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Special Issue on

Recent Advances in Interdisciplinary Mathematical Modelling, Nonlinear Dynamics, Fractional Systems, and Computational Techniques

Guest Editors

Khursheed Alam

Sweta Srivastav

Sangeeta Gupta

Sunil Kumar Maurya

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Guest Editors

Khursheed Alam
Department of Mathematics & Data Science
The A. H. Siddiqi Centre for Advanced Research
in Applied Mathematics & Physics (CARAMP)
Sharda School of Engineering and Science
Sharda University
Greater Noida 201310
Uttar Pradesh
India
E-mail: khursheed.alam@sharda.ac.in

Sweta Srivastav
Department of Mathematics & Data Science
Sharda School of Engineering and Science
Sharda University
Greater Noida 201310
Uttar Pradesh
India
E-mail: sweta.srivastav@sharda.ac.in

Sangeeta Gupta
Department of Mathematics & Data Science
Sharda School of Engineering and Science
Sharda University
Greater Noida 201310
Uttar Pradesh
India
E-mail: sangeeta.gupta@sharda.ac.in

Sunil Kumar Maurya
College of Arts and Science
University of Nizwa
Birkat Al Mouz, P. O. Box 33
Postal Code 616
Sultanate of Oman
E-mail: sunil@unizwa.edu.om

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FOREWORD

This special issue of *Journal of Interdisciplinary Mathematics,* titled "Recent Advances in Interdisciplinary Mathematical Modelling, Nonlinear Dynamics, Fractional Systems, and Computational Techniques", brings together a collection of contemporary research contributions reflecting the growing role of mathematics in understanding complex systems, developing analytical and computational models, and addressing challenging problems arising across science, engineering, technology, and social sciences. The papers included in this special issue were selected from 280 papers submitted to the International Conference on Applied and Interdisciplinary Mathematical Sciences (ICAIM-2025), which was held from 20–22 November 2025, at Sharda University, Greater Noida, India. A total of 17 papers were finally selected for inclusion in the present collection. The issue highlights the interplay between mathematical theory, modelling, nonlinear analysis, fractional calculus, dynamical systems, control theory, computational methods, and emerging interdisciplinary applications.

A significant group of contributions in this special issue focuses on nonlinear dynamical systems, chaos, synchronization, and control. The selected studies investigate synchronization and anti-synchronization of nonlinear and hyperchaotic systems using active, adaptive, impulsive, and sliding-mode control strategies. Particular attention is given to hyperchaotic financial systems, epidemiological models, and dissimilar nonlinear dynamical systems. These studies demonstrate how mathematical analysis and control techniques can be employed to understand complex dynamical behaviour and to develop robust strategies for synchronization, stability, and secure communication.

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Another important theme is the development and analysis of fractional-order mathematical models. Contributions addressing fractional-order tumour and environmental models, tuberculosis systems, fractional diffusion equations, and fractional-order hyperchaotic financial systems demonstrate the increasing importance of fractional calculus in modelling systems with memory, hereditary characteristics, and nonlocal behaviour. The combination of fractional modelling with adaptive control, disturbance observers, and synchronization techniques provides a powerful framework for investigating complex real-world phenomena.

This special issue also presents advances in mathematical modelling and nonlinear partial differential equations. Contributions on nonlinear parabolic partial differential equations, shallow-water waves, tsunami dynamics, and diffusion-based models illustrate the breadth of mathematical approaches used to describe biological, physical, and environmental processes. Analytical techniques such as Lie group methods, iterative numerical procedures, and diffusion models provide valuable tools for obtaining deeper insights into nonlinear phenomena and for developing effective computational solutions.

An additional dimension of this special issue is provided by research connecting mathematics with artificial intelligence, pattern recognition, image processing, and information security. Theoretical perspectives on interpretable and explainable artificial intelligence demonstrate the role of mathematical foundations in developing trustworthy learning models. Research involving near sets and chaotic behaviour contributes to the mathematical understanding of pattern recognition in complex systems, while studies on diffusion-based image denoising, deblurring, and medical image security demonstrate the practical relevance of mathematical and computational techniques in digital image analysis and secure information processing.

The collection further includes contributions from areas such as differential geometry, special functions, hypergeometric series, and mathematical modelling of social phenomena. Studies on osculating

surfaces of non-null curves in Minkowski 3-space, Bernoulli Apostol polynomials, bilateral basic hypergeometric series, and mathematical modelling of work/life balance illustrate the broad spectrum of contemporary interdisciplinary mathematics represented in this issue. Together, these contributions demonstrate that modern mathematical research extends beyond traditional disciplinary boundaries and provides common analytical and computational frameworks for diverse scientific and societal problems.

The papers included in this special issue represent contributions from researchers affiliated with universities worldwide, reflecting the international and collaborative character of contemporary mathematical research. The diversity of institutional backgrounds and research areas further strengthens the interdisciplinary scope of the issue and provides opportunities for researchers from different mathematical and applied disciplines to engage with one another.

We hope that this special issue will serve as a valuable reference for researchers, academicians, practitioners, and postgraduate students working in interdisciplinary mathematics and related areas. We also hope that the collection will stimulate further research and collaboration in mathematical modelling, nonlinear and fractional dynamical systems, control theory, computational mathematics, and emerging interdisciplinary applications.

We express our sincere gratitude to all authors for their valuable contributions and dedication to advancing knowledge in these rapidly evolving research areas. We are particularly thankful to Professor B. K. Dass, Chief Editor, for his constant support and encouragement during the publication process in the *Journal of Interdisciplinary Mathematics*, published by Taru Publications, New Delhi.

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