Book of Abstracts

ICoIAM 2026

International Conference of
Industrial and Applied Mathematics

29 – 31 October 2026
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About this book

This book gathers the contributions presented at the International Conference of Industrial and Applied Mathematics (ICoIAM 2026), held at the Dar Ismail Hotel in Tabarka, Tunisia, from 29 to 31 October 2026, on site and online through Google Meet. Contributions appear in the order of the conference program.

6	66	26	47
keynote lectures	oral talks on site	online talks	posters

How to read this book

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Presenters are underlined. Entries are numbered K (keynote), W (workshop), O (oral) and P (poster).

Editors' notes: 24 contributions, the keynote lectures and the workshop have no abstract available at the time of publication. Their entries carry a short note written by the editors from the title alone: it describes the topic and gives general background, marked as such, and says nothing about the authors' methods or results.

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KEYNOTE LECTURES AND WORKSHOP

K-1 Keynote lecture · Thu 29 Oct · 09h30 · Room A

On λ-Almost Statistical Convergence of Weight g in Partial Metric Space

Prof. Dr. Ekrem Savaş

Uşak University, Türkiye

This lecture is devoted to λ-almost statistical convergence of weight g in the setting of partial metric spaces. Statistical convergence extends the classical notion of limit by requiring convergence only outside sets of natural density zero.

Editors' note based on the title only; not written by the authors, and no results are implied.

K-2 Keynote lecture · Thu 29 Oct · 10h15 · Room A

Mitigating Bias in Federated Learning through Client Clustering and Personalized Models

Prof. Kenan M. Matawie

Western Sydney University, Australia

This lecture addresses the mitigation of bias in federated learning through client clustering and personalized models. In federated learning, several clients train a shared model without pooling their data, so differences between client datasets can affect the resulting model.

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K-3 Keynote lecture · Thu 29 Oct · 14h30 · Room A

On normalized fractional operators with exponential and Mittag-Leffler kernels

Prof. Thabet Abdeljawad

Prince Sultan University, Saudi Arabia

This lecture is devoted to normalized fractional operators with exponential and Mittag-Leffler kernels. Such operators replace the power-law kernel of classical fractional calculus with other kernels and are widely studied in the modeling of memory effects.

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K-4 Keynote lecture · Fri 30 Oct · 09h00 · Room A

Generalizing Integral Transforms for Weighted Fractional Differential Operators

Prof. Fahd Jarad

Çankaya University, Türkiye

This lecture concerns the generalization of integral transforms for weighted fractional differential operators. Integral transforms such as the Laplace transform are classical tools for solving fractional differential equations.

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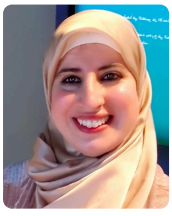

K-5 Keynote lecture · Fri 30 Oct · 13h45 · Room A

M2CARE: Multi-Agent Multi-Criteria Clinical Assessment with Risk Estimation for Chest X-Ray Report Generation

Prof. Mouna S. Mayouf

Capgemini Engineering, France

This lecture concerns M2CARE, a multi-agent, multi-criteria clinical assessment with risk estimation for chest X-ray report generation. Automatic report generation aims to assist radiologists in drafting reports from medical images.

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W-1 Workshop · Fri 30 Oct · 14h30 – 17h30 · Room A

AI & Mathematics Challenges

Prof. Mouna S. Mayouf

Capgemini Engineering, France

This three-hour workshop is devoted to challenges at the interface of artificial intelligence and mathematics.

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K-6 Keynote lecture · Sat 31 Oct · 09h00 · Room A

An Iterative Regularization Approach to an Ill-Posed Generalized Elliptic Problem

Prof. Nadjib Boussetila

University 8 May 1945 Guelma, Algeria

This lecture concerns an iterative regularization approach to an ill-posed generalized elliptic problem. In an ill-posed problem, solutions may not depend continuously on the data, which is why regularization methods are used.

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THURSDAY, OCTOBER 29 – ORAL SESSIONS

Differential Equations and Dynamical Systems I

Room A · 11h30–13h00 · Chair: Lahcène Chorfi

O-01 11h30 · Room A

On the existence and uniqueness of solutions for a ψ-Caputo fractional boundary value problem with fractional boundary conditions

Hamza Medjekal, Besma Berrehail

Department CPST, National Higher School of Technology and Engineering, Annaba 23005, Algeria.

The main purpose of the present work is the investigation of the existence and uniqueness of solutions to an implicit nonlinear boundary value problem of fractional differential equations involving ψ−Caputo fractional derivative and subject to fractional boundary conditions. The results of existence and uniqueness are proved thanks to Banach and Scheafer's fixed point theorems. Finally, we present appurtenant examples to illustrate the obtained results.

Keywords: ψ−Caputo fractional derivative, ψ−Riemann-Liouville fractional integral, boundary value problems, fixed point theorems.

O-02 11h45 · Room A

Resolvent and Integrated Resolvent Operators in Partial Functional Integro-Differential Equations: Existence Results and a Comparative Study

Sanaa Tebbal, Imene Medjadj

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Mathematics, and Statistics and their Applications Laboratory(LMSA), El Mnaouar, BP 1505, Bir El Djir 31000, Oran,Algeria

Partial functional integro-differential equations arise naturally in the mathematical modeling of various phenomena in physics, biology, engineering and control theory. In this review, we consider the abstract partial functional integro-differential equation $y'(t) = Ay(t) + \int_0^t B(t-s)y(s)\,ds + f(t, y_t)$, $t \geq 0$, $y_0 = \phi \in C = C([-r, 0]; X)$ where X is a Banach space, $A : D(A) \subset X \to X$ is a linear operator satisfying the Hille–Yosida condition, $B(t)$ is a family of bounded linear operators, and f is a nonlinear mapping. The existence theory for this class of equations strongly depends on the properties of the operator A. When $D(A)$ is dense in X, the classical resolvent operator associated with C_0-semigroup theory provides an appropriate framework for establishing the existence of mild solutions. In contrast, when $D(A)$ is not dense, the classical semigroup approach is no longer applicable, and the theory of integrated semigroups and integrated resolvent operators provides a suitable framework for the study of integral solutions. This review paper presents a comparative overview of these two analytical frameworks. It focuses on the construction and the principal properties of resolvent and integrated resolvent operators, the corresponding notions of mild and integral solutions, and representative existence results established in the literature. A comparative analysis is provided to emphasize the similarities and the fundamental differences between the dense and nondense settings. Finally, several perspectives and open problems related to functional integro-differential equations governed by nondensely defined operators are briefly discussed.

Keywords: Partial functional integro-differential equations; resolvent operator; integrated resolvent operator; existence of solutions; mild solution; integral solution; nondensely defined operator

O-03 12h00 · Room A

Growth Behavior of Solutions to Linear Differential Equations Under a Dominant Lower (α,β,γ)-Order Coefficient

Benharrat Belaïdi

Department of Mathematics, Laboratory of Pure and Applied Mathematics, University of Mostaganem, B. P 227 Mostaganem-(Algeria)

The study of growth and oscillation of solutions of complex differential equations has attracted considerable attention due to its importance in complex analysis and value distribution theory. In this talk, we investigate higher-order linear differential equations whose coefficients are entire functions. Special attention is given to the case where one coefficient dominates the others with respect to its lower (α, β, γ)-order and lower (α, β, γ)-type. Under these assumptions, we establish new results describing the growth and oscillatory behavior of solutions. The obtained findings reveal how the asymptotic properties of the dominant coefficient influence the behavior of the solutions and provide sharper estimates than several existing results. These results generalize and extend a number of earlier contributions in the literature and contribute to a broader understanding of the interplay between the growth of coefficients and the growth of solutions of higher-order linear differential equations.

O-04 12h15 · Room A

Computational solution of the Fuzzy Diabetes Model using a novel iterative approach

A. F. Jameel, E. B Bashier, A. K. Alomari, Walid Wannes, Khamis Al Kalbani (presented by Ali Jameel)

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The purpose of this study is to investigate a simple mathematical model of glucose-insulin dynamics that is used to Omani diabetic patients in order to find an approximate solution to diabetes inside a fuzzy environment by utilizing an approximate analytical method. Meanwhile, such approaches may provide more straightforward solutions, avoiding the need for extensive numerical calculations or complex linearization and discretization techniques that can be challenging when applied to fuzzy differential equation models. When it comes to actual-world circumstances, there are some pieces of information that we are unable to determine with exact precision. Because of this, we are required to accept the parameters as ambiguous and imprecise parameters. The concept of a system of linear differential equations, whose initial conditions are fuzzy numbers, is used to create the diabetes model. The fuzzy model, which is a method for solving dealing with fuzzy differential equations, is utilized as an approximate approach that is based on the multistage iteration method. In order to demonstrate the biological significance of the model, a fuzzy analysis is conducted. Tables and figures present the emergent numerical results, followed by sophisticated debates and conclusions.

O-05 12h30 · Room A

A Newton–Simpson Discretization for a Fractional Bratu-Type Integral Equation

Helmi Temimi

College of Integrative Studies, Abdullah Al Salem University, Khladiya, Kuwait

We study a nonlinear boundary value problem of Bratu type involving a Caputo fractional derivative of order $\alpha \in (1, 2]$. Starting from the fractional differential equation ${}^{C}D_{0+}{}^{\alpha}u(x) = -\lambda e^{u(x)}$, $0 < x < 1$, with homogeneous Dirichlet boundary conditions $u(0) = u(1) = 0$, we derive a nonlinear integral equation formulation. The resulting equation couples a global (Fredholm-type) integral and a Volterra integral with weakly singular kernels of order $\alpha - 1 > 0$. We then construct a high-order spatial discretization based on a uniform grid and composite Simpson's rule, and apply Newton's method with an analytically assembled Jacobian. A key feature of the scheme is a precomputed Volterra weight matrix that allows a vectorized evaluation of the nonlinear operator and its Jacobian. Under standard smoothness and invertibility assumptions, we establish an error bound of order $O(h^4)$ in the max norm for the spatial discretization, while Newton's method converges quadratically toward the discrete solution once the initial guess is sufficiently close.

Keywords: fractional Bratu problem; Caputo derivative; nonlinear integral equation; Simpson's rule; Newton's method; error analysis

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O-06 12h45 · Room A

New Theoretical Results on the Partial Stability of Deterministic and Stochastic Nonlinear Systems

Ezzine Faten

University of Sfax, Tunisia

This talk concerns new theoretical results on the partial stability of deterministic and stochastic nonlinear systems. Partial stability studies the behavior of only part of a system's state variables rather than the whole state.

Editors' note based on the title only; not written by the authors, and no results are implied.

Statistics, Probability, Stochastic Calculus & Optimization

Room B · 11h30–13h00 · Chair: Rabia Savaş

O-07 11h30 · Room B

A Jackson q-Poisson–Lindley Distribution

Samah Abu Siyam, Cindy Stiegelmeyer

Department of Mathematics and Statistics, College of Engineering, Abu Dhabi University, P.O. Box 59911, Abu Dhabi, United Arab Emirates

The Poisson–Lindley distribution is a mixture of a geometric and a shape-two negative-binomial component that share one geometric kernel. We deform the combinatorial count factor of the negative-binomial component by its Jackson q-integer and obtain a two-parameter count distribution whose deformation parameter moves continuously from the geometric distribution to the Poisson–Lindley distribution while the geometric tail rate is unchanged. The family is shown to be an exact Jackson q-integral mixture of the Euler distribution over an exponentially tilted Lindley q-density, which is the q-analogue of the classical Poisson–Lindley construction. Closed forms are given for the survival, hazard and generating functions, the mode and the factorial moments. The mass function is log-concave, strictly so for $q > 0$; the failure rate is nondecreasing, strictly increasing for $q > 0$ and constant at $q = 0$; and the distribution is over-dispersed for every parameter value. The parameters are identifiable, and the Poisson–Lindley hypothesis is a boundary hypothesis whose likelihood-ratio statistic has a mixed chi-square limit. A Kullback–Leibler scale quantifies when the deformation is detectable. Two published count data sets and a simulation illustrate the results.

Keywords: Poisson–Lindley distribution; q-calculus; Jackson q-integral; Euler distribution; log-concavity; boundary likelihood-ratio test

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O-08 11h45 · Room B

q-Gaussian Heavy-Tailed Fusion of Reservoir and Kalman Forecasts with Quantum-Like Interference

Ghassane Benrhmach, Imed Bouzida

Department of Mathematics and Statistics, College of Engineering, Abu Dhabi University, P.O. Box 59911, Abu Dhabi, United Arab Emirates
Laboratory of Probability and Statistics, Faculty of Sciences of Sfax, University of Sfax, Tunisia

We forecast a chaotic system from a noisy scalar record with a reservoir computer with direct multi-horizon readouts and an extended Kalman filter that propagates the equations of motion. Each predictor is summarized by a variance-matched q-Gaussian density, a Student-t reparameterisation in which one bounded index moves the tails from Gaussian to heavy at fixed variance. They are combined by the linear opinion pool or by a quantum-like rule that superposes square-root amplitudes with a disagreement-driven phase and nests the linear pool exactly. The fused density is proper, its distance to the linear pool is bounded by the Bhattacharyya overlap, and with equal weights and scales interference cannot move the point forecast. In 900 paired runs over six scenarios on Lorenz-63 and Rössler, with Gaussian, Student-t_3 and contaminated noise and a misspecified filter model, heavy-tailed components lower the log score by up to 0.14 nats and reliability weights by 0.15 nats, whereas interference at identical components, weights, and q changes it by under 0.01 nats. Tails and weights, not interference, improve the pooled forecast.

Keywords: forecast combination; q-Gaussian distribution; Student-t distribution; reservoir computing; extended Kalman filter; quantum-like probability; proper scoring rules; chaotic systems.

O-09 12h00 · Room B

Liouville Theorems for Mixed Fractional Laplacians

Imed Bouzida, Akram Al-Muraqab

Department of Mathematics and Statistics, College of Engineering, Abu Dhabi University, P.O. Box 59911, Abu Dhabi, United Arab Emirates

We give a focused account of Liouville-type theorems for the nonlinear equation driven by the sum of two fractional Laplacians of different orders with a power nonlinearity on the whole space. Such operators describe diffusion generated by the superposition of two jump processes with distinct scaling, and the interaction between the two orders is the main source of difficulty: the operator has no scaling invariance, so the tools developed for a single fractional Laplacian have to be adapted. We recall three notions of stability, namely global stability, finite Morse index and stability outside a compact set, and explain how they are related. The principal theorem states that the equation admits no nontrivial solution that is stable outside a compact set, for every exponent larger than one. The proof strategy is presented in a unified way: a stability inequality tested against cut-off functions yields weighted energy estimates; in the subcritical and critical regimes these estimates are combined with a Pohozaev identity for the extended problem, whereas in the supercritical regime a monotonicity formula and a blow-down argument reduce the question to a homogeneous limit that must vanish. The decisive role of the lower fractional order is emphasized throughout.

Keywords: mixed fractional Laplacian; stable solutions; Morse index; Liouville theorem; Pohozaev identity; monotonicity formula; blow-down analysis

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O-10 12h15 · Room B

Lattice Distribution and Lebesgue Normalisation of the Gamma–Lindley q-Distribution: Consequences for Likelihood-Based Inference

Imed Bouzida

Department of Mathematics and Statistics, College of Engineering, Abu Dhabi University, Abu Dhabi, United Arab Emirates

The Gamma–Lindley q-distribution of Bouzida et al. (Discover Applied Sciences, 2026) is a Jackson-calculus analogue of the admissible Gamma–Lindley distribution on $[0, \rho]$, $\rho = 1/((1 - q)\vartheta)$, used as the response distribution of a support-aware neural regression model. Its density is normalised by a Jackson integral, a sum over the grid $\{\rho q^k\}$, and we study the consequences. First, we prove that the distribution is that of ρq^K, where the integer K has closed-form probabilities and a closed-form distribution function that depend only on q and one mixing weight. Second, we represent K through independent Bernoulli(q^j) trials and give an inversion sampler that is exact in exact arithmetic and terminates with probability one; its floating-point implementation re-decides near-ties in interval arithmetic. Third, we show that the ordinary integral of the same density is $Z_L = w_1 A_0(q) + w_2 A_1(q)$, with two universal Euler-type series; we prove $A_0 > 1$, $A_1 > (1 + q)/2$ and $Z_L \to 1$ as $q \to 1^-$, and find numerically $Z_L \le 1.2026$. A log-likelihood that evaluates the Jackson density at continuous data therefore contains the data-free offset $\log Z_L$. In a simulation study the offset produces a spurious gain of 0.102 nats per observation over the true classical model and, for renormalised q-data, biases $\hat{q}$ downwards by 0.12–0.13. The Lebesgue-renormalised likelihood reduces the gain to 0.001 nats and the mean error of $\hat{q}$ to below 0.02. It does not remove sampling variability: for classical data, 29.5% of corrected estimates still fall below 0.9. On diabetes-progression data the offset is comparable to the differences between response families.

Keywords: Jackson integral; q-exponential function; Gamma–Lindley distribution; lattice distribution; normalising constant; exact simulation; likelihood inference.

O-11 12h30 · Room B

Méthode des SIEVES pour la prévision d'un processus autorégressif fonctionnel

Kamila Berhoune

Département de Mathématiques et Informatique, Faculté des Sciences exactes, Université Tahri Mohammed, Bechar 08000, Algeria

Recently, Mourid T and Bensmaine N [12] introduced a sieves estimator of the kernel of a one-order autoregressive Hilbertian processes's operator in the Gaussian case of an even 1-periodic kernel. In this paper we show the existence of this estimator in the case of an unspecified 1-periodic kernel, the almost sure convergence and we give an explicit form of the estimator in the Gaussian case. When the parameter is a Hilbert Schmidt operator we show the existence and almost sure convergence of sieves estimate in Hilbert–Schmidt norm. We also examine the prediction of continuous time stochastic process.

O-12 12h45 · Room B

Complexity Analysis of Large-Update Interior-Point Methods for HLCP Based on a New Parametric Kernel Function

El Amir Djeffal, Randa Chalekh
Mathematics Department, University of Batna 2, Algeria

This talk concerns the complexity analysis of large-update interior-point methods for the horizontal linear complementarity problem (HLCP), based on a new parametric kernel function. Kernel functions are used in interior-point methods to define search directions and proximity measures.

Editors' note based on the title only; not written by the authors, and no results are implied.

Online Session I – AI, Computer Science & Control

Room C – Online · 11h30–12h30 · Chair: Ahmed Ghorbel

O-13 11h30 · Room C – Online Online

Bayesian Network Modeling for Algorithmics Education

Wafa Louafi, Houda Tadjer, Yacine Lafifi
LabSTIC Laboratory, University 8 May 1945 Guelma 24000, Algeria

Algorithmics, a cornerstone of computer science curricula, poses significant challenges to students due to its abstract concepts and the need for structured problem-solving skills. This study pioneers the use of Bayesian Networks (BNs) to model the interplay of cognitive, pedagogical, and practical factors affecting student performance in algorithmics. We surveyed 1,073 students across various academic levels using a 14-item questionnaire targeting these dimensions. The resulting causal Bayesian Network identified six key determinants of student performance: (1) conceptual comprehension, (2) analytical reasoning, (3) teaching effectiveness, (4) independent practice time, (5) self-efficacy in problem-solving, and (6) course delivery clarity. Our analysis highlights insufficient practice and unclear course delivery as primary barriers to student performance. To address these challenges, we recommend implementing iterative practice sessions, scaffolded problem-solving frameworks, and enhanced conceptual clarity through visualizations and real-world analogies. Additionally, fostering metacognitive skills can help bridge the gap between theoretical understanding and practical application. This work provides educators and curriculum designers with evidence-based strategies to improve algorithmic proficiency in undergraduate programs. It also demonstrates the utility of probabilistic graphical models as a replicable tool for educational analytics, with broader applications in Science, Technology, Engineering, and Mathematics (STEM) education.

Keywords: Algorithmics, Bayesian Networks, Computer Science Education, Student Performance.

O-14 11h45 · Room C – Online **Online**

Towards an Intelligent Assistant against Academic Procrastination: A Self-Regulated Learning Approach

Houda Tadjer, Zohra Mehenaoui, Wafa Louafi, Yacine Lafifi

LabSTIC Laboratory
University 8 mai 1945 Guelma, Algeria

Academic procrastination is widespread among students and is associated with lower performance, stress and poorer well-being, especially in project-based learning, where students must plan and pace long assignments on their own. General-purpose tools such as Trello or Google Classroom support basic task management, but they neither model the student's behaviour nor adapt their support to it. Existing work on interaction traces shows that delay patterns can be detected in learning environments, but these studies stop at prediction and rarely close the loop towards personalised support. This paper presents the design of an intelligent virtual assistant grounded in self-regulated learning (SRL). A project-management layer lets students break projects into tasks and subtasks with deadlines and reminders, and lets teachers follow progress and give feedback. On top of it, an artificial-intelligence layer builds a student model from behavioural indicators (late submissions, the gap between planned and actual completion, low platform usage, repeated postponements), infers a procrastination level (low, medium or high) with a knowledge-based classifier, and drives a recommender that adapts reminders and advice, with the teacher kept in the loop. We describe the design and the functions of the system. The project-management functions are available in a web application, whereas the AI layer is specified but not yet implemented, and no empirical evaluation is reported; we outline the path towards learning-based models and a user study.

Keywords: Artificial intelligence in education · Intelligent assistant · Academic procrastination · Self-regulated learning · Student modelling · Adaptive recommendation · Project-based learning

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O-15 12h00 · Room C – Online **Online**

Optimal Control and Feedback Approximation for a Nonlinear Compartmental Labor Market System

Hani ABIDI, Walid BEN ARIBI

LR11ES13, Research Laboratory for Mathematical Modeling, Statistical Reliability, and Stochastic Analysis, Tunisia
Esprit School of Business, Tunisia
University of Tunis El Manar, Pasteur Institute of Tunis, LR16IPT09 Bio-(Informatics, Mathematics and Statistics) Lab, Tunis, Tunisia

This paper develops a nonlinear compartmental model for labor market dynamics with four states: unemployment, temporary employment, permanent employment, and vacancies. Hiring is governed by a Cobb–Douglas matching function, allowing congestion effects and flexible elasticities. We prove positivity, boundedness, global existence and uniqueness of solutions, and analyze the hiring-to-exit ratio $\mathcal{H}_L$ at a reference state. While an employment-free equilibrium does not exist when matching is active ($\beta > 0$), $\mathcal{H}_L$ governs the initial transient growth of temporary employment. The model is formulated as an optimal control problem with two bounded policy instruments: a vacancy subsidy and a temporary-to-permanent conversion incentive. Pontryagin's conditions are derived and related to the Hamilton–Jacobi–Bellman equation. Numerical solutions are obtained using a forward–backward sweep, providing an open-loop benchmark. Imitation-learning models are trained on this benchmark to approximate the policy in closed-loop form. Simulations show substantial unemployment reductions, growth in permanent employment, and an interpretable low-dimensional policy structure.

Keywords: Labor market dynamics; Optimal control; Compartmental models; Cobb–Douglas matching; Pontryagin's Maximum Principle; Hamilton–Jacobi–Bellman equation; Machine learning.

O-16 12h15 · Room C – Online **Online**

Analysis of data on the learning outcomes of autistic children through machine learning

Fayçal Imedjdouben, Tarek Mellahi, Nabila Naoui, Seif Allah El Mesloul Nasri

Scientific and technical research center for the development of Arabic language (CRSTDLA), Algiers, Algeria
The Sir Peter Rigby Digital Futures Institute, Aston University, Birmingham, United Kingdom

The Autism spectrum disorder significantly impacts knowledge acquisition processes. This paper explores the use of machine learning to analyze data on the learning outcomes of autistic children and predict their final learning outcomes. Using algorithms such as artificial neural networks, we leverage the learning outcomes of autistic children to predict their final learning outcomes. The results indicate 100% prediction accuracy, offering insights for improving knowledge acquisition.

Keywords: Autism, Machine Learning, Data Analysis, Artificial neural networks.

Mathematical Modeling and Simulation I

Room A · 15h30–17h15 · Chair: Nadjib Boussetila

O-17 15h30 · Room A

Intelligent technique for active points of quadratic programming problem under linear constraints

DJEFFAL Lakhdar, Said CHOUFI, El Amir DJEFFAL

University of Batna2 Faculty of Mathématics and Computer Science- Batna-Algeria
University of Batna2 Batna Algeria

In this work, we conduct a theoretical and algorithmic study of a active-set method to determine the extrema of a set of linear constraints (equalities, inequalities or mixed). The resolution method used is based on an iterative algorithm that, from any initial point (admissible or not), generates an improved point x_k. At this stage, we associate two matrices: an active matrix A_k whose lines are made up of linearly independent active constraints, and a matrix Z_k whose columns form a base of the kernel of the A_k matrix. This process generates a sequence (x_k), $k \in N$ which converges to an admissible point.

Keywords: Continuous optimization, quadratic problem, Active constraints, algorithm, constraint satisfaction problem, Inertia controlling

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O-18 15h45 · Room A

Fermatean Fuzzy–Stochastic Fractional Optimization for Sustainable Transportation Systems: Theory and a Healthcare Cold-Chain Application

Lydia Ait Amer, Thiziri Sifaoui, Farida Achemine

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Sustainable transportation planning must reconcile economic efficiency, service quality, environmental intensity, expert imprecision, and uncertain operating resources. This paper develops a Fermatean fuzzy–random multi-item, multi-mode transportation model with three linear-fractional objectives. Fermatean fuzzy numbers represent epistemically uncertain arc coefficients, while supply, demand, and aggregate mode capacities are modeled as *LR* fuzzy random variables with normally distributed centers. Nested possibility–probability constraints are transformed exactly into affine restrictions, and their monotonic response to possibilistic and probabilistic confidence levels is established. A score-preserving Fermatean embedding connects normalized assessments with admissible orthopairs and physical coefficients. Under positive denominators, fixed fractional aspiration levels are linear; consequently, the max–min fuzzy goal program is solved globally by bisection with linear-programming feasibility oracles, while an ε-constraint model is solved globally by Dinkelbach iterations. A healthcare cold-chain application with 3 warehouses, 4 hospitals, 2 modes, 2 products, and 48 shipment variables uses nonzero triangular *LR* spreads. At possibility level $\kappa = 0.90$, the calibration reproduces the corresponding normal-resource benchmark; at probability reliability $\rho = 0.90$, the max–min solution attains a common satisfaction of 0.61174. Additional analysis quantifies the effects of possibilistic confidence, probability reliability, Fermatean score intensity, and problem dimension.

Keywords: Fermatean fuzzy sets, fuzzy random variables, fractional transportation, possibility–probability constraints, fuzzy goal programming, sustainable logistics

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O-19 16h00 · Room A

Finite Element Method for a Semi Linear Parabolic Equation With Purely Integral Boundary conditions

Sihem Benamira, Taki Eddine Oussaeif, Abdelfatah Bouziani

Larbi Ben M'hidi University, Oum El Bouaghi, Algeria

The present paper is devoted to prove the existence and uniqueness of a weak solution of a semi-linear reaction diffusion equation with only integral terms in the boundaries by using the finite element method and a priory estimates.

Keywords: Non Local conditions, Integral conditions, Finite element method, A priori estimates, Semi-linear parabolic problem

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O-20 16h15 · Room A

Advanced Stochastic Differential Modeling for Adaptive Threat Prediction in Multi-Layer National Defense Systems

Laila Hassan Abosharb

Department of Applied Research and Development, Ministry of Defense, Tripoli, Libya
Libyan University for Applied and Humanitarian Sciences

Modern national security and defense environments are characterized by high volatility, tactical unpredictability, and complex multi-domain operations. Traditional deterministic predictive models, widely utilized in defense decision-support systems, typically assume ideal environmental conditions and rigid threat trajectories. Consequently, they fail to capture the continuous noise and chaotic fluctuations inherent in real-time combat scenarios, such as electronic warfare jamming, cyber-physical disruptions, and evasive target maneuvers. This paper introduces a novel, rigorous mathematical framework utilizing system-level Stochastic Differential Equations (SDEs) to achieve adaptive, real-time threat prediction across multi-layer defense systems (strategic, operational, and tactical). By employing Itô stochastic calculus, the proposed framework successfully segregates multi-layered threat dynamics into a deterministic drift component—representing predictable military doctrines and kinematic trajectories—and a stochastic diffusion component driven by Brownian motion, which mathematically models environmental and tactical uncertainties. To bridge the gap between theoretical abstract mathematics and real-time computational deployment within defense infrastructures, the continuous SDE systems are discretized using the Euler-Maruyama computational method and structured for parallel processing. Preliminary computational simulations demonstrate that the proposed adaptive stochastic model significantly outperforms conventional deterministic paradigms. The model provides superior predictive accuracy, establishes robust stability boundaries under intense noise, and drastically reduces decision-making latency in high-stakes defense environments. This framework offers a scalable, computationally viable foundation for next-generation resilient military command-and-control systems.

Keywords: Stochastic Differential Equations, Itô Calculus, Euler-Maruyama Method, Adaptive Threat Prediction, Multi-Layer National Defense, Computational Mathematics

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O-21 16h30 · Room A

Identification of 2D AR Models with Finite Impulse Response

Hanane Beghriche

Salah Boubnider University Constantine 3, Algeria

In recent years, several methods based on higher-order statistics have been proposed for the identification of AR, MA, ARMA models. The main objective of this work is to identify the parameters of two-dimensional Autoregressive Finite Impulse Response (2D AR FIR) model with non-Gaussian, non (minimum-phase errors by exploiting higher-order cumulants. First, we establish the almost sure convergence of the empirical estimators of higher-order statistics. We then address the pratical problem of identifying two-dimensional spatial autoregressive models using higer-order cumulants under te non-minimum-phase assumption. The obtained results demonstrate that the proposed identification approach is effective.

Keywords: Higher-order spatial statistics, No minimum phase, 2D AR FIR, almost sure convergence

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O-22 16h45 · Room A

Binary Self-dual codes from Quadratic Residues in F_{p^n}

Nazahet Fellah, Kenza Guenda

Faculty of Technology, M'hamed Bougara University of Boumerdès, Algeria

Let F_q be a finite field of order q, such that $q = p^n$ which is a prime power power. Paley-type bipartite graph $P(q, k)$ is defined for k a divisor of $q - 1$ such that, its vertex set is partitioned into two subsets $V_1 = V_2 = F_q$ and two vertices v_1, v_2 from different subsets are adjacent if and only if $(v_1 + v_2)^{(q-1)/k} = 1$ in F_q. In this contribution we are interested in the particular case $k = 2$ and $q \equiv 3 \pmod 8$ by taking the adjacency matrix A of the corresponding graph and adding the identity matrix I. We find that the row span of the resulting matrix $\tilde{A}$ generates a self dual code C of length $2q$ and in order to prove our outcome, we use a result of Winterhof based on distribution of quadratic residues in arbitrary finite fields F_{p^n}. This work generalizes a previous result due to Fellah et al. in finite fields F_p.

Keywords: Paley-type bipartite graphs, quadratic residues, self-dual codes, finite fields.

O-23 17h00 · Room A

Thermal Performance of Ag–MgO/Water Hybrid Nanofluid in a Magnetized Wavy Enclosure: Role of Geometry and Buoyancy Forces

Khamis Al Kalbani (presented by Khamis AlKalbani)
Faculty of Education and Arts, Sohar University, Suhar, Sultanate of Oman

This study investigates natural convection heat transfer in a two-dimensional wavy enclosure filled with *Ag–MgO/water* hybrid nanofluid under the influence of a horizontal magnetic field. The effects of the Rayleigh number ($10^3 \le Ra \le 10^6$), wall waviness parameter ($0 \le N \le 10$), Hartmann number (Ha = 0 and 20), and nanoparticle volume fraction on flow and thermal characteristics are numerically examined. The results show a transition from conduction-dominated to convection-dominated regimes with increasing Ra, accompanied by significant enhancement in flow circulation and heat transfer. Increasing wall waviness intensifies local heat transfer by periodically disrupting the thermal boundary layer, leading to multiple peaks in the local heat flux distribution. However, it reduces the overall heat transfer performance, with the average Nusselt number decreasing by approximately 31–36%. The addition of nanoparticles slightly enhances heat transfer due to improved effective thermal conductivity. The applied magnetic field suppresses convective motion through Lorentz forces, reducing heat transfer by up to 36%. Overall, the study highlights the competing effects of wall geometry, magnetic field, and nanoparticle loading on thermal performance in wavy enclosures pronounced heat transfer enhancement.

Keywords: Hybrid Nanofluid, Ag–MgO/water, wavy enclosure

Artificial Intelligence

Room B · 15h30–17h15 · Chair: Imed Bouzida

O-24 15h30 · Room B

A CNN-Transformer and Biomedical Language Model Framework for Automatic Chest X-Ray Report Generation

Yamina Bordjiba, Ali Seridi
Department of Computer Science, Faculty of Mathematics, Computer Science and Material Sciences, University of 8 May 1945, Guelma, Algeria

The manual writing of radiology reports remains a time-consuming and error-prone task, particularly in thoracic imaging where examination volumes continue to grow. This paper presents an automatic chest X-ray report generation system built on a hybrid encoder-decoder architecture: a frozen EfficientNet-B0 convolutional encoder extracts compact visual descriptors from chest radiographs, and a Transformer decoder produces the associated findings and impression sections. To raise the linguistic and terminological quality of the generated text, a dedicated post-processing stage based on BioGPT, a generative biomedical language model, refines the draft reports without altering their diagnostic content. Trained and evaluated on the publicly available Indiana University Chest X-ray collection, the proposed system substantially outperforms a CNN-LSTM baseline. The BLEU-4 score rises from 0.4191 to 0.8286 after the BioGPT refinement stage, ROUGE-L reaches 0.9248, and BERTScore attains 0.9628, indicating a high degree of semantic agreement with reference reports. A comparative study of existing approaches and an analysis of the residual errors highlight the contribution of combining an efficient visual encoder, an attention-based decoder and a domain-specific language model. These results suggest that such hybrid systems can serve as credible drafting assistants for radiologists.

Keywords: Radiology report generation, CNN-Transformer, EfficientNet-B0, BioGPT, chest X-ray, deep learning, medical image captioning, natural language generation

O-25 15h45 · Room B

TutoBot: A Hybrid Retrieval-Augmented LLM Assistant for First-Year University Student

Bourbia Riad, Seridi Ali, Lafifi Yacine, Boudra Athir
LabSTIC Laboratory, University 8 Mai 1945, Guelma, Algeria
LiM Laboratory, Faculty of Science and Technology, Souk-Ahras, Algeria
Computer Sciences Department, University 8 Mai 1945, Guelma, Algeria

First-year university students frequently need reliable access to academic regulations, study programs, administrative procedures, and tutoring information, which are distributed among heterogeneous institutional sources. This article presents HRA-TA, a hybrid architecture for retrieval-augmented generation tutoring, which combines lexical and dense search, metadata-based evidence refinement, neural re-ranking, and source-based large language model generation. The architecture is implemented through TutoBot and evaluated on a multilingual benchmark of 99 institutional questions in French, Modern Standard Arabic, and Algerian Darija/Arabizi. The complete configuration achieved a functional accuracy of 98.99% and a source match of 97.98%. An ablation study showed that the complete pipeline outperforms the BM25 only, FAISS only, Hybrid RRF, and Hybrid + Metadata configurations. The RAGAS evaluation achieved a factual correctness score of 0.8734 and a fidelity score of 0.4947; a targeted audit showed that low fidelity cases were mainly associated with the synthesis of multiple fragments and partial alignment between claims and context. The results confirm the practical interest of controlled and retrieval-based academic assistance, while highlighting limitations related to evidence alignment, benchmark size, and the current absence of complete cognitive tutoring functions.

Keywords: Retrieval-Augmented Generation, Large Language Models, Hybrid Retrieval, Higher Education, Academic Assistance, Intelligent Tutoring Systems

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O-26 16h00 · Room B

Unsupervised Machine Learning for Web Service Identification in Object-Oriented Legacy Systems: A Hierarchical Clustering Approach

Ali Seridi, Yamina Bordjiba, Riad Bourbia
Labstic Laboratory, 8 May 1945 University of Guelma, Guelma, Algeria

Object-oriented legacy applications continue to carry a substantial share of the business logic of enterprise information systems, and their migration toward service-oriented and microservice-based architectures remains a predominantly manual, expert-driven activity. This paper investigates whether unsupervised machine learning can support that activity in a transparent and reproducible way. We propose and empirically investigate a composite structural similarity function that integrates coupling, cohesion, and public-functionality visibility for hierarchical service identification. Coupling is computed from three complementary sub-metrics (non-inheritance interaction coupling, data abstraction coupling, and other-class method invocation coupling); cohesion is computed in both its direct and indirect forms; and the two are combined with the ratio of externally visible operations into a single normalized similarity score. The resulting matrix is clustered with agglomerative hierarchical clustering using average linkage, and the dendrogram is cut at a percentage of its root value to yield candidate services. The approach is implemented as a Java tool built on the JavaParser abstract syntax tree library, and the extracted coupling relations are cross-checked against the independent STAN static-analysis tool. On two Java applications, the pipeline returns singleton-like partitions for cut thresholds between 10% and 70%, and produces 5 and 2 candidate services, respectively, at the 75% cut, with measured end-to-end execution times of 2,940,223 ns and 1,380,749 ns. Because no validated ground-truth decomposition is available for these systems, we report a qualitative assessment of the resulting service boundaries rather than aggregate accuracy scores, and we discuss what a defensible quantitative evaluation of service identification would require.

Keywords: unsupervised machine learning · agglomerative hierarchical clustering · web service identification · legacy modernization · software reengineering · service-oriented architecture · coupling and cohesion · abstract syntax tree analysis

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O-27 16h15 · Room B

Text-Based Emotion Detection: A Comparative Evaluation of Traditional Machine Learning, CNN-BiLSTM-Attention, and DistilBERT

Zohra Mehenaoui, Zehor Nouichi, Houda Tadjer, Yacine Lafifi, Mohamed Akram Boudour, Sabrine Boudjemaa

LabSTIC Laboratory, University 8 Mai 1945, Guelma, Algeria

Computer Scienes Department, University 8 Mai 1945, Guelma, Algeria

Emotion detection goes beyond traditional sentiment analysis. It identifies specific emotions in text rather than simply classifying it as positive or negative. This study presents a redesigned multi-scale CNN-BiLSTM-Attention model for six-class emotion classification (Joy, Sadness, Anger, Fear, Love, and Surprise) and compares it with a CNN-BiLSTM baseline, traditional machine learning methods (Logistic Regression, Random Forest, and Support Vector Machines), and a fine-tuned DistilBERT model. To improve recognition of the underrepresented Surprise class, synonym-based data augmentation and class weighting were applied during training. The redesigned model achieved 98.25% accuracy, compared with 87.83% for the baseline CNN-BiLSTM, while the fine-tuned DistilBERT reached 98.50%. Although DistilBERT produced the highest accuracy, the redesigned CNN-BiLSTM achieved comparable performance with a smaller model size, making it a promising option for resource-constrained applications. Overall, the study provides a comprehensive evaluation of modern emotion detection approaches and offers practical insights into the relationship between prediction accuracy and computational efficiency for real world applications.

Keywords: Emotion detection, Natural language processing, Attention mechanism, CNN-BiLSTM, DistilBERT, Class imbalance, Transformer architectures

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O-28 16h30 · Room B

A Novel Capsule Network Architecture For Robust Classification in Complex Backgrounds

Ouafa Amira

Mathematics Department, Badji Mokhtar-Annaba University P.O Box.12, Annaba, 23000 Algeria.

We propose an enhanced Capsule Network capable of effectively separating discriminative information from non-discriminative information within input data. The proposed architecture extends the output layer of the conventional Capsule Network by introducing non-category capsules alongside the standard category capsules. In addition, a novel objective function is designed to guide the learning process. Under this learning framework, category capsules are encouraged to capture class-relevant entities, while non-category capsules model class-irrelevant components, such as background information and other non-discriminative features. By explicitly disentangling these two types of information, the proposed model improves feature representation and reduces the influence of background interference. Experimental results demonstrate that the proposed approach achieves superior classification performance, particularly on images containing complex and cluttered backgrounds.

Keywords: Deep learning; Capsule Network; Complex Background.

O-29 16h45 · Room B

A Comparative Study of Stacked and Convolutional Autoencoders with Wavelet Optimization for ECG Signal Denoising

Eihab Bashier, Hassan Al Reasi
Sohar University, Oman

Electrocardiogram (ECG) signals are frequently corrupted by various types of noise and artifacts during acquisition, which can significantly impact clinical diagnosis accuracy. This study investigates and compares two deep learning-based approaches for ECG denoising: a stacked autoencoder combined with optimized wavelet denoising, and a convolutional neural network (CNN) autoencoder combined with optimized wavelet denoising. Training data were generated from MIT-BIH arrhythmia database records using 1024-sample windows with 10 dB SNR noise and artificial jumping artifacts. The stacked autoencoder with wavelet optimization achieved an SNR of 17.02 dB and a correlation of 0.918, while the CNN autoencoder alone achieved 21.05 dB SNR and 0.95 correlation, with wavelet post-processing providing only a marginal improvement to 21.11 dB SNR. Both methods demonstrated excellent peak preservation with less than 2% peak detection error. Notably, the CNN autoencoder offers superior computational efficiency, training 2.5 times faster and inferring 7 times faster than the stacked approach, making it particularly suitable for real-time applications. Our results demonstrate that CNN autoencoders alone achieve state-of-the-art denoising performance without requiring wavelet post-processing when properly designed and trained.

Keywords: ECG denoising, stacked autoencoder, convolutional neural network, wavelet transform, deep learning, MIT-BIH database

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O-30 17h00 · Room B

An Intelligent Identification Framework for Large-Scale Nonlinear Stochastic Systems

Mourad Elloumi
Faculty of Sciences of Gafsa, University of Gafsa, Tunisia

This talk concerns an intelligent identification framework for large-scale nonlinear stochastic systems. System identification aims to build mathematical models of dynamical systems from observed data.

Editors' note based on the title only; not written by the authors, and no results are implied.

Online Session II – Differential Equations, Dynamical Systems & Mathematical Modeling

Room C – Online · 15h30–17h15 · Chair: Mohamed Haddar

O-31 15h30 · Room C – Online **Online**

Convergence and Error Analysis of Power Series Solutions for a Fractional Differential Equation

Kübra Değerli
Bahçeşehir University, Türkiye

This study investigates the convergence and accuracy of power series approximations for a class of fractional differential equations involving the Caputo derivative. A residual-based power series framework is used to generate successive approximations, while particular emphasis is placed on the behavior of the truncated series as the number of terms increases. The convergence of the approximations is examined numerically by considering several truncation levels, and the corresponding maximum errors are computed to quantify the accuracy of the obtained solutions. The numerical results reveal a systematic reduction in the approximation error with increasing truncation order, providing clear evidence of convergence and numerical stability. In particular, the computed errors demonstrate that high-accuracy solutions can be achieved with a relatively small number of series terms. These findings provide a quantitative assessment of the reliability of power series approximations and highlight the effectiveness of the approach for the numerical treatment of fractional differential equations.

Keywords: Fractional differential equations; Caputo fractional derivative; Residual Power Series Method; fractional power series; convergence; truncation error; error estimation.

O-32 15h45 · Room C – Online **Online**

Study of Synchronization in Discrete-Time Computer Virus Dynamics

Omar Kahouli, Imane Zouak, Adel Ouannas

Department of Electronics Engineering, Applied College, University of Ha'il, Ha'il, 2440, Saudi Arabia
System Dynamics and Control Laboratory, Department of Mathematics and Informatics, University of Larbi Ben M'hidi, Oum El Bouaghi 04000, Algeria
Department of Mathematics and Computer Sciences, University of Larbi Ben M'hidi, Oum El Bouaghi 04000, Algeria.

This work investigates the dynamical behavior and synchronization of a discrete-time SLB (Susceptible–Latent–Breaking-out) computer virus model. By varying key system parameters, we explore complex phenomena such as bifurcations and chaos, which reveal the model's sensitivity and unpredictability. A comprehensive chaotic analysis is performed through bifurcation diagrams, phase portraits, and the Maximum Lyapunov Exponent (MLE), confirming the presence of chaotic attractors and period-doubling routes to chaos. Additionally, a synchronization scheme is proposed in which a controlled replica (slave system) of the original SLB model is constructed to achieve complete synchronization with the uncontrolled (master) system. This provides valuable insight focusing on methods to mitigate the unpredictable spread of computer viruses. The findings highlight the model's relevance in cyber-epidemiology and its applicability to the design of robust cybersecurity protocols.

Keywords: computer virus model, discrete-time model, chaos, synchronization.

O-33 16h00 · Room C – Online **Online**

An evolution-state dynamical system

Wafiya Boukrouk

University of Jijel, Department of Mathematics, LAOTI laboratory, Algeria

We conduct a study of a dynamic system including a static algebraic relation. Following our recent studies on the system, we discuss in this paper an other form for the model, and then other results are obtained. The method consists of dimensional reduction in order to eliminate the algebraic part and retain only the differential part of the system.

Keywords: Set-valued mappings, dynamical systems, matrix, maximal monotone

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O-34 16h15 · Room C – Online **Online**

On the Synchronization Behavior of Fractional-Order Computer Virus System

Omar Kahouli, Imane Zouak, Adel Ouannas

Department of Electronics Engineering, Applied College, University of Ha'il, Ha'il, 2440, Saudi Arabia
System Dynamics and Control Laboratory, Department of Mathematics and Informatics, University of Larbi Ben M'hidi, Oum El Bouaghi 04000, Algeria
Department of Mathematics and Computer Sciences, University of Larbi Ben M'hidi, Oum El Bouaghi 04000, Algeria

This paper introduces a fractional-order discrete-time susceptible–infected (SI) model to simulate the propagation dynamics of computer viruses in digital environments. Leveraging the tools of fractional calculus in discrete time, the model accounts for long-term memory effects inherent in network interactions. A comprehensive investigation into the system's chaotic behavior is conducted using bifurcation diagrams, phase portraits, and the maximum Lyapunov exponent. To mitigate the destabilizing influence of chaos, a synchronization framework is developed, and the stability of the associated error system is examined. Numerical simulations validate both the emergence of chaos and the effectiveness of the synchronization approach. This study highlights the utility of discrete fractional modeling for understanding complex virus propagation patterns and provides a foundation for future control strategies in cybersecurity.

Keywords: fractional-order discrete-time model, computer virus model, chaos, synchronization

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O-35 16h30 · Room C – Online Online

Chaos, Complexity and Control in A New Fractional Map

Sabrina Riah, Adel Ounnas, Omar Kahouli

System Dynamics and Control Laboratory,Departement of Mathematics and computer science, University of Larbi Ben M'hidi, Oum El Bouaghi, 04000, Algeria
Department of Mathematics, Faculty of Science, Islamic University of Madinah, Madinah, 42351, Saudi Arabia
Department of Electronics Engineering, Applied College, University of Ha'il, Ha'il, 2440, Saudi Arabia

This work examines fractional-order discrete energy systems. System dynamics are modeled using a discrete-time fractional mathematical model. A rigorous stability study using the fractional-order eigenvalue criterion is performed after determining the equilibrium locations. To study the system's qualitative behavior, a detailed dynamical analysis is done. In instance, the Lyapunov exponent characterizes chaotic oscillations, and bifurcation diagrams with respect to important system parameters and fractional orders show the shift from stable to periodic and chaotic regimes. Fractional-order adaptive control is suggested to reduce chaotic dynamics. The developed control technique suppresses chaos and stabilizes the system, as shown by numerical simulations that match theoretical conclusions.

Keywords: fractional calculus, power system, dynamical behavior, control

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O-36 16h45 · Room C – Online Online

Nonlinear Dynamics and Chaos Control in a Fractional Discrete Computer Virus Model

Omar Kahouli, Imane Zouak, Adel Ouannas

Department of Electronics Engineering, Applied College, University of Ha'il, Ha'il, 2440, Saudi Arabia
System Dynamics and Control Laboratory, Department of Mathematics and Informatics, University of Larbi Ben M'hidi, Oum El Bouaghi 04000, Algeria
Department of Mathematics and Computer Sciences, University of Larbi Ben M'hidi, Oum El Bouaghi 04000, Algeria.

This study investigates the chaotic dynamics and stabilization of a fractional-order discrete-time SI (Susceptible–Infected) model for computer virus propagation. The present paper concentrates on controlling and stabilizing the system's chaotic behavior. The proposed model is constructed using the Caputo-like fractional difference operator to capture memory effects and complex temporal behavior inherent in digital networks. A detailed bifurcation analysis and maximum Lyapunov exponent computation reveal the onset of chaos for certain values of the fractional order. To mitigate this instability, a two-dimensional control law is designed to asymptotically stabilize the system to the virus-free equilibrium. Theoretical stability conditions are established using spectral analysis, and numerical simulations confirm the effectiveness of the proposed control scheme. These findings provide useful insights into controlling virus propagation in networked systems using fractional-order tools.

Keywords: fractional-order discrete-time model, computer virus model, chaos, stabilization, control law.

O-37 17h00 · Room C – Online Online

Stability of Thermo-Viscoelastic Systems with Localized Coupling

Chahrazed Messikh

Department of Mathematics, Faculty of Sciences, Badji Mokhtar University, Laboratory of Applied Mathematics, B.P.12, Annaba, 23000 Algeria.

This study examines the well-posedness and asymptotic stability of a coupled nonlinear thermo-viscoelastic system with localized interaction. The system consists of a wave equation with nonlinear damping of the form $|y_t|^{l}y_{tt}$, a Kelvin–Voigt-type term $-\gamma\Delta y_{tt}$, and a linear heat equation with variable function of coefficient α . We extend previous results for constant coefficients to the case functions, representing spatially localized thermal-mechanical interaction. The demonstration of global solution existence and uniqueness relies on an application of the Faedo–Galerkin method paired with a compactness argument. Furthermore, by employing a multiplier technique and a suitable Lyapunov functional, we prove that the system's energy decays exponentially to zero.

Keywords: Nonlinear Thermo-Viscoelasticity, Variable Coefficients, Faedo-Galerkin Method, Exponential Stability, Multiplier Technique.

Fractional Calculus I

Room A · 17h30–18h15 · Chair: Nassima Rezgui

O-38 17h30 · Room A

A Theoretical Analysis of Solution Existence for a Class of Fractional Pantograph Problems

Hamid Boulares

Laboratory of Analysis and Control of Differential Equations "ACED", Faculty MISM, Department of Mathematics, University 8 May 1945 Guelma, Algeria

This talk investigates the solvability of a certain class of fractional-order pantograph equations. The problem incorporates a Caputo-type fractional derivative and a proportional delay. By applying fixed point theorems, specifically the Schaefer and Banach contraction principles, we establish sufficient conditions for the existence and uniqueness of solutions. The results are illustrated with an example to demonstrate the applicability of the theoretical findings.

Keywords: Hybrid, equations of pantograph, stability, fractional operators

O-39 17h45 · Room A

Application of Fractional Calculus to Pharmacokinetic Modeling

Meryem MEDDAHI

Faculty of Technology, University of Hassiba Benbouali, Chlef, Algeria

In this work, we investigate the application of Caputo fractional derivatives to pharmacokinetic compartment models. The proposed fractional approach offers greater flexibility in describing drug concentration profiles and long-term retention phenomena. Analytical and numerical aspects of the model are discussed, highlighting the advantages of fractional-order formulations in improving the accuracy of pharmacokinetic predictions.

Keywords: Fractional calculus; Pharmacokinetics; Caputo derivative; Compartment models; Anomalous diffusion

O-40 18h00 · Room A

On the stability analysis of fractional order for non-linear uncertain systems

Hizia Khelifa

Faculty of Mathematics and Computer Sciences, Department of Mathematics, BP : P 78, Zaaroura Tiaret - Algeria

In this paper, we will study the stability analysis of fractional order problem by output feedback of a class of uncertain control systems, whose nominal part is linear and whose uncertain part is norm-bounded by a known function. We propose an output controller that forces the state to the origin, in the global exponential stability sense.

Keywords: Fractional calculus, Stability of fractional order systems, Lyapunov function.

Spectral Theory & Operator Theory

Room B · 17h30–18h30 · Chair: Mourad Elloumi

O-41 17h30 · Room B

A Spectral Collocation Method for Space-Time Fractional Partial Differential Equations

D. Arafa, N. Arar (presented by Djihene Arafa)

Laboratory of Applied Mathematics and Didactics, Department of Mathematics, Higher Normal School Assia Djebar, Constantine, Algeria
Department of Mathematics, University Constantine 1 - Brothers Mentouri, Constantine, Algeria

In this paper, we design and analyze a space-time spectral method for multi-term time-space fractional partial differential equations. The approximation is built on generalized fractional Legendre functions with two independent exponents, one for each variable. Operational matrices for fractional integration, fractional differentiation and products are derived in closed form, which reduces the problem to a Sylvester system for a single coefficient matrix; the system is later solved by a Newton iteration whose Jacobian is obtained by complex-step differentiation. The method is assessed on subdiffusion, diffusion wave, and nonlinear Burgers-Fisher equations, illustrating the efficiency of the solver and the accuracy gained by tuning the fractional order of the space and time bases to the behaviour of the solution.

Keywords: Space-Time fractional PDE, Fractional Legendre Polynomials, Operational matrices, Caputo derivative

O-42 17h45 · Room B

Rational Basis Functions for Nonlinear Convection–Diffusion–Reaction Problems on the Real Line

H. Khenissa, N. Arar (presented by Hadil Khenissa)

Laboratory of Applied Mathematics and Didactics, Department of Mathematics, Teacher Education College of Constantine, Constantine, Algeria

Department of Mathematics,University Constantine 1 - Brothers Mentouri, Constantine, Algeria

This paper presents a rational spectral Galerkin method for nonlinear convection–diffusion–reaction equations posed on the whole real line. The spatial discretization employs the Arar–Boulmezaoud rational functions, which are adapted to unbounded domains and require no artificial truncation of the computational domain. A variational formulation is established in a weighted Sobolev framework, and the mass, stiffness, convection and reaction operators are assembled by Gauss–Chebyshev quadrature after a rational change of variables. Time integration is performed by a Crank–Nicolson scheme combined with a Newton iteration. Two numerical examples, with linear and cubic reaction terms, illustrate the spectral accuracy and the domain independence of the method.

Keywords: spectral method, rational approximation, unbounded domain, weighted Sobolev space, convection–diffusion–reaction equation, Crank–Nicolson scheme, Newton method.

O-43 18h00 · Room B

Some fixed points in convex S-metric spaces

Nora Fetouci

LMPA Laboratory, Department of Mathematics, Jijel University, Algeria

The aim of this paper is to establish some existence results of a fixed point for a class of expansive mappings defined on a complete S-metric space.

Keywords: fixed point, convex G-metric space, Mann iterative process.

O-44 18h15 · Room B

Bivariate g-Weighted Ideal Deferred Statistical Convergence of Order α in Paranormed Spaces

Rabia SAVAŞ

Department of Mathematics and Science Education, Istanbul Medeniyet University, Istanbul, Türkiye

In this paper, we introduce ideal deferred statistical convergence of order α for bivariate sequences in paranormed spaces with respect to weight g. The proposed spaces are studied with respect to Pringsheim convergence, providing a natural extension of the corresponding one-dimensional setting to double sequences. We investigate their topological properties and establish inclusion relations among the newly constructed spaces. Moreover, the relationship between the introduced convergence and Cesàro summability is examined.

Keywords: Deferred statistical convergence, paranormed spaces, weight g, double sequences.

Online Session III – Mathematical Modeling and Simulation

Room C – Online · 17h30–18h45 · Chair: Ahmed Ghorbel

O-45 17h30 · Room C – Online **Online**

A Grünwald–Letnikov Fractional Regression Framework for GDP Modelling: Evidence and Sensitivity Analysis from Algeria

S. Soufli, Y. Adjabi (presented by Siham Soufli)
Dept. of Mathematics, University of Boumerdes, Algeria

This study proposes a Grünwald–Letnikov (GL) fractional regression framework for modeling Algeria's Gross Domestic Product (GDP) using a set of key macroeconomic indicators. Unlike conventional Ordinary Least Squares (OLS) regression, the proposed approach incorporates variable-specific fractional operators to account for memory-related and non-local effects in economic data. Fractional orders are estimated numerically using the L-BFGS-B optimization algorithm by minimizing the Mean Squared Error (MSE). The empirical results indicate that the GL fractional model provides a more accurate fit to the Algerian GDP data than the classical OLS model.To evaluate the robustness of the proposed framework, a sensitivity analysis is performed under different optimization bounds for the fractional orders. The obtained results remain highly stable across all tested configurations, demonstrating the numerical robustness and reliability of the proposed fractional modeling approach for GDP analysis.

Keywords: Fractional calculus, Grünwald–Letnikov derivative, GDP modeling, OLS regression, sensitivity analysis

O-46 17h45 · Room C – Online **Online**

A New Three-Term Conjugate Gradient Method Based on the Conjugacy Condition, with an Application to Image Restoration

Houria Selatnia, Amira Hamdi
Department of Mathematics, University of Souk Ahras, Souk Ahras, Algeria

We propose a new hybrid conjugate gradient method for unconstrained optimization, obtained by combining three classical conjugate gradient parameters, namely the Rivaie-Mustafa-Ismail-Leong parameter, the Liu-Storey parameter and the Hestenes-Stiefel parameter, through a convex combination whose weights are determined by requiring the resulting search direction to satisfy the conjugacy condition, with one weight left free as an algorithmic constant. We call the proposed method HYB. We prove, under the strong Wolfe line search conditions, that the proposed method satisfies the sufficient descent property at every iteration and converges globally. Numerical experiments comparing HYB against its three component methods, together with an application to the restoration of images corrupted by salt-and-pepper impulse noise, show that the proposed method performs favourably.

Keywords: Nonlinear conjugate gradient, Conjugacy condition, Sufficient descent, Global convergence, Strong Wolfe line search, Image restoration

O-47 18h00 · Room C – Online Online

Symmetry-Aware Epidemic Transport Planning: Exact Quotient Models, Approximation Guarantees, and Policy Design

Thiziri Sifaoui

Department of Mathematics and Computer Science, University of Tamanghasset, Tamanghasset 11000, Algeria
LAROMAD, Faculty of Sciences, UMMTO, Tizi Ouzou 15000, Algeria

Epidemic-aware public-transport planning couples nonlinear disease dynamics with large attributed time-dependent networks. A reduction based only on adjacency can alter epidemiological and operational quantities. This paper develops a symmetry-aware quotient method for a controlled metapopulation SEIR model that preserves node and arc orbits, directed incidence multiplicities, and orbit-size objective weights. Exact trajectory recovery is established for invariant states and controls, together with optimization equivalence on the invariant-policy class and sufficient conditions for an unrestricted scalarized problem to admit an invariant optimum. For imperfect symmetry, a computable defect recursion provides bounds on lifted trajectory error, objective error, and constraint violation. The computational study includes a cyclic benchmark, colored-automorphism detection, six-start unrestricted-control optimization, 15 weighted scalarizations, an explicit ε-constraint experiment, epidemiological sensitivity analysis, and a finite-grid evaluation of the $2B$ regret bound. Exact trajectories agree to 8.53×10^{-14}; at 256 nodes and 512 arcs, the quotient removes 98.44% of raw components and gives a 2.79-fold median speedup in the vectorized replicated benchmark. A seven-station Algiers Metro corridor uses public topology with synthetic demand and epidemic attributes. Its nominal twin-branch quotient is exact; after 5% attributed perturbations, the observed state error is 0.050% of mean station population, below a 0.232% certificate. These results characterize the conditions under which symmetry reduction is exact or approximate and quantify its computational effect.

Keywords: network symmetry; epidemic control; public transportation; quotient graph; invariant optimization; error certificate.

O-48 18h15 · Room C – Online Online

A new search direction for full-Newton step interior-point method for monotone linear complementarity problem

Linda Menniche, Billel Zaoui, Djamel Benterki

LMPA, Mohammed seddik Ben Yahia University , Jijel, Algeria
LIM, Akli Mouhand Oulhadj University, Bouira, Algeria
LMFN, Ferhat Abbas University, Setif, Algeria

In this paper, we propose a new full Newton step feasible interior-point method for monotone linear complementarity problems (LCPs). The proposed approach derives an efficient search direction through an algebraically equivalent transformation of the central path system. We establish the polynomial-time complexity of the method and prove that it achieves the best-known iteration complexity bound, namely $O(\sqrt{n}\log n/\varepsilon)$. Furthermore, numerical experiments are conducted to evaluate the performance of the proposed algorithm. The computational results demonstrate its effectiveness and efficiency compared with existing

Keywords: Linear Programming, Interior Point Methods, Monotone LCPs

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O-49 18h30 · Room C – Online Online

Optimization Techniques for Fractional Mathematical Models

Fadila Leslous

Mouloud Mammeri University of Tizi-Ouzou (UMMTO), Algeria

Fractional programming plays an important role in several fields such as economics, engineering, operations research, and optimization theory. This paper focuses on the resolution of a fractional optimization problem by presenting an effective mathematical approach for obtaining the optimal solution. The proposed method transforms the original fractional problem into an equivalent optimization model that is easier to solve while preserving the properties of the initial problem. The study includes the mathematical formulation of the fractional problem, the detailed resolution procedure, and the analysis of the obtained results. An illustrative example is presented to demonstrate the efficiency and applicability of the proposed approach. The results show that the adopted method provides accurate and reliable solutions with reduced computational complexity. This work highlights the importance of fractional optimization methods in solving real-world decision-making problems and contributes to the development of efficient optimization techniques for fractional models.

Keywords: Fractional programming, optimization, mathematical modeling, resolution method, optimal solution.

FRIDAY, OCTOBER 30 – ORAL SESSIONS

Differential Equations and Dynamical Systems III

Room A · 09h45–11h00 · Chair: Meryem Bey

O-50 09h45 · Room A

Sur la conception d'observateurs pour certains systèmes d'ordre fractionnaire

Hassen Ahmed
University of Sfax, Tunisia

This talk concerns the design of observers for certain fractional-order systems. An observer estimates the internal state of a dynamical system from its measured inputs and outputs.

Editors' note based on the title only; not written by the authors, and no results are implied.

O-51 10h00 · Room A

On the generalization of right fractional order derivatives and the Darboux problem for partial differential equations

Faicel Missaoui
University of Sfax, Tunisia

This talk concerns the generalization of right fractional order derivatives and the Darboux problem for partial differential equations. The Darboux problem is a classical boundary value problem for hyperbolic partial differential equations, with data prescribed on characteristic lines.

Editors' note based on the title only; not written by the authors, and no results are implied.

O-52 10h15 · Room A

Tempered Fractional Grönwall Inequality with Constant Delay and Finite-Time Stability of Neural Networks

Ahmed Taktak
University of Sfax, Tunisia

This talk concerns a tempered fractional Grönwall inequality with constant delay and the finite-time stability of neural networks. Grönwall-type inequalities are standard tools for obtaining bounds and stability estimates for solutions of differential equations.

Editors' note based on the title only; not written by the authors, and no results are implied.

O-53 10h30 · Room A

Generalized Grönwall Inequalities and Stability of Sequential Caputo-Type Fractional Differential Equations

Amine Ghoudi
University of Sfax, Tunisia

This talk concerns generalized Grönwall inequalities and the stability of sequential Caputo-type fractional differential equations. Sequential fractional equations involve successive applications of fractional derivatives.

Editors' note based on the title only; not written by the authors, and no results are implied.

O-54 10h45 · Room A

Limit Cycles in Whittaker Perturbations of the Linear Oscillator

Kina Abdelkrim, Mimouni Nihad
Department of Mathematics and computer science, Université de Ghardaia,47 000 Algeria

This paper derives a definitive upper bound on the maximum number of limit cycles that can emerge via bifurcation from the periodic orbits of the linear oscillator $\dot{x} = y$, $\dot{y} = -x$. We investigate a specific class of perturbations characterized by a Whittaker type differential equation. By mapping the analytical problem onto an equivalent first-order planar system, we leverage the first-order averaging method to track the birth of these limit cycles. Ultimately, a precise mathematical ceiling for the number of coexisting limit cycles is established.

Keywords: Whittaker equation, periodic orbits, limit cycles, averaging theory

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Fractional Calculus II

Room B · 09h45–11h00 · Chair: Mourad Elloumi

O-55 09h45 · Room B

Space-Time Estimates for Solutions to Linear Evolution Equations with Nonlocal Operators

Sara Biout

University of Science and Technology Houari Boumdiene USTHB, Laboratory of SD, Department of mathematics, 16111, Algiers, Algeria

This work gives a deep study for the behavior of solutions of the Cauchy problem for linear evolutive equation. Using the Kernel operator. First, we set the representative formula of solutions for the considered Cauchy problem. Then we provide estimates of space time for the corresponding equation.

Keywords: kerenal operator, fractional derivative, evolution equation, space time estimate.

O-56 10h00 · Room B

Fractional Four Point Newton–Cotes Type Inequalities for Differentiable s-Convex Functions

W. Kaidouchi, M. Benssaad, B. Meftah (presented by Wahida Kaidouchi)

Ecole normale supérieure d'enseignement technologique -Skikda-, département mathématiques et informatique. Azzaba, Skikda , Algeria
Département des Mathématiques, Faculté des mathématiques, de l'informatique et des sciences de la matière, Université 8 mai 1945 Guelma, Algeria

In this paper, by using a new identity, we establish some Newton type inequalities for functions whose first derivatives are *s*-convex via Riemann-Liouville fractional integrals. Several results are derived. Applications to inequalities involving special means are provided.

Keywords: Newton-Cotes inequality, s-convex functions, Hölder inequality, Riemann-Liouville fractional integrals

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O-57 10h15 · Room B

Étude qualitative d'un système dynamique en dérivée fractionnaire

Adel Seddiki

Department of Mathematics, Faculty of Sciences, M'hamed Bougara University of Boumerdès, Algeria

Dans ce travail, nous proposons une étude qualitative d'un système dynamique décrit par des équations différentielles d'ordre fractionnaire. Contrairement aux systèmes classiques à dérivées entières, les systèmes fractionnaires permettent de modéliser des phénomènes à mémoire et à hérédité, ce qui les rend particulièrement adaptés à de nombreuses applications en physique, ingénierie et biologie. Nous considérons un modèle dynamique non linéaire généralisé en dérivation fractionnaire au sens de Caputo. L'analyse porte sur l'existence et l'unicité des solutions, ainsi que sur l'étude de la stabilité des points d'équilibre en utilisant des méthodes adaptées telles que le critère de Matignon. Une attention particulière est accordée à l'influence de l'ordre fractionnaire sur le comportement dynamique du système. En outre, des simulations numériques sont réalisées à l'aide de MATLAB/Simulink afin d'illustrer les résultats théoriques et de mettre en évidence des phénomènes complexes tels que la bifurcation et le chaos. Les résultats obtenus montrent que la variation de l'ordre fractionnaire joue un rôle crucial dans la dynamique du système, offrant ainsi de nouvelles perspectives pour le contrôle et la modélisation des systèmes dynamiques complexes.

O-58 10h30 · Room B

Advanced Sensorless Fractional-Order Control of Doubly Excited Wind Generators with Fractional-Speed Observation

Rihab Issaoui

Tunisia

This talk concerns advanced sensorless fractional-order control of doubly excited wind generators with fractional-speed observation. Sensorless control estimates quantities such as rotor speed instead of measuring them with a dedicated sensor.

Editors' note based on the title only; not written by the authors, and no results are implied.

O-59 10h45 · Room B

Practical Stabilization of Fractional-Order Nonlinear Fuzzy Systems

Achraf Cherif

Department of Mathematics, Faculty of Sciences of Sfax, Sfax University, Sfax, Tunisia

This talk concerns the practical stabilization of fractional-order nonlinear fuzzy systems. Practical stability requires solutions to reach and remain in a neighbourhood of the origin rather than converge exactly to it.

Editors' note based on the title only; not written by the authors, and no results are implied.

Online Session IV – Differential Equations, Dynamical Systems & Modeling

Room C – Online · 09h45–11h00 · Chair: Abdelghani Lakhdari

O-60 09h45 · Room C – Online Online

Recent Advances in Hilfer Fractional Differential Equations: A Critical Review of Analytical Methods, Stability, and Future Research Directions

Rahmouna Achir, Imene Medjadj

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University Oran1 Ahmed Ben Bella. Geometry and Analysis Research Laboratory (GEANLAB). B.P. 1524, El M'Naouer, 31000, Oran, Algeria

Mathematics and Statistics and their Applications Laboratory (LMSA). El Mnaouar, BP 1505, Bir El Djir 31000, Oran, Algeria.

The Hilfer fractional derivative has emerged as one of the most significant generalized fractional operators due to its ability to interpolate continuously between the Riemann–Liouville and Caputo derivatives through an additional type parameter. This flexibility has made it an effective mathematical tool for modeling memory-dependent phenomena encountered in science and engineering. During the last decade, considerable attention has been devoted to the theoretical analysis of Hilfer fractional differential and integro-differential equations, leading to a wide variety of existence, uniqueness, and stability results. This review provides a comprehensive and critical analysis of the recent literature on Hilfer-type fractional equations. Rather than presenting a simple chronological survey, the available contributions are classified according to the type of fractional operator, the mathematical model considered, the functional framework, and the analytical techniques employed. Special emphasis is placed on fixed point methods, including Banach, Schauder, Krasnoselskii, Darbo, Mönch, Boyd–Wong, and Meir–Keeler theorems, as well as on Ulam–Hyers and Ulam–Hyers–Rassias stability analyses. A comparative discussion highlights the advantages and limitations of existing approaches and identifies several open challenges related to generalized Hilfer operators, nonlinear models, delay effects, and nonlocal conditions. The review concludes by outlining promising research directions that may contribute to the further development of Hilfer fractional calculus and its applications

Keywords: Hilfer fractional derivative; fractional differential equations; fixed point theory; stability

O-61 10h00 · Room C – Online Online

Optimal Harvesting in a Two-Zone Predator–Prey System with Holling Type-IV Predation and Dynamic Effort

Nabil Rhiati

Al Akhawayn University, Ifrane, Morocco

We consider a five-dimensional bioeconomic predator–prey system with unreserved and reserved prey, one predator population, and two harvesting efforts that respond dynamically to economic rent. The ecological dynamics combine movement between prey zones, density dependence, cross-interaction, and Holling type-IV predation. We prove positive invariance and ultimate boundedness of the full system and characterize the fully active bioeconomic equilibrium. Its local stability is determined from the complete 5 × 5 Jacobian, which leads to a fifth-degree characteristic polynomial and the corresponding Routh–Hurwitz conditions. For an illustrative parameter set, the interior equilibrium is positive and locally asymptotically stable, though only weakly damped. Varying the cross-interaction coefficient κ_1 produces a numerically detected oscillatory loss of stability before the equilibrium loses feasibility; no Hopf classification is claimed. We also formulate a separate infinite-horizon optimal-harvesting benchmark using Pontryagin's Maximum Principle, keeping manager-controlled effort distinct from the endogenous open-access effort dynamics.

Keywords: predator–prey model; marine reserve; Holling type IV; dynamic effort; bioeconomics; Routh–Hurwitz; optimal harvesting

O-62 10h15 · Room C – Online Online

A DMAIC Framework for Stochastic FMCG Inventory Optimization Under Demand Uncertainty

Douaa Madha, Rabie Zine

School of Science and Engineering, Al Akhawayn University in Ifrane, Ifrane, Morocco

Retailers with fast-moving consumer goods (FMCG) face persistent challenges: stockouts damage customers' satisfaction, and excess inventory increase costs. This paper proposes a DMAIC-based stochastic optimization framework that places customer service at the center of inventory decisions. It combines ABC classification, Holt–Winters forecasting, dynamic SS (safety stock), forecast-driven reorder points, JIT (Just in Time) inspired replenishment, Monte Carlo simulation, and enumeration-based constrained optimization. The novelty resides in the combination of class-specific service constraints with a formal adaptive control rule that recalibrates the policy when operational performance degrades. On the FMCG Multi-Country Sales Dataset, the optimized policy reduces the stockout rate from 3.01% to 1.02%, raises the service level from 96.99% to 98.98%, and lowers average inventory value by 5.36%, while Holt–Winters cuts out-of-sample MAPE from 8.94% to 7.49%. A proposed ablation study shows that the simultaneous improvement in service and inventory efficiency is driven by the combination of ABC differentiation and enumeration-based optimization, and not by forecasting alone.

Keywords: FMCG inventory, customer service, stochastic optimization, DMAIC, demand forecasting, Monte Carlo

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O-63 10h30 · Room C – Online Online

Global asymptotic stability of the fractional differential equations

Ghania REBIAI

University of 8 May 1945 Guelma, Algeria

In this talk, we present a criterion for the global asymptotic stability of fractional differential equations in triangular form. Our analysis is developed within the framework of generalized fractional derivatives. Furthermore, we introduce a novel methodology for studying the global asymptotic stability of fractional differential equations by combining fractional input stability with the stability properties of subsystems. Several examples are discussed to illustrate the effectiveness of the proposed approach.

O-64 10h45 · Room C – Online Online

Mathematical Modeling of Train Scheduling under Priority Constraints

Zineb LISSIOUED

LaROMaD Laboratory, Faculty of Mathematics, University of Science and Technology Houari Boumediene (USTHB), BP 32, 16111 Bab Ezzouar, Algeria

Railway train scheduling is a challenging combinatorial optimization problem that arises in the management of single-track railway networks. The scheduling process must coordinate trains sharing limited railway resources while respecting their predefined routes, travel times, release times, and desired arrival times. This study focuses on a particular scheduling environment in which prioritized and non-prioritized trains simultaneously operate on a bidirectional single-track railway network. The two categories of trains are distinguished by their operational requirements: prioritized trains, such as express passenger trains, must travel through their assigned routes without interruption, whereas non-prioritized trains may remain on their current track section when the next section is unavailable. Consequently, the former are subject to no-wait constraints, while the latter may experience blocking situations. The objective is to determine a feasible train schedule minimizing the total tardiness of all trains. The considered railway scheduling problem can be interpreted as a particular variant of the job shop scheduling problem with both blocking and no-wait constraints. In this representation, trains are modeled as jobs and railway track sections as machines. The predefined route of each train corresponds to the technological sequence of operations, while the traversal of a track section is represented by an operation whose processing time is equal to the corresponding travel time. The earliest departure time and desired arrival time of each train are represented by release times and due dates, respectively. […]

Keywords: Railway Train Scheduling; Prioritized Trains; Non-Prioritized Trains; Job Shop Scheduling; Blocking Constraints; No-Wait Constraints; Total Tardiness; Integer Programming; Exact Optimization.

Computer Science, AI & Control Theory and Automation

Room A · 11h30–12h45 · Chair: Imed Bouzida

O-65 11h30 · Room A

Multisecret-Sharing Schemes based on LCD Codes over Galois Rings

F. Rebaine, K. Guenda (presented by Rebaine Fatiha)

ATN Laboratory (USTHB), Algeria
Department of Mathematics, University M'hamed Bougara of Boumerdes (UMBB), Algeria

Data privacy is a major concern in modern communication and storage systems. Secret sharing provides an effective approach for protecting sensitive information by distributing it among authorized participants, with reconstruction requiring their cooperation. Coding theory offers a powerful framework for designing such schemes, although characterizing their access structures can be challenging. In this context, a multisecret-sharing schemes based on Linear Complementary Dual (LCD) codes is proposed. The scheme exploits the structural properties of LCD codes and their generator matrices to achieve secure and efficient secret distribution and reconstruction, with potential applications in distributed communication and cloud storage.

Keywords: Galois rings. LCD codes, Secret sharing, Distributed systems, Cloud storage.

O-66 11h45 · Room A

A bio-inspired hybrid optimization framework for the 1-D CSP

GUESSOUM fatima, CHERAITIA meryem, BOUDRIA asma, SALAH halima

LabSTIC Laboratory, 8 Mai 1945 University, Guelma
Higher Normal School of Technological Education, Skikda, Algeria
University of Algiers 3, Alger, Algeria
8 Mai 1945 University, GUELMA, Algeria

The one-dimensional cutting stock problem (1D-CSP) is a well-known NP-hard combinatorial optimization problem with numerous industrial applications. Its basic objective lies in cutting stock bars at a specific length in order to satisfy customer requests while minimizing overall raw material usage. This paper proposes an advanced continuous-discrete metaheuristic based on the Salp Swarm Algorithm (SSA) for solving the 1D-CSP. The proposed approach combines the exploration capability of swarm intelligence with a Random-Key continuous representation and an effective Variable Neighborhood Search (VNS) improvement strategy. The approach seeks to ensure an effective balance between global exploration and local exploitation, Computational experiments on benchmark instances show that the proposed approach consistently generates feasible solutions of high quality, yielding a reduced number of stock units under strict constraint satisfaction.

Keywords: Cutting Stock Problem, Constrained Optimization, Bio-inspired metaheuristic, Variable Neighborhood Search

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O-67 12h00 · Room A

Commande d'un bras manipulateur 6 D.D.L avec évitement d'obstacle par la logique floue

Hatem Ghodbane, Manel Moussaoui, Okba Kazar

Université Mohamed Khider Biskra

L'objectif de cet article est de proposer une méthode de contrôle d'un robot manipulateur à six degré de liberté avec évitement d'obstacle par la logique floue. Ce bras exécute la tâche de déplacement des objets bien définis dans un environnement bien déterminé. Cette méthode est orientée de manière à régler le problème de difficulté et parfois d'absence d'un modèle mathématique pour la modélisation et la commande des systèmes non linéaires. Elle permet d'aider le robot pour rejoindre un but bien défini avec la faculté d'évitement d'obstacles. Nous proposons également un simple contrôleur flou et un ensemble de modèles géométriques qui vont faciliter le suivi des meilleurs chemins pour le robot manipulateur. Les résultats obtenus en simulation montrent l'efficacité de l'approche proposée.

Keywords: bras manipulateur 6.D.D.l ; évitement d'obstacle ; logique floue

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O-68 12h15 · Room A

Commande d'une machine synchrone à aimants permanents et estimation de ces paramètres en utilisant le filtre de Kalman étendu

A. Titaouine, F. Benchabane, K. Yahia, A. Moussi (presented by Titaouine Abdenaser)
Laboratoire LMSE, Université Biskra, B. P 145 Biskra, Algérie
Laboratoire LGEB, Université de Biskra, B. P 145 Biskra, Algérie

Cet article présente la commande non linéaire d'une machine synchrone sans capteurs mécaniques de vitesse, position et couple de charge. La machine synchrone est alimentée par un onduleur de tension commandé par la technique MLI (sinus-triangle). La méthode utilisée pour l'estimation, sera substituée par un algorithme temps réel basé sur le filtre de Kalman étendu. Les résultats obtenus par simulation, montrent l'efficacité du filtre de Kalman étendu. Ils se caractérisent par une erreur d'estimation très petite pour différentes vitesses de rotation (grandes vitesses, basses vitesses) ainsi, que par l'insensibilité aux variations de la charge.

Keywords: Machine synchrone, modèle mathématique, commande non linéaire, filtre de Kalman étendu, estimation, identification

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O-69 12h30 · Room A

Assessing Machine Learning Techniques for Medical Diagnosis: A Comparative Study

Halima Salah, Selma Salah, Assem Alia, Fatima Guessoum, Hadil Sahtout, Amani Hebhoub
Higher Normal School of Technological Education(Enset), Skikda, Algeria
Laboratory of Science and Technology of information and Communication,Guelma,Algeria
School of Higher Commercial Studies (EHEC Algiers), Colea, Algeria
Laboratory of Applied Mathematics and Modeling, Guelma Algeria

Medical diagnosis remains a complex and challenging task due to the intricate, incomplete, and overlapping nature of clinical data. To address these challenges and support reliable disease classification, this study evaluates and compares five supervised machine learning algorithms: XGBoost, Random Forest, Decision Trees, Logistic Regression, and Support Vector Machine (SVM), across five benchmark medical datasets from kaggle and the UCI Machine Learning Repository covering Breast Cancer, Chronic kidney disease (CKD) , Heart Disease, hepatitis C and Diabetes Data Set. A rigorous preprocessing pipeline including data cleaning, normalization, parameter optimization, and cross-validation was implemented to prevent data leakage; with model performance assessed using precision, recall, F1-score, and accuracy. Random Forest and XGBoost demonstrated exceptional robustness across both binary and multiclass classification tasks, with XGBoost emerging as the optimal choice due to its superior accuracy and fast training speed. These findings provide practical guidance for researchers and developers in selecting efficient, high-performance machine learning models for clinical decision-support systems.

Keywords: machine learning, diagnostic , XGBoost

Material Science & Physics / Chemistry

Room B · 11h30–12h15 · Chair: Lahcène Chorfi

O-70 11h30 · Room B

Optimization of TIG Welding Parameters for Dissimilar AISI 430 Ferritic Stainless Steel / Copper Joints Using Response Surface Methodology

Nabil BENSAID, Mohamed Farid BENLAMNOUAR, Mohamed Amine Soualili, Hind Mansour, Rachid Amraoui

Research Center in Industrial Technologies CRTI, Cheraga 16014, Algiers, Algeria
Université Mohamed Khider Biskra, Algeria

Joining AISI 430 ferritic stainless steel to commercially pure copper is attractive whenever a part needs both structural integrity and good thermal or electrical conductivity, but the mismatch in thermophysical properties between the two metals makes a sound joint hard to achieve by Tungsten Inert Gas (TIG) welding. This work optimises the process using Response Surface Methodology (RSM) on an L15 orthogonal design, varying welding current (90–130 A), travel speed (120–180 mm/min), and torch offset (0.5–1.5 mm) on 2 mm plates joined with an ER309L filler. Ultimate tensile strength (UTS), elongation, and Vickers hardness (HV) were measured for each trial and fitted with quadratic regression in Design-Expert, then validated by analysis of variance; the resulting models describe the process's non-linear behaviour with satisfactory accuracy. Multi-response optimisation via the composite desirability function points to 102.8 A, 130 mm/min, and a 1.23 mm offset as the best overall compromise, giving predicted values of 202.8 MPa, 14.32 % elongation, and 157.1 HV at a desirability of 0.707. Current and offset both improve mechanical performance, while travel speed is mostly detrimental as it reduces heat input. Overall, thermal balance between the two dissimilar sides is the key lever for joint quality in this system.

Keywords: Alloying elements, X70 HSLA Steel, Microstructure, SMAW Welding, Mechanical Behavior

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O-71 11h45 · Room B

Co–Precipitation route of synthesis of $CoFeCeO_4$ nanoparticles and XRD, FTIR and VSM study

M. GHERIB, T. TAHRAOUI (presented by Mebarka Gherib)

National Higher School of Technology and Engineering-ANNABA, ALGERIA

Mixed metal oxides have emerged as a versatile class of functional materials due to their outstanding physicochemical properties, including ferroelectricity, electro-optical behavior, and enhanced catalytic activity. These features enable their broad applicability in oxidation reactions, dehydration processes, photocatalysis, and electrochemical systems. In this study, cobalt–iron–cerium oxide ($CoFeCeO_4$) was successfully synthesized via a co–precipitation method. The structural, morphological, and surface characteristics of the prepared material were systematically examined using X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM) combined with Energy Dispersive X-Ray Analysis (EDX). The results indicate that the incorporation of cerium plays a crucial role in modulating the crystal structure, surface properties, and defect chemistry of the oxide, leading to improved functional performance. Overall, this work highlights the importance of rare-earth elements in tuning the multifunctional behavior of mixed metal oxides and provides valuable insights for the design of advanced materials for catalytic and biomedical applications.

O-72 12h00 · Room B

Efficient HPLC method to resolve some wide-used drugs

Mohammed El Amin Zaid

Higher Normal School of Béchar, Algeria

The pandemic of coronavirus disease 2019 (COVID-19) associated with severe acute respiratory syndrome (SARS) was declared a pandemic by the World Health Organization (WHO); it began in Wuhan, China, in 2019 and spread to other continents. Approximately 14 to 30% of hospitalized patients diagnosed with COVID-19 develop severe respiratory failure requiring intensive care. Global mortality has increased, particularly in countries like Italy and Iran. With the increase in morbidity and mortality, the search for a cure has been a global demand. Among the potential drugs for treating COVID-19, the repurposing of old drugs such as Chloroquine, Hydroxychloroquine, Azithromycin, Remdesivir, etc., for use as antiviral treatments is an interesting strategy because their mechanism of action, safety profile, side effects, dosage, and interactions with other biological molecules are well known. Hydroxychloroquine (HCQ) is a drug derived from 4-aminoquinoline. It has been used as an antimalarial drug since World War II. It is also widely used in the treatment of lupus erythematosus, rheumatoid arthritis, and other inflammatory and skin diseases. Hydroxychloroquine is rapidly absorbed by the intestine, accumulating in organs such as the liver, spleen, lungs, and kidneys. It is currently being studied as a possible treatment for Covid-19. HCQ can have serious side effects such as retinal damage, muscle weakness, and cardiac arrhythmia. There are also numerous reports over the past thirty years indicating that the enantiomers of HCQ are metabolized differently when the racemic drug is administered. There is no published asymmetric synthesis of either enantiomer nor any progressive chromatographic resolution. To optimize the therapeutic value of a drug, it is necessary to determine if one of the enantiomers has a lower therapeutic value and/or significant side effects. Early research on drug development heavily relies on chromatographic techniques such as HPLC for the rapid resolution of stereo-isomers of candidate drugs. The drug is currently administered in racemic form for a variety of therapeutic targets. It is well documented that HCQ undergoes significant metabolism in humans to produce substantial levels of three chiral metabolites, leading to up to eight distinct chemical entities, each with their own pharmacokinetic and pharmacodynamic properties. Due to the current interest in drug repurposing strategies, researchers have emphasized that a crucial next step is determining the risk-benefit profile of the R and S enantiomers of HCQ. In our laboratory, we thought that the low effect of HCQ on the COVID-19 virus could be due to the racemic administration of the drug, which is why we were interested in the chiral separation of HCQ to better understand the recognition mechanism between the chiral stationary phase and the drug in order to increase its efficacy. High-performance liquid chromatography (HPLC) was successfully performed for QHC using two different polysaccharide-based chiral stationary phases, Chiralpack®AD-RH and Chiralcel®ODR, with high resolution factors ($2.34 < RS < 2.54$). Several effects are discussed as well as several conclusions drawn from this study.

Online Session V – Spectral Theory

Room C – Online · 18h00–19h15 · Chair: Inès Walha

O-73 18h00 · Room C – Online Online

Fredholm Theory and Essential Spectra of Linear Pencils: A Quasi-Inverse Approach

Hassen Khlif

Tunisia

This talk concerns Fredholm theory and the essential spectra of linear pencils through a quasi-inverse approach. Essential spectra are parts of the spectrum that remain stable under compact perturbations.

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O-74 18h15 · Room C – Online Online

Spectral Theory of Operator Matrices and Operator Pencils

Aymen Bahloul

University of Carthage, Tunisia

This talk concerns the spectral theory of operator matrices and operator pencils. Operator matrices arise naturally in the study of systems of coupled linear equations.

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O-75 18h30 · Room C – Online Online

On the criteria of a relatively Fredholm perturbations in the description of spectral properties of the sum of two operator matrices

Sana Bouzidi

University of Sfax, Tunisia

This talk concerns criteria for relatively Fredholm perturbations in the description of the spectral properties of the sum of two operator matrices. Fredholm perturbations are classes of operators that leave the Fredholm properties of an operator unchanged.

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O-76 18h45 · Room C – Online Online

Robust Adaptive Output-Feedback Sliding Mode Control for T-S Fuzzy Systems

Raja Taboubi, Borhen Torchani, Anis Sellami, Germain Garcia

LISIER, ENSIT, University of Tunis, Tunis, Tunisia
LAAS, CNRS, University Toulouse, Toulouse, France

This paper proposes a robust adaptive output-feedback sliding mode control (SMC) strategy for nonlinear systems represented by Takagi-Sugeno (T-S) fuzzy models. A novel adaptive switching gain law, is introduced to ensure robustness while minimizing chattering. Closed-loop stability is proven via Lyapunov analysis. Simulation results on an inverted pendulum validate the theoretical findings.

Keywords: Sliding Mode Control, T-S Fuzzy Systems, Adaptive Gain, Output-Feedback, Chattering Reduction, Lyapunov Stability.

O-77 19h00 · Room C – Online Online

Homogénéisation numérique du modèle de Frenkel-Kontorova

Sonda Walha

Faculty of Sciences of Sfax, University of Sfax, Tunisia

This talk is devoted to the numerical homogenization of the Frenkel-Kontorova model. The Frenkel-Kontorova model describes a chain of interacting particles in a periodic potential.

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SATURDAY, OCTOBER 31 – ORAL SESSIONS

Differential Equations and Dynamical Systems II

Room A · 10h00–11h45 · Chair: Meryem Bey

O-78 10h00 · Room A

General decay of Lord-Shulman thermoelastic system with past history

Abdelhak Djebabla, Marwa Boudeliou
Laboratory of Mathematics, Dynamics and Modelization, Badji Mokhtar-Annaba University

This paper investigates the general decay of solutions to a Lord–Shulman thermoelastic system with past history. By employing suitable energy methods and Lyapunov functionals, we establish energy decay estimates under appropriate assumptions on the memory kernel. The results show that the energy decay rate is determined by the properties of the relaxation function, providing a unified framework that includes exponential and polynomial decay.

Keywords: Asymptotic behavior; general decay; energy method.

O-79 10h15 · Room A

Qualitative Analysis of Stability and Oscillations in Delayed Multidimensional Difference Equations

Yacine Halim, Amira Khelifa
Abdelhafid Boussouf University, BP 26, 43000, Mila, Algeria
LMAM Laboratory, Mohamed Seddik ben Yahia University, BP 78 Oueld Aissa, Jijel 18000, Algeria

In this paper, we study the dynamical properties of a class of 4-dimensional rational difference equation systems that generalize earlier two and three dimensional models. The considered system includes a power-type nonlinearity characterized by a parameter $s > 0$, which significantly affects the qualitative behavior of the system. Our main focus is on proving the boundedness of solutions and analyzing the local asymptotic stability of the equilibrium points. We establish sufficient conditions ensuring stability and investigate the influence of the system parameters on the local behavior of solutions. Through extending several existing results to higher-dimensional cases, this work develops a more general theoretical framework and provides further understanding of the local dynamics, structural characteristics, and qualitative behavior of this family of nonlinear discrete systems.

Keywords: Rational recurrence models; delayed systems; asymptotic stability; oscillation; persistence; boundedness

O-80 10h30 · Room A

Applications of a Sine-Based 4D Weak Hyperchaotic System in Secure Communications, Image Encryption, and Analog Electronics

Houda Hassouna, Tidjani Menacer
Laboratory of Mathematical Analysis, Probability and Optimization, Biskra University, BP 145 RP, 07000 Biskra, Algeria
Laboratory of Applied Mathematics, Mohamed Khider University, BP 145 RP, 07000 Biskra, Algeria

This paper presents a compact four-dimensional weak hyperchaotic system based on a sinusoidal nonlinearity and demonstrates its practical applications in analog electronic circuits, multimedia encryption (images and audio), and secure communication via active synchronization. The system has only seven additive terms, no equilibrium points (hidden attractor), and exhibits two positive Lyapunov exponents ($LE_1 = 0.099871$, $LE_2 = 0.005313$) with a Kaplan–Yorke dimension $D_{KY} = 3.1105$. A complete analog circuit is designed and validated through simulation. For image encryption, a triple-diffusion scheme achieves near-ideal entropy, high NPCR, and very low correlation coefficients. For audio encryption, the same key stream provides a low signal-to-noise ratio and negligible plain–cipher correlation. The system passes all NIST randomness tests, confirming its suitability as a high-quality pseudo-random number generator. Active control synchronization is theoretically derived and numerically verified, with all errors converging exponentially to zero. The results demonstrate that the proposed sine-based system is a strong candidate for hardware-secured communication systems requiring low complexity and high statistical security.

Keywords: Weak hyperchaos; Sine nonlinearity; Hidden attractor; Image encryption; Audio encryption; Analog circuit; Random number generation; Secure communication.

O-81 10h45 · Room A

Dispersive Optical Solitons in Birefringent Fibers with Stochastic (2+1)-Dimensional Perturbed NLSE Having Parabolic Law of Refractive Index and Multiplicative White Noise

Abeer M. M. Hasek, Nouria Arar, Khaled A. E. Alurrfi, Mustafa A. Shibah, Abdulmalik A. Altwaty, Nehad Ali Shah, Jae Dong Chung, Fatima A. Salim

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Department of Mathematics, Faculty of Education, Wadi-Alshatti University, Brak, Libya.
Department of Mathematics, Faculty of Science, University of Benghazi, AL Marj, Libya.
Department of Mechanical Engineering, Sejong University, Seoul, South Korea.
Department of Mathematics, Faculty of Education, University of Zawiya,Al- Ajailat, Libya.

This study investigates the nonlinear stochastic (2+1)-dimensional perturbed nonlinear Schrödinger equation (NLSE) with parabolic law nonlinearity of refractive index, spatio-temporal dispersion (STD), and multiplicative white noise in the Itô sense. The primary objective is to explore novel properties of this complex system and its relationship to other nonlinear evolution equations. Utilizing a direct approach combined with the Liénard equation, the generalized (G'/G)–expansion method and the new projective Riccati equations method as computational schemes, we derive new exact solutions that reveal unique wave behaviors under stochastic perturbations. The physical significance of this model lies in its ability to describe wave propagation in diverse media, including optical fibers and plasma physics, where both nonlinearity and dispersion play crucial roles. Our results demonstrate the existence of stable soliton-like solutions despite the presence of noise and STD, providing valuable insights into the robustness of nonlinear wave phenomena in stochastic environments. The theoretical implications extend beyond optical systems, offering a framework for analyzing similar nonlinear stochastic partial differential equations. The study also underscores the importance of analytical methods when numerical techniques face limitations in handling high-dimensional stochastic systems. These results also advance the field of nonlinear science by introducing innovative solution techniques and expanding the understanding of nonlinear wave dynamics under realistic noisy conditions.

Keywords: Dispersive optical solitons, Birefringent fibers, Stochastic nonlinear Schrödinger equation (NLSE), Parabolic law nonlinearity, Multiplicative white noise, Spatio-temporal dispersion (STD), Liénard equation, Generalized (G′/G)–expansion method, New projective Riccati equations method

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O-82 11h00 · Room A

Computational Investigation of Bifurcation Behavior of Fractional Bratu problem via Integral transformation

Helmi Temimi, Marwan Alquran

College of Integrative Studies, Abdullah Al Salem University, Khaldiya, Kuwait
College of Science, Jordan University of Science & Technology, Irbid, Jordan

In this manuscript, we investigate the bifurcation behavior of the solution of the fractional Bratu problem involving a Caputo fractional derivative of order $\alpha \in (1, 2]$ given by ${}^{C}D^{\alpha}_{0+}u(x) + \lambda e^{u(x)} = 0$, $x \in (0, 1)$, (1) subject to the homogeneous Dirichlet boundary conditions $u(0) = u(1) = 0$. We derive an equivalent nonlinear integral-equation formulation. The resulting equation couples a global Fredholm-type integral and a Volterra integral with weakly singular kernels of order $\alpha - 1 > 0$. We then construct a high-order spatial discretization based on a uniform grid and composite Simpson's rule, and apply Newton's method with an analytically assembled Jacobian. A key feature of the scheme is a precomputed Volterra weight matrix, which enables a vectorized evaluation of the nonlinear operator and its Jacobian. This numerical scheme efficiently captures the multi-branched solution, marking an outstanding achievement in solving the fractional Bratu problem compared to existing methods that compute only the first-branch solution. Also, we numerically establish an error bound of order $O(h^{\alpha})$ in the max norm for the spatial discretization, while Newton's method converges quadratically toward the discrete solution once the initial guess is sufficiently close.

Keywords: fractional Bratu problem; Caputo derivative; nonlinear integral equation; Simpson's rule; Newton's method; error analysis

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O-83 11h15 · Room A

Existence of solutions for Solitons type equations: Derrick's Problem with twice p-laplacian

Abdelkader Dellal, Johnny Henderson, Abdelghani Ouahab

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In this paper we study a class of Lorentz invariant nonlinear field equations in several space dimensions. The fields are characterized by a topological invariant, which we call the charge. We prove the existence of a static solution which minimizes the energy among the configurations with nontrivial charge. In this spirit, a considerable amount of work has been done by V. Benci and collaborators and a model equation proposed in [2] will be the topic of this paper. The main purpose is to obtain soliton-like solutions with twice p-Laplacian.

Keywords: Soliton, variational calculus, splitting lemma

O-84 11h30 · Room A

Optical Solitons Construction in the Kundu–Mukherjee–Naskar Equation via the Generalized (U'/U)-Expansion Scheme

Khaled A. E. Alurrfi, Ayad M. Shahoot, Zaynab A. Khalleefah, Fawzi A. Abdelwahid, Nehad Ali Shah, Ajay Kumar, Abdelhakim Sahbani

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This study investigates new classes of optical soliton solutions within the framework of the Kundu-Mukherjee-Naskar equation, a nonlinear extension of classical wave models that captures diverse phenomena such as soliton propagation in optical fibers, rogue waves in oceanic systems, and beam dynamics in birefringent media. The analysis applies the generalized (U'/U)-expansion scheme, assisted by the Jacobi elliptic equation, to construct exact solutions for complex nonlinear structures. Through this approach, a broad spectrum of soliton forms is obtained, including dark solitons, straddled solitons, singular solitons, and solutions expressed in terms of Jacobi and Weierstrass elliptic functions. These solutions are examined both analytically and graphically to highlight their physical properties and propagation behavior.

Keywords: Optical solitons; Kundu-Mukherjee-Naskar equation; Generalized (U'/U)-expansion scheme; Jacobi-elliptic function solutions; Weierstrass-elliptic function solutions

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Mathematical Modeling and Simulation II

Room B · 10h00–12h00 · Chair: Imed Bouzida

O-85 10h00 · Room B

Two-parameter quasi-boundary value method for a backward abstract time-degenerate fractional parabolic problem

Rebbani Faouzia

Department CPST, National Higher School of Technology and Engineering, Annaba 23005, Algeria

This talk concerns a two-parameter quasi-boundary value method for a backward abstract time-degenerate fractional parabolic problem. Backward parabolic problems are ill-posed, and quasi-boundary value methods are regularization techniques used to treat them.

Editors' note based on the title only; not written by the authors, and no results are implied.

O-86 10h15 · Room B

Inverse source problem for Helmholtz equation

Lahcène CHORFI, Abir Benyoucef
Applied Mathematics Laboratory, University Badji Mokhtar-Annaba, Algeria
ENS, Université de Constantine, Algeria

We consider in this talk the inverse source problem for the Helmholtz equation. This problem consists to find a source $S(x, y)$ in the boundary-value problem: $\triangle u + k^2 u = S(x, y)$ in the square $D =]0, 1[^2$ (0.1) from the Cauchy's data ($u|_\Gamma = 0$, $\partial u/\partial n|_\Gamma = g$), where Γ is the boundary of D. The main purpose of this work is to provide a simple and effective numerical method for solving the multi-frequency inverse source problem. The main idea is to approximate the source function S by a Fourier expansion of the form $S_N(x, y) = \sum_{|m|,|n|\leq N} c_{nm}\varphi_{nm}(x, y)$ where $\varphi_{nm}(x, y) = \exp(2\pi i(nx + my))$.

Keywords: Equation de Helmholtz, Inverse source problem, uniqueness

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O-87 10h30 · Room B

Innovative Techniques in Stochastic Discrete Dynamics for Modeling Complex Systems

Ibrahim Sadok
Department of Mathematics and Computer Science, Faculty of Exact Sciences, University of Bechar

Images are often degraded during the data acquisition process. The degradation may involve blurring, information loss due to sampling, and various sources of noise. The purpose of image restoration is to estimate the original image from the degraded data. The present work sets forward a restoration technique for exponential dispersion noise based on Particle filtering (PF) using Hidden Markov Model. In order not to take observation information into account in general, the PF algorithm produced an incorrect sample from a discrete approximation distribution. To resolve this problem, we propose in the resampling stage of PF, samples which are generated from a continuous distribution rather than a discrete one based on Exponential Dispersion Models (EDM). An iterative approach, called the Expectation-Maximization (EM) algorithm, is used to find the maximum likelihood estimates of the relevant unknown parameters of the EDM. Moreover, under some conditions, the concavity of the conditional expected log-likelihood function is established in the maximization step of the EM algorithm. The proposed approach is rooted in ideas from statistics, control theory and signal processing. Experimental results are eventually displayed with simulation and satellite images, which demonstrate the good performance of the proposed approach.

O-88 10h45 · Room B

On Hermite–Hadamard-Type Inequalities in the Framework of G-Calculus

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This paper explores the extension of classical integral inequalities to the framework of multiplicative calculus, a non-Newtonian system where operations are defined using multiplicative analogues of differentiation and integration. We begin by reviewing fundamental concepts and quadrature rules in this new setting, including midpoint, trapezoidal, and Simpson-type formulas. A suitable notion of convexity is introduced, allowing us to derive multiplicative versions of Hermite–Hadamard-type inequalities as well as midpoint- and trapezoid-type bounds. The theoretical results are supported by a set of illustrative applications, demonstrating the potential of multiplicative calculus in extending classical mathematical analysis. This work can serve as an excellent reference that opens the door for future researchers to explore and expand the rich potential of this emerging calculus framework.

Keywords: Non-Newtonian calculus, multiplicative calculus, GG-convex functions, GA-convex functions, Hermite-Hadamard inequality, midpoint inequality, trapezium inequality

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O-89 11h00 · Room B

Nonparametric Estimation of a Censored Regression Function under Widely Orthant Dependence

Houria Bessa, Siham Bey, Abdelkader Tatachak
Lab. MSTD, Faculty of Mathematics, USTHB, BP 32, El-Alia 16111, Algeria.

This work studies regression estimation under random right censoring with Widely Orthant Dependent (WOD) data. A nonparametric estimator adapted to both the dependence structure and censoring is proposed. Its theoretical properties and finite-sample performance are evaluated through simulations.

O-90 11h15 · Room B

On the Stability of a Timoshenko System with Memory Effect and a Nonlinear Term

Djalal Boucenna
Algeria

This talk concerns the stability of a Timoshenko system with a memory effect and a nonlinear term. Timoshenko systems model the transverse vibrations of beams, taking shear deformation into account.

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O-91 11h30 · Room B

Exponential Stability of a Thermodiffusion Timoshenko System with Memory Effect

Salah Boulaares
Algeria

This talk concerns the exponential stability of a thermodiffusion Timoshenko system with a memory effect. Thermodiffusion couples the transfer of heat and of mass within a material.

Editors' note based on the title only; not written by the authors, and no results are implied.

O-92 11h45 · Room B

Hom-Probability Models for Industrial Reliability: Yau-Twisted Aggregation and Deformed Independence with Applications to Risk Analysis

Chaabane Benatmane
University of 20 August 1955, Skikda, Algeria

We introduce Hom-probability as a flexible framework for industrial reliability and risk analysis, via two fundamental models: the Hom-Bernoulli and Hom-exponential distributions. Probabilities and expectations take values in a commutative unitary Hom-ring $(A, \oplus, \odot, \alpha, \beta)$, where classical operations are replaced by Hom-deformed ones. Using Yau's twisting procedure, classical laws are transported into Hom-probabilistic analogues without altering numerical probabilities, while aggregation and independence are governed by (α, β). For the Hom-Bernoulli model, we derive explicit formulas for Hom-expectation, Hom-variance, and Hom-covariance, suitable for quality control under nonlinear aggregation. For the Hom-exponential distribution, we obtain closed-form expressions for Hom-moments, Hom-hazard rate, and a Hom-memoryless property, together with formulas for Hom-sums and Hom-minima of i.i.d. samples, directly applicable to component lifetime and degradation modeling. These examples show that Hom-probability provides a coherent deformation of classical models: numerical laws remain classical, but nonlinear aggregation and twisted independence emerge through (α, β), offering a flexible algebraic framework for distorted expectations, nonlinear variability, and structurally deformed stochastic behavior in industrial contexts.

POSTER SESSION

Group A

Friday, October 30 · 17h30 · Chair: Abdelhak Djebabla

P-01 17h30 · Group A

Functional local linear estimate of the conditional density function

Mohammed Abeidallah

Higher School of Management of Tlemcen, Algeria

The main goal is to establish the complete convergence of the estimator of the Conditional density constructed by the local linear method for spatial data of scalar response variable given a functional variable when the observations are spatially dependent.

P-02 17h30 · Group A

A Multi-Method Statistical Framework for Quantifying Spatio-Temporal Lagged Dependence Between Meteorological and Hydrological Droughts

Sabri Berhail

Engineering and Environmental Technology Laboratory, Mila University, Mila 43000, Algeria

This study develops a multi-method statistical framework to quantify lagged dependence between meteorological and hydrological droughts in the semi-arid Mekerra Basin (northwestern Algeria). Monthly precipitation and streamflow records are standardized using the Standardized Precipitation Index (SPI) and Standardized Streamflow Index (SSI) at 3- and 12-month time scales (SPI3, SPI12, SSI3, SSI12). The framework integrates Propagation Time (PT), the Drought Propagation Index (DPI), Granger causality analysis, and the Moving Trend Method (MTM) to characterize temporal delays, causal relationships, and spatial variability in drought propagation. These complementary statistical approaches enable systematic assessment of dependence structures, amplification processes, and non-stationary behavior in hydroclimatic time series. Results show pronounced spatial heterogeneity in lagged dependence along the upstream–downstream continuum. Upstream stations exhibit strong SPI–SSI coupling and short propagation times, reflecting rapid hydrological response to meteorological forcing. Downstream stations display weaker instantaneous coupling but stronger persistence and hydrological memory, resulting in enhanced lagged dependence. Event-based analysis indicates predominantly short propagation times with occasional long-lag responses. Granger causality confirms statistically significant predictive relationships between SPI12 and SSI12 at all stations ($p < 0.05$), with spatial variability in optimal lag structure. DPI results reveal a transition from buffering–amplification behavior upstream to persistent amplification downstream. MTM further indicates non-stationary evolution of drought propagation dynamics, characterized by increasing amplification trends in recent decades. Overall, the proposed framework provides a robust and transferable statistical methodology for analyzing lagged dependence in complex spatio-temporal systems, with applications in hydroclimatic variability and water resources management.

P-03 17h30 · Group A

Quantitative and Statistical Evaluation of Video-Based Feedback for Motor Skill Enhancement in Volleyball

Mohammed Zeroual

University of Biskra, Algeria

The integration of quantitative analysis and digital technologies in sports training offers an effective approach for evaluating and improving motor performance. This study investigates the effectiveness of different video-based feedback strategies for developing the swan diving skill in volleyball using Kinovea software. Twelve school volleyball players were divided into four equal groups: three experimental groups and one control group. The experimental groups received self-performance video replay, ideal-model video feedback, or a combination of both, whereas the control group received conventional verbal feedback. The training program lasted one and a half months with five sessions per week. Performance was assessed through pre- and post-intervention swan diving skill scores, and the data were analyzed using variance homogeneity tests, paired-sample comparisons, one-way ANOVA, and post-hoc analysis. The results showed no significant differences among the groups before the intervention, while significant differences were observed after training, with $F = 10.62$ and $p = 0.004$. The self-performance video-replay group achieved the greatest improvement, increasing its mean score from 11.0 to 25.0, and statistically significant improvements were also observed in the ideal-model feedback group. These findings demonstrate the value of statistical analysis in assessing technology-assisted training methods and indicate that self-observation through video replay can be an effective tool for improving motor skill performance in volleyball.

P-04 17h30 · Group A

Variance reduction in queuing system using refined descriptive sampling

Zioui Arezki

University of Bejaia, Algeria

This poster concerns variance reduction in queuing systems using refined descriptive sampling. Variance reduction techniques aim to improve the precision of simulation estimates for a given computing effort.

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P-05 17h30 · Group A

Adaptive Refined Descriptive Sampling for Simulation with Dependent Inputs

Kebaili Siham

University of Bejaia, Algeria

We propose an algorithm to generate refined descriptive samples from dependent random variables for the estimation of expectations of functions of output variables. The Iman and Conover algorithm is used to transform the dependent variables into independent ones. Hence, the asymptotic variance of such an estimate in the case of dependent input random variables is proved to be less than that obtained using simple random sampling

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P-06 17h30 · Group A

Martingale Analysis of the Busy Period in an M/G/1 Retrial Queue with Constant Retrial Rate

Houria Oukid

Saad Dahlab University Blida 1, Algeria

We investigate an M/G/1 retrial queue operating under a constant retrial policy. Customers arriving when the server is busy join an orbit and retry independently according to a constant retrial mechanism. Using the embedded Markov chain observed at departure epochs, we construct a martingale associated with the orbit-size process. Applying stopping-time arguments leads to a functional equation for the busy-period generating function and yields an explicit expression for the expected number of customers served during a busy period. Beyond the analytical results, the proposed approach provides a martingale-based alternative to classical generating-function techniques used in retrial queueing theory, offering a clear probabilistic interpretation of the busy period. Finally, the analysis highlights structural differences between constant retrial queues and classical linear retrial systems, and shows that the model converges to the standard M/G/1 queue as the retrial rate tends to infinity.

P-07 17h30 · Group A

Optimal Routing Control of a Single-Server Retrial Queue with Two-Phase Service Heterogeneous

Zineb Dahmane

Department of Mathematics, Faculty of Science, University of Blida 1, Blida, Algeria

In this paper, we consider the problem of dynamic routing control in a retrial queue with a single server that provides two phases of service. Customers arrive at the system according to a Poisson process and join an infinite-capacity queue (primary queue). There is a single server that provides two independent phases of service for each customer. When a customer completes his first phase, a system controller decides whether to keep this customer in service or to route him to the retrial box. If he remains in service, the customer receives his second phase and then leaves the system. When routed to the retrial box, the server immediately serves the first phase for the next customer in the queue. A retrial customer can receive his second phase only when the server is idle (no customers in the primary queue and in service). The goal is to find a routing policy that minimizes the expected total discounted holding cost over infinite horizon.

P-08 17h30 · Group A

Functional single-index k-nearest neighbor relative error regression under weak dependence

Wahiba Bouabsa

Djillali Liabès University of Sidi Bel Abbès, Algeria

We study estimation of the relative error regression function in a functional single-index regression model under quasi-associated dependence. We introduce a k-nearest neighbors (k-NN) estimator whose smoothing adapts to the local concentration of the covariate trajectories. Almost complete convergence rates are established under mild small-ball and dependence conditions. A simulation study compares the proposed k-NN estimator with its kernel counterpart, and a real data application to air quality forecasting (NOx → ozone) illustrates it's practical performance.

P-09 17h30 · Group A

Boundary Integral Formulations for the Laplace Equation under Generalized Boundary Conditions

Hamza Bouguerne

Badji Mokhtar Annaba University, Algeria

This poster concerns boundary integral formulations for the Laplace equation under generalized boundary conditions. Boundary integral formulations rewrite a problem posed in a domain as an equation on its boundary.

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P-10 17h30 · Group A

Spectral Analysis of a Coupled System of Second-Order Ordinary Differential Equations with Nonlocal Weighted Integral Boundary Conditions

Abdelkrim Zekri

Higher School of Management of Tlemcen, Tlemcen 13000, Algeria

In this work, we investigate a spectral problem for a system of second-order ordinary differential equations with a complex spectral parameter subject to weighted integral boundary conditions involving the first derivatives of the unknown functions. For sufficiently large values of the spectral parameter, we derive a priori estimates for solutions of the system and establish the Fredholm solvability of the corresponding operator. The obtained results extend known spectral and solvability properties for ordinary differential operators with nonlocal integral conditions to coupled systems.

P-11 17h30 · Group A

Controllability of Impulsive Stochastic Fractional Integro-differential Equations with Infinite Delay

Khalida Aissani

University of Sidi Bel Abbès, Algeria

This paper is concerned with the controllability of impulsive stochastic fractional integro-differential equations with infinite delay. By employing fractional calculus and Krasnoselskii's fixed point theorems.

P-12 17h30 · Group A

Adaptive Meir–Keeler Contractions in Double Controlled Metric Spaces: Theory and Applications to Caputo Fractional Equations

Ahmad Aloqaily

Prince Sultan University, Saudi Arabia

In this paper, we investigate fixed point results for a new class of Meir–Keeler type contractions in the setting of double controlled metric type spaces governed by two independent control functions. This framework strictly extends controlled metric type spaces and allows the treatment of nonlinear mappings that cannot be handled by a single control function. We establish existence and uniqueness fixed point theorems for generalized Meir–Keeler contractions in complete double controlled metric type spaces. As an application, we employ the obtained results to study the existence and uniqueness of solutions for nonlinear fractional differential equations involving the Caputo fractional derivative. Several illustrative examples, including non-Lipschitz nonlinearities, are provided to demonstrate the effectiveness of the proposed approach

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P-13 17h30 · Group A

A Dynamic Systems Approach to Reality Extra Analgesic Toxicity in Male Rats: Derivation of a Safe Daily Dose from Stability Criteria and Routh-Hurwitz Analysis

Fatima Sadaga

Omar Al-Mukhtar University, Libya

Concerns over cumulative toxicity, especially on the liver and kidneys, are raised by the widespread usage of combination analgesics like Reality Extra, which contains caffeine, diclofenac sodium, and paracetamol. This article evaluates a previous study on Reality Extra on male Wistar albino rats during a 12-day period. It explained the decrease to a severe drop in body weight growth (5.61% vs. 23.38%) and lower urea levels, the treatment group had significantly higher plasma AST (341 U/L vs. 165 U/L), ALT (328 U/L vs. 165 U/L), and creatinine (1.2 mg/dL vs. 0.8 mg/dL), indicating concomitant hepatorenal damage. We created a dynamic mathematical model based on these data, it consists of four ordinary differential equations that describe drug concentration, liver mass, kidney mass, and a biomarker of organ damage. The model was analyzed for equilibrium points and stability using the Routh-Hurwitz criterion. We derived a critical condition for a safe daily dose: $g_{safe} \leq a^2/(4a)$, where a and b are functions of organ clearance and damage coefficients. The experimental dose (7.23 mg/200 g body weight) exceeded this threshold, pushing the system toward a pathological steady state. This integrated approach provides a quantitative framework for predicting analgesic toxicity and optimizing dosing regimens.

P-14 17h30 · Group A

On the study of evolution equation with damping term and fractional integral conditions

Nassima Rezgui

University 8 May 1945 Guelma, Algeria

This poster concerns the study of an evolution equation with a damping term and fractional integral conditions. Damping terms model the dissipation of energy in evolution problems.

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P-15 17h30 · Group A

Nonexistence of global solutions to the Baouendi–Grushin heat equation with nonlocal nonlinearities

Achouak Bekkai

Mohamed Cherif Messaadia University, Souk Ahras, Algeria

In this paper, We study the following Cauchy problem for a heat-type equation driven by the Baouendi–Grushin operator with a nonlinear memory term: $u_t - \Delta_\lambda u = \int_0^t (t-s)^{-\gamma} |u|^{p-1}u(s)\, ds$, $(x, y, t) \in \mathbb{R}^N \times \mathbb{R}^k \times (0, \infty)$, $u(x, y, 0) = u_0(x, y)$, $(x, y) \in \mathbb{R}^N \times \mathbb{R}^k$, where $\Delta_\lambda = \Delta_x + |x|^{2\lambda}\Delta_y$ with $\lambda > 0$ denotes the Baouendi–Grushin operator, $\gamma \in [0, 1)$, $p > 1$, and $u_0 \in L^1_{loc}(\mathbb{R}^{N+k})$. Using the test function method we prove that if $u_0 \geq 0$ and $u_0 \not\equiv 0$, then no global weak solution exists whenever $1 < p \leq p_c := \max\{1 + 2(2-\gamma)/(Q-2+2\gamma), 1/\gamma\}$, where $Q = N + (1+\lambda)k$ is the homogeneous dimension.

P-16 17h30 · Group A

Two-parameter quasi-boundary value method for a backward abstract time-degenerate fractional parabolic problem

Rebbani Faouzia

Department CPST, National Higher School of Technology and Engineering, Annaba 23005, Algeria

This poster concerns a two-parameter quasi-boundary value method for a backward abstract time-degenerate fractional parabolic problem. Backward parabolic problems are ill-posed, and quasi-boundary value methods are regularization techniques used to treat them.

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P-17 17h30 · Group A

Iterative regularization for ill-posed inverse problems: Medical imaging - Quantification of mitral regurgitation

Mayssa Zayed

Faculty of Sciences of Sfax, University of Sfax, Tunisia

This work investigates an accelerated iterative regularization method for ill-posed inverse problems, with an application to medical image restoration and mitral regurgitation quantification. The proposed approach aims to improve convergence speed while controlling noise amplification. Its performance will be evaluated through theoretical analysis and numerical experiments, with particular attention to Doppler data reconstruction and comparison with the conventional PISA method.

Group B

Friday, October 30 · 17h30 · Chair: Mourad Elloumi

P-18 17h30 · Group B

Deep Learning for Skin Disease Classification: A Comparative Study of CNN, ResNet152V2 and EfficientNetB3

Sofia Akezouh

National Higher School of Telecommunication and ICTs, Oran, Algeria

In medical practice, the contribution of information technology can be considerable. These practices include the images that medical assistance uses to identify different pathologies of the human body. One of these images includes dermatological images, which cover a large part of our work in this paper. Images of skin lesions play a very important role in the identification and diagnosis of skin diseases, with infectious forms (bacterial, viral, fungal, and parasitic) representing a major reason for consultation. Our objective in this paper is to develop a model capable of classifying eight skin diseases: cellulitis, impetigo, athlete's foot, onychomycosis, ringworm, larva migrans, chickenpox, and shingles. To accomplish this task, we used deep learning techniques based on convolutional neural networks. Several studies were conducted on the Skin Disease Dataset from Kaggle, containing 1,159 images divided into 8 classes. The models proposed in this paper are: a Classic CNN and two pre-trained models (ResNet152V2 and EfficientNetB3). With four convolutional blocks and two fully connected layers, Classic CNN achieved a result of 88.03% after 30 epochs. This motivated us not only to modify the parameters but also to work on transfer learning. In the latter, the pre-trained models ResNet152V2 and EfficientNetB3 were used on the same dataset with different hyperparameter configurations to yield respective results of 97.01% and 98.72%. The best model EfficientNetB3 makes only 3 errors on 234 test images. It is important to note that the adoption of deep learning in medical practice allows for improved healthcare, reduced diagnostic delays, and optimized clinical outcomes for patients.

P-19 17h30 · Group B

Improving Accuracy and Diversity in E-commerce Recommendations through MLP and Diversity-Aware Re-Ranking

Ibtissem Gasmi

Computer Science and Applied Mathematics Laboratory (LIMA), Chadli Bendjedid University, El Tarf 36000, Algeria

In collaborative filtering for e-commerce recommendation systems, striking a balance between prediction accuracy and recommendation diversity remains a major challenge. While deep learning models have significantly improved rating prediction, they often produce highly similar recommendation lists, limiting item discovery and reducing recommendation diversity. To increase recommendation diversity while maintaining prediction accuracy, this research presents a two-stage recommendation framework. First, nonlinear user-item interactions are modeled, and preference scores are predicted by a multilayer perceptron (MLP) using learned vector representations of users and items. Second, the initial top-K recommendation list is refined using a Maximum Marginal Relevance (MMR) re-ranking strategy that balances estimated relevance with inter-item diversity. The proposed model is tested using three public datasets: MovieLens 100K, Amazon Reviews, and Amazon Beauty. Experimental results demonstrate that the MLP model makes accurate rating predictions across datasets, whereas MMR-based re-ranking significantly improves suggestion diversity.

P-20 17h30 · Group B

Memory–Aware Functional Connectivity Graphs for Alzheimer's Disease

Meryem Bey

Abdelhamid Mehri University Constantine 2, Algeria

This study proposes a theoretical mathematical framework for analyzing brain functional connectivity in Alzheimer's disease using graph-based modeling. It introduces a fractional-order approach based on the Capoto derivative to capture memory effects in neural signals. The framwork is shown to be consistent with classical connectivity models and provides a flexible foundation for future data-driven studies of memory-aware functional brain networks in neurodegenerative diseases.

P-21 17h30 · Group B

Rolling Bearing Fault Diagnosis Based on Convolutional Neuronal Network Feature Extraction, Hierarchical Clustering and Support Vector Machine

Mostefa Mohamed Touba

University of Biskra, Algeria

Rolling bearings are vital components in industrial rotary machinery, where early fault detection is essential to prevent failures and reduce maintenance costs. While vibration analysis remains a reliable diagnostic method, the incorporation of artificial intelligence (AI) techniques encompassing both deep learning (DL) and machine learning (ML) introduces new challenges, particularly related to high dimensionality and limited model interpretability. To address these issues, this study proposes a hybrid diagnostic framework that combines deep feature extraction via a pre-trained Inception V3 convolutional neuronal network (CNN) transfer learning with hierarchical clustering (HC) for feature selection. This method contributes to reducing high dimensionality and preserves interpretability, unlike conventional approaches such as principal component analysis (PCA). Subsequently, a support vector machine (SVM) classifier is then used for fault classification. Evaluated on the CWRU dataset, the proposed system demonstrates superior accuracy, efficiency, and interpretability compared to existing techniques, highlighting its potential for industrial fault diagnosis applications.

P-22 17h30 · Group B

Automatic classification of gear fault type and severity using a multi-feature Self-Organizing Maps (SOM)

Lilia Chaabi

Laboratory of Electrical Engineering, University 8 May 1945 Guelma, Algeria

This poster concerns the automatic classification of gear fault type and severity using multi-feature Self-Organizing Maps (SOM). A self-organizing map is an unsupervised neural network that arranges data on a low-dimensional grid.

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P-23 17h30 · Group B

Modeling and Optimization of Saponification of Ethyl Acetate Using Machine Learning Models

Abdelkrim Merzougui

University of Biskra, Algeria

The saponification of ethyl acetate is a benchmark reaction in chemical engineering, playing a critical role in reaction kinetics and industrial process design. Accurate modeling and optimization of this process are essential for maximizing product yield, improving energy efficiency, and controlling operational parameters such as reaction temperature, residence time, and initial reactant concentrations. In this study, data-driven Machine Learning (ML) techniques—specifically Artificial Neural Networks (ANN), Random Forest Regression (RFR), and Support Vector Regression (SVR)—were developed and evaluated to model and optimize the ethyl acetate saponification process. The ML models were trained and tested using experimental operational data. Performance metrics, including the Coefficient of Determination (R^2), Root Mean Square Error (RMSE), and Mean Absolute Error (MAE), were utilized to assess and compare the predictive accuracy of each model. Furthermore, optimization algorithms were coupled with the trained models to identify optimal operating conditions. The comparative results demonstrate that machine learning models, particularly ANN and RFR, exhibit superior predictive accuracy and generalization capabilities in capturing complex reaction dynamics. Overall, this approach provides an efficient, robust, and cost-effective framework for real-time monitoring and parameter optimization in chemical manufacturing processes.

P-24 17h30 · Group B

Industrial Risk Assessment Decision making with Feature Selection

Zouairi Saim

University of Oran 2 Mohamed Ben Ahmed, Algeria

Risk assessment is a critical process in the industrial safety field. Accurate risk prediction enables informed decision-making, resource allocation, and mitigation strategies. However, achieving reliable risk assessment models requires thoughtful consideration of the features (variables) used for prediction. These features can range from historical data (such as past incidents) to environmental factors (such as temperature or pollution levels), which in parallel serve as inputs to our models, shaping their predictions and influencing subsequent decisions. Our study illustrates the crucial role of Feature Selection techniques to enhance model performance and stability, and facilitating accurate risk prediction. Through the application of Recursive Feature Elimination (RFE) and Mutual Information (MI), we identified most relevant features that significantly contribute to make decision to better assessing risk in industry.

P-25 17h30 · Group B

Optimisation of path planning for an autonomous mobile robot in an industrial environment using the RRT* algorithm

Lalaoui Mohamed El Amine

Institute of Maintenance and Industrial Safety, University of Oran 2 Mohamed Ben Ahmed, Algeria

Trajectory planning is a fundamental challenge in autonomous mobile robotics, particularly in industrial environments where safety, robustness and efficiency requirements are high. This work proposes an optimisation approach for the Rapidly-Exploring Random Tree Star (RRT*) algorithm, applied to the autonomous navigation of a differential-drive mobile robot. Following geometric, kinematic and dynamic modelling of the robot, an implementation of the algorithm is developed in Python to generate collision-free trajectories in industrial environments containing static obstacles. The approach incorporates a bias towards the target as well as a trajectory smoothing step aimed at improving the quality of the resulting paths. The method's performance is evaluated across several simulation scenarios according to three main criteria: computation time, trajectory length and the smoothness of movement. The results obtained show a significant improvement in trajectory quality compared with the conventional RRT approach, with a reduction in sudden changes of direction, better convergence towards the target and safer navigation. These results confirm the value of the optimised RRT* algorithm for mobile robotics applications in the context of Industry 4.0 and open up prospects for its integration into real-world robotic platforms.

Keywords: Autonomous mobile robot, path planning, RRT*, industrial robotics, autonomous navigation, obstacle avoidance, optimisation, Industry 4.0

P-26 17h30 · Group B

A Machine Learning Approach to Gear Pitting Diagnosis via Hybrid Domain Feature Extraction

Ahmed Ghorbel

Tunisia

This poster concerns a machine learning approach to gear pitting diagnosis via hybrid domain feature extraction. Pitting is a surface fatigue failure of gear teeth.

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P-27 17h30 · Group B

Interpretable Machine Learning for High-Dimensional Bacterial Genomic Data: A Framework for Taxonomic Classification and Virulence Profiling

Rafik Ould Taleb

M'hamed Bougara University of Boumerdès, Algeria

Bacterial comparative genomics generates high-dimensional datasets in which correlated features, uneven sampling, and population structure can complicate statistical inference and predictive modelling. This work proposes an interpretable machine learning framework for analysing bacterial genomic diversity, with the genus Yersinia as a biological case study. The central objective is to investigate how complementary genomic representations can be integrated to support robust taxonomic classification and the characterization of virulence-associated gene repertoires. Following genome quality assessment and standardized annotation, bacterial genomes will be represented through sequence-derived descriptors and gene presence–absence matrices. Average nucleotide identity will provide an independent comparative reference for assessing taxonomic consistency. The proposed modelling strategy combines dimensionality reduction, regularized classification, and tree-based learning to address feature redundancy and high dimensionality. Model selection and hyperparameter optimization will be conducted within a nested cross-validation framework, using lineage-aware partitions to limit information leakage between closely related genomes. Predictive performance will be assessed using balanced accuracy and macro-averaged F1 scores, while comparisons between genomic representations will evaluate their respective contributions to classification. Interpretability analyses will examine the stability of influential features across validation folds and their relationships with annotated biological functions, including type III secretion system components. Virulence gene repertoires will be analysed as genomic characteristics rather than treated as direct evidence of pathogenicity. Where independently validated phenotypic labels are available, an additional predictive task will assess their association with genomic features. The proposed framework connects statistical learning, high-dimensional data analysis, and comparative genomics. It aims to support reproducible biological inference while explicitly addressing class imbalance, population structure, and uncertainty in genomic annotation

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P-28 17h30 · Group B

Towards Explainable Medical Imaging with XAI and VLMs

Besma Khalfoun

Capgemini Engineering, France

Deep learning has achieved remarkable performance in medical imaging, particularly in the automated detection of diseases from chest radiographs. However, the lack of explainability and interpretability of these models remains a major barrier to their adoption in clinical practice. Explainable Artificial Intelligence (XAI) methods aim to address this limitation by providing insights into the factors influencing model predictions. Among these methods, gradient-based approaches (Grad-CAM, Grad-CAM++), activation-based techniques (Score-CAM, Eigen-CAM), and perturbation or attribution methods (LIME, SHAP) offer complementary perspectives, although each presents limitations in terms of fidelity, robustness, and clinical relevance. In this work, we propose an explainability framework for pneumonia detection from chest X-ray images. Several XAI methods from different methodological families are quantitatively compared and evaluated according to three criteria: fidelity, robustness, and anatomical plausibility of the generated explanations. In addition, an interpretability module based on a Vision-Language Model (VLM) leverages the generated XAI maps, quantitative evaluation metrics, and model prediction outputs. Guided by a carefully designed prompt, the VLM integrates these heterogeneous sources of information to automatically generate a structured and contextualized interpretation report. The results demonstrate that combining complementary XAI methods with VLM-based reasoning enhances transparency and trust in AI-assisted diagnostic systems. Furthermore, the proposed framework is model-agnostic and can be readily extended to other computer vision models and application domains beyond medical imaging.

P-29 17h30 · Group B

Mathematical Modelling and Response-Surface Optimization of a Reheat-Regenerative Power Plant Based on Energy and Exergy Analysis

Taoufik Bensana

Higher Normal School of Technological Education of Skikda, Azzaba, Skikda, Algeria

This poster concerns the mathematical modelling and response-surface optimization of a reheat-regenerative power plant based on energy and exergy analysis. Exergy analysis measures the useful work potential that is lost in each part of a thermal process.

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P-30 17h30 · Group B

Mathematical and Dynamic Modeling of Biodiesel Reaction Mixture Separation Using UNIQUAC Model and MATLAB

Abdelkrim Merzougui

University of Biskra, Algeria

Modelling is one of the most diverse and fascinating fields of engineering, as it is capable of predicting results related to physical and chemical phenomena through mathematical models derived analytically or from experimental data. This paper covers the modeling, simulation, and numerical solution of the governing system of differential equations for a multistage distillation column designed to separate a mixture containing biodiesel reactional components in MATLAB. The vapor-liquid equilibrium data necessary for the computation of equilibrium compositions throughout the column are obtained using the UNIQUAC method to calculate the activity coefficients of components in the mixture. This utilizes experimental parameters available in literature for a system containing water, ethanol, glycerol, and soybean oil, which is modeled as a pseudo-component consisting of a mixture of fatty acids.

P-31 17h30 · Group B

Mathematical Modeling and Multi-Objective Optimization for Surface Roughness and Tool Vibration Control in Machining AISI 4140 Steel

Mohamed Walid Azizi

Environmental Engineering and Technology Laboratory (EETL), Abdelhafid Boussouf University of Mila, Mila 43000, Algeria

In the present work, the multi-response optimization of machining parameters in hard turning of AISI 4140 steel (52 HRC) with CVD coated carbide inserts (GC3015) is based on the Taguchi technique. The planning of the experiment was based on Taguchi's L9 orthogonal array. The response table and analysis of variance (ANOVA) have allowed us to check the validity of linear regression models and to determine the significant parameters affecting the surface roughness and cutting tool radial vibrations. The statistical analysis reveals that the feed rate has significant effects in reducing the surface roughness; whereas the depth of cut and cutting speed are observed to have a statistically significant impact on the cutting tool radial vibrations than the cutting speed. Consequently, mathematical models were developed to correlate the cutting parameters with surface roughness and cutting tool radial vibrations. The developed mathematical models were found to be reliable representatives of the experimental results with prediction errors less than ±5%. The optimum machining conditions to produce the lowest surface roughness with minimal cutting tool radial vibrations under these experimental conditions were searched using the desirability function approach for multiple response factors optimization. Finally, a series of validation experiments was performed to benchmark the predicted results against the actual measured responses.

P-32 17h30 · Group B

Numerical simulation of the cooling of a rotary kiln shell using an air jet

Bouhafs Mohammed

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The rotary kiln is an essential component of a cement plant, playing a central role in the cement manufacturing process. Modern rotary kilns are designed to maximise energy efficiency. They typically use preheating and heat recovery systems to reduce energy consumption. This helps to make the cement production process more sustainable and economically viable. The rotary kiln maintains very high temperatures, generally between 1400 and 1500 °C, in the kiln's firing zone, which are necessary for the calcination reactions of the raw materials. Precise temperature control is crucial to ensuring the quality of the clinker produced. It is with this objective in mind that this study was undertaken, which involves a numerical simulation of the cooling of the shell in the firing zone of a rotary kiln using ANSYS. A validation model exists, based on actual on-site measurements of the temperature distribution along this section of the shell. The geometry, boundary conditions and operating conditions were used to validate the numerical calculations. The results of the numerical simulation are in good agreement with those measured on-site. The objective is to cool the shell of the firing zone using a jet of air, employing fans. This will improve the cooling of the shell, and a solution has therefore been proposed to prevent the shell from deforming. The aim of this study is to model and simulate the cooling of a rotary kiln shell in ANSYS. The model corresponds to the actual setup in the factory: the geometry, boundary conditions and operating conditions were used to validate the numerical calculations. The results of the numerical simulation are in good agreement with those measured in the factory. To improve the cooling of the shell, a solution was proposed. Indeed, the addition of water injectors to the shell resulted in a considerable reduction in temperature of 52°C.

P-33 17h30 · Group B

Numerical Simulations of Thermal Dissipators: Assessment of the Effects of Fins and Composites on the Cooling of Electronic Components

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This study focuses on the thermal optimization of microchannel dissipators, emphasizing the impact of fins and composite materials on the cooling of electronic components. Using the COMSOL Multiphysics 6.3 software, numerical simulations were conducted to evaluate the thermal performance of various dissipator models. The results demonstrate that the geometry of the dissipator and the configuration of the channels with fins play a crucial role in the heat transfer characteristics. Copper fins significantly increase the heat exchange surface, thereby enhancing cooling efficiency. Additionally, the study revealed that composite materials, such as Metal Matrix Composites (MMC) and Carbon-Graphite Composites (GCC), offer interesting thermal and mechanical properties, promoting improved performance in thermal management applications. The results indicate that increasing the Reynolds number enhances heat transfer but also leads to an increase in pressure drop, necessitating effective energy management. In conclusion, this research opens avenues for the development of advanced models and the exploration of new materials, aiming to further improve cooling solutions for increasingly compact and high-performance electronic systems.

P-34 17h30 · Group B

The geometry of stenosis: 2. Classification of multiple axisymmetric stenoses

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As it is well-known, stenosis is defined as an internal narrowing of blood vessels (arteries) characterized by a degree of stenosis α, such that beyond it, the effects of stenosis will become significant and require urgent surgical interventions. The study of their geometry is then very important to determine their severity. In a recent work, [1], we have proposed a classification of the twenty-one models existing in literature concerning the geometry of simple axisymmetric stenoses, including our own model proposed in [2]. In the present work, we present a chronological classification of the ten models of multiple axisymmetric stenoses found in literature. In fact, this work is a second step in the realization of a large research work that its main aim is the classification of all of the existing geometric models of stenosis, proposed over the past fifty years, through numerous theoretical, numerical, and experimental studies. In each of these studies, a model of the geometry of the stenosed artery was proposed or followed. In a third step, we plan to treat the classification of all the remaining geometric models concerning simple and multiple non-axisymmetric stenoses.

Group C

Friday, October 30 · 17h30 · Chair: Abdelghani Lakhdari

P-35 17h30 · Group C

Theoretical and numerical results of contact problems in solid mechanics

Taallah Frekh

Badji Mokhtar Annaba University, Algeria

Several problems in mechanics, physics, control and those dealing with contacts, lead to the study of systems of variatonal inequalities. In this study we considered a deformed elastic solid with a unilateral contact of a rigid body. This model has been studied by Lions, J.L. and G. Stampacchia. In this paper, we studied the existence, uniqueness and continuity of the deformation of this solid with respect to the data.

P-36 17h30 · Group C

Viscous dissipation impact on mixed convection heat transfer in a non-Newtonian fluid flow

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This paper reports a computational analysis of mixed convection flow of non-Newtonian nanofluid considering the viscous dissipation effects. It presents the numerical predictions of hydrodynamic and thermal characteristics of the flow through a backward facing step with a baffle. The governing equations are solved using the finite volume method, as described by Patankar, by taking into account the associated boundary conditions. The SIMPLER algorithm is used to handle the pressure-velocity coupling. Empirical relations are used to determine the effective dynamic viscosity and the thermal conductivity of the nanofluid. The results are presented in terms of isotherms and streamlines for different Brinkman and Richardson numbers. It is found that considering the viscous dissipation contributes to internal heating and affects greatly the heat transfer in the fluid especially if it is charged with nanoparticles. Furthermore, it is concluded that the buoyancy forces can produce immense change in both the thermal and flow structures.

P-37 17h30 · Group C

Numerical Analysis of the impact of Solid Pollution Concentration on the Dynamic Behavior Fluid-Film Bearings

Boucherit Hamid

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This work presents a theoretical and numerical investigation of the influence of solid particle contamination in lubricating oils on the nonlinear dynamic behavior of a finite-length compliant journal bearing operating under isothermal and laminar flow conditions. Particular attention is devoted to the effect of the volumetric concentration of solid contaminants. The analysis is based on Einstein's mixture theory, which describes a suspension of rigid particles dispersed in a Newtonian fluid. Under the classical assumptions of hydrodynamic lubrication, the modified Reynolds equation governing the pressure distribution in the lubricant film is derived and numerically solved using the finite difference method. The displacement field at the fluid–liner interface induced by hydrodynamic pressure is evaluated through a thin elastic layer model. The numerical results reveal that solid contamination significantly affects the nonlinear dynamic performance of the compliant journal bearing. In particular, the presence of suspended particles alters the pressure distribution, increases the maximum hydrodynamic pressure, reduces the minimum lubricant film thickness, and modifies the trajectory of the journal center. Furthermore, increasing the volumetric concentration of solid particles intensifies these effects, leading to a substantial rise in peak pressure and a noticeable reduction in film thickness. At high contamination levels, the bearing system exhibits pronounced vibratory motions characterized by large-amplitude journal center trajectories, which may adversely affect its dynamic stability and operating performance.

Keywords: Compliant journal bearing, solid contamination, lubricating oil, volumetric concentration, nonlinear dynamics, Reynolds equation, finite difference method, non-Newtonian lubricants

P-38 17h30 · Group C

Design and hydrodynamic Analysis of a Centrifugal Pump for a liquid-propellant Rocket Engine Using CFD

Messaouda Guemmadi

M'hamed Bougara University of Boumerdès, Algeria

The objective of this work is to perform simulations using CFD software. This software allows the designer to gain a better understanding of the flow phenomenon in the centrifugal pump and thus correct the design to achieve improved performance. Often, the numerical results are compared with experimental data (Algerian Space Agency "ASAL") to validate different CFD methods. A new geometric design for centrifugal pumps is proposed, and its performance is evaluated using CFD numerical simulations. The proposed design contributes to the development and improvement of rocket propulsion systems.

P-39 17h30 · Group C

Data-Driven and Analytical Investigation of Free Vibration in Agglomerated FG-CNT Coated Nanoshells

Ahmed Amine

University of Naama, Algeria

This study analyzes the free vibration behavior of tri-coated functionally graded carbon nanotube (FG-CNT) reinforced nanoshells considering carbon nanotubes agglomeration and size-dependent effects. Effective material properties are evaluated using a two-parameter agglomeration model, while small-scale effects are incorporated through nonlocal strain gradient theory. The governing equations are derived via Hamilton's principle and solved using the Galerkin method. A detailed parametric study investigates the influence of gradation indexes, carbon nanotubes volume fraction, agglomeration parameters, and shell geometry on the dimensionless natural frequencies. Results show that increasing carbon nanotubes content enhances stiffness and frequency, whereas agglomeration reduces structural rigidity. In addition, machine learning models (ANN, SVM, Decision Tree, and Ensemble) are developed to predict the vibration response. The Ensemble model provides the highest accuracy. Shapley analysis identifies CNT volume fraction as the most influential parameter. The proposed analytical–ML framework offers an efficient tool for rapid prediction and design of FG carbon nanotubes nanoshells.

P-40 17h30 · Group C

Gear fault detection under steady-state and variable operating conditions using a hybrid SVMD-MODWA denoising approach

Abderrazek Djebala

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This poster concerns gear fault detection under steady-state and variable operating conditions using a hybrid SVMD-MODWA denoising approach. Denoising helps reveal fault signatures in vibration signals measured on machines.

Editors' note based on the title only; not written by the authors, and no results are implied.

P-41 17h30 · Group C

Choice of Seismic Reinforcement Methods

Rafik Madi

University 8 May 1945 Guelma, Algeria

The selection of strengthening methods for reinforced concrete buildings subjected to seismic actions requires a rigorous and comprehensive assessment of structural vulnerability and performance objectives. It is governed by several key factors, including the existing condition of the structure, material degradation, detailing deficiencies, irregularities, and compliance with current seismic design codes. The choice of an appropriate technique must also consider economic feasibility, constructability, architectural constraints, and the need to maintain building functionality during intervention. The primary objective of strengthening is to enhance global and local behavior by improving strength, stiffness, ductility, and energy dissipation capacity. Advanced numerical tools, particularly nonlinear static (pushover) and dynamic analyses, are widely used to evaluate the effectiveness of proposed retrofitting strategies. The objective of this article is to acheive an overview of solutions related to the reinforcement of structures in reinforced concrete buildings against the earthquake to choose the most rational reinforcement method. In the present research, the decision made is the reinforcement of the existing structure by jacketing columns and shear walls, addition of new L-shaped walls, demolition and reconstruction of some beams.

P-42 17h30 · Group C

Artificial Intelligence-Assisted Analysis and Optimization of Brake Disc Performance

Mohamed Haddar

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Brake discs are essential components of modern mechanical and automotive systems, where their thermal and mechanical performance strongly influences braking efficiency, reliability, and safety. Conventional brake disc design relies on analytical methods, numerical simulations, and experimental testing, which can be computationally expensive and time-consuming. Artificial Intelligence (AI) and machine learning offer promising tools for accelerating the analysis and optimization of these systems. This presentation investigates the application of AI techniques to predict and optimize the thermo-mechanical behavior of brake discs. Key parameters, including disc geometry, material properties, braking speed, applied load, friction coefficient, and cooling conditions, can be used as inputs to develop predictive models. Outputs such as temperature, thermal stress, deformation, and wear can then be estimated using machine learning algorithms. The proposed approach has the potential to reduce computational cost and simulation time while supporting the development of brake discs with improved thermal management, mechanical strength, and durability. The presentation will also address important challenges, including data quality, model accuracy, generalization, and validation against numerical or experimental results. This work demonstrates how AI can contribute to a more efficient and intelligent methodology for the design and optimization of mechanical systems.

P-43 17h30 · Group C

Modeling and Optimization of the Parameters Influencing the Stability of Back to Back Reinforced Earth Walls using Response Surface Methodology

Brahim Lafifi

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Back-to-back mechanically stabilized earth (MSE) walls have become an increasingly attractive solution in transportation infrastructure projects, including bridge approaches, highway embankments, and access ramps, owing to their cost-effectiveness, construction flexibility, and favorable mechanical performance. However, the growing scarcity of high-quality granular backfill materials has encouraged the use of hybrid backfill systems that combine selected and marginal soils. Although this approach can significantly reduce construction costs and environmental impacts, the influence of hybrid backfill configurations and reinforcement arrangements on the overall stability of MSE walls remains insufficiently understood. This study investigates the stability behavior and optimization of back-to-back geosynthetic-reinforced MSE walls constructed with hybrid backfill materials through a comprehensive numerical and statistical framework. Finite-element analyses were performed using PLAXIS to simulate the mechanical response of the reinforced wall system under various geometric and reinforcement configurations. To efficiently explore the design space and identify the most influential parameters, a design-of-experiments (DOE) methodology based on Response Surface Methodology (RSM) was employed. A fractional factorial experimental design was adopted to evaluate the effects of four key variables: reinforcement vertical spacing, reinforcement length, hybrid-backfill inclination angle, and hybrid-backfill thickness. The numerical results were analyzed using Analysis of Variance (ANOVA) to determine the statistical significance of the investigated factors and their interactions. Subsequently, predictive mathematical models were developed using RSM to establish quantitative relationships between the design variables and wall stability performance. To determine the optimal design configuration, the predictive response surface models were integrated with a desirability-function-based optimization approach. This procedure enabled the simultaneous consideration of stability and constructability requirements, leading to the identification of optimal combinations of reinforcement and backfill parameters. The proposed methodology provides an efficient and reliable framework for the design and optimization of back-to-back MSE walls incorporating hybrid backfills, offering practical guidance for engineers seeking economical, sustainable, and high-performance retaining structures in transportation infrastructure applications.

P-44 17h30 · Group C

Solar-Driven Dye Degradation by Sr-Modified ZnO Thin Films: Kinetic Modeling and Optimization of Photocatalytic Performance

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The optimization of photocatalytic materials requires a quantitative understanding of the relationship between material composition, optical properties, and pollutant degradation kinetics. In this work, strontium-modified ZnO thin films prepared by the successive ionic layer adsorption and reaction (SILAR) method were investigated for the solar-driven degradation of methylene blue (MB) and Rose Bengal (RB). ZnO films containing different Sr concentrations were characterized to determine the influence of Sr incorporation on crystal structure, surface morphology, and optical response. Sr modification preserved the characteristic ZnO crystalline structure while producing substantial changes in surface characteristics and reducing the optical band gap. Photocatalytic experiments revealed a non-monotonic dependence of degradation performance on Sr concentration, demonstrating that band-gap reduction alone does not determine photocatalytic efficiency. The 40 wt.% Sr composition exhibited the optimum performance, reaching degradation efficiencies of 89.62% for MB and 94.67% for RB under sunlight irradiation. The influence of reaction-medium modification was also evaluated, with MB removal increasing to 97.60% in the presence of NaOH and 91.47% with H2O2, whereas acidic conditions substantially reduced the degradation efficiency. First-order kinetic analysis was used to quantitatively describe the photodegradation behavior. The results highlight the importance of jointly considering composition, optical response, surface properties, and reaction kinetics when optimizing semiconductor thin films for solar-assisted wastewater treatment. The central numerical results in this version come directly from your study: the optimum 40 wt.% Sr film produced 89.62% MB and 94.67% RB degradation, while NaOH and H2O2 increased MB degradation to 97.60% and 91.47%, respectively. Your paper also reports the first-order kinetic treatment and associated rate constants.

P-45 17h30 · Group C

Response Surface Methodology-Based Optimization of Dissimilar Copper/Steel TIG Welding Parameters for Enhanced Mechanical Properties

Mohamed Farid Benlamnouar

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This study proposes an analytical framework for characterizing and optimizing the TIG welding process of dissimilar copper/steel joints using Response Surface Methodology (RSM). The approach aims to evaluate weld performance and identify optimal process conditions through a systematic experimental design. Desirability function analysis was employed to investigate the interactions between key process parameters, including welding current, shielding gas flow rate, and welding speed, and to determine their combined influence on the mechanical response of the welded joints. Tensile testing results were used as the primary performance indicator for mechanical property evaluation. Based on the obtained results, optimal parameter settings were identified, and practical recommendations were formulated to improve weld quality and operational safety while minimizing undesirable effects associated with the degradation of metallurgical integrity and mechanical performance of the joints.

P-46 17h30 · Group C

Valorization of agricultural wastes for eco-friendly formulation of Water-Based drilling Mud (WBM) with low cost by Gum LBG

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Currently in the field of oil well drilling, research tends to use new technologies including alternative components for drilling fluids. Among the compounds that can be used in drilling fluids, carob nuts. The aspect of this project has been inserted into a section for the recovery of agricultural waste in order to minimize the degradation of the natural environment. This part of the work focused on the development of a biopolymer derived from carob nuts because of its techno-functional properties (stabilizer, thickener, binder and gelatinizer). In order to enhance the carob grains, preliminary treatments were carried out: Acid shelling (maceration), washing, soaking, drying and grinding operations. During this work, we wanted to check the conformity and study the performance of locust bean gum, which is a biodegradable biopolymer of plant origin derived from biomass, obtained locally, that we are substituting for other conventional products in the field of water-based Muds drilling fluids. In particular we have studied the effect of carob gum as a filtrate reduction instead of polyanionic cellulose (PAC LV), and as a viscosifying instead of Xanthane gum which are imported biopolymers. These polymers often increase the cost price of a drilling operation. Finally a water-based drilling mud formulated using environmentally friendly and low-cost locust bean gum has been developed by substituting total and partial biopolymer of Xanthan Gum (PAC LV) giving better rheological properties and flow control. Fluid loss requirements necessary for proper oil well drilling operation.

P-47 17h30 · Group C

Modeling and Optimization of Water Absorption in Short-Sisal-Fiber-Reinforced Biocomposites Using ANN, RSM, and Fickian Diffusion Models

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The development of sustainable polymer composites reinforced with renewable resources offers a promising strategy for reducing the environmental impact of conventional materials. In this study, the moisture uptake characteristics of epoxy-based composites containing short Agave sisalana fibers and a constant biochar fraction of 2 wt.% were investigated. Four fiber loadings (10, 15, 20, and 30 wt.%) were considered to determine their influence on water absorption behavior. Predictive modeling and process optimization were performed using response surface methodology (RSM) and artificial neural networks (ANN) coupled with a genetic algorithm. The predictive performance of both approaches was assessed by comparing the calculated responses with the experimental measurements. The ANN model achieved correlation coefficients of 0.9999, 0.9702, and 0.9970 for the training, testing, and validation datasets, respectively, demonstrating its strong ability to reproduce the observed experimental trends. These findings highlight the potential of ANN-based modeling as an effective tool for analyzing water absorption and reducing the number of experiments required during composite development. Overall, the investigated epoxy composites reinforced with sisal fibers offer potential for sustainable material applications and promote the use of renewable reinforcements in polymer engineering.

Keywords: Agave sisalana; biocomposite; water absorption; ANN/RSM; desirability function/genetic algorithm

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