DE GRUYTER

SPECIAL ISSUE ON UNLEASHING THE POWER OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN DYNAMICAL SYSTEM RESEARCH

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DESCRIPTION

Dynamical systems research has long been a fundamental branch of science that studies the behaviour of complex systems evolving over time. From weather patterns and ecological ecosystems to economic models and physiological processes, understanding the dynamics of these intricate systems is crucial for predicting outcomes, optimizing processes, and making informed decisions. However, traditional methods of analysis often fall short when dealing with highly nonlinear, high-dimensional, and chaotic behaviours. In recent years, the integration of artificial intelligence (AI) and machine learning (ML) techniques has opened new frontiers in this field, empowering researchers to tackle intricate problems and gain deeper insights into complex systems.

In the traditional approach to dynamical systems research, scientists often relied on mathematical equations to represent the behaviour of a system. However, in many real-world scenarios, obtaining these equations can be impractical or even impossible due to the complexity and lack of complete information about the underlying processes. AI and ML offer an alternative path through data-driven discovery. By feeding historical data into ML models, researchers can extract underlying patterns and relationships that might not be apparent through conventional methods. This data-centric approach has opened up new avenues of inquiry and allowed scientists to gain deeper insights into the behaviour of complex systems, transcending the limitations of traditional analytical techniques. Dynamical systems research often deals with nonlinear phenomena that exhibit intricate behaviours and chaotic patterns. Identifying and understanding these nonlinear dynamics is essential for predicting system behaviour accurately. Machine learning has emerged as a potential tool for unveiling underlying nonlinear patterns in complex datasets. By employing ML techniques such as clustering and deep learning, researchers can uncover hidden patterns and relationships within the data, leading to more accurate models and insights into the system's behaviour. This is particularly beneficial in areas such as biology, where the interactions between genes, proteins, and cellular processes are highly nonlinear and difficult to comprehend without advanced computational tools.

The marriage of artificial intelligence and machine learning with dynamical systems research has ushered in a new era of scientific exploration and understanding. From modelling and prediction to control and optimization, these powerful technologies have extended the boundaries of what is possible in studying complex systems. Through data-driven discovery, researchers can now uncover nonlinear dynamics and gain deeper insights into previously inscrutable phenomena. As AI and ML continue to advance, we can expect even more exciting breakthroughs in dynamical systems research, pushing the boundaries of human knowledge and propelling us into a future of innovation and discovery.

Topics of interest include but are not limited to:

- Control of dynamical systems using reinforcement learning
- Time series prediction with recurrent neural networks
- Modelling chaotic dynamical systems with neural networks
- Generative models for dynamical systems
- Hybrid AI systems for hybrid dynamical systems
- Transfer learning for dynamical systems
- Safety and robustness in dynamical system learning
- Nonlinear system identification using deep learning
- Optimization in dynamical systems using ML
- Image and video processing
- AI accelerators

HOW TO SUBMIT

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All manuscripts will undergo the standard peer-review process (single blind, at least two independent reviewers). When entering your submission via online submission system please choose the option:

"SI Unleashing the Power of AI and ML in Dynamical System Research"

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The deadline for submissions is **April 27th, 2024,** but individual papers will be reviewed and published online on an ongoing basis.