Proceedings of Abstracts

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THE 7TH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

ICRAMCS 2025

April 24-25-26, 2025

ENSA Marrakech, Cadi Ayyad University, Morocco

This volume contains only the abstracts of the communications presented at the conference. Full papers, if any, will be published separately in peer-reviewed journals or proceedings.

Conference Proceedings of Abstracts Report

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FOREWORD & ACKNOWLEDGEMENTS

It is with immense pleasure and great pride that we welcome all participants, esteemed colleagues, and distinguished guests to **the 7th Edition of the *International Conference on Research in Applied Mathematics and Computer Science (ICRAMCS 2025)**. Organized by Cadi Ayyad University and held at the National School of Applied Sciences (ENSA) of Marrakech, this edition marks another milestone in our continuous effort to foster international scientific collaboration and promote cutting-edge research at the crossroads of applied mathematics and computer science.

This year, ICRAMCS 2025 has brought together scholars and researchers from **28 different nationalities**, reflecting the global reach and reputation the conference has acquired over the years. We are deeply honored by the presence of all participants who have joined us from around the world to share their expertise, ideas, and passion for scientific advancement.

We extend our heartfelt gratitude to our **keynote speakers** whose insights and academic excellence have greatly enriched the scientific program:

- **Prof. Ayman ALZAATREH**, American University of Sharjah, UAE
- **Prof. Mahamat Saleh DAOUSSA HAGGAR**, University of Ndjamena, Chad
- **Prof. Sandra FERREIRA**, University of Beira Interior, Covilhã, Portugal
- **Prof. Cemil TUNÇ**, Van Yuzuncu Yil University, Van, Turkey

Their contributions reflect the diversity and high caliber of thought leadership present at this edition of the conference.

Our sincere thanks go to the **organizing committee**, whose tireless work, dedication, and logistical coordination made this event possible. Their passion and commitment ensured the success of every detail, from the academic program to the welcoming environment.

We are also profoundly grateful to the **scientific committee** for their rigorous evaluation of submissions, ensuring that only the most promising abstracts were selected. This has contributed significantly to maintaining the academic rigor and credibility of ICRAMCS.

We appreciate the support of our **institutional partners and sponsors**, whose commitment to scientific excellence and international cooperation has been invaluable in the realization of this event.

Last but not least, we thank **all participants**, whether attending in person or online, for their enthusiasm, intellectual curiosity, and active engagement. Your contributions foster meaningful exchanges, spark new collaborations, and reinforce the global scientific community we are proud to be part of.

We look forward to future editions and hope that ICRAMCS 2025 serves as a memorable and inspiring experience for all. May this conference pave the way for new discoveries, long-lasting partnerships, and impactful innovations in applied mathematics and computer science.

Sincerely,

On behalf of the Organizing Committee of ICRAMCS 2025
Prof. Youssef EL FOUTAYENI
Cadi Ayyad University, Marrakech-Morocco

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- Applied Mathematics to Economics and Finance
- Biomathematics
- Dynamical systems and Differential Equations
- Fixed Point Theory and Applications
- Functional Analysis & Linear Algebra
- Operations Research & Optimization
- Optimal Control Theory and Applications
- Probability & Statistics and Stochastic Analysis
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- Artificial Intelligence and Machine Learning
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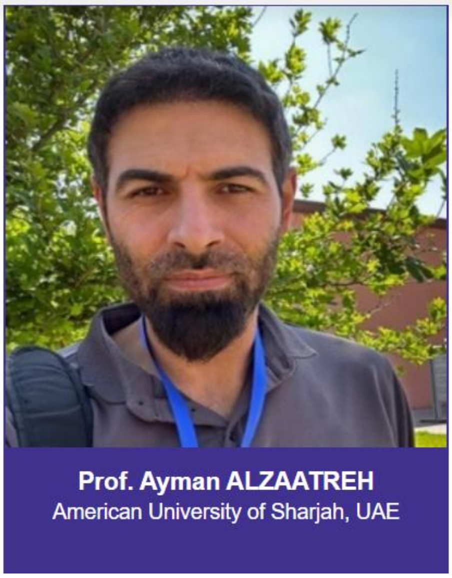
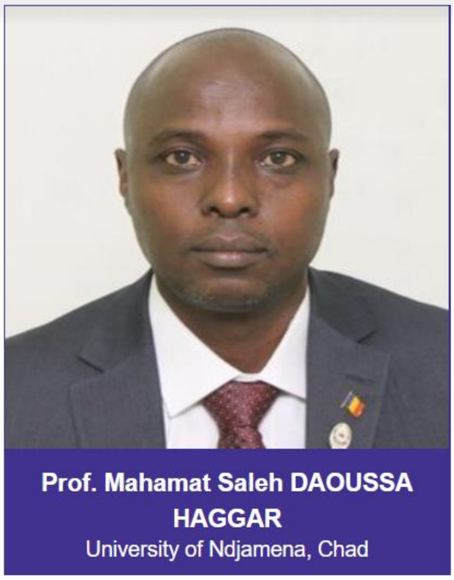


FEATURE RANKING WITH RELATIVE BELIEF: A BAYESIAN FILTER METHOD FOR MIXED-TYPE FEATURES IN CLASSIFICATION PROBLEMS

American University of Sharjah, Sharjah, UAE
aalzaatreh@aus.edu

Abstract

Feature selection is a crucial step in data mining and machine learning applications, particularly when dealing with high-dimensional datasets. It helps mitigate the curse of dimensionality, improve model performance, and reduce computational complexity. Among the available approaches, filter methods stand out for their efficiency, as they evaluate the relevance of features independently of the learning algorithm. In this talk, we present a Bayesian filter-based feature selection method based on the Relative Belief Ratio. This approach is employed to rank and select quantitative features based on the strength of evidence they provide in relation to the target variable, without requiring access to the learning model. The method is applied to both binary and multi-class classification problems. Additionally, the approach is extended to handle qualitative features, enabling a broader application of the proposed filter method in real-world datasets where non-numeric attributes are common. Several benchmark datasets are used to validate the effectiveness of the proposed method, showcasing its robustness and scalability in diverse classification settings.



A MATHEMATICAL MODEL FOR INVESTIGATING THE THERAPEUTIC RESPONSE OF REPAGLINIDE AND METFORMIN IN TYPE 2 DIABETES PATIENTS

University of NDjamena, NDjamena, Chad
msdhaggar@gmail.com

Abstract

In recent decades, several mathematical models of the glucose-insulin system have been developed to study the complications of diabetes and to diagnose and treat the disease by predicting outcomes. However, in this work, we focus on the interaction between two drugs used in the treatment of type 2 diabetes when lifestyle measures alone are insufficient to control blood glucose levels: metformin and repaglinide. Initially, we combine these two treatments using a new approach of a mathematical model of the glucose-insulin system that integrates the effects of these drugs. The model parameters are then estimated using an inverse optimization problem and available data. The response of metformin and repaglinide in type 2 diabetes patients is investigated through numerical simulations. The results show an increase in glucagon and insulin concentrations, as well as a decrease in glucose concentrations in the heart, tissues, and liver. These findings support the mechanism by which repaglinide lowers blood glucose levels by stimulating insulin release from the pancreas, while metformin helps reduce blood sugar by improving the body's response to insulin.

EXTENDING THE WEIBULL DISTRIBUTION FOR NON-MONOTONE FAILURE RATES

University of Beira Interior, Covilhã, Portugal
sandraf@ubi.pt

Abstract

The widespread use of the Weibull distribution in reliability and survival analysis has led statisticians to seek improved models that can handle data exhibiting non-monotone failure rates. As the typical Weibull distribution is somewhat limited, as it can only model hazard functions that are monotonically increasing or decreasing, in this talk we present an extension to obtain failure rates with bathtub-shaped and unimodal showing that this extension offers flexibility compared to the traditional Weibull distribution and it is especially useful when we are working with real-world data that might not fit the simple assumptions of the Weibull distribution. This presentation is substantiated by model comparisons and graphical illustrations that complement the theoretical foundation. The interest of the recommended distribution is confirmed through a real data set.

UNIQUE SOLUTIONS FOR INTEGRAL EQUATIONS, INTEGRO- DIFFERENTIAL AND CAPUTO FRACTIONAL DIFFERENTIAL EQUATIONS WITH DELAY: PROGRESSIVE CONTRACTIONS

Van Yuzuncu Yil University, Van, Turkey
cemtunc@yahoo.com

Abstract

In this study, first we handle nonlinear integral and integro-differential equations with delay. We investigate global existence and uniqueness of solutions of the considered equations by fixed point method using progressive contractions of T.A. Burton. We prove some new results including sufficient conditions with regard to global existence and uniqueness of solutions of the considered equations. We provide an example for illustrations.

Second, we handle a nonlinear Caputo fractional differential equation (CpFrDE) including multiple variable delays. We study uniqueness of the solutions of the CpFrDE under consideration. Here, we apply the method of progressive contractions on CpFrDEs including multiple variable delays. The vital point of the method of progressive contractions is that it is a very flexible idea to discuss the uniqueness of solutions for various mathematical models. We also provide an example to demonstrate how the outcome can be applied.

The present study has new contributions to the qualitative theory of integral and integro-differential equations and fractional differential equations.

TABLE OF CONTENTS

ABSTRACTS [MATHEMATICS]

ABSTRACTS [COMPUTER SCIENCE]

ICRAMCS 2025

THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

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L'image des opérateurs élémentaires

Communication Info

Authors:
El Mouadine Hamza [1]

[1] *Faculté des sciences - Université Chouaib Doukkali, El Jadida, Maroc*

Keywords:
(1) Théorie des opérateurs
(2) Opérateurs élémentaires
(3) Dérivations
(4) Dérivations généralisées
(5) Image, noyau

Abstract

Une dérivation interne δ_A est une application définie sur l'algèbre des opérateurs bornés $\mathcal{L}(H)$ par $\delta_A(X) = AX - XA$. L'appellation dérivation est justifiée par la relation $\delta_A(XY) = \delta_A(X)Y + X\delta_A(Y)$. Le point de départ de la théorie des dérivations a été l'établissement par Wintner [1], que l'opérateur identité ne peut jamais s'écrire sous la forme $AB - BA$, i.e., l'identité n'est pas un commutateur d'opérateurs bornés. Cette application dont la forme est simple, fut une source d'investigations depuis les années cinquante du siècle dernier dans tous les aspects :

- Détermination de son spectre et des parties du spectre [2] [3].
- Est-ce que toute application, qui est digne de l'appellation dérivation (elle vérifie la relation en haut), a la forme δ_A pour un operateur A ? [4].
- Détermination de la norme de δ_A [5] et d'autres problèmes [6].

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Mathematical Analysis of the Effects of Food Influencers on Consumers Food Choices

Communication Info

Authors:
Anwar El Fadil El Idrissi
Abdelhak Yaacoubi

MAEGE, Hassan II University of Casablanca-AIN SEBAA, Casablanca, Morocco

Keywords:
Food influencers, Mathematical modeling, Consumer behavior, Social media mar, Ket-ing, Epidemiological models, Stability analysis, Numerical simulation

Abstract

This research explores the impact of food influencers on consumer behavior in the food industry. The study categorizes the population into three groups: those who are unaware U, those actively engaged E, and those who have adopters A. The model uses equations inspired by epidemic studies to understand how new food trends spread or fade over time. Key parameters like engagement rate $\beta 2$, adoption rate $\beta 2$, net transition rate θ, and exit rate μ are assessed.
Numerical simulations show how interactions and receptiveness evolve over time, emphasizing the importance of strategies that enhance consumer engagement and simplify the adoption process while reducing dropout rates to promote acceptance. This research provides valuable insights for marketers and businesses looking to leverage social media influence in promoting new food products.

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April 24-25-26, 2025 | Marrakech, Morocco

Real Case Study of Moroccan Tri-Trophic Model with Alternative Food

Communication Info

Authors:

Nossaiba BABA[1]
Imane AGMOUR [1]
Youssef EL FOUTAYENI [2]
Naceur ACHTAICH [1]

[1] Hassan II University of Casablanca, Morocco
[2] Cadi Ayyad University-Marrakech-Morocco

Keywords:

(1) Fish population
(2) Alternative food
(3) Tri-trophic model
(4) Maja Squinado
(5) Octopus Vulgaris
(6) Xiphias gladius
(7) Stability analysis.

Abstract

In this study, we perform a comprehensive analytical and numerical analysis of the dynamics within the Moroccan tri-trophic marine ecosystem, focusing on the species Maja Squinado, Octopus Vulgaris, and Xiphias Gladius. We compare the behavior of the system with and without alternative food sources. Mathematically, we explore the positivity, boundedness, equilibrium points, and their stabilities in both scenarios. The effect of alternative food resources on intermediate predators (Octopus Vulgaris) is examined in the context of a Holling II functional response. Our results reveal that when predators rely solely on their preferred prey, their biomass initially peaks before declining. However, the availability of alternative food sources allows the prey population to recover, thus maintaining a stable predator biomass. This highlights the essential role of alternative food sources in maintaining ecosystem stability and the closer alignment of the model with real-world dynamics

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Existence de solutions d'équations présentant des non-linéarités asymétriques

Communication Info

Authors:

LAHBOUB Mohamed[1]

ABCHIR Chakib [2]

[1] *FST,Mohammadia, Morrocco*

Keywords:

(1) degré topologies

(2) operateurs elliptiques

(3) space reflexive

Abstract

On donne des résultats d'existence et la non-existence de solution du problème suivant :

$$Au = g(x,u) + h$$

Avec $\lim\limits_{+\infty} \frac{g(x,s)}{s} = \alpha$ et $\lim\limits_{-\infty} \frac{g(x,s)}{s} = \beta$ et A est un opérateur linéaire.

Pour cela on utilise la théorie du degré topologique au sens de Leray-Schauder ou de Brouwer et les inégalités vérifiées par l'operateur A où :

$$Au = \alpha u^+ - \beta u^-$$

On suppose que Ω est un ouvert borné de $\mathbb{R}^n$ et que l'operateur A :$D(A) \subset L^2(\Omega) \rightarrow L^2(\Omega)$ est auto adjoint à résolvante compacte cela signifie que D(L) est dense dans L^2 et que A est fermé.

On considère une valeur propre de multiplicité supérieur ou égale 2 de A et on note par φ une fonction qui lui associée.

g :$\Omega \times \mathbb{R} \rightarrow \mathbb{R}$ est une fonction carathéodory et $h \in L^2(\Omega)$,

On appelle le spectre de Fucik associé à l'operateur A et on note Σ l'ensemble des couples $(\alpha, \beta) \in \mathbb{R} \times \mathbb{R}$ tel l'équation

$$Au = \alpha u^+ - \beta u^-$$

Admet une solution non nulle dans D(A)

Références

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Analysis and Numerical Approximation of a Frictional Contact Problem arising in Thermo viscoelasticity

Communication Info

Authors:
Mohamed Essofi [1]
Mustapha Bouallala [2]
Youssef Ouafik [3]

[1] *Cadi Ayyad University, Polydisciplinary faculty, Modeling and Combinatorics Laboratory, Department of Mathematics and Computer Science B.P. 4162,Safi, Morocco*
[2] *Cadi Ayyad University, Polydisciplinary faculty, Modeling and Combinatorics Laboratory, Department of Mathematics and Computer Science B.P. 4162,Safi, Morocco*
[3] National School of Applied Sciences of Safi, Cadi Ayyad University, Safi, Morocco

Keywords:
(1) Thermo-viscoelastic
(2)Viscoelastic constitutive law,
(3)Contact,
(4)Friction
(5)Numerical simulation

Abstract

This research aims to investigate a quasistatic frictional contact problem involving a thermo-viscoelastic body and a thermally conductive foundation. The displacement behavior within the constitutive relation is modeled using a Kelvin-Voigt model, while the heat conduction aspect is characterized by a temperature-associated parameter. The contact condition is defined by an instantaneous normal response and a unilateral speed constraint, reminiscent of a form of Coulomb's law for dry friction. We propose a variational approach for this problem and establish the existence of its weak solution by employing a combination of techniques, including the theory of monotone operators and the Banach fixed-point theorem. To illustrate the effectiveness of our methodology, we conduct various numerical simulations to demonstrate the performance of the proposed approach.

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Generalising families of algebraic points of quotients of Fermat curves $\mathcal{C}_{r,r}(p)$

Communication Info

Authors:
Mohamadou Mor Diogou DIALLO[1]
Cherif Mamina COLY [2]

[1] *Department of Mathematics, Assane Seck University of Ziguinchor,* Ziguinchor, Senegal.
[2] *Department of Mathematics, Assane Seck University of Ziguinchor,* Ziguinchor, Senegal.

Keywords:
(1) Mordell-Weill group
(2) Rational Points
(3) Jacobian
(4) Galois Conjugate

Abstract

We explicitly determine all possible obstructions for algebraic points of arbitrary degree on the quotient curves $\mathcal{C}_{r,r}(p)$, defined by the affine equation

$$y^p = x^r(x-1)^r.$$

These curves form special cases of a family of quotients of the Fermat curve $\mathcal{C}_{r,s}(p)$, given by the affine equation

$$y^p = x^r(x-1)^s.$$

where $1 \leq r, s, r+s \leq p-1$. This family itself originates from quotients of the Fermat curve $\mathcal{F}_n$, defined by the affine equation

$$x^n + y^n + 1 = 0.$$

This note generalizes the results obtained by Gross and Rohrlich, who determined the rational points, denoted $\mathcal{C}_{1,1}(11)^1(\mathbb{Q})$, on the curve $\mathcal{C}_{1,1}(11)$ [12]. It also builds upon the work of Coly and Sall, who identified the set $\mathcal{C}_{2,2}(11)^3(\mathbb{Q})$ of algebraic points of degree at most 3 on the curve $\mathcal{C}_{2,2}(11)$ [5], as well as that of Diallo, Baldé, and Sall, who established the existence of points of arbitrary degree, denoted $\mathcal{C}_{3,3}(11)^\ell(\mathbb{Q})$, on the Fermat quotient curve $\mathcal{C}_{3,3}(11)$ [2]

A study of some operators defined on Banach spaces

Communication Info

Authors:
Sanaa BOUMNIDEL

Faculty polydisciplinary of Larache

Keywords:
(1) Banach spaces
(2) Linear operators
(3) Order vector

Abstract

Positive theory plays an important role in economics by providing a scientific approach to understanding economic behavior and developing economic models that can be used to make informed decisions. One of the most used operator in operator theory is the Dunford-Pettis operator, which is a linear operator on Banach spaces that satisfy a certain property, namely that they map weakly convergent sequences to norm convergent sequences.

Many new operators were defined on the basis of this famous operator in functional analysis field. We study the weak*Dunford Pettis operator which is derived from the concept of Dunford Pettis and we conclude some new results.

References

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Advanced Modeling of Temporal Dynamics Using Time-Adaptive Linear Mixed Models

Communication Info

Authors:
Dário FERREIRA[1]
Sandra FERREIRA [1]

[1] *UBI, Covilhã, Portugal*

Keywords:
(1) Time-Adaptive Models
(2) Temporal Data Analysis
(3) Dynamic Mixed Models

Abstract

This work presents the Time-Adaptive Linear Mixed Model (TALMM), a novel methodology for the analysis of temporally evolving data. Traditional linear mixed models (LMMs) often assume static random effects, limiting their applicability in dynamic contexts where data structures shift over time. TALMM extends this framework by introducing time-adaptive random effects, offering a versatile tool for accurately modeling temporal variations. This innovation is particularly impactful in areas such as computational science, applied mathematics, and fields like finance, biology, and social sciences, where data patterns evolve in response to changing conditions. The study delves into the theoretical foundation of TALMM, discusses parameter estimation techniques, and provides a comprehensive case study to demonstrate its effectiveness. Results underline the model's ability to enhance predictive accuracy and offer deeper insights into complex temporal processes.

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THE STRONGLY COHOPFIAN ABELIAN GROUPS IN THE CATEGORY OF ALGEBRAICALLY COMPACT ABELIAN GROUPS

Communication Info

Authors:
Seddik ABDELALIM

FSAC University Hassan II Casablanca Morocco

Keywords:
strongly co-Hopfian,
Abelian groups,
p-group,
torsion group,
pure-subgroup, algebraically compact
basic subgroups,

Abstract

The abelian group A is called Strongly CoHopfian if the chain Im(f) ⊂ Im(f^2) ⊂ \Im(f^3) ⊂ Im(f^4) ⊂ .... $ is stationary for all endomorphisms f of A.
In this paper, we characterize strongly CoHopfian abelian groups in the category of algebraically compact abelian groups, and we determine their properties in the category of abelian groups free torsion

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Simulation of a liquid chromatographic reactor using an isothermal nonlinear equilibrium model for gradient elution considering Bi-Langmuir adsorption

Communication Info

Authors:
Abdulaziz Garba AHMAD[1]
Haris Jaafar BELLO[1]
David Ugochukwu DAVID[2]

[1] Federal University of Technology, Babura, Nigeria
[2] National Mathematical Centre, Abuja, Nigeria

Keywords:
(1) Chromatographic reactor
(2) Bi-Langmuir isotherm
(3) Gradient elution
(4) One-dimensional
(5) High-resolution scheme

Abstract

This study presents the development of an isothermal nonlinear reactive equilibrium dispersive model (REDM) for liquid chromatography to examine the transport of a multi-component mixture through a single column under gradient elution, considering nonlinear adsorption thermodynamics. A generalized Bi-Langmuir adsorption equilibrium isotherm is used to analyze the model equations, with Danckwert boundary conditions applied. The resulting model comprises a set of convection-dominated partial differential equations for the mass concentrations in the liquid phase, coupled with differential and algebraic equations for the solid phase. A scheme of high-resolution finite volume method (HR-FVM) using an appropriate flux-limiter was employed to solve the model equations numerically. This suggested method deals with integral form of conservation laws, which avoids spurious oscillations, reduces numerical dissipation, and provides higher-order accuracy on the coarser grids. Further, the impact of modulator concentration is studied for a reversible reaction of type $A \overset{R}{\Leftrightarrow} B + C$. Furthermore, the effect of changing modulator concentration and model parameters on the separation of specific components is investigated. For instance, numerical simulations are used to assess the impacts of gradient start and end times, solvent composition, solvent strength parameters, axial dispersion coefficients, and the initial and final concentrations of the gradients. The proposed framework provides useful insights for optimizing gradient chromatography systems.

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ICRAMCS 2025
THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April24-25-26, 2025 | Marrakech, Morocco

Optimizing Control Strategies for Monkeypox through Mathematical Modeling

Communication Info

Authors:
Mohamed BAROUDI[1]
Imane SMOUNI[1]
Hicham GOURRAM [1]
Abderrahim LABZAI [2]
Mohamed BELAM [1]

[1] Laboratory LMACS, Sultan Moulay Slimane University, MATIC Research Team: Applied Mathematics and Information and Communication Technologie, Department of Mathematics and Computer Science, Khouribga Polydisciplinary Faculty, Morocco.
[2] Laboratory of Analysis Modeling and Simulation, Department of Mathematics and Computer Science, Faculty of Sciences Ben M'sik, Hassan II University of Casablanca, Morocco.

Keywords:
(1) Monkeypox virus
(2) Control optimal
(3) Pontryagin's maximum principle.

Abstract
Monkeypox is a zoonotic viral disease similar to smallpox, has emerged as a major global health concern following the COVID-19 pandemic. This study presents a novel mathematical model aimed at analyzing various epidemiological factors, particularly the less-explored transmission from humans to monkeys, where both species act as carriers. Our approach integrates comprehensive awareness campaigns, strict security measures, and targeted health interventions to limit transmission between hosts, with the goal of reducing human infections and eliminating the virus among animal populations. The model utilizes the continuous-time Pontryagin maximum principle to determine and apply optimal control strategies, with iterative simulations conducted in Matlab. Our results, derived from these simulations, show that implementing all proposed preventative strategies—such as public awareness efforts, isolation of infected monkeys, and vaccination—simultaneously is the most effective method to control the virus's spread. We observed a significant reduction in both human and animal infections when these strategies were combined. The study's conclusions provide important insights into the transmission dynamics of monkeypox, highlighting the critical role of multifaceted intervention strategies in controlling outbreaks. These findings are expected to support more effective public health management and contribute to the global effort to contain and ultimately eradicate monkeypox.

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Boosting LCP Solver Performance with Accelerated Updates

Communication Info

Authors:
Yamna ACHIK[1]
Noussaiba BABA[1]
Youssef EL FOUTAYENI [2,3]
Naceur ACHTIACH[1]

[1] *Hassan II University, Casablanca, Morocco*
[2] Cadi Ayyad University, *Marekech, Morocco*
[3] *Unit for Mathematical and Computer Modeling of Complex Systems, IRD, France*

Keywords:
(1) Linear complementarity problems,
(2) singular value decomposition (SV D),
(3) iterative approach.

Abstract

This paper introduces an efficient algorithm for solving linear complementarity problems (LCPs) [1,2], specifically targeting the LCP(M;q) [3,4] form, where M is a square matrix and q is a vector. The proposed method utilizes an iterative approach, systematically updating variables to achieve convergence to a solution that meets the required complementarity conditions. To optimize memory usage and computation time[5], the algorithm incorporates singular value decomposition (SVD), eliminating the need for computationally expensive matrix inversions and determinants. Experimental evaluations on benchmark problems showcase the algorithm's convergence properties and computational efficiency, highlighting its potential for practical applications. This work advances optimization methodologies by providing a robust and effective approach for solving complex LCPs across various fields. Continued development and application of this algorithm hold promise for enhancing computational efficiency and expanding the applicability of LCP

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Polynômes orthogonaux pour un produit scalaire de Sobolev

Communication Info

Authors:
Mohammed Karmouni[1]
Mohammed Tanjaoui[2]

[1] University Cadi Ayyad, Marrakech, Morocco.
[2] University Cadi Ayyad, Marrakech, Morocco.

Keywords:
(1) Polynômes orthogonaux ;
(2) Relation récurrente de Polynômes orthogonaux ;
(3) Polynômes orthogonaux de Sobolev.

Abstract

Une famille (P_n) de polynômes orthogonaux (P.O) est une **base orthogonale** associée à un produit scalaire défini sur $\mathbb{R}[X]$ vérifiant : P_n est unitaire et $d°P_n = n$. Une telle famille associée à un produit scalaire standard vérifie une propriété essentielle qui est la relation récurrente d'ordre 2 comme les polynômes de Tchebychev, polynômes de Legendre, polynômes de Hermite etc. Parce que le produit scalaire dans ce cas vérifie (voir [1]) la propriété suivante :

$$\forall P, Q \in \mathbb{R}_n[X] \ , \ \langle XP|Q\rangle = \langle P|XQ\rangle \quad (*)$$

Par contre il y a un autre type de famille (P.O) associée à un produit scalaire non standard qui ne vérifie pas cette relation récurrente (voir par exemple [2] et [3]).

On se propose une nouvelle technique pour trouver une relation récurrente d'ordre 2 pour une autre famille (P.O) associée à un produit scalaire, non standard, de type Sobolev.

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ON HOLLOW-LIFTING SEMIMODULES

Communication Info

Authors:
MOUSSA SALL [1]
LANDING FALL [2]
DJIBY SOW [3]

[1] *University Cheikh Anta Diop, Senegal*
[2] *University Cheikh Anta Diop, Senegal*
[3] *University Cheikh Anta Diop, Senegal.*

Keywords:
(1) Subtractive semimodule
(2) lifting semimodule,
(3) hollow-lifting semimodule

Abstract

A left R-semimodule M is called hollow if every proper subsemimodule of M is small in M.
A left R-semimodule M is called lifting if every subsemimodule of M lies above a direct summand of M therefore **N. Orhan**, **D.Keskin** and **R. Tribak** introduce the concept of hollow-lifting and hance:
a left R-semimodule M is called hollow-lifting if for every subsemimodule N of M with M/N hollow lies above a direct summand of M.
It is in wake that we will show when ever are the concepts of lifting, hollow-lifting and hollow semimodule are equivalent? How to characterize an hollow-lifting semimodule? When is a direct summand of an hollow-lifting semimodul is hollow lifting?

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Algebraic points of degree d on some quotients of Fermat curve of degree 11

Communication Info

Authors:
Moussa FALL[1]

[1] *Assane Seck University, Ziguinchor, Senegal*

Keywords:
(1) quotients of Fermat curve
(2) degree of algebraic point
(3) Morphism

Abstract

The aim of this work is to give a parameterization of the set of algebraic points of degree d on a special family of some quotients of Fermat curve of degree 11. The affine equation of this family is $C_r : y^{11} = x^r(x-1)^r$ where $r \in \{1,2,3,4,5\}$ and $d \in \{4, 5, 6\}$.
This work is made easy by the finiteness of the Mordell-Weil group, which allows us to use the Abel Jacobi map and the Riemann Roch spaces to determine the points on the curve C_1. The use of birational equivalences allows us to determine the points on C_r.
The results obtained extends the work of Coly and Sall who determined the algebraic points of degree at most 3 on the curve C_2 [2]

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A cubic B-spline quasi-interpolation approach for singularly perturbed time-dependent parabolic convection-diffusion problems

Communication Info

Authors:
Mohamed Chaher[1]
Abdellah Lamnii[1]
Mohamed-Yassir Nour[2]

[1] *University of Abdelmalek Essaadi, laboratory ISI, ENSATe, Tetouan, Morocco*
[2] *University Lorraine, CNRS, Inria, LORIA, F-54000 Nancy, France.*

Keywords:
(1) Singularly Perturbed
(2) Boundary value problems
(3) Shishkin mesh
(4) Cubic B-spline
(5) Quasi- interpolation

Abstract

In this paper, we present an efficient numerical scheme for solving singularly perturbed time-dependent parabolic convection-diffusion problems based on cubic B-spline quasi-interpolation. The temporal variable is discretized on a uniform mesh using the Crank-Nicolson method, while the spatial variable is discretized using a cubic B-spline quasi-interpolation method defined on a piecewise uniform Shishkin mesh. The stability and convergence of the method are established. To demonstrate its efficacy, we compare our proposed approach with several benchmark problems from the existing literature.

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ON THE GRAPH CONVERGENCE OF SUBDIFFERENTIALS OF PARACONVEX FUNCTIONS

Communication Info

Authors:
Abdessamad OUSSARHAN[1]

[1] *FPBM, USMS, Béni Mellal, Morocco*

Keywords:
(1) Paraconvexity
(2) Extended Brøndsted-Rockafellar's theorem
(3) Mosco-convergence
(4) Painlevé-Kuratowski convergence

Abstract

In 1965, Brøndsted and Rockafellar [2] established that the domain of Fenchel subdifferential of a closed proper and convex function is dense in its domain. Our purpose in this talk (see [1]) is to show that the theorem is valid if instead, one considers functions more general than convex, these functions are called paraconvex (introduced in [4] by Rolewicz). As an application, we extend Attouch's Theorem as well as a result of Combari and Thibault [3] concerning the graph convergence of subdifferentials of a sequence of convex functions to the graph convergence of appropriate subdifferentials of a sequence of paraconvex functions in the setting of arbitrary Banach space.

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Stochastic Gilpin-Ayala Model in Polluted Environment with Markovian switching

Communication Info

Authors:
Youssef EL KHALFI [1]
Adel SETTATI [1]
Aadil LAHROUZ [1]
Mourad EL IDRISSI [1]

[1] Laboratory of Mathematics and Applications, FSTT, Abdelmalek Essaadi University,Tetouan,Morocco.

Keywords:
(1) Stochastic model,
(2) Markovian Switching,
(3) Stability,
(4) Extinction,
(5) Persistance,
(6) Environment Polluted,
(7) Stationary distribution.

Abstract

This study examines the stochastic Gilpin-Ayala model in a polluted environment, incorporating Markovian switching and white noise. The Gilpin-Ayala parameter is permitted to vary according to the Markovian state. We begin by establishing the global stability of the trivial equilibrium state in the model. Sufficient and verifiable conditions are then derived to determine the population extinction and persistence criteria within this stochastic framework. Additionally, we demonstrate the existence of a stationary distribution under certain conditions. Finally, numerical simulations are presented to validate and illustrate the theoretical findings.

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Mathematical Modeling for Fisheries Management: The Sustainable Harvesting of Three Major Marine Species in Morocco

Communication Info

Authors:
Ilham AIT EL HARCH
Khalid OUTAAOUI
Youssef EL FOUTAYENI

1 Laboratory of Mathematics and Population Dynamics, Cadi Ayyad University, Marrakech, Morocco
2 Laboratory of Mathematics and Population Dynamics, Cadi Ayyad University, Marrakech, Morocco
3 École Nationale des Sciences Appliquées, Marrakech, Morocco

Keywords:
(1) Bioeconomic modeling
(2) Optimization Techniques
(3) Biological equilibrium

Abstract

This study aims to deepen the understanding and optimize fishing activity in Morocco by holistically integrating biological and economic aspects. On the biological front, we examine the rivalry between three marine species: Sardine, Mackerel, and Tuna, and the need to preserve the balance of their biomass. On the economic side, we focus on maximizing fishermen's profits.

We develop a biological equilibrium model for fishermen operating in the Atlantic region, where the three species coexist. These competing species exhibit their natural growth represented by logistic curves. We propose a mathematical model that takes into account the density and competition between species to explain population dynamics. Integrating human intervention adds a realistic dimension to our modeling. Fishermen specifically target all three species, thereby influencing population dynamics based on their fishing activities. This approach allows us to explore the effects of human-nature interaction on the biological equilibrium of sardine, mackerel, and tuna populations.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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A coupled system of fractional history-dependent hemivariational inequalities arising in contact mechanics

Communication Info

Authors :
Abderrahmane OULTOU[1]
Hicham BENAISSA [2]

[1] *Faculty Polydisciplinaire of Khroubga, Khroubga, Morocco*
[2] *Faculty Polydisciplinaire of Khroubga, Khroubga, Morocco*

Keywords:
(1) Hemivariational inequality
(2) History-dependent
(3) Rothe method
(4) Multivalued surjectivity theorem
(5) Contact problem

Abstract

The current work is devoted to investigate a new class of system consisting of fractional history-dependent hemivariational inequalities. By using the Rothe method (Semi-discrete) and the theorem of the surjectivity for a multivalued operator, the existence solution is established. Moreover, we apply the obtained results to study a new frictional contact problem between two viscoelastic bodies with long memories.

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April 24-25-26, 2025 | Marrakech, Morocco

Optimizing Flow Time and Carbon Emissions in Flexible Job-Shop Scheduling with Mixed-Integer and Constraint Programming

Communication Info

Authors:
Asma FEKIH [1], Mohamed Karim Hajji [2]

[1] LR-OASIS, National Engineering School of Tunis, University of Tunis El Manar, Tunis, Tunisia
[2] College of Engineering and Technology, American University of the Middle East, Kuwait

Keywords:
(1) Flexible Job-Shop
(2) Mixed-Integer Programming
(3) Constraint Programming
(4) Particle swarm algorithm
(5) Sustainable manufacturing

Abstract

The Flexible Job-Shop Scheduling Problem (FJSP) is a challenging optimization problem that involves efficiently scheduling a sequence of jobs across a given set of machines [1]. In the context of sustainable manufacturing, minimizing carbon emissions has become a critical objective [2]. This paper proposes two mathematical models: A Mixed-Integer Programming (MIP) and a Constraint Programming (CP) models, designed to minimize flow time and carbon emissions in FJSP. The models integrate energy consumption data [3][4] to incorporate carbon emission constraints within the scheduling process. To provide a comprehensive evaluation, a random-key based particle swarm algorithm is implemented to handle large-scale instances, while the CP and MIP models are employed to obtain exact solutions for medium-sized instances. This dual approach ensures a thorough analysis across different problem scales. Experiments conducted on a large set of randomly generated instances demonstrate the effectiveness of the proposed methods for sustainable manufacturing.

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Stochastic analysis of epidemic model with relapse incorporating Ornstein-Uhlenbeck process

Communication Info

Author:
Adil El Haitami[1]

[1] *Laboratory of mathematics and applications, FSTT, Abdelmalek Essaadi University, Tetouan, Morocco.*

Keywords:
(1) Stochastic SIRI epidemic model
(2) Relapse
(3) Ornstein-Uhlenbeck process

Abstract

The goal of this communication is to determine how a stochastic SIRI epidemic model with nonlinear relapse and a mean-reverting Ornstein-Uhlenbeck process reacts to stochastic perturbation. Initially, we establish the existence of a unique global solution that is achievable under all favorable initial conditions. Then, the new stochastic model threshold values, R_β and R_λ, are formed. We establish sufficient conditions for the disease to persist and go extinct. In conclusion, we present some computer simulations that demonstrate the theoretical insights that we have obtained. The results of this study have the potential to enhance our comprehension of epidemic models and contribute to the development of viable strategies for the prevention and control of diseases.

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Modified moving least squares meshless method for solving multidimensional mixed integral equations

Communication Info

Authors:
Zahra El Majouti

Laboratory of Computer Systems Engineering, Mathematics and Applications (ISIMA). Ibnou Zohr University, Agadir B.P. 80000, Morocco

Keywords:
(1) Modified moving least squares approximation,
(2) moving least squares approximation,
(3) nonlinear Integral equations,
(4) error estimates.

Abstract

The three-dimensional (3D) modified moving least-square method is expanded for solving the numerical solution of 3D linear and nonlinear Volterra–Fredholm integral equations of the second kind. This approach is very convenient for solving integral equations in high dimensions and it does not require any need for mesh connectivity. The size of the support used is the only factor that has a significant effect on the maximum errors of the MLS method. To overcome this problem, the MMLS approach with a non-singular moment matrix is applied to obtain better results than MLS approximation on using the best support, then applying the method in three dimensions can be easily achieved. The numerical experiments of the MMLS and classical MLS techniques are presented to show the difference between both methods for multi-dimensional problems. The convergence analysis is provided and some numerical tests are given to prove the applicability of this technique.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Three-Dimensional Asymptotic Analysis of a Bingham type fluids with Tresca law and Thermal Effects

Communication Info

Authors :
Rachid LMANGAD[1]
Zakaria FAIZ[2]
Hicham BENAISSA [3]

[1] *Polydisplinary Faculty of Khouribga, Khouribga,Morocco*
[2] *Polydisplinary Faculty of Khouribga, Khouribga,Morocco*
[3] *Polydisplinary Faculty of Khouribga, Khouribga,Morocco*

Keywords:
(1) Bingham type fluid
(2) variational inequalities
(3) 3D-asymptotic analysis
(4) thermal effects
(5) Tresca law

Abstract

We investigate the asymptotic analysis of a model for incompressible Bingham fluids with thermal effects in a three-dimensional thin domain Ω^{ε}, where Tresca boundary conditions are imposed on part of the boundary, and Dirichlet conditions on another. The domain Ω^{ε} is perturbed by a small parameter $\varepsilon > 0$. The main contribution is twofold: (1) we establish the weak variational formulation and prove the uniqueness of the problem's solution, and (2) we perform its asymptotic analysis as $\varepsilon \to 0$, deriving and proving the existence and uniqueness of the solution to the limiting problem.

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Études numériques du comportement vibratoire de sols sous écoulement turbulent: Application à l'érosion interne de digues

Communication Info

Authors:
Ikrame TERGUI[1]
Benaissa KISSI [1]
Hamza Khatib [1]
Hassan AAYA [2]

[1] Laboratoire de l'Ingénierie des structures, procédés, systèmes intelligents et informatique – ENSAM université Hassan II, Casablanca, Maroc
[2] Université Internationale de Casablanca, Maroc

Keywords:
(1) Erosion interne
(2) HET
(3) vibro-acoustique

Abstract

L'érosion interne, cause majeure de défaillance des ouvrages hydrauliques tels que les digues, se produit lorsque l'écoulement de l'eau transporte des particules de sol, compromettant ainsi leur stabilité [1]. L'essai d'érosion de trou (HET) est utilisé pour évaluer la résistance des sols à l'érosion sous des écoulements localisés[2].
Ce travail associe des analyses expérimentales réalisées à l'aide du HET à des simulations numériques sur Ansys Fluent, intégrant une approche diphasique basée sur les équations de Navier-Stokes et une loi d'érosion [3]. En outre, des capteurs vibro-acoustiques ont été utilisés pour identifier les vibrations acoustiques des écoulements turbulents, améliorant ainsi la détection et la quantification de l'érosion interne [4]. L'étude de l'impact des propriétés des sols sur l'érosion contribue à renforcer la sécurité des infrastructures hydrauliques et à affiner les modèles prédictifs [5].

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The Cracovian product with the right multiplication over the matrices

Communication Info

Authors:
Mehsin Jabel Atteya

Department of Mathematics,
College of Education,
Mustansiriyah University,
Falastin St., Baghdad, Iraq
E-mail:
mehsinatteya88@uomustansiriyah.edu.iq

Keywords:
(1) Cracovian product
(2) multiplication of matrices,
(3) transpose of a matrix

Abstract

In this article, we study the behavior of the Cracovian product and the right multiplication on the square matrices. We push some results which involve them on the square matrices. Cayley's matrix multiplication is known as obtaining c_{ik} $=\sum_{j=1}^{n} a_{ij}b_{jk}$, which is formed by writing matrices $A = [a_{ij}]_{mn}$,$B = [b_{jk}]_{nr}$ as $AB = C = [c_{ik}]_{mr}$, respectively taking rows from matrix A and columns from matrix B. The result of this binary operation gives a single matrix. There is no commutative property for the left product. If commutative structures are to be obtained, the right product is needed. Let F be a field. The set of all n– by–n matrices over a field (F) is denoted by $(K)_n(F)$. That means $(K)_n((F)) = [a_{ij}]_n|a_{ij} \in (F)$. The set of all regular matrices order n over a field F is denoted by $M_n(F) = [a_{ij}]_n|a_{ij} \in F$. The transpose of a matrix $A \in (K)_n((F))$ is denoted by A^T. The product of the reciprocal columns of two matrices with the same columns is defined as the Cracovian product. If A, B are any two square matrices of order n then the Cracovian product is $A\wedge B = B^TA$, where B^T is transpose of matrix B in [4]. Also, $A = [a_{ij}]_{rm}$, $B = [b_{jk}]_{nr}$ the matrix $C = \sum_{i=1}^{r} b_{ki}a_{ji}\ ]_{nm}$ is called the right product of the matrices A and B. It is denoted by $\overset{AB}{\longleftarrow}=C=[c_{kj}]_{nm}$. For more information read (1, 2, 3 and 5).

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Unconditionally Converging Operators

Communication Info

Authors:
Abderrahman RETBI[1]
[1] *Polydisciplinary Faculty, Sultan Moulay Slimane university , Beni Mellal, Morocco*

Keywords:
(1) V-sets
(2) Relatively compact Dunford-Pettis property
(3) Unconditionally converging operators

Abstract

We study the notion of **V**-sets in Banach spaces and Banach lattices, and we give some characterizations of it in terms of sequences. As an application, we establish new properties of unconditionally converging operators and 1-Schur property in Banach lattices. Next, by introducing the concept of the property **(VLD)** in Banach spaces, we investigate the Dunford-Pettis completely continuous property of unconditionally converging operator. Finally, we derive the relationships between the property **(VLD)** and the relatively compact Dunford-Pettis property (resp., the Pelczynski's property **(V)**), and we deduce some examples of Banach spaces with the property **(VLD)**.

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Reducing Secret Key Size in HAWK via Algebraic Techniques

Communication Info

Authors:
Nour-eddine RAHMANI [1]
Taoufik SERRAJ [1]

[1] Faculty of Sciences, Mohammed I University, Oujda, Morocco

Keywords:
(1) LIP
(2) Lattices
(3) Cryptography
(4) Security
(5) Digital Signatures

Abstract

The HAWK [1] signature scheme, based on the hardness of the Module Lattice Isomorphism Problem (module-LIP) [2,3,4], provides a fast and efficient framework for post-quantum cryptography. This study introduces a novel approach to optimizing HAWK's design using algebraic relations derived from linear algebra. We show that a third less of the secret key size can be cut without compromising security. An algebraic relation allows for this reduction, which enhances storage and computational effectiveness. The suggested approach not only maintains robust cryptographic guarantees but also makes HAWK more applicable in settings with limited resources. These findings demonstrate how algebraic methods can simplify algorithms for lattice-based cryptography.

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Deep learning and optimal control techniques for fractional derivative models in epidemiology

Communication Info

Authors:
Hassan AGHDAOUI[1]
Mouhcine TILIOUA [1]

[1] MAIS Laboratory, MAMCS Group, FST Errachidia, Moulay Ismail University of Meknes, P.O. Box 509, Errachidia 52000, Morocco.

Keywords:
(1) Deep learning
(2) fPINNs
(3) Epidemic models

Abstract

The main goal of this work is to address fractional forward and inverse problems using a deep learning method. A fractional Physics-Informed Neural Network (fPINN) is proposed to solve Fractional Differential Equations (FDE). The model minimizes the combined mean-squared residuals of FDE and the mean-squared errors in the initial and boundary conditions to fit the observed data. This study presents a novel method for estimating fractional-order derivatives within a mathematical epidemic model that includes fractional boundary conditions, utilizing real-world data for both training and validation.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

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Identification of Involutory MDS Matrices Through Evolutionary Algorithms

Communication Info

Authors:
El Mehdi BELLFKIH[1]
Imrane Chemseddine Idrissi[2]

[1] Faculty of science Ben M'sick, Casablanca, Morocco

Keywords:
(1) Evolutionary algorithms,
(2) Involutory MDS matrices,
(3) MDS Self-dual codes.

Abstract

This paper presents a novel methodology for identifying involutory maximum distance separable (MDS) matrices over finite fields $\boldsymbol{F_{2^q}}$, derived from MDS self-dual codes, through the use of evolutionary algorithms. Involutory MDS matrices are particularly valuable in various applications, including coding theory [1-2], due to their unique properties. Our approach utilizes evolutionary algorithms to efficiently explore the search space for involutory MDS matrices, ensuring both self-duality and optimal codeword distance maximization. By leveraging the optimization potential of evolutionary algorithms [3-5], the method automates the discovery process for these matrices. Extensive experiments demonstrate the effectiveness of the proposed approach and provide new insights into the structure of automorphism groups in MDS self-dual codes. These results have practical implications and contribute to the advancement of research in coding theory.

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Existence results for the 2d-elastic isotropic frictional contact problem

Communication Info

Authors:

Ayoub, BOUKHIRA[1]
Hicham BENAISSA [2]

[1] Polydisciplinary Faculty of Khouribga, Sultan Moulay Slimane University, Morocco
[2] Polydisciplinary Faculty of Khouribga, Sultan Moulay Slimane University, Morocco

Keywords:

(1) Isotropic
(2) Pseudomonotone
(3) Friction
(4) Elasticity

Abstract

In this article, we will study a bidimensional quasi-static contact problem, involving isotropic and linear elastic materials and frictional effects [1]. For this model, existence results are established by reformulating the problem as a variational inequality, involving a nonlinear operator that accounts for both elasticity and friction.
Our approach is based on a result by Brézis [2], which identifies a new class of operators, called pseudomonotone, for which the variational inequality can be solved. The class of pseudomonotone operators includes a more specific subclass known as Leray-Lions operators [3]. Defining the Leray-Lions operator requires proving a new property of the operator, which hold only for two-dimensional problems. We will first demonstrate this refined property in the particular case of a half-space [4], before extending it to more general geometries, namely bounded bodies [5].

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Zero-Divisors in Commutative Rings: A Graph-Theoretic Perspective

Communication Info

Authors:
Assila Khaireddin
Khalid Louartiti

Laboratory: Mathematics, Computer Science, and Decision Making (MCSDM)
National School of Applied Sciences of Tetouan (ENSATe)
Abdelmalek Essaadi University, Morocco

Keywords:
(1) Zero-Divisors
(2) Commutative Rings
(3) Graph-Theoretic

Abstract

Zero-divisors play a critical role in understanding the structure and behavior of commutative rings. A zero-divisor in a commutative ring R is defined as a non-zero element a such that there exists b≠0 satisfying ab=0. These elements provide insights into the properties of ideals, factorization, and modular arithmetic, making them essential in studying polynomial and matrix rings.

This research employs a graph-theoretic framework to explore zero-divisors through the construction of zero-divisor graphs, where vertices represent elements of a ring and edges denote zero-product relationships. These graphs offer a unique perspective, enabling the analysis of structural properties such as connectivity, chromatic numbers, cliques, and girth. The study further extends to zero-divisors in Noetherian and Artinian rings, highlighting their relevance in algebraic geometry, cryptography, and network optimization.

By bridging classical theories with modern advancements, this work addresses open problems and proposes innovative methodologies for investigating zero-divisors. The findings provide a comprehensive framework for advancing research in commutative algebra and its applications to graph theory.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Anti-synchronization of quaternion-valued neural networks with inertial term and proportional delay via a direct technique

Communication Info

Authors:
El Abed Assali[1,2]

[1] *University of Carthage, Faculty of Sciences of Bizerte, Department of Mathematics, Research Laboratory GAMA LR21ES10, 7021 Zarzouna, Bizerta, Tunisia.*

[2] *University of Jendouba, Higher School of Engineering of Medjez el Bab (ESIM), Route du Kef Km 5, Medjez el Bab, Tunisia*

Keywords:
(1) Quaternion-valued neural networks
(2) Anti-synchronization
(3) Control

Abstract

This paper introduces inertial quaternion-valued neural networks with proportional delays, defined as[1]

$$\ddot{x}_i(t) + a_i\dot{x}_i(t) = -d_i x_i(t) + \sum_{j=1}^{n} b_{ij} f_j\left(x_j(t)\right) + \sum_{j=1}^{n} d_{ij}^{q} g_j\left(x_j(q_j t)\right) + I_i. \qquad (1)$$

The study first focuses on analyzing the anti-synchronization of the proposed model by developing a novel Lyapunov functional with adjustable parameters. Several criteria are established to guarantee the anti-synchronization of quaternion-valued neural networks incorporating proportional delays and inertial terms. Traditionally, most results in this area rely on the variable substitution method, which simplifies the original second-order system into a first-order system [2,3]. On the other hand, the authors use an approach based on decomposing quaternion-valued neural networks into four equivalent real-valued networks, which adds complexity to the process [4]. In contrast, this paper adopts a non-separation and non-reduction order approach to system (1). Finally, a numerical example is given to validate the theoretical results.

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Étude de l'effet des perturbations par sauts sur la dynamique stochastique des modèles SIRS.

Communication Info

Authors :

Khalid EL BAKKIOUI[1]
Adel SETTATI[1]

[1] *Université Abdelmalek Essaâdi, Tangier, Morocco*

Keywords :

(1) *Modèle stochastique SIRS*
(2) *Sauts de Lévy*
(3) *Persistance*
(4) *Extinction*
(5) *Fonction de Lyapunov*
(6) *Seuil*

Abstract

Cette étude propose un cadre stochastique complet pour examiner l'impact des perturbations de Lévy sur la dynamique du modèle SIRS (Susceptible-Infectieux-Rétabli-Susceptible). Dans un premier temps, L'existence et l'unicité de la solution sont rigoureusement établies, offrant ainsi une base théorique solide pour des analyses ultérieures.
Les conditions critiques nécessaires à la persistance de la maladie sont dérivées, constituant des outils essentiels pour évaluer l'applicabilité du modèle dans des contextes épidémiologiques pratiques. De plus, les critères spécifiques permettant l'extinction de la maladie sont identifiés. Pour appuyer les résultats théoriques, des simulations numériques détaillées sont effectuées afin de valider le cadre proposé.

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Fractional analysis of nonlinear dynamics in Korteweg-de VriesBurgers' and modified Korteweg-de Vries Equations

Communication Info

Authors:
Musawa ALMUSAWA
Hassan ALMUSAWA

Department of Mathematics, Jazan University, Jazan, Saudi Arabia

Keywords:
(1) KdV Burgers' and mKdV equations
(2) Iterative transform method (ITM)
(3) Residual power series transform method (RPSTM)
(4) Caputo operator

Abstract

This paper investigates the fractional-order KdV Burgers' and modified KdV (mKdV) equations using two advanced mathematical techniques: the iterative transform method (ITM) and the residual power series transform method (RPSTM). These methods are employed to solve nonlinear fractional-order differential equations, with the Caputo operator providing the framework for fractional differentiation. The study highlights the effectiveness of ITM and RPSTM in obtaining approximate analytical solutions for these complex equations, which play a significant role in modeling wave propagation, fluid dynamics, and nonlinear systems. The proposed methods demonstrate robust convergence, accuracy, and computational efficiency in addressing the complexities of fractional-order systems. Through numerical examples and graphical representations, the paper provides insight into the behavior of solutions for different fractional orders, offering valuable contributions to the fields of mathematical physics and applied mathematics

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Design of a EWMA Control Chart by adaptation of Smoothing Constant based on a Function of estimated shift

Communication Info

Authors:
Abdullah AHMADINI

Department of Mathematics, Jazan University, Jazan, Saudi Arabia

Keywords:
(1) statistical process control
(2) control chart
(3) average run length
(4) adaptive control chart

Abstract

This study introduces a novel Adaptive EWMA (AEWMA) control chart designed to monitor the mean of a normally distributed process with enhanced responsiveness. The proposed methodology dynamically adjusts the smoothing constant based on a proposed continuous function of the estimated mean shift derived from the EWMA statistic. The Monte Carlo simulations are conducted to assess the performance of the AEWMA chart across various magnitudes of process mean shifts, using run-length profiles as the primary evaluation metric. The results indicate that the AEWMA chart outperforms traditional methods in terms of detection efficiency. To demonstrate its practical applicability, the AEWMA chart is applied to a realworld manufacturing dataset specifically analyzing the flow width resistance of substrates. The findings highlight the efficiency of the proposed chart, making it a valuable tool for improving process monitoring and quality control in industrial environments.

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A new domain decomposition strategy based on the hybrid FE-MESHLESS

Communication Info

Authors: Saad Hassouna1, Ramadane Abderrazak2, Abdelaziz Timesli1*, AzouaniAbderahim3
1Hassan II University of Casablanca, National Higher School of Arts and Crafts (ENSAM CASABLANCA), LISIME Laboratory,
2International University of Casablanca, Laboratory « Mathématiques et Sciences de l`ingénieur »,
3Sultan Moulay Slimane University, National School of Applied Sciences of Khouribga, LIPIM Laboratory,
Keywords:
domain decomposition method, schur complement, meshless method, finite Element Method, parallel computing.

Abstract

A new strategy for improving the convergence and efficiency of the class of domain decomposition known as interface variable related Schur complement techniques for simulating mechanical, electrical and thermal problems in the presence of crosspoints is examined in this work. To be more precise, we're not just interested in domain decomposition into two parts with the same physical properties, but rather in more general splitting components. In the first case, we obtain optimal convergence with a good pre-conditioner in two iterations, while the problem remains difficult in the second case. The primary objective is therefore to fill in some of the gaps in these problem domain decomposition techniques and to contribute to the solution of extremely difficult large-scale industrial problems. A parallel sparse direct solver of the multi-core environment of the whole system is used and each part of the system is handled independently of the change of the mesh or the shifting of the mathematical method of resolution.

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Geometric Analysis of Black Hole Shadows in Einstein-Maxwell-Dilaton Theory

Communication Info

Authors:
Hajar BELMAHI[1]
[1] Mohammed V University in Rabat, Rabat, Morocco

Keywords:
(1) AdS black holes
(2) Newman-Janis formalism
(3) Hamilton-Jacobi formalism

Abstract

Motivated by string theory, we explore the geometric properties of shadows cast by AdS black holes within the Einstein-Maxwell-Dilaton (EMD) framework. For static, spherically symmetric black holes, the shadow's boundary is circular, with its size determined by key physical parameters such as the black hole's charge and the cosmological constant. These properties are derived through analytical computations of photon trajectories in the corresponding spacetime geometry. For rotating black holes, we extend the analysis by employing the Newman-Janis algorithm and utilizing the Hamilton-Jacobi method to separate variables. This approach enables us to examine the deformation of the shadow caused by the black hole's angular momentum, revealing the intricate interplay between rotation and the shadow's size and shape.

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Self-similar solutions for active scalar equations in Fourier-Besov-Morrey spaces

Communication Info

Authors:
Fatima OUIDIRNE

FST of Sultan Moulay Slimane University, Laboratory LMACS, Beni-Mellal, Morocco.

Keywords:
(1) Active scalar equations;
(2) global well-posedness
(3) asymptotic behavior

Abstract

We study a family of dissipative active scalar equations with velocity fields coupled through higher-order multiplier operators. Focusing on sub-critical values for fractional diffusion, we establish global well-posedness for solutions with small initial data in a framework based on Fourier transforms, specifically Fourier-Besov-Morrey spaces. The smallness condition is tied to the weak norm of this space, allowing for initial data with large L^{2}-norms to be considered. We derive self-similar solutions depending on the homogeneity of the initial data and couplings and demonstrate that the solutions become asymptotically self-similar at large times. Our unified approach applies to various active scalar PDEs, including 1D models of dislocation dynamics in crystals, Burgers' equation, the 2D vorticity equation, $2D$ generalized SQG, and $3D$ magneto-geostrophic equations.

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Contrôle optimal dans un modèle mathématique de tricherie aux examens de certification

Communication Info

Authors:
Abdelbar EL MANSOURI[1]
Mohamed BELAM[1]
Abderrahim LABZAI[2]

[1] *Laboratory of Advanced Research in Industrial and Logistic Engineering, National High School for Electricity and mechanics, Casablanca, Hassan II University of Casablanca, Morocco.*
[2] *Laboratory of Analysis Modeling and Simulation, Department of Mathematics and Science, Faculty of Sciences Ben M'sik, Hassan II University of Casablanca, Morocco.*

Keywords:
(1) Tricherie scolaire
(2) Contrôle optimal
(3) Principe de Pontryagin

Abstract

Des chercheurs issus de divers domaines s'inquiètent de l'augmentation alarmante de la tricherie scolaire parmi les élèves et les étudiants [1], un phénomène ayant un impact négatif sur la qualité de l'éducation et de la formation [2]. En effet, la tricherie est passée d'un acte inacceptable à un « droit légitime » pour un nombre croissant d'étudiants [3]. Dans ce contexte, nous proposons un modèle mathématique visant à comprendre les mécanismes de propagation de ce phénomène, notamment lors des examens de certification. Nous examinons également l'efficacité de diverses solutions proposées pour lutter contre cette problématique. Notre approche repose sur le Principe de Maximum de Pontryagin [5], permettant d'identifier les meilleures stratégies de contrôle. Enfin, nous validons notre analyse théorique à l'aide de simulations numériques réalisées avec MATLAB.

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On derivations and symmetric elements in prime rings with involution

Communication Info

Authors:
Hiba FIHI[1]
Abdellah MAMOUNI [2]
Khalid OUARGHI [3]

[1] *Faculty of sciences of Moulay Ismail university, Meknes, Morocco*
[2] *Faculty of sciences of Moulay Ismail university, Meknes, Morocco*
[3] *Ecole Normale Supérieure of Moulay Ismail university, Meknes, Morocco*

Keywords:
(1) Derivation
(2) involution
(3) prime ring

Abstract

In [1] Bell and Daif proved that a semiprime ring must be commutative if there exists a derivation d on R such that [x,y]=[d(x),d(y)] for all x,y∈ R; and in [2] it is shown that a prime ring is commutative if for some nonzero derivation d, [d(x),d(y)]=[d(x),y]+[x,d(y)] for all x,y∈ R. Follow up on this path of investigation H. Fihi and A. Mamouni in [3] studied the behavior of a fixed element a ∈ H(R) satisfying some differential identities in prime rings with hermitian elements. Consequently,
O. Ait Zemzami, K. Ouarghi and A. Mamouni, showed that certain elements, defined by commutativity con ditions involving derivations over prime rings, are either central elements or they classified the involved derivations. In [5] M. A. Idrissi, L. Oukhtite and N. Muthana are interested in the study of center-like subsets in prime rings involving more general identities. Keep investigating along these lines, our purpose in this paper is to prove that the set of Hermitian elements, characterized by commutativity conditions involving derivations in prime rings with involution *, are either central elements or their square are central elements.

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On γ-Semigroup Dynamics for Specific Conformable Partial Differential Equations

Communication Info

Authors:
Manal MENCHIH[1]
Khalid HILAL [1]
Ahmed KAJOUNI[1]

[1] *Sultan Moulay Slimane University, BP 523, Beni Mellal, 23000, Morocco.*

Keywords:
(1) Chaos
(2) Hypercyclicity
(3) Conformable semigroup.

Abstract

This work investigates the behavior of conformable admissible weight functions that trigger hypercyclicity and chaos for the solution γ-semigroup of a conformable spatiotemporal partial differential equation in the space $L^p_{\rho_\gamma}([0,+\infty),\mathbb{C})$. We provide conditions that guarantee the occurrence of hypercyclicity and chaos. Furthermore, utilizing the conjugacy property, we extend our analysis to the hypercyclicity and chaos of the solution γ-semigroup associated with a spatiotemporal cell maturity-structured partial differential equation in the space $L^p_\gamma([0,+\infty),\mathbb{C})$.

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Asynchronous exponential growth for semi-linear differential equations with nondense domain: Applications to population dynamics

Communication Info

Authors:
Oumaima Moussafir[1]
Khalil Ezzinbi [1]
Abdellah Afoukal[2]

[1] Cadi Ayyad university, Marrakech, Morocco
[2] Sultan Moulay Slimane university, Beni Mellal, Morocco

Keywords:
(1) Hille-Yosida operators
(2) Extrapolation theory
(3) Age-structured models

Abstract

In our paper we studied AEG(for short) for a semi-linear evolution equation. We posit that the linear part is not densely defined however, it conforms to the resolvent estimates stipulated by the Hille-Yosida theory [1]. our results would be extensions of those obtained in [2]. We used also the extrapolated semigroups[3] to give proof to our main theorem. We studied also AEG strictly positive in Banach Lattice spaces with positive semigroups [4], also we mentioned the relation between AEG and the intrinsic growth constant [5]. Then we give some sufficient conditions ensuring AEG of the nonlinear semigroup solution of the differential equation.

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A generalized fuzzy TOPSIS-based framework for (SRI) portfolios selection

Communication Info

Authors:
Mohamed Reda JAOUANE[1]
Jaafar EL KARKRI[1]

[1] Mohammed V University in Rabat
Laboratory LERMA
Mohammadia School of Engineers, Rabat, Morocco

Keywords :
Socially Responsible Investments
Porfolio optimization
Fuzzy logic
Fuzzy TOPSIS
g-TOPSIS

Abstract

Socially Responsible Investments (SRI) involve environmental, social and governance (ESG) criteria into the decision process. They concern investors who aim to achieve both financial returns and ethical impact. The subjectivity of criteria characterizing (SRI) portfolios assessment makes it necessary to use efficient decision-making techniques to address the complexity and uncertainty inherent to the decision process. The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), especially its fuzzy version, is an efficient and practical framework in this context. This paper proposes a variant, particularly a generalized version of fuzzy TOPSIS, in order to deal with the uncertainty associated with Socially Responsible Investments portfolios evaluations. It shows how a new proposed variant of the method refines the decision-making process by dealing with the dynamic nature of investments environments, taking into account the investors profiles. The findings emphasize its potential to address the limitations of traditional fuzzy TOPSIS-based methods and improve the selection of (SRI) portfolios.

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New estimates of the q-numerical radius of Hilbert space operators

Communication Info

Authors:
Ahmed Elbarbouchi[1]
Mohamed Boumazgour [2]
Mohamed Chraibi Kaadoud[3]

[1] Faculty of Science, Ibn Zohr University, Agadir, Morocco.
[2] Faculty of Economic science, Ibn Zohr University.
[3] Faculty of Science Semlalia, Cadi Ayyad University, Marrakesh, Morocco.

Keywords:
q-Numerical radius, Hilbert spaces, bounded linear operators, operator inequalities, tensor products, operator theory.

Abstract

This paper is devoted to the study of the q-numerical radius wq() of bounded linear operators acting on Hilbert spaces. More precisely, we give several new estimates of the q-numerical radius of an operator as well as extensions of some existing results in this setting. We also present some q-numerical radius inequalities for the product and tensor product of bounded linear operators.

In this work, we propose several new estimates for the q-numerical radius, providing refinements and extensions to existing results in the literature. These estimates contribute to a better understanding of the geometric and algebraic characteristics of operators in the q-setting.

Furthermore, we establish new inequalities for the q-numerical radius in the context of operator products and tensor products. These results highlight intriguing relationships between the q-numerical radii of individual components and their combined structures, paving the way for potential applications in operator theory, quantum mechanics, and related fields of mathematical analysis.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

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An optimal coherent security system for a non-life insurance company using particle swarm optimization (PSO) algorithm

Communication Info

Authors:
Abderrahim EL ATTAR [1]
Yassine KOUACH [2]

[1,2] Hassan II university, Casablanca, Morocco

Keywords:
(1) Conditional Tail Expectation
(2) Optimization
(3) Non-life insurance
(4) Reinsurance
(5) Security Loading
(6) Technical benefit
(7) Particle Swarm Optimization

Abstract

Given the pervasive risks that insurance companies encounter, it is imperative for these companies to enhance their security systems. This article presents an optimal and coherent security system for a non-life insurance company, using reinsurance as a security tool and technical support. Therefor the objective of this study is to employ an optimization program designed to, simultaneously and optimally, determine the security loading and the parameters of reinsurance treaties. This approach aims to maximize technical benefit and minimize risk utilizing a new coherent risk measure based on Conditional Tail Expectation (CTE)). To accomplish this, a novel approach employing the particle swarm optimization (PSO) algorithm was implemented to resolve the proposed optimization program.

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New improvements of some classical inequalities

Communication Info

Authors:
Abdelmajid Gourty[1]
Mohamed Amine Ighachane[2]
Fuad Kittaneh[3,4]

[1]*Faculty of Sciences of Agadir (FSA)Ibn zohr university Agadir, Morocco.*
[2] *Chouaib Doukkali University El Jadida, Morocco.*
[3] *University of Jordan, Amman, Jordan.*
[4] *Korea University, Seoul 02841, Souh Korea.*
Keywords:
(1) Numerical radius
(2) mixed Schwarz inequality
(3) Kato's inequality

Abstract

This paper introduces a new scalar inequality that enhances classical results related to inner products and the numerical radius of operators. The study provides refined bounds for expressions involving operators and vectors in a Hilbert space. A key finding is the identification of a sequence of refined inequalities, which is shown to be increasing and converges to an improved upper bound of the mixed Schwarz inequality. These results represent a significant extension and refinement of existing mathematical inequalities, offering deeper insights and broader applications within operator theory.

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Modeling HPV with Cervical Cancer and HIV with AIDS Diseases Co infection

Communication Info

Authors:
KHALOUQI Dounia
NADIA IDRISSI FATMI

LIPIM ENSAK , Sultan Moulay Slimane University, Beni Mellal Morocco.

Keywords:
(1) Co-infection
(2) HPV
(3) Cervical Cancer
(4) HIV/AIDS
(5)Stability Analysis,

Abstract

In this article, a deterministic mathematical model for HPV co-infection with cervical cancer and HIV/AIDS diseases was formulated and rigorously analyzed. Local and global stability of balance without disease and Model endemicity was established using basic reproduction number. The results show that in the HPV-only model, HIV single model and HPV-HIV co-infection model if the base reproduction is less than one then the solution converges to the model disease-free equilibrium state and disease-free equilibrium is locally asymptotically stable. Endemic states are considered to exist when the basic reproduction number for each disease is greater than one. Sensitivity analysis of a model was carried out on the key parameters to know their relative importance and their potential impact on transmission dynamics of HPV and HIV separately. Numerical simulations indicate the effect of varying contact rate parameters on single disease and co-infection dynamics. As we increase contact rates, infections increase.

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An isoperimetric problem with a potential perturbation of regular kernel

Communication Info

Authors:
Idriss OUSKHNID
Abdslam BOUARICH

Faculty of Sciences and Techniques, Beni Mellal, Morocco

Keywords:
(1) Minimization
(2) Non-local repulsive
(3) Potential

Abstract

In this paper, we study the minimization of a functional defined as the sum of classical perimeter and a non-local repulsive regular potential. We establish the existence of a minimizer for this functional within the admissible class of a sets under a prescribed volume constraint. However, the shape of minimizer remains unknown at this stage. To address this, we introduce an additional potential of the form $\left|\chi_E - \chi_{B_r(x)}\right|$, where $x \in E$ to modify the original functional. This modification allows us to demonstrate that the modified functional has unique minimizer up to translation and its shape is a ball. We investigate this result to determine the shape of original functional.

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Boundary controllability for Caputo fractional differential equation

Communication Info

Authors:
Abdellah Lourini*[1]
Mohamed El Azzouzi[2]
Mohamed Laabissi[1]

[1] *Department of Mathematics, Faculty of Sciences, Chouaib Doukkali University, BP 20 El Jadida, 24000, Morocco*

[2] *Department of STIN, National School of Applied Sciences, Chouaib Doukkali University, BP 1166, El Jadida, 24000, Morocco*

*louriniabdellah3@gmail.com
Keywords:
(1) Controllability
(2) Caputo fractional derivative
(3) Boundary control
(4) Unbounded control operator
(5) Fractional semigroup

Abstract

The aim of this talk is to study the existence of mild solutions and the exact controllability of an abstract Caputo fractional system with semilinear boundary control in Banach spaces [1]. Sufficient conditions for the existence of mild solutions and controllability are established using Schauder's fixed-point theorem. Furthermore, for fractional linear boundary control, we provide a characterization of controllability via a standard fractional linear system with internal control [2]. An illustrative example is included to demonstrate the applicability and validity of the theoretical results.

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STOCHASTIC VASICEK PROCESS APPLIED TO MODEL AND FORECAST WATER PRODUCTIVITY

Communication Info

Authors:
Nadia MAKHLOUKI[1]
Ahmed Nafidi[2]
Ilyass MAKROZ [3]
Boujemâa ACHCHAB[4]

[1,2,3,4] *University hassan first, ENSA Berrechid, Morocco*

Keywords:
(1) Homogeneous Vasicek model
(2) Statistical inference
(3) Application to water productivity in Morocco.
,

Abstract

In this work, we study a stochastic homogeneous Vasicek diffusion process, and we determine its characteristics, such as the analytical expression, the trend functions, then by using the maximum likelihood approach based on discrete sampling, we estimate parameters and trend functions. To evaluate the capability of this process we use simulated sample paths of the model and examine the goodness of fit.
Finally, we applied the process to fit and predict the total water productivity in Morocco.

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ICRAMCS 2025
THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Optimality conditions for a class of bilinear control problems

Communication Info

Authors:
Redouane EL MEZEGUELDY[1]
Mohamed OUZAHRA[1]

[1] *MASI Laboratory, ENS, USMBA Fez, Morocco*

Keywords:
(1) Bilinear control
(2) Optimality conditions
(3) Evolution equations

Abstract

We explore optimality conditions for bilinear control problems in infinite-dimensional spaces, where the system evolves according to a nonlinear state equation driven by a bilinear control term. After establishing foundational results on solution regularity and existence, we prove the existence of optimal controls using variational methods and derive first- and second-order optimality conditions via sensitivity analysis of the control-to-state mapping. A central contribution shows that controls satisfying the first-order necessary condition and a quadratic positivity requirement on the second derivative of the cost functional—for all admissible perturbation directions—are guaranteed to be strict local minimizers.

These findings extend classical finite-dimensional optimization theory to abstract bilinear systems, addressing challenges unique to infinite-dimensional spaces. The quadratic positivity condition, first generalized to PDE-constrained optimization in foundational work [1], has been validated in diverse applications such as sparse controls [2, 3], Fokker-Planck models [4], and fractional PDEs [5].

Unlike PDE-specific models [1-5], our abstract framework uncovers universal structural properties of bilinear systems while clarifying the minimal assumptions required to ensure second-order sufficiency in general bilinear control.

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On m-EP operators

Communication Info

Authors:
Mohammed EL BILALI[1]
Mohammed MOUCOUF[1]

[1] Chouaib Doukkali University, Faculty of sciences, Department of Mathematics, Laboratory Fundamental Mathematics and their Applications, 24000 El Jadida, Morocco.

Keywords:
(1) m-EP operator
(2) Drazin inverse
(3) Moore–Penrose inverse

Abstract

Let H be a complex Hilbert space and let B(H) denote the set of all bounded linear operators on H. In this paper, we give new characterizations of m-EP operators. We start by proving that an operator T ∈ B(H) is an m-EP operator if and only if T is Drazin invertible and its Drazin inverse commutes with its Moore-Penrose inverse. We then discuss some new properties of m-EP operators using the range and the null space of T. Finally, in the aim of better understanding of the set of m-EP operators, we introduce two new operator classes related to the notion of Drazin-Moore-Penrese inverse called the m-DMP and m-MPD operators.

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A relationship between Favard space and admissibility for a analytic resolvent family of an integral Volterra system

Communication Info

Authors:
Rachid Guirhir[1]
Ahmed Fadili [2]

[1] *LIMATI, Sultan Moulay Slimane University of Beni Mellal, Morocco*
[2] *LIMATI, Sultan Moulay Slimane University of Beni Mellal, Morocco*

Keywords:
(1) Volterra equation
(2) Analytic resolvent family
(3) Favard space
(4) Admissibility

Abstract

The notion of admissibility control operators for Volterra systems is well studied in [3, 2]. The notion of analytic resolvent family of Volterra systems is well studied in [4, 5].
In this communication, we are concerned with a class of scalar Volterra equations. In order we present some new results concerning the Favard space of analytic resolvent for a Volterra system with infinite dimension generalizing some results in [1] and finally we establish some relationship between the Favard space and the admissibility of unbounded control operators for linear Volterra systems in Banach space generalizing some results in [6].

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Asymptotic behavior of solutions for parabolic problems of fractional type and sign-changing measure data

Communication Info

Authors:
Mohammed ABDELLAOUI [1]
Hicham REDWANE [2]

[1] *University Moulay Ismail of Meknes, Faculty of Sciences, Department of mathematics, Morocco*
[2] *Faculté d'Économie et de Gestion, Université Hassan 1, Settat, Morocco*

Keywords:
(1) Fractional order Sobolev spaces
(2) Fractional Capacity
(3) Asymptotic behavior
(4) Entropy solutions

Abstract

We prove a new asymptotic behavior result (with respect to the time variable t) of entropy solutions for fractional parabolic problems, with Dirichlet boundary at infinity, whose model is

$$\begin{cases} u_t + (-\Delta)_p^s u = \mu \ \ in\ Q := (0,\infty) \times \mathrm{R}^{\mathrm{N}}, \\ \qquad\qquad u(0,x) = u_0(x)\ in\ \mathrm{R}^{\mathrm{N}}, \end{cases}$$

where $(-\Delta)_p^s u$ is the fractional (s,p)-Laplace operator (with $ps < N, 0 < s < 1, and\ p > 2 - \frac{\mathrm{s}}{\mathrm{N}}$), $\mathrm{u}_0 \in \mathrm{L}^1_{\mathrm{loc}}(\Omega)$ and μ is a bounded, compactly supported Radon measure whose support is compactly contained in $Q := (0,\infty) \times \mathrm{R}^{\mathrm{N}}, N \geq 2$ (not depending on time) which does not charge the sets of the fractional (s,p)-capacity.

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Micromechanical Modeling of high temperature dependent thermo-elastic

Communication Info

Authors:
Nada TASSI [1,2]
Lahcen AZRAR [2]
Nadia FAKRI [3]

[1] Private University of Marrakech, Marrakech, Morocco
[2] ENSAM, UM5, Rabat, Morocco
[3] FST, Tangier, Morocco

Keywords:
(1) Mathematical modeling
(2) Integral equations
(3) Temperature dependent behavior
(4) Effective properties
(5) Green's functions
(6) Micromechanical method

Abdoun, F., & Azrar, L. (2020). Thermal buckling and vibration of laminated

Abstract

In this paper, the micromechanical modeling of the effective high temperature-dependent behavior of thermo-elastic composite materials is analyzed. The modeling is based on the micro-to-macro transition inclusion problem, employing temperature-dependent localization tensors.
Green's tensors are developed to derive temperature dependent integral equations related to Eshelby's tensors and micromechanical approaches. The effective behavior at high temperatures is determined using micromechanical methods and is presented for various inclusion volume fractions, shapes, and types of reinforced composites.

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The new fractional calculus and its applications

Communication Info

Authors:
Abdessamad AIT BRAHIM[1]

[1] *AMSC Laboratory, University of Sciences and Technology , Beni Mellal, Morocco*

Keywords:
(1) Conformbale fractional derivative
(2) non-conformable fractional deriva-tive
(3) Caputo fractional derivative

Abstract

This study presents a comparative analysis of non-conformable and conformable fractional derivatives, alongside the Riemann-Liouville and Caputo fractional derivatives. It evaluates their effectiveness in solving fractional ordinary differential equations and explores their applications in physics through numerical simulations. The results indicate that the conformable fractional derivative shows potential as a viable alternative to the non-conformable, Riemann-Liouville, and Caputo fractional derivatives in the order range of 1/2 < \alpha < 1.

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Regional Optimal Control Problem of RiemannLiouville Time Fractional Bilinear Systems with Bounded Control Operator in a Finite Time Horizon

Communication Info

Authors:
Hajar Oukassou
Rachid Larhrissi

MACS Laboratory, Faculty of Sciences, Moulay Ismail University, Morocco;
ha.oukassou@edu.umi.ac.ma
r.larhrissi@umi.ac.ma

Keywords:
(1) Quadratic cost
(2) Fractional bilinear systems
(3) Optimal control
(4) Regional controllability

Abstract

The main goal of this paper is to study the regional optimal control problem with a fixed desired state for a quadratic cost function. In the case of a bounded set of admissible controls, we will characterize the optimal control either for exactly or approximately attainable states. This problem can be formulated as an optimization problem with constraint on the desired state, which can also be approximated by a set of problems without constraint on the desired state.

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Solving Fractional Integral Equations via Proinov's Fixed Point Theorem

Communication Info

Authors:
Maha Belhadj[1]

[1] *Sousse university, Higher School of sciences and technologies of H. Sousse, Tunisia*

Keywords:
(1) measure of noncompactness
(2) Proinov type contraction
(3) Nonlinear integral equations

Abstract

Integral and differential equations in engineering models are studied using fixed-point methods to analyze the existence of solutions. Darbo [3] presented a generalization of the Schauder fixed point principle by using measures of noncompactness. Later, Sadovskii investigated a new result for condensing mappings. In recent times, there has been a significant increase in research on generalizations of Darbo's theorem and its applications [1, 2, 4]. In [5], Ur Rehman et al. established new results for $\alpha-\phi-$ and $\beta-\phi-$ condensing mappings on bounded subsets of Banach spaces. In this paper, we introduce a novel type of contraction mapping in Banach spaces and establish some fixed-point theorems for the sum of two mappings. As an application, we study the existence of fractional integral equations of a given order and provide examples to illustrate our results.

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Continuous propagation of panic in flight: Modelling, analysis and optimal time control

Communication Info

Authors:
Yassine KHOULDI[1]
Nadia IDRISSI FATMI[1]
Ayoub ABDELALIM[1]

[1] LIPIM Laboratory ENSA Khouribga, Sultan Moulay Slimane University, Beni Mellal, Morocco

Keywords:
(1) Safety
(2) Propagation
(3) Optimal control

Abstract

This work examines the propagation of panic among airline passengers using a continuous SIR model [1]. We apply Pontryagin's maximum principle to design and implement effective control strategies with the main aim of minimizing the number of panicked passengers during the flight. The SIR model, divided into three categories-susceptible, panicked and recovered passengers - was simulated using MATLAB. The results demonstrate the significant effectiveness of the controls implemented, underlining their vital role in maintaining flight safety. Without these measures, the number of panicked passengers could reach critical levels, posing a considerable risk to flight safety. In addition, our simulations have identified the optimal timing for the application of these control measures, a factor that considerably enhances their effectiveness [2,3].

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The generalized of 2-frame in 2-Hilbert space

Communication Info

Authors:
Samira TATOUTI[1]
Nordine Bounader[2]

[1] Ibn Tofail University, Kenitra, Morocco.
[2] Ibn Tofail University, Kenitra, Morocco.

Keywords:
(1) 2-inner Product;
(2) g-2-frames;
(3) g-2-frames operators.

Abstract

In the paper, we investigate 2-g-frames a generalization of 2-frames in 2-Hilbert spaces that is compatible with g-frames already known in Hilbert spaces, we will prove a version of the Riesz Representation Theorem in 2-Hilbert space to introduce a definition of g-2-frames, and provide some results concerning this notion. Finally, we will define g-2-frame operators and establish some of their characterizations in 2-Hilbert spaces.

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On quantitative stability for parametric equilibria with tri-functions

Communication Info

Authors:
Asma SAIDI[1]
Zakarya MAZGOURI [2]

[1]Ibn Zohr university, Agadir, Morocco
[2]Sidi Mohamed Ben Abdellah university, Fez, Morocco

Keywords:
(1) Equilibrium problems
(2) Holder continuity
(3) Variational inequalities

Abstract

Holder continuity is one of the most important concepts of quantitative stability; it serves as a generalization of Lipschitz continuity and has several uses in different mathematical fields [1]. It has been widely studied for parametric equilibrium problems with bifunctions [2].
Unfortunately, equilibrium theory formulated with bi-functions cannot be applied for interesting problems that are not monotone [3]. To overcome this issue, we consider equilibria formulated with trifunctions. More precisely, we suggest an extension of the results in [4], to parametric equilibria with trifunctions.
As applications, we consider Holder continuity for parametric variational inequalities and time-dependant variational inequalities where the constraints set depends on time which also enters as a parameter in the variational formulation.

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Identifying Major Influences on Photovoltaic Panel Efficiency via PCA

Communication Info

Authors:
Abbes KADYRI [1]
Mehdi FARHANE [1]
Khalid KANDOUSSI [2]
Otmane SOUHAR [1]

[1] UCD, El Jadida , Morocco
[2] ENSA, El Jadida , Morocco

Keywords:
(1) Principal Component Analysis
(2) Photovoltaic Solar Panels
(3) Dimensionality Reduction

Abstract

The efficiency of photovoltaic solar panels is influenced by numerous factors, including environmental conditions and industrial properties. Identifying the key factors that significantly impact panel efficiency can help manufacturers and installers enhance solar power output. This study employs Principal Component Analysis (PCA) to analyze a comprehensive dataset on solar panel performance, aiming to isolate significant influences. By analyzing a range of climatic and industrial variables, we reduce dimensionality and decipher the predominant factors affecting efficiency. The PCA results reveal that certain environmental factors and design characteristics are the most critical, explaining a substantial portion of the variance in panel performance. These findings corroborate the established understanding of the drivers of solar panel efficiency and highlight the robustness of PCA in processing complex multivariate datasets, thus aiding in the optimization of panel configurations for varying climatic conditions. This approach offers a novel perspective in improving the design and deployment strategies for more efficient solar energy systems globally.

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An Enhanced Cuckoo Search Algorithm with Lévy Flight for Efficient High-Order System Reduction

Communication Info

Authors:
Kamel BEN SLIMANE[1]
Zied TMAR[1,2]
Mongi BESBES [1,2]

[1] *University of Tunis El Manar, Tunis, Tunisia*
[2] *University of Carthage, Tunis, Tunisia*

Keywords:
(1) Model Reduction
(2) Cuckoo Search Algorithm
(3) Lévy Flight
(4) Metaheuristic Optimization
(5) Computational Efficiency
(6) System Approximation

Abstract

This paper presents an enhanced version of the Cuckoo Search Algorithm (CSA) based on Lévy Flight, aimed at reducing the order of high-order systems [1].
The proposed algorithm improves upon the traditional CSA by significantly reducing computational complexity and resource consumption while maintaining high accuracy in the model reduction process [2][3].
By leveraging the Lévy Flight mechanism, the algorithm exhibits better exploration and exploitation capabilities, ensuring faster convergence and superior performance compared to existing methods [4,5,6].
A series of numerical experiments demonstrate the efficiency and effectiveness of the proposed approach in reducing system order while preserving key system dynamics.
The results suggest that this novel version of the CSA provides a promising solution for model reduction in complex systems with large order, making it a valuable tool for both academic research and practical applications.

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Physics-Informed Neural Networks (PINNs): Progress, Challenges and Future Directions

Communication Info

Authors:
Mahjoub AAIBID[1] & Jaafar EL KARKRI [2]

[1,2] Mohammed V University in Rabat
Laboratory LERMA
Mohammadia School of Engineers, Rabat, Morocco

Keywords : Physics-informed neural networks (PINNs), Partial differential equations (PDE), Direct and inverse problems, conventional numerical methods, Neural network architectures, Optimization algorithms and techniques, and Loss function composition.

Abstract

The main goal of the present work is to provide an in-depth overview framework of the PINNs and their applications in solving direct and inverse problems related to partial differential equations (PDEs).

Although conventional numerical methods have proven effective over time, in many contexts, they can be constrained by various limitations. For high dimensional problems, large-scale computations can be prohibitively expensive due to the dramatic increase in the number of grids. In addition, the implementation of many conventional numerical methods requires full knowledge of the boundaries, initial conditions, and parameters.

Thus, PINNs leverage the flexibility of neural networks to encode physical laws directly into their structure, enabling them to provide solutions without the need for a pre-defined grid. This not only enhances computational efficiency, but also allows greater adaptability to complex boundary conditions and data assimilation tasks. To illustrate these advantages, we use the PINNs to solve a compartmental epidemiological model.

The presentation is organized as follows. The first section covers direct and inverse problems, focusing on conventional numerical methods to solve partial differential equations. The second section presents the PINNs framework and illustrates its application in solving compartmental epidemiological models. Finally, the third section discusses recent advancements in PINNs as well as their main challenges, with a focus on neural network architecture construction, optimization algorithm techniques, loss function composition and the training process.

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Entropy solution for some nonlinear d elliptic p(.)-Laplacien problem with Right-Hand Side Measure

Communication Info

Authors:
El Mehdi HASSOUNE [1]
Ahmed JAMEA [1,2]
Abdelghali AMMAR
Adnane KADDIRI[1]

[1]Equipe des Sciences et Technologies (ESTE), ENSA, Université Chouaib Doukkali El Jadida, Morocco
[2] CRMEF Casablanca-Settat, S.P. El Jadida El Jadida, Morocco

Keywords:
(1) Degenerate parabolic problem
(2) Entropy solution
(3) Weighted Sobolev space.

Abstract

In this paper, we demonstrate the existence of entropy solution for some nonlinear degenerate elliptic p(.)-Laplacian problems associated with Dirichlet-type boundary condition and right-hand side measure data. Our primary approach involves leveraging the variational method in conjunction with the theory of weighted Sobolev spaces.

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Statistical inference for a powers stochastic Rayleigh diffusion process, simulation and prediction

Communication Info

Authors:
Abdenbi EL AZRI[1,2]
Ahmed NAFIDI[2]
Abdelkrim MERBOUHA[3]

[1]Higher Institute of Nursing Professions and Health Techniques of Casablanca, Casablanca, Morocco
[2]Hassan First University of Settat, National School of Applied Sciences, Laboratory of Systems Modelization and Analysis for Decision Support, Berrechid, Morocco
[3]Sultan Moulay Slimane University, Faculty of sciences and techniques, Department of mathematics and Informatics, LMACS, Beni-Mellal, Morocco

Keywords:
(1) Stochastic Rayleigh diffusion process
(2) Simulation
(3) Fitting and prediction

Abstract

In this work, we study a new family of stochastic diffusion processes, defined by the power of the inhomogeneous Rayleigh process (see, [1]), which we term the powers of the stochastic Rayleigh diffusion process. We first define the new processes, then, the probabilistic characteristics of the process are examined, with particular attention to its analytic expression (see, [2]}), transition probability density function and mean functions. Otherwise, the parameters that appear in the present process are estimated by maximum likelihood with discrete sampling (see, [3,5]). Finally, we will apply this family of processes to simulated examples, highlighting opportunities for fitting and prediction (see, [4]).

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Existence Results for Nonlinear Parabolic Problems with Lower Order Terms in Musielak-Orlicz Spaces

Communication Info

Authors:
Abdeslam TALHA

Hassan First University of Settat, Faculty of sciences and Techniques, Laboratory MISI, 26000, Settat, Morocco.

Keywords:
(1) Musielak-Orlicz-Sobolev Spaces
(2) Nonlinear parabolic equations
(3) Poincaré inequality

Abstract

In this work, we prove an existence result of renormalized solutions in Musielak-Orlicz -Sobolev spaces for a class of nonlinear parabolic equations with two lower order terms and L1-data. Precisely we consider the following problem:

$$\frac{\partial u}{\partial t} + A(u) - div\big(\Phi(\mathrm{u})\big) + \mathrm{g(u)}\varphi(x, |\nabla \mathrm{u}|) = f$$

where Ω is a bounded Lipchitz open subset of R^N ($N \geq 2$) which satisfies the segment propriety, $Q = \Omega \times (0, T)$ and $A(u) = -\mathrm{div} a(x,t\ u, \nabla u)$ is a Leray-Lions operator defined on A : $D(A) \subset W_0^1 L_\varphi(Q) \to W^{-1,x} L_\psi\ (\Omega)$ where φ and ψ are two complementary Musielak-Orlicz functions, the right-hand side $f \in L^1\ (Q)$, we assume that g is an integrable function in $\mathbb{R}$ and satisfying the sign condition, while the function Φ is a continuous function on $\mathbb{R}$.

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Stochastic Processes as Classification Algorithms in Stock Market Prediction

Communication Info

Authors:
Mohammed Bouasabah

Ibn Tofail University

Keywords:
(1) Stochastic processes
(2) Market prediction
(3) Classification algorithms

Abstract

Stock market prediction remains a challenging task due to the inherent randomness and complexity of financial data. In this study, we explore the use of stochastic processes as classification algorithms to predict the next-day market trend (up or down) [1]. Specifically, we evaluate the performance of three well-known stochastic models: Geometric Brownian Motion (GBM), the Vasicek model, and the Cox-Ingersoll-Ross (CIR) model [2]. These models are applied to a dataset consisting of three sectoral exchange-traded funds (ETFs): XLF, XLK, and XLV [3]. To assess the effectiveness of each stochastic process in trend classification, we employ common performance metrics, including Precision, Recall, and F1-score [4]. The results provide insights into the suitability of stochastic processes for financial market classification tasks and highlight the comparative strengths and weaknesses of each approach.[5]

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Reinforcement Learning-Based Pole Placement for Complex Dynamic Systems: A Feasibility-Oriented Approach Reduction

Communication Info

Authors:
Kamel BEN SLIMANE[1]
Zied TMAR[1,2]
Mongi BESBES [1,2]

[1] *University of Tunis El Manar, Tunis, Tunisia*
[2] *University of Carthage, Tunis, Tunisia*

Keywords:
(1) Reinforcement Learning
(2) Pole Placement
(3) Complex Dynamic Systems
(4) Control Theory
(5) Feasibility-Oriented Design

Abstract

Traditional pole placement techniques in control theory primarily focus on the mathematical computation of pole locations without considering their physical feasibility in real-world systems [1].
This limitation can lead to control designs that, while theoretically optimal, fail to meet practical constraints such as stability margins, energy efficiency, and implementation feasibility [2].
This paper proposes a novel strategy for adjusting the dynamics of complex systems through reinforcement learning (RL) [3,4]. By leveraging the reward system inherent in RL algorithms, the proposed approach optimizes pole placement not only from a mathematical perspective but also by ensuring that the resulting system dynamics align with practical operational constraints [5].
The effectiveness of this methodology is demonstrated through simulations on benchmark dynamic systems, showcasing improved adaptability and robustness compared to conventional pole placement methods.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Applications of Variational Inequality and Reaction-diffusion Equations in Epidemiology

Communication Info

Authors:
Omar Elamraoui [1]
EL Hassan Essoufi [1]
Abderrahim Zafrar [2]

[1] Univ. Hassan 1, Laboratory MISI, 26000 Settat, Morocco
[2] Sidi Mohamed Ben Abdellah University, Faculty of Sciences Dhar el Mahraz,Department of Mathematics,Fes, Morocco

Keywords:
(1) SIR model,
(2) Variational inequality,
(3) Uzawa algorithm.

Abstract

This work studies some nonlinear variational inequalities with typical operators defined on the reflexive and separable Banach spaces and verifies the uniform monotone and pseudomonotone properties. This study yields some new results, such as the existence and strong convergence of solutions, all based on the Galerkin method. An application of this framework has been given in epidemiology problems considering the Spatio-temporal SIR model which is defined as a reaction-diffusion system. In such application Signorini boundary condition is considered for Infected individuals while Neumann boundary condition is considered for Susceptible and Recovered individuals. The work is ended with numerical analysis of the problem by applying splitting method and Uzawa algorithm based on augmented Lagrangian method. Some tests are included to show the solutions.

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ICRAMCS 2025
THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Stochastic Optimal Control in Epidemic Dynamics: Applications To Public Health

Communication Info

Authors:
Mohcine EL BAROUDI [1]
Hassan LAARABI [1]
Samira ZOUHRI [1]
Mostafa RACHIK [1]
Abdelhadi ABTA [1,2]

[1] *LAMS, Hassan II University of Casablanca, Faculty of Sciences Ben M'sik, Casablanca, Morocco*
[2] *Poly-disciplinary Faculty, Cadi Ayyad University, Safi, Morocco*

Keywords:
(1) *Stochastic optimal control*
(2) *Stochastic differential equation*
(3) *SEIR model*
(4) *Stochastic maximum principle*

Abstract

This study evaluates the effectiveness of mask-wearing and proactive screening in mitigating the transmission of an epidemic after its onset. Unlike previous research that emphasizes costly interventions such as travel restrictions and vaccination programs [1], this analysis focuses on accessible measures like mask-wearing and proactive testing. A stochastic SEIR (Susceptible-Exposed-Infected-Recovered) model is developed, incorporating control variables for mask-wearing and active screening [2]. By applying a stochastic version of Pontryagin's maximum principle [3], the study aims to identify optimal strategies for implementing these controls. The solution methodology combines the Forward-Backward Sweep Method with a customized Runge-Kutta scheme specifically designed for stochastic differential equations. The findings indicate that, even after the initiation of disease transmission, the simultaneous implementation of mask-wearing and active screening can significantly reduce the number of exposed and infected individuals, offering a cost-effective strategy for resource-constrained nations [4].

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Stochastic Modeling of Disease Spread: SIS Model

Communication Info

Authors:

Mohamed Rafik[1] *Faculty of Science, Ibn Zohr University, Agadir, Morocco*

Younes El Ansari[1] *Faculty of Science, Ibn Zohr University, Agadir, Morocco*

Keywords:
(1) SIS model
(2) Stochastic differential equation (SDE)
(3) Epidemic model

Abstract

We present a stochastic SIS epidemic model formulated as an SDE, incorporating randomness in the transmission rate. We derive conditions for disease extinction and persistence based on a stochastic basic reproduction number. We establish the existence of a unique positive solution.

We find that persistence occurs when the stochastic reproduction number is greater than one, while extinction is possible when it is less than or equal to one.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Comparison of Bayesian and Frequentist Approaches in Nominal Item Response Theory Modelling

Communication Info

Author:
Olayiwola Matthew ADETUTU

Federal University of Technology, Minna, Nigeria

Keywords:
(1) Bayesian
(2) Frequentist
(3) Nominal

Abstract

The research utilized a non-linear regression model to quantify unobserved characteristics of candidates in examinations and their outcomes [1]. Performances of Bayesian over Frequentist approaches in estimating nominal item response theory model parameters $P\left(y_{ij} = k \middle| a_i, b_i, \theta_j\right) \frac{\exp\{a_{ik}(\theta_j - b_{ik})\}}{=\sum_{h=1}^{4} \exp\{a_{ih}(\theta_j - b_{ih})\}}$, $\theta_j \sim N(0,1)$ [2]. Priors $a_{ik} \sim dnorm(m.a, pr.a)I(0,0)$, $b_{ik} \sim dnorm(m.b, pr.b)$, $m.a \sim dnorm(0,0.1)$, $m.b \sim dnorm(0,0.1)$ $pr.a \sim digamma(10,1)$ and $pr.b \sim digamma(10,1)$ were used to determine the posterior densities and Brooks-Gelman-Rubin Convergence Diagnostic Statistic suggested 10000 updates to have valid estimates of the intended parameters in accordance to [4]. Findings revealed that Bayesian technique gave positives, and interpretable item discriminating parameters with relatively low standard errors, and more confined credible intervals for the parameters' estimates in line with the principle of item response theory modelling [5].

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An Extension of Young's Inequality in the Framework of s-Convex Functions

Communication Info

Authors:
Lahcen TARIK[1]

[1] *Ibn Tofaïl University, Kenitra, Morocco*

Keywords:
(1) Young's inequality
(2) s-convex functions,
(3) Hermite-Hadamard inequalities.

Abstract

Young's inequality[1,2] is a fundamental result in mathematical analysis, widely used in optimization and inequality theory [3]. In this talk, we present a nontrivial version of this inequality, which we refer to as the *s-Young inequality*, based on the notion of s-convexity in the second sense [4]. Our approach relies on the use of Hermite-Hadamard inequalities for s-convex functions in second sense [5] to establish this new form of Young's inequality. We will outline the central ideas of the proofs and highlight the key steps in their development.

Keywords: Young's inequality, s-convex functions, Hermite-Hadamard inequalities.

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April 24-25-26, 2025 | Marrakech, Morocco

Gaussian and Rank-based Optimal Tests for Non Linear Regression Model

Communication Info

Authors:
Dounia BOURZIK[1]
Abdelhadi AKHARIF[1]
Aziz LMAKRI[2]
Amal MELLOUK[3]

[1] LMA, FSTT, Abdelmalek Essaadi University, Tetouan, Morocco.

[2] AICSE laboratory, ENSAM, Hassan II University, Casablanca, Morocco.

[3] Regional Center for Education and Training Trades, Tangier, Morocco.

Keywords:

(1) Local asymptotic normality

(2) Gaussian tests

(3) Rank tests

Abstract

In this paper, we identify a non-linear regression model by proposing both parametric and nonparametric tests that are locally and asymptotically optimal. These tests are specifically designed to evaluate whether the null hypothesis of a traditional linear regression model can be rejected in favor of a non-linear regression model, utilizing the Local Asymptotic Normality (LAN) property. The effectiveness of the proposed tests is validated through numerical simulations, which demonstrate that the Wilcoxon version of rank-based tests consistently outperforms Gaussian parametric tests.

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ANALYSIS OF THE STABILITY OF A MATHEMATICAL MODEL FOR MEASLES

Communication Info

Authors:

Hicham GOURRAM[1]
Issam SAHIB[1]
Mohamed BAROUDI[1]
Imane SMOUNI[1]
Abderrahim LABZAI [2]
Mohamed BELAM [1]

[1] Laboratory LMACS, Sultan Moulay Slimane University, MATIC Research Team: Applied Mathematics and Information and Communication Technologie, Department of Mathematics and Computer Science, Khouribga Polydisciplinary Faculty, Morocco.

[2] Laboratory of Analysis Modeling and Simulation, Department of Mathematics and Computer Science, Faculty of Sciences Ben M'sik, Hassan II University of Casablanca, Morocco.

Keywords:

(1) Measles
(2) Control optimal
(3) Pontryagin's maximum principle.

Abstract

The worldwide measles crisis has escalated into a significant public health issue due to its lethal nature, generating widespread anxiety. Our study presents a dynamic mathematical model constructed using comprehensive mortality data from the World Health Organization and actual data on measles outbreak propagation. By utilizing the Routh-Hurwitz criteria and formulating Lyapunov functions, we demonstrated both local and global stability for scenarios with and without the presence of the disease. Furthermore, we conducted a sensitivity analysis on the model's parameters to assess their impact on the basic reproduction number, ${R_0}$. Our theoretical results were substantiated through numerical simulations performed with MATLAB.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Moments Method of Estimation for Diffusion Processes with Random effects driven by Fractional Brownian Motion with Real Application

Communication Info

Authors:
Mohammed ER-RACHIDI[1]
Hamid EL MAROUFY[1]
Mohamed El OMARI[2]

[1] Faculty of Science and Technology, Sultan Moulay Slimane University, Béni-Mellal, Morocco
[2] Polydisciplinary Faculty of Sidi Bennour, Chouaib Doukkali University, El Jadida, Morocco

Keywords:
(1) Random effects
(2) Method of moments
(3) Geometric Fractional Model

Abstract

The method of moments is a very popular estimation procedure to be applied when likelihood-based methods are difficult to implement, which is the case of the present work. We are concerned with the estimation of the unknown population parameters of the common distribution of random effects from stochastic differential equations driven by a fractional Brownian motion. Based on method of moments we formulate consistent estimators of these parameters and examine their asymptotic normality. We demonstrate their performance by numerical simulations. As an illustration, we apply the method to real Asian financial data. Supplemental material for the article is available online.

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Optimal control problem for a bilinear vibrating plate equation with bounded distributed controls

Communication Info

Authors:
Tawfik JABER[1]
Omar BALATIF [2]

[1] *Faculty of sciences, Chouaib doukkali University, El Jadida,, Morocco.*
[2] *Faculty of sciences, Chouaib doukkali University, El Jadida,, Morocco.*

Keywords:
(1) Bilinear systems.
(2) Plate equation.
(3) Gradient problem.

Abstract

Our aim is to investigate the gradient tracking problem of a bilinear vibrating plate equation evolving in a spatial domain excited by bounded distributed control acts on the velocity term. We minimize a specified functional cost constituted of the deviation between a target gradient state and the reached one and the energy term. Hence, we prove that an optimal control exists, and we give a characterization of it using an optimality system argument. Moreover, we discuss two additional cases of control sets, space and time one. The given simulation illustrates the theoretical approach by minimizing the gradient plate state using an optimal control in different spaces.

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Exponential decay for mild solutions of second order integro-differential equations with delay

Communication Info

Authors:
Nebghouha Mohamed
Abdoulay Sene
Moustapha Dieye

[1] Université Cheikh Anta Diop, Dakar, Senegal
[2] Université Cheikh Anta Diop, Dakar, Senegal
[3] Ecole polytechnique de Thies, Thies, Senegal,

Keywords:
(1) Integro-differential equations with delay
(2) Hilbert spaces
(3) Exponential stability

Abstract

This work led to the development of a special type of second-order evolution equation, specifically integro-differential equations with delay in a Hilbert space H. Certain conditions are provided that guarantee the existence of a resolvent operator, which is a key mathematical tool in solving such equations. As a result, the asymptotic behavior of solutions can be analyzed and understood. An example of our method's effectiveness is provided.

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Analysis of the Dynamical Behavior of a Stochastic SEIS Epidemic Model with Nonlinear

Communication Info

Authors:
Abdelatif KARIMINE[1]
Zuhair BEHRAOUI [2]
Regragui TAKI [3],

[1] FSJ, El Jadida, UCD, Morocco
[2] EST, Sidi Bennour ,UCD, Morroco
[3] FSJES, Salé, UM5, Morocco

Keywords:
(1) Stochastic epidemic model
(2) Extinction
(3) Persistence
(4) Stationary distribution

Abstract

In this study, we analyze a stochastic SEIS epidemic model with nonlinear innate immunity under the influence of white noise. We first prove the existence and uniqueness of a global positive solution for the proposed system, ensuring the well-defined behavior of the model over time. Then, we established sufficient conditions for the extinction and persistence in mean of the infectious disease. Moreover, by formulating a suitable stochastic Lyapunov function, we establish sufficient conditions for the existence and uniqueness of an ergodic stationary distribution of the model's solution. Finally, the theoretical results are verified by some numerical simulations.

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Generalized Common fixed point in fuzzy-metric spaces and application to an integral equation.

Communication Info

Authors:
Hamid BEN.HSSAIN[1]
Aziz ELBOUR [1]
Abdelhak EL HADDOUCHI [1]

[1] *Faculty of Sciesnces and Technics, Errachidia, Morocco*

Keywords:
(1) Fuzzy metric spaces
(2) Common fixed point
(3) Implicit relation
(4) Integral equation

Abstract

The purpose of this paper is to present a general common fixed point theorem, which satisfies a specific implicit relation in fuzzy metric spaces. The results extend existing theorems and lead to new specific conclusions. Finally, we highlight the usefulness of these results by applying them to integral equation.

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Existence result for a system of ψ-Caputo-type hybrid fractional differential inclusions

Communication Info

Authors:
MOHAMED EL FADOUAKI [1]
KHALID HILAL [1]
AHMED KAJOUNI [1]
HAMID LMOU [1]

[1] Laboratory of Applied Mathematics and Scientific Computing, Sultan Moulay Slimane University, Beni Mellal, Morocco

Keywords:
(1) Fractional differential hybrid inclusions
(2) ψ-Caputo fractional derivative
(3) Fractional differential inclusions
(4) ψ-Caputo fractional differential inclusions

Abstract

In this paper, we study the existence of solutions to a class of ψ-Caputo-type fractional hybrid differential inclusions with nonlocal boundary conditions. We study a fractional order system of derivatives of order α where $1 < \alpha \leq 2$, subjected to integral and discrete multipoint boundary conditions. The study extends previous research [1,2,3] on fractional hybrid differential equations by introducing the ψ-Caputo fractional derivative operator [4], which offers enhanced flexibility in modeling complex phenomena. Our primary theoretical mechanism, based on fixed point theory in Banach algebras (Dhage's fixed point theorem [5]), gives existence results in the presence of mixed Lipschitz and Carathéodory conditions. The theory is developed in the setting of multivalued mappings, thus offering a more general treatment of the question. We provide comprehensive theoretical results, featuring existence theorems, and complement our results with examples to illustrate the use of the theoretical results in practice.

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Best proximity point theorems for tricyclic diametrically contractive mappings

Communication Info

Authors:
Mohammed EDAROUI[1]
Adil BAIZ [2]
Amine FAIZ[3]
Jamal MOULINE[4]
Khadija BOUZKOURA[5]

[1] FSBM, Casablanca, Morocco
[2] FSBM, Casablanca, Morocco
[3] FSBM, Casablanca, Morocco
[4] FSBM, Casablanca, Morocco
[5] FSBM, Casablanca, Morocco

Keywords:
(1) Fixed point
(2) tricyclic diametrically
(3) tricyclic contraction
(4) pointwise tricyclic

Abstract

In this article, we are referring to introducing a new class of mappings called tricyclic diametrically contractive mappings, which are defined as the union of triad nonempty subsets of a metric space. The authors provide necessary and sufficient conditions for the existence of the best proximity point for these mappings.
This new class of mappings extends the theory of traditional diametrically contractive mappings and provides a more general framework for studying fixed points and optimization problems in metric spaces. The best proximity point, which is a particular type of fixed point that is closest to a given point in the metric space, is an important tool for solving optimization problems. The results provided in this article represent a significant contribution to the field of analysis and its applications. They are expected to have far-reaching implications for the study of fixed points and optimization problems in metric spaces. The new class of tricyclic diametrically contractive mappings and the conditions for the existence of the best proximity point are likely to be of great interest to researchers in mathematics and science, as well as practitioners in various fields that make use of optimization algorithms.

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An extension of Van Velck's functional equation on semigroups

Communication Info

Authors:
Youssef ASERRAR[1]

Elhoucien ELQORACHI [1]

[1] Ibn Zohr University-Faculty of Sciences, Agadir, Morocco

Keywords:
(1) Semigroup.
(2) Automorphism.
(3) Measure.
(4) Van Velck's functional equation.

Abstract

Let S be a semigroup, $Z(S)$ the center of S. In this paper, we determine the complex-valued solutions of Van Vleck's functional equation

$$\int_S f(xyt)d\mu(t) - \int_S f(\sigma(y)xt)d\mu(t) = 2f(y)g(x),\ x, y \in S,$$

where μ is a measure that is a linear combination of Dirac measures $(\delta_{z_i})_{i\in I}$, such that $z_i \in Z(S)$ for all $i \in I$, and $\sigma : S \to S$ is an involutive automorphism. We also give some interesting consequences.

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Fuzzy Complex Conformable Differentiation

Communication Info

Authors:
Atimad HARIR

[1] *Laboratory of Applied Mathematics and Scientific Computing,Ecole Normale Superieure Sultan Moulay Slimane University, B.P. 523, Beni Mellal, Morocco*

Keywords:
(1) Complex Fuzzy numbers
(2) fuzzy conformable derivative
(3) complex fuzzy conformable derivatives

Abstract

In this paper, some important fuzzy real fractional calculus results are extended to the context of fuzzy complex-valued functions of a real variable. Two conformable derivatives of such functions are defined, which are expansions of [1] conformable derivatives of real fuzzy mappings[4]. Two examples of complex fuzzy conformable derivatives are shown, as well as their features [2,3].

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Stabilité et contrôlabilité des équations aux dérivées partielles d'ordre quatre

Communication Info

Authors:
Yassine EL ISSAOUY[1]
Abdelkarim HAJJAJ [2]
Brahim ALLAL [3]

[1] Université Hassan 1, Settat, Maroc
[2] Université Hassan 1, Settat, Maroc
[3] Université Ibn Zohr, Agadir, Maroc

Keywords:
(1) Équations aux dérivées partielles.
(2) Opérateur d'ordre 4.
(3) Stabilité, contrôlabilité.
(4) Semi-groupes d'opérateurs
(5) Stabilité, contrôlabilité.
(6) méthodes de multiplicateurs

Abstract

Les équations aux dérivées partielles d'ordre quatre [2] apparaissent naturellement dans divers modèles physiques et mécaniques, notamment dans la théorie des plaques et des poutres en élasticité. Cette présentation est consacrée à l'étude des propriétés analytiques et asymptotiques de ces équations, avec un accent particulier sur la stabilité [1] et la contrôlabilité des solutions. Nous examinerons les méthodes mathématiques modernes permettant d'analyser ces systèmes, en mettant en avant l'approche des semi-groupes d'opérateurs [3], les méthodes de multiplicateurs et les techniques variationnelles. Des exemples concrets, comme l'équation de Petrovsky [4] fortement amortie et les équations de type Euler-Bernoulli, seront discutés pour illustrer les résultats théoriques et leurs applications potentielles.

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Counting primitive kth Roots of Unity Modulo n

Communication Info

Authors:
Abderrahim MAKKI NACIRI

[1] *Faculty Semlalia, Cadi Ayyad University, Marrakesh, Morocco*.

Keywords:
(1) Roots of unity
(2) Primitive root of unity
[3]Möbius-inversion formula

Abstract

Given positive integers n and k, we provide an explicit formula for the number of kth roots of unity modulo n, assuming the prime factorization of n is known. Furthermore, when the prime factorization of k is also available, we explicitly determine the number of primitive kth roots of unity using the Möbius inversion formula. In the case where n is a factorial, we provide a bound on the number of square roots modulo n without relying on the prime factorization of n.

The concept of primitive kth roots of unity is a fundamental tool with numerous applications. In computer science, kth roots of unity are utilized in the Fast Fourier Transform (FFT) algorithm. They also feature prominently in constructing cyclic codes and are employed in pseudorandom number generators.

In cryptography, primitive roots of unity are essential components of public-key protocols, including the Diffie-Hellman key exchange and RSA algorithm. The concept is also closely tied to the discrete logarithm. problem.

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Translation surfaces generated by two relatively normal-slant helices in Euclidean 3-space

Communication Info

Authors:
Salma KHAN[1]
Malika IZID[1]
Abderrazzak El Haimi[1]
Bouchra Aharmim[1]
Amina OUAZZANI CHAHDI[1]

[1]LAMS, Faculty of Sciences Ben M'Sick, University Hassan II of Casablanca, Morocco.

Keywords:
(1) Translation surface
(2) *Line of curvature.*
(3) Normal curvature
(4) *Darboux frame*
(5) Relatively normal-slant helix

Abstract

In differential geometry, a translation surface is a surface obtained by translating a curve $\alpha = \alpha(u)$ along another curve $\beta = \beta(v)$. Translation surfaces can be locally parametrized by

$$\varphi(u, v) = \alpha(u) + \beta(v),$$

where $\alpha : I \subset \mathbb{R} \to E^3$ and $\beta : J \subset \mathbb{R} \to E^3$, with E^3 a 3-dimensional Euclidean space.

In this study, we provide parametric representations and propose illustrative examples of some translation surfaces, defined by

$$M : X(u, v) = \alpha(u) + \beta(v),$$

in the case where the curves $u \to \alpha(u)$ and $v \to \beta(v)$ are relatively normal-slant helices for the initial surface Σ, provided with their respective Darboux frames. $(T_\alpha, V_\alpha, U_\alpha)$ and $\left(T_\beta, V_\beta, U_\beta\right)$, i.e. each of the two vector fields V_α and V_β makes a constant angle with a fixed direction. We distinguish two cases:
α and β relatively normal-slant helices and lines of curvature for the initial surface Σ, and in the second case α and β relatively normal-slant helices with $\tau_{g_\alpha} \neq 0$ and $\tau_{g_\beta} \neq 0$.

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Stochastic two-strain epidemic model with saturated incidence rates driven by Lévy noise

Communication Info

Authors:
Marya SADKI[1]
Karam ALLALI[1]

[1]Laboratory of Mathematics, Computer Science and Applications, Faculty of Sciences and Technologies, University of Hassan II of Casablanca, PO Box 146, Mohammedia, Morocco

Keywords:
(1) Two-strain
(2) Epidemic model
(3) Extinction
(4) Persistence in mean
(5) White noise
(6) Lévy noise

Abstract

In this work, we introduce a stochastic two-strain epidemic model driven by Lévy noise describing the interaction between four compartments; susceptible, infected individuals by the first strain, infected ones by the second strain and the recovered individuals. The forces of infection, for both strains, are represented by saturated incidence rates. Our study begins with the investigation of unique global solution of the suggested mathematical model. Then, it moves to the determination of sufficient conditions of extinction and persistence in mean of the two-strain disease. In order to illustrate the theoretical findings, we give some numerical simulations.

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Improved qualitative results for retarded integro-differential equations

Communication Info

Authors:
Osman TUNÇ

[1] *Department of Computer Programing, Baskale Vocational School, Van Yuzuncu Yil University, Campus, 65080, Van, Turkey*

Keywords:
(1) Lyapunov-Krasovskiĭ functional
(2) Integro-differential equations
(3)Stability
(4)Boundedness

Abstract

This paper focuses on a class of nonlinear time-varying retarded integro-differential equations. Using the Lyapunov-Krasovskiĭ functional method, we establish some new results under sufficient conditions ensuring uniform stability, uniform asymptotic stability, integrability, and boundedness of solutions to the retarded integro-differential equations. The main novelty and originality of this article are that the considered integro-differential equations with retarded arguments are new mathematical models and the qualitative results given are also new.

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Dynamic Conduct of a Stochastic Unemployment Model

Communication Info

Authors:
Oumaima AARABATE[1]
Omar BALATIF [1]

[1] *Laboratory of fundamental mathematics and their applications, Faculty of sciences, University of Chouaib Doukkali, El Jadida, Morocco*

Keywords:
(1) Unemployment model
(2) Asymptotically stable in the large
(3) Stochastic Lyapunov function.

Abstract

In this paper, we propose and analyze a mathematical model with stochastic perturbation of the issue of unemployment by considering three main variables. Namely graduates or individuals who have reached the age of employment, salaried individuals and employees, and then individuals who have been made redundant or who have resigned from work. After the description of the proposed model, we study the existence and the uniqueness of the nonnegative solution. Furthermore, we investigate the asymptotic behavior of this solution by analyzing the stability of the system at the equilibrium points. Finally, some numerical simulations are performed to verify the theoretical analysis using Matlab.

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BLOCK COORDINATE DESCENT METHODS OF CENTER

Communication Info

Authors:
Khaoula Kharfati[1]
Ahmed Roubi[2]

[1] FST, Settat, MOROCCO
[2] FST, Settat, MOROCCO

Keywords:
(1) BCD methods
(2) Method of center
(3) Optimality conditions

Abstract

A block coordinate descent method, is an iterative procedure that solves block-structured optimization problems, where each block of coordinates is subject to its own constraints. For such problems, we develop a new method that act by solving less constrained and of smaller size subproblems. We propose, the block coordinate descent method of centers (BCDMC), that solves an unconstrained or at least less constrained problems, which are of smaller size than the original problem. Under regularity properties involving the objective function, we establish optimality conditions on the entire decision variable, based on those established for its block coordinates. These methods generate sequences whose every cluster point satisfies these optimality conditions.

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ICRAMCS 2025
THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

A Mathematical model for the interaction between Covid-19 and Tuberculosis dynamics

Communication Info

Authors:
BENAMARA Ibtissam[1,2]
BENAZZA Hafida [2]
FAIZ Mariem [2]

[1] SMARTiLab Laboratory, Moroccan School of Engineering Sciences (EMSI), Rabat Morocco.

[2] *Mathematics, Computer Sciences, and Applications Information Security Laboratory (LABMIA-SI), Faculty of Sciences, Mohammed V University, Rabat, Morocco.*

Keywords:
(1) COVID-19
(2) Tuberculosis
(3) Co-infection
(4) Reproduction number.

Abstract

This study examines a mathematical model that captures the transmission dynamics of COVID-19 and tuberculosis within a population, emphasizing the interplay between the two diseases. The model incorporates key epidemiological factors, such as co-infection and disease progression, to better understand their joint impact. The existence and uniqueness of the endemic equilibrium are rigorously proven, followed by a comprehensive analysis of the equilibrium points and their local stability. To provide deeper insights, a sensitivity analysis is conducted to identify critical parameters influencing disease dynamics. Finally, numerical simulations are carried out to validate the theoretical results and explore potential scenarios, offering valuable perspectives for public health strategies.

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Trajectory tracking problem for 2-D Heat Equation

Communication Info

Authors:
Abdelhadi ELHARFI[1]
Mustapha EL HASSANI[2]
Samir El MOURCHID[2]

[1] Department of Mathematics, Regional Center for Education and Training Professions, Sous Massa, Agadir, Morocco..
[2] Laboratory of Mathematical Analysis and Applications, Ibn Zohr University, Agadir, Morocco.

Keywords:
(1) Backstepping transformation
(2) the Laplace transform
(3) C_0-semigroup
(4) Green's function
(5) trajectory tracking

Abstract

The trajectory tracking problem (TTP) refers to the procedure of finding an input control that steers the system output to follow a predefined path. In this paper, we investigate the TTP for controlled systems governed by a 2-D Heat equation in which we target a perfect matching of the system output with a desired trajectory. The controller as well as the corresponding state response are explicitly given by means of the target trajectory and the solutions of appropriate kernels PDEs. The approach is based on backstepping techniques, the Laplace transform, and Green's functions.

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On the Robustness of Augmented Box-Behnken Designs to Two Missing Observations

Communication Info

Authors:
Oluchukwu C. ASOGWA[1]
Oluwaseun A. OTEKUNRIN [3]
Nnaemeka M. EZE [4]

[1] Alex Ekwueme Federal University, Ndufu-Alike, Ebonyi State, Nigeria
[3] University of Ibadan, Ibadan, Nigeria
[4] University of Nigeria, Nsukka, Nigeria

Keywords:
(1) Robustness of designs
(2) Missing observations
(3) Third-order designs

Abstract

Second-order response surface models might sometimes be inadequate and unfeasible in real-life investigations due to the lack of fit caused by the presence of third-order terms [1]. This willingly opens the door for augmentation of a second-order response surface model to a third-order model. The third–order designs that take care of the estimates of the model in this work are augmented Box-Behnken Designs (ABBDs), which have always been confronted with missing observations [2]. This scenario that has affected the design's power of test and desirable properties, often comes up when observations are lost, or ignored [3]. Therefore, this work developed a minimax loss ABBDs robust to two missing observations under minimax loss criterion [4]. The developed robust designs have applications in experimental fields [5, 6].

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Pythagorean Fuzzy Sublattices and Ideals

Communication Info

Authors:
Meryem FAKHRAOUI [1]
Idris BAKHADACH [1]
Said MELLIANI [1]

[1] Sultan Moulay Slimane University, Beni Mellal, Morocco

Keywords:
(1) Fuzzy Lattice
(2) Pythagorean Fuzzy Sublattice
(3) Pythagorean Fuzzy Homomorphism

Abstract

This research delves into the exploration of Pythagorean fuzzy sublattices and Pythagorean fuzzy ideals within the context of lattice theory. Through a rigorous analysis of structural theorems concerning these concepts derived from Pythagorean fuzzy sets, we uncover significant parallels with classical theory. Additionally, we investigate the behavior of Pythagorean fuzzy ideals under lattice homomorphisms. Our findings shed light on the applicability and utility of Pythagorean fuzzy theory in lattice-based structures, offering insights into their properties and relationships.

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Qualitative results for intuitionistic fuzzy Cauchy Problem

Communication Info

Authors:
El Houssine BOUZID[1]
Bouchra BEN AMMA[2]
Said MELLIANI[1]
Lalla Saadia CHADLI [1]

[1]LMACS, Faculty of Sciences and Technologies, Sultan Moulay Slimane University, Beni Mellal, Morocco.
[2] LMACS, Higher School of Education and Training, Sultan Moulay Slimane University, Beni Mellal, Morocco.

Keywords:
(1) Intuitionistic fuzzy number
(2) Cauchy Problem
(3) Gronwall's Lemma
(4) Metric space
(5) Fixed point Theorem
(6) Integral equations
(7) Hyers-Ulam stability

Abstract

In this study, we will investigate, based on Banach fixed-point Theorem, the existence and uniqueness of a solution to The intuitionistic fuzzy Cauchy Problem (IFCP), by introducing a new metric in the space of intuitionistic fuzzy functions. Using Gronwall's Lemma, some qualitative properties of the solution, and its Hyers-Ulam stability, are also discussed. The new metric introduced in this paper makes the contraction condition easy to obtain. The approach used in this study has a larger domain of applicability, and gives an idea about the behavior of the solution to (IFCP), which can help us to develop numerical methods to find an approximate solution.

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Stability Analysis of a Mathematical Model for Malaria Transmission

Communication Info

Authors:
FAIZ Mariem[1]
BENAZZA Hafida [1]
BENAMARA Ibtissam [1]
TAFTAF Chaimaa [1]

[1] Mathematics, Computer Sciences, and Applications Information Security Laboratory (LABMIA-SI), Faculty of Sciences, Mohammed V University, Rabat, Morocco

Keywords:
(1) Malaria
(2) Epidemic model
(3) Disease free-equilibrium
(4) Basic reproduction number

Abstract

This study analyzes the stability of a mathematical model for malaria transmission, formulated as a system of five differential equations. We examine the local stability of the disease-free equilibrium (DFE) and the endemic equilibrium. Our results establish that the DFE is locally asymptotically stable when the basic reproduction number R0 < 1, implying disease eradication. Conversely, when R0 > 1, the DFE becomes unstable, and the endemic equilibrium is locally asymptotically stable, suggesting disease persistence. Numerical simulations support our theoretical findings and provide further insights into the influence of key parameters on malaria transmission dynamics. These results contribute to a better understanding of malaria spread and inform the development of effective control strategies.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Stability and sensitivity analysis of HIV Co-Infections with HCV, HBV, and TB

Communication Info

Authors:
CHAIMAE EL MOURABIT[1]
NADIA IDRISSI FATMI [1]

[1] LIPIM, National School of Applied Sciences of Khouribga, Sultan Moulay Slimane University, Morocco

Keywords:
(1)HIV co-infections
(2) Mathematical modeling
(3) Stability analysis

Abstract

HIV co-infections with HCV, HBV, and TB pose challenges due to their complex interactions, immune effects, and treatment implications. This study develops a mathematical model using nonlinear differential equations to describe transmission dynamics and disease progression. The model incorporates viral replication, immune response, and treatments, including ART, DAAs for HCV, and anti-TB therapy. We analyze the stability of sub-models for HIV-HCV, HIV-HBV, and HIV-TB, deriving the basic reproduction number as a threshold for disease persistence. Stability conditions at disease-free and endemic equilibrium states are examined using the Jacobian matrix for local stability and Lyapunov functions for global stability. Furthermore, a sensitivity analysis is performed to assess the impact of key model parameters on the basic reproduction number and the equilibrium states. Numerical simulations are carried out to validate the theoretical findings.

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Multi-cell discrete-time SIRI epidemic model with travel restrictions and vaccination controls

Communication Info

Authors:
Samira ZOUHRI[1]
Mohcine ELBAROUDI [1]
Hassan LAARABI[1]

[1] Laboratory of Analysis, Modeling, and Simulation (LAMS), Department of Mathematics and Computer Science, Hassan II University of Casablanca, Faculty of Sciences Ben M'sik, Casablanca, Morocco

Keywords:
(1) Discrete SIRI model
(2) multi-cell
(3) optimal control

Abstract

In this paper, we propose a multi-cell discrete-time SIRI epidemic model that describes the spatial-temporal spread of an infectious disease in a geographical domain represented as a grid of cells (regions) divided into p^2 cells. We assume that people can move between these cells due to their connectivity. To investigate the efficacy of travel restrictions and vaccination in preventing epidemic spread, we include two control variables in our model. We aim to reduce the number of infected individuals in each cell designated as infectious by the health authority, while also minimizing the expenses associated with implementing the travel ban and vaccination efforts. We develop an optimal control approach using the definition of a supplementary function that identifies the automatic activation of travel restrictions and vaccination in every cell according to health authority decisions. We present numerical results testing the spread of epidemics in different scenarios.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

April 24-25-26, 2025 | Marrakech, Morocco

Commutativity of prime rings and Banach algebras with generalized (β, α)-derivations

Communication Info

Author:
Abderrahmane RAJI

LMACS Laboratory, FST, Sultan Moulay Slimane University, Beni Mellal, Morocco

Keywords:
(1) Prime rings
(2) Prime Banach algebras
(3) Generalized (β, α)-derivations.

Abstract

In ring theory, numerous research in ring theory have demonstrated that certain rings must be commutative under certain conditions. In this context, we recall an important result due to Howard E. Bell [3, Theorem 4.1], where he showed that a prime ring R with nonzero center and char(R) = 0 or char(R) > n > 1 must be a commutative ring if R admits a nonzero derivation d satisfying $d([x^n, y]) - [x, y^n] \in Z(R)$ for all $x, y \in R$.

Our major objective is here is to use this idea to investigate the commutativity of prime associative rings and prime Banach algebras with generalized (β, α)-derivations satisfying certain differential identities. Consequently, we use continuous linear generalized (β, α)-derivations to extend our theoretical results on rings to unital Banach algebras.

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Spectrum of discrete 2n-th order difference operateur with periodic boundary conditions and its applications

Communication Info

Authors:
Omar Hammouti

Sidi Mohamed Ben Abdellah University, Fez, Morocco

Keywords:
(1) discrete boundary value problems
(2) 2n-th order
(3) variational methods

Abstract

Let n∈ ℕ*, and N≥n be an integer. We study the spectrum of discrete 2n-th order eigenvalue problems:

$$\begin{cases} \displaystyle\sum_{k=0}^{n}(-1)^k\Delta^{2k}u(t-k) = \alpha u(t), \quad t\in[1,N]_{\mathbb{Z}}, \\ \Delta^i u\big(-(n-1)\big) = \Delta^i u\big(N-(n-1)\big), \quad i\in[0,2n-1]_{\mathbb{Z}} \end{cases}$$

where α is a parameter, $[1,N]_{\mathbb{Z}}$ denotes the discrete interval {1, 2, 3,.....N} and Δ is the forward difference operator defined by Δu(t)=u(t+1)-u(t), Δ^0u(t)=u(t)

and $\Delta^i u(t) = \Delta^{i-1}(\Delta u(t))$ for i=1,2,3…2n.

As an application of this spectrum results, we show the existence of a solution of discrete nonlinear 2n-th order problems by applying the variational methods and critical point theory.

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Integral inequalities for log (m; h1; h2) convex stochastic

Communication Info

Authors:
Oualid Rholam[1]
Yassine Laarichi [2]
Mohammed Barmaki [3]

[1] *ENSA Kenitra, Morocco*
[2] *ENSA Kenitra, Morocco*
[3] *ESEF Kenitra, Morocco*

Keywords:
(1) Keyword1 Godunova-Levin interval-valued functions
(2) Keyword2 Stochastic process
(3) Keyword3 Hermite-Hadamard and Jensen-type inequalities

Abstract

Godunova-Levin interval-valued functions have attracted considerable attention in mathematical research due to their versatility and wide-ranging applications across diverse domains [1].
Originally formulated within deterministic contexts, these functions provide a robust framework for addressing uncertainty and imprecision. However, as contemporary mathematical investigations increasingly intersect with stochastic processes, the significance of studying stochastic processes becomes apparent.
Consequently, there emerges a pressing need to extend the applicability of Godunova-Levin functions into the realm of stochastic processes.
the key motivations driving this research is the exploration of novel interval Hermite-Hadamard and Jensen-type inequalities within the context of stochastic processes, as demonstrated in the subsequent references [2], [3] and [4]. These inequalities serve as fundamental tools in mathematical analysis, playing pivotal roles in theoretical developments and practical

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

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Comparative Study of Information-Theoretic Multi-Label Feature Selection

Communication Info

Authors:
Hasna CHAMLAL[1]
Tayeb OUADERHMAN[2]
Mouhsin MESKAOUI [3]

[123] Computer Science and Systems Laboratory (LIS), Faculty of Sciences Ain Chock, Hassan II University of Casablanca, Morocco

Keywords:
(1) Multi-label learning
(2) Feature selection
(3) Information theory
(4) Label relationships

Abstract

Multi-label feature selection (MLFS) is essential in high-dimensional data analysis for identifying discriminative features while effectively managing label dependencies. This study presents a comparative analysis of two state-of-the-art MLFS methods—LRFS and LSMFS—each addressing distinct aspects of label interactions.

LRFS [1] reduces label redundancy by categorizing labels into redundant and non-redundant groups, optimizing feature subsets to minimize informational overlap and enhance discriminative power. In contrast, LSMFS [2] extracts all supplementary information and the maximum supplementary information of features for each label from other labels, leveraging inter-label dependencies to enrich the feature selection process.

The comparative evaluation, conducted on benchmark multi-label datasets, employs metrics including Hamming Loss, Accuracy, and Macro-F1. Results indicate that LRFS is particularly effective in redundancy-prone environments, while LSMFS excels in scenarios where inter-label information is pivotal for improving classification performance. These complementary strategies highlight the nuanced trade-offs in MLFS design, suggesting that method selection should align with specific dataset characteristics.

Future work will focus on formulating a new feature relevance term based on label importance-weighted relevance and label-dependency redundancy, aiming to further enhance feature selection and multi-label classification performance.

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Numerical Analysis of Air Pollution Dispersion from Steady Single Point Emission Source

Communication Info

Authors:
Ait LhoussainHamid[1]
Younes Abouelhanoune[1]

[1] *ENSA Al-Hoceima, Abdelmalek Essaadi University, Tetouan, Morocco.*

Keywords:
(1) Emission Source
(2) Dispersion
(3) Air pollution modeling

Abstract

Dispersion models predict the spread of pollutants from sources such as industrial sources, vehicle emissions, or unattended spills of chemicals, and therefore support planning for emergencies. It will be undertaken here from a single point source, taking wind direction and speed, molecular diffusion, and convection into account. Atmospheric dispersion is affected by meteorological conditions, topography, and source characteristics. Computational methods in numerical simulations aid in the modeling of pollutant dispersion from a point source, considering wind information, topography, and emission distribution. Air quality and possible impacts are simulated to assess cost-effective pollution control and mitigation strategies.

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Feedback stabilization of non-homogeneous semilinear neutral systems with distributed delay

Communication Info

Authors:
Mohamed ERRAKI[1]
Atmane EL HOUCH[2]

[1] Hassan 2 University, Casablanca, Morocco
[2] Hassan 2 University, Casablanca, Morocco

Keywords:
(1) Semilinear systems
(2) Non-homogeneous systems
(3) Neutral systems
(4) Strong stabilization
(5) Distributed delay

Abstract

This paper addresses the stabilization problem for a class of non-homogeneous semilinear neutral systems with distributed delay, evolving on a real Hilbert space. Sufficient conditions in term of observation estimates are given to achieve the strong stabilization via bounded feedback control. Moreover, under an appropriate decomposition of the state space, we consider a feedback control that depends only on the state projection on a suitable subspace and guarantee the exponential stabilization in the bilinear case. Finally, we present examples and numerical simulations to illustrate the effectiveness of the obtained results.

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On The Existence of Weak Solutions for Double-phase-Laplacian-Like Systems

Communication Info

Authors:
Hasna MOUJANI [1]
Abderrazak KASSIDI [2]
Ali EL MFADEL [3]
M'hamed ELOMARI[4]

[1,2,4] Laboratory LMACS, Faculty of sciences and techniques, Sultan Moulay Slimane University, Beni Mellal, Morocco.
[3]Superior School of Technology, Sultan Moulay Slimane University, Khenifra, Morocco.

Keywords:
(1) Double phase operator
(2) Galerkin method
(3) Young measure

Abstract

This paper deals with the existence of weak solutions for a class of nonlinear Dirichlet boundary value systems driven by a double phase Laplacian-like operator. We establish the required result under some assuptions on the nonlinearity **f** by relying on Musielak–Orlicz-Sobolev spaces, the Young measures method for managing weak convergence and the Galerkin approximation.

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K-frames in super Hilbert c*modules

Communication Info

Authors:
LFOUNOUNE ABDELLATIF[1]
ROUMAISSAE EL JAZZAR[2]
Faculty of Sciences, University of Ibn Tofail, Kenitra, Morocco

[1] *IBN TOFAIL, KENITRA, MOROCCO*
[2] *IBN TOFAIL, KENITRA, MOROCCO*

Keywords:
(1) K-frame
(2) super Hilbert $C*$-modules
(3) duality

Abstract

In this talk, we explore the theory of K-frames in super Hilbert C∗-modules, extending frame theory from Hilbert spaces to the richer structure of Hilbert C∗-modules. We introduce the concept of super Hilbert modules as direct sums of Hilbert C∗-modules and develop a framework for defining and characterizing K-frames in this setting. Our main results provide new characterizations of K-frames, along with necessary and sufficient conditions for sequences in super Hilbert C∗-modules to form K-frames. Furthermore, we examine the relationships between K-frames, minimal frames, and orthonormal bases, presenting several theoretical propositions and illustrative examples. These findings contribute to a deeper understanding of operator theory and functional analysis in the context of C∗-algebras, with potential applications in quantum information theory and signal processing.

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Les fondements mathématiques de l'Analyse en composantes principales normées et applications.

Communication Info

Authors:
Ayad EL BAZ

ENCG, EL Jadida, Maroc

Keywords:
(1) Analyse en composantes principales
(2) Mathématique
(3) ACPN
(4) Donnée
(5) Information

Abstract

Ce travail présentera les fondements mathématiques de l'analyse en composantes principales normées (ACPN) ainsi qu'une application de cette technique sur des données financières.

Dans un premier temps, nous exposerons les bases de l'algèbre linéaire les plus utiles pour mieux expliquer l'ACPN d'un point de vue mathématique L'ACP, en tant que technique d'analyse des données, s'intéresse à l'extraction et au résumé des informations contenues dans une grande base de données concernant des individus et des variables.

Dans le cadre de ce travail, nous expliquerons comment se fait le passage d'un espace des variables, considéré comme espace vectoriel, de grande dimension à un espace de faible dimension. Une telle réduction se réalise avec une faible perte d'information. Dans un second temps, ce travail présentera une application de l'ACPN sur des données financières sous le logiciel SPSS. Il évoquera également les interprétations des résultats obtenus qui prennent en considération les points de vue mathématique et financier.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

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Existence of solutions of fractional equation with fractional integral boundary conditions

Communication Info

Author:
Karima ALI KHELIL

Badji Mokhtar University, Annaba, Algeria

Keywords:
(1) Fractional derivative
(2) Boundary value problem
(3) Krasnoselsky's theorem

Abstract

In this work, we are interested in the study of the following boundary value problem [1]:

$$\begin{cases} \mathrm{D}^{\alpha} w(s) = \varphi\big(s, w(s)\big), \quad s \in (0,1), \\ w(0) = 0, \\ w(1) = I^{\beta} w(1), \\ w'(1) = I^{\beta} w'(1) \end{cases}$$

where $\varphi: [0,1] \times \mathbb{R}_+ \longrightarrow \mathbb{R}_+$ is a continuous positive function and D^{α} is the Caputo fractional derivative operator of order α, I^{β} is the Riemann-Liouville fractional integral operator of order β such that $2 < \alpha \leq 3, \; 0 < \beta < 1$.

The main objective are to obtain conditions for the existence of solutions [2].

We present different conditions for the existence of solutions based on *Arzela-Ascoli* and *Krasnoselskii* theorems [3, 4, 5].

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Enhanced Qualitative Results for Nonlinear Integro-Differential Equations of Higher Order

Communication Info

Authors:
Melek GÖZEN

[1] *Department of Business Administration*
Faculty of Management
Van Yuzuncu Yil University
65080, Erciş –Van, Turkey

Keywords:
(1) Enhanced qualitative results
(2) integro-differential equation
(3) higher order
(4) stability
(5) boundedness

Abstract

The objective of this study is to establish new and improved results on the stability and boundedness of solutions to higher-order integro-differential equations. The fundamental approach in the proofs involves defining a suitable new Lyapunov function to establish the novel results of this study. We provide two examples to verify the results of this study. This article presents novel results and significant contributions to the qualitative theory of higher-order integro-differential equations.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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A constructive method for feedback stabilization of a collection of stochastic nonlinear systems

Communication Info

Authors:
HananeHIMMI[1]
Mohamed Oumoun[2]

[1]*Ensa, Cadi Ayad University, Marrakech, Morocco*

[2]*Ensa, Cadi Ayad University, Marrakech, Morocco*

Keywords:
(1) Simultaneous stochastic stabilization
(2) State feedback
(3) Stochastic control Lyapunov function

Abstract

The simultaneous stabilization problem consists in finding a single controller which simultaneously stabilizes a finite collection of control system. The goal of this communication is to study the problem of simultaneous stabilization in probability, by state feedback, for a class of nonlinear stochastic systems whose drift and diffusion terms are dependent on the control. We extend some results proved by [1] for deterministic control systems to a collection of stochastic nonlinear systems for which classical methods are not applicable and the coefficients are only continuous and not necessary Lipchitz.
Under the assumption that a collection of stochastic control Lyapunov functions is known and based on the generalized stochastic Lyapunov theorem [2], we drive sufficient conditions for the simultaneous stabilization by a continuous state feedback controller.
This work generalizes the previous work [3] and is published in [4]. An illustrative example is given to verify the effectiveness of the result.

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Study on the Behavior of Net Asset Values of Diversified Mutual Funds

Communication

Authors:
Zineb BELLACHE [1]
Hicham
EL BOUANANI [2]

Market Analysis and Economic Governance Research Laboratory ***(MAEGE).***
University HASSAN II, Casablanca, Morocco

Keywords:
(1) Mutual Funds
(2) Net Asset Value
(3) Financial Market Analysis

Abstract

This study examines the performance dynamics of diversified UCITS in Morocco, analyzing the relationships between fund performance, benchmark indices, and macroeconomic and geopolitical events. The analysis highlights the conservative portfolio management approach adopted by Moroccan funds, which prioritizes stability and capital preservation. While this strategy results in low volatility, it also limits global market opportunity capture due to dependence on the domestic economy (*1*).
The Capital Asset Pricing Model (CAPM) is used to evaluate the influence of interest rates, inflation, and exchange rate fluctuations on fund returns, aligning with recent studies on macroeconomic impacts in emerging markets (*2*). Findings reveal that interest rates negatively impact fund values, with beta coefficients around 0.5, indicating limited correlation with global markets. However, positive alphas suggest benchmark outperformance despite limitations in qualitative data on management decisions (*3*).
Drawing parallels with research on macroeconomic policies in developing countries (*4*), this study advocates for incorporating qualitative data and sentiment analysis to better understand the drivers of fund performance in Morocco's unique financial landscape. These findings align with recent studies on investment funds in emerging markets, which highlight their specific characteristics and challenges (*5*).

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Entropy Solutions for Some Elliptic Unilateral Problems with Degenerate coercivity

Communication Info

Authors:
Brahim EL OMARI [1]
Youssef HAJJI [2]
Hassane HJIAJ[3]
Ismail JAMIAI[4]

[1] *Abdelmalek Essaadi University, Tétouan, Morocco*
[2] *Abdelmalek Essaadi University, Tétouan, Morocco*
[3] *Abdelmalek Essaadi University, Tétouan, Morocco*
[4] *Abdelmalek Essaadi University, Tétouan, Morocco*

Keywords:
(1) Entropy solutions
(2) Unilateral Problems
(3) Obstacle problems

Abstract

In this work, we consider the following elliptic unilateral problems with degenerate coercivity whose prototype is given by:

$$-\sum_{i=1}^{N} D^i a_i(x,u,\nabla u) + g(x,u,\nabla u) = f - \sum_{i=1}^{N} D^i \phi_i(x,u) \ \ in\ \Omega$$

with $\qquad u = 0\ on\ \partial\Omega.$

Where Ω is an open bounded set of $\mathbb{R}^N$ $(N \geq 2)$, where the Carathéodory functions $a_i(x,s,\xi)$ verifying the degenerate condition, and the lower order term $g(x,s,\xi)$ verify only some growth condition, and the f data is assumed to belong to $L^1(\Omega)$.

In this work we prove the existence of unilateral entropy solutions for these equations.

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Mathematical Model for Heroin Consumption Spread with Stability Analysis and Control Strategies

Communication Info

Authors:
Khadija BENCHEIKH [1]
Zineb ELGHOUBARI [2]
Regragui TAKI [3]

[1] Chouaib Doukkali, Faculty of Sciences,Eljadida Morocco
[2] Chouaib Doukkali, Faculty of Sciences, Eljadida, Morocco
[3] Chouaib Doukkali, Faculty of Sciences, Eljadida,Morocco

Keywords:
(1) Basic reproduction number
(2) stability analysis
(3) optimal control strategies

Abstract

Heroin, an opioid derived from morphine, poses serious public health problems due to its addictive nature and harmful effects on the central nervous system. Assuming that heroin use follows a process that can be modeled in the same way as an infectious disease [1]. Mathematical modeling is used as a tool to understand and control heroin addiction [2]. It is, therefore, essential to calculate the basic reproduction number R_0[3], analyze the local and global stability of equilibrium points, and identify the most critical strategies through optimal control theory [4]. This approach will help determine how such epidemics can be controlled and ultimately eradicated from communities.

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Semigroup Dynamics of a Conformable Spatial PDE: Chaos and Hypercyclicity

Communication Info

Authors:
Khadija ELKHALLOUFY [1]
Manal MENCHIH [1]
Khalid HILAL [1]
Ahmed KAJOUNI [1]

[1] USMS, Beni Mellal, Morocco.

Keywords:
(1) Chaos
(2) Hypercyclicity
(3) Conformable spatial PDE

Abstract

The aim of this study is to analyze the dynamics of an initial value problem associated with a conformable spatial partial differential equation [1] within the space of complex-valued continuous functions on $[0, +\infty)$, where functions vanish at infinity. First, we demonstrate that the solution generates a strongly continuous semigroup [5]. Next, we construct a quasiconjugacy between this solution and another semigroup defined on a conformable weighted function space [2, 3]. Under specific conditions, we demonstrate that the problem exhibits both hypercyclicity and chaos.

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Properties of 'Kermack KcKendrick' like models

Communication Info

Authors:
Hamidou A DIALLO[1]
Khalil EZZINBI [1]
Nisrine OUTADA [1]
Gauthier SALLET [2]

[1] Université Cadi Ayyad LMDP, Marrakech, Morocco
[2] Université de Lorraine IECL CNRS 7502, Metz, France

Keywords:
(1) Kermack–McKendrick
(2) Final size
(3) Multiroup

Abstract

In this paper, we investigate the mathematical properties of a 'Kermack–McKendrick' like model that extends the classical Susceptible–Infected–Removed (SIR) framework by incorporating multiple infected classes as well as dedicated compartments for hospitalized and Intensive Care Unit (ICU) cases. This model, formulated under five hypotheses detailed later in the paper, comprises 13 compartments. We prove that every solution trajectory converges to a disease-free equilibrium. Moreover, we compute the basic reproduction number and show that the model admits a first integral. We also establish a final size relation, demonstrating that the final size S_∞ is uniquely determined for any value of R_0. Finally, we extend our analysis to an age-stratified model, leading to a multi-group framework.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

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Asymptotic almost periodicity of bounded solutions for some partial functional differential equations with delay

Communication Info

Authors:

Thami AKRID[1]

Abdelhai ELAZZOUZI [2]

Aziz OUHINOU [3]

[1] *CRMEF, Marrakech, Morocco*

[2] University Sidi Mohamed Ben Abdellah *, Taza, Morocco*

[3] *University of Sultan Moulay Slimane, Béni Mellal, Morocco*

Keywords:

(1) differential equations with delay

(2) fractional power of an operator

(3) spectral decomposition

Abstract

We investigate the solution's behavior for abstract inhomogeneous partial functional differential equations (PFDEs) accordingly to an asymptotically almost periodic exogenous term. Here, the linear operator is made of a sectorial operator and a functional operator in the phase space with a domain.

Firstly, when the semigroup solution is hyperbolic, we establish that bounded solutions on $\mathbb{R}^+$ are asymptotically almost periodic. Moreover, necessary and sufficient conditions are provided for the initial condition to yield an asymptotically almost periodic solution.

Secondly, in the non-hyperbolic case, using certain ergodicity techniques, sufficient conditions are established to determine whether a bounded solution on $\mathbb{R}^+$ is asymptotically almost periodic.

The obtained theoretical results are applied to a partial differential equation involving spatial derivatives in the delayed term.

This work is a continuation and generalization of the works [2; 3; 4].

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Numerical shape optimization process based on a new shape derivative formula constrained by a semi-linear PDE

Communication Info

Authors:
Taib ANNOUAOUI
Abdelkrim CHAKIB
Ibrahim KHALIL

Applied Mathematics Team (AMT), Faculty of Sciences and Techniques, Sultan Moulay Slimane University, B.P.523, Beni Mellal, Morocco

Keywords:
(1) Shape optimization
(2) Semi-linear PDE
(3) Convex domains
(4) Shape derivative
(5) Support function
(6) Gradient algorithm

Abstract

This work is devoted to investigate the performance of a shape optimization approach based on the new shape derivative formula, involving support functions of convex domains, established in [1], through a comparative numerical study with the approach based on the Hadamard's shape derivative using the deformation of domains by vector fields [3]. In this regard, let us mention that the effectiveness of this new approach for solving classical shape optimization problems constrained to Laplace or Stokes linear state equation, has recently been proved in [2]. So, we aim here to extend and perform this shape optimization process for solving more general shape optimization problem constrained to a semi-linear partial differential equation (PDE) involving appropriate nonlinear functions. To do that, we begin first by showing the existence of an optimal shape for the considered shape optimization problem, then we derive the shape sensitivity analysis using both the Hadamard's and the new shape derivative approaches, under some regularity assumptions on the nonlinear function. Finally, we propose a numerical comparative study between two shape optimization processes resulting from these shapes derivatives approaches, for solving shape optimization problems of minimizing quadratic cost functionals, constrained to various semi-linear PDE, associated to appropriate nonlinear functions. This showed once again the effectiveness and performance of the new approach, in solving this kind of problems, in terms of the accuracy on the solution and CPU time, compared to the classical approach.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Universal Approximation for Partial Differential Equations: Bridging Theory and Practice with Physics-Informed Neural Networks

Communication Info

Authors:
Mohamed ALOUAT[1]
Hicham EL BOUJAOUI [1]
Said Raghay [2]

[1] *Ibn Zohr university, Agadir, Morocco*
[2] *Cadi Ayad university, Marrakech, Morocco*

Keywords:
(1) Universal approximation theorem
(2) Partial differential equations
(3) Artificial Neural networks
(4) PINNs

Abstract

The universal approximation theorem (UAT) has played a foundational role in understanding the expressive power of neural networks, originally proving that feedforward neural networks can approximate any continuous function on a compact domain. Over time, these results have been extended to more complex function spaces, including Sobolev spaces and distributions, bridging the gap between classical function approximation and the numerical solution of partial differential equations (PDEs).

These developments have deepened our understanding of the capability of artificial neural networks to approximate not only a scalar-valued functions but also solutions of partial differential equations with varying degrees of regularity. In this work, we analyze fundamental results on universal approximation theorems in the context of PDEs and consider their implications for neural network-based methods. We also highlight the role of Physics informed neural networks (PINNs) as a numerical approach for solving PDEs, illustrating their relevance through selected examples.

By bridging theoretical insights with empirical results, this study aims to evaluate the extent to which neural networks can serve as robust solvers for PDEs.

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Couples System of Nonlinear Impulsive Hybrid Differential Equations with Linear and Nonlinear Perturbations Involving \psi-Caputo Fractional Derivative

Communication Info

Authors:
Fatima-Ezzahra Bourhim
Ali El Mfadel [2]
M'hamed Elomari [3]

[1] *LMACS laboratory, FST Beni Mella-Morocco*
[2] *LMACS laboratory, FST Beni Mella-Morocco*
[3] *LMACS laboratory, FST Beni Mella-Morocco*

Keywords:
(1) Coupled systems
(2) Fractional Derivative
(3) Fixed point theorems

Abstract

In this work, we prove the existence and uniqueness of solutions to impulsive coupled system of nonlinear hybid fractional differential equations involving \psi-Caputo fractional derivative of order \alpha \in (0,1) with linear and nonlinear perturbations. We prove our main results by applying the nonlinear alternative of Leray-Schauder type and Banach's fixed point theorem. As application, on example is included to show the applicability of our results.

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Study of Mild Solutions for Fractional Differential Inclusions under Nonlocal Conditions Involving the \psi-Caputo Derivative

Communication Info

Authors:

Mahacine MALOUH[1]

M'hamed ELOMARI [2]

Mohamed BOUAOUID[3]

[1] University Sultan Moulay Slimane, Beni Mellal, Morocco

[1] University Sultan Moulay Slimane, Beni Mellal, Morocco

[3] University Sultan Moulay Slimane, Beni Mellal, Morocco

Keywords:

(1) fractional differential inclusions

(2) Hausdorff measure of noncompactness

(3) Hausdorff measure of noncompactness

Abstract

This is concerned with the existence of mild solutions for \psi-fractional differential inclusions with nonlocal conditions in Banach spaces. The results are obtained by using fractional calculus, Hausdorff measure of noncompacteness, and the milticalued fixed point theorem.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Controabillity analysis of Hilfer fractional stochastic pantograph differential equation with fractional Brownian motion and Poisson noise

Communication Info

Authors:
Ayoub LOUAKAR[1]
Devaraj VIVEK[2]
Ahmed KAJOUNI[3]
Khalid HILAL[4]

[1,3,4] LAMSC, Sultan Moulay Slimane University, Beni Mellal, Morocco.
[2] Department of Mathematics, PSG College of Arts and Science, Coimbatore-641 014, India.

Keywords:
(1) Pantograph equations
(2) Stochastic equations
(3) Control theory

Abstract

We discuss the existence and controllability of the Hilfer fractional stochastic pantograph equation with fractional Brownian motion and Poisson noise. The existence of a mild solution to the proposed problem is proved and the controllability of the control problem is established. The results are obtained using fractional calculus theory, semigroup theory, stochastic analysis, and fixed-point theory under sufficient conditions. The theoretical findings are validated through an example.

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Optimal Embeddings and Interpolation: Connecting Sobolev Spaces and Their Norms

Communication Info

Authors:
Maaarir Souad [*1]
El Hadfi Youssef [1]

[*1] *Laboratory LIPIM, National School of Applied Sciences, Khouribga, 25000, Sultan Moulay Slimane University, Morocco.*

Keywords:
(1) Optimal Inequalities,
(2) Sup-Laplacian Operator,
(3) Non-diffusion Equation.

Abstract

The Gagliardo–Nirenberg inequalities are interpolation inequalities that were independently established by Gagliardo and Nirenberg in the late 1950s. Recently, their ties to theoretical aspects of information theory and nonlinear diffusion equations have enabled researchers to derive optimal forms of these inequalities, identifying both the sharp constants and the explicit solutions for optimizers. In this note, we explore the key connections between Shannon-type entropies, diffusion equations, and a category of these inequalities, in light of these recent discoveries.

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Numerical Simulation of Biphasic immiscible flow in porous media

Communication Info

Authors:

JAHID Oumayma ,
ABOU EL HANOUNE Younes,
BOUJRAF Ahmed

Abdelmalk Essaadi University, National School of applied Sciences, Al Hoceima, Morocco.

Keywords:
(1) Out-flow in porous media
(2) biphasic
(3) immiscible
(4) incompressible
(5) finite volume

Abstract

This study is about the numerical resolution of biphasic flow problem establishment of the biphasic, immiscible flow in porous area equations, while considering that the two phases are incompressible. It is about Darcy's equation coupled with mass conservation's equation. The used method is the finite volume of the IMPES type (Implicit in Pressure, Clarify in Saturation). We also proceed on the numerical resolution of the system.
The simulation results demonstrate the influence of rock heterogeneity, saturation distribution, and mobility ratios on flow dynamics. The proposed numerical approach provides valuable insights into multiphase transport phenomena in porous media, aiding in optimizing recovery strategies.

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Log-volatility Models for Modelling Financial Return Series in the Presence of Zeros: a Comparative Study

Communication Info

Authors:
Abdeljalil SETTAR[1]
Sara CHEGDAL [1]

[1] *Faculté des Sciences et Techniques, Université Hassan 2, Mohammedia, Morocco*

Keywords:
(1) log-GARCH
(2) SV
(3) Kalman filter

Abstract

In this work, we address the challenges posed by zero returns in both log-GARCH and stochastic volatility (SV) models, with a particular focus on their asymmetric variants. Building upon previous imputation techniques for handling zero returns, as discussed in [1,2, 3], we propose a unified approach that enhances parameter estimation accuracy for both model classes. Specifically, we employ the Quasi-Maximum Likelihood (QML) estimation method, incorporating the Kalman filter for both the asymmetric log- GARCH and asymmetric SV models, to ensure robust parameter estimation even in the presence of zero returns. A comparative study is conducted on a set of financial return series containing zeros, examining the performance of the models in question using our proposed estimation method.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

April 24-25-26, 2025 | Marrakech, Morocco

Mathematical Advances in 3D Numerical Analysis for Air Pollution Dispersion Models

Communication Info

Authors:
Mehdi FARHANE [1]
Abbes KADYRI [1]
Abdelilah KADDAR [2]
Otmane SOUHAR [1]

[1] *Chouaib Doukkali University, El Jadida , Morocco*
[2] *ENSA, El Jadida , Morocco*

Keywords:
(1) Advection-Diffusion Model
(2) Logarithmic Wind Profile
(3) GILTT Method
(4) Numerical Analysis
(5) Atmospheric Dispersion

Abstract

Air pollution dispersion modeling is essential for understanding pollutant transport in the atmospheric boundary layer. This study presents mathematical advances in 3D numerical analysis applied to an advection-diffusion model, incorporating a logarithmic wind speed profile. This term prevents the derivation of an exact analytical solution in the general framework, thus requiring an advanced numerical approach. We employ the Generalized Integral Laplace Transform Technique (GILTT) to obtain a robust and physically consistent numerical solution. A rigorous validation is performed by comparing our results with experimental atmospheric dispersion data from Copenhagen and Prairie Grass. The excellent agreement observed between simulations and experimental measurements demonstrates the relevance of the proposed model and its potential for applications in air quality assessment and regulatory decision-making.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Mathematical Analysis of a Stochastic Epidemic Model: Existence, Uniqueness, Persistence, and Control

Communication Info

Authors:
MOHAMED OUTAIK
Affiliation:
université chouaib doukkali
faculté des sciences el jadida
Keywords:
-Brownian Motion.
-Stochastic Perturbation.
- Existence and Uniqueness (of Solutions).
-Persistence (of Disease)
-Stochastic Stability .
-Intervention Strategies.

Abstract

This study focuses on the mathematical analysis of an epidemic model. Starting from a classical deterministic formulation, we introduce a Brownian motion-type noise term to account for the inherent random fluctuations in population dynamics and disease transmission. The primary objective is to rigorously investigate the mathematical properties of this stochastic model. We establish results regarding the existence and uniqueness of strong solutions, thereby ensuring the well-definedness of the model. Particular attention is paid to the persistence of the disease, that is, its ability to persist within the population over the long term despite stochastic perturbations. We also analyze the stability of the system, exploring the conditions under which equilibria can be perturbed or reinforced by the noise. Finally, we address the question of epidemic control within the stochastic context. We investigate the impact of various intervention strategies on disease dynamics, taking into account the uncertainty introduced by the Brownian motion. The results obtained allow us to evaluate the robustness of these strategies in the face of random fluctuations and to propose recommendations for effective disease management.

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New absorbing boundary conditions for the Schrödinger equation

Communication Info

Authors:
Sabah Kaouri[1]
Mostafa Abounouh [2]
Hassan Al Moatassime [2]

[1] *EMSI, Marrakesh, Morocco*
[2] *FST, Marrakesh, Morocco*

Keywords:
(1) Absorbing boundary conditions
(2) Transparent boundary conditions
(3) Schrödinger equation
(4) Finite Difference method

Abstract

This paper focuses on deriving transparent boundary conditions for the one-dimensional time-dependent Schrödinger equation. These conditions enable the restriction of the original PDE, defined on an unbounded domain, to a finite interval, making it suitable for numerical simulations with less reflections. The primary objective of this work is to develop an appropriate discretization of these transparent boundary conditions in combination with a selected discretization scheme for the PD, typically Crank–Nicolson finite differences for the Schrödinger equation. The resulting discrete transparent boundary conditions ensure an unconditionally stable numerical scheme while completely eliminating reflections at the boundaries.

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on the Study of Non-smooth Nonconvex Optimization Problem for Image Restoration by Learnable Descent Algorithm and Plug-and-play Method

Communication Info

Authors:
Brahim Khaider[1]
Amine Laghrib [1]
Aissam Hadri [2]
Lekbir Afraites [1]

[1] EMI, Sultan Moulay Slimane University, Beni Mellal, 25000, Morocco
[2] LAB SIV, Ibnou Zohr University, Agadir, 80000, Morocco

Keywords:
(1) neural network
(2) processing image
(3) denoising
(4) optimization

Abstract

This paper primarily focuses on nonconvex and nonsmooth minimization problems that consist of three terms, with practical applications including image recovery. The optimization model under study includes a fidelity term and two regularization terms, with the main challenges arising from the nonsmooth neural network-based regularization. To address these challenges, we first adopt the separation of the three opera-
tors method introduced by Davis and Yin [1] (referred to as DYS). Subsequently, we propose an algorithm that integrates the Plug-and-Play (PnP) [2] framework and the Learnable Descent Algorithm (LDA) [3].We tackle the non-smooth and non-convex minimization problem by employing Nesterov's smoothing tech-
nique and developing the convergence theory for the three-operator splitting algorithm.Finally,numerical experiments were conducted to evaluate the performance of the PnP-LDA-LS algorithm against several

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A generalization of the Nash equilibrium solution

Communication Info

Authors:
Saloua AMRANI ZERRIFI
Ahmed DOGHMI

INSEA, Rabat, Morocco

Keywords:
(1) Nash Equilibrium
(2) Generalization of the Nash Equilibrium solution
(3) Multi-valued functions

Abstract

The Nash equilibrium is one of the most important concepts in game theory, particularly for non-cooperative games. In this paper, we present a generalization of the Nash equilibrium solution. We begin by examining the problem of Nash implementation, introducing the concept of freedom to compare two strategies through an algorithm that measures this freedom within a given set. This approach allows us to generalize the Nash equilibrium solution and identify the necessary and sufficient conditions under which a multi-valued social choice correspondence can be implemented in this generalized framework. This generalization of the Nash equilibrium enables players with different strategies to achieve optimal expected payoffs in various situations that were previously unattainable.

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General Energy Decay of a Thermoelastic Timoshenko System of Type III with Memory Damping

Communication Info

Authors:
Messikh Chahrazed

Keywords:
(1) Timoshenko system
(2)Thermoelasticity of type III
(3)General decay .

Abstract

In this work, we consider a one-dimensional thermoelastic Timoshenko system with memory damping terms. In this system, heat conduction is governed by Green and Naghdi's type III theory.

Thermoelasticity has attracted significant interest since Dafermos's pioneering article was published in 1968. Since then, many works have studied the asymptotic behavior using various methods, such as the multiplier technique and semigroup theory. For more details, one can refer to [1,5]. Notably, Salim A. Messaoudi and Belkacem Said-Houari [5] established exponential stability through the energy method. Additionally, Fatori et al. [4] demonstrated that exponential stability holds if and only if the wave speeds associated with the hyperbolic part of the system are equal.

The objective of our work is to study the same problem introduced by Ghennam and Djebabla [3], but with a modification in the boundary conditions, replacing theirs with Dirichlet-Neumann conditions. We prove that the system exhibits a general decay rate, independent of the system's coefficients, thereby improving upon the above mentioned work.

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Coupling Homogenization and large deviation principle in a local time under nonlinear Wentzell boundary condition

Communication Info

Authors:
Ousmane CISSE[1]
Jean-Tosse DIATTA [2]
Clément MANGA[3]
Ibrahima SANE [4]

[1] *UASZ, Ziguinchor, Sénégal*
[2] *UASZ, Ziguinchor, Sénégal*
[3] *UASZ, Ziguinchor, Sénégal*
[4] *UASZ, Ziguinchor, Sénégal*

Keywords:
(1) Local time SDE ,
(2) Homogenization, Large deviation 2
(3) Wentzell Boundary conditions 3

Abstract

In this paper, we consider a stochastic differential equation (SDE) driven by a Brownian motion and which depends on two small parameters (δ parameter of homogenization and ε parameter of large deviation). The SDE moves in the domain $\overline{D} = D \cup \partial D$ under Wentzell boundary conditions. We show that the family of solutions satisfies a large deviation principle with a good rate function. This result is an extension of the work Alioune and al [2].

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Absolute convergence of Mellin transforms

Communication Info

Authors:
Othman TYR[1]

[1]*ESEFA, Ibn Zohr university, Agadir, Morocco*

Keywords:
(1) Mellin transforms
(2) Lipschitz conditions
(3) Mellin convolutions

Abstract

The problem of the integrability of Mellin transforms is presented. Sufficient Lipschitz conditions are given to solve this problem. These results are inspired by well-known works of Titchmarsh in classical Fourier harmonic analysis (see [1]). Some results on the integrability of Mellin transforms of the Mellin convolutions are also given.

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Existence and stability results of a thermoelastic nonlinear shear beam

Communication Info

Authors:
My Driss AOURAGH[1]
Mustapha EL BAZ[2]

[1]*EST Meknès, AFAA Group, Moulay Ismail University of Meknès, Morocco*

[2]*AM2CSI Group, MSISI Laboratory, FST Errachidia, Moulay Ismail University of Meknès, Morocco*

Keywords:
(1) Nonlinear shear beam
(2) Faedo-Galerkin method
(3) Stability exponential
(4) Numerical result

Abstract

In this work, we analyze the stabilization of a thermo-elastic nonlinear shear beam model with thermal dissipation.

First, in this work, we establish the well-posedness of the problem by using the Faedo-Galerkin method. Next, we prove that the energy of the problem decays exponentially regardless of any relationship between coefficients of the system by using multiplier method, since the system has only one wave speed.

Finally, we validate our theoretical results findings through some numerical experiments, utilizing a finite element scheme in space and both implicit Euler and Crank-Nicolson methods in time.

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Simulation numérique de la diffusion d'un pollutant dans un cours d'eau

Communication Info

Authors:
Cyr-Séraphin NGAMOUYIH MOUSSATA[1]
Randhall Rosnille MPEMBA MASSAKA [2]

[1] *Université Marien NGouabi, Brazzaville, Congo*
[1] *Université Marien NGouabi, Brazzaville, Congo<*

Keywords:
(1) Methode pseudo-spectrale
(2) Schéma numérique hybride
(3) Diffusio d'un polluant

Abstract

Dans ce travail, nous présentons un schéma numérique hybride qui combine la méthode des éléments finis et la méthode pseudo spectrale pour l'approximation spatiale. Le but est de produire un schéma stable et convergent malgré le manque de régularité dans la solution exacte. Nous avons démontré l'efficacité de cette approche numérique par l'étude du phénomène de diffusion de polluants dans un cours d'eau. Ce problème est un modèle de réaction-diffusion non linéaire appliqué à la propagation d'une espèce polluante au sein d'un domaine spatial, sous l'effet d'un champ de vitesse fluide stationnaire et incompressible.

Le problème aux limites est formulé comme suit :

$$\begin{cases} \dfrac{\partial C}{\partial t} - \Delta C + v.\nabla C + F(C) = 0 \;\; dans \; [0;T] \times \Omega \\ \dfrac{\partial C}{\partial t} = 0 \;\; sur \;\; [0;T] \times \partial\Omega \\ C(0) = C_0 \;\; dans \; \Omega \end{cases}$$

Où $C(t,x,y)$ est la concentration du polluant en un point (x,y) à l'instant t, v est la vitesse du fluide et $F(C)$ représente le terme de réaction du polluant.

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ICRAMCS 2025

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Estimating parameters of stochastic SI_aI_s model for HIV transmission using the ensemble Kalman filter

Communication Info

Authors:
Youssef BELGRAOUI[1]
Aziza BELMAATI[1]

[1] LMCSA Laboratory, Faculty of Sciences and Technology, Hassan II University, Mohammedia, Morocco

Keywords:
(1) Stochastic SI_aI_s epidemic model
(2) HIV/AIDS
(3) Ensemble Kalman filter
(4) Estimation parameters

Abstract

Stochastic epidemic models play a crucial role in studying the spread of infectious diseases, with the stochastic SI_aI_s model being particularly relevant for HIV transmission dynamics. These models often contain unknown parameters that can affect the accuracy of predictions. Therefore, estimating these parameters is essential for improving their reliability.

The stochastic SI_aI_s model divides the population into three compartments: susceptible individuals (S), infected individuals without obvious clinical symptoms (I_a) , and infected individuals with obvious clinical symptoms who are tested for HIV and diagnosed (I_s). This model, as presented in the article by Rao et al. [1], provides a framework for understanding disease dynamics, predicting outbreaks, and assessing intervention strategies.

In this study, we estimate a few parameters of the model and the transmission states of HIV by developing an ensemble Kalman filter (EnKF) based on the stochastic SI_aI_s epidemic model [2-4].

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Dynamic Analysis of a Fractional S1S2IQR Epidemic Model with Standard Incidence Rate

Communication Info

Authors:
Yassine BABRHOU[1]
Khadija CHANNAN
Brahim EL BOUKARI
Khalid HILAL
Ahmed KAJOUNI

[1] Laboratory LMACS, Sultan Moulay Slimane University, Beni Mellal, Morocco

Keywords:
(1) $S_{1}S_{2}IQR$ epidemic model
(2) fractional order differential equations
(3) basic reproduction number

Abstract

We propose a fractional epidemic model $S_{1}S_{2}I Q R$ with a standard incidence rate using the Caputo fractional-order derivative [1]. For our proposed model, the existence, uniqueness, non-negativity, and boundedness of the solution are established [2]. The model has two equilibrium points: disease-free equilibrium and endemic equilibrium, and by using the method of next generation matrix we compute the basic reproductive number R_{0} that determines the extinction and the persistence of the infection [3]. Furthermore the global asymptotic stability of steady states is established by using suitable Lyapunov functionals and applying LaSalle's invariance principle [4].
Finally, to illustrate our results, we establish a numerical simulations [5].

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New generalization of the C-condition for $(\xi;\zeta)$ mappings in Cauchy problem conformable on modular metric spaces

Communication Info

Authors:
Fadwa Gholali[1]
Lalla Saadia Chadli [1]
Hicham Moussa [1]

[1] *Laboratory of Applied Mathematics and Scientific Computing, Sultan Moulay Slimane University, Beni Mellal, Morocco*

Keywords:
(1) Fixed point theorem
(2) Modular metric space
(3) C-condition
(4) $(\xi;\zeta)$-mappings
(5) Cauchy problem conformable

Abstract

In this paper, we introduce a novel generalization of the C-condition for $(\xi;\zeta)$ mappings within the framework of modular metric spaces [3]. This work extends the fixed point results known for such mappings in traditional metric spaces to the more general setting of modular spaces. Specifically, we examine the boundary value problem under the scope of conformable derivatives, demonstrating the existence and uniqueness of solutions within modular metric spaces [1,2]. Our study contributes to the broader mathematical understanding by addressing several key aspects. Firstly, we provide a comprehensive analysis of the generalized C-condition [3], offering new insights and extending its applicability. Secondly, we explore the theoretical underpinnings of conformable derivatives [4] and their role in boundary value problems, thereby enhancing the existing theoretical framework. The practical importance of our results is showcased through various applications, highlighting their relevance and potential impact in real-world scenarios. These applications not only demonstrate the utility of our theoretical findings but also underscore the versatility of modular metric spaces in addressing complex mathematical problems. Overall, our results significantly enrich, extend, and generalize several previously established findings in the literature, paving the way for future research in this area. We believe that this work will serve as a foundational reference for further investigations into fixed point theory, modular metric spaces, and their applications.

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Existence of Solutions for a Class of Superlinear Anisotropic Robin Problems with Variable Exponent

Communication Info

Authors:

AbdelRachid El Amrouss

Fouad kissi

Ali El Mahraoui

[1] FSO,University Med 1^er,Oujda, Morocco
[2] FSO,University Med 1^er,Oujda, Morocco
[3]FSTH,University AbdelMalek Essaadi, Al-Hoceima,Morocco

Keywords:
(1) variable exponent Lebesgue space
(2) Anisotropic space
(3) Robin elliptic problems

Abstract

In this work we study the existence of solutions of a nonlinear anisotropic elliptic Robin problem. We set up that the problem admits a sequence of weak solutions and multiplicity results under suitable conditions.

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A functional equation originated from the product in a cubic number field

Communication Info

Authors:
Aziz MOUZOUN[1]
Driss ZEGLAMI [2]

[1]Department of Mathematics, E.N.S.A.M, Moulay ISMAÏL University , Menkes, MOROCCO.
[2]Department of Mathematics, E.N.S.A.M, Moulay ISMAÏL University , Menkes, MOROCCO.

Keywords:
(1) Functional equation
(2) Number theory
(3) Multiplicative function
(4) Semigroup and monoid

Abstract

Let K be either $\mathbb{R}$ or $\mathbb{C}$ and $\alpha \in \mathbb{R}$. We determine the semigroup solutions $f : \mathbb{R}^3 \longrightarrow S$ of the following new parametric functional equation :

$$f(x_1x_2 + \alpha y_1z_2 + \alpha y_2z_1, x_1y_2 + x_2y_1 + \alpha z_1z_2 , x_1z_2 + x_2z_1 + y_1y_2) = f(x_1, y_1, z_1)f(x_2, y_2, z_2),$$

for all $(x_1, y_1, z_1), (x_2, y_2, z_2), \in \mathbb{R}^3$.

which results from the product of two numbers in a cubic free field. We equip $\mathbb{R}^3$ with a binary operation to show that the non-zero solutions of this equation are monoid homomorphisms.

We then investigate our results to introduce and find the solutions of d'Alembert's functional equations with endomorphisms.

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Viral Diffusion-Dynamics Model with Cellular Immune Response

Communication Info

Authors:
AICHA SABIQ [1]
SAMIR BOUJIJANE [2]
KHALIL EZZINBI [1]

[1] *LMDP-FSSM-UCA, Marrakesh, Morocco*
[2] CRSA-UM6P, Benguerir, Morocco

Keywords:
Reaction-Diffusion
Viral Dynamics
Cellular immune response

Abstract

In this paper, we study the global dynamical behavior of a viral dynamics model that incorporates immune responses [1] and spatial diffusion [2]. The global stability of the model is analyzed in terms of two threshold parameters, the basic reproduction number R_0 [3] and the immune response reproduction number R_1 [1]. The obtained results signify that the infection dies out if $R_0 \leq 1$ and persists if $R_0 > 1$. Numerical simulations are performed to support our theoretical findings and to illustrate the impact of spatial diffusion on the stability of the model.

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Mathematical and Numerical Analysis of Chemotherapy Resistance in Tumors: Modeling Integrating Darwinian, Lamarckian, and Microvesicle-Mediated Mechanisms with the WENO5 Scheme

Communication Info

Authors:
Mohammed EL HAMMANI[1]
Sidi Mohamed DOUIRI [1]
Imad EL HARRAKI [2]

[1] Mohammed V university, Rabat, Morocco
[2] ENSMR, Rabat, Morocco

Keywords:
(1) Tumor modeling
(2) Chemotherapy resistance
(3) Fixed point

Abstract

We develop a mathematical model to describe the dynamics of chemotherapy-sensitive and resistant tumor cells, incorporating three resistance mechanisms: Darwinian selection, Lamarckian induction, and microvesicle-mediated transfer. Using a fixed-point method, we establish existence and uniqueness, prove positivity and mass preservation, and analyze asymptotic behavior. Numerical simulations highlight the impact of microvesicle transfer and Lamarckian induction on resistance. Our findings suggest that targeting these mechanisms could improve chemotherapy efficacy, providing insights into tumor growth and resistance dynamics for better treatment strategies.

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The impact of tracing, monitoring, and hospitalizing on epidemic dynamics: an application to Ebola

Communication Info

Authors:
Mohamed LADIB[1]
Aziz OUHINOU[1]

[1] *University of Sultan Moulay Slimane, Beni Mellal, Morocco*

Keywords:
(1)Mathematical Epidemiology
(2) Contact tracing
(3) Ordinary Differential Equations (ODEs)

Abstract

In this work, we study the ODE system proposed in [1] to model the contact tracing intervention. The effective reproduction number is expressed in two main cases using the next-generation approach described in [2], then reformulated in terms of measurable quantities. According to found expressions, and when contact tracing is perfectly executed, we derive conditions on the fraction of untraced cases to be hospitalized and the average infections caused by traced cases, to bring the effective reproduction number below unity. In parallel, the existence of equilibria and the stability of the DFE are investigated. Moreover, the model is fitted to data of the Ebola disease collected by WHO during the 2014-2016 outbreaks in West Africa. Finally, numerical simulations are provided to explore the effect of some key parameters on the effective reproduction number.

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Neural Network Approach for Estimating Initial Conditions and Parameters in ODE Models: Application to an SEIuIdR Epidemiological Framework

Communication Info

Authors:
Ahmed SADIK[1]
Amine LAGHRIBE[2]
Aziz OUHINOU[1]

[1] University of Sultan Moulay Slimane, Faculty of Sciences and Techniques, *Béni Mellal, Morocco*
[2] University of Sultan Moulay Slimane, National School of Applied Sciences, Khouribga, Morocco.

Keywords:
(1) Optimisation
(2) Artificial Neural Networks
(3) Calibration
(4) Inverse problem
[5] Epidemic

Abstract

In this study, we present an innovative approach for parameter identification and initial condition calibration in autonomous models governed by ordinary differential equations (ODEs), beginning from any initial time t0; The method is applied to autonomous epidemiological models, including the SIuIdR frameworks, and utilizes neural networks to optimize the objective function. This approach distinguishes itself through its simplicity and efficiency, offering promising outcomes for epidemiological modeling.

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An inverse problem for determining the initial condition in a time-fractional diffusion equation using the ADMM method

Communication Info

Authors:
Fatima ISMAGUE [1]
Lekbir AFRAITES [1]
Abdelilah HAKIM [2]
Mohamed Srati [1]

[1] *Sultan Moulay Slimane University, Beni-Mellal, Morocco*

[2] *Cadi Ayyad University, Marrakech, Morocco*

Keywords:
(1) Inverse problem
(2) Optimal control
(3) Stability
(4) Optimization techniques

Abstract

In this paper, we study the inverse problem of identifying the initial condition in a linear subdiffusion model from measurement data using the alternating direction multiplier method (ADMM). The linear sub-diffusion model involves a Caputo fractional derivative of order $\alpha \in (0, 1)$ in time. To address our model, we first examine the regularity of the solution for the direct problem. Then, we establish the existence of the optimal solution and prove the convexity of the considered cost function by using its first derivative. Finally, the efficiency and accuracy of the present method are illustrated by some numerical examples.

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Spectral properties of skew-adjacency matrices in tournaments

Communication Info

Authors:
Soukaïna MAHZOUM[1]
Abderrahim BOUSSAIRI[2]
Sara EZZAHIR[3]
Soufiane LAKHLIFI [4]

[1]LMFA, FSAC Hassan II University of Casablanca, Casablanca, Morocco
[2]LMFA, FSAC Hassan II University of Casablanca, Casablanca, Morocco

Keywords:
(1) Tournament
(2) Skew-adjacency matrix
(3) Skew-characteristic polynomial
(4) Determinant

Abstract

A tournament is a digraph in which every pair of vertices is jointed by exactly one arc. Let T be a tournament with n vertices $v_1, \dots, v_n$. The skew-adjacency matrix of T is the n × n zero-diagonal matrix $S = [s_{ij}]$, such that s_{ij}=1 if v_i dominates v_j and s_{ij} = −1 if v_j dominates v_i. It is well-known that the determinant of S is zero or a square of an odd integer. The skew-characteristic polynomial of T is the skew-characteristic polynomial of its skew-adjacency matrix. In this talk we characterize the class of tournaments T such that every principal submatrix of their skew-adjacency matrices has determinant at most 9 and we introduce the skew-characteristic polynomial of tournaments in this class.

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Transferts de fonds et cycles économiques au Maroc : une analyse empirique

Communication Info

Authors:
Samir FARHI[1]
Hicham EL BOUANANI[1]

LMAEG, Hassan II University of Casablanca, Casablanca, Morocco

Mots-clés :
(1) Transferts de fonds
(2) Propriétés cycliques
(3) Maroc
(4) Hodrick-Prescott
(5) Fonctions de réponses impulsionnelles

Résumé

Les transferts de fonds constituent une source vitale de financement pour de nombreux pays en développement, en raison de leur volume croissant et de leur potentiel à contribuer à la croissance et au développement des pays d'origine. Le Maroc s'inscrit pleinement dans cette dynamique. En outre, grâce à leur nature cyclique, ces transferts peuvent également fonctionner comme une forme d'assurance privée pour les pays bénéficiaires, La compréhension de ces propriétés cycliques est essentielle pour les pays qui dépendent fortement de ces flux, car cela leur permet de réagir de manière appropriée aux variations des cycles économiques et permet d'anticiper leur réaction au moment de crise.
Cette communication examine la cyclicité des transferts de fonds vers le Maroc en appliquant le filtre de Hodrick-Prescott à des données annuelles de 1980 à 2022. Elle s'appuie sur des modèles économétriques et des fonctions de réponses impulsionnelles afin d'analyser les interactions entre ces flux et les cycles économiques.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Handling High-Dimensional Mixed Data: A Penalized Regression Framework with SCOPE and Adaptive Encoding Strategies

Communication Info

Authors:
Ismail ARJDAL[1]
Echarif EL HARFAOUI[2]

[1] *Faculty of Sciences, Chouaïb Doukkali University, El Jadida, Morocco*

Keywords:
(1) Multiple linear regression
(2) Mixed variables
(3) High dimension
(4) Ridge, Lasso
(5) Group Lasso
(6) ENET
(7) SCOPE

Abstract

This study explores multiple linear regression techniques for high-dimensional ($p \gg n$) datasets with mixed variable types (nominal, ordinal, and continuous). Traditional regression methods face challenges like multicollinearity and variable selection, especially with categorical variables. To address these, we employ penalized regression methods (Lasso, ENET, and SCOPE) alongside tailored coding strategies (full disjunctive, cumulative, and score-based coding). Through a real case study, we compare encoding approaches, demonstrating the effectiveness of our methodology in enhancing model robustness and parsimony. Our findings highlight SCOPE advantages in handling high-dimensional mixed data, offering insights for researchers and practitioners.

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On Supercyclicity of Linear Relations

Communication Info

Authors:
Ali Ech-Chakouri

Department of Mathematics. Dhar El Mahraz Faculty of Science, Sidi Mohamed Ben Abdellah University, BO 1796 Fes-Atlas, 30003 Fez Morocco.

Keywords:
(1) Supercyclic
(2) Super transitive
(3) Linear Relation

Abstract

In this work, we introduce the notions of supercyclicity and super transitivity for linear relations (multivalued linear operators) on an infinite-dimensional separable Banach space.
We provide examples and establish several properties of supercyclic multivalued linear operators. We also determine conditions under which TS is a supercyclic multivalued linear operator if and only if ST is a supercyclic multivalued linear operator. Moreover, we present various characterizations of supercyclic linear relations. Among these characterizations, we show the equivalence between supercyclic multivalued linear operator and super transitive multivalued linear operator. Finally, we provide criteria for determining the supercyclicity of multivalued linear operators.

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Disjoint Topologically Recurrent Operators

Communication Info

Authors:
El Mostafa SADOUK[1]
Otmane BENCHIHEB[2]
Mohamed AMOUCH[3]

[1] *Faculty of science, Chouaib Doukkali University, Eljadida, Morocco.*

[2] *Faculty of science, Chouaib Doukkali University, Eljadida, Morocco.*
[3] *Faculty of science, Chouaib Doukkali University, Eljadida, Morocco.*

Keywords:
(1) Hypercyclic operator
(2) Disjoint hypercyclic operator
(3) Recurrent operator

Abstract

In this article, we will discuss and introduce the notion of disjoint topological recurrence for finitely many operators acting on a real or complex Fréchet space X. In addition, we characterize the disjoint topologically recurrent of finitely many different powers of weighted shifts, both in the unilateral and bilateral cases, acting on sequence spaces.

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Comparison of Two Algorithms for the Finite Volume Method

Communication Info

Authors:

[a] Ayoub CHEDDOUR
[b] Mohammed KRICHE
[a] Abdelhai ELAZZOUZI

[a] Department of mathematics, Sidi Mohamed Ben Abdellah University, Mathematics and data science laboratory FP Taza, Morocco.

[b] Department of mathematics, Mohammed V University, Laboratory of Mathematics, Statistics and Applications Rabat, Morocco.

Keywords:
Finite volume method
Numerical Simulation

Abstract

The finite volume method has been extensively studied by many researchers and plays a crucial role in various fields, including engineering and medicine. It is particularly used for modeling fluid flows and optimizing fluxes in transport networks. Moreover, this method is recognized for its accuracy and reliability in complex numerical models [1,2].

In this study, we address the issue of redundancy in the algorithm by optimizing the flux calculation. Specifically, we compute the flux only once and then multiply it by an appropriate factor to obtain the second flux. Additionally, we enhance efficiency by looping over edges rather than triangles. This approach reduces computational cost while maintaining solution accuracy.

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Numerical technique for solving tempered variational problems

Communication Info

Authors:
S. Ounamane[1]
L. Sadek[2]
B. Abouzaid[1]
E. Sadek[1]

[1] National School of Applied Sciences, Chouaib Doukkali University, El Jadida, Morocco;

[2] Department of Mathematics, Faculty of Sciences and Technology, Al-Hoceima, Abdelmalek Essaadi University,Morocco

Keywords:
(1) TCFD
(2) TFVP
(3) estimate the error

Abstract

In this talk, we present the extended truncated exponential method for solving tempered fractional variational problems (TFVPs) with integral constraints. The method leverages the extended truncated exponential function (ETEF) and the tempered fractional derivative to transform TFVPs into solvable algebraic systems. We derive the operational matrix of derivatives for the ETEF and apply it to approximate the solutions of TFVPs efficiently. The method demonstrates superior performance in terms of computational efficiency and accuracy compared to existing approaches. Several numerical examples validate the effectiveness of our method and we compared the results of our method with those of [1] and [2].

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A study of a class of nonlinear double-phase parabolic systems: An example from advances in reaction-diffusion models (ARD)

Communication Info

Authors:
Adnane KADDIRI[1]
Ahmed JAMEA [2]
Abdelghali AMMAR [é]
El mehdi HASSOUNE [1]

[1] University of Chouaib Doukkali, El Jadida, Morocco.
[2] National School of Applied Sciences, University of Chouaib Doukkali, El Jadida, Morocco.

Keywords:
(1) Double phase problem
(2) Existence
(3) uniqueness

Abstract

In this paper we are interested in the existence and uniqueness questions of a class of nonlinear double phase parabolic problems under Dirichlet type boundary conditions with a nonlinear source term which satisfies the L1-data regularity, which models advances in reaction-diffusion phenomena (ARD). In the functional framework of Musielak-Orlicz spaces, we use rothe method and semi-discritization of Euler then our goal is achieved.

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TPFA method for Two-dimensional Burgers' equation

Communication Info

Authors:
Zaroual Bazirha [1]
Lahcen Azrar [1,2]

[1] Research Center STIS, M2CS, Department of Applied Mathematics and Informatics, ENSAM, Mohammed V University, Rabat, Moroco.
[2]Department of Mechanical Engineering, Faculty of Engineering, King Abdulaziz University, Jeddah, Saudi Arabia

Keywords:
(1) TPFA
(2) Semi-implicit
(3) Super-convergence
(4) Burgers' equation

Abstract

This paper presents a methodological approach based on the Two-Point Flux Approximation (TPFA) finite volume method [1] for solving the two-dimensional viscous Burgers' equation [2]. A semi-implicit discretization is applied to the nonlinear viscous Burgers' equation. The approach leverages the simplicity of the TPFA method, while avoiding the need to solve the nonlinear system arising from the nonlinear term in the equation. The accuracy and efficiency of the proposed numerical scheme are demonstrated through several tests, where the chosen time step depends only on the square of the spatial step size.
Super-convergence is observed for low Reynolds numbers in both the discrete L^2 and L^∞-norms.

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The continuous Mehler–Fock wavelet packets transform

Communication Info

Authors:
Abdelaali DADES[1]
Radouan DAHER [2]

[1] Hassan II university, FSAC, Casabalanca, Morocco
[2] Hassan II university, FSAC, Casabalanca, Morocco

Keywords:
(1) Wavelet
(2) Mehler–Fock transform
(3) Scale discrete function

Abstract

In this talk, the continuous Mehler–Fock wavelet packets is defined and studied. More precisely, Plancherel and reconstruction formulas are given for this transform. The Calderón reproducing formula is also proved.

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April 24-25-26, 2025 | Marrakech, Morocco

Efficient Splitting Method for the Korteweg–De Vries Equation

Communication Info

Authors:
Salaheddine MAAQOUL[1]
Hassan BELHADJ[1]

[1] *Department of Mathematics, Faculty of Sciences and Techniques of Tangier; Abdelmalek Essaadi University, Morocco.*

Keywords:
(1) *Korteweg–De Vries equation.*
(2) *Splitting Method.*
(3) *Finite Difference Method.*

Abstract

In this work, the splitting method is employed to compute numerical solutions of the Korteweg–De Vries equation. For many years, this approach has been widely used to solve complex problems, yielding highly satisfactory results. First, we separate the linear and nonlinear terms and solve each subproblem using the most suitable numerical methods. Then, we analyze the stability and investigate the consistency of the splitting method. The theoretical accuracy and efficiency of the method are validated through numerical test cases. The proposed method offers the advantages of high precision and excellent running time.

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Study of Water Seepage in Al-Wahda Dam and Its Impact on the Stability of the Earth Dam

Communication Info

Authors:
Borhan AL RABEEI[1]
Fouzia KASSOU[2]
Abdessamad GHAFIRI[3]

[1] *Dept. Of Civil Engineering, Université Hassan II, Faculté des Sciences de Ben Msik, Casablanca, Morocco*

[2] *Dept. of Civil Engineering, Ecole Hassania Des Travaux Publics, Casablanca, Morocco*

[3] *Dept. Of Civil Engineering, Université Hassan II, Faculté des Sciences de Ben Msik, Casablanca, Morocco*

Keywords:
(1) Earth dam
(2) stability
(3) python

Abstract

The study addresses the challenges of seepage through earth dams, focusing on continuous flow issues in porous media and slope stability analysis. [1].
The Monte Carlo method is employed to solve continuous flow problems, with results compared to the finite element method. [2].
Circular slices are analyzed to determine the factor of safety, and overall stability is evaluated using the Monte Carlo method, specifically the random walking approach. [3].
A Python program, based on the Bishop method, iteratively calculates the factor of safety against sliding, providing accurate and refined results. [4.5]. This technique proves valuable in seepage analysis, offering a robust tool for estimating hydraulic head in dam bodies. The study establishes theoretical foundations and provides practical application and comparative analysis with the finite element method, yielding meaningful conclusions.

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April 24-25-26, 2025 | Marrakech, Morocco

On cotangent fractional operators and their properties

Communication Info

Authors:
Lakhlifa Sadek[1]

[1] Department of Mathematics, Faculty of Sciences and Technology, BP 34. Ajdir 32003 Al-Hoceima, Abdelmalek Essaadi University, Tetouan, Morocco

Keywords:
(1) Cotangent fractional integral;
(2) Cotangent fractional derivative
(3) Riemann–Liouville cotangent fractional derivative
(4) Caputo cotangent fractional derivative

Abstract

In this work, we present a new type of fractional derivatives involving exponential cotangent function in their kernels called Riemann–Liouville and Caputo cotangent fractional derivatives, respectively, and their corresponding integral. The advantage of the new fractional derivatives is that they achieve a semi-group property. We give some theorems and lemmas, and we give solutions to linear cotangent fractional differential equations using the Laplace transform.

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About the class of bounded-E^a operators

Communication Info

Authors:
HOUDA MOKTAFI[1]
HASSAN KHABAOUI[2]
KAMAL EL FAHRI[3]

[1] *Ibnou Zohr University, Agadir, Morocco*
[2] Moulay Ismail University, *Meknès, Morocco*
[3] *Ibnou Zohr University, Agadir, Morocco*

Keywords:
(1) Banach lattice.
(2) bounded-E^a operator.
(3) L-weakly compact set.

Abstract

We introduce and study the class of the bounded-E^a operators, which maps the closed unit bull of a Banach space to a subset of the maximal ideal E^a. Using the uaw-convergence and the un-convergence, we establish some equivalent conditions so that the range of a norm bounded set by an operator be a subset included in E^a. We extract in the sequel some important characterizations of bounded-E^a operators. We provide as well some characterizations of the order continuity of the norm as an application. We examine the domination problem of this operator and provide the relation between the bounded-E^a and the compact operators.

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Network Scale Effects on Stochastic SIS Epidemic Persistence and Extinction

Communication Info

Authors:
Bilal El Khatib[1]
Adel Settati[2]
Aadil Lahrouz [3,4]

[1, 2, 3] Laboratory of Mathematics and Applications, Department of Mathematics, Faculty of Sciences and Techniques, B.P. 416-Tanger Principale, Tanger, Morocco.

Keywords:
(1) White noise
(2) Stochastic epidemic model
(3) Extinction of disease
(4) Stochastic Persistence
(5) Complexe network

Abstract

This paper examines a stochastic SIS epidemic framework on scale-free networks modeling human contact patterns. Using white noise perturbation techniques [1], we identify a threshold parameter R_σ that determines disease dynamics. When $R_\sigma < 1$, infection exponentially declines to extinction [3]; when $R_\sigma > 1$, the disease persists stochastically. We analyze the critical case of $R_\sigma = 1$ using techniques from stochastic differential equations [2]. Our research highlights how network structural properties influence epidemic behavior, extending time-delay approaches [4]. Computational simulations incorporating scale-free network topology provide comprehensive understanding of the model's behavior, with implications for public health policies and epidemic management strategies based on stochastic population dynamics [5].

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Numerical Analysis and Energy Decay of Timoshenko Linear Beam System

Communication Info

Authors:
Ali SMOUK [1]
Atika RADID [1]

[1] *Faculty of Sciences Aïn Chock, Hassan II University, Casablanca Morocco*

Keywords:
(1) Timoshenko linear beam
(2) Numerical approximation
(3) Energy decay

Abstract

This paper presents a comprehensive study of the Timoshenko linear beam model, focusing on the numerical approximation and energy decay properties of the system. We consider a system of partial differential equations that describe the dynamics of a Timoshenko beam, incorporating mass, inertia, and damping effects. The model is subject to clamped and free boundary conditions, and initial conditions are specified. We propose a finite element method combined with an implicit Euler scheme to approximate the solution of the system. The discrete energy associated with the numerical scheme is analyzed, and we prove that it decays over time under certain conditions. Numerical simulations are conducted to validate the theoretical results, demonstrating the effectiveness of the proposed method in capturing the energy decay behavior of the Timoshenko beam.

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April 24-25-26, 2025 | Marrakech, Morocco

On the stability of a stochastic delay differential equations of fourth order

Communication Info

Authors:
Cemil TUNÇ[1]
Zozan OKTAN[2]

[1,2] Van Yuzuncu Yil University, Van – Turkey

Keywords:
(1) Stability
(2) Stochastic differential equation,
(3) Lyapunov-Krasovskii functional,
(1) Variable time delay

Abstract

This article deals with a nonlinear stochastic differential equation of fourth order with variable time delays. In the article, a result on the asymptotic stability of zero solution of the considered equation is established. The proof of the result is based on the Lyapunov-Krasovskii functional method. To illustrate the verification of the result, an example is provided in a particular case. The result of the article extends and improves previous ones in the relevant literature.

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Multiresolution analysis for solving viscoelastic fluid flow with slip boundary conditions

Communication Info

Authors:
Meryieme EL Farragui[1]
Otmane Souhar[1]
Georgios C. Georgiou[2]

[1]*Department of Mathematics , University Chouaib Doukkali, El Jadida, Morocco*

[2]*Department of Mathematics and Statistics, University of Cyprus, Nicosia, Cyprus*

Keywords:
(1) Johnson-Seglman model;
(2) Simple shear flow
(3) Navier slip

Abstract

The problem of Poiseuille flow involving a Johnson-Segalman fluid [1] has been analyzed analytically using the wavelet homotopy analysis method (WHAM) [2, 3]. Initially, the transformation of non-linear partial differential equations into ordinary differential equations is achieved, accounting for slip boundary conditions. The resulting analytical solution is expressed as an infinite series, and its convergence is established. The evolution of the flow is studied in both the stable and unstable regimes. We investigate the impact of the slip numbers on the velocity profiles. These results are consistent with existing research on other Non-Newtonian flows with wall slip

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Mathematical Modeling and Analysis of Fast Food Consumption Dynamics

Communication Info

Authors:
Issam Sahib[1]
Bouchaib Khajji [2]
Mohamed Belam [1]

[1] Laboratory LMACS, Sultan Moulay Slimane University, Department of Mathematics and Computer Science, Khouribga Polydisciplinary Faculty, Morocco
[2] Laboratory of Analysis Modeling and Simulation, Department of Mathematics and Computer Science, Faculty of Sciences Ben M'sik, Hassan II University of Casablanca
Keywords:
(1) **Mathematical Model**
(2) **Optimal Control**
(3) **Fast Food**

Abstract

This research presents a continuous mathematical model, called PLSCQ, aimed at simulating the behavior of fast-food consumers influenced by public and private addiction treatment centers. The analysis focuses on the model's key features, including the basic reproduction number R0, which assesses the potential spread of fast-food addiction within a population. A sensitivity analysis highlights the parameters with the most significant impact on R0. Stability analysis shows that the system is asymptotically stable, both locally and globally, at the consumption-free equilibrium E0 when $R0 \leq 1$, indicating controlled consumption levels. Conversely, when $R0 > 1$, a new equilibrium $E*$ with ongoing consumption emerges, where the system remains asymptotically stable. This model provides valuable insights into the influence of addiction treatment centers on fast-food consumption dynamics and identifies key factors for effective addiction management.

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Dynamics and numerical analysis of a Fractional Order Host-Parasite Model with Diffusion

Communication Info

Authors:
Chaima MOUTALIBI[1]
Ahmed AGHRICHE [1]
Youssef EL HADFI [1]

1 IPIM Laboratory, National School of Applied Sciences Khouribga, Sultan Moulay Slimane University, Khouribga, Morocco

Keywords:
(1) Parasite-host model
(2) Diffusion
(3) Fractional-order
(4) Caputo derivative
(5) Basic reproduction number
(6) Stability

Abstract

This study investigates a fractional-order SI parasite-host model that includes diffusion effects. It explores essential properties of the solutions, including existence, uniqueness, positivity, and boundedness, while considering spatial interactions. Additionally, the local and global stability of the equilibrium points are examined, with a particular focus on the basic reproductive number R_0. Simulations are conducted to illustrate the impact of diffusion and confirm the theoretical results.

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Comparative Analysis of Seismic Strengthening Systems for Existing Structures: Viscous Fluid Dampers vs. Traditional Bracing

Communication Info.

Authors:
NOUR EDDINE Abdelouahab 1, RAMADANE Abderazzak2, MOUZZOUN Miloud3,

1International University of Casablanca, Laboratory « Mathematics and Engineering Sciences»,

2International University of Casablanca, Laboratory « Mathematics and Engineering Sciences»,

3 Hassania School of Public Works Laboratory « of Civil Engineering, Hydraulics, Environment, and Climate (LaGCET) »,

Keywords:
Nonlinear dynamic analysis, Shear wall strengthening, Viscous fluid damper strengthening, Energy balance, Seismic performance, Vulnerability, Structural stiffness, Energy dissipation.

Abstract

As part of the rehabilitation of existing reinforced concrete structures, which are often under-designed to withstand seismic loads, selecting an appropriate strengthening strategy is a crucial challenge. Traditional approaches mainly rely on increasing stiffness by adding reinforced concrete shear walls, an effective but restrictive solution due to its impact on architectural configuration, additional loads, work complexity, and sometimes the need for foundation resizing.

This study presents a detailed comparison between two strengthening methods: the use of linear and nonlinear viscous fluid dampers and the traditional column-wall system. The objective is to assess their respective effectiveness in reducing dynamic response and improving structural stability under seismic loading.

The analysis is conducted on a structure equipped with diagonal viscous fluid dampers at each floor, allowing energy dissipation through either a linear or nonlinear behavior. The results show that nonlinear dampers, characterized by a nonlinearity parameter α\alphaα (0 < α\alphaα < 1) appearing in the equation of the force generated by the damper:

$$F_d(t) = C_{NL}|\dot{x}|^{\alpha}\operatorname{sgn}(\dot{x}),$$

outperform linear dampers in terms of efficiency for the same damping coefficient and equivalent stiffness.

In comparison, the column-wall system provides reinforcement through stiffness K:

$$K_{voile} = \frac{12\,EI}{h^3}$$

limiting lateral displacements but increasing internal forces within the structure.

The study also proposes a simplified procedure to adjust the damping coefficient of linear devices to match the performance of nonlinear dampers. The results highlight that while the column-wall bracing system is a robust solution in terms of stiffness, viscous dampers offer a more flexible and efficient alternative for energy dissipation, thereby reducing internal forces and minimizing heavy interventions on the existing structure.

These findings emphasize the importance of selecting the appropriate strengthening system based on structural and architectural constraints, adopting an optimized approach to ensure the stability and resilience of buildings against earthquakes.

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MCMC tools for Model Uncertainty In Environment Emission Analysis

Communication Info

Authors:
El houcine HIBBAH[1]
[1] *Sultan Mouly Slimane University , Beni Mellal, Morocco*

Keywords:
(1) Endogenous regression
(2) Model uncertainty
(3) Seemingly unrelated regression

Abstract

Social and economic determinants from many countries around the world are used to model environment degradation. Environment modelling is a field with model uncertainty [1], where we have to choose from a large number of factors to find which ones explain effectively CO2 emissions. In addition, some of the explaining variables are endogenous due to a causality effect with the principal environment variable. Thus, we recourse to seemingly unrelated regression [2] to tackle endogeneity encountered, where we adopt a Bayesian model selection [3] via reversible jump Markov Chain Monte Carlo method, that explores all possible models space, in order to select the best parameters explaining environment degradation. By the way, we can get the inclusion probability for each parameter. Thus we can know which of the variables explain importantly the environment degradation. Finally, we will be guided to discover the best instruments or the artificial variables that makes the estimation of the endogenous variables efficient [4].

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Three-Parameter Estimation of the Stochastic Generalized Rayleigh Diffusion Process

Communication Info

Authors:
Yassine CHAKROUNE[1]
Ahmed NAFIDI[1]

[1] Laboratory of Systems Modelization and Analysis for Decision Support (LAMSAD), Hassan First University of Settat, National School of Applied Sciences of Berrechid, Morocco

Keywords:
(1) *Generalized Raleigh distribution;*
(2) *Stochastic diffusion process;*
(3) *Maximum likelihood estimation;*
(4) *Simulated annealing;*
(5) *Statistical inference;*

Abstract

Modeling real data using stochastic processes is a very useful and powerful tools for many fields of research, such as science and technology, infectious diseases, biology and others. In this context, we introduce a new stochastic diffusion process related the generalized Rayleigh distribution (see, [3]). Then, we identify the analytic solution of the stochastic differential equation, the transition probability density function and the mean functions (see,[2,6]). To estimate the three process parameters in this process, we use the maximum likelihood method based on discrete sampling (see, [1, 4]). The system of likelihood equations has no explicit solution, so the form of the maximum likelihood estimators cannot be obtained. It is essential to use numerical methods such as the simulated annealing algorithm (see, [5, 7]). We will finish by investigating the possibility of using this new process to fit and predict simulated data.

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Viability results for first-order functional differential inclusions with ϕ-Laplacian in Banach spaces

Communication Info

Authors:
Najib ASKOURAYE [1]
Myelkebir AITALIOUBRAHIM [2]

[1] Polydisciplinary Faculty of Khouribga, Khouribga, Maroc
[2] Polydisciplinary Faculty of Khouribga, Khouribga, Maroc

Keywords:
(1) Viability
(2) measurability
(3) Multifunction
(4) selection
(5) functional differential inclusion

Abstract

In this work, we prove the existence of solutions the existence of solutions for the specified functional differential inclusion

$$\begin{cases} (\phi(x(t)))' \in F(t, T(t)x), \text{ a.e. on } [0,\tau]; \\ x(s) = \varphi(s), \forall s \in [-a, 0]; \\ x(t) \in C(t), \forall t \in [0,\tau]. \end{cases}$$

The existence of the solution is obtained under the following conditions :

(H1) $C: [0,1] \to 2^E$ is a set-valued map with closed graph and $\mathcal{K}: [0,1] \to \mathcal{C}_a$ is a set-valued map defined by $\mathcal{K}(t) = \{\varphi \in \mathcal{C}_a, \varphi(0) \in C(t)\}$ and $F: \mathrm{Gr}\,(\mathcal{K}) \to 2^E$ is a set-valued map with nonempty closed values, measurable with respect to the first argument and Lipschitz continuous with respect to the second argument and integrably bounded.

(H2) $\phi: E \to E$ is a homeomorphism function.

(H3) (**Tangential condition**) For each measurable function $v(\cdot): [0,1] \to E$, for all $\rho > 0, t \in [0,1]$ and $\psi \in \mathcal{K}(t)$, there exists $f \in S_{v,\rho}(\psi)$ such that

$$\liminf_{h \to 0^+} \frac{1}{h} d\left(\psi(0) + \int_t^{t+h} f(s)ds, \phi(C(t+h))\right) = 0.$$

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Study of $ \psi $-Hilfer Fractional Fuzzy Hybrid Integro-Differential Equations

Communication Info

Authors:
Samira ZERBIB[1]
Khalid HILAL[1]
Ahmed KAJOUNI [1]

[1]LMACS, Sultan Moulay Slimane University, Beni Mellal, Morocco

Keywords:
(1) Fuzzy hybrid equation
(2) Fuzzy $ \psi $-Hilfer derivative
(3) Fixed point theorem

Abstract

Perturbation techniques are essential in the analysis of nonlinear dynamical systems that are difficult to solve or study directly. The inherent nonlinearity of such systems often lacks the smoothness required for investigating the existence and other properties of solutions. However, introducing perturbations allows these problems to be approached using existing analytical methods from different perspectives. Dynamical systems modified in this way are referred to as hybrid differential equations.

This manuscript focuses on establishing the existence of solutions for a class of fuzzy nonlinear ψ-Hilfer fractional differential equations. Our approach relies on the extended ψ-Hilfer fractional derivative of order $q,\sigma\in(0,1)$, applied to fuzzy functions, combined with the Dhage fixed point theorem. To illustrate the applicability of our findings, we conclude with an example demonstrating how the results can be utilized.

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N_α^F Fractional Semi-Groups Of Operators

Communication Info

Authors:
Rachid Bahoul[1]
Houssame Rachad [2]
Thabet Abdeljawad[3]

[1] *Department of Mathematics, polidisciplinary faculty, Sultan Moulay Slimane University, Beni Mellal,Morocco.*
[2] *Department of Mathematics, polidisciplinary faculty, Sultan Moulay Slimane University, Beni Mellal, Morocco.*
[3] *Department of Mathematics and Sciences, Prince Sultan University, Riyadh 11586, Saudi Arabia..*

Keywords:
N_α^F Fractional Semi-Groups.
Fractional differential equation.
Mean value Theorem.
Mild solution

Abstract

Our aim in this work is to introduce a new definition of the J. E. Napoles and M. N. Quevedo derivative in [1] and to generalize some fundamental calculus theorems, such as the Mean Value Theorem and Rolle's Theorem. Additionally, we extend the classical properties of semigroups for this derivative, including strong continuity and differentiability, along with its generator and its properties. These results allow us to define mild solutions for the fractional Cauchy problem. We also provide an example using the well-known translation semigroup. This theory can be applied in the future to solve problems in a wide range of domains, such as population dynamics.

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Existence of weak solutions for a (p(x), q(x))-elliptic system via topological degree

Communication Info

Authors:
Abdellatif YASSIR[1]
Mostafa EL MOUMNI [2]

[1] Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco

Keywords:
(1) p(x)-Laplacian
(2) weak solution
(3) topological degree
(4) variable exponent Sobolev space
(5) variable exponent Sobolev space

Abstract

This work examines the existence of weak solutions for (p(x),q(x))-elliptic systems. The proof is based on Berkovits' topological degree theory, under precise conditions imposed on the nonlinear terms.

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A Functional Principal Component Analysis Approach to Conditional Copula Estimation

Communication Info

Authors:
Cheikh Tidiane SECK[1]
Toihir Soulaimana DJALOUD [2]

[1] *Université Alioune Diop, Bambey, Sénégal*
[2] *Université Alioune Diop, Bambey, Sénégal*

Keywords:
(1) Conditional copula;
(2) Karhunen--Lo\`eve expansion;
(3) Nonparametric estimation.

Abstract

Conditional copula model arises when the dependence between random variables of interest is influenced by another covariate. Despite its relevance for many applications in dependence modelling, there are few nonparametric approaches devoted to its estimation.
In this paper, we propose a new nonparametric approach which is based on functional principal component analysis. We consider the conditional copula process $C_X(u,v): 0 \leq u, v \leq 1$, where X designs the covariate, and give its Karhunen--Loève expansion, from which we derive our estimator. We then establish its $\sqrt{n}$-consistency and weak convergence in $L^2([0,1]^2)$ to a Gaussian limit process with explicit covariance function.

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Optimal Control Problem for a Semilinear Wave Equation

Communication Info

Abdelhak Bouhamed[1]
Abella El Kabouss[2]
Hassane Bouzahir[1]

[1]LISTI Laboratry, National School of Applied Sciences, Agadir, Morocco,

[2]Faculty of Economics and Management-Guelmim, Ibn Zohr University, Morocco .

Keywords:
(1) Wave equation
(2) Boundary bilinear control
(3) Optimal control problem.

Abstract

The aim of this work is to study the optimal control of a semilinear wave equation, where the control enters the system bilinearly through the boundary. The objective is to determine a distributed control that drives the system from an initial state to a desired one in finite time while minimizing a quadratic cost functional. Our goal is to prove the existence of an optimal control within a closed convex set. Then, by exploiting the differentiability of the cost functional with respect to the control, we establish the necessary conditions that an optimal control must satisfy.

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A New Estimation Approach for Structural Equation Models

Communication Info

Authors:
Zouhair El Hadri [1]
Sabah Laarif [2]

[1] Faculty of Sciences, Mohammed V University, Rabat, Morocco
[2] Faculty of Sciences, Mohammed V University, Rabat, Morocco

Keywords:
(1) Structural Equation Modeling
(2) Implied covariance matrix
(3) Finite iterative method

Abstract

Structural Equation Modeling is a multivariate technique that analyzes causal relationships between latent variables and their measured indicators, forming a hypothesis on their specific pattern of relations. The estimation process is a key step in modeling, often performed with the popular BFGS algorithm ([1],[2]). A new approach was recently introduced by El Hadri et al. in the context of Path Analysis models ([3],[4]). This method has strong convergence properties that outperform the BFGS algorithm, offering a simple and effective alternative. In this paper, we extend this new procedure to Structural Equation Models while maintaining its strong convergence properties and superior efficiency compared to the classical method.

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Approximate Optimality and Approximate Duality for Multiobjective Fractional Interval-valued Problems

Communication Info

Authors:
Moustaid Mohamed Bilal[1]
Dali Issam [2]

[1] *Chouaib Doukkali Universit, Faculty of sciences, El Jadida, Morocco*

Keywords:
(1) Fractional interval multivalued programming problem
(2) LU-Pareto solutions
(3) LU-convexity

Abstract

In this article, we establish approximate Karush–Kuhn–Tucker necessary and sufficient optimality conditions for approximate LU-Pareto solutions of a multiobjective fractional interval valued programming problem, where the numerator and denominator of the objective functions are assumed to be interval-valued functions. Furthermore, two duals, namely Wolfe and Mond–Weir duals, are introduced, and duality results are proven under LU-convexity assumptions. Several examples are provided to illustrate the results.

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A New Approach to Modeling Multidrug-Resistant Tuberculosis

Communication Info

Authors:

Laouina aziza[1]

Baheraoui Zuhair [1]

El Rhoubari Zineb [1]

[1] Faculty of sciences, Chouaïb Doukkali University, El jadida, Morocco.

Keywords:

(1) Epidemic models,
(2) Tuberculosis
(3) Global stability.

Abstract

Our objective in this study is to introduce and analyze a new drug-resistant tuberculosis epidemic model [1]. We determine the basic reproduction number R0 [2] and conduct a sensitivity analysis [3]. Furthermore, we investigate the existence and stability of both the disease-free and endemic equilibrium states [4].

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Existence, Uniqueness, and Stability of Solutions for Nonlinear Neutral Volterra-Fredholm Integro-Differential Equations with Caputo Fractional Derivatives

Communication Info

Authors:
El Habib BANOUISSE[1]
M'hamed ELOMARI[1]
Aziz EL GHAZOUANI[1]

[1] *Laboratory of Applied Mathematics and Scientific Computing, Sultan Moulay Slimane University, Beni Mellal, Morocco.*

Keywords:
(1) Caputo fractional derivatives
(2) Existence and uniqueness
(3) Krasnoselskii fixed point theorem
(4) Ulam-Hyers-Rassias stability
(5) Neutral Volterra-Fredholm integro-differential equations

Abstract

This work investigates a non-linear Volterra-Fredholm integrodifferential equation with Caputo fractional derivatives and particular order constraints. The work rigorously proves the existence and uniqueness of analytical solutions using the Banach principle. It also provides a unique result on the presence of at least one solution, which is backed by strict criteria derived from the Krasnoselskii fixed point theorem. Furthermore, the study includes neutral Volterra-Fredholm integro-differential equations, broadening the application of the results. Furthermore, the research investigates the idea of generalized Ulam Hyers Rassias stability for the given solutions, which provides important insights into their long-term behavior. To emphasize the practical relevance and trustworthiness of the conclusions, an illustrated examples is provided, successfully proving the theoretical discoveries' application.

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Commutativity of 3-prime near-rings involving homoderivations

Communication Info

Authors:
Slimane EL AMRANI[1]
Abderrahmane RAJI[1]

[1] LMACS Laboratory, Faculty of Sciences and Technology, Sultan Moulay Slimane University, Beni Mellal, Morocco

Keywords:
(1) Prime near-rings
(2) homoderivations
(3) Commutativity

Abstract

Throughout this paper, N will be a left near-ring. An additive mapping $d : N \to N$ is said to be a derivation if $d(xy) = d(x)y + xd(y)$ for all $x,y \in N$ or equivalently as noted in [4], that $d(xy) = xd(y) + d(x)y$ forany $x,y \in N$. In [2], the notion of homoderivation on ring was introduced by El Sofy as follows: An additive mapping $h : N \to N$, is called a homoderivation if $h(xy) = h(x)h(y)+xh(y) + h(x)y$ holds for all $x, y \in N$.
Many results on commutativity in prime and semi-prime rings admitting suitably constrained derivations, generalized derivations, and homoderivations have been published in the literature (see [1], [3] and [4]).
The main objective of the present paper is to investigate homoderivations in 3-prime near-rings that satisfy certain differential identities

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Le Marketing expérientiel et e-commerce : Le rôle des facteurs atmosphériques numériques dans le comportement d'achat des consommateurs

Communication Info

Authors:
Loubna EL HATTAB [1]
Tarik ZARI [2]

[1] Doctorante, Faculté des Sciences Juridiques Economiques et Sociales Mohammedia, Mohammedia, Morocco

[2] Professeur, Faculté des sciences juridiques, économiques et sociales d'Ain Sebâa, Casablanca, Morocco

Keywords:
(1) Atmosphère des sites web
(2) E-commerce
(3) Intention d'achat
(4) Emotion
(5) SOR

Abstract

Avec l'essor d'Internet haut débit et des technologies immersives, l'impact des canaux de distribution sur l'expérience et le comportement des consommateurs suscite un intérêt croissant. Depuis l'article fondateur de Kotler (1973) sur les « atmospherics », les chercheurs en marketing et en psychologie ont étudié l'influence des éléments d'ambiance sur les réponses émotionnelles et comportementales des consommateurs [1]. D'abord explorés dans les magasins physiques [2], [3], ces facteurs ont ensuite été transposés aux environnements numériques avec le développement du commerce en ligne [4].

Aujourd'hui, alors que l'expérience d'achat devient de plus en plus immersive et interactive, l'impact des atmosphères numériques – comprenant l'ambiance du site web, son design et la présence sociale – sur la prise de décision des consommateurs suscite un intérêt croissant [5], [6]. Pourtant, la recherche sur ce sujet demeure fragmentée.

Dans ce travail, nous nous intéressons à étudier l'influence de l'atmosphère numérique sur le comportement d'achat des consommateurs, en s'appuyant sur une revue de la littérature antérieure. Plus précisément, cette étude poursuit deux objectifs : (1) identifier les cadres théoriques majeurs expliquant l'impact des atmosphères numériques sur les émotions et l'intention d'achat des consommateurs ; (2) mettre en évidence les lacunes existantes et proposer des pistes de recherche futures pour enrichir ce champ en pleine évolution. Une étude empirique sera présentée pour validation.

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ICRAMCS 2025
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The Navier-Stokes Equations: Mathematics' Greatest Unsolved Challenge

Communication Info

Authors:
MOHAMMED EL ALAOUI [1]
MOULAY RCHID SIDI AMMI [2]

[1] FST, ERRACHIDIA, MOROCCO
[2] FST, ERRACHIDIA, MOROCCO

Keywords:
(1) Navier-Stokes equations
(2) nonlinear partial differential equation

Abstract

Navier Stokes, the cornerstone of fluid dynamics, envelops the complex interaction of non-linear partial differential equations that govern phenomena from turbulent flows to atmospheric movement. This enduring sporting challenge, particularly explores the problem of Fefferman's Millennium Award [1], which seeks to demonstrate the existence and smoothness of solutions in three dimensions or evidence of a time-limited explosion. Based on foundational insights from Landau and Lifshitz [2], we emphasize the equations "pivotal role in modeling physical systems, while Pope [3] illuminates the complexities of turbulence - vortex expansion and energy dissipation - that challenge analytical accuracy in 3D. In contrast, Kuksin and Shirikyan [4] make progress in 2D disturbance via random methods, highlighting the disparity with unresolved 3D status. Despite extensive practical applications, theoretical foundations remain elusive, with non-internal and non-local influences forming enormous barriers. Solving this puzzle promises transformative leaps in mathematics and applied science, enhancing Navier Stokes' equations as specific limits for human investigation.

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Epidemic Model of Tuberculosis: Analysis of Dynamic Transmission and Simulation

Communication Info

Authors:
Soufiane HAMANI[1]

[1] *FSDM, USMBA, FEZ, MOROCCO*

Keywords:
(1) Tuberculosis
(2) SIRI
(3) Modeling

Abstract

In this work we study a mathematical modeling of tuberculosis transmission. The study will use a SIRI (Susceptible-Infected-Recovered-Immune) model to analyze the dynamics of disease transmission.
We solve the model numerically and we present the simulation results.

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Exponential stabilization of wave equation with control saturation

Communication Info

Authors:
Wafae Abaakil
Mohamed Laabissi[2]

[1] Chouaib Doukkali University, El jadida, Morroco
[2] Chouaib Doukkali University, El jadida, Morrocco

Keywords:
(1) Exponential stability
(2) nonlinear semigroup
(3) wave equation

Abstract

This work investigates the exponential stabilization of a wave equation subject to saturation. The system is governed by a partial differential equation(PDE) with a nonlinear saturation function applied to the control input, ensuring bounded actuation[1]. In contrast with the existing works [2], the control f is given by $f(s,t) = -sat(a(s)x(t,s))$ with sat is the saturation function [3] and $a(s)$ is a positive function that satisfies some specific conditions [4]. The well posedeness of the system is proved by using the theory of nonlinear semigroups [5], and the exponential stability is shown by an appropriate Lyapunov functional. Numerical simulations are provided to validate the theoretical results, demonstrating the effectiveness of the proposed approach in stabilizing the wave equation while respecting input constraints.

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Modeling Inflation in the Euro Area: Approach and Perspectives

Communication Info

Authors:
Kaoutar EL MOUSSAOUY[1]
Mohammed MESTARI[1]
Mohammed BENHOUAD [1]

[1] ENSET, Mohammadia , Morocco

Keywords:
(1) inflation
(2) Modeling
(3) euro area
(4) Economic Dynamics
(5) Monetary Policy

Abstract

This paper aims to model inflation in the euro area to analyze its dynamics and identify the key factors that drive it. The study will first review some existing models, notably Taylor's famous model [1] and the Vector Autoregression (VAR) econometric model [2], to provide a theoretical foundation. Using a quantitative approach, it will then develop a model to enhance the understanding of inflation trends and their interactions with the economy. The objective is to assess recent developments and provide insights into the underlying mechanisms while considering economic uncertainties and the policies implemented to stabilize inflation.

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Locally meshfree RBF kernel-based method for solving multidimensional hyperbolic equations

Communication Info

Authors:
Lanceni KEITA[1]
Lahcen AZRAR[1]
Ateq Ahmed AL-GHAMEDI[2]

[1]*Research Center STIS, M2CS, Department of Applied Mathematics and Informatics, ENSAM, Mohammed V University, Rabat, Morocco*

[2]*Faculty of Sciences, Departmentof statistics, King Abdulaziz University,Jeddah, Saudi Arabia*

Keywords:
(1) Meshfree method
(2) Hyperbolic equations
(3) Stability and simulation

Abstract

A methodological approach based on the Wendland compactly supported radial basis function (RBF) [1] is elaborated and applied to various nonlinear multidimensional hyperbolic equations on irregular domains. The focus is firstly on the Burgers type equationdefined by the following equation [2]:(*)

$$\begin{cases}\dfrac{\partial \boldsymbol{u}}{\partial \boldsymbol{t}}(\boldsymbol{x},\boldsymbol{t}) + \mu(\boldsymbol{u}(\boldsymbol{x},\boldsymbol{t}).\boldsymbol{\nabla})\,\boldsymbol{u}(\boldsymbol{x},\boldsymbol{t}) - \boldsymbol{\zeta L u}(\boldsymbol{x},\boldsymbol{t}) \\ \qquad\qquad = \boldsymbol{f}(\boldsymbol{x},\boldsymbol{t}),\quad \boldsymbol{for\ x \in \Omega\ and\ t \in [t_0;T]}\end{cases}$$

where L is a linear partial differential operator, f *and* g are known functions and u is the velocity component. A Method of Lines (MOL) meshfree method is elaborated allowing to transform the partial differential problem (*) into a nonlinear ordinary differential system, solved with an explicit scheme ensuring efficient updates.

Key challenges addressed are the implementation of various mixed boundary conditionsand thehandling of irregular domains in meshfree methods. The scheme's stability is rigorously analyzed, and various computational tests are elaborated leading to a valuable tool for simulating complex engineering systems.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

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Super-Recurrence of Elementary Operators

Communication Info

Authors:
LAKRIMI Hamza[1]
AMOUCH Mohamed [2]

[1,2] Laboratory of Fundamental Mathematics and their Applications LMFA, Department of Mathematics, Faculty of sciences, Chouaïb Doukkali University, 24000 El Jadida, Morocco.

Keywords:
(1) Orbit
(2) Supercyclicity
(3) Recurrent operators
(4) Super-recurrent operators
(5) Elementary operators

Abstract

Let X be a separable Banach space over the field C of complex numbers, B(X) the algebra of all bounded linear operators on X and (J, $||.||_J$) be an admissible Banach ideal of B(X). For A, B ϵ B (X), let L_A ϵ B(B(X)), and R_B ϵ B(B(X)) be the left and the right multiplication operators, respectively. The two-sided multiplication $M_{A,B}$ ϵ B(B(X)) is defined by $M_{A,B}$ (S)=(L_A R_B)(S)=ASB and the generalized derivation $\delta_{A,B}$ ϵ B(B(X)) is defined by $\delta_{A,B}$ (S)=(L_A - R_B)(S)=AS-SB.
The aim objective of this presentation is concerned to study the transmission of some proprieties related to super-recurrence from operators $A, B \epsilon B(X)$ to their elementary operators L_A, R_B, $M_{A,B}$ and $\delta_{A,B}$ defined on an admissible Banach ideal of operators (J, $||.||_J$).

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Solving the Flow Shop Scheduling Problem by Two Metaheuristics

Communication Info

Authors:
Hajar Sadki [1]

[1] *University, Hassan II of Casablanca, FST Mohammedia, Morocco*

Keywords:
(1) flow shop scheduling
(2) Metaheuristics
(3) Genetic algorithm

Abstract

In this work, our subject is to solve a flow shop scheduling problem. The goal is to minimize the makespan of all jobs. We will use two efficient metaheuristics: the first is the iterative local search algorithm (ILS) and the genetic algorithm (GA) [1,2]. We will choose different sizes of the instance, and we will compare the result given by the metaheuristics. The numerical test shows that the genetic algorithm gives the best performance compared to the iterative local search algorithm.

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Existence and Uniqueness Results for Higher-Order Nonlinear Fractional Differential Equations via Coincidence Degree Theory

Communication Info

Authors:
Sami BAROUDI[1]
Abderrazak KASSIDI[1]
Ali EL MFADEL[1]
M'hamed ELOMARI[1]

[1] *Laboratory of Applied Mathematics and Scientific Computing, Sultan Moulay Slimane University, Beni Mellal, 23000, Morocco.*

Keywords:
(1) ψ-Caputo fractional derivative
(2) Mawhin's coincidence degree theory
(3) Fractional differential equations
(4) Banach contraction principle
(5) Adomian decomposition method

Abstract

In this paper, we introduce a new class of fractional differential equations involving the ψ-Caputo derivative of order $\alpha \in (2,3)$, addressing both theoretical foundations and numerical implementations. We establish the existence of solutions using Mawhin's coincidence degree theory and prove uniqueness via Banach's contraction principle. To tackle the computational challenges, we apply the Adomian decomposition method, ensuring high accuracy and efficiency. A detailed case study is provided to validate our approach, highlighting its practical relevance and potential applications in complex dynamic systems.

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Quasi-orthogonal extension property of symmetric matrices

Communication Info

Authors:
Abderrahim Boussaïri[1]
Brahim Chergui [1]
Sarir Zaineb [1]
Mohamed Zouagui [2]

[1] *FSAC, University of Hassan II Casablanca*
[2] *ISchool of Engineering, International University of Casablanca*

Keywords:
(1) Symmetric matrix
(2) Principal sub-matrix
(3) Quasi-orthogonal matrix
(4) Quasi-orthogonal extension
(5) Quasi-orthogonal index

Abstract

An $n \times n$ real matrix Q is quasi-orthogonal if $Q^T Q = qI_n$, for some positive real number q. If M is a principal sub-matrix of a quasi-orthogonal matrix Q, then we say that Q is a quasi-orthogonal extension of M. A class $\mathcal{M}$ of square matrices has the *quasi-orthogonal extension property* (QOEP for short) if every matrix M in $\mathcal{M}$ has a quasi-orthogonal extension Q in $\mathcal{M}$. For a class $\mathcal{M}$ that has QOEP, the *quasi-orthogonality index* of an $n \times n$ matrix $M \in \mathcal{M}$ is the least integer d, denoted by $ind(M)$, such that M has a quasi-orthogonal extension in $\mathcal{M}$ of order $n + d$.

In this work, we focus on the class of symmetric matrices and prove that it has QOEP. Furthermore, we determine the quasi-orthogonality index for symmetric matrices.

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Compact operators on right quaternionic Banach spaces

Communication Info

Authors:
Somayya MOULAHARABBI[1]
Mohamed BARRAA[2]

[1] Cadi Ayad University, Marrakech, Morocco
[2] Cadi Ayad University, Marrakech, Morocco

Keywords:
(1) Quaternionic Banach space
(2) Compact operators
(3) Orthogonality
(4) Duality

Abstract

In recent years, the study of operators on quaternionic Banach spaces has gained significant attention due to its importance in both theoretical and applied mathematics. Among these, compact operators play a fundamental role in functional analysis, and their study in right quaternionic Banach spaces presents new challenges and insights. In this paper, we study compact operators on right quaternionic Banach spaces and extend Fredholm's alternative theorem to this setting. We first establish fundamental properties of compact operators in quaternionic Banach spaces. Then, we present and prove Fredholm's alternative theorem for quaternionic compact operators and explore its implications. Finally, we examine specific properties of the S-spectrum of these operators.

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Luh hypercyclic vectors for composition operator

Communication Info

Authors:
Noureddine Karim
Otmane BENCHIHEB
Mohamed AMOUCH
Chouaib Doukkali University, El jadida, Morocco

Keywords:
(1) Hypercyclicity
(2) composition operator

Abstract

For a function phi which is holomorphic on Omega, We deal with the construction of holomorphic functions f on Omega such that f and all its derivatives and antiderivatives under Cphi have dense orbit, which will be called a Luh hypercyclic vector for Cphi. We show that there is a dense linear manifold of Luh hypercyclic vectors.

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Fuzzy Mathematics and LSTM for time series forecasting

Communication Info

Authors:
Yassine LAARICHI[1]
Oualid RHOULAM[1]

[1] University Ibn Tofail, Kenitra Morocco

Keywords:
(1)Fuzzy logic
(2) Time series prediction
(3) LSTM networks

Abstract

varies approaches has been put forward for time series forecasting, from statistics to neural networks[1], and data transformations [2]. However, conventional models struggle with the inherent imperfections of historical data, which can be noisy or incomplete [3]. This study explores a new approach for timed series prediction, combining fuzzy logic with machine learning to improve forecast accuracy. The findings demonstrate the value of fuzzy mathematics in financial time series analysis, with broader implications for stock market and economic modeling.

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ICRAMCS 2025

THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Spatiotemporal Modeling for rainfall data in Morocco using the Quadrantal Autoregressive Model

Communication Info

Authors:
Marouane insaf [1]
Nabil azouagh [1]
Mustapha kabil [1]

[1] *Faculty of Sciences and Technics of Mohammedia, Hassan II University. Mohammedia, Morocco*

Keywords:
(1) Spatiotemporal modeling
(2) Quadrantal Autoregressive
(3) Rainfall forecasting

Abstract

Moroccan rainfall modeling has been extensively studied by researchers, primarily using regression techniques [2,3,6] and temporal approaches [1]. However, as noted by [4], these methods do not adequately account for spatial variability, which may introduce bias in parameter estimation. To overcome this limitation, this study proposes the Quadrantal Space-Time Autoregressive (QSTAR) model, introduced in **[7]** and study in **[5]**, for rainfall prediction in Morocco. The model's performance is assessed using two key metrics: Mean Absolute Percentage Error (MAPE) and Root Mean Squared Error (RMSE) across two distinct data partitions. The evaluation demonstrates that QSTAR consistently delivers robust and stable predictions, exhibiting remarkable performance across varying data sizes and strong resilience to training noise. These findings highlight the model's generalization capabilities and its effectiveness in capturing spatiotemporal dynamics, marking it as a promising approach for rainfall forecasting to enhance planning and policy development.

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A Fast Algorithm for Optimizing Load-Carrying Capacity in Lubrication Systems including Wall Slip and Cavitation

Communication Info

Authors:
Salma RAIOUADI [1]
Mohamed EL ALAOUI TALIBI [2]
Mouna HILAL [3]

[1] UCA, FSSM, Ibn Al Banna Laboratory of Mathematics and Applications (LIBMA), Marrakech, Morocco
[2] UCA, FSSM, Ibn Al Banna Laboratory of Mathematics and Applications (LIBMA), Marrakech, Morocco
[3] UCA, FPS, Laboratory of Modeling and Combinatorics (LMC), Safi, Morocco

Keywords:
(1) Optimization
(2) Navier
(3) Fast algorithm

Abstract

In this work, we study cavitation and slip boundary problems for lubricated sliding contacts. The cavitation is modeled by the conservative compressible approach based on a non linear density-pressure relationship. The applied slip boundary condition is the Navier slip model, where the wall velocity is proportional to shear rate. Improving the performance of mechanical devices has always been a concern in mechanical engineering. The goal of this study is to find the optimal zone that maximizes the load capacity, defined as the integral of the pressure, which is obtained by solving the compressible Reynolds equation. We study the existence and uniqueness of the solution to the compressible Reynolds equation and prove the existence of an optimal solution. 1D simulations using a fast algorithm and a genetic algorithm, reveal optimal lubrication configurations, compared with previous work.

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Existence criteria for fractional sequential hybrid integro-differential equations with tempered ψ-Caputo operators

Communication Info

Authors:
Walid BENHADDA[1]
Abderrazak KASSIDI[1]
Ali EL MFADEL[1]
M'hamed ELOMARI[1]

[1] *Laboratory of Applied Mathematics and Scientific Computing, Sultan Moulay Slimane University, Beni Mellal, Morocco.*

Keywords:
(1) Hybrid differential equation
(2) Tempered ψ-fractional integral
(3) Tempered ψ-Caputo fractional derivative

Abstract

The aim of this paper is to investigate the existence results for two types of fractional hybrid integro-differential equations involving tempered ψ-Caputo fractional operators. The existence of solutions is established using Dhage's fixed point theorem for three operator equations in a Banach algebra and a generalized Krasnoselskii fixed point theorem. Finally, two illustrative examples are given to verify our theoretical results.

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Hyers-Ulam Type Stabilities of Iterative Integro-Differential Equations of High Order

Communication Info

Authors:
Merve SENGUN OGUZ[1]
Cemil TUNC [2]

[1] Van Yuzuncu Yil University, Van – Turkey
[2] Van Yuzuncu Yil University, Van – Turkey

Keywords:
(1) Hyers-Ulam Stability
(2) Hyers-Ulam-Rassias Stability
(3) Iterative Integro-Differential Equation

Abstract

In this study, we establish sufficient conditions of Hyers-Ulam stability, Hyers-Ulam-Rassias stability and -semi-Hyers-Ulam stability for an iterative Volterra integro-differential equation of higher order. Using fixed point method, Bielecki metric, etc., we prove new three theorems regarding the iterative Volterra integro-differential equation of higher order. The results of this study provide new, extensive and improved contributions to the qualitative theory of integro-differential equations.

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April 24-25-26, 2025 | Marrakech, Morocco

Choquard-Kirchhoff problems involving variable exponents depending on the solution

Communication Info

Authors:
Noureddine Moujane[1]
Mohamed El Ouaarabi[1,2]
Said Melliani[1]

[1] LMACS, Sultan Moulay Slimane University, FST, Beni Mellal, Morocco
[2] Faculty of Sciences Ain Chock, Hassan II University, Casablanca, Morocco

Keywords:
(1) Musielak-Orlicz Sobolev space
(2) Choquard-Kirchhof problems
(3) Topological degree methods

Abstract

In this paper, we establish the existence of weak solutions to Choquard-Kirchhoff-type problems involving a double-phase operator, where the exponents depend on the solution. Such problems arise in various areas of applied mathematics and physics, providing a flexible framework that is well-suited for modeling complex systems. such as the flow of non-Newtonian fluids through porous media, phase transitions, and fluid dynamics.

By employing the topological degree theorem, we prove the existence of weak solutions for the considered problem within the framework of Musielak-Orlicz-Sobolev spaces under appropriate assumptions.

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Minimizing Fractional Programs by Blocks

Communication Info

Authors:
Chimaa ENNOURI[1]
Ahmed ROUBI [1]
Karima BOUFI [2]

[1] Faculty of Sciences and Technologies, Settat, Morocco
[2] Higher Institute of Health Sciences, Settat, Morocco

Keywords:
(1) Fractional Programming
(2) Dinkelbach's Algorithm
(3) Block Coordinate Descent Method

Abstract

We are interested in solving optimization problems, known as fractional programs, whose objective function is defined as the ratio of two real-valued functions defined on $\mathbb{R}^n$. This type of problems is difficult to solve since they are generally non-convex, and become more difficult when their size n is very large. For this, we combine two methods to solve them: Dinkelbach's algorithm, which transforms the fractional problem into a sequence of simpler (convex) subproblems defined by a parameter, and the Block Coordinate Descent algorithm which divides the variables into blocks and solves the problems by successively optimizing with respect to each block of variables while keeping the other blocks fixed. These two methods reduce the overall problems complexity and optimize their resolution.

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Optimal Control Strategies for Reducing Cardiovascular and Type 2 Diabetes Risks in Psoriasis and Psoriatic Arthritis: A Mathematical Analysis and Numerical Simulation

Communication Info

Authors:
Oumaima Bouaoultaine[1]
Maryem El Karchani[2]
Nadia Idrissi Fatmi[3]

[1,2,3] ENSAK, Sultan Moulay Slimane University, Beni Mellal, Morocco

Keywords:
(1) Psoriasis
(2) Psoriatic arthritis
(3) Type 2 Diabetes
(4) Cardiovascular health
(5) Optimal controls
(6) Pontryagin's maximum principle
(7) Numerical simulations

Abstract

In this study, we present a novel mathematical model that describes the dynamics of psoriasis and psoriatic arthritis. The main objective is to mitigate the associated risks to cardiovascular health and type 2 diabetes through control strategies based on three key factors: patient awareness programs, medical follow-up, and the promotion of a healthy and consistent lifestyle. We prove the existence of optimal controls and characterize them using state variables and adjoint functions, relying primarily on Pontryagin's maximum principle. Numerical simulations under various scenarios highlight the effectiveness of the proposed optimization approach.

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Optimality conditions and duality of approximate proper efficiency for bilevel multiobjective fractional programming problems with extremal-value function

Communication Info

Authors:
Ahmed RIKOUNE[1]
Mohamed LAGHDIR [2]

[1] Department of Mathematics, Faculty of Sciences, Ibn Zohr University, B.P. 8106, Agadir, Morocco
[2] Department of Mathematics, Faculty of Sciences, Chouaib Doukkali University, BP. 20, El Jadida, Morocco

Keywords:
(1) Multiobjective fractional programming
(2) Bilevel programming
(3) Conjugate duality
(4) Approximate optimality conditions

Abstract

In this paper, we establish necessary and sufficient approximate optimality conditions and some duality results of approximate proper efficient solutions for a constrained bilevel multiobjective fractional programming problem (P) with an extremal-value function. Using a parametric approach, the problem (P) is first equivalently transformed into a parametric problem (P^{μ}) with $\mu \in \mathbb{R}^p$, for which we construct then a dual problem. This is achieved in terms of conjugate duality theory. Under appropriate assumptions, the ε-weak duality and ε-strong duality results for (P^{μ}) are presented. These results permit us to give dual characterizations for the approximate proper efficient solutions to the problem (P).

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Hamiltonien de Davydov-Chaban avec la masse dépendante de la déformation pour le potentiel sextique

Communication Info

Authors:
Imad TAGDAMTE[1]
Mostafa OULNE [1]
[1] High Energy Physics and Astrophysics Laboratory, Department of Physics, Faculty of Sciences Semlalia, Cadi Ayyad University, Marrakesh, Morocco

Keywords:
(1) Hamiltonien de Davydov-Chaban
(2) Potentiel sextique
(3) la Masse Dépendante de la Déformation

Abstract

Ce travail présente des expressions analytiques pour les spectres et les fonctions d'onde dérivées de l' hamiltonien de Davydov-Chaban [1] , qui modélise le mouvement collectif des noyaux non axiaux dans un potentiel sextique et intègre le formalisme de la Masse Dépendante de la Déformation (DDM) [2]. La solution obtenue, désignée sous le nom :(Z(4)-SDDMA), est obtenue grâce à l'application combinée de la Solvabilité Quasi-Exacte (QES) [3] et de la Méthode de Perturbation Quantique (QPM). Les spectres et les taux de transition B(E2) sont fournis pour une sélection de 15 noyaux : $^{122-132}$Xe, $^{188-198}$Pt et $^{112-114}$Pd, montrant un bon accord avec les données expérimentales [4]. Il convient de noter que le paramètre DDM joue un rôle crucial en permettant, pour la première fois, de représenter les niveaux de la bande γ 6^{+} et 7^{+} ainsi que les niveaux supérieurs dans leur ordre naturel, ce qui résout une anomalie précédemment identifiée dans tous les modèles basés sur l'hamiltonien de Davydov-Chaban [5].

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Dynamical analysis of tumor-dystrophin interaction model with impact of age of onset

Communication Info

Authors:
Naima MEFTAH[1]
Mohamed AMOUCH [2]

[1] Faculty of Sciences,
Chouaib Doukkali University,
El Jadida, Morocco

Keywords:
(1) Tumor growth
(2) Dystrophin protein
(3) Stability analysis
(4) Lyapunov function
(5) Numerical simulations

Abstract

In this research work, the authors present a mathematical model to study the biological interplay between tumor growth, dystrophin protein, and the impact of age of onset and staging through a system of ordinary differential equations (ODEs). An area that has not been thoroughly explored in mathematical biology. Initially, a simplified model examines the interplay between dystrophin and tumor growth, with analytical and numerical solutions verifying stability at equilibrium points. Subsequently, a more intricate model factoring in the age of onset and staging is developed, and stability is again demonstrated via analytical and numerical methods. In the final phase, a three-dimensional model is introduced, and the Picard-Lindelof theorem confirms the existence and uniqueness of solutions. Stability analysis demonstrates conditional stability at the equilibrium points The Lyapunov function is used for global stability analysis to confirm that the system follows a predictable, stabilizing trajectory rather than being chaotic or oscillatory. Numerical simulations, executed using the fourth-order Rung-Kutta method, support the analytical results numerically as well as graphically.

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Qualitative analysis of a SEIR epidemic model in spatially heterogeneous environment

Communication Info

Authors:
Oualid Bahouh[1]
Aziz Ouhinou [2]
Khalil Ezzinbi[3]

[1] *University Sultan Moulay Slimane, Beni mellal,Morocco.*
[2] *IUniversity Sultan Moulay Slimane,Benimellal,Morocco.*
[3] *Faculty of Sciences Semlalia, Marrakech, Morocco.*

Keywords:
SEIR model.
Epidemic reaction–diffusion model.
Logistic source.
Endemic equilibrium.

Abstract

Our aim in this work to study a diffusive SEIR epidemic model with a saturated incidence rate[1], a logistic growth rate for susceptibles, and Holling type II treatment in a spatially heterogeneous environment. We first analyze some fundamental properties of the parabolic system, including the uniform upper bound of solutions, the global stability of the disease-free equilibrium (DFE), uniform persistence, and the existence of endemic equilibria. Our numerical analysis supports the theoretical framework, demonstrating that the DFE is asymptotically stable under a stronger condition than R_0<1.

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A Mathematical Model of Rust Disease Propagation with Delays

Communication Info

Authors:
Siham HACHOUM[1]
Imane EL BERRAI[1]

[1] *Faculty of Sciences Ben M'sick, Hassan II University, Casablanca, Morocco*

Keywords:
(1) Epidemic model
(2) Time delay
(3) Incubation period

Abstract

Plants play an essential role in sustaining life on Earth, yet they are susceptible to diseases that can escalate into epidemics, threatening crop yields and food security. This study presents a deterministic mathematical model to simulate the dynamics of a wheat epidemic, focusing on rust - a prevalent fungal disease affecting wheat crops globally.

This disease is characterized by a latency period during which the pathogen invades host cells, reproduces, and spreads within the plant. his latency influences the speed of symptom onset and the extent of disease proliferation. To accurately capture this time-dependent aspect of disease progression, we introduced delays into the model, resulting in a system of delay differential equations (DDEs). We analyzed the dynamics of this DDE system, focusing on equilibria and stability to understand the effects of delayed transmission within the plant. Finally, we compared the numerical solutions of the original ordinary differential equations (ODEs) with those of the DDEs to illustrate how the introduction of delays influences disease dynamics.

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On the A-contractions operators

Communication Info

Authors:
Kenza GOUACH[1]
Hamid EZZAHRAOUI [2]

[1]*Mohammed V university Faculty of sciences, Rabat, Morocco*
[2] *Mohammed V university Faculty of sciences, Rabat, Morocco*

Keywords:
(1) A-contraction
(2) A-isometry
(3) Contraction

Abstract

The class of operators T acting on a hilbert space H relative to a positive operator A on H and satisfying $T^*AT \leq A$, is called A-contractions that generalizes the well-known contractions, one of the most studied and understood classes of operators, we'll try to take it as the starting point for our study.
Even there are differences between the two classes , our work on A-contractions operators is based on extending some properties of contractions. As it was possible for the classical Nagy-Foiaş-Langer and von Neumann-Wold decompositions, we will try to give the generalization of more decompositions for an A-contraction T, but this would not be possible without specifying the appropriate assumptions.

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Beamforming Optimization techniques for 6G Networks: Approaches and Perspectives

Communication Info

Authors:
Mossaab ATZEMOURT [1]
Zakaria HACHKAR [1]
Younes CHIHAB [2]

[1] *Cadi Ayyad University, Polydisciplinary Faculty, Safi, Morocco*
[2] *Faculty of Sciences, Ibn Tofail University, Kenitra, Morocco*

Keywords:
(1) Beamforming Optimization
(2) Sixth-generation (6G)
(3) Machine learning algorithms
(4) Intelligent reflective surfaces
(5) Reconfigurable intelligent surfaces

Abstract

Beamforming plays a key role in the evolution of sixth-generation (6G) wireless communication systems by optimizing signal transmission and reception [1]. This paper explores advanced approaches proposed in the literature to improve the efficiency of beamforming in complex and highly mobile environments, focusing on three major challenges: energy optimization, dynamic adaptability and interference mitigation. Key solutions include intelligent reflective surfaces [2], deep reinforcement learning [3], hybrid beamforming [4] and machine learning algorithms [5]. These technologies enable real-time adjustment of beams, improved network coverage and efficient management of terahertz band constraints. Reconfigurable intelligent surfaces [6], in particular, optimize wave reflection for targeted interference management and improved spectral efficiency. Together, these innovations act as strategic levers to meet the requirements of 6G, including ultra-low latency, high device density and reliable connectivity, while ensuring sustainable energy consumption.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Logistic Growth and Relapse in the Stochastic Dynamics of SIRI Epidemics

Communication Info

Authors:
Mouad ESSEROUKH [1]
Adel SETTATI [1]
Aadil lahrouz [1]

[1] Laboratory of Mathematics and Applications, Department of Mathematics, Faculty of Sciences and Techniques, B.P. 416-Tanger Principale, Tanger, Morocco.

Keywords:
(1) Stochastic SIRI model
(2) Logistic growth
(3) Extinction of disease

Abstract

This paper develops a stochastic SIRI epidemic model that incorporates nonlinear relapse dynamics, logistic population growth, and a bilinear incidence rate. We begin by establishing the existence and uniqueness of a positive global solution, ensuring the model's well-posedness. Subsequently, we derive sufficient conditions that determine whether the disease will persist in the population or eventually become extinct. These theoretical results are rigorously analyzed and validated through numerical simulations, which illustrate the interplay between key model parameters and epidemic outcomes. Our findings provide valuable insights into the complex dynamics of infectious diseases with relapse and population regulation.

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ON A CLASS OF GENERALIZED P(X)-BIHARMONIC PROBLEM WITH NO-FLUX BOUNDARY CONDITION

Communication Info

Authors:
Khalid Soualhine[1]
Mohamed Talbi [2]
Najib Tsouli[1]

[1] University of Mohammed I, Oujda, Morocco
[2] CRMEF, Oujda, Morocco.

Keywords:
(1) p(x)-biharmonic operator.
(2) No-flux boundary condition.
(3) Weak solutions.

Abstract

Using variational methods, we obtain in this work, the multiplicity of nontrivial weak solutions for a class of generalized p(x)-biharmonic problem involving two nonlocal terms and two real parameters with indefinite weight under no flux boundary condition. The novelty here can be seen as a generalization and continuation to some existing results.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Height of Reed-Muller Codes: A Computational Study

Communication Info

Authors:
Saber DARMOUN[1]
Khalid ABDELMOUMEN [2]
Hussain BEN-AZZA[3]

[1] Sidi Mohamed Ben Abdellah University, Ecole Normale Supérieure, Fez, Morocco

[2] Sidi Mohamed Ben Abdellah University, Ecole Normale Supérieure, Fez, Morocco

[3] Moulay Ismail University, ENSAM, Meknes, Morocco

Keywords:
(1) Reed-Muller Codes
(2) Power of a code
(3) Height of a linear code

Abstract

The theory of error-correcting codes is essential in the field of communication, particularly for ensuring the reliability of information transmission. Among the most well-known families of codes, Reed-Muller codes play a key role in error correction and optimization of communication system performance. These codes are widely used in applications such as data storage and wireless communication. In this study, we focus on the notion of the power of a linear code, as defined in reference [1], and the Height of an error-correcting code. The main objective of our work is to explore the power of classical and q-ary Reed-Muller codes and determine their associated heights. We generate a large number of examples using a computational software. This approach has not only deepened our understanding of the properties of Reed-Muller codes but has also raised new questions that may enrich the field of linear codes research. Our results pave the way for further discussion on the extension of this study to other families of codes.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

April 24-25-26, 2025 | Marrakech, Morocco

The generalized Laplace transform method for a ψ $-$Caputo coupled system of Volterra integro-differential equations

Communication Info

Authors:

Asmaa Baihi[1]

Hamid Lmou[1]

Khalid Hilal[1]

Ahmed Kajouni[1]

[1] Laboratory of Applied Mathematics and Scientific Computing, Sultan Moulay Slimane University, Beni Mellal, Morocco.

Keywords:

(1) ψ -Caputo fractional derivative;

(2) Volterra integral operator; generalized Laplace transform method; Banach's fixed point theorem;

(3) Hyers–Ulam stability

Abstract

In this paper, we deal with the coupled system of For Volterra integrodifferential equations of order (p,q), we use the generalized Laplace transform method to find the solution and obtain results on uniqueness using Banach's fixed point theorem. Next, we examine different stabilities in the sense of Ulam-Hyers (UH) of the given problems. Finally, a concrete application is given to illustrate the effectiveness of our main results.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

April 24-25-26, 2025 | Marrakech, Morocco

Hyers-Ulam Stability Analysis of Some Third-Order Linear Differential Equations with Constant Coefficients

Communication Info

Authors:
Karim FARHAT[1]
Idriss ELLAHIANI[1]
Omar AJEBBAR[1]
Belaid BOUIKHALENE[2]

[1] Polydisciplinary Faculty, Sultan Moulay Slimane university, Beni Mellal, Morocco
[2] National School of Applied Sciences, Sultan Moulay Slimane university, Beni Mellal, Morocco

Keywords:
(1) Hyres-Ulam stability
(2) Differential equation

Abstract

This paper examines the Hyers-Ulam stability of the third-order linear differential equation

$$(E) : y^{(3)}(x)+(\delta-2)y''(x) -(2\delta-1)y'(x)+\delta y(x)= 0, \ \ x \text{ in } [a,b]$$

Where δ is a real parameter and $[a,b]$ is a real interval. A fundamental question in stability theory is whether approximate solutions of differential equations remain close to exact solutions under small perturbations. In this context, we establish that if a function f satisfies the inequality

$$|f^{(3)}(x)+(\delta-2)f''(x)-(2\delta-1)f'(x)+\delta f(x)| \leq \varepsilon, \text{ for all } \varepsilon > 0$$

then there exists an exact solution y of equation (E) such that

$$|y(x) - f(x)|\leq K\varepsilon$$

Where K is the Hyers-Ulam stability constant.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Generalized solution of transport equation in Colombeau algebra using fixed point

Communication Info

Authors:
Soukaina SADEK
M'hamed ELOMARI
Abdellah TAQBIBT

Faculty of Sciences and technologies,
University of Sultan Moulay Slimane, Beni Mellal, Morocco

Keywords:
(1) Generalized solution
(2) Transport equation
(3) Colombeau algebra
(4) Fixed point theorem
(5) Association

Abstract
In this paper, we investigate the existence and uniqueness of the generalized solution for an important class of transport equations within the framework of Colombeau algebra G. Our approach relies on the application of the fixed-point theorem, combined with specific computational techniques to handle nonlinear initial conditions in the time variable t. Furthermore, we establish a connection between the classical and generalized solutions of the transport equation, highlighting the consistency of our approach within the Colombeau algebraic setting. Our results contribute to a deeper understanding of generalized functions in the context of partial differential equations with singularities or irregular data.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Green Supply Chain Management and Overall Performance of Moroccan Industrial Firms: An Empirical Assessment Using Structural Equation Modeling

Communication Info

Authors:
Abdelali OUFKIRI[1]
Tarek ZARI [2]

[1] Hassan II University of Casablanca / Faculty of Legal, Economic and Social Sciences Ain Sebaa, Casablanca,Morocco
[2] Hassan II University of Casablanca / Faculty of Legal, Economic and Social Sciences Ain Sebaa,Casablanca,,Morocco

Keywords:
(1) supply chain management
(2) green management
(3) overall performance

Abstract

Green Supply Chain Management (GSCM) is increasingly recognized as a strategic approach to enhancing firms' overall performance by integrating environmental considerations into supply chain operations [1]. In the context of Moroccan industrial firms, the adoption of GSCM practices aims to improve operational efficiency and strengthen social legitimacy [2]. This study employs Structural Equation Modeling (SEM) to examine the impact of internal environmental practices on firms' overall performance. The findings reveal a significant positive relationship between internal GSCM practices and performance improvement [3]. However, the extension of environmental practices to external stakeholders, such as suppliers and customers, does not yield a significant performance boost [4]. These results highlight the importance of internal environmental initiatives in achieving sustainability goals and competitive advantage [5].

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On the Optimization of Control Flow Graphs: Algorithmic and Computational Perspectives

Communication Info

Authors:
M. Hafid [1*]
S. Abdelalim [2]
I. Elmouki [2]
D. Karim [1]

[*] *Meryemh553@gmail.com*
[1] *Faculty of Sciences and Techniques of Mohammedia, University Hassan II of Casablanca, Morocco.*
[2] Faculty of Sciences Ain Chock, University Hassan II of Casablanca, Morocco.

Keywords:
(1) Control Flow Graph
(2) DGCNNs
(3) Artificial Intelligence
(4) Software defect

Abstract

After analyzing the fundamental properties of Control Flow Graphs (CFGs), we focus on their structural refinement through formal algorithmic methods. Simplifying CFGs is essential for improving program analysis, particularly in areas such as software verification and defect detection. More importantly, we explore how CFG transformations enhance the effectiveness of Dynamic Graph Convolutional Neural Networks (DGCNNs) in predicting software defects. By refining CFG structures while preserving key control dependencies, we enable more expressive graph-based representations for learning-based approaches.

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An equilibrium vectorial version of Borwein-Preiss's variational principle

Communication Info

Authors :
DOUHOU ABDESSAMAD
MAADEN ABDELHAKIM

Faculté des Sciences et Techniques, Beni Mellal, Maroc

Keywords:
(1) Variational principles
(2) Vector equilibrium problems
(3) Quasi-metric spaces
(4) Gerstewitz's functional

Abstract

In this work, we investigate in vector optimization problems where functions map from a quasi-metric space to a vector space that may or may not be endowed with a topological structure. We propose an extended algebraic vectorial version of lower semicontinuity, inspired by topological setting, and discribe it in terms of the closedness of level sets. The primary contribution of this work is the to present a vectorial equilibrium form of the Borwein-Preiss variational principle, as discussed in [5], by establishing the existence of solutions for perturbed equilibrium problems. To do this, we use a nonlinear scalarization approach by applying some algebraic properties of the Gerstewitz's functional [3,4]. In a particular case, a vectorial form of an Ekeland-type variational principle for bifunctions will be deduced.

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Topological degree for an anisotropic equation with variable growth

Communication Info

Authors:
Hamza JOURHMANE [1]
Abderrazak KASSIDI [1]
M'hamed ELOMARI [1]
Khalid HILAL [1]

[1] *Faculty of sciences and techniques, Beni Mellal, Morocco*

Keywords:
(1) Topological degree
(2) Periodic solution
(3) Dirichlet conditions
(4) Generalized Sobolev spaces
(5) Anisotropic p(x, t)-Laplacian
(6) Variable growth

Abstract

The idea behind the present paper is to establish the existence of a periodic non-negative solution for a degenerate parabolic equation [2] with anisotropic p(x, t)-Laplacian operator [3] and strongly nonlinear source under Dirichlet type boundary conditions [4]. This will be approached by a proof based on the Leray-Schauder topological degree [1], which can be challenging to work with in this type of equations as well as the blow up argument [5].

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The global existence of the stochastic Quasi-geostrophic equations in Fourier-Besov-Morrey

Communication Info

Authors:
Hassan Khaider[1]
Mohamed El Ouaarabi [2]
Abderrahmane Raji[1]

[1] Faculty of Science and Technology of Beni Mellal, Sultan Moulay Slimane University, Beni Mellal.

2 Faculty of Sciences Aïn Chock, Hassan II University, Casablanca.

Keywords:
(1) Itô integral.
(2) Stochastic Quasi-geostrophic equations.
(3) Fourier-Besov-Morrey spaces.

Abstract

This paper investigates the global well-posedness of solutions for the two-dimensional stochastic Quasi-Geostrophic (SQG) equation in Fourier-Besov-Morrey spaces. By employing the Itô integral, we establish the existence and uniqueness of global mild solutions under suitable assumptions on the initial data and the external random forcing term. For comparison, we also present corresponding results for the deterministic case. The analysis leverages tools from harmonic analysis, including Littlewood-Paley theory and Fourier-Besov-Morrey spaces, which are well-suited for handling the regularity and scaling properties of the equation. Using a fixed-point approach and stochastic estimates, we derive precise conditions ensuring the well-posedness of the SQG equation in this critical functional framework. Our results extend previous studies on deterministic quasi-geostrophic equations by incorporating stochastic forcing, thereby contributing to the understanding of randomness in geophysical fluid models.equation.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

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A Novel Dynamic Threshold Approach for Image Restoration

Communication Info

Authors:
Abdelghafour ATLAS[1]
Jamal ATTMANI[1]
Fahd KARAMI[2]

[1]LMSC, Cadi Ayyad University, ENSA Marrakech, Morocco
[2]MIMSC, Cadi Ayyad University, EST Essaouira, Morocco

Keywords:
(1) Image Processing
(2) Perona-Malik Equation
(3) Dynamical threshold

Abstract

This study presents a mathematical and numerical analysis of a novel image denoising model. The model is developed by combining the H−1-norm decomposition approach with a dynamic threshold-based Perona–Malik (DTPM) method. By incorporating a dynamic threshold function into the edge indicator, the model adaptively adjusts the diffusion mode and strength based on the image's characteristics. Using Schauder's fixed point theorem, we prove the existence and uniqueness of weak solutions for the proposed model. Finally, numerical experiments and comparative analyses are conducted to demonstrate the model's effectiveness and performance..

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Points algébriques de degrés au-plus 5 sur la courbe C d'équation affine $y^2 = 3(x^5 - 1)$

Communication Info

Authors:
El Hadji SOW[1]
Oumar SALL [2]

[1] Université Assane SECK, Ziguinchor, *Sénégal*
[2] Université Assane SECK, Ziguinchor, *Sénégal*[3]

Keywords:
(1) Courbes planes
(2) Degré d'un point
(3) Points rationnels
(4) Extentions algébriques
(5) Jacobienne

Abstract

Dans ce travail, nous déterminons l'ensemble des points algébriques de degrés au-plus 5 sur $\mathbb{Q}$ sur la courbe C d'équation affine : $y^2 = 3(x^5 - 1)$.
L'énoncé obtenu étend un résultat de Siksek qui a décrit dans [3] l'ensemble des points $\mathbb{Q}$-rationnels sur cette courbe.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

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Sequential efficiency optimality conditions for a robust multiobjective fractional optimization problems

Communication Info

Authors:
M'hamed MABROUK[1]
Mohamed LAGHDIR[2]
Ahmed ED-DAHDAH[3]

[1,2,3]Department of Mathematics, Faculty of Sciences, Chouaïb Doukkali University, BP. 20, El Jadida, Morocco

Keywords:
(1) Conjugate function
(2) Efficiency solution
(3) Robust multiobjective fractional optimization
(4) Optimality conditions

Abstract

The aim of this paper is to establish, without any constraint qualification, sequential optimality conditions for a vector constrained robust multiobjective fractional programming problem, characterizing an efficient solution. This is achieved in terms of the epigraphs of the conjugate, approximate subdifferential, and the subdifferential of the involved functions at the minimizer. Finally, we present an example illustrating the main results of this paper.

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ICRAMCS 2025
THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Regularized generalized canonical correlation analysis for multiblock data analysis

Communication Info

Authors:
Hanane ZAHRAOUI[1,2]
Zouhair EL HADRI [1]
Mohamed HANAFI[2]
Mohamed ZIANI[1]

[1] *Faculty of sciences, Rabat, Morocco*
[2] *ONIRIS, Nantes, France*

Keywords:
(1) Multiblock datasets
(2) RGCCA
(3) Regularization
(4) High-dimensional data

Abstract

This paper explores multiblock data analysis different methods, where the variables are separated into distinct blocks measured on the same individuals. We focus here on a special and powerful framework for exploring complex, high-dimensional and multicollinear datasets, called Regularized canonical correlation analysis (RGCCA) [1].

RGCCA is used to uncover relationships across different data blocks [2], but it requires experts to define the links between them in advance [3], a step that can be challenging and could influence both the analysis and the results.

In this paper, we aim to demonstrate the flexibility and practical utility of RGCCA through real-world applications, where we illustrate the flexibility and practical value of RGCCA, emphasizing its ability to provide stable and reliable insights while achieving strong goodness of fit [4].

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ICRAMCS 2025

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The $M^{[X]}/M/1$ queue with single server breakdowns

Communication Info

Authors:
Amal EZZIDANI[1]
Mohamed GHAZALI [1]
Othmane EL MOIZE [2]

[1] FSTS, Settat, Morocco
[2] ENSA, Tetouan, Morocco

Keywords:
(1) batches arrivals
(2) single server breakdowns
(3) embedded Markov chains

Abstract

In this paper, we consider a batch arrival $M^{[X]}/M/1$ queue model with single server breakdowns and the sizes of successive arriving batches being independent and identically distributed random variables. For this model, we analyze a two-dimensional Markov chain and give its quasi-upper triangle transition probability matrix. Under the system stability condition, we derive the steady-state probabilities, and then obtain the expressions of the various performance measures of the queueing system. Finally, some numerical examples are given to illustrate the effect of the parameters on the system performance measures.

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Approximate weak and proper subdifferentials of the difference of two vector convex mappings and applications

Communication Info

Authors:
Ahmed ED-DAHDAH[1]
Mohamed LAGHDIR[2]
M'hamed MABROUK[3]
Abdelghali Ammar[4]

[1,2,3]*Department of Mathematics, Faculty of Sciences, Chouaïb Doukkali University, BP. 20, El Jadida, Morocco*
[4]*Department of Computer Engineering, Networks and Telecommunications, National School of Applied Sciences, 9 Cadi Ayyad University, Safi, Morocco*
Keywords:
(1) Approximate Pareto subdifferential
(2) DC programming
(3) Vector optimization
(4) Optimality conditions

Abstract

In this paper, we provide a general formula concerning the weak and proper approximate subdifferentials of the difference of two vector convex mappings (DC) in terms of the star difference. This formula is applied to establish necessary and sufficient approximate optimality conditions, characterizing weakly and properly approximate efficient solutions for a constrained DC programming problem and a constrained multiobjective fractional programming problem.

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April 24-25-26, 2025 | Marrakech, Morocco

Comparing Penalized and Random Effects Quantile Regression Models for Longitudinal Data

Communication Info

Authors:
Fatima Zahra AHSOUS[(a)]
Hasna CHAMLAL[(a)]
Karim OULKACHA[(b)]

(a)Computer Science and Systems Laboratory (LIS), Faculty of Sciences Ain Chock, Hassan II University of Casablanca, Morocco

(b) 201, Ave Président-Kennedy H2X 3Y7, Montreal, Quebec, Canada

Keywords:
(1) Quantile regression
(2) Longitudinal data
(3) Random effects
(4) Penalty methods
(5) Asymmetric Laplace distribution

Abstract

In traditional mixed models, longitudinal data analysis relies on Gaussian random effects models. However, this assumption does not provide enough flexibility to handle heterogeneous individual effects. We present two linear quantile regression models for longitudinal data, one incorporates L 1 regularisation to manage the individual fixed effects [1], and the other includes random effects using the Asymmetric Laplace Distribution [2] to account for the dependence between repeated measurements within the same subject. The first method applies L_1 regularization to shrink individual fixed effects and uses Sparse linear algebra and interior point methods to efficiently solve the large scale optimization problem. The second model uses the Asymmetric Laplace Distribution to estimate quantile regression parameters and uses likelihood ratio tests to evaluate the significance of the parameters. The results show that models effectively selects optimal shrinkage level for individual effects, outperforms penalized fixed effects approaches and provides a robust alternative to mean regression with random effects for skewed longitudinal data. Regularization significantly reduces estimation variability and handles a large number of fixed effects.

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ICRAMCS 2025

THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Multiplicity of solutions for fractional (p, q)-Laplacian equations involving the critical exponents and Hardy potential in R^N

Communication Info

Authors:
Rachid ECHARGHAOUI[1]
Rachid SERSIF[1]

[1] *Ibn Tofail university , Kenitra, Morocco*

Keywords:
(1) Fractional (p,q)-Laplacian
(2) Critical point theorem.
(3) Variational methods,

Abstract

In this paper, we study a fractional (p,q)-Laplacian equation with critical exponent exponents and Hardy potential in R^{N}. By using an abstract critical point theorem from [4] and by employing the concentration compactness principle of Lions. we obtain a multiple solutions for β sufficiently large. A similar problem with subcritical exponents is also considered.

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Li-Yorke chaotic C0-semigroup

Communication Info

Authors:
Halima HASSANI[1]
Mohamed AMOUCH [2]

[1] University Chouaib Doukkali, El Jadida, Morocco
[2] University Chouaib Doukkali, El Jadida, Morocco

Keywords:
(1)Li-Yorke chaos
(2) Hypercyclicity
(3) C0-semigroups

Abstract

A strongly continuous semigroup (shortly C_0 -semigroup) (T_t)_{t \geq 0}on a Banach space X is said to be Li-Yorke chaotic if it admits an uncountable scrambled set. In this talk, we will review some results regarding Li-Yorke chaos for C_0 -semigroups. Also, we will introduce and study a generalization of this class of C_0 -semigroups, providing necessary and sufficient conditions for this new class. Additionally, we will explore the connections between this notion and other existing concepts in linear dynamics. At the end of the talk, we will present several examples to illustrate these ideas.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Threshold Dynamics of an Hiv Reactivation Model with Latent Infection, Macrophages, Logistic Growth, and Distributed Delay

Communication Info

Authors:
Hanane HMARRASS[1]
Redouane QESMI[2]

[1] *LMSM, Department of Mathematics, Sidi Mohamed Ben Abdellah University, Faculty of Science and Technology, Fez, Morocco*

[2] *LMSM, Department of Mathematics, Sidi Mohamed Ben Abdellah University, Higher school of Technology, Fez, Morocco*

Keywords:
(1) HIV
(2) logistic growth
(3) Distributed Delay
(4) Hopf Bifurcation.

Abstract

To better understand the within-host dynamics of viral infections, including HIV, we develop an age-structured model that captures interactions between the virus and two distinct cell populations. This model incorporates a latent reservoir in the second compartment, a loss term in the free virus equation, and a logistic growth term for healthy cells. Using the method of characteristics, we reduce the system to a set of differential equations with distributed delay. A comprehensive mathematical analysis is conducted, including stability and bifurcation analysis, to identify key factors influencing disease progression. We determine the basic reproduction number, which dictates whether the infection persists or is eradicated. Furthermore, we establish sufficient conditions for the local and global asymptotic stability of the disease-free equilibrium and identify bistability phenomena. By examining the endemic equilibrium through a fourth-order exponential polynomial characteristic equation, we detect Hopf bifurcations on both the forward and upper branch of the backward bifurcation. Finally, numerical simulations validate the theoretical findings.

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April 24-25-26, 2025 | Marrakech, Morocco

Dynamics of interval maps

Communication Info

Authors:
BOUMAAZA TOURIA
AMOUCH MOHAMED
BENCHIHEB OTMANE

Chouaib Doukkali University, Faculty of science El Jadida, Morocco.

Keywords:
(1) Recurrent
(2) R-mixing
(3) interval map

Abstract

An operator T acting on a metric compact space X is said to be recurrent if, for each nonempty open subset U of X, there exists n ∈ N such that $T^n(U) \cap U \neq \emptyset$. In this paper, we introduce and study the notion of recurrence of interval map. We investigate some properties of this class of operators and show the links between recurrence, R-mixing and weakly R-mixing of operators and interval maps.

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Applications of discrete moments in image watermarking

Communication Info

Authors:
Chaimae CHEKIRA[1]
Hakim EL FADILI [2]

[1] LIPI, USMBA, Fez, Morocco
[2] LIASSE, USMBA, Fez, Morocco

Keywords:
(1) Discrete moments
(2) Watermarking
(3) Reconstruction

Abstract

Discrete moments are an effective frequency features for describing the visual content of an image. They have thus been widely and successfully applied in various fields of technical research [1], as they offer a number of advantages, including high image representation capacity while minimizing computational complexity. In addition, they enable near-perfect reconstruction of the original image with low error and high robustness against noise. In particular, image moments are useful in watermarking applications [2], as they minimize image reconstruction error after data hiding in the moment domain while guaranteeing quality watermark extraction even in the presence of attacks. The following study presents the most known orthogonal moments in different coordinate spaces (cartesian and polar) and their application into image watermarking [3].

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April 24-25-26, 2025 | Marrakech, Morocco

On The Rank of a Subfamily of Elliptic Curves Extracted From $E(t)$: $y^2 = x^3 - (a + bt)x$

Communication Info

Authors:
KOUAKOU Kouassi Vincent
Université Nangui ABROGOUA, Côte d'Ivoire

Keywords:
(1) Ellliptic Curves
(2) Independence
(3) Rank
(4) Specialization
(5) Generators
(6) Birationally equivalent to

Abstract

We extract an infinity subfamily

$$E(k): y^2 = x^3 + (k^2 - 1)x$$

of elliptic curves from the curve

$$E(t): y^2 = x^3 - (a + bt)x\,.$$

Then, by imposing, successively, points on the obtained curves $E(k)$, we increase the rank. At the end, we show that its rank is at least 3 over $\mathbb{Q}(h)$.

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ICRAMCS 2025
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April 24-25-26, 2025 | Marrakech, Morocco

ON THE RESOLUTION OF THE LATTICE VECTOR PROBLEMS USING UNIMODULAR MATRICES

Communication Info

Authors:
Mohammed-Yasser EZ-ZAHER
Seddik ABDELALIM
Chaymae ED-DYB
Ilias ELMOUKI

Faculté des sciences Ain Chock, Université Hassan 2, Casablanca

Keywords:
(1) Lattice reduction
(2) Orthogonalization
(3) Gram-Schmidt Process
(4) QR decomposition
(5) LLL algorithm

Abstract

In this talk, we introduce a matrix scheme that uses a QR decomposition adjusted to the Gram-Schmidt orthogonalization process for the resolution of the lattice vector problems, using unimodular matrices.
This matrix procedure enables us to guarantee the quasi-orthogonality between the desired vectors under a new inequality and even establish an updated condition on the basis reduction with respect to its size.

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April 24-25-26, 2025 | Marrakech, Morocco

Uncertainty modelling of the nonlinear Black-Scholes equation and decision-making using fuzzy logic

Communication Info

Authors:
Amal Aarab[1]
Aicha Driouch[2]

[1] Hassan First University, Berrechid, Morocco
[2] Cadi Ayyad University, Marrakesh, Morocco

Keywords:
(1) Fuzzy logic
(2) Black-Scholes Equation
(3) Nonlinear PDE
(4) Decision-Making

Abstract

In the field of finance, particularly in option pricing, forecasting the value of underlying assets is challenging due to fluctuations in interest rates and volatility. To enhance prediction accuracy, a fuzzy-based approach [1] serves as a powerful tool for capturing the uncertainty inherent in financial markets. This study introduces a numerical method for pricing European options by employing a fuzzy-parameter partial differential equation [2]. We investigate the extended nonlinear Black-Scholes model proposed by Barles and Soner; studied numerically in [3,4] for the crisp case; enabling the computation of a range of European option prices. The fair price is determined using the center of gravity method [5], while the corresponding confidence level and confidence interval are obtained through an optimization process. These findings contribute to improved forecasting and decision-making in financial applications.

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Stochastic analysis of temporal tumor evolution with macrophage effects

Communication Info

Authors:
Abdelaziz BEN LAHBIB [1]
Lahcen AZRAR [1]
Ateq Ahmed AL-Ghamedi [2]

[1] *Research Center STIS, M2CS, Department of Applied Mathematics and Informatics, ENSAM, Mohammed V University, Rabat, Morocco.*

[2] Department of Statistics, Faculty of Science, King Abdulaziz University, Jeddah, Saudi Arabia

Keywords:
(1) Stochastic Differential Equations
(2) Extinction and Persistence
(3) Tumor-macrophage

Abstract

This paper investigates the behavior dynamic of tumors with macrophage interaction. Stochastic analysis is elaborated under the environment noise in order to explore the impact of random fluctuations on the dynamics of the model. The deterministic analysis is also briefly done including stable and unstable limit cycles, period-doubling bifurcation under certain parameter conditions. Theoretical theory based on Lyapunov analysis method is elaborated to prove the existence of a unique positive solution and to determine sufficient condition for the persistence and extinction of tumor cells. Additionally, numerical simulations are elaborated to validate the theorical findings and to observe the impact of noise in the Hopf bifurcation.

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April 24-25-26, 2025 | Marrakech, Morocco

Évaluation du système Ramed dans la ville d'Agadir : Modélisation par équations structurelles

Communication Info

Authors:

Amine RADAH[1]
Mohamed ELHIA[2]

[1] FSJES Ain Sebaa, Université Hassan II, Casablanca, Maroc
[2] FSJES Ain Sebaa, Université Hassan II, Casablanca, Maroc

Keywords:

(1) Modèle d'équations structurelles (SEM)
(2) Système Ramed
(3) Sécurité sociale

Abstract

Depuis 2021, le Maroc a entrepris une réforme historique en généralisant la couverture médicale pour l'ensemble de sa population, s'inscrivant dans un projet plus large de renforcement de la sécurité sociale. Cette initiative vise à garantir un accès universel aux soins de santé et marque une étape décisive dans les politiques sociales du pays, dans la continuité des efforts déjà engagés avec la mise en place du Régime d'Assistance Médicale (RAMED) en 2008. Ce programme, conçu pour offrir une couverture médicale aux citoyens économiquement démunis, est fondé sur des principes de solidarité, d'équité et d'inclusivité.
Malgré l'importance du RAMED dans l'élargissement de l'accès aux soins, le programme a rapidement montré ses limites. Les bénéficiaires ont dû faire face à des défis persistants, notamment des infrastructures médicales insuffisantes, des processus administratifs complexes, et des insuffisances dans la qualité des services. Ces problématiques soulèvent la question de l'adéquation du RAMED avec les besoins réels des populations cibles et appellent à une réflexion sur les améliorations nécessaires pour garantir l'efficacité de la couverture généralisée.
Cet article propose une évaluation novatrice du niveau de satisfaction des bénéficiaires du système RAMED dans la ville d'Agadir, une zone à forte densité de population et à diversité socio-économique marquée. En utilisant une modélisation par équations structurelles (SEM), nous identifions les facteurs clés qui influencent la perception de la population vis-à-vis de ce système. Cette recherche fournit des éléments empiriques précieux pour optimiser les politiques de santé et contribuer à la réussite du projet de généralisation de la couverture médicale, tout en consolidant la sécurité sociale pour l'ensemble de la population.

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ICRAMCS 2025

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April 24-25-26, 2025 | Marrakech, Morocco

Adaptive Sampling-Enhanced PINNs for Improved Thermal Modeling in Additive Manufacturing

Communication Info

Authors:
Idriss BARBARA [1]
Tawfik MASROUR [1,2]
Mohammed HADDA [1]

1 ENSAM-Meknes, Moulay Ismail University of Meknes, Morocco.
2 University of Quebec at Rimouski, Rimouski, Canada.

Keywords:
(1) Physics-Informed Neural Networks (PINN)
(2) Partial Differential Equations
(3) Adaptive sampling
(4) Thermal modeling

Abstract

Accurate thermal modeling is critical for ensuring the quality and structural integrity of additive manufacturing processes. While Physics-Informed Neural Networks (PINNs) [1] have emerged as a powerful tool for solving partial differential equations (PDEs) such as the heat equation, their performance is often hindered by the limitations of uniform or random sampling strategies [2]. I am working on introducing an adaptive sampling technique designed to boost the performance of PINN when addressing the heat equation in thermal modeling of additive manufacturing processes. Unlike traditional approaches that rely on uniform or random sampling, the method I present strategically focuses on regions with higher error estimates. The result is a more efficient training process and enhanced accuracy in temperature prediction. In this communication, I will outline the adaptive sampling strategy, share insights from its application, and discuss its potential impact on real-time thermal control and process optimization in additive manufacturing [3].

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Stabilization with decay estimate of distributed parameter second order systems by bilinear control damping

Communication Info

Authors:
Khalil EL KAZOUI[1]
Hassan Ezzaki[2]

[1]Ibn zohr university, Agadir Morocco

Keywords:
(1) Distributed Parameter Systems
(2) Stabilization
(3) Decay estimate

Abstract

This paper deals with stabilization and energy decay rates of second-order bilinear systems in a Hilbert space. Namely, we examine a class of bounded feedback control to investigate weak, strong, and exponential stabilization. Firstly, we discuss the well-posedness of mild solutions of the considered systems using the cosine family. Secondly, we provide some sufficient conditions to ensure feedback stabilization for the bilinear systems which are presented in terms of observation estimates. Moreover, we derive an explicit decay estimate of the energy in the case of strong stabilization. Finally, we offer examples with numerical simulations to demonstrate the applicability of our theoretical results.

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Anticycling in Linear Problems with Big Data

Communication Info

Authors:
Asmaa AIT BRIK[1]
Seddik Abdelalim [2]
Ilias Elmouki [3]
Tarik Yassir [4]

[1,2,3,4] Faculty of Sciences Ain Chock, University Hassan II of Casablanca, Morocco

Keywords:
(1)Cycling problem
(2)Linear program
(3)Simplex method
(4)Anti-cycling
(5)Lexicography
(6)Bland's rule

Abstract

In this talk, we aim to discuss the cycling problem often met in the resolution of linear programs. In fact, if we take just the example of the simplex method, we could find ourselves in front of either an open loop or an infinite number of iterations due to the absence of non-degenerate bases. In order to avoid such issues in computation, we could refer for instance to two anticycling methods, namely lexicography and Bland's rule, and then we look for more advanced procedures that may be beneficial even for big data.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Numerical Solution of Time-Dependent Heat Diffusion Problems Using an Enriched Finite Element Method

Communication Info

Authors:
Ibrahim BASSIR[1]
Boujemâa ACHCHAB [1]
Mohammed SEAID [2]

[1] National School of Applied Sciences, Berrechid, Morocco
[2] School of Engineering and Computing Sciences, University of Durham, Durham, UK

Keywords:
(1) Finite Element Method (FEM)
(2) Partition of Unity Method
(3) Time-Dependent Diffusion
(4) Generalized Finite Element Method

Abstract

We present a generalized finite element method, enriched by a partition of unity, for time-dependent diffusion problems.
This approach, which extends the traditional finite element method, incorporates multiple exponential functions to capture both spatial and temporal diffusion decay within the finite element space.
Compared to the conventional FEM, it is simpler, more efficient, and provides greater accuracy.
Numerical results confirm the method's efficiency and accuracy for transient diffusion equations.

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Dynamics of a Two-Strain Epidemic Model in Complex network with Nonlinear Incidence rate and time delay

Communication Info

Authors:
Hakim HABRI
Amine El KOUFI [2]
Brahim FAHID [3]

[1] Ibn Tofail university, Kenitra, Morocco
[2] Ibn Tofail university, Kenitra, Morocco
[3] Ibn Tofail university, Kenitra, Morocco

Keywords:
(1) Complex networks
(2) Nonlinear incidence
(3) Global stability

Abstract

Motivated by [1, 2, 3], we proposed a new two-strain SIR epidemic model in heterogeneous complex networks with nonlinear incidence rate and two time delays. The model consists of four equilibrium points: the disease-free equilibrium, the strain 1 endemic equilibrium, the strain 2 endemic equilibrium and the both strains endemic equilibrium. We analyzed the global stability of these equilibrium points using suitable Lyapunov functions and LaSalle's invariance principle [4, 5]. Two basic reproduction numbers are found, R_1 *and* R_2. If $R_1 < 1$ *and* $R_2 < 1$, the disease die out. However, if either $R_1 > 1$ *or* $R_2 > 1$, the corresponding strain will persist, which leads to endemic state.

Finally, we performed numerical simulations on scale-free networks to validate our theoretical results.

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Developing A Supervised Learning-Based Web Application For Cancer Tumor Analysis

Communication Info

Authors:
Nouhaila HOUSSA [1]
Seddik ABDELALIM[2]
Chaymae ED-DYB[3]
Ilyas ELMOUKI[4]

[1 2,3,4]LMFA Faculty of Sciences Ain Chock, University Hassan II of Casablanca, Morocco

Keywords:
(1) Breast cancer
(2) Flask framework
(3) React
(4) Machine Learning
(5) Supervised classification
(6) logistic regression

Abstract

One of the most prevalent cancers in women worldwide is breast cancer, and lowering mortality rates depends on early identification. Conventional diagnostic techniques mostly depend on clinical expertise, where errors in judgment or delays can significantly impact outcomes.The emergence of web technologies, machine learning, and contemporary frameworks such as Flask and React, present promising opportunities to assist with clinical decision-making. This project investigates the deployment of a Flask-React web application that uses cutting-edge machine learning algorithms to classify breast cancer as benign or malignant. In order to minimize pre-processing and guarantee robust performance, our classification introduces a logistic regression and trains it on clinical datasets. The Flask backend handles data processing and model inference, while the React frontend provides a dynamic and intuitive user interface, enabling healthcare professionals to input patient data and visualize classification results seamlessly.

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Analysis of Anisotropic Interpolation Error in Sobolev Spaces with Applications to Mesh Optimization

Communication Info

Authors:
Mohamed elhassan BASSIR[1]
Boujemâa ACHCHAB [1]
Abdellatif AGOUZAL [2]

[1] National School of Applied Sciences, Berrechid, Morocco
[2] Camille Jordan Institute, Lyon, France

Keywords:
(1) Anisotropic interpolation
(2) Mesh adaptation
(3) Finite element

Abstract

We present results on anisotropic interpolation error for functions in Sobolev spaces, establishing explicit upper and lower bounds. The study focuses on sequences of conformal, anisotropic meshes in dimensions d=2 and d=3, using a metric based on the Hessian matrix. This metric controls the interpolation error by incorporating measurements of the volume and perimeter of the simplices. The goal is to guide the construction of quasi-optimal meshes that enhance both accuracy and computational efficiency. These results have applications in a posteriori error estimation and mesh adaptation strategies for solving partial differential equations using the finite element method.

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Optimizing over the Weakly Efficient set of a Multi-Objective Optimization Problem

Communication Info

Authors:
Zakia ANKHILI[1]
Hanane HIMMI[1]
Mohamed Oumoun[1]

[1] *National School of Applied Sciences-Marrakesh, Cadi Ayyad University, Morocco*

Keywords:
(1) multi-objective optimization
(2) linear programming
(3) weakly efficient set
(4) penalty method

Abstract

Optimizing over the efficient set or the weakly efficient set of a multi-objective problem remains a challenging issue. The main reason is that the feasible set of our optimization problem is implicitly defined. Moreover, the efficient solution set is neither closed nor convex, even when all functions are linear. Identifying an efficient solution can therefore be difficult. To address this challenge, several advanced approaches have been proposed to find efficient solutions for nonlinear multi-objective optimization problems [1-4].

In this paper, we focus on studying a nonlinear multi-objective optimization problem over the weakly efficient set of a linear multi-objective optimization problem. We propose a penalty method inspired by [5,6] to characterize the weakly efficient set and prove that our problem can be reduced to solving a sequence of multi-objective optimization problems with linear constraints. Finally, we present an algorithm to solve this problem.

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April 24-25-26, 2025 | Marrakech, Morocco

Stability and Numerical Results for Double Wall Carbon Nanotubes Modeled as Shear Beams

Communication Info

Authors:
My Driss Aouragh[1]
El Alami Bouchra [2]
El Baz Mustapha[2]
M'hamed Segaoui [2,3]
Abdelaziz Soufyane [4]

[1] EST, Moulay Ismail University of Meknes, Morocco
[2] FST Errachidia, Moulay Ismail University of Meknes, Morocco
[3] ENSIASD of Taroudant, Ibn Zohr University, Morocco
[4] College of Sciences, University of Sharjah, UAE

Keywords:
(1) Shear beam
(2) Double Wall Carbon Nanotubes
(3) Stabilization

Abstract

We consider the one-dimensional equation for the double wall carbon nanotubes modeled by a coupled shear beam system with a distributed damping system. By applying the theory of semigroups of linear operators, we prove the well-posedness of the problem. We also demonstrate the exponential stabilization of the total energy of the system, with partial damping, without assuming equal wave velocities. Additionally, we analyze the fully discrete problem using the finite element method. We present the construction of numerical energy and simulations that demonstrate our theoretical exponential decay results.
.

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Mathematical Model of Tumor Spheroid with Real-Time Cell Cycle and Physics-Informed

Communication Info

Authors:
Hamza AGUEDJIG[1]
Sidi Mohamed DOUIRI [1]
Imad EL HARRAKI[2]
Mohammed EL HAMMANI[1]

[1] FSR, Rabat, Morocco
[2] ENSMR, Rabat, Morocco

Keywords:
(1) Modeling
(2) Tumor
(3) Neural network
(4) Cell Cycle

Abstract

This work is part of the ongoing advancements in mathematical modeling of tumor growth using mathematical equations. What sets this study apart from previous works is its integrative approach, which aims to establish a connection between the theoretical foundations inherited from past research and contemporary technological and scientific advancements. First, our study provides a general theoretical framework that allows a comprehensive and in-depth understanding of the mathematical modeling of tumor growth. Next, we propose a practical mathematical model to describe the proliferation of tumor spheroids using partial differential equations, leveraging their fluorescence during the cell cycle through the Fluorescence Ubiquitination-based Cell Cycle Indicator technology. This approach differs from previous studies that relied primarily on medical imaging. Finally, this research introduces an innovative alternative for solving our complex model using recent advances in artificial intelligence. Specifically, the solutions to the proposed model were obtained using Physics-Informed Neural Networks, an approach that has produced promising results and suggests a novel perspective for this field.

In general, this work bridges the gap between traditional concepts and modern tools, paving the way for new methodologies in the mathematical modeling of cancerous tumors and offering an alternative perspective to the current state of the art.

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Variable exponent Kirchhoff-type problems involving singular and non-local terms on Riemannian manifolds

Communication Info

Authors:
Hind Bouaam[1]
Mohamed El Ouaarabi[2]
Said Melliani[1]

[1] Applied Mathematics and Scientific Computing Laboratory, Faculty of Science and Technics, Sultan Moulay Slimane University, Beni Mellal, BP 523, 23000, Morocco.

[2] Fundamental and Applied Mathematics Laboratory, Faculty of Sciences Aïn Chock, Hassan II University, Casablanca, BP 5366, 20100, Morocco.

Keywords:
(1) Nonlocal terms
(2) singular term
(3 Nehari manifold method
(4) fibering maps

Abstract

In this paper, we investigate a bi-nonlocal elliptic problem of the $\gamma(m)$-Kirchhoff type, incorporating a singular term, within the framework of complete non-compact Riemannian manifolds. Our primary goal is to establish the existence of at least two non-trivial weak solutions, provided that a certain parameter remains sufficiently small.
To achieve this, we employ the Nehari manifold method combined with the concept of fibering maps.

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Dynamic analysis of fractional order SEQIR epidemic model with nonlinear incidence rate and application to COVID-19 pandemic in Morocco and Italy

Communication Info

Authors:
Fatima CHERKAOUI[1]
Khalid HILAL[1]
Abdelaziz QAFFOU [1]

[1] *Laboratory LMACS, FST of Beni-Mellal, Sultan Moulay Slimane University, Morocco*

Keywords:
(1) Caputo derivative
(2) Fractional differential equations
(3) COVID-19

Abstract

In December 2019, a new pandemic was detected in Wuhan, China, it is a member of the coronavirus family and has quickly spread to every nation on Earth. In this paper, we study the fractional SEQIR epidemic model with saturated incidence rate using Caputo fractional derivative describing the dynamics of COVID-19. The existence, uniqueness, positivity and boundedness of the solution are established. We show the existence of the equilibrium points (disease free and endemic equilibrium) and we investigate their local and global stability. By using MATLAB software, we provide a numerical simulation to illustrate our theoretical results and we predict the dynamics of COVID-19 in Italy and Morocco built on real-world data.

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A bi-nonlocal fourth-order elliptic problem

Communication Info

Authors:
Aicha OUBAHA[1]
Mohamed El OUAARABI [1, 2]
Abderrahmane RAJI[1]

[1] Laboratory LMACS, Faculty of Science and Technology of Beni Mellal, Sultan Moulay Slimane University, Beni Mellal, BP 523, 23000, Morocco
[2] Fundamental and Applied Mathematics Laboratory, Faculty of Sciences Aïn Chock, Hassan II University, Casablanca BP 5366, 20100, Morocco

Keywords:
(1) Fourth-order elliptic equations
(2) Kirchhoff-type problems
(3) Variational methods

Abstract

This paper examines a class of p(x)-Kirchhoff equations featuring bi-nonlocal terms. By applying variational methods, particularly the Mountain Pass Theorem and Ekeland's variational principle, we demonstrate the existence and multiplicity of nontrivial weak solutions for a fourth-order bi-nonlocal p(x)-Kirchhoff-type problem. This bi-nonlocal problem, involving operators with variable exponents, was first investigated by Corrêa and Augusto Cézar [2, 3].
The significance of electrorheological fluids in physical and biological phenomena has generated substantial interest in Kirchhoff-type systems. Discovered by Willis Winslow in 1949 [5], these distinctive fluids possess the remarkable ability to rapidly alter their mechanical properties when subjected to electromagnetic fields. The problem studied relates to a stationary form of the Kirchhoff equation, originally introduced by Kirchhoff in 1883 (see [4]). The idea of this article was initiated by Nguyen Thanh Chung who studied a class of fourth-order elliptic equations (see [1]).

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Output stabilization of infinite dimensional bilinear systems with delayed observation

Communication Info

Authors:
Omar JARIR[1]
Hassan EZZAKI[1]
Khalil El KAZOUI[1]

[1] *LAMA Laboratory, Department of Mathematics, Faculty of Sciences, Ibn zohr University, Agadir, Morocco*

Keywords:
(1) Infinite dimensional system
(2) delay bilinear systems
(3) output stabilization

Abstract

In this paper we are concerned with output stabilization of infinite dimensional bilinear systems with delayed observation. We first establish the well-posedness of such systems, and then we provide sufficient conditions for strong and weak output stabilization. Through the analysis of the wave equation and beam equation, we demonstrate the applicability and effectiveness of our proposed methods.

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Mesh-Free Approaches for Solving the Advection-Dispersion Equation in Unsaturated Flow Systems

Communication Info

Authors:
Radoine Belkanoufi[1]
Ahmed Taik [1]
Abdelaziz Beljadid[2]

[1]Faculty of Sciences and Techniques Mohammedia, Hassan II University, Casablanca, Morocco.
[2] University of Ottawa, Canada.

Keywords:
(1) Meshless Methods
(2) Advection-Dispersion Equation
(3) Variable Saturation

Abstract

In this presentation, we discuss the application of meshless techniques[1] for the numerical modeling of the Advection-Dispersion Equation (ADE) in variably saturated flow conditions [2]. We demonstrate the difficulties and challenges encountered when applying these methods to problems with varying saturation levels in porous media[3]. Through numerical simulations, we illustrate the key computational issues and limitations of the meshless approach in modeling transport phenomena under different flow conditions. The results provide important insights for environmental and hydrogeological modeling applications.

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Global stability analysis, stabilization and synchronization of an SEIR epidemic model

Communication Info

Authors:
Farid MORTAJI1
Hassan LAARABI1
Mostafa RACHIK1
Abdelhadi ABTA2

1LAMS, Hassan II University of Casablanca, Casablanca, Morocco
2LAMS, Cadi Ayad University, Safi, Morocco

Keywords:
SEIR epidemic model; nonlinear dynamics; Chaos control; backstepping control; Lyapunov function; global stability

Abstract

This paper examines an SEIR epidemic model with recruitment regulated by a constant function. The SEIR model categorizes the population into four groups (Susceptible, Exposed, Infectious, and Removed) and uses differential equations to analyze the dynamics of infectious diseases. The study determines the basic reproduction number R0 and shows that if R_0<1, the disease-free equilibrium is stable, whereas if R_0>1, a stable endemic equilibrium emerges. Global stability analysis is conducted using Lyapunov functions. Then, the backstepping method is applied to design a control law for eradicating the disease and synchronizing two SEIR systems. Finally, numerical simulations illustrate the theoretical findings.

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ICRAMCS 2025

THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

April 24-25-26, 2025 | Marrakech, Morocco

Analytical investigation of Fractal Fractional Differential Equations with Nonlocal Conditions

Communication Info

Authors:
Najat CHEFNAJ[1]
Khalid Hilal [1]
Ahmed Kajouni [1]

[1]LMACS, Sultan Moulay Slimane University, Faculty of Sciences and Technics, Beni Mellal, Morocco

Keywords:
(1) Existence theory
(2) fractal fractional derivative
(3) Existence theory

Abstract

Fractional calculus refers to integration or differentiation of any order. The field has a history as old as calculus itself, which did not attract enough attention for a long time. In the past decades, the theory of fractional differential equations has become an important area of investigation because of its wide applicability in many branches of physics, economics and technical sciences.

This study explores the existence of solutions for a boundary value problem involving fractal-fractional ABC derivatives. Utilizing Darbo's and Mönch fixed-point theorems [2] in conjunction with measures 13 of noncompactness [1], we derive our main results. Additionally, a practical example is presented to 14 demonstrate the applicability of our theoretical findings.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Asymptotics of Yule's nonsense correlation for Ornstein-Uhlenbeck paths: The correlated case.

Communication Info

Authors:
Soukaina DOUISSI[1]
Frederi Viens [2]
Philip Ernst[3]

[1]Ecole Nationale des Sciences Appliquées, Marrakech, Morocco
[2] Rice University, Houston, Texas, United States.
[3] Imperial College London, London, United Kingdom.

Keywords:
(1)Malliavin Calculus
(2) Yule's Statistic
(3) Rates of Convergences

Abstract

In this paper we study the asymptotics of the the so-called Yule's nonsense correlation for two Orstein-Uhlenbeck Processes (X1,X2) that are assumed to be correlated and observed continuously over a time interval [0,T].
Using Malliavin Calculus and other tools from the analysis on Wiener spaces, we were able to prove that under the hypothesis of correlation, Yule's statistic is asymptotically Gaussian and we found the rate of this convergence in law which is of the order of $1/T^{1/2}$ for the Wasserstein's metric.
Several applications to statistical inference problems are proposed including in particular a test of hypothesis that is proved to be asymptotically powerful.
This paper extends the line of research of references [1], [2], [3] and [4].

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

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Existence and uniqueness of solutions for a p(x)-Schrödinger-type equation under Fourier boundary conditions

Communication Info

Authors:
Hayat BENKHALOU[1]
Ayman EL JANATHI[2]

[1]Abdelmalek Essaâdi University, Tétouan, Morocco
[2] [1]Abdelmalek Essaâdi University, Tétouan, Morocco

Keywords:
(1) Existence and uniqueness
(2) Sobolev spaces with variable exponent
(3) Fourier boundary conditions
(4) Renormalized solutions

Abstract

In this paper we prove the existence and uniqueness of renormalized solutions to the nonlinear elliptic problem defined as follows

$$\begin{cases} -div(a(x,|\nabla u|)\nabla u) + |u|^{p(x)-2}u = f(x) - div(\varphi(x,u)) \ \ in \\ ku + \big(a(x,|\nabla u|)\nabla u - \varphi(x,u)\big)\eta = \ g \ \ in\ \partial\Omega \end{cases}$$

in the setting of Sobolev spaces with variable exponents, where Ω is a bounded open subset in $\mathrm{IR}^N (N \geq 3)$ with Lipschitz boundary. η is the outer unit normal vector on $\partial\Omega$ and k is a strictly positive real constant. The nonlinear term $\varphi(x,u)$ verifies some growth condition, the right hand-side f belongs to $L^1(\Omega)$ and $g \in L^1(\partial\Omega)$.

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ICRAMCS 2025

THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

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A coupled continuous dynamical system for nonconvex optimization.

Communication Info

Authors:
Aïcha BALHAG [1]
Abderrahim JOURANI [2]

[1] *Laboratoire de Mathématique, Modélisation et Systèmes Automatiques*
Ecole Normale Supérieure de Marrakech
Université Cadi Ayyad.

[2] *Institut de Mathématiques de Bourgogne .UMR 5584 CNRS*
Université Bourgogne
F-21000 Dijon, France

Keywords:
(1) Kurdyka-Łojasiewicz property.
(2) Non convex minimization problem.
(3) Desingularization function.

Abstract

In this paper, we deal with a coupled continuous dynamical system associated with an unconstrained (not necessarily convex) minimization problem. Assuming that a regularization of the objective function satisfies the Kurdyka-Łojasiewicz property, we show that the trajectory converges towards a critical point of the objective function. We also study the convergence rate in a manner dependent on a one-dimensional worst-case gradient system as used by Bégout–Bolte–Jendoubi in [1] for quasi-gradient systems, it yields convergence results related to the geometry of the objective function via the desingularization function. This study is a generalization of many previous results. Moreover, when the function is twice differentiable, our system is equivalent to a second-order in time differential equation combining hessian-driven damping with time rescaling parameters. Our results exhibit novelty by offering study of asymptotic convergence in general case of these parameters in non-convex function. it paves the way for the investigation of a new family of inertial algorithms for non-convex optimization with a good asymptotic convergence properties.

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Segmentation of Transition Matrices Using Eigenvalues

Communication Info

Authors:
Chaimaa RIAHI[1]
Youssef EL FOUTAEYNI [2]

[1] University Hassan 2, Casablanca, Morocco
[2] University Cadi Ayyad, Marrakech, Morocco

Keywords:
(1) Profit maximization
(2) Markov chain
(3) Eigenvalues
(4)Matrix Decomposition

Abstract

Understanding state dynamics in Markov processes is essential for many real-world applications. In this work, we introduce a spectral-based approach to segment transition matrices, revealing hidden structures in stochastic systems. By leveraging eigenvalues [4] and eigenvectors, we identify meaningful segments that maintain key transition properties while uncovering hidden patterns. Our method extends the Markov chain-based temperature estimation model by **Riahi et al.** [1], incorporating spectral properties [5] to enhance segmentation techniques. Additionally, our approach aligns with bioeconomic equilibrium modeling principles discussed in **Riahi et al.** [2], reinforcing its relevance to complex dynamic systems. This framework is particularly useful for applications in climate modeling [3], financial time series analysis, and other dynamic systems. We discuss theoretical justifications, computational feasibility, and initial experimental results, which confirm the effectiveness of spectral segmentation in uncovering hidden structures within Markov chains.

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ICRAMCS 2025

THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Mathematical Modeling of Ecosystem Interactions

Communication Info

Authors:
Fatima-Ezzahra AZZOUGAGH[1]
Imane AGMOUR[1]
Youssef EL FOUTAYENI[2]

[1]Cadi Ayyad University, Marrakech, Morocco
[3]University of Hassan II, Casablanca, Morocco

Keywords:
(1) Mathematical Modeling
(2) Ecosystem Interactions
(3) Climate Change

Abstract

The study of bioeconomic models is a crucial tool for understanding the complex relationship between natural resources and their economic exploitation, as well as the impact of human activities on the environment, in order to determine a sustainable management strategy.

In this context, we can cite [1, 2] which provides us a bioeconomic modeling of the exploitation of marine species, in addition to [3, 4], where the authors showed the influence of pollution on marine ecosystems. We also mention the effect of the wind which is the subject of the article [5]. In this presentation, we seek to synthesize current research and paves the way for future researches aimed at integrating the stochastic study into future work.

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ICRAMCS 2025

THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

April 24-25-26, 2025 | Marrakech, Morocco

Numerical Simulation of the Spatial Solow Model

Communication Info

Authors:
Abdellah EL AABBADI [1]
Hicham EL BOUJAOUI [1]
Abderrazak BOUFALA [2]

[1] ENSA UIZ, Agadir, Morocco
[2] College of Law and Economics UIZ, Agadir, Morocco

Keywords:
(1) Spatial economics
(2) Deep learning
(3) Solow Growth Model
(4) Partial Differential Equations (PDEs)

Abstract

This research presents a spatial-temporal [1] extension of the Solow growth model [3] , operating in continuous time and space domains. We establish formal mathematical proof regarding the existence of a solution to this spatially-distributed economic growth framework and demonstrate its asymptotic convergence properties toward a stationary equilibrium. The concluding section of the manuscript offers numerical simulations across diverse parameterizations, providing empirical validation of the theoretical convergence results and illustrating the spatial-dynamic properties of the model under various initial conditions.

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ICRAMCS 2025

THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Conservation Laws and Symmetry Reductions of the Time-fractional modified Hunter–Saxton Equation

Communication Info

Authors:
Nisrine Maarouf [1]

[1] Sultan Moulay Slimane university, Béni Mellal, Morocco

Keywords:
(1)Lie Symmetry analysis
(2) Hunter Saxton equation
(3) Conservation Laws

Abstract

We analyze the Time fractional modified Hunter-Saxton equation through the lens of Lie group theory. The Lie point symmetries of the equation are identified, and the corresponding Lie algebra is employed to construct an optimal system of one-dimensional subalgebras. These subalgebras facilitate the reduction of the equation to nonlinear third-order ordinary differential equations. By solving these reduced equations, we obtain exact traveling wave solutions that are invariant under the symmetry transformations. Additionally, we derive a family of nonlocal conservation laws by transforming the dependent variable of the equation.

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ICRAMCS 2025
THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Examining the Impact of Fuel Prices and Inflation on High-Speed Rail Demand in Morocco: A Predictive Modeling Study

Communication Info

Authors:
Sanae BAQQASS [1,4]
Sokaina EL KHAMLICHI [2,3]
Imade BENSAOUD [1]
Abdelhak ZOGLAT [1]
Amine AMAR [4]

[1] *Mohammed V University, Rabat, Morocco.*
[2] *Ibn Zohr University, Morocco.*
[3] *School of Information Sciences, Rabat, Morocco.*
[4] *School of Science and Engineering (SSE), Ifrane, Morocco.*

Keywords:
(1) HSR Demand
(2) Stochastic Modeling
(3) Machine Learning
(3) Grid Search
(3) Predictive Modeling

Abstract

This study aims to model and forecast High-Speed Rail (HSR) demand in Morocco, focusing on understanding the relationship between demand, fuel prices, and inflation. The analysis uses time series data from December 2018 to January 2023, which includes monthly observations of HSR demand, fuel basket prices, and inflation rates. The primary objective is to examine the elasticity of HSR demand with respect to fuel prices and inflation and to develop predictive models for future demand.

Various machine learning models, including Support Vector Regression (SVR), Random Forest, XGBoost, and Multilayer Perceptron (MLP), are employed to forecast HSR demand. The dataset is preprocessed with time series transformations, and the data is split into training and testing sets for model evaluation. Hyperparameter tuning is performed using grid search to optimize model performance. The results of this study will contribute to better understanding the factors influencing HSR

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ICRAMCS 2025
THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Integrating Numerical Methods and Neural Networks for Solving Shallow Water Equations

Communication Info

Authors:
Ismail Oubarka[1,2]
Fayssal Benkhaldoun [2]
Imad Elmahi[1,3]
Eric Deleersnijder [4]

[1] College of Computing, Mohammed VI Polytechnic University, Lot 660, Ben Guerir, 43150, Morocco
[2] Sorbonne Paris Nord University, LAGA,7539, Villetaneuse, 1348, France
[3] ENSAO, LMCS, Mohammed I University, B.P. 669, Oujda, 60000, Morocco
[4] Université Catholique de Louvain, IMMC and ELI, B-1348, Louvain-la-Neuve, 1348, Belgium

Keywords:
(1) SWE
(2) Neural Networks
(3) FVM
(4) Deep Learning

Abstract

This research studies the integration of numerical methods and neural networks to solve and predict solutions for shallow water equations (SWE). Using various numerical schemes, we generate high-fidelity data that captures the dynamic behavior of shallow water systems. This data serves as the foundation for training a deep neural network to approximate SWE solutions by learning underlying patterns and predicting future states. Our approach involves generating spatial and temporal training data, training the neural network, and validating its predictions against numerical solutions. The effectiveness of the model is assessed through error calculations and comparative visualizations, demonstrating its ability to capture essential shallow water dynamics. The results highlight the potential of neural networks as powerful tools for approximating complex physical phenomena, offering a promising alternative to traditional numerical methods.

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ICRAMCS 2025
THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Stability Analysis of a Reaction-diffusion Fractional-Order SEIR Model with a Saturated Incidence Rate and vaccination

Communication

Authors:
Chouaib Bounkaicha[1]
Karam Allali[1]

[1] Laboratory MCSA, FST Mohammedia, University Hassan II, Mohammedia, Morocco.

Keywords:
(1) Global stability
(2) fractional derivative
(3) epidemic mode
(4) saturated incidence function
(5) reaction-diffusion system

Abstract

In this work, we present and analyze a reaction-diffusion SEIR model with a time fractional order derivative. The model presents the transmission of the infectious diseases among four compartments (susceptible, exposed, infected and recovered) using fractional-order differential equations (FDE), taking into consideration spatial diffusion in each compartment. To represent the non-linear force of infection, a saturated incidence function was chosen. Our initial approach involves proving the validity of the proposed model by demonstrating existence, uniqueness and boundedness of solutions. Throughout our study, we will examine the basic reproduction number R_0. Next, the global stability of both equilibria was considered using the Lyapunov criterion. Finally, the numerical simulations were conducted to validate the theoretical findings and highlight the impact of vaccination on reducing the severity of infection, as well as the impact of the fractional derivative order on equilibrium stability. It has been demonstrated that the fractional derivative order and has no impact on the stability of the equilibria, but it has a big effect on the rapidity of the convergence toward the steady state. In addition, it was observed that when the diffusion parameters are increased, the pick of infected and exposed individuals also gets maximized.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

April 24-25-26, 2025 | Marrakech, Morocco

Optimization Algorithms for Real-World Challenges: A Comparative Analysis of CG, BFGS, and L-BFGS

Communication Info

Authors:

Mohamed Ziouane[1]
Mourad Nachaoui [2]
Amine Laghrib [3]
Abdeljalil Nachaoui [4]

[1, 2] *EMI faculty of sciences and techniques, Sultan Moulay Slimane University, Beni Mellal, Morocco*

[3] *LIPIM, ENSA Khouribga, Sultan Moulay Slimane University, Khouribga, Morocco*

[4] *Jean Leray Mathematics Laboratory UMR6626 CNRS, Nantes University 2, Nantes, France*

Abstract

Optimization algorithms are critical tools in various scientific, engineering, and economic applications. This work focuses on numerical optimization techniques, with particular attention to the efficiency and performance of three widely used methods: Conjugate Gradient (CG), Broyden-Fletcher-Goldfarb-Shanno (BFGS), and Limited-memory BFGS (L-BFGS). These algorithms are well-established in optimization theory and are applied to a variety of problems, particularly those arising from inverse problems or ill-conditioned systems. Inverse problems, often encountered in fields such as signal processing, image reconstruction, and parameter estimation, are characterized by the difficulty of deriving input parameters from observed outputs. This typically leads to optimization tasks involving noisy, incomplete, or unreliable data. Additionally, ill-conditioned problems are those where small perturbations in the input data can lead to large variations in the output, requiring specialized algorithms to ensure numerical stability and convergence.

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ICRAMCS 2025

THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

April 24-25-26, 2025 | Marrakech, Morocco

Hybrid MLP-XGBoost Model for Bitcoin Price Prediction

Communication Info

Authors:
Hanae El fahfouhi[1]
Zakariae En-Naimani[2]
Khalid Haddouch[1]

[1] Laboratory of Applied Sciences and Emerging Technologies, Sidi Mohamed Ben Abdellah University, Fez, Morocco.
[2] Laboratory Computer Science, Artificial Intelligence and Cyber Security (2IACS), University of Hassan II Casablanca, Mohammedia, Morocco.

Keywords:
(1) Time series Prediction
(2) Multi-Layer Perceptron
(3) XGBoost

Abstract

This paper addresses the challenges posed by Bitcoin price volatility by proposing a novel hybrid modeling approach that combines Multi-Layer Perceptron (MLP) and XGBoost. Given the highly dynamic nature of Bitcoin's daily closing prices [1], we preprocess historical data and systematically evaluate our model against standard implementations of MLP, Long Short-Term Memory (LSTM), and Recurrent Neural Network (RNN). Our approach integrates the strengths of deep learning and ensemble learning: the MLP model effectively captures linear dependencies through its layered structure [2], while XGBoost, a powerful gradient boosting framework, excels in identifying intricate nonlinear patterns [3],[4]. The hybridization of these models results in superior predictive accuracy, measured by Mean Absolute Error (MAE) and Root Mean Squared Error (RMSE). Our findings highlight the effectiveness of model hybridization in financial forecasting and demonstrating improved forecasting accuracy for daily Bitcoin prices.

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EEFQIO: A hybrid meta-heuristic optimization algorithm for global optimization

Communication Info

Authors:
Imad EL KARKRI[1]
Abdelghni LAKEHAL[2]

[1] Polydisciplinary Faculty LaracheAbdelmalek Essaadi University, MAE2D, Larache, 92000, Morocco

[2] Polydisciplinary Faculty LaracheAbdelmalek Essaadi University, MAE2D, Larache, 92000, Morocco

Keywords:
(1) Optimization
(2) Metaheuristics
(3) Swarm intelligence

Abstract

Electric Eel Foraging Optimization (EEFO) [1] is a novel meta-heuristic algorithm inspired by the group foraging behaviors of electric eels. While EEFO exhibits strong global search ability, its slow convergence limits practical use. Quadratic Interpolation Optimization (QIO) [2], based on the generalized quadratic interpolation method, offers fast convergence but often falls into local optima. To address these limitations, a hybrid algorithm, EEFQIO, combining EEFO and QIO, is proposed. EEFQIO is tested on 12 benchmark functions from the CEC 2022 suite [3] and compared with established metaheuristics. Results show that EEFQIO combines the global search ability of EEFO with the fast convergence of QIO, outperforming other algorithms in solution quality and computational efficiency.

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ICRAMCS 2025

THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

THE CONTROLLABILITY OF LINEAR FRACTIONAL DELAY DENAMICAL SYSTEMS

Communication Info

Authors:
Wadii Ghandor 1
Ahmed Aberqi 2
Touria Karite 3

[1] *Mathematical Analysis and Applications Laborator , Department of Mathematical , Faculty of Sciences, Sidi Mohamed Ben Abdellah University, Fez, Morocco,*
[2] Mathematical Analysis and Applications Laborator , Department of Mathematical , Faculty of Sciences, Sidi Mohamed Ben Abdellah University, Fez, Morocco,
[3] *National School of Applied Sciences, Sidi Mohamed Ben Abdellah University, Avenue My Abdallah, Fez BP 72, Morocco.*

Abstract

The authors of the most recent work [1] addressed the problem of relative controllability and provided an explicit representation of solutions using the delayed Mittag-Leffler function. Similarly, Li and Wang [2] used an explicit solution formula to discuss the controllability criteria of a fractional differential system with state delay. Nawaz, M., Wei, J. and Jiale, S. [3] discussed the controllability of fractional differential system with state and control delay by using Caputo fractional derivative. Inspired by following this study ,In this research, we examine the controllability of linear fractional differential control systems with delays in both state and control by using Riemann-Liouville fractional derivatives. Utilizing an explicit solution formula,we establish a rank criterion for controllability. We provide necessary and sufficient conditions for the controllability of these fractional differential systems. Finally, a numerical example is presented to illustrate and support the findings.

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Exchange rate pass-through in Morocco: A Markov Switching Analysis

Communication Info

Authors:
Yassine EL-ALOUY
Ayad EL BAZ

National School of Commerce and Management, Chouaib Doukkali University, El Jadida, Morocco

Keywords:
(1) Exchange rate pass-through
(2) Markov Switching model
(3) Inflation

Abstract

This study investigates the exchange rate pass-through (ERPT) to the Consumer Price Index (CPI) in Morocco using quarterly data from 2003Q1 to 2022Q4. A Markov Regime Switching model is employed to analyze the dynamic nature of the ERPT under varying economic conditions. Furthermore, an Autoregressive (AR) model is utilized to forecast CPI inflation and assess its potential impact on the feasibility of adopting an inflation-targeting regime. Results indicate that the exchange rate acts as a shock absorber, likely due to the ±5% flexibility band within the current exchange rate regime. The estimated long-run ERPT coefficient is -1.32, suggesting an inverse relationship between exchange rate fluctuations and CPI. CPI forecasts from 2023Q1 to 2024Q1 predict a declining trend of approximately 0.49%, attributed to external factors, specifically imported inflation.

The findings suggest that, under the current exchange rate regime and observed ERPT dynamics, certain preconditions for a successful transition to a full-fledged inflation-targeting regime may not be fully satisfied.

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ICRAMCS 2025
THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Predicting Stock Market Volatility with LSTM Models

Communication Info

Authors:
Zahnaoui ibtissam[1]
El boujaoui hicham [2]

[1] *ENSA, Agadir, Morocco*
[2] *ENSA, Agadir, Morocco*

Keywords:
(1) Volatility Forecasting
(2) LSTM
(3) ANN,GARCH

Abstract

This study focuses on predicting stock market volatility using machine learning techniques, specifically Long Short-Term Memory (LSTM) networks. The main goal is to compare the performance of LSTM and EGARCH-LSTM models using major stock indices like the S&P 500, NASDAQ, and Dow Jones from January 2012 to January 2023. LSTM models are used because they can capture long-term patterns in time series data. The EGARCH-LSTM model combines the EGARCH (Exponential Generalized Autoregressive Conditional Heteroskedasticity) model with LSTM to better handle both volatility and time dependencies. The models are evaluated using Root Mean Squared Error (RMSE) and Mean Absolute Error (MAE) to measure their prediction accuracy. The results show that the EGARCH-LSTM model performs better in predicting volatility than the LSTM model alone. This study adds to the growing use of machine learning in financial markets, especially for forecasting volatility (Chen et al., 2020; Zhang et al., 2018; Lee et al., 2021).

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Existence and Ulam-Hyers Stability of mild solutions for a class the hybrid fractional ψ-Caputo

Communication Info

Authors:
HAYAT MALGHI[1]
Khalid Hilal[2]
Abdelaziz Qaffou[3,4]

[1] *LMACS,Sultan Molay Slimane University, Beni Mallal,Morocco*

[2] *LMACS,Sultan Molay Slimane University, Beni Mallal,Morocco*

[3] *LMACS,Sultan Molay Slimane University, Beni Mallal,Morocco*

Keywords:
(1) cosine and sine family operators,
(2) phi-caputo fractional derivatives,
(3) hybrid fractional evolution equation

Abstract

This study investigates the existence, uniqueness, and Ulam-Hyers stability of a class of hybrid ϕ-Caputo time-fractional systems of order δ in the range (1,2]. By leveraging well-established fixed-point theorems, we establish rigorous conditions under which solutions exist and are unique. Furthermore, we analyze four distinct types of Ulam-Hyers stability to provide a comprehensive understanding of the stability behavior of the proposed fractional systems. To illustrate the applicability and effectiveness of our theoretical findings, we present a concrete example demonstrating the validity of the obtained results.

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Fractional powers of Hankel transform in Colombeau algebra

Communication Info

Authors:

Latifa El BEZDAOUI[1]

Mhamed ELOMARI [1]

Lalla Saadia CHADLI [1]

[1] Laboratory of Applied Mathematics and Scientific Computing, Sultan Moulay Slimane University, 23000, Beni Mellal, Morocco.

Keywords:

(1) fractional Hankel transform

(2) generalized functions

(3) Colombeau algebra

Abstract

In this communication, we introduce the fractional powers of Hankel transform for a new class of generalized functions within the Colombeau algebra. We also establish the key properties of this transform within this framework.

To demonstrate the theoretical results and highlight the importance of incorporating this transform into Colombeau algebra, we apply it to solve partial differential equations involving Kepinski type operators.

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A modeling approach to assess the effect of contact tracing on epidemic dynamics

Communication Info

Authors:
Khalid ERRAMI[1]
Aziz OUHINOU [1]

[1] University of Sultan Moulay Slimane, Beni Mellal, Morocco

Keywords:
(1) Mathematical epidemiology
(2) Contact tracing
(3) Delay differential equations (DDEs)

Abstract

In this work, we aim to develop a new mathematical model for contact tracing, with a more realistic and advanced approach to describe its effect on disease dynamics. For this purpose, we begin with an SIR model and incorporate the detection of infectious individuals, along with the screening and monitoring of their contacts. We formulate the effective reproduction number (Re) in terms of the basic reproduction number (R0) and the reproduction number of monitored individuals (Rm) using the next generation approach described in [1]. We show the effect of different parameters related to detection, tracing, and monitoring on Re. We conclude our work with a discussion of all the obtained results.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Common recurrent vectors

Communication Info

Authors:
Fatima-ezzahra SADEK [1]
Mohamed AMOUCH [1]

[1] *Chouaib Doukkali University, El jadida, Morocco*

Keywords:
(1) Recurrent vectors
(2) Recurrent operators
(3) Hypercyclicity

Abstract

Recurrence is one of the fundamental concepts in the theory of dynamical systems. Its study was first initiated by H. Poincaré with the Poincaré recurrence theorem [5]. In 2012, this notion was studied systematically in linear dynamics in two fundamental papers by G. Costakis et al. in [3,4]. According to these works, an operator T is said to be recurrent if for each non-empty open set U, there exists a positive integer n such that $T^n(U) \cap U \neq \emptyset$. A vector x is called recurrent for T if there exists a strictly increasing sequence of positive integers $(n_k)_k$ such that $T^{n_k}x \to x$ as $k \to \infty$. For a deeper understanding of recurrence, see [1,2].

In this work, we investigate the existence of common recurrent vectors for families of recurrent operators. We show that, contrary to the case of countable families, there may not always exist a common recurrent vector for an arbitrary uncountable family of recurrent operators. Furthermore, we provide several characterizations of the set of common recurrent vectors.

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Solving the biharmonic problem using isogeometric analysis over multipatch domain

Communication Info

Authors:
Lahcen El OUADEFLI[1]
Abdeslam El AKKAD[1,2]
Ahmed ELKHALFI[1]
[1] *Al Idrissi Laboratory for Research in Science and Engineering, Faculty of Sciences and Techniques, Sidi Mohammed Ben Abdellah Uneversity, B.P. 2202 Route Imouzzer, Fes, 30000, Morocco.*
[2] *Département de Mathématiques, Centre Régional des Métiers d'Education et de Formation de Fès-Meknès (CRMEF Fès-Meknès), Rue de Koweit 49, Ville Nouvelle, Fes, 30050,* Morocco.

Keywords:
(1) Biharmonic problem,
(2) Isogeometric analysis,
(3) Multipatch domains.

Abstract

The biharmonic problem arises in various engineering and physics applications, particularly in elasticity and fluid mechanics. Traditional finite element methods (FEM) face challenges in accurately representing complex geometries and ensuring C^1-continuity, which is essential for solving fourth-order partial differential equations. In this talk, we employ Isogeometric Analysis (IGA) to solve the biharmonic problem over multipatch domains. IGA, based on Non-Uniform Rational B-Splines (NURBS), naturally provides higher-order smoothness, making it well-suited for biharmonic problems. We discuss the construction of suitable function spaces, the enforcement of inter-patch continuity, and the numerical implementation in a MATLAB framework. Several benchmark examples demonstrate the accuracy and efficiency of the proposed approach.

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ICRAMCS 2025

THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

An explicit three-term Polak–Ribière–Polyak conjugate gradient method for bicriteria optimization

Communication Info

Authors:
Youssef ELBOULQE[1]
Mounir EL MAGHRI [2]

[1] Faculty of Sciences Semlalia, Cadi Ayyad University, Marrakech, Morocco.
[2] Faculty of Sciences Aïn Chock, Hassan II University, Casablanca, Morocco.

Keywords:
(1) Multicriteria optimization
(2) Pareto optimality
(3) Pareto critical point
(4) Descent directions
(5) Line search
(6) PRP conjugate gradient method

Abstract

In this work we propose a three-term Polak–Ribière–Polyak conjugate gradient method for bicriteria optimization without using any scalarization technique. Three advantages are to be noted for this new method. First, the descent directions are given explicitly and can then be directly computed. Second, the descent property is sufficient independently of the line search. Third, without Lipschitz continuity hypothesis and under only an Armijo type condition, global convergence towards Pareto stationary points is proved. Numerical experiments including comparisons with other methods are also reported.

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Étude des déterminants de la perception des TPME marocaines à l'égard du produit bancaire islamique « Salam » : régression logistique

Communication Info

Authors:
Hajar Fatih
Sara Elouadi

[1] *FSJESAS, UHII, Casablanca,Maroc*

Keywords:
Salam
Banques participatives
TPME
Régression logistique

Abstract

L'article examine la réticence des banques participatives marocaines à financer les TPME, en se concentrant sur le produit Salam comme alternative pour le fonds de roulement. La partie théorique analyse les obstacles structurels, réglementaires et culturels freinant son adoption, ainsi que les perceptions des TPME face à ce mode de financement. L'étude empirique, basée sur une régression logistique, identifie les facteurs influençant l'acceptation du Salam, tant du côté des entreprises que des banques. Les résultats visent à proposer des recommandations pour améliorer l'accessibilité au financement participatif des TPME.

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ICRAMCS 2025

THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Etude de la relation non linéaire entre l'incertitude liée à l'inflation et l'inflation : Cas du Maroc

Communication Info

Authors:
Maarouf Mourad[1]
[1] Cadi Ayyad University, Marrakech, Morocco
Keywords:
(1) inflation uncertainty
(2) inflation
(3) non linearity
(4) changement de regime markovien

Abstract

Ce travail explore la relation entre l'inflation liée à l'inflation et l'inflation [1], [2] tout en adoptant une non linéarité dans la dynamique de cette association. Notre recherche vise à capturer cette non linéarité dans le comportement de la moyenne et la variance conditionnelle tout en adoptant un configuration économétrique ARFIMA-EGARCH-M[3] intégré dans un modèle à changement de régime markovien[4]. Notre objectif consiste à montrer d'une part, la prévalence d'un phénomène de persistance des chocs dans le comportement de l'inflation, d'autre part, le comportement asymétrique de l'incertitude liée à l'inflation. Cette modélisation offre des dynamiques structurelles sous-jacentes, permettant d'identifier le comportement de la relation entre l'incertitude inflationniste et l'inflation en fonction des différents régimes de la volatilité de l'inflation.

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Approximate Controllability of Fractional Control Systems with Infinite Delays via β−Order Cosine Families in Banach Space

Communication Info

Authors:
Ismail Sadouki[1]
Ali El Mfadel [2]
Abdelaziz Qaffou [3]

[1] LMACS Laboratory, Sultan Moulay Slimane University, Beni Mellal, Morocco
[2] LMACS Laboratory, Sultan Moulay Slimane University, Beni Mellal, Morocco
[3] LMACS Laboratory, Sultan Moulay Slimane University, Beni Mellal, Morocco

Keywords:
(1) Approximate Controllability
(2) Control Systems
(3) Control Systems

Abstract

This paper investigates the approximate controllability of semilinear fractional control systems of order $\beta \in (1, 2)$ with infinite delay, a class of systems that captures the dynamics of various real-world phenomena with memory and hereditary properties. Using the advanced theory of strongly continuous β-order cosine families and the sequence method, we establish sufficient novel conditions for approximate controllability. The analysis accounts for the combined challenges of fractional dynamics, nonlinearities, and infinite delays, providing a robust framework for understanding and controlling such systems. The results are illustrated through a practical example that demonstrates their applicability and effectiveness. This study not only extends the existing theoretical foundation of fractional control systems but also opens new pathways for addressing complex control problems in science and engineering.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

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Existence of solutions for uncertain nonlocal fractional differential equations via generalized Krasnosel'skii fixed point theorem.

Communication Info

Authors:
Khadija Elhakimy[1]
Ali El Mfadel [2]
Said Melliani [3]

[1] LMACS Laboratory, Sultan Moulay Slimane University, Beni Mellal, Morocco
[2] LMACS Laboratory, Sultan Moulay Slimane University, Beni Mellal, Morocco
[3] LMACS Laboratory, Sultan Moulay Slimane University, Beni Mellal, Morocco

Keywords:
(1) uncertain fractional differential equations
(2) Krasnosel'skii fixed point theorem
(3) fuzzy metric spaces

Abstract

In this study, we explore the existence of solutions for a class of uncertain fractional differential equations involving nonlocal derivatives. Our approach relies on an extended version of Krasnosel'skii's fixed point theorem within fuzzy metric spaces. By applying this theorem, we establish the existence of a fuzzy solution defined over a specific interval. Additionally, we examine a related integral problem, which allows us to effectively apply the proposed mathematical tools. Finally, we conclude with some physical motivations.

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ICRAMCS 2025

THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Hausdorff type operators and wavelet transform associated with the modified Whittaker

Communication Info

Authors:
Yassine Fantasse[1]
Abdellatif Akhlidj[1]
Fethi Soltani[2]

[1]Laboratory of Fundamental and Applied Mathematics, Department of Mathematics, Faculty of Sciences Ain Chock, University Hassan II, Casablanca, Morocco
[2]Faculté des Sciences de Tunis, Laboratoire d'Analyse Mathématique et Applications, LR11ES11, Université de Tunis El Manar;c Ecole Nationale d'Ingénieurs de Carthage, Université de Carthage, Tunis, Tunisia

Keywords:
(1) Mehler–Fock transform
(2) Localization operators
(3) Scalogram

Abstract

In the present paper, we introduce the Hausdorff type operators associated with the Whittaker operator where and we prove the boundedness of these operators in space . We investigate continuous Whittaker wavelet transformation and obtain some useful results. The relation between Whittaker wavelet transforms and the Hausdorff type operators here is also established. The properties of the adjoint of the Hausdorff type operators are discussed.

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April 24-25-26, 2025 | Marrakech, Morocco

Transmission of Pathogens among species - A mathematical version -

Communication Info

Authors:

SANNAKY Ibtissam[1]

EL BERRAI Imane [1]

ADNAOUI Khalid[1]

[1] Faculty of sciences Ben M'sick, Casablanca, Morocco

Keywords:

(1) Mathematical modeling

(2) Pathogens

(3) Epidemiology

Abstract

In recent years, Mathematical modeling has shown to have a crucial role in the understanding of disease dynamics[3]. It helps to understand the transmission process and allows us to try some control techniques using mathematical and analytical tools to study the efficiency of the approaches before adopting them into the real world[2]. In this study, we examine a mathematical model that describes the transmission of one type of pathogen among various kinds of species[1], we will do the suitable analysis, and then simulate the results to match the theoretical findings[4]. Then we will demonstrate how we can use those mathematical results to help epidemiologists and health-care systems in the decision-making regarding the propagation of the studied disease[5].

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ICRAMCS 2025
THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Long-Term Behavior of Stochastic SVIQS Epidemic Models

Communication Info

Authors:
Soulaimane AZNAGUE [1]

[1] *Laboratory of Mathematics and Applications, FSTT, Abdelmalek Essaadi University, Tetouan, Morocco*

Keywords:
(1) SVIQS model
(2) Disease extinction
(3) Stationary distribution

Abstract

In this study, we present a stochastic SVIQS epidemic model incorporating imperfect vaccination and quarantine measures. We analyze the long-term behavior of the system and introduce a real-valued threshold Δ to classify disease extinction and persistence. Specifically, we show that if $\Delta < 0$, the disease dies out, whereas if $\Delta > 0$, the system admits a unique positive stationary distribution. To support and complement our analytical results, we provide numerical simulations illustrating the impact of key parameters on disease dynamics.

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Framework for Evaluating University Faculty Efficiency Using Hierarchical Network Data Envelopment Analysis

Communication Info

Authors:
Anis Mardiana AHMAD[1,2]
Noor Saifurina NANA KHURIZAN [2]

[1] School of Mathematical Sciences, Universiti Sains Malaysia, 11800 USM, Penang, Malaysia
[2] Mathematical Science Studies, College of Computing, Informatics and Mathematics, Universiti Teknologi MARA Kedah Branch, Sungai Petani Campus, 08400 Sungai Petani, Kedah, Malaysia

Keywords:
(1) Efficiency
(2) Higher Education
(3) Hierarchical Data Envelopment Analysis

Abstract

This study introduces a five-stage framework employing Hierarchical Network Data Envelopment Analysis (HNDEA) to evaluate the efficiency of university faculties. University faculties primarily engage in teaching, research, and educational services. Previous models such as those by Kao [1] and Kashim et al. [2] have depicted university faculties with hierarchical structures but lacked distinct subunits within the research function, limiting the granularity of efficiency assessments. To address this limitation, our framework incorporates specific subunits under the research function, namely publications, grants, and innovations. This detailed segmentation allows for a more comprehensive and precise evaluation of research efficiency, facilitating the identification of specific areas requiring improvement. A key stage in our framework involves the development of tailored HNDEA models that reflect this nuanced structure.

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A modified location model based on robust approaches for mitigating the impact of outliers

Communication Info

Authors:

Kartini KASIM [1,2]
Hashibah HAMID [1]
Ayu ABDUL-RAHMAN [1]

[1] Department of Mathematics, School of Quantitative Sciences, UUM College of Arts and Sciences, Universiti Utara Malaysia, Kedah, Malaysia
[2] Mathematical Sciences Studies, College of Computing, Informatics and Mathematics, Universiti Teknologi MARA Kedah Branch, Kedah, Malaysia

Keywords:

(1) Location model
(2) Mixed variable
(3) Classification
(4) Outlier
(5) Robust approach

Abstract

Location model (LM) is a statistical method used to classify objects into two groups, particularly when dealing with mixed variables [1] - [4]. In a previous study, a framework of an improved version of the LM using the MOM estimator, paired with a robust covariance matrix (MADn x Spearman rank) was developed [5]. The improved LM, known as RLM_{MMSR}, is recommended for mitigating the effects of outliers on classification model with mixed variables, particularly the LM. In this study, simulation results of the RLM_{MMSR} are presented and compared to the classical LM to determine the model performance in the presence of outliers. Based on misclassification rates, the simulation results reveal that the RLM_{MMSR} outperformed the LM when data are contaminated with outliers. These findings not only demonstrate the potential of the RLM_{MMSR} in classification fields that involve mixed variables but also emphasize its effectiveness in mitigating the effect of outliers.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Some Estimation Methods for a Random Coefficient in the Gegenbauer Autoregressive Moving-Average Model

Communication Info

Authors:
Oumaima ESSEFIANI[1]
Rachid EL HALIMI[1]
Said HAMDOUNE [1]

1 Mathematics and Applications Laboratory, Abdelmalek Essaadi University, Tangier 90000, Morocco

Keywords:
(1) GARMA model
(2) Conditional least squares
(3) Weighted conditional least squares
(4) Mean squared errors

Abstract

The Gegenbauer autoregressive moving-average (GARMA) model is pivotal for addressing non-additivity, non-normality, and heteroscedasticity in real-world time-series data. While primarily recognized for its efficacy in various domains, including the health sector for forecasting COVID-19 cases [1], this study aims to assess its performance using yearly sunspot data. We evaluate the GARMA model's goodness of fit and parameter estimation specifically within the domain of sunspots. To achieve this, we introduce the random coefficient generalized autoregressive moving-average (RCGARMA) model, extending the standard GARMA model to incorporate unobserved heterogeneity [2]. We develop methodologies utilizing conditional least squares (CLS) and conditional weighted least squares (CWLS) estimators [3, 4]. Employing the ratio of mean squared errors (RMSE) criterion, we compare the efficiency of these methods using simulation data. Notably, our findings highlight the superiority of the conditional weighted least squares method over the conditional least squares method. Finally, we provide an illustrative application using two real data examples, emphasizing the significance of the GARMA model in sunspot research [5].

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On the optimal control of rumor and its impact on the economic environment

Communication Info

Authors:
Salaheddine BELHDID[1]
Omar BALATIF [1]

[1] Laboratory of Fundamental Mathematics and Their Applications, Department of Mathematics, Faculty of Sciences El Jadida, Chouaib Doukkali University, El jadida

Keywords:
(1) Optimal control,
(2) rumors,
(3) compartment models,

Abstract

This paper delves into the pervasive issue of misinformation and disinformation propagation within social networks. Employing a compartmental model, inspired by epidemiological modeling [1], we characterize the dynamics of information diffusion as it spreads through different segments of a population. The model incorporates distinct compartments representing individuals susceptible to misinformation, actively spreading it, and those who have developed immunity to its influence. To mitigate the detrimental impact of misinformation, we introduce optimal control strategies that dynamically manipulate key parameters influencing the spread of false information. Leveraging control theory, we formulate an optimization problem to minimize the prevalence of misinformation while considering resource constraints and ethical considerations. Our findings highlight the effectiveness of targeted interventions in curtailing the dissemination of misinformation [2], [3], [4].

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Proposition of a novel SIRS epidemic model with double epidemics and coexisting epidemics

Communication Info

Authors:
Ouyadri Mourad [1]
Amine El Koufi [2]
Mohamed El Fatini [3]

[1] LIMA Laboratory, Faculty of Sciences El Jadida Chouaib Doukkali University El Jadida 24000, Morocco
[2] Department of Mathematics and Computer Science High School of Technology, Ibn Tofail University P.O. 240, K´enitra 14000, Morocco
[3] Laboratory of Partial Differential Equations Algebra and Spectral Geometry, Faculty of Sciences Ibn Tofail University, BP 133, K´enitra 14000, Morocco

Keywords:
(1) Epidemic model;
(2) stability analysis;
(3) optimal control;
(4) Pontryagin's maximum principle.

Abstract

Improving epidemic models to better reflect reality has long been a prominent concern for governments and researchers. This paper presents a novel Susceptible–Infected– Recovered–Susceptible (SIRS) epidemic model for human populations, offering a comprehensive analysis. The proposed model introduces a generalized SIRS epidemics framework encompassing three propagation scenarios. The paper establishes the positivity and boundedness of the system and demonstrates the stability of its equilibrium points. Furthermore, a controlled system is introduced, accompanied by three suggested control strategies to minimize the infected population while optimizing cost. To validate the analytical findings, a numerical example is provided. The paper concludes with a summary and outlines future research directions.

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Eikonal Equation Solved with a Novel Lattice Boltzmann Method Framework

Communication Info

Authors:
Yassine DOUICH[1]
Hassan SIKAN [1]
Youssef HANYF [2]

[1] Department of Computer Science, laboratory LAROSERI, Faculty of Sciences, El JADIDA, Morocco
[2] National School of Commerce and Management, Ibn Zohr University, Dakhla, Morocco

Keywords:
(1) Eikonal Equation
(2) , Lattice Boltzmann Method
(3) Distance Function

Abstract

In this paper, we present an advanced lattice Boltzmann method (LBM) tailored to solving the Eikonal equation, a critical nonlinear Hamilton-Jacobi partial differential equation with widespread applications in image processing [1], geosciences, computer vision, and more [2,3,4,5,6]. The proposed method integrates a nonlinear local equality constraint into the traditional LBM framework, enhancing its capability to address the complexities of the Eikonal equation. Using the Chapman–Enskog expansion, we rigorously derive the macroscopic Eikonal equation from the microscopic LBM dynamics. Our method's stability is established through Von Neumann analysis, ensuring robust performance across various scenarios. Numerical simulations demonstrate the approach's accuracy, efficiency, and adaptability in solving multidimensional Eikonal problems. The results highlight the potential of the LBM as a powerful and versatile tool for tackling nonlinear PDEs in computational science.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Identities Involving Symmetric and Skew-Symmetric Elements in a Prime Ring with Involution

Communication Info

Authors:
Jihad BENZAID 1
Lahcen Oukhtite 2
Omar AIT ZEMZAMI 3

1FST; FEZ; Morocco
2FST, FEZ, Morocco
3EST, AGADIR, Morocco

Keywords:
(1) prime rings
(2) derivations
(3) symmetric elements

Abstract

This work investigates algebraic identities satisfied by symmetric and skew-symmetric elements in a prime ring equipped with an involution of the second kind. More specifically, we examine conditions involving generalized derivations acting on these elements.

The results obtained generalize several previous studies by extending the classes of identities considered and providing new sufficient conditions to ensure certain structural properties of prime rings with involution. These findings contribute to a deeper understanding of the interplay between involutions, derivations, and structured elements in noncommutative rings.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

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Le comportement mécanique des plaques FG poreuses sur des fondations élastiques

Communication Info

Authors:
Fikri karim 1
ADNAOUI KHALID 2
Laila Mouakkir*3,4*

[1] Faculté des Sciences Ben *M'Sick, CASA, MAROC*
2 Faculté des Sciences Ben *M'Sick, CASA, MAROC*
3 Faculté des Sciences Ben *M'Sick, CASA, MAROC*

Keywords:
(1) plaque à gradient fonctionnel
(2) fondation de Pasternak
(3) porosité

Abstract

Un matériau fonctionnellement gradué (FGM) est un type de matériau dont la composition de la structure varie de manière continue dans une ou plusieurs directions. Cette variation graduelle engendre des changements correspondants dans les propriétés physiques, mécaniques ou thermiques du matériau.

Dans cette étude, la réponse de flexion d'une plaque poreuse à gradation fonctionnelle reposant sur des fondations de Pasternak et sous diverse charge mécanique est examinée en utilisant la théorie trigonométrique raffinée de la déformation par cisaillement. Les équations qui régissent sont déduites sur la base du principe de travail virtuel, Des solutions analytiques sont obtenues en utilisant la méthode de Navier

Une étude détaillée est effectuée pour examiner l'influence de plusieurs paramètres à savoir : Les effets du paramètre de porosité et des paramètres de fondation, de l'indice de loi de puissance l'indice matériel p, le rapport d'épaisseur a/h et le rapport géométrique a/b sur les déflexions et les contraintes sont présentés

Mckean-Vlasov BSDEs with locally monotone coefficient

Communication Info

Authors:
Soufiane MOUCHTABIH[1]
Brahim BOUFOUSSI [2]

[1] Cadi Ayyad University, Marrakesh, Morocco
[2] Cadi Ayyad University, Marrakesh, Morocco

Keywords:
(1) Mckean-Vlasov BSDE,
(2) locally monotone coefficient,

Abstract

Nonlinear backward stochastic differential equations (BSDEs), introduced in [1], have found a wide field of applications as optimal stochastic control, mathematical finance, and they provide probabilistic representation for the solutions of semilinear partial differential equations.
The Mckean Vlasov BSDEs (MVBSDE), called also mean-field BSDE, is a class of BSDEs whose generator also depends on the solution's law introduced in [3] and solved, in a general framework, in [4] under Lipschitz continuity of the coefficient and square integrability assumption on the terminal condition.
We consider a MVBSDE of the form
Y_t =-F(t, Y_t, Y_t,[Y_t])dt+ Z_t dB_t
where [Y_t] stands for the law of Y_t. We show that if F is locally monotone in y, locally Lipschitz with respect to z and law's variable, and the monotonicity and Lipschitz constants κ_N, L_N are such that $L^2_N + \kappa_N^+ = O(\log(N))$, then the MVBSDE has a unique solution.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

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BIOECONOMIC MODELING OF MARINE FISHERIES: SUSTAINABLE MANAGEMENT OF GUITARFISH AND PLAICE IN AGADIR

Communication Info

Authors:
Khalid Outaaoui[1,2]
Ilham Ait El harch [1,2]
Youssef El foutayeni [1,2]

[1] Laboratory of Mathematics and Population Dynamics, Cadi Ayyad University,Marrakech, Morocco.
[2] Unit for Mathematical and Computer Modeling of Complex Systems, IRD, France

Keywords:
(1) Bioeconomic Model
(2) Sustainable Management
(3) Mathematical Modeling
(4) Resource Optimization

Abstract

This study examines the ecological and economic importance of guitarfish (Rhinobatos, Raja undulata) and plaice (Pleuronectes platessa) in Agadir, Morocco. These species are crucial for maintaining ecological balance but face threats from overfishing [1-2], habitat destruction, pollution, and climate change. The study uses Lotka-Volterra models [3], and a bioeconomic model with optimization techniques to analyze their population stability and propose sustainable management strategies [4-5]. It aligns with the UN's Sustainable Development Goals (SDGs), promoting ecological and economic balance in fisheries management.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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A new approach based in deep neural network for solving stochastic optimal control driven by diffusion process with jumps

Communication Info

Authors:
Hamid OULGHAZI.

UMI, FST Errachidia, Morocco.
Department of Mathematics
(A2MSDS Group).

Keywords:
(1) SDE with jump
(2) control optimal stochastic
(3) Deep neuaral Network

Abstract

In this work, We concentrate on the numerical solution of high-dimensional stochastic optimal control problems [1], where the system state is represented by a diffusion process with jumps [2].
By applying the maximum principle [3] and deep neural networks [4], we reformulate the original control problem as a variational problem and propose specialized algorithms to solve this new formulation [5].
The algorithms, along with the different architectures used, have been presented. Numerical results from application, such as the mean-variance portfolio selection problem in a financial market with two different assets in the jump diffusion process case, demonstrate the effectiveness of the proposed algorithms, especially in high-dimensional.

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The Autoregressive Distributed Lag (ARDL) cointegration approach for analyzing the relationship between interest rates and per capita income variables.

Communication Info

Authors:
Hamza DAOUDI [1]

[1] *Department of Electrical Engineering, Faculty of Science and Technology. Tahri Mohammed University, Bechar, Algeria.*

Keywords:
(1) ARDL
(2) Cointegration
(3) Causality
(4) Time series

Abstract

This paper explores the cointegration relationship between interest rates (IR) and per capita income (PCI) in Saudi Arabia. To investigate this relationship, we employ advanced time series techniques, including unit root tests and the ARDL (Autoregressive Distributed Lag) cointegration approach. The study utilizes annual data spanning from 1997 to 2015. The findings reveal two key insights: first, the two variables exhibit different orders of stationarity, indicating a mixed integration order; second, there exists a significant long-term cointegration relationship between interest rates and per capita income. These results provide valuable insights into the dynamic interaction between monetary policy and economic growth in Saudi Arabia.

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Strongly nonlinear parabolic equations with natural growth

Communication Info

Authors:
Mohamed Masmodi [1]

[1] Ibn Tofail University, Kenitra, Morocco

Keywords:
(1) Sobolev spaces
(2) Parabolic equations
(3) Unbounded domains

Abstract

In this paper, we deal with the existence and boundedness of solutions for nonlinear parabolic problem whose model is

$$\begin{cases} \partial u_t + \Delta_p u + \mu|u|^{p-2}u = L(x,t,u) \quad in\ \Omega \times (0,T) \\ u(x,t) = 0 \qquad on \qquad \partial\Omega \times (0,T) \\ u(x,0) = u_0 \quad in \quad \Omega \end{cases}$$

where Ω is unbounded domain, $L(x,t,u) = d(x,t)|\nabla u|^p + f(x,t) - div\, g(x,t)$, T is a positive number, $1 < p < N$, $d \in L^{\infty}(\Omega \times (0,T))$, $\Delta_p u$ is the p-Laplace operator and the lower order terms have a power growth of order p with respect to ∇u. The assumptions on the source terms lead to the existence results though with exponential integrability.

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A multiplicity result via Ljusternick–Schnirelmann category for a fractional equation involving Hardy-Littlewood-Sobolev critical exponent in general domains

Communication Info

Authors:

Rachid ECHARGHAOUI[1]

Mohamed Belhaj KHARMOUDI[1]

Moussa KHOUAKHI[2]

Mohamed MASMODI[1]

1 Ibn Tofail University, Kenitra, Morroco

2 Sidi Mohamed Ben Abdellah, Fes, Morroco

Keywords:

(1) Fractional Laplacian

(2) critical exponent

(3) Choquard equation

Abstract

In this paper, we consider the following problem

$$\begin{cases}(-\Delta)^s = \lambda|u|^{q-2}u + \left(\int_\Omega \frac{|u(y)|^{2^*_{\mu,s}}}{|x-y|^\mu}dy\right)|u(y)|^{2^*_{\mu,s}-2}u & in\,\Omega \\ u = 0 \quad on \quad R^N\setminus\Omega \end{cases}$$

where Ω is an open bounded set with continuous boundary in R^N $(N \geq 4s)$, $0 < \mu < N$, $2^*_{\mu,s} = \frac{2N-\mu}{N-2s}$ and $q \in [2; 2^*_{u,s})$, where $2^*_s = \frac{2N}{N-2s}$. Using the Nehari manifold and Ljusternik-Schnirelmann category, we relate the number of positive solutions of the above problem to the topology of Ω

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Exponential stabilisation in Banach spaces for a class of bilinear systems with distributed delay

Communication Info

Authors:
Marwan FAKHRI
Atmane EL HOUCH
Yassine BENSLIMANE

ENS, Casablanca, Morocco

Keywords:
(1) Banach space
(2) Distributed delay
(3) Exponential stabilisation

Abstract

In this paper, we focus on the problem of exponential stabilisation for a class of bilinear systems with distributed delay evolving in Banach state spaces. Sufficient conditions in term of observation estimates are formulated to achieve the exponential stabilisation via an explicit bounded feedback control. Additionally, through an appropriate decomposition of the state space, we introduce a new feedback control that depends only on the state projection into a suitable subspace, achieving the exponential stabilisation of the system at hand. Finally, we present two examples to illustrate the effectiveness of the obtained results.

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Non-negative spherical barycentric coordinates for non-convex geodesic polygons and applications

Communication Info

Authors:
Nacer NAIT ALI[1]
Alaa Eddine BENSAD[1]
Aziz IKEMAKHEN[1]

[1] *Faculty of Science and Technology Gueliz, Marrakech, Morocco*

Keywords:
(1) Spherical barycentric coordinates
(2) Spherical image deformation
(3) Geodesic polygons

Abstract

Spherical barycentric coordinates provide a unique way of representing points on the sphere with respect to the vertices of a spherical triangle. For spherical polygons with more than three vertices, they are generalized from their planar counterparts [1-2] using projections on tangent spaces [3], leading to several families of generalized spherical coordinates [4]. This framework is important for applications on spherical surfaces in computer graphics and geometry modeling, since it enables linear interpolation, smooth transition, and data deformation at vertices. However, robust computations require non-negativity of coordinates, especially for curve and image deformation where negative values produce significant artefacts [5]. In this paper, we present a method for computing smooth and non-negative spherical barycentric coordinates relative to any spherical polygon. Compared to traditional methods, the proposed coordinates ensure smoother and higher-quality deformations.

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Multiplicity of solutions for a singular Kirchhoff bi-nonlocal elliptic problem driven by the p(x)-biharmonic operator

Communication Info

Authors:
Hassan ABOUBKER[1]
My Driss MORCHID ALAOUI [2]

[1] *FST Errachidia, Morocco*
[2] *FST Errachidia, Morocco*

Keywords:
(1) p(x)-Biharmonic operator
(2) Variable exponents
(3) p(x)-Kirchhoff
(4) Symmetric mountain pass lemma
(5) Hardy term.

Abstract

In this presentation, we investigate the existence and multiplicity of non-trivial weak solutions for a p(x)-Kirchhoff bi-nonlocal elliptic problem driven by p(x)-Biharmonic operator with a Hardy term .
Using variational techniques and the symmetric mountain pass lemma, we obtain our main results under some suitable conditions.

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Existence and multiplicity of positive solutions for a critical fractional Laplacian equation with singular nonlinearity

Communication Info

Authors:
Rachid ECHARGHAOUI[1]
Moussa KHOUAKHI[2]
Mohamed MASMODI[1]

[1] Ibn Tofail University, Kenitra, Morocco
[2] Sidi Mohamed Ben Abdellah, Fes, Morroco

Keywords:
(1) Fractional Laplacian
(2) critical exponent
(3) singularity

Abstract

In this paper, we consider the following problem

$$\begin{cases}(-\Delta)^s u = g(x)u^{2_s^*-1} + \lambda u^{-\delta} & in\ \Omega \\ u > 0\ in\ \Omega, \quad u = 0 & on\ \partial\Omega\end{cases}$$

where $\Omega \subset \mathbb{R}^N (N > 2s)$ is a smooth bounded domain, $s \in (0,1)$, λ is a positive constant, $0 < \delta < 1$, $2_s{}^* = \frac{2N}{N-2S}$ and $(-\Delta)^s$ is the spectral fractional Laplacian. Based upon the Nehari manifold and using variational method we relate the number of positive solutions to the global maximum of the coefficient of the critical nonlinearity g.

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OPTIMAL DESIGN OF WATER DISTRIBUTION NETWORKS USING LION OPTIMIZATION ALGORITHM

Communication Info

Authors:
Alaeddine BOUIDI[1]
Mohammed Karim BENHACHMI[1]
Abdeslam TALEB[1]

[1] Department of Process and Environmental Engineering, Faculty of Science and Technology of Mohammedia, Hassan II University of Casablanca, Casablanca, Morocco

Keywords:
(1) Optimal Cost Design
(2) Metaheuristic algorithm
(3) Performance Indicator

Abstract

The demand on drinking water continues to increase due to demographic and industrial fast growth, in this context and since 70% of the cost for water distribution project is linked to pipe sizing [1], we find a large number of studies focused on the optimization of the design of water distribution networks [2] by searching for the best combinations of diameters from commercial pipes [3] providing solutions that allow water needs to be met at lower cost.
The formulation of this optimization problem can be done by the following objective function to estimate the costs [4]: $\mathrm{F_{obj}} = \sum_{i=1}^{N_{pipes}} c_i l_i + P$,
where $\mathrm{F_{obj}}$ is the total construction cost of the network, N_{pipes} is the number of pipes, c_i is the cost of pipe i per unit length, l_i is the length of pipe i and P is a penalty applies to avoid infeasible solutions.
The objective of this study is to develop a program for optimizing the cost of pipes using a new metaheuristic method called Lion Algorithm [5].

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Geometric Properties of the N-Bishop Frame and Its Spherical Indicatrices

Communication Info

Authors:
Malika IZID[1]
Amina CAHADI OUAZZANI 1

[1] Faculty of Science Ben M'Sick/University Hassan II of Casablanca, Casablanca, Morrocco

Keywords:
(1) *N-Bishop frame*
(2) *Spherical indicatrice*
(3) *Slant helices,*
(4) *Frenet invariants,*
(5) *Euclidean 3-space.*

Abstract

This study introduces the N-Bishop frame and Its Spherical Indicatrices. The N-Bishop frame, similar to the Bishop frame, is obtained by rotating the alternative frame $\{N, C, W\}$ around the principal normal vector by giving angle. It is an orthonormal frame, consisting of the principal normal vector N of given curve and to vectors $\{M_{1N}, M_{2N}\}$ from the plane perpendicular to N; these vectors are linearly independent and remain relativell parallel to the perpendiculaire plane of N. This basis must satisfy the conditions expressed in the following matrix formula

$$\begin{bmatrix} N' \\ M_{1N}' \\ M_{2N}' \end{bmatrix} = \begin{bmatrix} 0 & k_{1N} & k_{2N} \\ -k_{1N} & 0 & 0 \\ -k_{2N} & 0 & 0 \end{bmatrix} \begin{bmatrix} N \\ M_{1N} \\ M_{2N} \end{bmatrix}$$

The set $\{N, M_{1N}, M_{2N}\}$, called the $N-$Bishop frame, with k_{1N} and k_{2N} representing the $N-$Bishop curvatures, satisfies the following matrix relations:

$$\begin{bmatrix} N \\ C \\ W \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & \sin\theta \\ 0 & -\sin\theta & \cos\theta \end{bmatrix} \begin{pmatrix} N \\ M_{1N} \\ M_{2N} \end{pmatrix}$$

This leads to the relations between the invariants of the alternate frame f, g and the $N-$Bishop invariants $k_{1N}$and k_{2N}:

$$f = \sqrt{k_{1N}^2 + k_{2N}^2}, \qquad g = \theta', \qquad k_{1N} = f\cos\theta\,, \qquad k_{2N} = f\sin\theta$$

Let $\varphi = \varphi(s)$ be a regular curve in space E^3. If we translate the second (resp. third) vectors fields of the $N-$Bishop frame to the center of the unit sphere S^2, we obtain a spherical curve called the Spherical Image of the M_{1N} (resp. M_{2N}) vector of the N-Bishop frame or the indicatrix of the curve $\varphi = \varphi(s)$.
By analyzing the spherical indicatrices derived from this frame, the work provides new geometric characterizations of curves, particularly slant helices. Key results establish explicit relationships between N-Bishop invariants and traditional Frenet invariants, offering a refined approach to curve analysis..

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON \

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The Coho;ological for an elliptic system p lqplqcien coupled critical terms and concave-convex nonlinearities

Communication Info

Authors:
ABDESLAM EL YAHAI

Rachid ECHARGHAOUI[2]

[1]*Department of Mathematics, Faculty of Sciences, Ibn Tofail University, Kenitra B. P. 133, Morocco.*

Keywords:
((1) Multi-critical problem.

(2) Multiple solutions.

(3) Elliptic equation

Abstract

In present paper, we investigate the existence of multiple positive solutions to the following multi-critical elliptic problem

$$\begin{cases} -\Delta u = \lambda |u|^{p-2}u + \sum_{i=1}^{k} \left(|x|^{-(N-\alpha_i)} * |u|^{2_i^*} \right) |u|^{2_i^*-2} u \ in\ \Omega \\ \\ u \in H_0^1(\Omega) \end{cases} \tag{0.1}$$

in connection with the topology of the bounded domain $\Omega \subset \mathbb{R}^N$, $N \geq 4$, where $\lambda > 0$, $2_i^* = \frac{N+\alpha_i}{N-2}$ with $N - 4 < \alpha_i < N, i = 1, 2, \cdots, k$ are critical Hardy–Littlewood–Sobolev exponents and $2 < p < 2^* = \frac{2N}{N-2}$. We show that there is $\lambda^* > 0$ such that if $0 < \lambda < \lambda^*$ problem (0.1) possesses at least $cat_{\Omega}(\Omega)$ positive solutions. We also study the existence and uniqueness of positive solutions for the limit problem of (0.1).

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Study of Nonlinear Elliptic Equations with Measurable Boundary Conditions in Anisotropic Weighted Sobolev Spaces

Communication Info

Authors:
SAID AIT DADA ALLA[1]
Badr ELHaji[2]

[1;2] *LaR2A , FS Tetouan ,Maroc*

Keywords:
(1) Anisotropic weighted Sobolev spaces
(2) Monotonicity conditions
(3) Minty's,lemma,

Abstract

The novelty of this note is to establish existence result for the following anisotropic elliptic equation
- div $B(x, \vartheta, \nabla\vartheta) + H(x, \vartheta) = f$ - div F
where the datum $f \in L^1(\Omega)$ and
$F \in \prod_{i=1}^{N} L^{P_i'}(\Omega, \omega^*)$ and $H(x, \vartheta) \in L^1(\Omega)$.
Furthermore only the large monotonicity conditions will be assumed on $B(x, s, \xi)$.
To overcome this difficulty we will use the approach of Minty's lemma in the anisotropic weighted Sobolev spaces.

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Compartmental Model of Kidney Function Decline Under the Influence of Diabetes and Hypertension

Communication Info

Authors:
Ahlam ELKHETTAB[1]
Imane ELBERRAI [2]

[1] Hassan 2 University, Casablanca, Morocco
[2] Hassan 2 University, Casablanca, Morocco

Keywords:
(1) Chronic Kidney Disease
(2) Compartmental Model
(3) Mathematical Modeling
(4) Disease Progression
(5) Ordinary Differential Equations
(6) Renal Function Decline

Abstract

Chronic kidney disease (CKD) is a major public health concern, often driven by underlying conditions such as diabetes and hypertension. This study presents a compartmental model to analyze the progression of kidney function decline under the influence of these risk factors.

The system is modeled using a set of ordinary differential equations (ODEs) describing the evolution of each compartment over time. Simulations demonstrate that without intervention, the proportion of individuals in CKD increases significantly, whereas appropriate treatment and disease management slow progression. This model provides a quantitative framework to assess the impact of risk factors and treatment strategies on kidney function decline, offering valuable insights for public health planning and clinical decision-making.

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Unveiling the Mathematical Marvels: Exploring Differential and Integral Equations for Multivariate Hermite-Frobenius-Genocchi Polynomials

Communication Info

Authors:
Musawa ALMUSAWA [1]
Khalid ALDAWSARI [2]
Waleed HAMALI [1]

[1] ***Jazan University, Jazan,*** *Saudi Arabia*
[2] ***Prince Sattam Bin Abdulaziz*** *University, AlKharj, Saudi Arabia*

Keywords:
(1) Multi-variate Hermite-Frobenius-Genocchi polynomials
(2) Volterra integral equation
(3) Shift operators

Abstract

In this article, a novel family of multi-variate Hermite-Frobenius-Genocchi polynomials is constructed and its several characterizations are observed. The properties of these polynomials, such as recurrence relations and shift operators, are investigated. Differential equations, partial differential equations, and integrodifferential equations satisfied by these polynomials are derived using the factorization method. Additionaly, the Volterra integral equation is derived for these multi-variate Hermite-Frobenius-Genocchi polynomials, which enhances the understanding and application of the factorization method in physics and engineering.

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About Critical 3- Hypergraphs

Communication Info

Authors:

Abderrahim Boussaïri[1]

Brahim Chergui[1]

Pierre Ille[2]

Mohamed Zaidi[1]

[1]Laboratoire Mathématiques Fondamentales et Appliquées, Faculté des Sciences Aïn Chock, Hassan II University of Casablanca, Morocco

[2]Aix Marseille Univ, CNRS, Centrale Marseille, I2M, Marseille, France

Keywords:

(1) 3-Hypergraph

(2) Module

(3) Prime

(4) Critical

Abstract

Given a 3-hypergraph H, a subset M of V(H) is a module of H if for each $e \in E(H)$ such that $e \cap M \neq \emptyset$ and $e \setminus M \neq \emptyset$, there exists $m \in M$ such that $e \cap M = \{m\}$ and for every $n \in M$, we have $(e\setminus\{m\}) \cup \{n\} \in E(H)$. For example, $\emptyset$, V(H) and {v}, where $v \in V(H)$, are modules of H, called trivial modules. A 3-hypergraph with at least three vertices is prime if all its modules are trivial. Furthermore, a prime 3-hyper-graph is critical if all its induced subhypergraphs, obtained by removing one vertex, are not prime. We characterize the critical 3-hypergraphs.

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Skew-adjacency matrices of tournaments

Communication Info

Authors:
Abderrahim BOUSSAIRI[1]
Sara EZZAHIR [1]
Soufiane LAKHLIFI[2]
Soukaina MAHZOUM[1]

[1] *Laboratoire Mathématiques Fondamentale et Appliquées, Faculté des Sciences Aïn Chock, Casablanca, Morocco*
[2] *Computer Science & Smart Systems Laboratory, Ecole Supérieure de Technologie, Casablanca, Morocco.*

Keywords:
(1) Tournament
(2) Skew-adjacency matrix
(3) Principal minor

Abstract

Let T be a tournament with n vertices $v_1, \dots, v_n$. The skew-adjacency matrix of T is the $n \times n$ zero-diagonal matrix $S = [sij]$ in which $s_{ij} = -s_{ji} = 1$ if v_i dominates v_j. It is well-known that the determinant of S is zero or the square of an odd integer [1]. Moreover, the principal minors of S are at most 1 if and only if T is a local order [2,3]. In this paper, we characterize the class of tournaments for which the principal minors of the skew-adjacency matrix do not exceed 9 [4].

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SEQUENTIAL CALCULUS RULE FOR CODERIVATIVE AND APPLICATION

Communication Info

Authors:
ECHCHAABAOUI EL MAHJOUB
LAGHDIR MOHAMED

[1] *Université Chouaib Doukali*

Keywords:
Cone-Convex Set-Valued Mappings, Set-Valued Analysis, Set-Valued Optimization

Abstract

The main aim of this paper is to present a general description of the calculus rules for coderivatives of set-valued mappings between Banach spaces in terms of sequences, without requiring any constraint qualifications. Additionally, an application for calculating coderivatives of solution maps in parameterized generalized equations is included.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Boas-type theorems for the modified Whittaker transform

Communication Info

Authors:
Mohammed EL BOUAZIZI[1]
Mohamed EL HAMMA [2]
Radouan DAHER [3]

[1] Faculté des sciences Aïn chock – Casablanca, Maroc.

[2] Faculté des sciences Aïn chock – Casablanca, Maroc.
[3] Faculté des sciences Aïn chock – Casablanca, Maroc.

Keywords:
(1) Modified Whittaker transform.
(2) Generalized translation operator.
(3) Lipschitz classes.

Abstract

Boas's theorem is crucial in harmonic analysis because it provides sufficient conditions for the convergence of Fourier series, thereby extending classical results to less regular functions. It plays a key role in studying the convergence and regularity properties of trigonometric series. In this paper, we establish necessary and sufficient conditions in terms of $F_W(f)$, the modified Whittaker transform of f, to determine whether f belongs to one of the generalized Lipschitz classes H_δ^p and h_δ^p. By using the modified Whittaker transform, we introduce a formal framework that connects the properties of the function f to the mentioned classes. This work thus provides a more precise mathematical approach to studying functions in contexts where regularity and Lipschitz properties are crucial. The results obtained are particularly valuable for applications in harmonic analysis and in functional spaces where these classes play a key role in understanding the structure of functions.

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About the Spectral Theory of Graphs and Two-graphs

Communication Info

Authors:
Imane SOUKTANI [1]
Abderrahim BOUSSAIRI [2]
Mohamed Zouagui [3]

[1] Hassan II University, FSAC, Casablanca
[2] Hassan II University, FSAC, Casablanca
[3] International University, Casablanca

Keywords:
(1) Graph
(2) Two-graph
(3) Spectral monomorphy

Abstract

A two-graph is k-spectrally monomorphic if all its sub-two-graphs have the same characteristic polynomial. The complete two-graphs and the empty two-graphs are trivially k-spectrally monomorphic. In this paper, we show that there are no others for $k \in \{3, \ldots, n-3\}$. Moreover, we prove that for $n \geq 5$, a non-trivial two-graph with n vertices is (n-2) spectrally monomorphic if and only if it is regular.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Iterative algorithm for a common solution of split equilibrium problems and fixed points problems of a finite family of nonexpansive mapping

Communication Info

Authors:
Ihssane HAY[1]

[1] *Equipe MAISI, Ibn Zohr University, ENSA, BP 1136, Agadir, Morocco.*

Keywords:
(1) Split equilibrium problem
(2) Fixed point problem

Abstract

The main objective of this paper is to study a new iterative method for solving a split equilibrium problem and fixed point of a finite family of non-expansive mapping in a real Hilbert space. Under some suitable assumptions, we prove the strong convergence of our method presented in this paper to the common element of the solution set of split equilibrium problems and the set of fixed points problems in the setting of Hilbert space. Moreover, we give a numerical example to illustrate the efficiency of our proposed iterative method. Our results improve some existing methods in recent literature.

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Hyperbolic Differential Equation with Fuzzy Parameters

Communication Info

Authors:
Bouchra BEN AMMA[1]
Said MELLIANI[2]
Lalla Saadia CHADLI[2]

[1]LMACS, Higher School of Education and Training, Sultan Moulay Slimane University, Beni Mellal, Morocco.
[2] LMACS, Faculty of Sciences and Technologies, Sultan Moulay Slimane University, Beni Mellal, Morocco.

Keywords:
(1) Intuitionistic fuzzy number.
(2) Intuitionistic fuzzy solutions.
(3) Fixed Point.

Abstract

This paper examines boundary value problems for partial hyperbolic differential equations with fuzzy boundary conditions. A new weighted metric is introduced to investigate the existence and uniqueness of fuzzy solutions to these problems in a complete fuzzy metric space. A numerical example is provided to demonstrate the effectiveness of the proposed theory.

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5D Black Holes and Black strings from M-Theory in Complete Intersection Calabi-Yau Three-folds (CICY3).

Communication Info

Authors:
BOUHOUCH Abderrahim [1]

[1] Departement de Physique, Equipe des Sciences de la matière et du rayonnement, ESMaR, Faculte des Sciences, Université Mohammed V de Rabat, Rabat, Morocco.

Keywords:
(1) Calabi-Yau manifolds
(2) M-theory
(3) Black objects
(4) Weighted Projective Spaces

Abstract

Using N = 2 supergravity formalism, we investigate certain behaviors of five dimensional black objects from the compactification of M-theory on a Calabi-Yau three-fold. The manifold has been constructed as the intersection of two homogeneous polynomials of degrees (ω +2,1) and (2,1) in a product of two weighted projective spaces given by $WP^4(\omega, 1,1,1,1) \times P^1$. Firstly, we determine the allowed electric charge regions of the BPS and non BPS black holes obtained by wrapping M2-branes on appropriate two cycles in such a proposed Calabi-Yau three-fold. Secondly, we show that the non BPS states are unstable for generic values of ω. Finally, we conduct a similar study of five dimensional black strings and we show that the non-BPS black string states are stable in the allowed regions in the magnetic charge space by determining the recombination factor.

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Mathematical modeling of improving the understanding of a mathematical concept learned by a teacher of mathematics with optimal control

Communication Info

Authors:
Soukaina HILAL[1]
Youssef BENFATAH[1]
Hassan LAARABI[1]
Mostafa RACHIK[1]

[1] *Faculty of Sciences Ben M'Sik Casablanca Morocco*

Keywords:
(1) Mathematical concept
(2) Discrete time model

Abstract

The aim of this paper is to increase the number of excellent learners studying a new mathematical concept presented by a teacher of mathematics. For this reason we consider a LLRSRR discrete time model where L refer to Learners who have no idea of the presented mathematical concept, LR Learners who have weak misrepresentation (not well understand the new concept), SR Learners who have strong misrepresentation (very bad understanding the concept) and R denote the class of Learners who become master of such concept. An experimental study involving 106 students of Morocco in ninth grade was performed (three different classes of such level). The results revealed that working on various activities related to the studied concept, provide a variety of teaching methods and support by the professor and parents tore-explain the concept allows learners to well understand the new mathematical concept.

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Image denoising via optimal control of the diffusivity function in the Perona-Malik model

Communication Info

Authors:
Kawtar LEHRIZI[1]
Omar GOUASNOUANE[1]
Anouar BENLOGHFYRY[2]
Noureddine MOUSSAID[1]

[1] LMCA, FSTM, Hassan 2, University, Casablanca, Morocco

Keywords:
(1) Optimal control
(2) Perona-Malik
(3) diffusivity

Abstract

In this work, we propose a novel model for image denoising inspired by the well-known Perona-Malik model. To address the inherent limitations of the Perona-Malik equation, such as the staircasing effect and contrast loss, we introduce an innovative approach based on the optimal control of the diffusivity function. By adaptively regulating the diffusion process, our model effectively enhances noise suppression while preserving crucial image features. Comparative evaluations against state-of-the-art models demonstrate the superiority of our approach in maintaining structural details and achieving improved denoising performance

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Integrodifferential evolution systems with nonlocal initial conditions

Communication Info

Authors:
Khalil EZZINBI[1]
Sylvain KOUMLA[2]
Nelio N'DOGOTAR[3]

[1]Cadi Ayyad University,
ezzinbi@uca.ac.ma
[2*] Adam Barka
University, Abeche, Chad,
E-mail: skoumla@gmail.com
[3] University of Sarh
Sarh, Chad, E-mail:
neliondogotar@gmail.com

Keywords:
Integrodifferential equations, Nonlinear evolution equation; nonlocal initial condition; delay; Krasnoselskii's fixed point theorem for a sum of operators, resolvent operatos

Abstract

The paper deals with systems of abstract integrodifferential equations subject to general nonlocal initial conditions. We suppose that undelayed part admits a resolvent operator in the sense given by Grimmer in [Grimmer, R., Resolvent operators for integral equations in Banach space. Transaction of American Mathematical Society. 273 (1982) 333-349]. In order to allow the nonlinear terms of the equations to behave independently as much as possible, we use a vector approach based on matrices, vector-valued norms and a vector version of Krasnoselskii's fixed point theorem for a sum of two operators. The assumptions take into account the support of the nonlocal initial conditions and the hybrid character of the system. Two examples are given to illustrate the theory.

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Double Conformable Fourier Transform

Communication Info

Authors:
Khadija ELGOURMATI[1]
Rachid BAHLOUL[2]

[1, 2] Department of Mathematics, poli-disciplinary faculty, Sultan Moulay Slimane University, Beni Mellal, Morocco.

Keywords:
(1) Conformable derivative.
(2) Conformable
(3) Fourier transform.

Abstract

Using the new definition of the α-conformable derivative introduced by Khalil et al. (2014), we provide a new definition of double conformable Fourier transform, called an (α, β)-conformable Fourier transform, and we use it to find the transform of the (λ, μ)-derivative of a function and its corresponding integral. Further, we establish several important results for such a transform, including its relation to the usual Fourier transform and its convolution theorem. Finally, we employ the (λ, μ)-Fourier transform to solve an (λ, μ)-conformable differential equations.

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Efficient blind image deconvolution using Sobolev space priors and GCV-based parameter estimation

Communication Info

Authors:
Bouchra LAAZIRI[1]
Abdelilah HAKIM[1]
Said RAGHAY[1]

[1] Department of Mathematics, FSTG, University of Cadi Ayyad, Marrakesh, Morocco

Keywords:
(1) Blind image deconvolution
(2) supervised Bayesian approach
(3) regularization

Abstract

Classical image deconvolution aims to estimate the true image when the blur kernel (or point spread function, PSF) of the blurring system is known a priori [1]. In contrast, blind image deconvolution tackles the more challenging—yet more realistic—problem where the PSF is unknown [2, 3].
Bayesian inference with appropriate priors on both the image and the blur has been successfully applied to this blind problem [4], particularly using Gaussian priors and joint maximum a posteriori (JMAP) estimation. However, this approach tends to be unstable and often introduces significant ringing artifacts in practical applications.
To address these limitations, we propose a regularized version incorporating H^1 regularization terms for both the sharp image and the blur kernel. We also present practical techniques for estimating the smoothing parameters [5]. Our resulting algorithm is computationally efficient and demonstrates superior performance compared to several well-known methods in the literature.

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E-learning et acceptation des technologies : Évaluation de l'acceptation de la plateforme d'apprentissage en ligne E-Takwine par les enseignants à travers le modèle TAM

Communication Info

Authors:
Jihane BAKKALI [1]
Malika EL GAJOUI [2]

[1] Enseignante chercheuse, FSJES-Souissi, UMV-Rabat, LARMODAD, Maroc
[2] Doctorante, FSJES-Souissi, UMV-Rabat, LARMODAD, Maroc

Keywords:
(1) E-learning
(2) TAM
(3) E-Takwine

Abstract

Les technologies de l'information et de la communication (TIC) se sont imposées au fil des dernières décennies. Le domaine de l'éducation se trouve au cœur de cette dynamique [1]. Dans ce contexte, le ministère de l'éducation nationale a mené des initiatives telles que les projets d'apprentissage en ligne [2].

Cet article analyse l'adoption de la plateforme E-Takwine par les enseignants marocains en s'appuyant sur le modèle TAM de Davis (1989)[3][4]. À travers un questionnaire en ligne, l'étude explore la perception de l'utilité et de la facilité d'utilisation de la plateforme, et l'impact sur l'intention d'utilisation. Nous intégrerons d'autres dimensions telles que l'influence du contexte socioculturel marocain [5] et les caractéristiques spécifiques de la plateforme étudiée. Les résultats permettront de formuler des recommandations pour améliorer l'adoption des plateformes d'apprentissage en ligne au Maroc.

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Enhancing the T-Coffee Method for RNA Sequence Alignment through the Divide and Conquer Principle

Communication Info

Authors:
Abdelhakim EL FATMI [1]
M. Ali BEKRI [2]

[1] *Faculty of economics and management Ibn Tofail University, Kenitra, Morocco.*
[2] *Faculty of sciences Moulay Ismail University, Meknes, Morocco.*

Keywords:
(1) Bioinformatics
(2) Multiple sequence alignment
(3) RNA

Abstract

Multiple sequence alignment (MSA) is a fundamental tool in bioinformatics and has been the focus of numerous studies in recent years [1].
In this study, we propose a novel approach to MSA by improving the T-Coffee method through the application of the divide-and-conquer (DC) principle. The proposed method involves three steps. The first utilizes a DC strategy to detect similar regions among sequences and segment them into smaller parts. The second phase involves aligning the dissimilar regions using the well-established T-Coffee method. In the third phase, all regions identified in the first step are combined with the sub-alignments generated in the second phase to construct the complete alignment. To evaluate the effectiveness of our method, we compared it with several established methods for RNA MSA, including T-Coffee [2], Crustal Omega [3], Kaling [4] , MAFFT [5], Muscle [6], and MARNA, using a dataset of 30 test cases from the Bralibase benchmark and the two parameters SPS (Sum-of-Pairs Score) and SCI (Structure Conservation Index). This comparative study demonstrated that our method consistently provided better results in most cases. The proposed method shows the highest average SPS (0.93) and SCI (0.96) compared to other methods.

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ICRAMCS 2025

THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

April 24-25-26, 2025 | Marrakech, Morocco

Medical image analysis using machine learning models

Communication Info

Authors:
Khadija El Haddad[1]
Aissam Bekkari, [2]
Walid Bouarifi,[2]
Abdelilah JRAIFI [1]

[1] National School of Applied Sciences, Cadi Ayyad University Country, Safi, Morocco
[2] National School of Applied Sciences, Cadi Ayyad University Country, Marrakech, Morocco

Keywords:
(1) Machine Learning
(2) Stochastic Gradient Descent
(3) Linear Discriminant Analysis
(4) Light GBM
(5) XGBoost

Abstract

The healthcare field presents a real challenge for professionals due to disease prediction complexity, patients' demand for high-quality care, and the large amount of data generated, including genomic data, medical records, and sensor data. Accurately analyzing this information is a tremendous issue. Machine Learning (ML) has revolutionized the medical field over the last decades by automating the analysis process using advanced algorithms. These algorithms allow accurate large-scale analysis, early-stage prediction of dangerous diseases, and improved medical practices.

Medical image analysis is fundamental for modern healthcare. It involves interpreting various types of data, such as MRIs, X-rays, and more.

This study is a comparative analysis of medical images exploring many existing studies such as [1-5] based on ML methods: XGBooster classifier, Light GBM (LGBM), Linear Discriminant Analysis (LDA), and Stochastic Gradient Descent (SGD), using two MRI datasets: Brain Tumors and Pneumonia datasets. The outcome of this research paper achieves an accuracy of 97%.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Efficient Lane Detection using Mobile U-Net Model

Communication Info

Authors:
Najia AIT HAMMOU[1,2]
Hajar MOUSANNIF [1]
Brahim LAKSSIR [2]
Abdellah ELAISSAOUI [3]

[1] Cadi Ayyad University, Marrakech, Morocco
[2] MAScIR Foundation UM6P, Benguerir, Morocco
[3] INRA, Settat, Morocco

Keywords:
(1) AI model
(2) Edge detection
(3) Image processing
(4) Row navigation

Abstract

Row navigation is a key technique often used for agricultural tasks such as weeding or harvesting, ensuring autonomous movement between crop rows. In order to follow a precise trajectory, avoid obstacles, and work in varied conditions, the robot must stay aligned with the crop rows, detect and avoid objects or uncultivated areas, and adapt to changes using only computer vision with a camera. The principle relies a priori on image processing, especially edge detection. Lane detection is a fundamental problem of inter-row navigation, which necessitates the use of an artificial intelligence (AI) model in order to provide effective and autonomous robot guiding. This research begins with a brief review showing the importance of applying AI for lane detection in agricultural fields. Next, we present the steps involved in implementing an appropriate model, Mobile U-Net, going through data preparation, data pre-processing, configuration of Mobile U-Net, training, and ending with the evaluation stage to test the effectiveness of this model on our data.

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Enhancing Thoracic Disease Classification Using YOLOv8n-cls: A Lightweight Deep Learning Approach

Communication Info

Authors:
Hanan SABBAR[1]
Hassan SILKAN[1]
Khalid ABBAD[2]
Khalid BELLFKIH[3]
[1] Chouaib Doukkali University, El Jadida, Morocco
[2] Sidi Mohamed Ben Abdellah University, Fez, Morocco
[3] Hassan II University, El Jadida, Morocco

Keywords:
(1) YOLOv8
(2) Thoracic disease classification
(3) Chest X-ray
(4) Deep learning
(5) Medical imaging

Abstract

This study explores YOLOv8n-cls for classifying thoracic diseases from chest X-ray images. The lightweight YOLOv8n-cls model, chosen for its speed, efficiency, and accuracy, achieved a top-1 accuracy of 92.49% at epoch 50. Comparisons between YOLOv8n and YOLOv8x showed similar performance. Despite data augmentation, improvements were limited by dataset size and diversity. Other architectures achieved [1] high validation scores but struggled with test data generalization, emphasizing the importance of test performance in clinical applications [2-3]. YOLOv8n-cls, despite initial overfitting, showed promise through early stopping. Metrics analysis highlighted areas for improvement, particularly in reducing false positives and negatives for conditions like fibrosis. The dataset included 7,172 images across five classes [5-6]. While results are promising. This work demonstrates the potential of lightweight models like YOLOv8n-cls for efficient thoracic disease classification.

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A Novel Image Encryption Scheme Combining Hill Cipher and One-Dimensional Chaotic Map

Communication Info

Authors:
Mohamed HTITI[1]
Abdelaziz AHAITOUF [1]
Ismail AKHARRAZ[2]

[1] Laboratory of Engineering Sciences (LSI), Polydisciplinary Faculty of Taza, Sidi Mohamed Ben Abdellah University, Fez, Morocco
[2] Laboratory of Mathematical and Informatics Engineering, Ibnou Zohr University, Agadir, Morocco

Keywords:
(1) Hill Cipher
(2) Chaotic Map
(3) Image Encryption

Abstract

The integration of Hill cipher [1] and 1D chaotic maps [2] has gained significant attention in image encryption due to their complementary strengths. While the Hill cipher provides a strong cryptographic foundation, chaotic maps introduce unpredictability and sensitivity to initial conditions, enhancing the security of encryption algorithms. Recent studies have explored various combinations of these techniques, such as VHC-CIES, which combines a Hill cipher variant with improved chaotic maps [3], and other schemes incorporating elliptic curve cryptography (ECC) and 3D chaotic maps [4]. In this paper, we propose a novel image encryption scheme that utilizes a special matrix with two adjustable parameters, ensuring invertibility for efficient encryption and decryption. To further enhance security, a chaotic map [5] is integrated to generate a dynamic key, which modifies the special matrix, introducing unpredictability and robustness against potential attacks.

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Some Stationaries Markov models

Communication Info

Authors:
Meryem AMEUR[1]
Yassine CHAJRI [2]
Cherki DAOUI [3]
Najlae IDRISSI [4]

[1,2,3,4] FST, Beni Mellal, Morocco

Keywords:
(1) Image segmentation
(2) HMC
(3) PMC
(4) Color images

Abstract

Here, we compare the model Hidden Markov chain with independent noise with two correlated hidden Markov models such as Correlated Hidden Markov Chain and the recent version of Markov model, Pairwise Markov Chain.

We use these models, to segment some color textured images, our purpose is to demonstrate: The role of the correlation between pixels component the image, in improving segmentation quality.

From the results, we can remark that, our demonstration has been approved.

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April 24-25-26, 2025 | Marrakech, Morocco

Co-clustering methods: An experimental review

Communication Info

Authors:
Meriem GANMATI[1]
Hasna CHAMLAL [2]
Tayeb OUADERHMAN [3]

[1] *meriem.ganmati-etu@etu.univh2c.ma*

[2] *hasna.chamlal@univh2c.ma*

[3] *tayeb.ouaderhman@univh2c.ma*

Computer Science and Systems Laboratory (LIS), Department of Mathematics and Computer Science, Faculty of Sciences Ain Chock, Hassan II University of Casablanca, Morocco.

Keywords:
(1) clustering
(2) co-clustering
(3) Coclust

Abstract

Co-clustering is a powerful technique used in unsupervised learning, which simultaneously groups the rows and columns of a matrix[1]. Its aim is to group data into similar clusters, so that all samples in a cluster are similar to each other and different from samples in other clusters.[2] To achieve this goal, partitional or diagonal clustering algorithms are used, while Map-Reduce clustering algorithms perform better in the case of high-dimensional data. The role of these algorithms is to define advantageous homogeneous sub-matrix (biclusters).[3] This paper comprehensively reviews the most significant clustering algorithms : ***CoclustInfo*** algorithm that adopts an information-theoretic approach and the block-diagonal algorithms namely ***CoclustMod*** and ***CoclustSpecMod*** . [4]
Furthermore, those approaches are implemented in **R** and compared in terms of clustering performance by conducting various experimental evaluation schemes. Moreover, the significance of the experimental comparisons is examined using Friedman and Holm's post-hoc statistical tests.[5]

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April 24-25-26, 2025 | Marrakech, Morocco

Enhancing Firewall Log Analysis with Deep Learning: A Novel SIEM Architecture for Threat

Communication Info

Authors:
Yasmine ABOUDRAR[1]
Khalid BOURAGBA [2]
Mohamed OUZZIF [3]

[1] *University Hassan 2, Casablanca, Morocco*
[2] *University Hassan 2, Casablanca, Morocco*
[3] *University Hassan 2, Casablanca, Morocco*
Keywords:
(1) SIEM
(2) DL
(3) AI

Abstract

The SIEM (Security Information and Event Management))is designed for the detection and response of cyber threats in real-time. This paper proposes an innovative SIEM architecture using Deep Learning algorithms that could be useful for improving the quality of the firewall log analysis. Our approach includes the pre-processing of a network traffic dataset comprising suspicious attacks, to which Deep Learning techniques can be applied to classify and detect anomalies. The proposed model achieved an accuracy superior than 85%, hence showing effectiveness in identifying potential threats. These findings infer the benefits of Deep Learning integrated into SIEM systems in enhancing automated threat detection and response mechanisms.

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April 24-25-26, 2025 | Marrakech, Morocco

Intrusion Detection System using ML and DL approaches: A Systematic literature review

Communication Info

Authors:
Hicham ZMAIMITA[1]
Abdellah MADANI [2]
Khalid ZINE-DINE [3]

[1] Chouaib Doukkali University El Jadida, Morocco
[2] Chouaib Doukkali University El Jadida, Morocco
[3] Mohammed V University, Rabat,Morocco

Keywords:
(1) intrusion detection system
(2) Machine learning
(3) Deep learning
(4) IDS
(5) cybersecurity

Abstract

With the rapid evolution of cyber threats, intrusion detection systems (IDS) have become an important element of cybersecurity. Traditional IDS methods are often based on signature detection, which is not sufficient for newly discovered or obfuscated attacks. In recent years, machine learning (ML) techniques or deep learning (DL) methods have been proposed as complete alternatives offering better accuracy, scalability and automation. This systematic review aims to analysis the most recent machine learning and deep learning methods for intrusion detection or classification more specifically. Systematic reviews were conducted following the various PRISMA guidelines with the inclusion of peer-reviewed publications obtained from the major digital libraries (IEEE Xplore, ACM Digital Library, Google Scholar, SpringerLink and ScienceDirect) from 2015 to 2024. In the end, 85 studies were selected on the basis of these rigorous inclusion and exclusion criteria. Generally, we observed that supervised learning algorithms such as SVMs, Random Forests and kNNs achieved high detection rates on relevant benchmark datasets such as NSL-KDD, CICIDS2017 and UNSW-NB15 [1] [2] [3]. As far as DL models are concerned, the CNN, RNN and Hybrid framework [4] [5] methods seem promising for improving methods for identifying or classifying advanced attacks, in particular zero-day or real-time attacks.

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Optimizing Performance and Security in Invasive Cardiac IoMT with MQTT, CoAP, and Encryption

Communication Info

Authors:
Charaf Eddine AIT ZAOUIAT [1]
Mohamed EDDABBAH [2]

[1] *Polydisciplinary Faculty of Sidi BennourChouaib Doukkali , University, El Jadida, Morocco*

[2] *Higher School of Technology of Essaouira, Cadi Ayyad University Marrakesh, Morocco*

Keywords:
(1) IoMT
(2) MQTT
(3) CoAP

Abstract

Security is a major challenge in the Internet of Medical Things IoMT since sensitive patient data needs to be safeguarded along with maintaining the integrity of the communication between various devices [1]. Ensuring confidentiality and authenticity in pacemakers, defibrillators, and other medical devices requires maintaining efficient communication over resource constraint environments [2].

Light weight communication protocols such as MQTT and CoAP find their wide adaptability in the IoMT to enable secure and Efficient data transfer is done using it. This work focuses on a performance analysis of MQTT and CoAP in terms of latency, efficiency, and energy consumption, considering both the effects that security mechanisms such as TLS for MQTT and DTLS for CoAP can produce [3].

The obtained results clearly indicate that CoAP, based on the light-weight UDP design, presents lower latency of about 20-35% and higher efficiency by 15-25% compared to MQTT, with regard to packet size variation

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A literature review on OWL-based biomedical ontologies for Clinical Information Management

Communication Info

Authors:
Fatima ZINNANE[1]
Mounsif FERNANE [2]
Abdellah MADANI [3]

[1]*Computer Science Department, Faculty of Science, Chouaib Doukkali University, El Jadida, Morocco.*
[2]*Computer Science Department, Faculty of Science, Chouaib Doukkali University, El Jadida, Morocco.*
[3]*Computer Science Department, Faculty of Science, Chouaib Doukkali University, El Jadida, Morocco.*

Keywords:
(1) Biomedical ontologies
(2) OWL
(3) Healthcare

Abstract

The role of ontologies is essential in various fields [1], particularly biomedical information management [2]. This study examines the function of biomedical ontologies based on OWL (Web Ontology Language) [3], which provides a formal, machine-readable representation of medical expertise. This major advance substantially simplifies interoperability between healthcare systems, following the example of the Fundamental Model of Anatomy (FMA) [4], the Disease Ontology (DO) [5] and others, in the management of clinical information. The implementation of ontologies has been proven to facilitate automated reasoning processes while offering important diagnostic resources and promoting data standardization in the context of electronic medical records. The results of the current study provide evidence that the continued implementation of OWL-based ontologies will lead to further substantial improvements in decision support systems and biomedical research, contributing to more efficient healthcare management.

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Automated Machine Learning for Healthcare: A Meta-Learning Approach to Algorithm Selection

Communication Info

Authors:
Mohamed Abdelbaki [1]
Adnane Latif [1]
Charaf Eddine Ait Zaouiat [2]
Habiba ELFATOUAKI[1]

[1]*National School of Applied Sciences, University of Cadi Ayyad, Marrakesh, Morocco.*

[2]*Polydisciplinary faculty of sidi bennour. Chouaib Doukkali University, Morocco,*

Keywords:
(1) Meta-Learning
(2) Healthcare AI
(3) Algorithm Selection

Abstract

The rapid growth of healthcare data presents both opportunities and challenges in medical decision-making [1]. Machine learning (ML) techniques have proven effective in extracting meaningful insights from medical datasets [2]. However, selecting the most suitable ML algorithm remains a significant challenge, particularly for healthcare professionals with limited expertise in artificial intelligence (AI) [3]. This paper presents a meta-learning-based system designed to automate algorithm selection based on dataset characteristics and past performance. The system was evaluated across multiple medical applications, including dementia prediction, heart disease classification, ECG signal analysis, and real-time IoT-based health monitoring. Experimental results demonstrate that our approach achieves performance comparable to or exceeding existing studies while reducing the need for manual intervention.

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April 24-25-26, 2025 | Marrakech, Morocco

Enhancing Malware Detection with Deep Learning: A Study on AI-Driven Security Solutions

Communication Info

Authors:
Safa RKHOUYA[1]
Khalid CHOUGDALI [2]

[1] National School of Applied Sciences (ENSA) Ibn Tofail University, Kenitra, Morocco
[2] National School of Applied Sciences (ENSA) Ibn Tofail University, Kenitra, Morocco

Keywords:
(1) Malware
(2) Deep learning
(3) Cybersecurity

Abstract

As more cyber-attacks are AI-driven, the traditional malware detection methods have become ineffective to deal with such increased sophistication of the attacks. The cybercriminals use AI for developing sophisticated malware that easily bypasses any traditional security solution. So, cybersecurity experts need to also use AI to enhance their detection capability. This paper examines how deep learning can enhance malware detection by identifying patterns in executable files. We explore different neural network models to automatically recognize malicious behaviors and improve detection accuracy while reducing false alarms. Our findings demonstrate the potential of AI-powered security solutions to strengthen cybersecurity defenses.

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Abstract

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The $\mathcal{F}$-limit of a collection of ideals

Communication Info

Authors:
Ayoub OUDIKA [1]
Hassan MOUADI [2]
Driss KARIM [3]

[1] *LMIA, Faculty of Sciences and Technology of Mohammedia, Hassan II University, Casablanca, Morocco*

[2] *LISIMA, Polydisciplinary Faculty of Taroudant, Ibnou Zohr University, Agadir, Morocco*

[3] *LMIA, Faculty of Sciences and Technology of Mohammedia, Hassan II University, Casablanca, Morocco*

Keywords:
(1) $\mathcal{F}$-limit

Abstract

In this work, we propose a generalization of the concept of an $\mathcal{F}$-limit of a collection of prime ideals by replacing the ultrafilter $\mathcal{F}$ with a family $\mathcal{F}_\kappa$ associated with an infinite cardinal κ. This approach leads to the definition of a new topology on the spectrum of commutative rings.

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ICRAMCS 2025

THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Digital Design of Moroccan Zellige Geometric Patterns

Communication Info

Authors:
El Houcini Ettajer[1]
Youssef Aboufadil[1]
Abdelmalek Thalal[2]

[1] Laboratory of Physics, Energies, Environments and their Applications (LP2EA), Department of Physics, Cadi Ayyad University, Polydisciplinary Faculty of Safi, Morocco.
[2] Emeritus Professor, Laboratory of Materials, Energy and Environment (LaMEE), Faculty of Sciences Semlalia, Cadi Ayyad University, Marrakech, Morocco.

Keywords:
(1) Zelliges
(2) Moroccan geometric art
(3) Mathematical algorithms

Abstract

Moroccan geometric art, particularly zelliges, is among the most refined forms of Arab-Islamic art, characterized by unique aesthetics and rigorous mathematical construction rules [1,2]. Transmitted selectively, only a few privileged individuals learned from Mâalams, preserving traditions but limiting development [3]. Our goal is to create existing and new zellige patterns to enrich traditional motifs [4]. We are developing a computer algorithm to design patterns and determine the best fit for specific surfaces [5]. This approach enhances the diversity and beauty of zellige while enabling adaptation to various artistic and architectural contexts [6].

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New Solutions for Evolving VoIP Threats: Enhancing the Security of Asterisk PABX

Communication Info

Authors:
Zineb ELLAKY[1]
Yassir MATRANE [2]
Faouzia BENABBOU [3,4]

[1] UH2C, Casablanca, Morocco
[2] UH2C, Casablanca, Morocco
[3] UH2C, Casablanca, Morocco
[4] UH2C, Casablanca, Morocco

Keywords:
(1) VoIP
(2) Asterisk PABX
(3) security,
(4) OpenVPN
(5) Radius
(6) LDAP
(7) SSO

Abstract

Voice over IP (VoIP) has emerged as an essential solution for businesses aiming to reduce their communication costs. However, the adoption of VoIP raises significant security concerns, exposing organizations to risks such as call hijacking, fraud, identity theft, eavesdropping, and traffic interception. This article presents an in-depth study of the implementation and securing of a Private Automated Branch Exchange (PABX) based on Asterisk, an open-source IP telephony software. Our approach included Designing a Virtual Testing Environment: We established a testing environment consisting of two interconnected sites to simulate a typical enterprise network. Installing and Configuring Asterisk: We deployed and configured an Asterisk server to manage VoIP calls, emphasizing key technical aspects. We conducted a white-box penetration test to identify potential vulnerabilities. Securing Communications: We implemented robust security measures, including the use of OpenVPN to create encrypted tunnels for securing data exchanges. Centralized Authentication: We integrated a FreeRadius server to ensure centralized client authentication, thereby enhancing system access security. We identified major security challenges and proposed concrete solutions to mitigate them.

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ICRAMCS 2025
THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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A Hybrid Machine Learning and Generative AI Model for Predicting Academic Performance from Learning Traces

Communication Info

Authors:
Jamal Eddine RAFIQ [1]
Abdelali ZAKRANI [1]
Said NOUH [1]

[1] *Hassan II University, Casablanca, Morocco*

Keywords:
(1) *Online Learning*
(2) *Academic Performance Prediction*
(3) *Hybrid Machine Learning*
(4) *Generative AI*
(5) *Model Interpretation*

Abstract

Analyzing students' learning traces in digital environments provides valuable insights into the factors influencing their academic performance [1][2]. This paper introduces a hybrid model that combines Machine Learning (ML), Deep Learning (DL), and Generative Artificial Intelligence (GenAI) to predict students' Grade Point Average (GPA) using learning traces from six dimensions: demographic, cognitive, social, emotional, contextual, and normative [3][4]. First, Random Forest is employed to select the most influential features. Then, a combined model based on MLP, LSTM, and XGBoost is trained to enhance prediction accuracy. Generative AI (DeepSeek) is integrated to enrich contextual data and provide personalized recommendations to learners. Finally, SHAP is used to interpret the results, offering explanations for the model's decisions. The evaluation of the model on a large dataset demonstrates a significant improvement in performance compared to traditional approaches.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

A Blockchain-IoT Framework for Transparent Food Supply Chains in Urban Quick-Service Restaurants

Communication Info

Authors:
Zouhair Elhadari[1]
Hicham Zougagh[1]
Noureddine Idboufker[2]
Mohamed Ech-chebaby[1]

[1]Faculty of Sciences and Techniques Moulay Slimane University, Beni Mellal, Morocco.
[2]National School of Applied Sciences Cady Ayyad University, Marrakech, Morocco

Keywords:
(1) Blockchain and IoT
(2) Food Supply Chains
(3) Blockchain-IoT Framework

Abstract

The rapid urbanization phenomenon has ushered in significant challenges for cities worldwide, necessitating the exploration of innovative solutions such as smart cities to efficiently manage burgeoning urban populations. Among the various facets of smart city development, the integration of blockchain technology and Internet of Things (BcIoT) platforms has garnered attention from researchers aiming to address critical issues [1], including transportation, healthcare, and notably, food traceability [2]. Despite notable progress in sectors like transportation and healthcare, the domain of food safety within smart cities has been relatively neglected. However, the increasing recognition of the paramount importance of food safety underscores the urgent need to bolster food transparency and traceability within supply chains [3]. This research introduces a pioneering BcIoT-based layered model tailored to enhance food traceability in quick-service restaurants for smart cities efficiently. Beginning with the identification of optimal traceability units, the proposed system aims to bolster transparency and traceability within the food supply chain [4], [5]. It further proposes the design of a multi-layered model leveraging blockchain technology and aims to contribute to future advancements in food traceability systems within smart cities, ultimately advancing public health and safety measures in urban environments.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Assessing Integration Orders for SARIMA Modeling: Tunisia Gas Demand Forecasting

Communication Info

Authors:
Mohamed SLIMAN [1]
Neila BEDIOUI [2]
Mongi BESBES [3]

[1] Tunisian Company of Electricity and Gas, Tunis, Tunisia
[2,3] National Engineering School of Tunis (Laboratory of Robotics, Informatics, and Complex Systems), Tunis, Tunisia

Keywords:
(1) Natural gas demand
(2) SARIMA
(3) Integration orders

Abstract

Energy demand forecasting has gained importance due to the emerging need to achieve better energy efficiency, lower carbon footprint, cost-effective energy, and a smoother energy transition to renewable [1]. Gas, with its lower carbon footprint and affordability, serves as a transitional fuel.
SARIMA is popular for energy demand forecasting, but the estimation of its integration orders is often overlooked for non-stationary series [2]. This study emphasizes the significance of selecting appropriate integration orders [3] for accurate long-term forecasting, emphasizing the need for specific methodologies and hyperparameter tuning. In this paper, we present a case study on forecasting low-pressure gas consumption in central Tunisia using SARIMA models. Hourly data from ten gas stations in the region (January 2015 to August 2023) is downsampled and analyzed. The focus is on developing accurate mid to long-term forecasting models, addressing stationarity challenges [4], and determining appropriate integration orders (d, D).
Two methodologies are explored for estimating these orders utilizing statistical tests. The analysis includes a comprehensive comparative study using scale-independent metrics to determine the most effective method. The findings provide insights for gas

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April 24-25-26, 2025 | Marrakech, Morocco

A Comparative Study of Similarity Metrics for SVM-Based Recurrent Ticket Prediction

Communication Info

Authors:
Salma LIICHI[1]
Abdellah AZMANI[1]
Mohamed KOUNAIDI[1]
Ikhlass BOUKROUH[1]

[1] *Intelligent Automation & BioMedGenomics (IABL). Faculty of Sciences and Technology, Tangier, Morocco Abdelmalek Essaâdi University, Tetouan, Morocco*

Keywords:
(1) Support ticket system
(2) Support Vector Machines
(3) Jaccard similarity
(4) Cosine similarity
(5) SBERT similarity

Abstract

Support ticket system (STS) is one of the most critical customer relationship management (CRM) solutions through which companies are capable of managing customer requests properly [1] [2].
This paper presents a comparison of the performance of three methods to predict ticket recurrence with Support Vector Machines (SVM), which is a suitable algorithm for binary classification. The first method uses Jaccard similarity; the second uses Cosine similarity and the third uses SBERT and Cosine similarity by a hybrid approach [3] [4] [5].
The comparison of the three techniques regarding the performance of prediction based on accuracy indicates that the Jaccard-based approach is 0.7419 accurate, whereas applying Cosine Similarity provides much better performance at 0.8710. The hybrid procedure of SBERT and Cosine Similarity yields the best possible accuracy at 0.9355 and identifies that the hybrid procedure significantly boosts the predictive potential of the model in predicting ticket recurrence.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Modélisation informatique des pavages Quasi-périodiques : L'art des zelliges marocains

Communication Info

Authors:
Youssef ABOUFADIL[1]
El Houcini ETTAJER[1]
Abdelmalek THALAL[2]

[1] LP2EA, Faculté Polydisciplinaire de Safi, Université Cadi Ayyad, Marrakech, Maroc
[2] Faculté des Sciences Semlalia, Université Cadi Ayyad, Marrakech, Maroc

Keywords:
(1) Symétrie
(2) pavages Quasi-périodiques
(3) zellige marocain
(4) modélisation informatique

Abstract

Les motifs quasi-périodiques d'un cristal se reproduisent au niveau atomique, formant des motifs réguliers qui ne se répètent jamais. La similitude entre les panneaux de zellige marocain dans les monuments historiques et les motifs de diffraction des quasi-cristaux souligne que les maîtres artisans marocains ont créé, depuis le XIVe siècle, des motifs décoratifs présents dans des schémas quasi-périodiques.
Pour visualiser un quasi-cristal en deux dimensions, on peut suivre l'approche de Penrose (1974) qui a développé un pavage non périodique du plan en utilisant deux types de tuiles, ou utiliser la méthode de grille multiple de De Bruijn (1981) généralisée par Duneau et Katz (Duneau & Katz, 1985; Katz & Duneau, 1986).
Dans ce projet, nous allons modéliser le processus de création des pavages de zellige quasi-périodiques en combinant la méthode de grille multiple avec la méthode artisanale appelée Hasba. Ensuite, nous présenterons des exemples de motifs de zellige quasi-périodiques présents dans les monuments historiques marocains, tout en introduisant de nouveaux pavages pour enrichir la diversité des motifs de zelliges quasi-périodiques.

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Enhancing Dialectal Sentiment Analysis: Contextual Transcoding and Sentence Optimization Using Genetic Algorithms

Communication Info

Authors:
Hasnae SAKHI[1]
Sanaa EL FILALI [2]

[1] *LTIM, FSBM, Hassan II University, Casablanca, Morocco.*

[2] LTIM, *FSBM, Hassan II University, Casablanca, Morocco.*

Keywords:
(1) genetic algorithms
(2) Sentiment Analysis
(3) Moroccan Dialect
(4) Arabic Transcoding

Abstract

This study focuses on enhancing sentiment analysis for the Moroccan dialect (Darija) by leveraging its transcoding into Modern Standard Arabic (MSA) to utilize existing NLP tools. Darija presents significant challenges for natural language processing due to its lack of computational resources and notable linguistic differences from MSA. To address these issues, we developed a supplementary dictionary for Darija-specific words not found in standard Arabic resources, facilitating their conversion to MSA. However, the initial approach faced limitations in accurately preserving the contextual meaning of words, particularly for those with multiple interpretations. To overcome this, we integrated multilingual embeddings into the transcoding process, ensuring accurate contextualization of words during their conversion. Additionally, genetic algorithms were employed to optimize sentence structure by identifying and eliminating redundant or insignificant words, preserving meaning while reducing noise in the transcoded text. This combined approach was evaluated using classical machine learning models, showcasing its potential to improve sentiment analysis for Darija. Beyond Darija, this research offers a scalable and efficient solution for other Arabic dialects, emphasizing the importance of context-aware transcoding and sentence optimization in natural language processing applications.

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ICRAMCS 2025

THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

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Navigating the Future of Cryptography: Opportunities and Challenges in the Age of AI and Quantum Computing

Communication Info

Authors:
Najat RAFI[1]
Khadija Bouzkoura [1]
Abdelhakim CHILLALI [2]

[1] Hassan II University , Casablanca, Morocco
[2] Sidi Mohamed Ben Abdallah University, Taza, Morocco

Keywords:
(1) Cryptography
(2) Artificial Intelligence
(3) Quantum computing
(4) privacy-preserving technologies
(5) Post-quantum cryptography

Abstract

As the digital landscape continues to grow, the field of cryptography stands at a critical juncture, facing unprecedented challenges and opportunities. This paper explores the future of cryptography by examining emerging trends and generating insightful predictions concerning its future trajectory in the next decade. We analyze the impact of quantum computing on traditional cryptographic algorithms, the integration of artificial intelligence in cryptographic practices, the importance of privacy-preserving technologies, and the implications of regulatory frameworks. By synthesizing insights from current research and industry developments, we provide a comprehensive overview of the future landscape of cryptography, offering valuable perspectives for researchers, practitioners, and policymakers alike.

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A Novel Optimization Model for Transfer Learning in Convolutional Neural Networks

Communication Info

Authors:
Otmane MALLOUK[1]
Nour-Eddine JOUDAR[1]
Mohamed ETTAOUIL[1]

[1] Modelling and Mathematical Structures Laboratory, Department of Mathematics, Faculty of Science and Technology of Fez, Sidi Mohamed Ben Abdellah University, Fez, Morocco.

Keywords:
(1) Transfer learning
(2) Deep learning
(3) Convolutional neural networks
(4) Proximal algorithms

Abstract

Transfer learning [1-2] has achieved remarkable success across various applications. However, conventional deep transfer learning techniques, such as parameter sharing [3] and fine-tuning [4], often lack a structured strategy for parameter transmission. In this communication, we present STP-CNN, an optimization-based framework for parameter-based transfer learning in convolutional neural networks [5]. Our approach leverages a Lasso-based transfer model with a regularization term to control transferability, ensuring selective adaptation of network parameters. We solve this model using the proximal gradient descent method, allowing precise identification of transferable parameters at each convolutional layer for direct reuse or fine-tuning in the target network. Experimental results demonstrate the effectiveness of STP-CNN in optimizing transferability and improving classification performance.

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April 24-25-26, 2025 | Marrakech, Morocco

Performance evolution between ECGenELGAMAL and EdGenELGAMAL

Communication Info

Authors:
Madicke DIOP[1]
Demba SOW [2]

[1] UCAD, Dakar, Senegal
[2] UCAD, Dakar, Senegal

Keywords:
(1) GenELGAMAL
(2) Elliptic Curves
(3) Edwards Curves

Abstract

Elliptic curves [1] and Edwards curves [2] are mathematical tools widely used in the construction of modern cryptographic protocols [3]. Introduced by Harold M. Edwards in 2007, Edwards curves are distinguished by their optimized arithmetic operations, such as scalar multiplication, which uses simpler and more efficient addition formulas compared to elliptic curves. In this paper, we first implement the GenElGamal [4] scheme on classical elliptic curves (ECGenElGamal) and on Edwards curves (EdGenElGamal). Subsequently, we conduct a comparative study of the performance of these two implementations. This design exploits the properties Edwards curves for faster and more efficient cryptographic systems, while ensuring security based on the hardness of ECDLP [5].

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

April 24-25-26, 2025 | Marrakech, Morocco

Prediction of agricultural yields in Morocco using a hybrid algorithm: Segmentation and analysis of irrigation satellite images combined with machine learning and deep learning approaches

Communication Info

Authors:
Imade ABOURABIA[1]
Soumaya OUNACER[1]
Mohammed Yassine ELGHOUMARI[1]
Mohamed AZZOUAZI[1]

[1]*faculty of sciences ben m'sik/University Hassan II, Casablanca, Morocco*

Keywords:
(1) *Agriculture in Morocco*
(2) *Machine Learning (ML)*
(3) *Deep Learning (DL)*
(4) *Irrigation Optimization*
(5) *Satellite Imagery*
(6) *(GAN)*
(7) *Random Forest Regressor*
(8) *(CNN)*
(9) *Sustainable Practices*
(10) *Crop Yield*
(11) *Prediction*
(12) *Productivity*

Abstract

Agriculture is crucial to Morocco's economy, providing food security, livelihoods, and a significant share of GDP. However, the sector faces challenges such as climate change, water scarcity, and the need for sustainable practices [1], [2]. This study integrates machine learning (ML) and deep learning (DL) to improve agricultural productivity and optimize irrigation in regions like Doukkala, Settat, Souss, and Zemamra [3].
Using high-resolution satellite images and Generative Adversarial Networks (GAN), a dataset of 48,000 images was prepared to classify four irrigation types: surface, drip, sprinkler, and subsurface irrigation [4]. Random Forest Regressor achieved the highest accuracy in predicting agricultural yields (r^2: 0.91, MAE: 0.28, MSE: 0.16), outperforming other ML models. For irrigation classification, Convolutional Neural Networks (CNN) achieved 97% validation accuracy and high F1 scores for all irrigation types [5].
This study demonstrates the effectiveness of integrating ML, DL, and satellite imaging to address Morocco's agricultural challenges. It establishes a scalable framework for enhancing productivity, resource efficiency, and sustainability in the agricultural sector [6].

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Impact de Chatgpt : Utilisation de L'intelligence Artificielle Et de L'algorithme Génétique Pour Prédire La Performance des étudiants

Communication Info

Auteurs:
Lamyae MIARA[1]
Asmae BLILAT[2]
Mohammed BENOMAR EL MDEGHRI [3]

[1] ENSI, Tanger, Maroc
[2] ENCG, Fès, Maroc
[3] EMI, Rabat, Maroc

Keywords:
(1) ChatGPT
(2) Prédiction
(3) Algorithme génétique
(4) Réseaux de neurones

Résumé

Cette étude analyse l'impact de l'utilisation de ChatGPT[1] sur la performance académique[2] des étudiants, en se basant sur un questionnaire distribué à 500 étudiants issus de deux écoles marocaines: l'ENSI de Tanger et l'ENSA de Tétouan. Le questionnaire aborde divers aspects liés à l'utilisation de ChatGPT, tels que la fréquence d'utilisation, les domaines d'application, la note en informatique, leur niveau d'expertise dans l'utilisation de cet outil, etc. L'objectif principal de cette étude est de prédire l'impact de ChatGPT sur la note finale des étudiants au cours du semestre.

L'étude examine plusieurs hypothèses, notamment :

1. L'utilisation de ChatGPT a un impact significatif sur les notes finales des étudiants.
2. Les méthodes d'utilisation de ChatGPT influencent leur performance académique.
3. Les facteurs contextuels, tels que la fréquence d'utilisation de ChatGPT et les domaines d'application, jouent un rôle clé dans la réussite académique.

Les données collectées ont été analysées pour déterminer s'il existe une corrélation entre les réponses aux questionnaires et les notes des étudiants. Les résultats ont montré que la régression linéaire[3] ne peut pas être utilisée pour effectuer la prédiction. Ainsi, nous avons appliqué l'algorithme génétique[4] pour optimiser la sélection des caractéristiques les plus pertinentes. Ces caractéristiques ont ensuite été utilisées comme entrées pour un modèle de réseau de neurons[5], conçu pour prédire les notes des étudiants avec une précision maximale.

Cette recherche contribue à la littérature scientifique en fournissant une méthodologie innovante pour l'analyse des données éducatives, tout en offrant des insights pratiques sur l'intégration des outils d'IA générative dans les systèmes éducatifs. Les implications de cette étude sont multiples : elle propose des recommandations pour les éducateurs et les décideurs politiques sur la manière d'optimiser l'utilisation de ChatGPT dans l'apprentissage, tout en soulignant les limites et les défis potentiels liés à son adoption à grande échelle.

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A Game-Theoretic Variational Model for Image Denoising and Decomposition involving

Communication Info

Authors:
Requia ADDOUCH[1]
Noureddine MOUSSAID [1]
Omar GOUASNOUANE [1]
Anouar BEN-LOGHFYRY [1]
[1] *FST, Mohammedia, Morocco*

Keywords:
(1) Nonlocal-operator
(2) Noise removal
(3) Nash game

Abstract

In this work, we propose a game-theoretic variational model for image denoising [3, 4] and decomposition, using fractional [2] and non-local operators [1] to separate structure and texture. The problem is formulated as a two-player game within a Nash equilibrium framework [5], where one player reconstructs the denoised image while the other extracts texture. We establish theoretical guarantees on existence and uniqueness and validate the model through numerical experiments, demonstrating its effectiveness in noise reduction and precise image-texture separation.

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Enhancing Industrial Maintenance with Machine Learning and Vibration Analysis

Communication Info

Authors:
Ibtissam EL HARNAF[1]
Khadija ACHTAICH [2]
Samir TETOUANI [3]
Salma SAMMAH [4]

[1]*Faculty of Sciences Ben M'Sick, Technologies of Information and Modelisation Laboratory, The Higher School of Textile and Clothing Industrie, advanced numerical engineering laboratory, Casablanca, Morocco*
[2]*Faculty of Sciences Ben M'Sick, Technologies of Information and Modelisation Laboratory, Casablanca, Morocco*
[3]*The Higher School of Textile and Clothing Industrie, Advanced Numerical Engineering Laboratory, Casablanca, Morocco*
[4]*Faculty of Sciences Ben M'Sick, Technologies of Information and Modelisation Laboratory, Casablanca, Morocco*

Keywords:
(1) Predictive maintenance1
(2) Machine learning2
(3) Vibration analysis3

Abstract

This research focuses on the incorporation of artificial intelligence in industrial maintenance. It emphasizes predictive maintenance by utilizing vibration data. LSTM-GRU [1] models were employed for extracting features, along with XGBoost [2] for predicting failures, utilizing historical and real-time signals gathered from sensors. This method allows for the prompt identification of machinery malfunctions, improved planning for interventions, and decreased costs, aligning with the concepts of Industry 4.0 [3]. Industrial case studies confirm the methodology, showcasing marked enhancements in equipment reliability [4] and operational efficiency. The findings highlight the ability of AI-powered [5] solutions to transform maintenance methods, promoting sustainability and minimizing downtime.

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Une démarche mathématique pour supporter l’agrandissement optique dans les fontes dynamiques

Communication Info

Authors:
Abdelouahad BAYAR[1]

[1]*PSSII Lab – Université Cadi Ayyad – École Supérieure de Technologie de Safi, Safi, Maroc*

Keywords:
(1) Fontes Dynamiques
(2) Caractères Dynamiques
(3) Agrandissement Optique
(4) Ensembles de Séquences de Points
(5) Agrandissement Non-linéaire
(6) Obliquité
(7) Convexité
(8) Correspondance de Vecteurs

Résumé

Dans cet article, le problème du développement de fontes de caractères dynamiques en respectant le concept de l’agrandissement optique est concerné. La conception de fontes prenant en charge des caractères dont la taille et/ou la forme varient en fonction du contexte, se heurte encore à de grandes difficultés. Ceci est dû au manque de moyens formels, supportant l’agrandissement non-linéaire des objets mathématiques, utiles pour la spécification des symboles dans la fonte tout en maintenant la similarité et la satisfaction visuelles. Des travaux de recherches ont été réalisés pour trouver des solutions au problème [1][2][3]. Autre que les langages de fontes adoptés dans ces approches [1][2][3], le support du dynamisme est basée sur l’adoption d’une façon empirique de déplacement de points de contrôle menant à un résultat satisfaisant. Notre travail, par contre, porte sur Le développement d’une méthode permettant d’apporter des agrandissements non-linéaires à un ensemble de séquences de points tout en conservant les propriétés de convexité, d’obliquité, et de correspondance de vecteurs. Les caractères dynamiques développés à base de ce modèle, comme les symboles mathématiques extensibles et les lettres Arabes supportant le concept de Kashida, peuvent subir des extensions en conservant les propriétés de convexité, obliquité, et d'épaisseur; bases cruciales pour supporter l’agrandissement optique.

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Quality of Experience (QoE) Prediction in Morocco's Telecom Sector for Urban and Rural Areas

Communication Info

Authors:
Mohamed BABACHEKH[1]
Youssef Bourass [1]
Amina BENGAG [1]
Fadwa BOUHAFER [1]
Anass El Haddadi
Abdelkhalak BAHRI [1]

[1] Data Science and Competitive Intelligence team (DSCI), National School of Applied Sciences of Al-Hoceima, Abdelmalek Essaadi University

Abstract

A crucial indicator for assessing telecom services is Quality of Experience (QoE), which goes beyond Quality of Service (QoS) to take customer pleasure into account. With an emphasis on Maroc Telecom, Orange Maroc, and Inwi, this research investigates AI-driven models for forecasting and enhancing QoE in Morocco's telecom industry. Telecom operators may proactively handle service faults and improve performance by combining real-time network data, customer input, and predictive analytics.

This research presents a systematic approach to computing QoS metrics, such as latency, jitter, and packet loss, which are foundational to QoE assessment. By utilizing a combination of AI-driven models and multiple key indicators, telecom companies can achieve more accurate forecasting for QoE prediction. The integration of statistical, machine learning, and deep learning models enables a more precise assessment of service degradation, allowing operators to take proactive corrective actions. The experimental results obtained demonstrate that combining different forecasting approaches leads to improved network efficiency and enhanced customer satisfaction by ensuring more reliable service performance. Future studies will explore the role of edge computing and 5G in further optimizing QoE management.

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Machine Learning for Diabetes Prediction: a Gradient Boosting Approach with the Pima

Communication Info

Authors:
José L. Pereira [1]
Luzia Mendes [1]
Davide Carvalho [2]

[1] Faculty of Dental Medicine, University of Porto, Portugal
[2] Faculty of Medicine, University of Porto, Portugal

Keywords:
(1) Diabetes Prediction
(2) Gradient Boosting Machine (GBM)
(3) Pima Indians Diabetes Dataset

Abstract

Diabetes mellitus remains a growing global health concern, affecting over 530 million adults [1]. Type 2 diabetes, which comprises approximately 98% of diagnoses worldwide, is characterized by complex metabolic interactions that pose challenges for early detection [2]. Traditional statistical methods often fall short when modeling high-dimensional data with non-linearities and missing values. In this study, we employed a Gradient Boosting Machine (GBM) approach on the Pima Indians Diabetes Dataset to address these hurdles. By integrating predictive mean matching (PMM) for multiple imputation [3] and ROSE-based class balancing [4], we constructed a robust predictive model capable of handling data heterogeneity. The GBM model achieved an overall accuracy of 96.50%, with sensitivity of 96.97% and specificity of 96.04%, notably outperforming many conventional techniques. These results showcase the potential of ensemble-based machine learning [5] in refining diabetes prediction, thus offering a valuable tool for patient screening.

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Optimising credit risk management with AI: Case study on the application of SVM and ANN to assess the creditworthiness of bank customers

Communication Info

Authors:
Dr. Karim AMZILE[1]

[1] *BIGOFE laboratory FSJES-Ain Chock, Casablanca, Morocco*

Keywords:
(1) Credit risk
(2) Artificial Intelligence
(3) Bank
(4) SVM
(5) ANN

Abstract

Managing credit risk has always been a major challenge for banking institutions, requiring careful thought and a rigorous strategy. The aim is to predict, with optimum accuracy, which customers present a high risk of non-solvency or of being unable to repay their loans in full.

Most financial institutions attach considerable importance to this issue, both in terms of financial resources and knowledge, backed up by in-depth scientific research.

This is the context of the present work, in which two artificial intelligence methods, SVM [4] and ANN, were used to predict the creditworthiness of a bank's business customers. To do this, the article used historical data on a bank's business customers.

However, a process of data mining techniques was adopted to build these SVM and ANN models, and after evaluating the models obtained, the results obtained in this study show that the intelligence techniques provide relevant results in terms of the accuracy of the predictions made.

In addition, the accuracy of the SVM_{rbf} = 98,33% exceeds that of the ANN which is 93%.

Enhancing Model Accuracy through Explainable Error Analysis: A Decision Tree-Based Approach for XAI

Communication Info

Authors:
Sidi Mohamed DAFALI
Mohamed KISSI
Omar EL BEGGAR

Faculty of Sciences and Techniques of Mohammedia *University hassan2 of Casablanca, Morocco*

Faculty of Sciences and Techniques of Mohammedia *University hassan2 of Casablanca, Morocco*

Faculty of Sciences and Techniques of Mohammedia *University hassan2 of Casablanca, Morocco*

Keywords:
(1) eXplainable Artificial Intelligence (XAI)
(2) Decision Trees
(3) Model Explainability
(4) Error Analysis
(5) Machine Learning Transparency

Abstract
The transparency and explainability of machine learning models have become key challenges in the development of trustworthy and ethical artificial intelligence (AI)[1]. Although often highly performant, the most complex models, such as deep neural networks, frequently exhibit opacity, complicating the understanding of their functioning and errors[2]. In this paper, we propose an original approach based on decision trees to identify and explain classification errors of predictive models. By segmenting the data into correct and incorrect predictions, we train a decision tree on misclassified examples to enable the discovery of precise patterns explaining the initial error. On one hand, the explanations provided by this method are interpretable due to their simple rule-based format[3]. On the other hand, they allow for the improvement of the initial model's learning process. We evaluate our approach on several diverse datasets, demonstrating its effectiveness in explaining a significant number of errors and showing that when these insights are used to refine the model, they lead to tangible performance improvements. Our work aligns with current initiatives within Explainable Artificial Intelligence (XAI) and meets the transparency and reliability thresholds required for critical applications (healthcare, finance, justice[3]). By integrating this method directly into the model development framework, we contribute to building end-user trust without compromising the goal of high model performance[4].

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L'Utilisation de l'IA et du Machine Learning dans les Prévisions de Ventes et l'Optimisation des Performances Commerciales dans le domaine des OPCI

Communication Info

Authors:
Yassir DAHBI[1]
Aissam BEKKARI [2]
Aberrazzak NEJEOUI [3]
Mustapha OUJAOURA [4]

[1] LMCS Laboratory ENSA, Marrakech, Morocco

Keywords:
(1) OPCI
(2) Appels clients
(3) Processus de prévision
(3) Apprentissage automatique

Abstract

Cet article aborde le manque d'études empiriques sur le processus de génération de ventes au sein des Organismes de Placement Collectif en Immobilier (OPCI) en se concentrant sur l'impact des appels clients sur la clôture des opportunités. Dans ce papier nous utilisons des techniques d'analyse prédictive, y compris la sélection de caractéristiques et l'optimisation des hyperparamètres, afin de développer un modèle d'apprentissage supervisé adapté aux dynamiques uniques des processus de vente des OPCI.
L'objectif étant d'identifier les attributs critiques au sein de l'entonnoir de vente qui influencent significativement le processus de prévision, en mettant particulièrement l'accent sur le rôle des appels clients dans la conclusion des opportunités.
Le document explore différents types d'apprentissage automatique, avec un accent particulier sur l'apprentissage supervisé, et son applicabilité dans la prise de décision et la prévision commerciale dans le contexte des OPCI.
La méthodologie proposée est présentée dans le cadre de CRISP-DM, englobant des phases telles que la préparation des données, le nettoyage, la transformation et la modélisation. Les défis liés aux données manquantes et catégorielles, ainsi que l'importance de la sélection des caractéristiques et de leur encodage dans la prévision des ventes des OPCI sont également examinés.
La nouvelle approche proposée permet de prévoir efficacement la probabilité de succès dans les ventes des OPCI en analysant l'impact des appels clients, et en identifiant les attributs critiques au sein de l'entonnoir de vente.

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Machine learning and remote sensing for urban sprawl detection: A case study of Casablanca

Communication Info

Authors:
Hafsa OUCHRA[1]
Abdessamad BELANGOUR[2]
Allae ERRAISSI[3]

[1] *Laboratory of Information Technology and Modeling LTIM, Hassan II University, Faculty of Sciences Ben M'sik, Casablanca, Morocco*
[2] *Laboratory of Information Technology and Modeling LTIM, Hassan II University, Faculty of Sciences Ben M'sik, Casablanca, Morocco*
[3] *Chouaib Doukkali University, EL Jadida, Morocco*

Keywords:
(1) Remote sensing
(2) Machine learning
(3) Urbain planning

Abstract

Rapid and uncontrolled urbanization represents a major challenge for large metropolises, particularly Casablanca, where urban expansion significantly affects the environment and territorial resource management. This work proposes an approach based on machine learning and remote sensing [1]to analyze the evolution of urban sprawl over a 20-year period (2000-2020). By exploiting Landsat OLI/TIRS satellite images [2] via Google Earth Engine (GEE) and using supervised classification algorithms [3], [4] such as Random Forest (RF), Support Vector Machine (SVM) and CART, we were able to identify and quantify changes in land use [5]. The results show a significant increase in the urban area (from 21.8% in 2000 to 38% in 2020), accompanied by a reduction in vegetated surfaces and bare soil. A comparative evaluation of the algorithms revealed that Random Forest offered the best performance, with overall accuracy reaching 94% in 2010 and a Kappa coefficient greater than 0.85 over all the periods studied.

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Noise-Resilient Segmentation: A Novel Framework for Medical Images

Communication Info

Authors:
Chaimae OUCHICHA[1]

[1] *Department of Management Assistance Techniques, Hassan 1st University (UH1), ENCG, Settat, Morocco*

Keywords:
(1) Image processing
(2) Brain tissue segmentation
(3) Noise
(4) Fuzzy clustering
(5) Convergence analysis.

Abstract

Image segmentation is one of the most important and challenging processes in medical image analysis, particularly for Magnetic Resonance Imaging (MRI) brain scans. Accurate segmentation of brain tissues, such as gray matter, white matter and cerebrospinal fluid, is essential for diagnosing neurological disorders and conducting research. However, traditional segmentation methods often struggle with noise, intensity inhomogeneity, and the overlapping nature of tissue intensities in MRI data. In this context, we propose a novel approach to MRI brain segmentation using fuzzy clustering, which addresses these challenges by incorporating spatial information and handling uncertainty in voxel classification. Experiments were conducted on publicly available MRI datasets, and results show that the proposed fuzzy clustering approach outperforms traditional FCM and other state-of-the art methods in terms of segmentation accuracy and robustness to noise. The proposed algorithm demonstrates significant potential for clinical applications where accurate brain tissue segmentation is crucial.

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Simulation of Interactions of Heavy Charged Particles in Hadron Therapy Using Monte Carlo Geant4 Tools.

Communication Info

Authors:
Imane Mhiliss [1]
Rajaa Sebihi [1]
Abdessamad Didi [2]

[1] LPHE-MS, Faculty of Sciences, Mohammed V University, Rabat.
[2] National Centre for Energy, Science, and Nuclear Techniques -CNESTEN-, Rabat, Morocco.

Keywords:
(1) Radiotherapy
(2) Hadrontherapy
(3) Bragg Peak
(4) Charged particles
(5) Energy deposition
(6) Monte Carlo simulation
(7) Geant4

Abstract

Radiotherapy is one of the most common methods for treating cancer, typically involving the irradiation of tumours with high-energy photons. However, this approach often damages healthy tissues along the irradiation path. Hadron therapy, an innovative form of radiotherapy, uses charged particles such as protons or carbon-12 ions to target tumours more precisely. It is particularly effective in treating radio-resistant tumours near critical organs while minimising side effects due to its ability to deliver highly concentrated energy at the tumour site through the Bragg Peak. This study aims to model a detector based on a 50 × 50 × 50 cm^3 water phantom and to simulate, using the Monte Carlo tool Geant4, the interactions of charged heavy particles within an energy range of 300 to 400 MeV. The objective is to analyse the mechanisms responsible for energy deposition beyond the Bragg Peak. This work contributes to a better understanding of the physical processes involved in hadron therapy.

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A Comprehensive Review of Data Mining Techniques for Analyzing Factors Influencing Graduates' Employability

Communication Info

Authors:
Brahim BELLA[1]
Yman CHEMLAL[2]
Mohamed AZZOUAZI[3]
Abderrahmane DAIF[4]

[1] Faculty of Sciences Ben M'Sick / Hassan II University of Casablanca, Casablanca, Morocco
[2] Faculty of Sciences Ben M'Sick / Hassan II University of Casablanca, Casablanca, Morocco
[3] Faculty of Sciences Ben M'Sick / Hassan II University of Casablanca, Casablanca, Morocco
[4] Faculty of Sciences Ben M'Sick / Hassan II University of Casablanca, Casablanca, Morocco

Keywords:
(1) Data Mining
(2) Graduates' Employability
(3) Predictive Analysis
(4) Employability Factors
(5) Higher education

Abstract

Graduate employability is a key concern for higher education institutions and governments. This review examines data mining techniques used to study the factors influencing graduates' transition to employment. It synthesizes findings from various studies on methods like classification, clustering, and association rule analysis for predicting employability outcomes. Key factors influencing employability include academic performance, soft skills, technical skills, and demographics [1]. The review evaluates the effectiveness of algorithms such as decision trees, Naive Bayes, SVM, and neural networks in predicting employment results [2]. It also explores the role of educational data mining (EDM) and learning analytics (LA) in understanding student behaviors and identifying employability patterns [3]. Challenges like data imbalance and the need for qualitative studies are discussed [4]. Future research will focus on explainable AI (XAI) for improved model interpretability and examining social and economic factors on employability. This review aims to provide insights for educators, policymakers, and researchers to enhance graduate employability through data-driven strategies, guiding targeted interventions for improved employment outcomes [5].

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VAE-Based Anomaly Detection for Load Balancing in Cloud Computing

Communication Info

Authors:
Salma YAMARI [1]
El Habib BEN LAHMAR [1]

[1] HASSAN II University-Mohammedia-Casablanca, Faculty of Sciences Ben M'sik.
[1] Laboratory of Information Technology and Modelling Casablanca Morocco

Keywords:
(1) Variational Autoencoder (VAE)
(2) Load Balancing
(3) Anomaly Detection
(4) Generative AI
(5) Cloud Computing

Abstract

In the face of dynamic and unpredictable workloads in cloud computing environments, having an effective load-balancing method is essential in addressing the relationship between cloud resources and performing effective resource utilization[1]. This research introduces an anomaly detection framework leveraging a Variational Autoencoder (VAE) trained to detect overloaded machines in cloud environments by utilizing Google's Borg cluster dataset [2]. By learning normal operational patterns, the VAE detects anomalies in CPU and memory usage, aiding an intelligent load balancer in making real-time decisions. The framework is integrated in the CloudSim simulation environment [3], demonstrating significant improvements in detection accuracy and system stability. This approach extends existing adaptive anomaly detection models such as the one proposed by Jiang [4], exploring the potential benefits of generative AI techniques like VAE [5] in workload management.

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A Comparative Study of NLP Techniques for Bias Detection in Recruitment Processes

Communication Info

Authors:
Fatima Zahra ABBOUR[1]
Soufiane ARDCHIR[2]
Soumaya OUNACER[1]
Mohamed AZZOUAZI[1]
Khadija MAHJOUBI[1]

[1] *Faculty of sciences Ben M'sik, Hassan II University, Casablanca, Morocco*
[2] *National School of Business and Management, Hassan II University, Casablanca, Morocco*

Keywords:
(1) Natural Language Processing
(2) Bias Detection
(3) Recruitment Processes

Abstract

This study has a comparative overview of Natural Language Processing (NLP) techniques for identifying bias in recruitment text. We discuss the application of word embedding, sentiment analysis, and transformer models to identify potentially discriminatory language in job advertisements and resumes in terms of gender, race, and age biases. We have a qualitative overview of the techniques in light of their mechanisms and suitability in identifying bias. We point out the pragmatic effects and theoretic differences among these NLP approaches. This analysis aims to provide a comprehensive description of how different NLP techniques can be used to detect and address bias in recruitment processes, and their strengths and pitfalls for pragmatic purposes respectively.

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Integrating the STEAM Approach in Primary Education: Contributions of Mathematics and Computer Science for Innovative Learning

Communication Info

Authors:
Fatimazahra Ouahouda[1]
Khadija Achtaich [2]

[1] FSBM, Casablanca, Morocco
[2] Fsbm, Casablanca, Morocco

Keywords:
(1) STEAM education
(2) Primary education
(3) Scratch

Abstract

The STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach is increasingly recognized as an effective educational model for fostering creativity, critical thinking, and problem-solving skills in primary education. This paper explores the integration of STEAM in primary classrooms, focusing on the contributions of mathematics and computer science to enhance student engagement and learning outcomes. By incorporating interactive activities, digital tools, and coding platforms such as Scratch, this approach encourages hands-on learning and interdisciplinary connections. The study highlights the benefits of STEAM-based instruction in developing computational thinking, logical reasoning, and collaborative skills among young learners. Challenges and best practices for successful implementation in primary schools are also discussed.

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PRÉDICTION DE LA RÉSURGENCE DE DIX MALADIES INFECTIEUSES SOUS SURVEILLANCE

Communication Info

Authors:
Abdourahmane NDAO[1]
Cheikh Tidiane SECK [1]
Boly DIOP [2]

[1] *Department of Mathematics, Alioune Diop University, Bambey, Senegal*
[2] *Prevention Department, Ministry of Health, Dakar, Senegal*

Keywords:
(1) Forêt aléatoire binaire multiple
(2) Arbre de décision multi-output
(3) Critère d'inertie
(2) Keyword2
(3) Keyword3

Abstract

Dans ce travail, nous proposons deux nouveaux modèles de prédiction de la résurgence de dix maladies infectieuses sous surveillance épidémique au Sénégal [1]. Le premier modèle est une forêt aléatoire binaire multiple (FABM) utilisant l'algorithme de forêt aléatoire « ranger » avec le critère de Gini, et permet de prédire séparément chacune de ces dix maladies infectieuses en tenant compte des interdépendances avec les autres [2]. Le second modèle est un arbre de décision « multi-output » (ADMO), utilisant le critère d'inertie (basé sur la distance du khi-deux) comme mesure d'impureté des nœuds, et permet de prédire simultanément l'ensemble de dix maladies infectieuses en fournissant leur probabilité de réapparition [3]. Les données sont issues de la base globale de données de surveillance des maladies au Sénégal et concernent, entre autres, des informations sur 68 698 cas confirmés des dix maladies ciblées et des caractéristiques intrinsèques aux districts de surveillance [4]. Les résultats ont montré que ces pathologies ont une probabilité de résurgence moyenne

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A hybrid approach for feature selection based on graph partitioning and TOPSIS

Communication Info

Authors:
Abdelali OUBAOUZINE
Tayeb OUADERHMAN
Hasna CHAMLAL

Computer Science and Systems Laboratory (LIS), Faculty of Sciences Ain Chock, Hassan II University of Casablanca, Morocco

Keywords:
(1) Feature selection
(2) Graph partitioning
(3) TOPSIS

Abstract

Feature selection plays a key role in dimensionality reduction by extracting essential variables from large datasets. This work proposes an innovative method for feature selection in high-dimensional datasets, combining the mrMR algorithm, a graph partitioning technique and TOPSIS approach. After an initial filtering phase aimed at selecting the K best variables, a graph-based model integrates relevance and redundancy through a new weighting of edges to extract meaningful subgraphs using a graph partitioning technique. The final selection optimizes modularity, accuracy and diameter, ensuring an effective and compact subset of variables by the TOPSIS method. Experimental results on high dimensional datasets validate the effectiveness and superiority of this approach over existing methods.

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Analysis of Global Discourse on the Palestinian War: Text Classification through transfer

Communication Info

Authors:
Yassir MATRANE[1]
Zineb ELLAKY [2]
Faouzia BENABBOU [3]

[1] Faculty of sciences Ben M'Sick / University Hassan II of Casablanca, Morocco
[2] Faculty of sciences Ben M'Sick / University Hassan II of Casablanca, Morocco
[3] Faculty of sciences Ben M'Sick / University Hassan II of Casablanca, Morocco

Keywords:
(1) Text Classification
(2) Political Discourse Analysis
(3) Natural Language Processing

Abstract

The Palestinian-Israeli conflict generates diverse online reactions, with social media becoming a critical arena for public discourse beyond traditional media narratives. This research develops an automated classification system to identify pro- and anti-Palestinian sentiments in online discussions. Building on approaches in [1] and [2], we fine-tuned transformer-based models including BERT, DistilBERT, and XLM-RoBERTa. The used dataset of more than 6,000 comments follows methodological insights from [3]. XLM-RoBERTa achieved 95% accuracy, outperforming other models and showing better cross-cultural applicability than in [4]. These findings extend [5] by contributing to the growing body of work on automated stance detection in complex geopolitical discussions, providing insights into global public opinion beyond mainstream media narratives.

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Solving Reaction-Diffusion Equations Using Kolmogorov-Arnold Neural Networks: A Comparative Study with Exact Solution

Communication Info

Authors:
Imane HARIRI[1]
Atika RADID [1]
Karim RHOFIR [2]

[1] FSAC, Casablanca, Morocco
[2] ENSAK, Khouribga, Morocco

Keywords:
(1) Kolmogorov-Arnold networks
(2) Reaction-diffusion equations
(3) Deep Learning

Abstract

In this work, we investigate the effectiveness of Kolmogorov-Arnold Neural Networks (KANs) in solving reaction-diffusion partial differential equations (PDEs). These equations describe various physical and biological processes[1], making their accurate numerical resolution crucial. We propose a framework based on KANs to approximate the solutions of selected reaction-diffusion PDEs and evaluate their performance by comparing the predicted solutions with the corresponding exact solutions. The accuracy of the proposed approach is assessed using the L2 error metric. Our study builds upon recent advancements in physics-informed machine learning [2] and function approximation theories [3], demonstrating the potential of KANs as an alternative to traditional numerical methods for solving complex PDEs.

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Optimisation des systems temps reel dans les véhicules autonomes

Communication Info

Authors:
Meryem SAQALLI[1]

[1] *ENSEM School Hassan II University, Casablanca, Maroc*

Keywords:
(1) Système temps réel
(2) Système embarqué
(3) Système distribué
(4) Système multi-agents
(3) Intéligence Artificielle

Abstract

Actuellement, les systèmes temps réels sont de plus en plus présents dans le quotidien, on les trouve dans l’aéronautique, transport ferroviaire, l’automobile, l’électroménager ou le multimédia.
Les voitures autonomes utilisent des systèmes embarqués pour contrôler la perception (capteurs, caméras, LIDAR, etc.) et l'actionnement (freins, direction, accélération). Ces systèmes doivent respecter des contraintes temporelles rigides pour garantir la sécurité, la réactivité et la stabilité des décisions.
Dans cet article nous proposons une nouvelle Plateforme temps réel « Timer » pour une architecture distribuée basé sur le système multi-agents et nous abordons les défis rencontrés par les véhicules autonomes pour respecter les contraintes temporelles strictes imposées par les systèmes embarqués. Les conclusions de cette étude soulignent l'importance d'une gestion optimale des ressources pour garantir une réactivité en temps réel dans des situations complexes et imprévisibles, telles que les interventions d'urgence sur la route.

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Comparative Study of Text Classification Using Deep Learning Models

Communication Info

Authors :
Youssef ETTAFSSAOUI[1]
Omar BENCHAREF [2]

[1,2] Cadi Ayyad University, Faculty of Science and Technology, L2IS Laboratory, Marrakech, Morocco.

Keywords:
(1) Text Classification
(2) Natural Language Processing
(3) Deep Learning
(4) Embedding Model
(5) Conv1D
(6) Long Short-Term Memory
(7) Transformer

Abstract

In natural language processing, text classification is a basic job for which many deep learning architectures fight to get best performance. Aiming to find the most efficient strategy involving accuracy, recall, and F1-score while considering computational complexity and training efficiency, this work compares four different deep learning models for text classification using the BBC News dataset. Extensive data preparation, hyperparameter tuning [1], and a standardized performance evaluation system [2] were among the strict approaches used here. With a good trade-off between accuracy and computational requirements, the findings show that embedding-based models outperformed more intricate designs like Transformers [3]. These results complement earlier studies stressing the effectiveness of simpler models in text classification problems [4]. The work emphasizes the need of balancing model complexity and interpretability in real-world applications, therefore supporting the possible use of embedding-based strategies [5].

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Adaptive Boundary-Aware Progressive Ensemble for Imbalanced Classification

Communication Info

Authors:
Hajar KAMEL
Hasna CHAMLAL
Tayeb OUADERHMAN

Computer Science and Systems Laboratory (LIS), Faculty of Sciences Ain Chock, Hassan II University of Casablanca, Morocco

Keywords:
(1) Imbalanced Data
(2) Class overlap
(3) Clustering
(4) Classification
(5) Boundary Sampling

Abstract

Classifying imbalanced data with high class overlap remains a challenge [1][2]. Traditional methods suffer from noise in oversampling or information loss in undersampling, failing to address overlapping distributions [3]. We propose Boundary-Focused Adaptive Ensemble (BFAE), integrating dynamic boundary sampling, progressive learning, and adaptive ensemble weighting. BFAE prioritizes high-impact samples near decision boundaries and uses Elastic Weight Consolidation to prevent catastrophic forgetting. Its adaptive ensemble framework refines classifier weights in real time. Extensive experiments show BFAE outperforms state-of-the-art methods [4], achieving high accuracy, precision, and recall, making it a robust solution for imbalanced classification.

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Improving Security in Intelligent Transportation Systems: CNN Model for Multi-Class Intrusion Detection in VANETs

Communication Info

Authors:
Khadija MOUATASSIM[1]
Abdelfettah MABROUK [2]
Chaimae OUCHICHA [2]

[1] *Chouaïb Doukkali University, El Jadida, Morocco*
[2] *Chouaïb Doukkali University, El Jadida, Morocco*
[2] *Hassan 1st University (UH1), Settat, Morocco*

Keywords:
(1) Artificial Intelligence
(2) vehicular ad hoc networks (VANETs)
(3) Intrusion detection system
(4) Security

Abstract

intelligent transportation systems (ITS) [1] are booming, offering innovative services to improve the safety and efficiency of transportation networks. An essential component of these systems is the vehicular ad-hoc network (VANET) [2], which plays a key role in collision prevention and real-time data security [3], However, VANETs face significant security challenges, making Intrusion Detection Systems (IDS) [4], essential for detecting malicious activities. The integration of Artificial Intelligence (AI) [5] has notably improved attack detection. in this paper we propose a new network intrusion detection model using Convolutional Neural Networks (CNN) for multi-class classification and the Experimental results show that the proposed model is capable of automatically identifying and classifying multiple types of intrusions.

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Context-Aware IoT-Driven Smart Resource Allocation Recommendation System for Sustainable Tourism Management

Communication Info

Authors:
Mohamed El Amine CHAFIKI[1]
Oumaima STITINI [1,2]
Soulaimane KALOUN [1]

[1] Faculty of Science and Technology, Laboratory of Computer and System Engineering (L2IS), Cadi Ayyad University, Marrakesh, Morocco
[2] Ecole Normale Superieure, Marrakech, Morocco

Keywords:
(1) Context-Aware Recommendation System
(2) Smart Tourism
(3) Resource Allocation
(4) Sustainable Tourism Management
(5) Multi-Criteria Decision Support

Abstract

Tourism makes a basis for local wealth and fast growing economic, but the ever-increasing number of tourists that land in a region will always pressure local amenities such as water or electric networks. Which remains detrimental for over-populated, damaging for the environment and also makes visitors unsatisfactory in their tour experience. To address these issues, we propose an Internet of Things-enabled, context-aware recommendation system that utilizes environmental and users' data in real time for the optimization of tourism resources. We propose a retrieval augmentation mechanism by utilizing historical and real-time data to optimize decision-making and a Multi-Criteria Decision Support System to ensure balanced resource allocation by addressing visitor satisfaction, sustainability, and operational efficiency. Initial results show that our model enhances resource usage, maximizes facility oversight, and assists tourism bodies in evidence-based decision making.

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Urban digital twin towards city digital twin: Framework development.

Communication Info

Authors:
Zayneb MIRAOUI[1]
Abdelkader NASSER[2]
Mohcine KODAD[3]

[1] Laboratory LaMoN2E, FSO, Team MEGCE HSTO University Mohamed I, Oujda, Maroc.

[2] Laboratory LaMoN2E, FSO, Team MEGCE HSTO University Mohamed I, Oujda, Maroc.

[3] Laboratory MATSI, HSTO, University Mohamed I, Oujda,

Keywords:
(1) City digitalization
(2) Urban management
(3) Smart cities

Abstract

As the global population continues to expand and more individuals migrate to urban areas, the urban management of cities is becoming increasingly challenging[1]. In response, recent efforts have been made to adopt smart city initiatives, which aim to integrate digital information and connect management tasks with inhabitants[2], The key objectives of these initiatives are to enhance city functions, provide a high-quality of life to citizens, and maintain a good harmony between technology evolution and nature[3].
The role of the digital twin (DT) technology[4] in smart city development is a significant area of research. which will provide a high visual modulization of the city and full autonomous bidirectional connectivity of data [5] between real physical city entities and their virtual counterparts.
This paper aims to highlight the role of the digital twin technology in city development, in the related work section, analyze multiple frameworks of urban digital twin (UDT) concept, and digital twin city (DTC) system, then discuss basic similarities and current challenges. to propose as a result, a structural model design of the DTC system based on urban digital twin concept.

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ICRAMCS 2025
THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Blockchain et Marque Employeur dans le Commerce International : Une Analyse Structurelle de son Impact et de ses Enjeux

Communication Info

Authors:
GUERBAZ RABY
RAFIK TAHA

[1] *FSJES AIN SEBAA, CASABLANCA, MORROCO*
[2] *FSJES AIN SEBAA, CASABLANCA, MORROCO*

Keywords:
(1) Blockchain
(2) Marque employeur
(3) Équations structurelles

Abstract

Dans un monde de plus en plus numérique et interconnecté, la blockchain se positionne comme un outil stratégique qui affecte la réputation de l'employeur dans le monde du commerce international. Cette recherche propose un modèle d'équations structurelles (SEM) pour examiner les effets de la blockchain sur la marque employeur, en mettant l'accent sur sa contribution à l'attractivité de l'entreprise (Y2) et à la confiance des salariés (Y3). Le modèle structurel repose sur quatre hypothèses principales :
(1) la blockchain améliore la transparence des compétences (X1 → Y1).
(2) une meilleure transparence des compétences accroît l'attractivité de l'entreprise (Y1 → Y2).
(3) la blockchain renforce directement la confiance des employés (X1 → Y3), et (4) la confiance des employés joue un rôle médiateur dans l'attractivité de l'entreprise (Y3 → Y2).
Les résultats démontrent que la blockchain influence de manière importante la transparence des compétences, un facteur clé pour renforcer l'attractivité et la confiance des employés. Effectivement, les entités qui mettent en œuvre la blockchain constatent une amélioration de la transparence des compétences, ce qui se traduit par une plus grande attraction pour les talents et une confiance accumulée de leurs employés. Ces conclusions valident que la blockchain est un outil clé pour optimiser les avantages de la marque employeur dans l'administration des ressources humaines. Cette étude enrichit la littérature en présentant un modèle SEM solide pour évaluer l'influence de la blockchain sur la marque employeur. Elle présente également des conséquences concrètes pour les décideurs qui souhaitent renforcer leur attractivité et leur compétitivité sur le marché mondial des compétences. Les recherches à venir pourraient se pencher sur l'association de la blockchain avec d'autres technologies innovantes, telles que l'intelligence artificielle et le big data, dans le mais d'améliorer encore la gestion des ressources humaines.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Application of Advanced Transformer Neural Networks for Honey Quality Assessment through Thermal Imaging

Communication Info

Authors:
Ilias BOULBARJ[1]
Abdelaziz BOUKLOUZE [2]
Samira DOUZI [3]
Hassan DOUZI [1]

[1] *Faculty of Sciences Ibn Zohr, Agadir, Morocco*
[2] *Faculty of Medicine and Pharmacy Mohammed V, Rabat, Morocco*
[3] *Faculty of Medicine and Pharmacy Mohammed V, Rabat, Morocco*

Keywords:
(1) Honey Adulteration
(2) Transformers
(3) Attention mechanism
(4) Thermal imaging

Abstract

This study proposes a new method for detecting honey adulteration using the Vision Transformer (ViT) model [1] combined with thermal imaging. Honey adulteration is a significant health and economic issue, and conventional detection methods are slow and not very sensitive. Thermal imaging offers a unique advantage by detecting temperature variations in honey, which can indicate differences in sugar content, moisture, and the presence of adulterants. A large dataset was created with thermal images of 9 pure honey samples and 84 adulterated samples at various contamination levels, used to train and calibrate the model. The results showed a 99.9% accuracy, 99.5% sensitivity, and 100% specificity. This research demonstrates that thermal imaging with Transformers [2] can effectively and accurately identify honey adulteration, offering a promising tool for quality control in the honey industry.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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A Dominant sets Approach to Interactive Image Segmentation

Communication Info

Authors:
Abdelbasset MANSOURI [1]
My Driss AOURAGH [2]

[1] FST Moulay-Ismail University, Errachidia, Morocco
[2] EST Moulay-Ismail University, Meknès, Morocco

Keywords:
(1) Dominant sets
(2) Interactive image segmentation
(3) Pairwise constraints

Abstract

Interactive image segmentation remains a very interesting topic for computer vision community because it is an essential step in different applications such as image editing, medical image analysis, etc..
Many of modern interactive image segmentation methods model the image using a graph [1], such as Graph cuts algorithm [2], Random walker [3] and Shortest path models [4].
Unlike these algorithms [2–4] which express user annotations using individual constraints. In this work, we propose a novel approach to interactive image segmentation by incorporating user annotations using pairwise constraints in Dominant sets [5]. Experimental results on a well-known benchmark dataset show the effectiveness of our method compared to other algorithms.

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IA Générative pour une Irrigation Durable : Combler le Manque de Données dans l'Agriculture Marocaine

Communication Info

Authors:
Mohamed MOURAFIK
Laila Moussaid

[1] *ENSEM, Casablanca, Maroc*
[2] *ENSEM, Casablanca, Maroc*

Keywords:
(1) Smart irrigation
(2) generative IA
(3) Données synthétiques

Abstract

L'optimisation de l'irrigation au Maroc fait face à un obstacle majeur : le manque de données précises et à jour sur les conditions agricoles, les ressources en eau, et les besoins des cultures. Pour pallier cette lacune, la technologie de l'IA générative est utilisée pour produire des données synthétiques, capables de simuler des scénarios réalistes et variés pour enrichir les bases de données agricoles [1]. Ces données permettent une modélisation plus précise des systèmes d'irrigation, améliorant ainsi la gestion des ressources hydriques dans des contextes de pénurie d'eau [2]. En effet, l'IA générative peut générer des ensembles de données à partir de paramètres climatiques et environnementaux limités, comblant ainsi les écarts de données réelles [3]. Au Maroc, où les défis liés à la sécheresse sont exacerbés par le changement climatique, ces données synthétiques permettent de mieux prévoir les besoins en eau des cultures et de concevoir des stratégies d'irrigation plus adaptées et durables [4]. Cette approche innovante a le potentiel de réduire la consommation d'eau tout en augmentant les rendements agricoles, soutenant ainsi les efforts du pays en matière de gestion durable des ressources [5].

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Fine-tuning AraBERT for Arabic Text Extraction and Classification via Chatbot

Communication Info

Authors:
Monir EL OUARROUDI[1]
Abdelilah JRAIFI[2]
Driss HARZALLA [3]

[1] FST, Marrakech, Doctorant
[2] ENSA, Safi, Morocco Dept IRT Labo MISCOM
[3] ENSA, Safi, Dept IRT Labo MISCOM

Keywords:
(1) AraBERT
(2) Fine-tuning
(3) Natural Language Processing (NLP)

Abstract

This article proposes an innovative approach to Arabic document extraction and classification by combining AraBERT with a conversational interface. The study aims to automate these tasks while addressing the linguistic challenges specific to Arabic. Our methodology follows a three-step process: (1) specialized document preprocessing (handling diacritics and dialectal variations), (2) fine-tuning AraBERT for domain-specific understanding, and (3) integrating an extraction and classification framework into a natural language chatbot.
This approach enhances accuracy compared to generic language models, achieving optimal performance on various document types (contracts, administrative forms, academic texts). It contributes to the advancement of Arabic NLP by bridging the gap between advanced language models and practical applications, potentially reducing document processing time by up to 78%.

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ICRAMCS 2025
THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Nash game theory combined with convolutional neural network for similar images retrieval

Communication Info

Authors:
Meriem MANSOUHI
Samira EL MOUMEN
Noureddine MOUSSAID

[1] Université Hassan II de Casablanca, **(FSAC)**, LMFA, Casablanca, Morocco
[2] Université Hassan II de Casablanca, (FSAC), LMFA, Casablanca, Morocco
[3] Université Hassan II de Casablanca, FSTM, LMCSA, Mohammedia, Morrocco

Keywords:
(1) image retrieval
(2) convolutional neural network
(3) Game theory

Abstract

Content-based image retrieval (CBIR) relies on feature extraction techniques such as color, shape, and texture to retrieve visually similar images [1]. Traditional CBIR methods have difficulty effectively extracting these different features, resulting in unsatisfactory retrieval results [2]. In this study, we introduce a novel approach combining **Nash game theory** with **convolutional neural networks (CNNs) [3]** to enhance retrieval performance**. Our method** transforms the problem into a multi-player game where each feature extraction method is treated as an independent player in a non-cooperative game [4]. A Nash equilibrium is reached when no player can improve the results.
We test our method on the **Oxford5k dataset** (Philbin et al., 2007) [5] and shows competitive performance compared to Content-based image retrieval traditional methods.

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April 24-25-26, 2025 | Marrakech, Morocco

Hybrid Content-Based Recommendation System Using Machine Learning Models

Communication Info

Authors:
El mehdi LGHAOUCH[1]
Soumaya OUNACER[1]
Soufiane ARDCHIR[2]
Mohamed AZZOUAZI[1]

[1] Faculty of Sciences Ben M'Sik/ Hassan II University, Casablanca, Morocco.
[2] National School of Business and Management/Hassan II University, Casablanca, Morocco.

Keywords:
(1) Recommendation system.
(2) Machine learning.
(3) Content-based recommendations.

Abstract

Recommender systems help users discover items that match their preferences [1], such as food products from large review datasets. While deep learning is prominent, traditional machine learning models like Support Vector Machines (SVMs), Random Forest, and Logistic Regression remain valuable for their simplicity, efficiency, and interpretability [2][3]. This study evaluates these models in a content-based recommendation framework using food review data, measuring performance through accuracy, precision, recall, MAE, and RMSE [4]. Results show that traditional models achieve competitive performance, especially in resource-constrained settings. The findings highlight their suitability for real-world food recommendation systems, balancing effectiveness and practicality. This work provides guidance for selecting algorithms tailored to specific operational needs.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Smart Inventory Management: Q-Learning algorithm for Spare Parts Optimization

Communication Info

Authors:
Kaoutar AJMILI[1]
Houda EL HADAF [2]
Abdelilah JRAIFI [3]

[1]MISCOM-Laboratory. ENSA-S, University Cadi Ayyad, Safi, Morocco
[2]Department of Industrial Engineering/EIGSI Casablanca, Morocco
[3]MISCOM-Laboratory. ENSA-S, University Cadi Ayyad, Safi, Morocco

Keywords:
(1) Q-Learning Algorithm
(2) Weibull low
(3) Spare parts
(4) Inventory management

Abstract

Inventory replenishment is an ongoing process that maintains products in inventory to meet customer demand [4]. The (s, S) policy is a widely used method of inventory control in dynamic systems with random demand. According to this policy, if the initial inventory level of a period is equal to or less than the reorder point, an order is issued for replenishment to bring the stock level to level S [3]. This paper introduces a Markov decision process-based mathematical model for one-echelon system inventory control with the cases of failure that follow the Weibull low [1][2]. The Q-Learning algorithm is both theoretically and practically well-suited to addressing stochastic transitions and reward structures when there is an unknown model environment a priori [5]. The proposed approach is to determine the optimum order quantity of spare parts per period and reduce overall costs of inventory management through the incorporation of various cost considerations in decision-making.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Data-Centric AI for Enhancing Data Quality in Healthcare: Big Data and IoT Applications

Communication Info

Authors:
Imane RAFIQ [1]
Zahi JARIR [2]
Hiba ASRI [3]

[1] *FSSM Cadi Ayyad University, Marrakech, Morocco*
[2] *FSSM Cadi Ayyad University, Marrakech, Morocco*
[3] *FSSM Cadi Ayyad University, Marrakech, Morocco*

Keywords:
(1) Data-Centric AI
(2) IoT
(3) Big Data
(4) Healthcare
(5) Data Quality
(6) Bias Mitigation
(7) Privacy
(8) Disease Prediction
(9) Machine Learning

Abstract

The integration of Artificial Intelligence (AI), the Internet of Things (IoT), and Big Data is transforming healthcare by enabling predictive diagnostics, real-time monitoring, and personalized treatment through data-driven analytics and intelligent decision-making [1]. However, data quality issues, including missing values, noise, bias, and inconsistencies, hinder the effectiveness of AI-driven healthcare systems [2]. Ensuring reliable AI applications requires shifting from model-centric AI, which prioritizes algorithm refinement, to Data-Centric AI (DCAI), which emphasizes systematic data improvements [3], [4]. Our study explores DCAI as a solution to healthcare data challenges, enhancing data completeness, standardization, and bias mitigation. We highlight the METRIC model for systematic data assessment and propose future research directions to improve scalability and trustworthiness in AI-driven healthcare, integrating advanced AI techniques such as generative AI and multimodal frameworks with DCAI principles for more ethical AI applications [5].

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

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Olive Yield Prediction in the Mediterranean Region Through Integrating Satellite Data, IoT, and Deep Learning: A Comprehensive Review

Communication Info

Authors:
Abderrahmane SADIQ[1]
Jilali ANTARI[1]
Abdelouafi BOUKHRIS[1]
Asma EL MEJDI[1]

[1] *Laboratory of Computer Systems Engineering, Mathematics and Applications (ISIMA), Polydisciplinary Faculty of Taroudant, Ibnou Zohr University, Morocco*

Keywords:
(1) Yield prediction
(2) Satellite imagery
(3) Internet of Things
(4) Deep learning

Abstract

Predicting olive yield in the Mediterranean region can be significantly advanced through the integration of satellite imagery, Internet of Things, and deep learning [1]. This review explores how key vegetation indices derived from multi-spectral satellite imagery (e.g. Sentinel-2) [2], combined with IoT-generated data, enhance yield prediction models. To analyse these heterogeneous datasets, this review investigates the combined use of advanced models—namely Transformers, CNNs, and RNNs—to capture and integrate spatial, temporal, and contextual patterns across the data [3]. In this context, integrating multi-source satellite with IoT inputs can enhance the accuracy of yield prediction models designed for the specific agricultural challenges of the Mediterranean region [4]. This review highlights advancements, evaluates the strengths and limitations of these approaches, and discusses their potential to optimize resource management, and support sustainable olive farming practices. Challenges such as data fusion, model interpretability, and regional adaptability are also addressed [5], with a focus on developing scalable and generalizable solutions.

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The Impact of Socio-Cultural Variations on Sentiment Analysis in Dialect

Communication Info

Authors:
IKBAL CHABBAKI

Faculty of Sciences Ben M'Sik, Casablanca, Morocco

Keywords:
(1) Moroccan Dialect
(2) Linguistic Variation
(3) Machine Learning
(4) Lexicon-Based Methods
(5) Natural Language Processing (NLP)
(6) Demographic Influence
(7) Cultural and Linguistic Diversity

Abstract

Sentiment analysis in the Moroccan dialect presents unique challenges due to social and cultural diversity, linguistic change, and the interaction between dialectal Arabic, Classical Arabic, and French. This study aims to explore how factors such as age, geographical location, and social class influence sentiment expression.

Using a mixed-methods approach, we analyzed a variety of texts from social media, online forums, and interviews with native speakers. To achieve this, we applied sentiment analysis techniques, including lexicon-based methods and machine learning models, to measure sentiment while accounting for the impact of linguistic change.

Preliminary results indicate significant variation in sentiment expression across different demographic groups. These findings highlight the need to develop sentiment analysis models that consider the cultural and linguistic characteristics of the dialect to better capture the complexity and richness of emotions expressed within this community.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

April 24-25-26, 2025 | Marrakech, Morocco

Improvement of Convolutional Neural Networks for Brain Tumor Detection through Bayesian Optimization

Communication Info

Authors:
Fatima FATIH[1]
Zakariae EN-NAIMANI [2]
Khalid HADDOUCH [1]

[1] Laboratory of Applied Sciences and Emerging Technologies, ENSA, Sidi Mohamed Ben Abdellah University, Morocco
[2] Laboratory Computer Science, Artificial Intelligence and Cyber Security (2IACS), ENSET, Mohammedia, University of Hassan II Casablanca, Morocco

Keywords:
(1) Hyperparameter Tuning
(2) Bayesian Optimization
(3) Convolutional Neural Networks

Abstract

Early detection of brain tumors is crucial for improving survival rates. However, their diversity in size and shape complicates the analysis of medical images and can lead to human errors. Artificial intelligence, particularly convolutional neural networks (CNNs), offers a promising solution due to their ability to capture complex image features [1]. These models, inspired by the human visual cortex, can outperform experts in tumor classification. However, their performance depends on tuning hyperparameters such as dropout rates and L2 regularization, which influence the model's generalization [2][3]. Poor tuning can lead to overfitting, reducing the model's reliability on new data. Techniques such as dropout and batch normalization help improve the robustness of CNNs. Bayesian optimization is used to fine-tune these hyperparameters efficiently by targeting the most promising combinations [4][5]. Various regularization scenarios are tested. The study demonstrates that Bayesian optimization enhances CNN performance by minimizing overfitting and maximizing accuracy. These advancements are essential for strengthening the reliability of brain tumor detection models and improving medical diagnosis.

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ICRAMCS 2025

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April 24-25-26, 2025 | Marrakech, Morocco

Meshless and Monte Carlo Method for Solving the Drug transport equations with random coefficients

Communication Info

Authors:
Saad eddine Essarrout [1]
Said Raghay [2]
Zouhir Mahani [3]

[1] department of science computing University Ibn Zohr, Agadir, Morocco

[2] faculty of science and techniques, cadi Ayyad University Marrakesh, Morocco

[3] department of science computing University ibn Zohr, Agadir, Morocco

Keywords:
(1) Monte Carlo Method
(2) Meshless Method
(3) Drug Transport Equation
(4) Random Coefficients

Abstract

A combination of the Meshless techniques and the Monte Carlo method has been developed for drug transport problems. The governing two-dimensional pharmacokinetic aquation with random coefficients are simulated in complex geometric domains. For spatial discretization the meshless technique and the Monte Carlo method are integrated in our effective approach. For accurate shape function construction, the Random point interpolation Method (RPIM) employed polynomial basis function. Thorough testing on our problem reveals that decreasing the time step led to an algorithm's efficiency. The successful integration underscores the potential of the present method, providing a hopeful pathway for tackling pharmacokinetic challenges across diverse scientific applications.

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Damage and Dynamic Behavior of Civil Engineering Structures up to Failure

Communication Info

Authors:
Zakaria LAGHRIB [1]
Benaissa KISSI [1]
Hamza KHATIB [1]
Hassan AAYA [2]

[1] National School of Arts and Crafts (ENSAM), Casablanca, Morocco
[2] International University of Casablanca (UIC), Casablanca, Morocco

Keywords:
(1) Civil engineering structures
(2) Dynamic properties
(3) Numerical modeling
(4) Finite element model
(5) Material degradation

Abstract

Civil engineering structures, such as bridges, buildings, and dams, are exposed to static and dynamic loads, as well as material degradation (cracking, deformation, corrosion). These factors alter dynamic properties, increasing the risk of failure.

This study investigates damage evolution, variations in dynamic properties, and early failure indicators using numerical modeling and experimental validation. Finite element models simulate structural deterioration, incorporating crack propagation and material degradation. The analysis provides insights into damage progression and its effects on structural behavior under various loads.

The findings contribute to improved structural monitoring strategies, enabling early detection of critical damage and enhancing predictive maintenance approaches.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Advances in Feature Selection for Gene Expression Data: A Systematic Review of 2024

Communication Info

Authors:
Sara BAALI[1]
Mohammed HAMIM [1]
Hicham MOUTACHAOUIK[1]
Mustapha HAIN[1]

[1] *ENSAM, Casablanca, Morocco*

Keywords:
(1) Feature Selection
(2) Gene Expression Data
(3) Classification

Abstract

The complexity of high-dimensional gene expression data necessitates effective feature selection to enhance cancer classification accuracy and efficiency[1]. This review examines recent feature selection methods proposed in 2024, emphasizing the dominance of hybrid filter-wrapper approaches[2]. Support Vector Machines (SVM) remain the most effective classifier, while KNN and AdaBoost also demonstrate competitive performance[3]. Deep learning-assisted techniques are emerging as promising solutions for improving classification accuracy and model robustness[4]. Additionally, 10-fold cross-validation remains the most widely adopted evaluation method, ensuring reliability and generalizability. Despite these advancements, challenges persist in scalability, computational efficiency, and dataset variability. Addressing these limitations through optimized feature selection strategies is essential for improving diagnostic precision and facilitating clinical applications[5].

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Risk Management in Supply Chains with the Use of Industry 4.0 Technologies

Communication Info

Authors:
Meriem BENHAFID [1]
Aziz AKHIATE [2]

[1] *ENSAM, Casablanca, Morocco*
[2] *ENSAM, Casablanca, Morocco*

Keywords:
(1) Industry 4.0 technologies
(2) Risk management
(3) Blockchain
(4) IoT
(5) Proactive risk management
(6) Cybersecurity

Abstract

Risk management in supply chains is crucial in a globalized environment. Industry 4.0 technologies, such as IoT, AI, blockchain, and Big Data, enable proactive risk management. IoT ensures real-time monitoring of inventory and equipment, while AI, through predictive analytics, anticipates disruptions. Blockchain guarantees traceability and transparency, reducing the risk of fraud. Big Data analyzes large amounts of data to identify emerging risks. These technologies not only help companies respond to potential threats but also enhance collaboration among supply chain partners. By improving communication and sharing real-time data, they enable more efficient problem-solving. Additionally, they allow for faster recovery from disruptions by providing valuable insights for contingency planning. However, these technologies present challenges, including cost and cybersecurity concerns. Nevertheless, their adoption strengthens the resilience of supply chains, allowing for more reactive and informed risk management.

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ICRAMCS 2025

THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Offensive Text Detection Using Natural Language Processing (NLP)

Communication Info

Authors:
Tarik HADDANE[1]
Said BAHASSINE[1]
Abdelali ZAKRANI[1]

[1] *Artificial Intelligence, Modeling and Computational Engineering (AIMCE), ENSAM, CASABLANCA, MOROCCO*

Keywords:
(1) offensive text detection
(2) natural language processing
(3) machine learning

Abstract

Given the rapid explosion of content on the web, which leads to major societal issues due to offensive content, offensive language is defined as any form of verbal, written, or symbolic expression that targets an individual or group, often due to prejudice, insults, or discriminatory content. Its forms and meanings can vary depending on context, language, and time period [1]. The automatic processing of such texts relies on natural language processing (NLP) techniques.Our study aims to synthesize existing approaches to provide a comprehensive comparison in terms of methods, datasets, and metrics[3]. We base our analysis on research articles from the past four years to outline the direction of our study and define the main focus of our contribution. This involves examining different perspectives to determine key aspects such as: **What types of offensive text? In which language? Using which data sources? And with what evaluation metrics?**

Furthermore, we consider the major challenges related to offensive text detection, such as language ambiguity, linguistic evolution, and algorithmic biases [2].

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ICRAMCS 2025

THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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QSAR-Guided Ebola Virus Glycoprotein Inhibitors Design

Communication Info

Authors:
Nouhaila Ait Lahcen [1]
Wissal Liman [1,2]
Mehdi Oubahmane [1,2]
Ismail Hdoufane [1]
Mohammed M. Alanazi [3]
Youssef Habibi [2]
Mohamed Maatallah [1]
Driss Cherqaoui [1,2]

[1] Cadi Ayyad Uiversity, Marrakech, Morocco.
[2] University Mohammed VI Polytechnic, Benguerir, Morocco.
[3] King Saud University, Riyadh, Saudi Arabia.

Keywords:
(1) Quantitative Structure–Activity Relationship
(2) QSAR models
(3) Ebola Virus glycoprotein

Abstract

Ebola virus disease (EVD) is a deadly infection, with historical fatality rates reaching up to 90% [1,2]. A critical therapeutic target for halting viral replication is the Ebola Virus glycoprotein (EBOV-GP), which mediates entry of the virus into human cells [3]. This study applies Quantitative Structure–Activity Relationship (QSAR) models, a family of mathematical methods that relate molecular structures to biological activity, to design novel inhibitors of EBOV-GP. Two QSAR models were developed using a dataset of amodiaquine derivatives, achieving robust predictive performance. The first model is SMILES-based and employs a Monte Carlo approach, whereas the second uses a genetic algorithm coupled with multiple linear regression (GA-MLR) [4,5]. Both models highlight quantitative correlations between molecular descriptors and anti-EBOV-GP activity, illustrating how structural features can be translated into predictive mathematical relationships. According to the insights provided by the CORAL model, five new drug candidates were mathematically designed by modifying structural fragments associated with higher inhibitory potential; their predicted activities were then independently confirmed through the GA-MLR model. To further validate these computational predictions, molecular docking and molecular dynamics simulations were conducted to explore ligand–protein interactions, alongside ADMET evaluations to confirm favorable pharmacological profiles. Overall, this work demonstrates the power of QSAR as a mathematical framework for accelerating the discovery of promising EBOV-GP inhibitors and underscores the role of data-driven modeling in guiding targeted therapeutic development.

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Optimizing CNN Hyper-parameters via Simulated Annealing for Enhanced Brain Tumor Classification

Communication Info

Authors:
Youssef Smili [1]
Youssef Fakhri [2]
Sofia El Amoury [1]

[1] ENIC, FSTS, Hassan First University, Settat, Morocco

[2] Laboratory RI, Faculty of Sciences of Kenitra, Ibn Tofail University, Kenitra, Morocco

Keywords:
(1) Brain tumor classification
(2) Convolutional Neural Networks (CNN)
(3) Hyper-parameter Optimization
(4) Simulated Annealing (SA)

Abstract

Accurate classification of brain tumors is vital in medical imaging due to the complex and variable nature of tumor structures. Although Magnetic Resonance Imaging (MRI) offers detailed anatomical information, manually distinguishing normal from abnormal tissues remains challenging and time-consuming, highlighting the need for automated diagnostic systems [1]. Convolutional Neural Networks (CNNs) have proven effective in automating feature extraction and enhancing diagnostic accuracy [2]. However, their performance is highly dependent on optimal hyper-parameter tuning. In this study, we employ the Simulated Annealing (SA) algorithm to optimize the hyper-parameters of a CNN tailored for brain tumor classification using MRI scans. Our approach utilizes direct hyper-parameter encoding along with a robust perturbation strategy to efficiently explore the solution space. The SA-optimized CNN achieves a validation accuracy that outperforms those obtained using Particle Swarm Optimization and Genetic Algorithms [3,4]. These findings underscore SA's potential as an efficient tool for hyper-parameter optimization in complex medical imaging applications.

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ICRAMCS 2025
THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Generative AI for Software Quality Assessment: A Systematic Review and Analysis of Applications in Code Quality, Technical Debt, and Bug Detection

Communication Info

Authors:
Yassine BOUSDOG[1]
Abdelali ZAKRANI[1]
Said NOUH [2]

[1]ENSAM, AIMCE Laboratory, Casablanca, Morocco
[2] LTIM Laboratory, Faculty of Sciences Ben M'Sick, Hassan II University of Casablanca, Casablanca, Morocco

Keywords:
Generative AI, Software Quality, LLMs, Code Quality, Technical Debt, Bug Detection, Defect Prediction, Code Review, AI in SE, Model Interpretability, AI Reliability, Trust in AI, Human-AI Collaboration, Context Awareness, Static Analysis, Scalability, ML for Code, Software Maintenance, Explainability, AI Validation.

Abstract

Ensuring high software quality remains a challenge in software engineering. Traditional methods like static analysis and manual reviews struggle with precision and scalability. Recently, Generative AI (GenAI), including LLMs (e.g., GPT-4, Codex, CodeBERT), has emerged for code analysis, defect prediction, and quality improvement. However, its reliability and interpretability are still under investigation.

This paper reviews GenAI applications in (1) Code Quality Assessment, (2) Technical Debt Detection, and (3) Bug Detection. Analyzing multiple studies (2020–2024), we find that while LLMs provide superior contextual analysis, they face challenges like data dependence, domain-specific variability, and limited explainability. Key research gaps include model generalization, trust, and human-AI collaboration. While GenAI shows promise for software quality assurance, rigorous validation is needed before widespread adoption.

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A Comparative Study of Bagging and Boosting Techniques for Correcting Data Transmission Errors

Communication Info

Authors:
El Assad Mohammed[1]
Saïd Nouh[1]
Seddiq El Kasmi Alaoui[2]
Azzouazi Mohamed[1]

[1] LTIM Laboratory, Facultty of Sciences Ben M'Sick, Hassan II University of Casablanca
[2] LIDSI Lab, Ain Chock Sciences Faculty, Hassan II Univeristy of Casablanca

Keywords:
(1) Bagging
(2) Boosting
(3) Error Correcting Codes
(4) Machine Learning
(5) Joundan codes
(6) BCH codes
(7) Bit Error Rate (BER)
(8) Signal to Noise Ratio(SNR)

Abstract

In a previous work [1], we have used the boosting technique in our ELBoostDec model for decoding Bose, Ray-Chaudhuri, and Hocquinghem (BCH) codes, Joundan codes, and Quadratic Residue (QR) codes. In this article, we present a comparative study between two ensemble learning techniques: bagging and boosting, which combine predictions from multiple diverse and complementary models for decoding Joundan codes et al. [2]. We have designed, developed, and tested a new decoder ELBaggDec, based on Bagging. The results show that ELBoostDec significantly outperforms ELBaggDec in terms of bit error rate (BER) and also in terms of time complexity. With the same number of trees and the same maximum depth, ELBoostDec consistently delivered good results on the studied codes using two decision trees with a maximum depth of 13 and at the same SNR=8 dB.: for the BCH(15,7,5) code, ELBoostDec achieved a BER=4.8×10^{-5}, whereas ELBaggDec yielded a BER=7.1×10^{-3}, which is significantly lower. For theJoundan(26,13,7) code, ELBoostDec achieved a BER=2.51×10^{-6}, while ELBaggDec yielded a BER=5.81×10^{-3}, which is also significantly lower.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Computational Design of Potent Dimeric Phenylthiazole NS5A Inhibitors for Hepatitis C Virus

Communication Info

Authors:
Wissal LIMAN [1]
Nouhaila AIT LAHCEN [2]
Driss CHERQAOUI [2]
Achraf EL ALLALI [1]

[1] Bioinformatics Laboratory, College of Computing, University Mohammed VI Polytechnic, Morocco.
[2] Department of Chemistry, Faculty of Sciences Semlalia, BP, 2390 Marrakech, Morocco.

Keywords:
(1) Quantitative Structure–Activity Relationship
(2) HCV
(3) NS5A

Abstract

Hepatitis C Virus (HCV) remains a major global health concern due to its widespread prevalence and the lack of an effective vaccine. Although significant advancements have been made in therapeutic treatments since the virus was first identified, its persistence necessitates the development of novel intervention strategies [1]. The nonstructural protein NS5A plays a vital role in the HCV life cycle, contributing to both viral replication and assembly, making it a key target in all currently approved HCV combination therapies [2]. In this study, a quantitative structure-activity relationship (QSAR) analysis was conducted to design new inhibitors with improved potency against HCV. A dataset of 82 phenylthiazole derivatives was utilized to develop a QSAR model using the Monte Carlo optimization method [3]. This model provided crucial insights into the structural features influencing inhibitory activity. Based on these findings, novel NS5A inhibitors were designed. To further evaluate their potential, molecular docking was performed to estimate the binding affinity of the newly designed compounds within the NS5A protein [4]. Molecular dynamics simulations were then carried out to analyze their stability and interactions over time. Additionally, MMGBSA (Molecular Mechanics Generalized Born Surface Area) calculations were used to determine the binding free energies, offering further insights into their binding strength and stability. Lastly, an ADMET (absorption, distribution, metabolism, excretion, and toxicity) analysis was conducted to assess the pharmacokinetic and toxicity profiles of the proposed inhibitors. This integrated computational approach provides a comprehensive understanding of the designed inhibitors' efficacy, stability, and safety, offering valuable insights for their potential development as effective therapeutic agents against HCV [5].

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

A Review of Machine Learning and Deep Learning for Stock Market Crash Prediction

Communication Info

Authors:
Wafae SAIFI[1]
Said NOUH[1]
Said BAHASSINE[2]
Imrane CHEMSEDDINE IDRISSI[1]

[1]TIM Laboratory, Faculty of Sciences Ben M'Sick, Hassan II University, Casablanca, Morocco
[2]AIMCE Laboratory, ENSAM, Hassan II University, Casablanca, Morocco

Keywords:
(1) Digital finance
(2) Stock market crash
(3) Machine learning
(4) Deep learning
(5) Financial indicators
(6) Macroeconomic indicators
(7) Sentiment anlysis
(7) Systematic literature review

Abstract

Digital finance has been an important factor in the stabilization of financial markets, enabling the application of artificial intelligence in predicting and mitigating high risks such as stock market crashes with significant consequences [1-2]. This systematic literature review (SLR) aims to examine relevant studies on the Machine Learning (ML) and Deep Learning (DL) approaches that have been employed in predicting stock market crashes. From the examination of 20 studies published from 2018 to 2025, it reflects the diversity of approaches used, with neural networks [3], Support Vector Machines (SVM), and XGBoost models being among the most common [4-5]. The results further show that the use of various indicators, such as financial, macroeconomic, and sentiment data, enhances the predictability and trustworthiness of prediction systems [4][6]. The review also identifies gaps in current approaches, particularly with regard to the integration of textual elements and the explanation of models, thus guiding future research to address these gaps.

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Long-Term Electricity Demand Forecasting with Deep Learning Techniques

Communication Info

Authors:
Ibtissam LAHJILI[1]
Aziz LMAKRI[1]
Badr HIRCHOUA[1]
Mustapha HAIN[1]

[1] AICSE Laboratory, ENSAM, Hassan II University in Casablanca

Keywords:
(1) Time series
(2) Forecasting
(3) Electricity
(4) Deep learning
(5) LSTM
(6) GRU

Abstract

Electricity demand forecasting is essential for the efficient management of electrical grids and energy resources. Many studies have demonstrated the effectiveness of deep learning techniques in addressing this challenge, particularly recurrent neural networks such as Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU), which have shown superior performance in capturing temporal dependencies in electricity consumption patterns [1]. These models are widely used due to their ability to model long-term dependencies and handle complex fluctuations in time series data [2]. Their specialized architecture enables efficient processing of sequential data and learning of nonlinear temporal relationships, making them suitable for electricity demand forecasting [3]. In this study, we explore the application of LSTM and GRU models to predict electricity demand not only for historical and current periods but also for long-term future trends [4]. The results demonstrate that these models can provide accurate and reliable forecasts, supporting optimized energy management strategies and proactive decision-making [5].

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ICRAMCS 2025

THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

April 24-25-26, 2025 | Marrakech, Morocco

Enhancing Water Sustainability: Transformer Networks for Evapotranspiration Forecasting

Communication Info

Authors:
Abdelouahed TRICHA
Laila MOUSSAID

National High School for Electricity and Mechanics (ENSEM), Hassan II University of Casablanca, Casablanca, Morocco

Keywords:
(1) Transformer Networks
(2) Evapotranspiration Forecasting
(3) Smart Water Management

Abstract

Accurate reference evapotranspiration (ET_0) forecasting is vital for optimizing agricultural water use in Mediterranean climates, where seasonal droughts and variable rainfall strain water resources[1]. While the FAO-56 Penman-Monteith equation remains the gold standard [2], its reliance on solar radiation and wind speed data limits its applicability in regions with sparse meteorological infrastructure. This study proposes a Transformer-based deep learning model [3] to forecast ET_0 using only temperature, humidity, and wind speed—parameters widely available in developing regions. Trained on a 40-year NASA POWER dataset for Casablanca, Morocco, the Transformer leverages self-attention mechanisms to identify long-term climatic patterns, outperforming traditional Long Short-Term Memory (LSTM) networks and FAO-56 under missing data conditions. Results demonstrate improved accuracy over conventional methods, enabling reliable ET_0 estimates with minimal inputs. These findings suggest that Transformer-based architectures can significantly enhance predictive capabilities in agricultural water management, leading to more informed and efficient irrigation practices [4], [5].

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Approche de Classification Hiérarchique Descendante des Variables autour des Composantes Latentes : Applications aux données de pêche maritime Mauritaniennes

Communication Info

Authors:
Brahim Mohamed Tfeil [1,2]

Evelyne Vigneau [3]

[1] *Institut Mauritanien de Recherches Océanographiques et des Pêches, Nouadhibou, Mauritanie*
[2] *Université de Nouakchott, Mauritanie*
[3] *Oniris, Nantes, France*

Keywords:
(1) Classification hiérarchique
(2) composante latente
(3) groupe de variable

Abstract

A l'instar d'une approche de classification ascendante des variables (CLV) (Vigneau et al. 2006), on propose une nouvelle approche de classification descendante autour des composantes latentes. La conception se base sur le principe qu'à l'étape initiale, étape zéro, toutes les variables sont regroupées en une seule classe, ensuite on procède à un processus de division de l'une de deux premières classes suivant un critère T de homogénéités de sorte que chaque variable soit liée de manière optimale à la composante du groupe auquel elle est affectée. T= $n\sum_{k=1}^{K}\sum_{j=1}^{p}\delta_{kj}Cov^2(x_{kj}, C_k)$, p nombre de variables, C_k la composante latente du groupe G_k, $c'_k c_k = 1$ où δ_{kj}=1 si la jème variable appartient à la classe G_k et $\delta_{kj} = 0$ sinon. A l'étape i, la division d'une classe de variables candidate (G_i), en deux classes, C_1 et C_2 produit une variation du critère T donnée par Δ= $T_{i-1} - T_i = \lambda_1^{(C1)} + \lambda_1^{(C2)} - \lambda_1^{(C1\cup C2)}$ où $\lambda_1^{(C1)} et\ \lambda_1^{(C2)}$ sont les plus grandes valeurs propres associées avec les matrices de covariance des variables dans le groupe C1, C2 et C1UC2. Toutefois, avant de procéder à une division d'une classe candidate G_k, on effectue une consolidation des classes obtenues par l'algorithme *K_menas*. Une démarche de tests de faisabilité-fonctionnalité de cette approche a permis d'explorer une dizaine de cas de figures de données simulées a donné des résultats presques identiques avec l'approche CLV, avec un gain de temps d'exécution important (27 secondes contre 9 minutes) en faveur de l'approche descendante pour données volumineuses (au delà de 6000 variables).

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Artificial Intelligence in Thermal Energy Storage: A Bibliometric Analysis

Communication Info

Authors:
Jaouad Zerhouni[1]
Mohamed Hosni[1]
M'Barek Bakkas[2]

[1] IEST Research Team, AIDTM Laboratory, ENSAM, University Moulay Ismail of Meknes, Morocco
[2] Department of Energy Engineering, ENSAM, University Moulay Ismail of Meknes, Morocco

Keywords:
(1) Thermal Energy Storage
(2) Bibliometric
(3) Machine Learning
(4) Artificial Intelligence
(5) Solar Energy

Abstract

Energy storage plays a fundamental role in improving the efficiency, reliability, and sustainability of modern energy systems. Among various energy storage technologies, Thermal Energy Storage (TES) has found widespread applications in diverse fields, including renewable energy integration, industrial processes, and heating and cooling systems [1]. TES systems help mitigate energy supply fluctuations, enhance energy utilization, and reduce overall energy consumption. However, optimizing the design, performance, and operational efficiency of TES systems remains a complex challenge. In recent years, the integration of Artificial Intelligence (AI), particularly Machine Learning (ML) and Deep Learning (DL), has emerged as a powerful approach to advancing TES technologies [2]. AI-driven methods enable predictive modeling, real-time optimization, and intelligent control strategies, significantly improving the efficiency and adaptability of TES applications. The growing intersection of AI and TES research highlights the need for a comprehensive assessment of the scientific landscape in this domain.

This study presents a bibliometric analysis to investigate research trends and scholarly contributions at the intersection of AI and TES. A bibliographic dataset comprising 2,941 scientific publications from the period 2000 to 2024 was sourced from the Scopus digital library. The analysis employs key bibliometric indicators to evaluate publication trends, author and source productivity, patterns of scientific collaboration, and keyword co-occurrence, following the guidelines proposed by Anders [3]. The analysis was performed using the **Biblioshiny** tool [4]. This study provides insights into the evolution of AI applications in TES research, identifying influential authors, highly cited works, and emerging research directions.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Robotic Control through Liquid Neural Networks and Hindsight Experience Replay

Communication Info

Authors:
Kaouthar OUBBAD[1]
Abdelilah JRAIFI [1]
Ilias ELMOUKI [1]
Mohammed MADIAFI[1]

[1] *ENSA, Safi, Morocco*

Keywords:
(1) Liquid Time Constant
(2) Reinforcement learning
(3) Robot Control
(4) Hindsight Experience Replay

Abstract

In robotic control, a robot must learn from its environment to act appropriately and perform tasks effectively [4]. This process is achieved through Reinforcement Learning (RL) [1]. To adapt to dynamic environments and learn from real-world data, we used Liquid Time Constant (LTC) networks [2]. Here, we introduce LTC networks because they offer advantages such as interpretability and robustness to noise. However, the agent often encounters sparse or binary rewards during training, which can limit its learning potential. To overcome this challenge, we use in this work, the Hindsight Experience Replay (HER) [3].

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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L'Impact de l'Intelligence Artificielle Générative sur le Génie Logiciel : Analyse de Modèles Open-Source

Communication Info

Authors:
Zakaria MOUHIB[1]
Said NOUH[1]
Abdelali ZAKRANI[2]

[1]TIM laboratory, Faculty of Sciences Ben M'Sick, Hassan II University, Casablanca, Morocco
[2]AIMCE Laboratory, ENSAM, Hassan II University, Casablanca, Morocco

Keywords:
SE LLM, Software Engineering Large Language Model, Software Engineering LLM, SE Large Language Model, Code LLM, Code Large Language Model

Abstract

L'intelligence artificielle générative occupe aujourd'hui une place prépondérante dans divers domaines, tels que la création de contenu, le génie logiciel, la santé, l'éducation, et la finance. En particulier, elle a transformé le génie logiciel, en dépit des défis techniques et de la complexité associés à son utilisation. Cette révolution est due à la capacité de ces modèles à effectuer des tâches variées, allant de la rédaction de code à la détection d'erreurs, en passant par l'amélioration des processus de développement logiciel.

Le génie logiciel ne se limite pas uniquement à la programmation ; il englobe plusieurs étapes essentielles telles que la documentation, la conception, le développement, les tests, et la maintenance. Cette étude explore les avancées récentes dans ce domaine, en se concentrant sur quatre modèles open-source : Granite Code Models [1], Stable Code [2], CodeGemma [3], et DeepSeek-CodeR [4]. Ces modèles, entraînés sur des ensembles de données vastes et variés – combinant code, langage naturel et jeux de données mathématiques renforçant le raisonnement logique – exploitent des architectures sophistiquées, telles que les **transformers** et le modèle **Fill-in-the-Middle**, pour mieux comprendre le contexte et répondre aux besoins des utilisateurs.

Ces modèles se distinguent par leur performance dans des tâches spécifiques, telles que la complétion de code, la modernisation d'applications, la correction d'erreurs, la traduction entre langages et l'explication du code. Ils ont été évalués à travers plusieurs benchmarks reconnus, tels que **HumanEval**, **MBPP**, **RepoBench** et **LeetCode Contest**, et ont surpassé des modèles propriétaires tels que **GPT-3.5** et **CodeLlama**, bien que leur nombre de paramètres soit inférieur. Les versions optimisées de ces modèles, qui sont adaptées pour suivre des consignes en langage naturel, améliorent encore la qualité des résultats ainsi que l'interaction avec les développeurs.

De plus, ces modèles sont disponibles sous des licences open-source permissives, ce qui les rend facilement adoptables par les entreprises et les chercheurs. En conséquence, ces modèles offrent des avantages considérables pour optimiser le développement logiciel, réduire les coûts et accélérer les cycles de production.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Advanced AI Techniques for Solving Partial Differential Equations: A Case Study on the Black-Scholes Model

Communication Info

Authors:
Zakaria ELBAYED[1]
Abdelmjid QADI ELIDRISSI [2]

[1 2] Laboratory for Analysis and Modeling of Systems and Decision Support, Center for Doctoral Studies in Science and Technology and Medical Sciences, Hassan First University, National School of Applied Sciences, Berrchid, Morocco
Keywords:
Partial differential equations, Artificial intelligence, Deep learning, PINNs, FNOs, Transformers, Black-Scholes model, Computational finance, Noise robustness, Model hybridization.

Abstract

The resolution of partial differential equations (PDEs) is a critical challenge across various scientific and engineering domains. Traditional numerical methods, while effective, often struggle with high-dimensional problems and noisy datasets. Recent advances in artificial intelligence, particularly deep learning models, offer promising alternatives to conventional techniques. This study conducts a comprehensive quantitative and qualitative analysis of three advanced AI-driven approaches—Physics-Informed Neural Networks (PINNs), Fourier Neural Operators (FNOs), and Transformers—in solving the Black-Scholes PDE, a canonical model in financial mathematics. Through rigorous experimentation on synthetic datasets under both ideal and noisy conditions, our results demonstrate that Transformers exhibit superior robustness to noise and adaptability to complex boundary conditions, outperforming other models in terms of accuracy and stability. The study also highlights the distinct advantages of PINNs in handling physical constraints and outliers, while FNOs show exceptional scalability in high-dimensional settings . These findings not only underscore the potential of AI models in advancing PDE resolution but also provide valuable insights into optimizing model selection and hybridization strategies for future research. This work paves the way for more efficient and scalable AI-based solutions to address real-world challenges in scientific computing and beyond.

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Artificial neural networks based-optimal control of nonlinear epidemic model

Communication Info

Authors:
BIDAH AYMANE
ZAKARY OMAR

Keywords:
Artificial intelligence,
Artificial neural networks,
Deep learning

SIR model

Abstract

This research explores the use of two control strategies in a nonlinear SIR epidemic model with vaccination: the **Pontryagin's Minimum Principle (PMP)**, a traditional control method, and **Artificial Neural Networks (ANNs)**, a more modern data-driven approach. The study shows that **ANNs** outperform the traditional PMP in managing the epidemic.

The key findings highlight that, with ANN-based optimal control, the number of recovered individuals increases faster than in the previous controlled or uncontrolled systems. Additionally, the number of susceptible individuals drops sharply in the first few days and continues to decrease at a slower rate, achieving a more efficient eradication of the disease. This rapid reduction in infected individuals, alongside an early and significant recovery rate, illustrates the effectiveness of prioritizing vaccination in the initial stages of the epidemic.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Impact of Data Preprocessing on Classification Model Performance

Communication Info

Authors:
Mouataz IDRISSI KHALDI[1]
Allae ERRAISSI [2]
Mustapha HAIN [1]
Mouad BANANE[1]

[1] Laboratory of Artificial Intelligence and Complex Systems Engineering, ENSAM ,Hassan II University, Casablanca, Morocco
[2] Chouaib Doukkali University, El Jadida, Morocco

Keywords:
(1) Data pre-processing
(2) Supervised classification
(3) Feature selection

Abstract

Data preprocessing is essential for optimizing the performance of supervised classification models. This paper presents a review of the main pre-processing techniques (cleaning, normalization, augmentation, missing value management) and an ongoing experimental analysis to assess their impact on Naive Bayes, Decision Tree, Random Forest, kNN and SVM algorithms. Existing research shows that cleaning and normalization improve accuracy [1], missing value management enhances robustness [2], and data augmentation promotes generalization [3]. Our study anticipates a significant improvement in performance metrics (accuracy, F1-score, ROC-AUC) thanks to optimal selection of preprocessing methods [4], supporting the hypothesis that careful data preparation enhances model robustness [5].

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Effectiveness of Transfer Learning-Based Deep Learning Model in Facial Expression Recognition Compared to a Sequential Model

Communication Info

Authors:
Fouad LEHLOU[1]
Adil EL MAKRANI[2]

[1] Laboratory of Research in Informatics, FS, UIT,, Kenitra, Morocco
[2] Department of Informatics, Laboratory of Research in Informatics, FS, UIT,, Kenitra, Morocco

Keywords:
(1) Deep Learning
(2) Transfer Learning
(3) Fer2013

Abstract

Facial expression recognition (FER) [1] is a growing field within computer vision and machine learning, with applications in psychology, education, human-computer interaction, and market research. Accurately detecting facial expressions is essential for improving interactions between humans and intelligent systems [2]. This study examines emotion classification using the FER-2013 dataset, focusing on identifying facial expressions across seven categories: anger, fear, disgust, happiness, surprise, sadness, and neutral. To achieve this, we compare the performance of different convolutional neural network (CNN) architectures [3], including a Sequential model. Our results emphasize the importance of transfer learning, which utilizes pre-trained models to enhance accuracy and efficiency. Fine-tuning a deep learning model proves to be more effective than training from scratch, demonstrating the benefits of leveraging prior knowledge for facial expression recognition.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

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Balancing Performance and Efficiency in Sentiment Analysis: Traditional and Neural Approaches

Communication Info

Authors:
Kamal WALJI[1]
Allae ERRAISSI [2]
Abdelali ZAKRANI and Mouad Banane [1]

[1] Laboratory of Artificial Intelligence & Complex Systems Engineering, Hassan II University, ENSAM, Casablanca,Morocco.
[2] Chouaib Doukkali University, El Jadida, Morocco;

Keywords:
Sentiment Analysis
Natural Language Processing (NLP)
Traditional Machine Learning
Neural Networks
Logistic Regression
LSTM
Computational Efficiency

Abstract

The Sentiment analysis in natural language processing (NLP) extracts valuable insights from textual data. Traditional machine learning models (e.g., Logistic Regression, Naïve Bayes, Random Forest) offer computational efficiency but often struggle with complex semantics. Advanced neural networks (e.g., CNNs, LSTMs) provide superior accuracy at higher computational costs.

This study fills a research gap by comparing these models using a multi-criteria framework that evaluates accuracy, computational efficiency, robustness to noisy data, and adaptability to diverse text structures. Experiments on the IMDB sentiment analysis dataset show that while LSTM achieved the highest accuracy (0.88), simpler models like Logistic Regression offered competitive performance (0.87) with significantly lower computational costs.

These findings highlight scenarios where simpler models may outperform complex architectures in resource-constrained environments. Future research could explore hybrid models that blend traditional efficiency with the advanced contextual analysis of modern neural architectures, including Transformers.

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Integration of Artificial Intelligence in Wastewater Treatment Processes: A Comprehensive Analysis of Emerging Trends

Communication Info

Authors:
Mourad ARRACH[1]
Noureddine El Baraka[1]
Abderrahmane SADIQ[2]

[1] Laboratory of Analysis, Modeling, Engineering, Natural Substances and Environment, Polydisciplinary Faculty of Taroudant, UIZ, Agadir, Morocco
[2] Laboratory of Computer Systems Engineering, Mathematics and Applications(ISIMA) Polydisciplinary Faculty of Taroudant, UIZ, Agadir, Morocco
Keywords:
(1) Machine Learning
(2) Wastewater Treatment
(3) Environmental Compliance

Abstract

This research explores the integration of Artificial Intelligence into wastewater treatment processes to enhance efficiency, reduce costs, and ensure environmental compliance of the process [1]. Wastewater treatment plants in production units often face challenges with undesirable outcomes in treated water, impacting the quality of reused water and the environment [2]. This study explores the application AI techniques through machine learning, leveraging real-time and historical data to optimize treatment processes, and address emerging trends in wastewater management [3]. Through an analysis of current applications and innovations, the research underscores the transformative potential of AI in revolutionizing the field, offering sustainable solutions to global water treatment challenges. Furthermore, this study aims also to explore the latest advancements to identify solutions applicable in contexts with socio-economic conditions like those of Morocco and comparable regions [4].

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ICRAMCS 2025
THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

A Multi-Agent System for AI-Powered Contract Validation Under Moroccan Law

Communication Info

Authors:
Aymane MALIH[1]
Omar BENCHAREF[1]

*Laboratory of Computer and Systems Engineering (**L2IS**), Cadi Ayaad University, Marrakech, Morocco*

Keywords:
(1) Multi-Agent Systems
(2) Contract Validation
(3) Large language models
(4) Moroccan Law

Abstract

A legal system like Moroccan law is complex, and contract validation under legal guidelines is a time-consuming task, especially if expert knowledge is required, as in the case of Moroccan law [1]. Introducing a multi-agent system using language models to simplify and automate contract validation for non-experts is the purpose of this paper. The system is built around three key agents: Clause Extractor, Compliance Checker, and Explanation Agent. The system supports multiple contract types in both French and Arabic to be aligned with Morocco's linguistic and legal context [2]. By integrating language models with a multi-agent approach, the system is able to address complex legal challenges and thereby enables businesses and individuals to confidently manage their contracts [3]. The testing results show that the architecture is able to provide accurate and practical feedback to help users detect and solve problems before finalizing agreements. From the research, the above-outlined goals are achieved, and hence this paper contributes to the growing field of AI-driven legal technology, offering a practical and easily implementable solution for contract validation under the laws of Morocco.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

April 24-25-26, 2025 | Marrakech, Morocco

Enhancing Breast Cancer Diagnosis using Blood Vessel Segmentation in Breast MRI

Communication Info

Authors:
Laila EL JIANI[1]
Sanaa EL FILALI[1]
El Habib BENLAHMAR[1]
Fatima-Zahra ALAOUI[1]
Zouheir BANOU[1]

[1] Hassan II University, Casablanca, Morocco

Keywords:
(1) Breast MRI
(2) Breast Cancer
(3) Medical Imaging
(4) Angiogenesis
(5) Blood Vessel Segmentation
(6) Computer Vision

Abstract

Magnetic Resonance Imaging (MRI) is a sensitive, non-invasive technique for monitoring and identifying lesions, establishing it as standard clinical practice [1,2]. However, its effectiveness in visualizing blood vessels in breast tissue requires further investigation [3]. Blood vessel analysis provides valuable insights into tumor progression and information that can be correlated with the underlying tumor biology [4,5]. This paper offers an extensive review of techniques and methodologies. A significant contribution of this work is the introduction of a unified workflow that combines the advantages of the different approaches examined, providing a more cohesive solution for blood vessel segmentation in breast MRI. The paper also examines the challenges and limitations in this field, including image quality, algorithmic constraints, anatomical complexities, and data scarcity. Our study identifies ongoing issues, particularly the need for robust evaluation metrics and standardized datasets. Addressing these issues is essential for driving future advancements in breast MRI vessel segmentation and improving clinical outcomes.

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April 24-25-26, 2025 | Marrakech, Morocco

L'intelligence artificiel dans le contexte de la Cyber-sécurité

Communication Info

Authors:
Zakariae CHEDDOUR

Department of Mathematic ,
University Abdelmalek Essaadi,
Faculty of Sciences and Technology
Al Hoceima, BP 34. Ajdir 32003 Al Hoceima, Morocco.

Keywords:
(1) Cybersécurité

Abstract

Avec l'augmentation exponentielle de la propagation des menaces associée à la diffusion quotidienne de nouveaux logiciels malveillants, il est particulièrement impossible d'envisager de traiter efficacement ces menaces en se basant uniquement sur des analyses effectuées par les analystes. Il est nécessaire d'introduire des algorithmes qui permettent d'automatiser la phase d'introduction de l'analyse appelée triage. C'est-à-dire d'effectuer un tri préliminaire des menaces à soumettre à l'attention des professionnels de la cybersécurité, ce qui permet de répondre de manière rapide et efficace aux attaques en cours.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

April 24-25-26, 2025 | Marrakech, Morocco

Advanced Phonocardiogram (PCG) Signal Processing Using VMD

Communication Info

Authors:
JAMAL ISKNAN[1]
SAMIR ELOUAHAM [2]

[1] ENSA, AGADIR, MOROCCO
[2] ENSA, AGADIR, MOROCCO

Keywords:
(1) Phonocardiograms (PCG)
(2) Variational mode decomposition (VMD)
(3) Empirical mode decomposition (EMD)
(4) Discrete wavelet transform (DWT)

Abstract

Heart murmurs are biosignals used for early diagnosis of cardiovascular diseases. Digital heart sound recordings called phonocardiograms (PCG) are essential for identifying and automatically classifying possible heart diseases, leading to more efficient and accurate diagnosis. Variational mode decomposition (VMD) is an advanced signal processing technique that can decompose broadband signals into multiple narrowband components and improve feature extraction. However, there are challenges in selecting the appropriate number of modes and penalty coefficients, which can affect the accuracy of the decomposition. To address this issue, empirical mode decomposition (EMD) was proposed to extract sub-band signals as eigenmodes. Discrete wavelet transform (DWT) is also used to improve signal analysis and noise reduction The results show that VMD is an innovative method that provides superior performance and is a more effective solution due to its lower RMSE error compared to other methods. This makes VMD a promising tool for improving heart sound analysis and early detection of cardiovascular diseases.

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Enhancing Blockchain PoW with Fisher-Yates Shuffle and a Merkle-Damgård-Inspired Hash

Communication Info

Authors:
Asmaa CHERKAOUI[1]
Seddik ABDELALIM [2]
Abdelkarim LKOAIZA [3]
Ilias ELMOUKI [4]

[1,2,3,4] *Institution, City, Country*
Laboratory of Fundamental, And Applied Mathematics, Faculty of Sciences Ain Chock, University Hassan II of Casablanca, Casablanca, Morocco

Keywords:
(1) Merkle-Damgård Hash
(2) Fisher-Yates shuffle
(3) Blockchain
(4)Proof of Work

Abstract

In this talk, we introduce a Fisher-Yates shuffle for the development of the Merkle-Damgård construction [2] while using our own programming functions and without a call from any hashing library. Since the National Institute of Standards and Technology (NIST) computer scientist Chris Celi recommended that the Secure Hash Algorithm 1 (SHA-1) to be phased out in 2030 \cite{b14} in spite of their use in many digital signatures, we focus in our work, on getting inspired by the currently unbreakable Secure Hash Algorithm 2 (SHA-2) [1]. To the best of our knowledge, this is the first time that such an interesting suffling is implemented in this family and this could reinforce the security of our hash. Finally, we provide a practical explanation of how the use of our approach could be beneficial for the Proof-of-Work (PoW) in blockchain.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

April 24-25-26, 2025 | Marrakech, Morocco

Agriculture 5.0: Plant Disease Detection Using Deep learning - Comparison study between CNN and VGG16

Communication Info

Authors:
ALAOUI Fatima-zahra[1]
EL JIANI Laila[1]
ELFILALI SANAA[1]
AIT ABDELOUAHDI Rachida[1]
Zouheir Banou[1]
[1] University Hassan II Casablanca, Faculty of Science Ben M'sick, Casablanca, Morocco

Keywords:
(1) Plant disease detection,
(2) Deep Learning,
(3) CNN,
(4) Transfer Learning,
(5) VGG16,

Abstract

Integrating artificial intelligence methods, such as deep learning, holds significant potential for enhancing the accuracy and efficiency of plant disease detection. In this article, we provide a comprehensive overview of the application of deep learning in the field of plant disease detection, utilizing a Convolutional Neural Networks (CNN) model. The utilization of Convolutional Neural Networks (CNN), a deep learning model tailored for image analysis, has proven to be highly effective in the detection of plant diseases. Leveraging extensive datasets related to plant diseases and transfer learning techniques, CNNs consistently achieved accuracy rates exceeding 98%. This article underscores the potential of deep learning, particularly the CNN model, as a powerful and effective tool for plant disease detection. Furthermore, we demonstrate that using transfer learning models, such as VGG-16, resulted in an accuracy rate of 95%.

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ICRAMCS 2025

THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 24-25-26, 2025 | Marrakech, Morocco

Adopting the Grendel Approach in Blockchain Signature

Communication Info

Authors:
Abdelkarim LKOAIZA[1]
Seddik ABDELALIM[2]
Asmaa CHERKAOUI [3]
Ilias ELMOUKI4[4]

1Laboratory of Fundamental and Applied Mathematics, Faculty of Sciences Ain Chock, University Hassan II of Casablanca, Casablanca, Morocco

Keywords:
(1) Grendel hashing
(2) Blockchain signature
(3) Keccak family,

Abstract

In this presentation, we introduce our own custom-developed programming to generate a spongebased function without relying on any hashing libraries. We then explore its implementation in a blockchain signature, drawing inspiration from Keccak methods, including the recently robust Secure Hash Algorithm 3 (SHA-3). However, our main contribution lies in introducing the Grendel permutation instead of the Keccak permutation, as both utilize sponge-based techniques but differ in their shuffling process. To the best of our knowledge, this is the first time such an approach has been applied to blockchain signatures.

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Stock Trends Forecasting with FinBERT and Bi-LSTM

Communication Info

Authors:
Mohamed Rida SAHIB[1]
Hamza ELKINA [1]
Taher ZAKI [1]

[1] Faculty of Applied Sciences, Ait Melloul, Morocco

Keywords:
(1) Stock Price Prediction
(2) Sentiment Analysis
(3) FinBERT
(4) Bi-LSTM

Abstract

This study proposes a hybrid model combining FinBERT for financial sentiment analysis with Bi-LSTM for stock trend forecasting [1]. FinBERT [2] extracts sentiment from financial news, which, when integrated with historical stock data, helps the Bi-LSTM model capture temporal dependencies. The model is evaluated using stock price and news datasets, showing improved predictive accuracy over traditional models. Results highlight the effectiveness of integrating sentiment analysis with deep learning [3] for better stock market predictions, benefiting investors and analysts.

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THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

April 24-25-26, 2025 | Marrakech, Morocco

A Practical Approach of DevSecOps Integration in Multi-Tier Web Applications

Communication Info

Authors:
Abderrahim RIDA[1]
Ayoub AIT LAHCEN[1]

[1] Engineering Sciences Laboratory, National School of Applied Sciences, Ibn Tofail University, Kenitra, Morocco

Keywords:
(1) DevOps
(2) DevSecOps
(3) CI/CD pipelines
(4) Multi-tier Web Applications.

Abstract

DevSecOps pipelines are diverse and the configurations of each DevSecOps team may be unique. While the used methodologies may be different, they have a common objective driven toward fast and secure delivery, supported with efficient communication between Development, Operations, and Security teams [1]. With the use of multiple DevSecOps pipelines, It would be crucial to adjust a specific pipeline intended for Multi-tier Web Applications, even with the potential challenges that can arise [2]. The practical pipeline, described here, can be used as a template for DevSecOps teams working on Multi-tier Web Applications, whether such applications are structured as monolithic architectures or realized using micro-services [3]. The purpose is to share this novel pipeline to determine its effectiveness, hence establishing a baseline CI/CD that DevSecOps teams can adapt to meet their specific requirements [4]. This approach aligns with the growing need for integrating security into DevOps practices to ensure robust and secure software delivery [5].

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Ensemble Classification Methods for Stock Market Movement: A Review

Communication Info

Authors:
Ilyas Elkinani[1]
Mohamed Hosni [1]
Ibtissam Medarhri [2]
Tawfik Masrour[3]

[1] IEST Research Team, AIDTM Laboratory, ENSAM, University Moulay Ismail of Meknes, Morocco

[2] MMCS Research Team, LMAID, ENSMR, Rabat, Morocco

[3]IASI Research Team, AIDTM Laboratory, ENSAM, University Moulay Ismail of Meknes, Morocco

Keywords:
Ensemble Methods
Machine Learning
Stock Market
Classification

Abstract

Ensemble methods combine multiple models to improve prediction accuracy and overcome the limitations of individual techniques [1]. They are widely used in various fields, including stock market forecasting, to enhance prediction tasks in both classification and regression [2,3]. Given the complexity of market characteristics, these methods provide more stable and reliable predictions [2]. The goal of this study is to analyze the state of the art in ensemble classification methods applied to stock market prediction concerning seven aspects: publication venues, stock market tasks addressed, types of ensembles proposed, individual techniques used to construct the ensembles, combiners adopted in ensemble methods, validation frameworks used to evaluate the proposed ensembles, and tools utilized to build the ensembles.
A total of 60 journal papers, published between 2000 and 2024, were outsourced from Scopus and Web of Science digital libraries after a selection process. The study found that *Expert Systems with Applications* is the most frequently used source venue and that, among the three existing stock market tasks, stock price prediction was the most frequently addressed. The homogeneous ensemble type was the most widely used for performing the classification task. Regarding individual techniques, this review found that decision trees, support vector machines, and neural networks were the most frequently adopted for building ensemble classifiers. For combination strategies, majority voting was the most commonly used rule. As for the evaluation framework, the S&P 500 index dataset was the most commonly used by researchers for their experiments, with accuracy being the most frequently used metric to assess the predictive capability of ensemble methods. The holdout method was the most widely adopted validation method. The review reveals that various tools can be used for experiments with ensemble classification methods, including Python and WEKA software. This study provides an in-depth analysis of ensemble methods in stock market prediction, identifying research gaps.
The findings show that most studies report higher accuracy for ensemble classifiers compared to individual models, highlighting the need for a systematic review and meta-analysis to confirm their superiority.

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ICRAMCS 2025

THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
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Predictive Maintenance in Industrial Systems Using Machine Learning: A Review

Communication Info

Authors:
Oussama Benmansour [1]
Ibtissam Medarhri [1]
Mohamed Hosni [2]

1MMCS Research Team, LMAID, ENSMR, Rabat, Morocco
2IEST Research Team, AIDTM Laboratory, ENSAM, University Moulay Ismail of Meknes

Keywords:
(1) Machine Learning
(2) Predictive Maintenance
(3) Artificial intelligence
(4) Review
(5) Industrial

Abstract

Predictive maintenance (PdM) has emerged as a crucial strategy in modern industrial settings, leveraging machine learning (ML) to enhance equipment reliability and reduce unplanned downtimes [1]. Unlike traditional maintenance strategies that rely on reactive or scheduled interventions, PdM enables real-time anomaly detection and failure prediction through sensor data and historical records [2]. Recent studies highlight the effectiveness of ML techniques in optimizing maintenance schedules and improving asset reliability.
This study presents a systematic mapping of ML classification techniques in industrial predictive maintenance. A total of 199 articles, after a selection process, in industry and manufacturing published between 2000 and 2024 were outsourced from the Scopus digital library. Findings indicate that fault diagnosis is the most frequently investigated task, with Support Vector Machines and decision trees being the predominant ML techniques. Additionally, recent research highlights the increasing role of deep learning in PdM, with architectures such as convolutional neural networks (CNNs) and long short-term memory (LSTMs) proving effective in anomaly detection and remaining useful life (RUL) estimation. Furthermore, a comparative analysis of ML models in real-world industrial applications demonstrates that ensemble methods like XGBoost provide an optimal balance between predictive accuracy and computational efficiency [3]. The datasets analyzed are primarily derived from real-world sensor data and maintenance records, ensuring practical applicability.
These findings emphasize the need for further exploration of hybrid approaches and alternative classification techniques to advance industrial AI applications.

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April 24-25-26, 2025 | Marrakech, Morocco

Dynamique des Bibliothèques Python Pour Les Matrices issues des Problèmes Inverses Mal Posés.

Communication Info

Authors:
Aziz SOUKRI[1]
Omar EL BANNAY[1]
Karim GHOFIR[1]

[1] *ENSA, Khouribga, Maroc*

Keywords:
(1) Matrices denses ;
(2) Matrices creuses ;
(3) Matrices de convolution ;
(4) Décomposition DVS ;
(5) Régularisation.

Abstract

En mathématiques analytiques et en ingénierie des traitements d'images, Les problèmes inverses mal posés constituent un défi majeur. Les travaux de recherche menés dans ce sens sont principalement focalisés sur des algorithmes concentrés sur les propriétés de la décomposition en valeurs singulières (SVD) et particulièrement dans les techniques de régularisation (comme par exemple la régularisation de TIKHONOV, la régularisation TSVD ou encore la Totale Variation) [1,2,3,4]. L'objectif de ce travail consiste dans un premier temps à développer des algorithmes permettant de réduire la dynamique (vitesse) de création des matrices de convolution, et d'effectuer une comparaison avec d'autres algorithmes basés sur des bibliothèques prédéfinies ; et dans un deuxième temps, selon les propriétés de la matrice de convolution, une étude comparative des différentes méthodes d'inversion ou de décomposition en valeurs singulières. L'étude comparative menée a révélé que l'application de ces algorithmes, réduisent significativement le temps nécessaire aux traitements adéquats à un système désiré. Quelques exemples seront présentés pour valider l'étude.

References

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