SPECIAL ISSUE 2024:
SYNERGIZING AI AND OPERATIONAL RESEARCH FOR NEXT GENERATION ENGINEERING SOLUTIONS

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FOREWORD

The 21st century has ushered in an era of unprecedented technological advancement, positioning engineering at the forefront of innovation. This progress is accompanied by increasingly complex challenges. Modern engineering systems are characterized by intricate interdependencies, vast data streams, and a constant need to adapt to dynamic environments. From optimizing resource allocation in smart grids to designing resilient infrastructure for the changing climate, engineers face multifaceted problems that demand sophisticated solutions. Traditional engineering approaches, while valuable, often struggle to address these challenges in their entirety. The sheer volume of data, coupled with the need for real-time decision-making and the inherent uncertainties of complex systems, necessitates a paradigm shift in how we approach engineering solutions. In this context, the intersection of Artificial Intelligence (AI) and Operational Research (OR) presents unprecedented opportunities for developing innovative engineering solutions. AI, with its capacity for pattern recognition, predictive modeling, and data-driven insights, complements OR's strength in optimization, simulation, and decision analysis. By integrating these powerful approaches, we can develop next-generation engineering solutions that are not only efficient and effective but also robust, adaptable, and capable of navigating the complexities of our interconnected world. This synergy is pivotal in addressing contemporary issues in sustainability, urbanization, autonomous systems, and more.

In this context, there are significant challenges that must be addressed to fully harness the potential of AI and OR in engineering. These include handling the vast amounts of data generated, ensuring the scalability and security of solutions, and integrating these technologies seamlessly into existing systems. Introducing AI and OR tools for engineering solutions offers a powerful approach to address these challenges. These tools encompass a range of techniques including modeling, simulation, optimization, and data-driven insights. AI algorithms can analyze large datasets to identify patterns and make predictions, while OR methodologies can optimize resource allocation and decision-making processes. Emphasizing the role of AI and OR, this special issue aims to bridge the gap by gathering and disseminating cutting-edge research in the domain. It will provide a platform for researchers and practitioners to share insights, innovations, and best practices, contributing to the advancement of engineering sciences in building a smarter, more sustainable world.

The fusion of AI and OR is not merely a technological advancement – it is a crucial step towards building a smarter, more sustainable, and resilient world. By enabling engineers to design and manage systems with greater efficiency, adaptability, and foresight, the following global challenges can be properly addressed:

- Resource Optimization: In an era of increasing resource scarcity, AI-powered OR can optimize resource allocation in areas like energy, water, and materials, minimizing waste and environmental impact.
- Sustainable Infrastructure: Designing and maintaining resilient infrastructure requires anticipation of future needs and adaption to changing conditions. AI and OR provide the tools to model complex systems, predict failures, and optimize maintenance schedules for long-term sustainability.
- Enhanced Decision-Making: From disaster response to supply chain management, AI-driven OR can empower decision-makers with real-time insights, predictive analytics, and optimized solutions, leading to more informed and effective actions.

By synergizing the strengths of AI and OR, we can develop more intelligent, robust, and efficient solutions for a wide range of engineering applications.

This special issue seeks to showcase cutting-edge research, innovative applications, and emerging trends in the synergistic use of AI and OR for next-generation engineering solutions, by setting three major objectives:

- Advance the State-of-the-Art: To foster the development and dissemination of novel algorithms, methodologies, and frameworks that effectively integrate AI and OR for enhanced engineering design, analysis, and decision-making.
- Bridge the Gap between Theory and Practice: To encourage contributions that demonstrate the practical implementation and impact of AI-driven OR in real-world engineering projects and case studies.
- Inspire Future Research: To identify promising research directions and stimulate further exploration of the synergistic potential of AI and OR in addressing emerging engineering challenges.

The topics covered in special issue include: intelligent decision support systems, multi-criteria decision-making applications, machine learning and data-driven modeling in engineering, performance evaluation and optimization, uncertainty management, fuzzy set and its extensions in complex engineering systems, sustainable engineering solutions using AI and OR. We hope these enticing topics will draw great attention from researchers across the world and will serve as an impetus for further work in the field.