) presents transformative opportunities for in-building connectivity by enabling a broad range of IoT devices. However, several challenges hinder widespread IoT adoption, including the absence of comprehensive end-to-end standards, fragmented cyber security solutions, and a limited number of fully developed vertical applications. This paper explores the technical opportunities IoT offers in smart buildings and examines the key challenges affecting its deployment.

Keywords: Internet of Things, cyber security, Smart City, IOT tools, Ethernet.

Magneto-Thermal Convection of Bioconvective Tri-Hybrid Sisko Nanofluid Flow Through a Permeable Vertical Cone

Presented By

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Abstract

The article analyzes the magnetohydrodynamic (MHD) flow of a tri-hybrid Sisko nanofluid over a permeable vertical cone. The nanofluid consists of silver, copper and silver di-oxide nanoparticles suspended in water. The model incorporates the effects of thermal radiation and magnetic effects in the presence of gyrotactic microorganisms. Governing partial differential equations (PDEs) describing the flow are transformed into ordinary differential equations (ODEs) using similarity transformations and solved numerically with the 5th-order Runge-Kutta Fehlberg method with the shooting technique. The study examines the impact of key parameters, including magnetic field strength, thermal radiation, and nanoparticle concentration, on velocity, temperature, and concentration profiles through graphs and tables. The velocity profile falls with higher magnetic and porous parameters. For different volume fractions and other significant parameters, the skin friction and Nusselt number are presented quantitatively in tabulations. Raising nanoparticle fractions and increasing thermal radiation effect enhances heat transmission by 60.6% of tri-hybrid Sisko nanofluid flow. Furthermore, the inclusion of chemical reaction effects increases mass transfer by 45.14%, highlighting the significant role of reactive processes in improving mass transport within the fluid system. The findings are validated against available results in the literature, demonstrating a high level of agreement. This investigation provides valuable insights for enhancing energy efficiency in industrial applications such as nuclear reactors, electronic cooling, heat exchangers, biomedical cooling, and aerospace thermal management systems, where precise control of heat and mass transfer is essential.

Keywords: Tri-hybrid Sisko nanofluid; bioconvection; thermal radiation; magnetic field; vertical cone; porous medium.

A Comprehensive Case Study by the DEA BCC Model for Madhya Pradesh District Hospitals

Presented By

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Abstract

The evolving healthcare environment has brought attention to the significance of district hospital systems, with a major area of research presently concentrating on the effectiveness of public healthcare systems. With a focus on its theoretical foundations, methodological framework, and real-world applications in Madhya Pradesh's district hospitals, this study examines the Banker, Charnes, and Cooper (BCC) model within Data Envelopment Analysis (DEA). The ability of the BCC model to assess district hospitals' efficacy under variable returns to scale (VRS) is emphasized. There is also discussion of noteworthy results, implications, and potential avenues for further research. In order to transform ineffective hospitals into effective establishments, we utilize the target values. The optimal performances shown by a particular set of observations are now analyzed to identify the goal values.

Keywords:Data Envelopment Analysis, BCC Model, Efficiency, District Hospital, Madhya Pradesh.

Compact stars under the purview of modified gravity in Modified Chaplygin gas and MIT Bag model background

Presented By

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Abstract

Modified f(T) gravity theory is highly impactful for studying compact stars in present astrophysics. Physical attributes of the compact stars, such as density and pressure of the stars, have been evaluated for the modified Chaplygin gas model and MIT Bag model fluid background. To assess the physical characteristics of the compact stars in the purview of modified f(T) gravity theory, we have chosen some viable f(T) models such as Exponential f(T) gravity theory, Logarithmic f(T) gravity theory, and Combined f(T) gravity theory. Reformulated density and pressure have been represented graphically for better understanding. In this study, we have observed that density and pressure have demonstrated decaying patterns with respect to the radial coordinates. To further reconsolidate our results, we have validated the energy conditions.

Keywords: Modified Chaplygin gas model; MIT bag model; Exponential f(T) gravity theory; Logarithmic f(T) gravity theory; Combined f(T) gravity theory.

Advancing India's Development through Fuzzy Metric Spaces: A Synthesis of Mathematical Innovation and Application

Presented By

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Abstract

This study bridges the historical legacy of Indian mathematics and the contemporary advancements in fuzzy metric spaces to highlight their transformative potential for India's socio-economic development. Building upon foundational contributions like the decimal system and the concept of zero, the paper explores how fuzzy metric spaces—characterized by continuous t-norms and fixed-point theorems—can address complex challenges in modern science and technology. Key findings illustrate the versatility of fuzzy metrics in areas like digital communication, economic modeling, and infrastructure planning, demonstrating their capacity to optimize solutions amidst ambiguity. The research also emphasizes the importance of robust mathematics education in fostering innovation and human capital. By integrating historical insights with cutting-edge theories in fuzzy metric spaces, the paper underscores the critical role of mathematical modeling in driving India's growth as a knowledge-based economy. This synthesis of past and present not only enriches the understanding of mathematical applications but also provides actionable strategies for leveraging mathematics as a catalyst for sustainable development.

Keywords: Fuzzy Metric Spaces, Fixed-Point Theorems, Indian Mathematics Legacy, Socio-Economic Development, Mathematical Modeling, Sustainable Growth.

Advanced Iterative Methods for Computing Generalized Matrix Inverses

Presented By

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Abstract

In this study, we propose a new second-order iterative method and its higher-order extension for computing the generalized inverse. Additionally, an accelerated hyperpower iterative method is introduced. We establish the necessary and sufficient conditions for the convergence of these methods and derive error bounds for their estimation. The proposed iterative methods are applied to compute , the Moore-Penrose inverse , and the Drazin inverse for singular square matrices, rectangular matrices, randomly generated rank-deficient matrices, and full-rank matrices. The results are compared with existing methods, demonstrating that our approaches offer improved performance in terms of computational efficiency and accuracy.

Keywords: Iterative methods, Generalized inverse, Moore-Penrose inverse, Drazin inverse, Convergence analysis, Rank-deficient matrices.

Investigating rainfall patterns across an Indian meteorological subdivision using fuzzy relations in the form of BFR and composite BFR

Presented By

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Abstract

This research presents a method based on binary fuzzy relations (BFR) to get insight into the rainfall patterns over northeast India. A fuzzy set is a generalisation of a classical set in which the scenarios that cannot be described within the binary framework are obtained by generalising the characteristic function to a membership function. A fuzzy relation deals with the degree of belongingness of an ordered pair to some given relation and the most convenient way of representing it through a membership matrix. In this work we have considered Pre monsoon (X1), Summer monsoon (X2), Post monsoon (X3) and Annual (X4) rainfall for the period 1871- 2016 over North-East India. We have considered BFR for the pairs (X1, X2), X2,X3, X3,X4, X2,X4. It may be noted that in this work we have considered the conditional probabilities of the bivariate frequency distributions as the membership grades for the corresponding BFR. In the next phase we have generated composition of 2 BFR's through fuzzy max-min relationships. In this way we have compared the membership grades of the BFRs and the composite BFR's to understand the roles played by summer monsoon rainfall and post monsoon rainfall in the annual rainfall and the study has concluded through the fuzzy cardinalities associated with the composite BFRs.

Keywords: BFR; Composite BFR; Fuzzy cardinality; rainfall; northeast India.

Dynamics of accelerating universe in modified f (Q) gravity with latest observational data

Presented By

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Abstract

In the current study, we have considered a parameterizations of deceleration parameter to describe the cosmological dynamics of the accelerating universe in f (Q) gravity. The power law symmetric teleparallel gravity with a specific form f (Q) = Q + nQ m is assumed for the modelling purpose. Here, m and n are constants and Q is the non-metricity term that describes the gravitational interaction in space time. Latest observational datasets of BAO, H(z) and Pantheon are utilized to predict the best fit values of parameters and current value of Hubble constant. The Markov Chain Monte Carlo (MCMC) algorithm has been used to decide the best plausible values of parameters. We numerically represent the physical and geometrical features of the models and thoroughly explore their development. We analyzed our models using the jerk and Om diagnosis that depict the derived cosmic models are different from the ΛCDM model expressing late time accelerated expansion of cosmos with phantom type of universe. We also discussed the viability of models by the analysis of energy conditions.

Heat and Mass Transfer Optimization in Wavy Microchannels: A Dual-Method Exploration of Nanofluids

Presented By

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Abstract

This study investigates the heat and mass transfer characteristics of nanofluids in a wavy microchannel, utilizing water-based suspensions with Al_2O_3, CuO, and Graphene nanoparticles. The governing partial differential equations (PDEs) are transformed into ordinary differential equations (ODEs) using similarity transformations. The resulting ODEs are solved using a numerical shooting technique in MATLAB and an analytical Akbari-Ganji (AG) method in Maple, with both methods validated against each other. Results demonstrate that the wavy geometry enhances heat and mass transfer, with Graphene nanofluids outperforming CuO and Al_2O_3 due to their superior thermal conductivity. This study highlights the potential of Graphene nanofluids in wavy microchannels for advanced thermal management, offering insights into optimizing nanofluid-based cooling systems.

Keywords: Heat transfer, mass transfer, wavy microchannel, nanofluids, shooting technique, Akbari-Ganji (AG) method, thermal enhancement, thermal conductivity, cooling systems.

Algebraic Cryptanalysis of Lightweight Signature Scheme based on Multivariate Polynomials over Galois Field

Presented By

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Abstract

Multivariate Public Key Cryptography (MPKC) is a leading candidate for Post-Quantum Cryptography (PQC), providing security against large-scale quantum adversaries. The security of MPKC is based on the computational hardness of solving multivariate quadratic (MQ) systems. However, MinRank attacks, which exploit the MinRank problem, pose significant threats to MPKC-based schemes. This study investigates rank-based vulnerabilities in lightweight signature schemes constructed from MQ equations over a Galois field. I conduct a cryptanalysis of Lite-Rainbow, a variant of the Rainbow signature scheme, utilizing both the rectangular MinRank attack and Beullens' simple attack. I demonstrate how the rank properties of the system facilitate practical key recovery. Finally, I propose countermeasures that increase the complexity of rank-based attacks, enhancing both the security and efficiency of lightweight MPKC signature schemes.

Keywords:Multivariate Polynomials, Isomorphism of Polynomials, MinRank Problem, Post Quantum Cryptography.

Unveiling Vulnerabilities: A Comprehensive Survey of Side-Channel Attacks on Lattice-Based Cryptography

Presented By

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Abstract

This survey delves into the intricacies of side-channel attacks (SCAs) on lattice-based cryptographic schemes, with a focus on NIST-recognized algorithms such as CRYSTALS-Kyber and CRYSTALS-Dilithium. As the world transitions towards post-quantum cryptographic solutions to safeguard against future quantum threats, it is imperative to address the practical vulnerabilities that manifest during real-world implementations. These vulnerabilities, often exploited through side-channel analysis, pose significant risks despite the theoretical robustness of the algorithms. This paper systematically reviews the latest advancements in SCAs targeting Kyber and Dilithium, highlighting methodologies, attack vectors, and their profound impact on the security of these schemes. In the realm of power analysis attacks, both simple power analysis (SPA) and differential power analysis (DPA) have demonstrated the capability to extract secret keys from Kyber and Dilithium implementations by meticulously analyzing power consumption patterns. Recent studies have revealed the susceptibility of polynomial multiplication operations in Kyber to DPA, while SPA has exposed key-dependent behaviors in Dilithium's signing process. Electromagnetic (EM) attacks further compound these vulnerabilities by allowing non-invasive extraction of sensitive information through the analysis of emitted electromagnetic waves. The efficacy of EM attacks has been substantiated through targeted experiments on both Kyber and Dilithium, emphasizing the need for robust shielding and noise injection techniques. Fault injection attacks represent another critical threat, where deliberate faults induced through methods like voltage glitching, and laser irradiation can compromise the integrity of cryptographic computations. In Kyber, such attacks have been shown to facilitate the recovery of private keys by introducing faults during decryption processes, while similar vulnerabilities have been identified in Dilithium's signature verification mechanism. The combination of fault injection and side-channel analysis presents an even more formidable challenge, as demonstrated by recent research that synergistically exploits these techniques to unravel hidden dependencies and cryptographic weaknesses. To counteract these sophisticated attacks, a plethora of countermeasures have been proposed and evaluated. Techniques such as hiding and masking aim to obscure the correlation between power consumption/emissions and processed data, thereby mitigating the risk of power and EM analysis. For fault injection attacks, redundancy-based error detection and correction mechanisms have been recommended to enhance the resilience of Kyber and Dilithium implementations. Constant-time algorithms and randomized processes further bolster security by eliminating timing dependencies and adding unpredictability to cryptographic operations. This survey not only consolidates the current state of research on SCAs targeting Kyber and Dilithium but also provides a critical analysis of the effectiveness of existing countermeasures. By offering a comprehensive overview of the latest attack strategies and defenses, this paper aims to guide future research towards developing more secure and resilient post-quantum cryptographic systems. The insights gained from this survey underscore the necessity of a holistic approach to cryptographic security, one that integrates algorithmic strength with robust implementation practices to withstand the evolving landscape of side-channel threats.

The numerical solution of Reynolds equation for couple stress using Daubechies modified wavelet multigrid method

Presented By

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Abstract

Recently, wavelets have abundant applications, especially in the numerical solution of differential equations. This paper describes the modified wavelet multigrid technique for the numerical solution of Reynolds equation using Daubechies wavelet. The employment of the conventional numerical methods has been found to involve some difficulty to observe fast convergence in low computational time. To overcome this, we have proposed Daubechies modified wavelet multigrid method using wavelet intergrid operators. The test problems are presented to reveal the applicability and attractiveness of the proposed scheme.

Keywords:Daubechies wavelet multigrid; Differential equations; Reynolds equation; Intergrid operators.

Machine Learning for Early Detection and Risk Assessment in Cardiovascular Diseases

Presented By

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Abstract

Cardiovascular diseases (CVDs) are a leading cause of mortality globally, emphasizing the need for early detection and risk assessment to improve patient outcomes. Machine learning (ML) has emerged as a powerful tool for analyzing large, complex healthcare datasets to identify patterns and predict disease risks with high accuracy. This study explores the application of ML models for the early detection and risk assessment of CVDs using various data sources, including electronic health records (EHRs), medical imaging, laboratory results, and wearable device data. Supervised learning techniques such as decision trees, support vector machines (SVM), and deep learning algorithms can classify patients based on risk levels and provide early warnings for potential cardiovascular events. Additionally, ensemble methods and neural networks offer improved accuracy by handling non-linear relationships within the data. The integration of predictive ML models with clinical workflows allows healthcare providers to make data-driven decisions and offer personalized preventive care. Challenges such as data privacy, model interpretability, and imbalanced datasets remain significant hurdles. Future research should focus on developing explainable AI (XAI) techniques to enhance the transparency of ML models and ensure clinical acceptance. Moreover, the use of federated learning can address privacy concerns by enabling secure, distributed training on sensitive healthcare data. Leveraging machine learning for CVD risk assessment can ultimately facilitate early intervention, reduce healthcare costs, and improve patient outcomes by providing timely, accurate predictions.

Keywords: Cardiovascular disease, early detection, deep learning, predictive healthcare, supervised learning, electronic health records, risk assessment.

Modelling Queues with Fuzzy Membership Functions: A New Framework

Presented By

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Abstract

This research identifies the steps involved in determining the membership function of a queuing problem. Queuing system is a process to measure the efficiency of a model by underlying the concepts of queue models: arrival and service time distributions, queue disciplines and queue behaviour. The Queuing Theory Model gives performance measures of a single value while the Fuzzy Queuing Model has a range of values. The Dong, Shah and Wong (DSW) algorithm is used to define the membership function of performance measures in the Fuzzy Queuing Model. The main objective of this research is to evaluate the performance of a single server queuing model in terms of fuzzy and intuitionistic queuing theory. Using an intuitionistic fuzzy queue, this research presents a novel method of assessing the M/Ek/1 queuing model having FCFS service discipline with Erlang services. The computation of α-cut intervals is an arithmetic procedure for intuitionistic fuzzy numbers. Construction of the membership functions of the performance measures in queuing systems is to be done and then apply the fuzzy number where the inter arrival time and service time are fuzzy numbers with shape function. The results obtained from the Fuzzy Queuing Model are more consistent to measure the queuing performance for solving the problem in waiting line and will improve the quality of services.

Keywords: Membership Function, Queuing Theory Model, Fuzzy Number, DSW Algorithm, Erlang services, α-cut

Revenue optimization and numerical bifurcation analysis of a prey-predator model with age-selective non-linear prey harvesting

Presented By

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Abstract

Age-selective harvesting strategies have been shown to be more realistic due to the occurrence of specific characteristics in harvested individuals such as larger body size, which are economically more profitable. Optimization of net revenue from harvesting is integral for economically beneficial fisheries, and steps must be taken to avoid over-exploitation of the harvested population. Moreover, bifurcation analysis of mathematical models with age-selective harvesting is a relatively unexplored area of research. Hence, we proposed and analyzed the dynamics and bifurcations of a prey-predator model of Hassell-Varley type in which prey population follows Richards' type growth and is subjected to age-selective non-linear harvesting under predator-induced fear. The coexistence equilibrium is shown to be dependent on maturation delay, and Pontryagin's maximum principle is utilized to obtain the optimal harvesting policy. Hopf-bifurcations are noted for various biological parameters, which highlight the role of these parameters in stabilizing the system. Numerical bifurcation analysis is performed using DDE-BIFTOOL in MATLAB, showing the presence of codimension-2 bifurcations of various types. These numerical simulations highlight the impact of excessive harvesting in introducing unstability in the proposed system. Hence, utilization of Richards' type growth in our proposed model leads to more generalized observations and shows a new avenue in the study of age-selective harvesting strategies on prey-predator systems using numerical bifurcation analysis and optimal control theory.

Keywords: Hassell-Varley type functional response, Age-selective Harvesting, Optimal control, Bifurcation.

Lattice-Based Authenticated Key Exchange Protocols: A Comprehensive Analysis

Presented By

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Abstract

Lattice-based authenticated key exchange (AKE) protocols have gained significant attention as post-quantum secure alternatives, motivated by the threat of quantum adversaries. At the core of these protocols lie well-studied hard problems in lattice-based cryptography (LBC), such as Learning With Errors (LWE), Ring-LWE (RLWE), Module-LWE (MLWE), and the Short Integer Solution (SIS). Each variant leverages the presumed difficulty of solving high-dimensional lattice problems, even with the computational power of quantum computers. By encoding secret information within small error terms and employing modular arithmetic over rings or modules, lattice-based AKE schemes offer both conceptual elegance and strong security guarantees. A critical technical challenge in these systems is parameter selection, which must balance security, efficiency, and memory constraints. Choosing parameters that yield low failure rates in error reconciliation, while maintaining compact key sizes, fast polynomial operations, and resilience against side-channel attacks is nontrivial. Moreover, fully standardized parameter sets for diverse application scenarios remain under debate. In LBC, many constructions rely on the Random Oracle Model (ROM) to streamline proofs; however, there is a growing desire for stronger theoretical assurance through security arguments in the Standard Model, albeit at the cost of increased computational complexity. This tension between practicality and provable rigor underscores the need for more advanced proof techniques capable of handling complex lattice assumptions without sacrificing efficiency. Additionally, interoperability with legacy systems remains a significant hurdle that demands careful consideration to enable a seamless transition. Advances in algebraic number theory, combined with novel error-correcting mechanisms and specialized hardware accelerators, could further enhance the performance of lattice-based AKE. Integrating side-channel resistance and countermeasures against quantum fault injection attacks will also be pivotal as adversaries develop increasingly sophisticated techniques. Finally, broadening the security models to capture real-world adversarial capabilities while carefully quantifying the trade-offs between theoretical soundness and computational practicality will guide the development of next-generation protocols.

Potential role of Deep Learning models in prognosis of Autoimmune and Inflammatory Disorders

Presented By

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Abstract

The study explores Deep Learning models used in bridging the Autoimmune and Inflammatory Disorders. Due to growing environmental and psychological risk factors, individuals are more susceptible to immune and inflammatory dysfunction. Thus the prognosis and detailed treatment is imperative. Herein, Deep Learning models such as Convolutional Neural Networks (CNNs), Recurrent Neural Network (RNN), AutoY and LSTMY models, Autoencoders are employed. The analysis of the review suggests that heat maps with deep learning models are effective for accurate decision-making process. To mitigate certain limitations like overfitting, "black-box" models, high computational memory management, Model Compressions and efficient architectures are required.

Keywords: CNN, RNN, Autoencoders, LSTMY, Autoimmunity, Inflammation.

Optimization and Machine Learning Approaches for Agricultural Yield Prediction and Resource Allocation

Presented By

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Abstract

The study explores various computational techniques like linear programming, genetic algorithms, machine learning models, clustering methods, reinforcement learning, and dynamic programming for optimizing agricultural yield prediction and resource allocation. The results indicate that machine learning models, particularly Random Forest Regression, achieve significant predictive accuracy, while optimization techniques like genetic algorithms enhance yield-related decision-making. The study identifies the limitations of linear programming due to dimensional mismatches and highlights the potential of reinforcement learning for resource allocation strategies.

Keywords: Machine Learning, Optimization, Genetic Algorithm, Reinforcement Learning, Dynamic Programming, Crop Yield Prediction

Review of Deep learning techniques and Machine learning approach in Predictive Analysis of Player Performance in Cricket

Presented By

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Abstract

The application of deep learning techniques and machine learning in cricket analytics has gained significant importance, offering new insights into player performance and match outcomes. This review combines findings from various studies that explore the use of deep learning and machine learning techniques in cricket. Deep learning models, such as Convolutional Long Short-Term Memory (CLSTM), have been effectively utilized to analyze cricket data, capturing both spatial and temporal dependencies to predict match scores and outcomes with high accuracy. These models process comprehensive datasets that include players' performance, venue conditions, and historical match data, providing valuable insights into the dynamics of the game. Machine learning approaches have been employed to predict player performance by analyzing historical data, including batting and bowling averages, and other performance metrics. Techniques such as random forest, support vector machines, and decision trees have been used to classify and predict player performance, demonstrating high accuracy in various studies. These models help in player selection and strategy formulation by providing data-driven insights into player capabilities and potential performance in upcoming matches. By using comprehensive datasets and advanced algorithms, model accuracy can be improved. Thus, these techniques provide valuable tools for decision-making in cricket, benefiting players, coaches, and analysts.

Keywords: Deep learning, machine learning, cricket analytics, players' performance analysis, match outcomes.

Optimal control study of a SEIR model with two target population and nonlinear incidence rate

Presented By

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Abstract

The present study introduces a SEIR model that incorporates the individual awareness regarding the disease transmission. Based on this understanding, the susceptible population is divided into two distinct classes: aware and unaware. It is assumed that there is unrestricted interaction between these two susceptible populations. The model demonstrates two distinct steady states: disease-free steady (DFS) and endemic steady (ES) state. Additionally, conditions for the stability of both steady states are derived. The results indicate that the DFS state is stable when the basic reproduction number (BRN) is less than unity, whereas the ES state exists when BRN is greater than unity and is locally stable under specific parametric conditions. Furthermore, the system is numerically solved using MATLAB. Results indicate that unaware individuals are at a higher risk of infection compared to those who are aware. The impact of specific parameters on the population dynamics are shown graphically. Additionally, optimal control study is performed to regulate the infection in the population. Various control strategies have been considered and the most effective strategy to curb the spread of infection involves reducing the number of susceptibles, exposed and infected individuals while increasing the recovered individuals.

Keywords: Awareness; optimal control; control profile.

Convolutional neural networks for medical image analysis

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Abstract

Medical image interpretation has long depended on human professionals, including radiologists and doctors, to diagnose illnesses. Nevertheless, the intricacy of medical images and differences in expert interpretation present challenges in maintaining efficiency and accuracy in diagnosis. Artificial intelligence (AI), specifically deep learning, has greatly changed medical image analysis with the development of computer technologies. Among other deep learning models, Convolutional Neural Networks (CNNs) are the most popular and efficient method because they can automatically learn features without the need for manual feature engineering in traditional machine learning algorithms. CNNs have been remarkably successful in several applications in medical imaging, including disease classification, detection of lesions, image segmentation, and augmentation. They have been utilized in several medical imaging modalities such as X-ray, magnetic resonance imaging (MRI), and computed tomography (CT) scans. Furthermore, the clinical utility of CNNs depends on addressing ethical issues, regulatory acceptance, and model explainability. This article presents an extensive review of CNN applications in medical imaging, from the most used CNN architectures to their application in medical imaging tasks and the limitations they pose, CNNs keep leading the way towards intelligent medicine, making healthcare solutions more accurate, efficient, and personalized

Skin Disease Detection System

Presented By

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Abstract

Skin disease detection System is a web based application Designed to assist users in identifying Various skin diseases by uploading Images of an affected area as an input. A pre-trained deep learning CNN model Is used to classify the uploaded skin Images into one of ten disease Categories, including Cellulitis, Impetigo, Athlete's Foot, Nail Fungus, Ringworm, Cutaneous Larva Migrans, Chickenpox, Shingles, Acne, and Rosacea. The Flask for the web Framework and TensorFlow/Keras for The deep learning model is used and, With the help of PIL and NumPy, the System pre-precosses images to ensure Compatibility with the model. CNN Model processes the skin lesions Images and extracts the features like Edges, shape and textures, and classifies Between normal and infected one. The Application predicts disease, sensitivity Offering a preliminary diagnostic tool For managing skin conditions.

Keywords: Skin lesions, Image Analysis, Disease Classification, Image Segmentation, Disease Detection, Image Processing

Mathematical application used in Innovative Agriculture Engineering

Presented By

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Abstract

Almost everything in the universe uses mathematics, and there are applications of mathematics in every part of life, sometimes visible and sometimes invisible. "Agriculture" is one of the major industries that uses mathematics, and farmers are increasingly relying on their ability to solve problems, make decisions, and manage finances. They use advanced mathematical technologies to calibrate irrigation pumps and other devices. This essay highlights some of the important applications of mathematics in the field of agriculture. Agriculture and Mathematics Together The agriculture sector is one of the primary industries that uses mathematics, and the ability to solve problems, make decisions, and manage finances is essential to success.

Mathematical tools can be used to measure soil fertility, determine the amount of water that can be used in relation to the area that can be used for cultivation, determine the amount of money that can be invested in a specific crop, and measure fertilizer epidemiology, DNA sequencing, and gene technology. Agriculture has always served as the backbone of any country's economy by feeding the growing population and supplying raw materials for industry. It is obvious that applying mathematics to improve agriculture is important and desirable. Various mathematical models, such as deterministic, empirical, and stochastic approaches, are used in agriculture. Mathematical disciplines like algebra, dynamics, mensuration, differential equations, linear programming, transportation and assignment problems, probability, mechanics, and more are all included in these dynamic models.

Optimal Strategies for deteriorating items in inventory control management & Economic order quantity model for imperfect items

Presented By

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Abstract

In this paper, we learn new methods of how to overcome the shortage of perishable and perishable goods in the business through inventory control management. In the current market environment, how to mitigate the impact of the downturn plays a role. In this paper we look at how inventory control management can be overcome by some principles by modeling the shortage of start-up businesses for perishable goods. Whether it is necessary to stock perishable goods or not so that our storage does not decrease and there is no loss, to conserve the goods. Like price dependent on stable time, demand dependent on sensitive stock and stock of perishable goods due to carbon emissions effect. The carbon emission impacts of perishable goods can be accurately modeled by analyzing the carbon transport associated with storage of carbon. This study is specifically designed to design and model economic order and quantity. Keeping in view the imperfect quality of goods and different objectives, in which trigger inventory is reordered at a different stage from the end to the end. The model is organized using the last order, starting order, best order and screening method. Following the EOQ order strategy, the seller sells the imperfect products at the end of the cycle at a cost saving. Instead of returning them, the supplier buys the best quality products from the supplier. The study does not cover the period of sale of the imperfect inventory, but improves it and utilizes the positive inventory in a long and timely manner. The proposed research findings and provide it a correct model and critical analysis and we prepare a new model.

Leveraging Deep Learning for Early Diagnosis and Management of Shrimp Diseases in Aquaculture

Presented By

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Abstract

India, a leading global producer of fish and aquaculture products, exports significant quantities, particularly frozen shrimp. With initiatives like the Pradhan Mantri Matsya Sampada Yojana (PMMSY) and Fisheries and Aquaculture Infrastructure Development Fund (FIDF), the government supports industry growth. Shrimp farming in India uses various models, requiring optimal environmental conditions. Disease outbreaks, such as Yellow Head Disease and White Spot Syndrome, are key challenges, with emerging technologies like machine learning and CNNs aiding in early detection. This paper explores the role of government schemes and advanced monitoring technologies in enhancing shrimp farming sustainability and disease management. Future work proposes the application of CNN for the early detection and management of shrimp diseases, with a focus on enhancing disease prediction accuracy and providing actionable insights for shrimp farmers.

Principles of Numerical Analysis: Algorithms and Their Uses

Presented By

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Abstract

A crucial area of computer science and mathematics is numerical analysis, which offers techniques and techniques for resolving mathematical issues that come up in a variety of domains, including as physics, engineering, computer science and finance. The principles of numerical analysis are examined in this abstract, with a focus on the fundamental algorithms and the variety of uses for them. The basis for numerical analysis is found in the creation and evaluation of numerical algorithms, which are methodical processes intended to rough answers to mathematical issues that would be difficult or impossible to resolve analytically. These algorithms are crucial for solving practical issues where analytical answers are frequently not feasible because of nonlinearity or complexity. Beginning with the fundamentals of error analysis and approximation theory, this abstract explores the essential elements of numerical analysis. It emphasizes the significance of comprehending the constraints and origins of inaccuracy in numerical calculations, highlighting the trade-offs

between computational efficiency and accuracy. An important idea called numerical stability is investigated to make sure algorithms get accurate results even when there are computational errors and rounding errors. The abstract then examines a number of numerical methods, such as linear and nonlinear equation solving, numerical integration, and interpolation. The emphasis also covers optimization techniques and iterative approaches, demonstrating how they can be used to address complex issues in scientific and engineering applications. The abstract also covers the numerical treatment of differential equations, which is an important topic with many applications in biology, engineering, and physics. This abstract provides a variety of applications from several disciplines to demonstrate the usefulness of numerical analysis. Financial modelling for risk assessment, numerical simulation of fluid dynamics, and finite element analysis for structural engineering are a few examples. The interdisciplinary character of numerical analysis is demonstrated by highlighting the function of numerical algorithms in data analysis, machine learning, and image processing.

To sum up, this abstract offers a summary of the foundations of numerical analysis with a focus on the creation, evaluation, and use of numerical algorithms. By being aware of these basics, Robust numerical techniques can be utilized by researchers, engineers, and practitioners to tackle intricate issues in many different engineering and scientific fields. The abstract promotes more research. Utilizing sophisticated numerical techniques and how they are incorporated into new technology, supporting continuous developments in the field of computational science.

Keywords:Numerical Analysis, Algorithms and Applications.

Innovative Statistical Approaches to Environmental Monitoring and Analysis

Presented By

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Abstract

This research explores the application of advanced analytical methods to understand complex environmental and climatic patterns over time. Leveraging satellite-based metrics and statistical techniques, the study examines trends and variability in a region affected by dynamic climatic factors. The findings reveal significant spatial and temporal variations, offering valuable insights into broader implications for environmental management and sustainability. These results underscore the importance of innovative methodologies in addressing critical environmental challenges.

Keywords: Climate change, extreme value distribution, simulation.

An Algorithm for solving linear fractional programming problem using Crammer's Rule

Presented By

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Abstract

For dealing with many types of linear inequalities, various methods have been introduced in linear fractional programming method. To find the optimality of an objective function. In this paper an algorithm has been developed for the solution of linear fractional programming problem with Crammer's rule for determining the optimal results. The system of Cramer's rule has been studied since the 1970s. It is known and simple for the solution of linear equations. for this solution Cramer's rule is a method for solving linear simultaneous equations. It makes use of determinants for solving system of linear equations and so a knowledge of these is necessary before proceeding. In such type of problems, the given objective function is in the form of fractional programming there are some standard methods for finding the accuracy of the optimal values of linear fractional programming but here we have used crammer's rule for the accuracy of the optimum result which is explained with numerical example.

Keywords: Linear fractional programming, crammer's rule, linear inequalities, optimization, linear programming, Determinants and optimal solution.

Exponential Consensus of Nonlinear Multi-Agent Systems Through Sampled-Data Control with Time-Delay Using Discontinuous Lyapunov Functionals

Presented By

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Abstract

In this article, we investigate exponential consensus in nonlinear multi-agent systems using sampled-data control and time-delay effects. Using a novel method that permits exponential consensus, and a loop-based discontinuous Lyapunov functional is constructed while explicitly considering the impact of time delays. This dynamic adjustment provides significant advantages over conventional methods and accelerates stabilization. The discontinuous Lyapunov functional shows its utility in sampled-data systems by producing less conservative stability requirements than earlier approaches. In order to boost computing efficiency, a new integral inequality is developed and redefined to decrease free matrix variables while maintaining its basic structure and adapting it to the particular requirements of time-delayed scenario. Linear matrix inequalities are used to calculate the control gain matrices, which are required to ensure system performance. Simulations and numerical examples are used to illustrate the suggested method's decreased conservatism, demonstrating its effectiveness in handling time-delay effects.

Keywords: Exponential consensus, Multi-agent systems, Sampled-data control, Discontinuous Lyapunov functional, Linear matrix inequalities.

Climate Change and Agricultural Drought: A Remote Sensing Perspective

Presented By

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Abstract

Agricultural drought is a growing concern in many regions, impacting crop productivity and livelihoods. This study explores the application of remote sensing techniques to assess drought conditions over a multi-decade period. Using indices derived from satellite imagery, such as vegetation and temperature-based metrics, the research highlights the spatial and temporal variations in drought severity. Results reveal significant changes over time, driven by climatic and environmental factors. The findings underscore the importance of remote sensing tools in understanding drought dynamics and provide insights that could inform agricultural and environmental management strategies.

Keywords: Agricultural Drought, Climate Change, Remote Sensing.

Acalypha Indica Leaves drying: Mathematical Modelling of Kinetics and Diffusivity in a Hot-Air-Oven-Dryer

Presented By

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Abstract

The drying kinetics of Indian Acalypha Indica leaves have been investigated by using a hot-air-oven dryer. The parameters in the drying process are temperature (40°C,50°C,60°C) and air velocity (1.3 m s-1, 1.7 m s-1). The drying process occurs in the falling rate period with no constant rate period is observed in the experiment. Thin-layer mathematical models are used to describe the drying characteristics of the leaves. The best model has been chosen based on the highest overall coefficients of determination (R2) and the lowest overall root mean square error (RMSE). Effective diffusivity has been calculated, and Arrhenius relations has been constructed to determine the activation energy for the samples in the hot-air oven dryer.

Keywords: Drying, Medicinal Plant, Arrhenius relation.

Novel Fixed-Point Theorem in Soft Digital Metric Space with its Applications

Presented By

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Abstract

This paper introduces a novel metric space, termed Soft Digital Metric Space (SDMS), which integrates the concepts of soft set theory with digital metrics. The proposed SDMS offers flexible way to measure distances between digital elements, often with some degree of uncertainty or vagueness involved. The study presents several new fixed-point theorems within the context of SDMS, extending classical results from traditional metric spaces to this new setting. These theorems establish the existence, uniqueness, and convergence of fixed points under specific conditions. Furthermore, the paper demonstrates the application of these fixed-point results in solving practical problems in areas such as Image Analysis, Pattern Recognition, Data Mining. The introduction of SDMS provides a fresh perspective in the study of fixed-point theory and its applications in various domains of mathematics and computer science.

Keywords: Soft metric space, Fixed point, Digital metric space, Complete metric space.

A time-dependent sampled-data controller design for delayed fractional-order dynamical systems

Presented By

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Abstract

Research on sampled-data controllers for fractional-order dynamical systems has primarily focused on periodically sampled controllers that do not depend on the sampling time. However, recent studies suggest that incorporating sampling-time dependency in controller design can enhance system stability. Despite these findings, fractional-order systems with time delays have not been adequately addressed in this context. To bridge this gap, this study develops a theoretical framework for designing a sampling-time-dependent sampled-data controller tailored to fractional-order systems with time delay. A novel sampled-data control strategy is introduced, incorporating two distinct terms—one of which explicitly depends on sampling instants. This refinement enhances traditional sampled-data controllers by improving stability performance. Additionally, a specialized Lyapunov functional is constructed, accounting for both fractional-order dynamics and time delay. This approach has yet to be fully explored in fractional-order control design. By employing the Lyapunov direct method and linear matrix inequality (LMI) techniques, sufficient conditions for stabilizing the considered nonlinear fractional-order system are derived. The proposed method ensures improved stability analysis by integrating fractional-order time delay into the control structure. Finally, numerical simulations are conducted to validate the theoretical findings, demonstrating the effectiveness of the developed controller.

Keywords: Stability analysis, Sampled-data controller, Fractional-order delayed systems, Lyapunov functional.

Minimizing Portfolio Uncertainty with Exchange-Traded Funds: An Optimization Approach Based on Machine Learning.

Presented By

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Abstract

Portfolio optimization continues to be a fundamental challenge in financial decision-making requiring a well-balanced trade-off between lowering risk exposure and maximizing profits. Combining risk-sensitive portfolio optimization techniques with machine learning-based predictive modeling in this work creates a diversified and strong investment portfolio. From the National Stock Exchange (NSE), 31 assets in all including sector-specific stocks, Exchange-Traded Funds (ETFs), and sector-specific stocks were selected in order to promote portfolio variety and risk-adjusted performance. By means of feature engineering techniques like Random Forest and Linear Regression models, feature extraction from past stock price variations allowed to extract interesting information, therefore enabling more accurate projections. The top 15 performing stocks were discovered based on expected returns and then put into the process of portfolio optimization. Aiming to maximize the Sharpe Ratio and thereby reduce Value-at- Risk (VaR), the basic optimization framework was the Mean-VaR model utilized to develop a powerful risk-adjusted investing strategy. This approach assures a more constant return profile and significantly lowers downside risk exposure. Since their inclusion clearly reduced volatility and tail risk, therefore promoting a more consistent capital allocation approach, the report stresses the significant part ETFs play in improving portfolio resilience. By reducing risk levels and therefore maintaining investment performance, ETFs were extremely crucial in enhancing portfolio variety and so decreasing susceptibility to market volatility. Since Random Forest better captures non-linear relationships in financial data than traditional regression-based approaches, it proved to be the best successful predictor among the machine learning models applied thus. Its ability to apply ensemble learning techniques changed the optimal asset selection for portfolio building, lowered overfitting, and raised forecast accuracy. The results underline the need of portfolio selection systems driven by machine learning since they reveal their potential to increase risk-adjusted returns and investment stability.

The possibilities of combining predictive analytics with financial optimization models are underlined in this study, therefore offering a flexible and practical foundation for modern investment strategies. Using innovative machine learning techniques can help investors maximize asset allocation, enhance decision-making, and correctly manage financial risk in volatile markets.

A Comprehensive Review on Random Forest-Based Intrusion Detection System

Presented By

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Abstract

Intrusion detection systems (IDS) play a crucial role in cybersecurity practice. They identify malicious activity, unauthorized access, and potential security threats. IDS have central roles in protecting sensitive information, ensuring efficient operations, and avoiding interruptions. The traditional methods of IDS usually cannot cope with advanced cyberattacks, including those devised with zero days and advanced persistent threats. ML enhanced the capabilities of IDS and allowed them to learn from data, thereby detecting unusual patterns and adapting to the changing scenarios of cyberattacks. Among the widely used ML techniques, Random Forest has been one of the most highly reliable in IDS. It is highly accurate, reliable, and capable of handling large, noisy, and unbalanced datasets in which malicious activities are scarce as compared to normal ones. RF combines several decision trees to enhance its accuracy in reducing errors with a minimum possibility of overfitting. This makes it useful in the detection of advanced threats such as DDoS attacks, stealthy intrusions, and other sophisticated cyberattacks in real time. This flexibility makes it adaptive to different settings, ranging from IoT networks, cloud computing systems, and even industrial infrastructures. RF also supports feature prioritization, making it highly efficient in processing complex datasets and consequently identifying threats very swiftly. This paper explores the use of RF in IDS, noting its strong points, which include high detection accuracy, high adaptability, and high scalability, but poses the challenge of minimizing false positives, scaling up to meet emerging threats, and enhancing its ability to scale. When these challenges are overcome, RF-based IDS will become a crucial part of modern cybersecurity strategies.

Keywords: Advanced Persistent Threats (APTs), Cybersecurity, DDoS Attacks, Intrusion Detection Systems (IDS), Machine Learning (ML), Random Forest (RF), Real-Time Detection.

A Reviewon Zero Knowledge Proofs for Group Signatures

Presented By

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Abstract

Zero-knowledge proofs (ZKPs) play a crucial role in enhancing the privacy, security, and efficiency of group signature schemes. ZKP enables anonymous yet verifiable authentication. This paper reviews the integration of ZKPs in group signatures. The ZKP ensures the anonymity of the signer. Also, it allows the controlled traceability by a trusted authority. In this paper, we explore various cryptographic techniques (such as ZK-SNARKs, ring signatures, and lattice-based proofs). The efficiency, security guarantees, and applicability in real-world scenarios are analyzed. Additionally, we discuss challenges related to scalability, quantum resistance, and trust assumptions in existing schemes. By evaluating recent advancements and open research questions, this review provides a comprehensive understanding of the ZKP-based group signatures and their future directions.

Keywords:Anonymity, Authentication, Cryptographic Techniques, Group Signatures, Privacy, Security, Zero-Knowledge Proofs (ZKPs).

A Review on Zero Knowledge Proof for Authentication in Cloud Computing

Presented By

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Abstract

Cloud computing has transformed how businesses and individuals access and manage resources over the internet. Securing cloud-based systems remains a major concern. Authentication mechanisms are important for ensuring that only authorized users can accesssensitive data. Zero Knowledge Proofs (ZKPs) have emerged as a promising cryptographic protocol. They enhance authentication processes and reduces the risk of exposing sensitive information. This paper reviews Zero Knowledge Proofs and their use in authentication within cloud computing environments. We explore various ZKP techniques. We also discuss the benefits and the challenges of integrating ZKPs into cloud systems. Additionally, the paper highlights real-world implementations and applications. This offers insights into the feasibility of adopting ZKPs for secure authentication in cloud computing.

Keywords: Authentication, Cloud Computing, Cryptographic Protocol, Security, Sensitive Information, Zero Knowledge Proofs (ZKPs), ZKP Techniques

OPTIMIZATION OF WIRELENGTH FOR EMBEDDING HALF HYPERCUBE TO NECKLACE GRAPHS

Presented By

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Abstract

Embedding an interconnection network into another is widely used for simulating and implementing parallel algorithms in parallel processing and computing systems. The quality of an embedding from the guest graph to the host graph is determined by parameters like dilation, congestion, wirelength, load, and expansion. For an embedding, edge congestion is the maximum count of edges from the guest graph embedded as a single edge in the host graph. Wirelength or layout of an embedding refers to the sum of congestions on each edge of the host graph. Wirelength problem refers to finding the minimum possible wirelength between two structures of all possible embeddings. Minimizing the wirelength decreases wiring, reducing the cost and communication delay among the parallel processing components. Properties like regularity and the smaller number of inter-processor connections in hypercube and hypercube variants have made them prominent structures in the field of study and have been explored extensively. The half hypercube, a hypercube variant, possesses several properties, including symmetry, fewer edges, smaller diameter, and lower overhead making it a desirable interconnection network for large-scale systems. This paper intends to give the exact wirelength of embedding half hypercube into necklace and windmill graphs.

Keywords: Embedding, congestion, wirelength, edge isoperimetric problem, half hypercubes.

CNN-Based Image Classification: A Research Study on Methods, Challenges, and Prospects

Presented By

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Abstract

Image classification stands as a pivotal task in computer vision, enabling automated recognition and categorization of diverse visual data. Convolutional Neural Networks (CNNs) have emerged as powerful tools for this purpose, demonstrating remarkable success in various applications including healthcare, autonomous vehicles, and industrial quality control. In this study, we survey existing CNN-based image classification techniques, highlighting key challenges such as imbalanced datasets, complex image features (particularly in medical domains), and the computational demands of training deep networks. We then propose a baseline CNN pipeline developed using TensorFlow and Keras, incorporating transfer learning to expedite convergence and data augmentation to improve generalization.

Our experimental evaluation on publicly available medical image datasets confirms enhanced classification performance over standard CNN models, underscoring the value of leveraging pretrained networks and robust optimization strategies. In addition, we analyze practical issues ranging from hyperparameter tuning to dataset quality and offer insights into optimization approaches that can be generalized across various domains.

By synthesizing current practices, elucidating bottlenecks, and demonstrating a practical CNN framework, this study not only provides a consolidated reference for researchers but also identifies future directions. These include leveraging emerging architectures such as vision transformers, integrating multimodal data, and exploring more advanced augmentation techniques. Ultimately, our findings lay the groundwork for continued innovation in CNN-based image classification and its expanding real-world applications.

Keywords: Image Classification, Machine Learning, Deep Learning, Convolutional Neural Network, Computer Vision

Physics

Design of novel functional materials with low lattice thermal conductivity

Presented By

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Abstract

Materials having low lattice thermal conductivity (kL) are critical to the development of efficient energy conversion devices. This study examines the low lattice thermal conductivity of binary compounds by examining lattice dynamics and phonon transport. kL exhibits anomalous patterns in their deviation from the anticipated trend, as determined by their atomic mass. We suggest the following principal factors that may be responsible for the low kL behaviour of these materials: Transverse acoustic (TA) phonon modes are diminished despite their low atomic mass, Low-lying optical (LLO) phonon modes descend substantially into the acoustic mode region, thereby augmenting the overlap between longitudinal acoustic and LLO phonon modes, which expands the scattering phase space and finally elevated scattering rates resulting in low phonon lifetimes. The current study provides valuable insights for the design of low kL functional materials, which remains crucial for sustainable energy conversion applications.

Keywords: Phonons, Lattice thermal conductivity, thermal energy.

Pressure-Induced Electronic Transitions in Alkaline-Earth oxides

Presented By

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Abstract

This study explores the effects of pressure on the structural and electronic properties of binary alkaline-earth oxides, specifically calcium oxide (CaO) and strontium oxide (SrO). Determination of the electronic structure was done using the Tran-Blaha modified Becke-Johnson (TB-mBJ) potential, which offers improved band gap predictions compared to the standard PBE-GGA functional. At ambient pressure, both CaO and SrO are found to be indirect band gap insulators. Application of high pressure induces structural phase transitions, and our calculations reveal distinct changes in the electronic band structures. While the high-pressure B2 phase of CaO remains an indirect band gap semiconductor, a notable transition to a direct band gap semiconductor is observed in the B2 phase of SrO. This pressure-induced indirect-to-direct band gap transition in SrO is a key finding of this work, highlighting the influence of pressure on the electronic properties of these materials.

Keywords: High pressure, Phase transitions, electronic structure, first principle calculations.

Revisiting Fractional Action Cosmology through Holographic Dark Fluid with different IR-cutoffs

Presented By

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Abstract

The late-time acceleration of the universe, as discovered in the late 90s by the analysis of distant Supernovae Ia data, is a matter of multifaceted research in cosmology. Before this discovery, the expansion of the universe was thought to be decelerated, and the discovery of accelerated expansion paved a new way for modern cosmology. Various observational studies further support the late time acceleration. Dark Energy (DE) is considered the driving force behind this accelerated expansion. The Dark energy is an exotic matter characterized by the negative equation of state (EoS) parameter defined by $\omega = p/\rho$, where p and ρ stand for the pressure and energy density of DE, respectively. In our study, we consider a flat FRW universe, and as a phenomenological model of DE, we take Holographic DE, which is based on the holographic principle. Considering holographic as the background fluid, we revisit Fractional Action Cosmology, which is a modified gravity model to explain the late time acceleration. In the study's first phase, we consider the Hubble horizon as the enveloping horizon of the universe and take the holographic fluid accordingly. Considering this, we reconstruct the EoS parameter in the Fractional Action Cosmology framework. In this case, the scale factor is taken to be in power law form. The reconstructed EoS parameter is observed to show quintessence behaviour. Subsequently, the four energy conditions NEC, WEC, SEC and DEC are investigated based on the reconstructed pressure and density. In the next phase, a more generalized version of the IR cutoff is chosen, and this IR cutoff is reconstructed in the Fractional Action Cosmology framework. The EoS parameter is reconstructed, a crossing of phantom boundary is observed, and it is dominantly quintessence.

Keywords: Fractional Action Cosmology; Holographic Dark Energy; Reconstruction; EoS parameter.

THE FUTURE OF NANOMATERIALS: EMERGING APPLICATIONS AND CHALLENGES : A REVIEW

Presented By

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Abstract

Nanomaterials, with their extraordinary properties stemming from their nanoscale dimensions, are poised to revolutionize a wide range of industries. From medicine, where nanoparticles enable targeted drug delivery and personalized treatments, to renewable energy technologies that promise enhanced energy storage and efficiency, the potential applications are vast. Nanomaterials also show promise in electronics, environmental remediation, and agriculture, offering innovations like flexible electronics and sustainable farming practices. However, these advancements come with challenges, including concerns about human health, environmental impact, and ethical implications. Ensuring the safe and responsible use of nanomaterials requires addressing issues like toxicity, regulatory frameworks, and scalable manufacturing. This paper explores both the transformative potential of nanomaterials across various sectors and the critical hurdles that must be overcome to realize their full promise, offering a balanced perspective on the future of nanotechnology.

Effect of fluorescein dye on morphological, optical, dielectric, thermal and mechanical properties of KDP, ADP and ZTS single crystals

Presented By

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Abstract

In recent years, optoelectronics has driven the development of a novel nonlinear optical (NLO) material. These materials found in various applications such lasers, electro-optical modulation, and Q-switching etc. In this context, desirable crystals of Fluorescein Dye doped KDP, Fluorescein Dye doped ADP and Fluorescein Dye doped Zinc Thiourea Sulphate (ZTS) were grown from aqueous solution. Diffraction studies were carried out to quantify the unit cell dimensions and space group using Bruker smart Apex D single crystal X-ray diffractometer. The dopant matrix shows the marginal changes for the cell parameters however, does not alter the space group upon doping by the inclusion of the dopant. From FTIR spectrum the vibrational assignments were consigned for the validation of FKDP, FADP and FZTS crystal. The DRS analysis indicates that in ADP percentage of reflection is increased marginally in the visible region, but in case of FKDP and FZTS decreases. TGA implies that the crystals stability up to 226°C, 215°C and 227°C for FKDP, FADP and FZTS respectively. The NLO characteristic was proven by the Nd:YAG (1064 nm) laser light emitting green light. The low value of the dielectric constant and dielectric loss at higher frequencies shows the materials potentiality in the construction of NLO devices. The hardness studied shows that the grown crystals belong to soft materials category. SHG efficiency was observed to rise in the case of ADP and decrease in the case of KDP and ADP with fluorescein using the Kurtz powder method. This suggest that dopant has significant effect on the comprehensive properties of the KDP, ADP and ZTS crystals.

Keywords: Crystal growth, KDP, ADP, ZTS crystals, Dyes, NLO Studies.

Slotted Planar Microstrip Patch Antenna for Wi-Fi 6E and ISM Band Applications

Presented By

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Abstract

In this work, a Triple-band planar patch (TBPP) antenna for Wi-Fi 6E and industrial, scientific, and medical (ISM) band applications is presented. The antenna's dimensions comprise a total volume of 26×28×1.6 mm3. The FR4 substrate is utilized in the antenna design, leading to resonant frequencies of 2.77 GHz, 4.74 GHz and 6.51 GHz. Consequently, the antenna exhibits a VSWR value of 1.4, 1.6 and 1.03, a return loss of -21.83, -20.68 dB and -24.54 dB. The suggested antenna, with its slotted planar geometric structure, small volume, performs satisfactorily in the Satellite communication (2.77 GHz), Point to point microwave link, Wi-Fi 6E (4.74 GHz) and 5G applications (6.51 GHz) bands. The proposed work uses Fire Resistance FR4 epoxy as dielectric with the thickness of 1.6 mm. The High Frequency Structure Simulator (HFSS) software was use to analyze the proposed work, and fabrication to authenticate the design. Vector Network Analyzer was used for experimental examination. The frequency spectrum is also used for wireless communication, radar system, and ISM band applications.

Keywords: Microstrip antenna, Slotted Planar Patch, Dual-band, ISM, WLAN.

Masses of Bs Mesons in a Phenomenological Model

Presented By

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Abstract

The first heavy hadron discovered was the charmonium state in 1974, detected simultaneously at SLAC and BNL. Ever since, because of enhanced accelerator and detection facilities at various colliders, approximately hundred different heavy hadrons have been experimentally discovered. The study of heavy hadrons are important because it provides important information regarding strong interaction and various properties of strongly interacting particles can be understood. Lattice QCD, effective field theory, approaches based on Bethe-Salpeter equation and NRQCD, phenomenological potential models etc. are some of the theoretical approaches presently used to study heavy hadrons. In this work, we have investigated the properties of Bs mesons using a non-relativistic potential model. The central quark-antiquark potential used in our work is the Song-Lin potential along with the smeared spin-spin interaction:

$$V(r) = -\frac{b}{\sqrt{r}} + a\sqrt{r} + \frac{32\,\pi\alpha_s}{9\,m_b m_s}\left(\frac{\sigma}{\sqrt{\pi}}\right)^3 exp(-\sigma^2 r^2) + V_0$$

To obtain the Bs meson masses, we have solved the non-relativistic Schrodinger equation, with the above potential, numerically using the matrix Numerov method. The -wave ground state masses obtained from our analysis are MeV and MeV, and the experimental values for these states are respectively MeV and MeV. We see that our results are in good agreement with the experimental results.

Keywords: Bs Mesons; non-relativistic model; Song-Lin potential.

Effect of Sintering Aids Upon Dielectric Microwave Properties of $ZnNb_2O_6$ Columbite Niobates

Presented By

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Abstract

Of the columbite niobate ceramics with the formula M2+Nb2O6, several compounds (M2+ = Zn) display dielectric losses at microwave (1-10 GHz) frequencies resulting in Qf values between 40,000 and 90,000 GHz, making them suitable materials for use in dielectric resonator applications. However, their temperature coefficient of resonant frequency (τf) values were high, at between −50 to −90 ppm, and the optimum sintering temperatures were found to be 1150 oC, 1200 oC, 1300 oC and 1350 oC for M = Zn respectively. Doping with relatively large amounts of TiO2 and CaTiO3 was found to reduce τf in most cases, but with a large increase in dielectric losses (decrease in Q). This paper details the doping of these ceramics with sintering aids (<2 wt%) such as V2O5 and CuO, in an attempt to reduce the sintering temperature. It was found that in many cases the dopants also had an extremely beneficial effect upon microwave properties, decreasing τfconsiderably and substantially increasing the quality factor (Q).

Keywords: Dielectric resonators, columbite, $ZnNb_2O_6$, niobates, sintering aids.

Synthesis and Characterization of MgO Nanoparticles: A Comprehensive Study

Presented By

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Abstract

Magnesium oxide (MgO) nanoparticles have attracted significant attention due to their exceptional physicochemical properties, including high surface reactivity, excellent thermal stability, and a wide band gap energy range (3.18–4.85 eV). These properties make MgO nanoparticles highly suitable for applications in catalysis, biomedical sciences, environmental remediation, and optoelectronics. In this study, MgO nanoparticles were synthesized using a simple chemical precipitation method, employing magnesium nitrate hexahydrate ($Mg(NO_3)_2 \cdot 6H_2O$) as the precursor and sodium hydroxide (NaOH) as the precipitating agent. The reaction was carried out at 80°C with continuous stirring and filtering at to obtain MgO nanoparticles. The synthesized nanoparticles were characterized using various analytical techniques to determine their structural, morphological, and optical properties. X-ray diffraction (XRD) analysis confirmed the formation of highly crystalline MgO nanoparticles with characteristic diffraction peaks corresponding to the cubic phase. The average crystallite size was estimated using the Debye-Scherrer equation and found to be in the nanometer range. Scanning electron microscopy (SEM) images revealed the morphology and particle size distribution, confirming nanoscale features. Fourier-transform infrared (FTIR) spectroscopy identified the presence of Mg–O vibrational modes, verifying successful synthesis. These findings highlight the successful synthesis of MgO nanoparticles with desirable properties for potential applications in diverse technological fields. The study provides insights into the structural and optical characteristics of MgO nanoparticles and their suitability for future research in nanotechnology and material science.

Keywords: MgO. Nanoparticles, Synthesis, X-ray diffraction.

Chemistry

A High-Performance Schiff Base Chemosensor for Fast and Selective Cu^{2+} Detection via Colorimetric Response

Presented By

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Abstract

A simple, "turn on" colorimetric chemosensor 3-(1H-benzo[d]imidazol-2-yl) quinolin-2-amine (SBL) based on benzene-1, 2-diamine and quinoline derivative has been designed, synthesized and characterized. Interestingly, the novel colorimetric probe SBL exhibited a highly sensitive, selective and quick response (within 1 min) to Cu2+ in ethanol and water (95:5/v:v) medium amongst other metal ions. Notably, visual colour change was observed with the addition of Cu2+ to the chemosensor SBL from colourless to yellow. The binding constant of SBL-Cu2+ complex determined from Benesi-Hildbrand plot was found to be 6.33 x 103 M-1. The limit of detection and limit of quantification was also evaluated and observed to be 8.01 x 10-7 M and LOQ is 2.67 x 10-6 M. Moreover, the binding stoichiometry of SBL with Cu2+ was determined to be 2:1 by Job's plot. This novel chemosensor SBL provided a new method for rapid and naked-eye recognition of Cu2+ with a cheap and easy-to-make process, high efficiency and stable storage.

Keywords: Cu2+, 2-amino quinoline, colorimetric probe, Schiff base, sensor.

Comparative Analysis of different water samples with respect to pure water via complexometric titration

Presented By

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Abstract

The determination of water hardness in natural water bodies such as ponds and rivers is essential for evaluating water quality and understanding its ecological health. This study investigates the hardness of water samples from various ponds and rivers using the EDTA (Ethylenediaminetetraacetic acid) titration method. EDTA, a chelating agent, forms stable complexes with calcium (Ca^{2+}) and magnesium (Mg^{2+}) ions, which are the primary contributors to water hardness. By titrating water samples with a standard EDTA solution and using an appropriate indicator, such as Eriochrome Black T, the concentration of these metal ions is determined. The hardness of the water is calculated based on the volume of EDTA required to reach the endpoint of the titration. The results provide insights into the variation of water hardness across different locations, highlighting the influence of geological and biological on water chemistry. This method is effective for monitoring water quality in natural aquatic systems, enabling informed decisions for conservation, water management, and the protection of aquatic life.

Biology

Biowaste Derived Biochar: Synthesis and Application in Forensic Latent Fingerprints Development

Presented By

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Abstract

In forensic investigations, human latent fingerprints (LFPs) serve as crucial tangible evidences. LFPs with unique and distinct characters can be utilised for the forensic investigations in the identification of criminals. The widely used method for the development of LFPs is powder dusting method. Numerous chemical powders have already been used for the development of LFPs. However, the production processes, expenses, and toxicity-related factors limit their regular utilization. To address these constraints, this study was performed to assess the efficacy of biowaste derived Biochar (BC) in the identification of LFPs on various surfaces. Commonly available biowaste, Cow dung (CD), was utilized as a precursor to synthesize BC in an easy, economical, environmentally friendly, and sustainable approach. The synthesis of BC was carried out by pyrolysis in muffle furnace at 350°C for the residence time of 4 hours. The physical and chemical properties of BC was analysed by the SEM, FTIR, XRD, and Raman characterisation techniques. Further, the BC was tested for the development of LFPs on the selected non-porous (Glass slide, Coloured plastic test tube holder, Steel spatula, Transparent plastic bottle) and porous (Cardboard sheet, Plywood piece, White paper, Indian currency note) surfaces using powder dusting method. As developed LFPs provided good quality prints on both porous and non-porous surfaces. High quality prints were obtained on porous surfaces indicated by the development of ridge characteristics in the LFPs. These BC powder can serve as a promising tool in the field of forensic fingerprint analysis.

Keywords: Cow dung; Biomaterials; Biochar; Forensics; Latent Fingerprints.

Investigation of structural- activity relationship and interaction mechanism of flavone with HSA - Pharmacokinetics of drug as Antidiabetic

Presented By

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Abstract

Diabetes mellitus (DM) is a widespread metabolic disorder that disrupts the body's ability to properly metabolize carbohydrates, fats, and proteins, leading to high blood sugar levels. The number of people affected by diabetes is rising rapidly, particularly in Asian countries,
making it a leading cause of death worldwide. Although there are various medications available to manage diabetes, such as insulin and oral drugs, these treatments often come with serious side effects, leading to a growing demand for safer alternatives. Flavonoids, a large group of plant-derived compounds, have shown potential in managing diabetes, especially through their ability to inhibit enzymes like α-amylase and α-glucosidase, which help reduce blood sugar levels. Flavone, a specific type of flavonoid, has drawn attention due to its non-toxic properties and underexplored potential for diabetes treatment. This study focuses on how flavone interacts with Human Serum Albumin (HSA), aiming to improve the effectiveness of diabetes treatments. Using techniques like fluorescence, FTIR, Circular Dichroism (CD), and 1 H NMR, we examined how flavone binds to HSA. Our findings reveal moderate binding affinity, with significant changes to the structure of HSA,
indicating that flavone could enhance drug delivery and bioavailability. The fluorescence add-on effect data analyzed via the Stern-Volmer plot demonstrated a linear relationship between the fluorescence enhancement and HSA concentration, these findings highlight the moderate affinity of Flavone for HSA and its potential implications in drug delivery, where protein-ligand interactions play a pivotal role. The results provide a valuable framework for further research into the pharmacokinetics and biophysical behavior of Flavone.These results suggest that flavone holds promise as a safer, more effective alternative for managing diabetes, with fewer side effects compared to traditional treatments.

Antioxidant Potential and Bioactive Compounds in Discarded Ink Glands of Amphioctopus aegina: A Sustainable Therapeutic Prospect

Presented By

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Abstract

The ocean is one of the largest ecosystems, home to diverse flora and fauna with complex interactions. To survive in such an environment, marine organisms have developed unique adaptive mechanisms. Cephalopods, a distinct group of mollusks, have evolved an inking behavior as a defense strategy. They produce ink from their ink gland and release it to evade predators. Studies suggest that cephalopod ink contains various bioactive molecules with potential therapeutic significance. While squids, cuttlefish, and octopuses are widely consumed as seafood, their ink glands are typically discarded as food industry waste. In this study, discarded ink glands from Amphioctopus aegina were collected and analyzed for the presence of zoochemicals and antioxidant activity. Zoochemical analysis confirmed the presence of phenols, alkaloids, and flavonoids. Both water and ethanolic extracts of octopus ink showed strong reducing potential. Also free radical scavenging activity increased with increasing concentration and IC50 values of water extract and ethanol extract were found to be 65.76µg/mL and 51.70µg/mL, respectively. Additionally, both extracts exhibited significant total antioxidant capacity with 138.26 ±1.15µg AAE/mL and 89.54 ±0.64µg AAE/mL. These results indicate their potential as therapeutic agents. Further exploration could maximize their pharmaceutical benefits.

Keywords: Marine pharmacology, Cephalopods ink, food industry waste, antioxidant activity.

Phytochemical Screening, GC-MS Profiling and In vitro Antioxidant Activity of Leaves of Dysoxylum malabaricum Bedd. ex C. DC.

Presented By

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Abstract

Plants have remained a major part of traditional medicine improving the health and safety of local populations and supplementing or replacing contemporary medical therapies. Phytochemical profiling of plant extracts plays a significant role in identifying pharmacologically important bioactive compounds and help in drug design and discovery. Dysoxylum is a genus of woody plants belonging to the mahogany family, Meliaceae. To date, few studies have been conducted on Dysoxylum malabaricum and a complete screening of the phytochemical compounds present in the leaves of D. malabaricum has not been carried out. So, this study aims at thoroughly investigating and identifying the phytochemical constituents and bioactive compounds present in the leaf extracts of D. malabaricum through phytochemical screening, chemical profiling using GCMS and further evaluation of the in vitro antioxidant activity of the leaf extracts. Leaves of D. malabaricum were extracted using Soxhlet extraction method in 3 different solvents (methanol, water and chloroform). Quantitative estimation of phytochemicals (total phenolic content and total flavonoid content) and in vitro antioxidant assays (DPPH and FRAP) were carried out, followed by chemical profiling of the extracts using GC-MS which revealed the presence of many important bioactive compounds. The methanolic extract showed a higher concentration of phenolics (67.88 ± 0.26 mg GAE/g dry weight) and flavonoids (57.55 ± 0.23 mg QE/g dry weight) when compared to aqueous and chloroform extracts. The methanolic extract also demonstrated remarkable DPPH scavenging (with IC50 value 32.45 ± 0.22 µg/ml) and ferric reduction activities. The results demonstrate that D. malabaricum is an effective source of bioactive and antioxidant compounds.

Keywords: Dysoxylum; bioactive compounds; GCMS analysis; antioxidants.

Green synthesis of ZnO nanoparticle from Kalanchoe pinnata leaf extracts and its application studies

Presented By

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Abstract

Environment sustainability is now one of the top global priority and green or biological synthesis of zinc oxide nanoparticles (ZnO NPs) using plant extract has gained attention for being eco-friendly, simple and affordable. In the present research, carried out on a reduced scale we have described the green biosynthesis of ZnO nanoparticles (NPs) by using Kalanchoe pinata. This succulent herb has fleshy leaves and is referred to as 'Patharchatta' in Ayurveda, which translates to 'breaker of stones'. Kalanchoe pinata exhibits several medicinal properties one of which is its ability to dissolve renal calculi (kidney stones). This plant was used for phyto-synthesis of ZnO nanoparticles. To promote crystal formation $Zn(CH_3COO)_2$ (zinc acetate) was used as precursor with vigorous stirring for 2 h. The filtrate was separated by centrifugation and dried in the hot air oven overnight before calcination. Following synthesis, the ZnONPs were subjected to various characterization techniques such as, UV-visible spectroscopy, X-ray diffraction (XRD), Fourier-transform infrared (FTIR) spectroscopy, and scanning electron microscopy (SEM). Using Zeta Potential and DLS the stability of ZnO NPs were analysed and the real time distribution of nanoparticles were monitored respectively. An evident absorption peak was revealed at 377.43nm of the UV-visible spectrum, corroborating the formation of ZnO while XRD confirmed the wurtzite hexagonal structure, based on the sharp peaks attained at particular angles. This study is aimed at the biosynthesis and characterization of ZnO nanoparticles, as well as evaluation of their antimicrobial and anticancer effect on kidney cancer cell lines. Given Kalanchoe pinata's traditional use in dissolving kidney stones, we sought to investigate whether ZnO NPs derived from this plant exert any effect on human embryonic kidney (HEK 293) cell lines in vitro.

Keywords: Green synthesis, Kalanchoe pinata, zinc oxide nanoparticles, sustainability, anti-microbial.

Extensive phytochemical investigation, GC-MS characterization and microencapsulation of Vitex altissima leaves

Presented By

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Abstract

The burgeoning field of natural products research continues to unveil the therapeutic potential of plant extracts, particularly those possessing immunomodulatory properties. This study outlines a comprehensive and systematic approach to address the crucial intersection of immunomodulation and drug delivery, aiming to bridge the gap between traditional plant medicine and modern pharmaceutical applications, by investigating the phytochemical profile of the leaves of the tree, namely Vitex altissima, and explore the potential of microencapsulation to enhance its bioavailability, for therapeutic applications. Vitex altissima belongs to the family of Verbenaceae, and this tree is known to possess a vast variety of phytochemicals like carbohydrates, flavonoids, saponins, phenolic acids and terpenoids. The roots of this tree have been traditionally used to treat allergy, ulcers, inflammation, wounds, urinary infections etc. The study will involve a series of preparatory steps involving the leaf extract preparation in the desired solvent and its further characterization by extraction of the bioactive compounds from these extracts using techniques like Soxhlet extraction and its identification using instruments like GC-MS (Gas Chromatography-Mass Spectrometry). The second phase of the research will focus on the microencapsulation of the identified bioactive compounds using ion gelation technique, and further analyzed them using Fourier Transform- Infrared Spectrometry (FT-IR) spectrum and Field- emission scanning electron microscope (FE-SEM). The GC-MS results of the hexane extract showed many antioxidant and antimicrobial compounds, some of them being copaene, ylangene, aromandendrene etc and the methanolic extract on the other hand showed antioxidant, anti-cancer and anti-fungal compounds like 2-Tridecen-1-ol, (E), 1-Tridecyne, 1-Hexadecyne, 1-Dodecyne. The Field- emission scanning electron microscope (FE-SEM) analysis of the microcapsule revealed the microcapsule to have an oval morphology and the presence of dispersed particles and small pores. The FT-IR results showed characteristic peaks at 3348.8303 cm^{-1}, 2831.86801 cm^{-1}, 2933.26117 cm^{-1}, 1645.13966 cm^{-1}, 1455.206 cm^{-1} and 1012.50349 cm^{-1}.
Keywords: Soxhlet extraction, GC-MS, phytochemicals, microencapsulation, FE-SEM, FT-IR

Bridging Structure and Evolution: A Torsional Approach to Protein Phylogenetics

Presented By

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Abstract

Protein classification has traditionally relied on sequence and structural similarities. However, backbone conformations, defined by phi (ϕ) and psi (ψ) dihedral angles, play a crucial role in determining protein folding and function. This study introduces a Ramachandran-based phylogenetic approach to classify proteins based on backbone conformational distributions. By constructing phylogenetic trees from Ramachandran plots, we compared their clustering patterns with sequence-based (FASTA) and structure-based (DALI) phylogenies to evaluate their effectiveness. The study investigates whether proteins with similar phi-psi angle distributions also cluster together in traditional phylogenetic trees. If backbone conformations align with evolutionary trees, it confirms that backbone flexibility is evolutionarily conserved. Conversely, discrepancies suggest that backbone angles may evolve independently of sequence changes, influenced by functional requirements or environmental factors. Furthermore, structural conservation despite sequence divergence was observed, indicating that proteins with low sequence identity can still fold into similar structures due to functional constraints. Comparing Ramachandran-based trees with sequence trees highlighted instances where backbone flexibility remained preserved even as amino acid compositions changed. Additionally, the evolution of backbone flexibility and functional adaptations was analyzed, revealing how certain protein families develop enhanced flexibility or rigidity to adapt to biological roles. These insights are valuable for understanding protein stability, enzyme efficiency, and ligand interactions. The study highlights the potential of torsion angle-based classification as a complementary tool in protein phylogenetics, offering new perspectives on structural evolution and functional adaptation.

Keywords: Protein, Hemoglobin, Ramachandran Plots, Phylogenetic tree.

Effects of Sulphur dioxide on wheat cultivar grown at different fertility levels

Presented By

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Abstract

Field experiment were conducted to investigate the interactive effect of Sulphur dioxide and fertility regimes on the cultivar Malviya 206 plants were grown at 6 different fertility levels. 30 days old plants were exposed to 0.15 PPM Sulphur dioxide for 4 hours per day for 5 days per week for 8 weeks plants for grown at different combination of Nitrogen, Phosphorus and potassium and without fertilizers .Morphological characteristics and growth indices were computed for control and their respective treated plants at different stages of growth. SO2 fumigation resulted into foliar injury symptoms ,significant reduction in growth parameters like shoot and root length, number of tillers, leaves, ears, leaf area and growth indices such as leaf area ratio, leaf weight ratio, root : shoot ratio, specific leaf, relative growth rate, net assimilation rate, total Biomass and net primary productivity were reduced due to SO2 fumigation. Maximum inhibitory response was shown by plants grown without fertilizers. The study suggest that fertilizer amendment have, how ever, decreased the magnitude of reduction caused by Sulphur dioxide.

Computational Investigation of BRCA1-Protein Interactions Using STRING-Based Network Analysis and Protein-Protein Docking

Presented By

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Abstract

BRCA1 is a key tumor suppressor protein that plays a crucial role in DNA damage response and repair pathways. It interacts with multiple critical proteins, including BARD1, PALB2, BRIP1, TP53, ATM, and FANCD2, forming multi-protein complexes essential for maintaining genomic integrity. Disruptions in BRCA1 interactions due to mutations or external stress factors may lead to genomic instability and increased cancer susceptibility. While STRING provides a network-level understanding of BRCA1's functional interactions, protein-protein docking allows for a structural-level evaluation of these interactions. This study integrates STRING-based network analysis and docking simulations to investigate BRCA1's binding interactions and identify potential alterations in stability.

The BRCA1 protein-protein interaction (PPI) network was constructed using STRING (https://string-db.org/). High-confidence interactors (score ≥ 0.9) were selected for further analysis. Three key BRCA1 partners (BARD1, PALB2, BRIP1) were identified for structural studies. 3D structures were obtained from RCSB PDB or AlphaFold, and protein-protein docking was performed using ClusPro/HADDOCK to predict binding affinities and interface residues. Interaction stability was evaluated based on hydrogen bonds, salt bridges, and hydrophobic interactions.

The results from STRING analysis highlighted key functional interactors of BRCA1, while docking studies identified strong binding interfaces and critical residues contributing to stability. Comparative docking scores suggested varying binding affinities among different interactors, with BARD1 exhibiting the strongest predicted interaction. This study provides valuable insights into BRCA1's role in protein-protein interactions, which may contribute to a deeper understanding of its function in DNA repair pathways.

Further studies incorporating experimental validation of these interactions will be essential in confirming the computational predictions. These findings can contribute to future investigations on how BRCA1 interactions influence genomic stability and cancer susceptibility.

Keywords: BRCA1, Protein-Protein Interactions, STRING, Molecular Docking, Cancer, DNA Repair

A Study on Total and Fecal Coliform Bacteria in Urban Wetlands of Patna

Presented By

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Abstract

Urban wetlands are considered as a very crucial components of urban ecosystems because they act as a natural filter for pollutants. The local communities residing nearby uses it for various purposes such as fishing, waste disposal, idol immersion, swimming, bathing and drinking. These ecosystems are in danger today because of contamination due to anthropogenic activities, which are harmful to both the environment and people. This study explores the annual and site-specific seasonal variation of microbiological parameters the Total coliform (TC) and Fecal coliform (FC) in the water of two urban wetlands, Site 1(Sandalpur pond) and Site 2(Manikchand pond) of Patna. The study was conducted for the years 2022 to 2023 with a focus on the summer and winter seasons respectively. Water samples were collected from both the sampling sites during the summer and winter seasons of the year 2022 and 2023 respectively. Six different sampling stations were chosen at equal distances on both sites. To collect water samples glass stoppered bottles were used. Samples for analysis were transported to the lab in an ice box. The multiple tube fermentation technique also called the Most Probable Number (MPN) was used to estimate the Total coliforms and Fecal coliform. The samples obtained from both the sites were positive with respect to the coliform occurrence. The study revealed a distinct seasonal variation of their population with relatively higher values in summer and lower during winter. The highest mean value of TC was seen at site 2 during summers of 2023, whereas FC mean value was also high for the same site and season. From the results of this investigation, there's need to monitor the water quality from time to time to detect the actual source of contamination and also to pass the water through a form of treatment to prevent epidemic outbreak, since the values obtained are far above the WHO guidelines for water intended for domestic use.

Keywords: Total coliform, Fecal coliform, Summer season, Winter season, Seasonal variation.

Computational Strategies for Neuroblastoma Analysis Through Next-Generation Sequencing

Presented By

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Abstract

Neuroblastoma is among the most prevalent extracranial solid tumors in children, contributing to nearly 15% of pediatric cancer-related fatalities. Originating from neural crest progenitor cells of the sympathetic nervous system, it predominantly affects the adrenal medulla and paraspinal ganglia. Neuroblastoma exhibits a high degree of clinical and biological heterogeneity, ranging from spontaneous regression in low-risk cases to aggressive disease with poor prognosis in high-risk patients. Genetic and epigenetic alterations play a crucial role in tumor progression, with key oncogenic drivers including MYCN amplification, ALK mutations, ATRX alterations, and TP53 dysregulation. Understanding the molecular landscape of neuroblastoma is essential for improving diagnosis, risk stratification, and therapeutic strategies.

Next-Generation Sequencing (NGS) has revolutionized neuroblastoma research by enabling comprehensive genomic, transcriptomic, and epigenomic profiling at an unprecedented scale. Computational approaches are essential for managing and interpreting the vast complexity of NGS data, driving the discovery of clinically relevant biomarkers and potential therapeutic targets. Key bioinformatics strategies include sequence read alignment, variant detection, gene expression analysis, and pathway enrichment evaluation.

State-of-the-art tools streamline these processes, enhancing accuracy and efficiency. The BWA aligner ensures precise sequence alignment, while the Genome Analysis Toolkit (GATK) facilitates robust variant calling, enabling the identification of somatic and germline mutations. The Variant Effect Predictor (VEP) further refines this analysis by functionally annotating genetic variations, aiding in the detection of structural alterations and epigenetic modifications.

These advanced methodologies contribute significantly to understanding neuroblastoma's molecular landscape, ultimately supporting precision oncology approaches. By integrating computational power with NGS, researchers can decode the disease's genetic drivers, paving the way for improved diagnostics, prognostic models, and targeted therapeutic strategies to enhance clinical outcomes. The continued evolution of computational genomics will be instrumental in deciphering neuroblastoma biology, improving early detection, and developing targeted therapies to enhance patient outcomes.

In-Silico Screening of Phospholipase A2 Inhibitors for Effective Snakebite Management

Presented By

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Abstract

Snake envenomation remains a significant global health challenge, particularly in rural areas with limited access to effective treatments and imposes the development of precise and cost-effective therapeutic approaches. This study focuses on the in-silico screening of potential inhibitors targeting phospholipase A2 (PLA2), a key enzyme in venom toxicity. Initially, ADME (Absorption, Distribution, Metabolism, and Excretion) analysis was conducted to evaluate the oral bioavailability and pharmacokinetic profiles of potential inhibitors. Promising candidates such as varespladib, ellagic acid, vanillic acid and wedelolactone demonstrated favourable sdrug-like properties. Subsequently, molecular docking and dynamics simulations were performed to assess the binding interactions and stability of these compounds with PLA2 enzymes from the Indian medically significant snakes (Big Four): Naja naja, Daboia russelii, Bungarus caeruleus, and Echis carinatus. Varespladib exhibited the highest binding affinity and formed stable interactions with catalytic residues of the PLA2 enzymes, highlighting its strong potential as a therapeutic candidate. These in-silico results establish a strong foundation for experimental validations and contribute to the development of effective, orally administrable therapies for snakebite treatment.

Keywords: Snakebite, Phospholipase A2 inhibitors, ADME analysis, Molecular docking, Varespladib.

In silico study of Phospholipase A2 from Apis mellifera and Crotalus atrox and their interaction with breast cancer receptors

Presented By

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Abstract

Phospholipase A2 (PLA2) enzymes play a crucial role in lipid metabolism and have been associated with various biological activities, including potential anticancer properties. This study aims to conduct a comparative in silico analysis of Apis mellifera PLA2 and Crotalus atrox PLA2 to explore their interaction with key breast cancer receptors. Sequence similarity and physicochemical characterization were performed to understand the structural and functional properties of both PLA2 enzymes. Pairwise global sequence alignment using EMBOSS-NEEDLE was carried out to assess sequence homology between the two PLA2 proteins. Physicochemical parameters, including molecular weight, isoelectric point, stability index, and hydropathicity, were analyzed using PROT-PARAM to understand the structural features of each enzyme. To evaluate the anticancer potential of PLA2, molecular docking studies were conducted against key receptors overexpressed in breast cancer: Epidermal Growth Factor Receptor (EGFR, PDB ID: 2J6M), Human Epidermal Growth Factor Receptor 2 (HER2, PDB ID: 3PPO), Estrogen Receptor Alpha (ERα, PDB ID: 3ERT), and Progesterone Receptor (PDB ID: 4OAR). The docking simulations were performed using AutoDock Vina, and the docking interactions were visualized and analyzed in PyMOL to determine binding affinities and molecular interactions.

The results provide insights into the structural similarities between Apis mellifera and Crotalus atrox PLA2 and their differential binding affinities toward breast cancer receptors. The best interaction was observed between ERα with both PLA2.These findings contribute to understanding the role of PLA2 in cancer biology and may serve as a foundation for future studies exploring PLA2 as a potential therapeutic target in breast cancer.

Keywords: Phospholipase A2, breast cancer, molecular docking, EGFR, HER2, ERα, progesterone receptor.

A Hybrid Machine Learning Framework for Heart Disease Prediction: Optimizing Decision Tree Classifiers with Advanced Disease Attribute Selection and Meta-Learning Techniques

Presented By

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Abstract

Heart disease remains a leading cause of mortality worldwide, necessitating accurate and efficient predictive models for early diagnosis. This study proposes a hybrid machine learning framework that enhances heart disease prediction by optimizing decision tree classifiers with advanced disease attribute selection and meta-learning techniques. The framework integrates feature selection methods, such as recursive feature elimination (RFE) and principal component analysis (PCA), to identify the most relevant attributes, thereby improving classification performance. Additionally, meta-learning strategies, including ensemble techniques and hyperparameter optimization, are employed to refine the decision tree model and enhance generalization. The proposed approach is evaluated on benchmark heart disease datasets, demonstrating superior predictive accuracy, reduced model complexity, and improved interpretability compared to conventional classifiers. The results highlight the effectiveness of hybrid machine learning methodologies in medical diagnosis, offering a promising direction for clinical decision support systems (CDSS).

Keywords: Heart Disease Prediction, Machine Learning, Decision Tree Classifier, Feature Selection, Meta-Learning, Clinical Decision Support.