ADVANCES IN DATA-DRIVEN APPROACHES FOR MULTISCALE AGENT-BASED SYSTEMS

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ABSTRACT

Multiscale agent-based systems, characterized by the interplay of microscopic agent behaviours and emergent macroscopic phenomena, are fundamental in modelling complex systems across disciplines such as biology, physics, and social sciences [1]. However, capturing the dynamics of such systems poses significant computational and analytical challenges due to their inherently multiscale nature. Traditional numerical methods often struggle to bridge the scales efficiently, motivating the development of data-driven approaches that leverage advances in machine learning, statistical inference, and high-performance computing [2].

This mini-symposium focuses on recent advances in data-driven numerical methods tailored to multiscale agent systems. It aims to bring together researchers working at the interface of computational science, engineering, physics, and applied mathematics to discuss innovative strategies for modelling, simulation, and analysis. Topics of interest include, but are not limited to, machine learning frameworks for surrogate modelling (e.g. neural networks, kernel methods), hybrid methods combining data-driven and physics-based approaches, and innovative techniques for uncertainty quantification and optimal control problems. Additionally, the mini-symposium will explore the challenges of ensuring physical interpretability, robustness, and generalizability in data-driven methods, especially in scenarios with limited or noisy data. Real-world case studies, including applications in epidemiology, biology, plasma physics, and traffic systems, will illustrate the potential of these methods.

REFERENCES

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