ADVANCES IN NONLOCAL PROBLEMS WITH APPLICATIONS

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ABSTRACT

Nonlocal models are a strategic element for understanding and addressing complex real-world challenges in physical phenomena characterised by long-range interactions, memory effects, anomalous diffusion, and fracture mechanics. Notable fields of application include geophysics, aeronautics, and materials science. Capturing the dynamics of such systems poses significant computational and analytical challenges due to their nonlocality, nonlinearity, and their inherently multiscale nature. In recent years, several advancements in the mathematical modeling of phenomena with nonlocal effects, in their analytical understanding, and in their numerical approximation have been made. This mini-symposium aims to bring together experts and emerging researchers with backgrounds in mathematics, physics, and engineering, to share innovations, discuss challenges, and explore the potential of mathematical methods in addressing critical questions related to nonlocal models, from both a theoretical and computational point of view. The mini-symposium will feature contributions that span a diverse range of methodologies and approaches, including, but not limited to, material failure and damage, variational methods, robust numerical methods for complex structural analysis, peridynamics and nonlocal approaches for fracture, finite element methods and virtual element methods for crack simulations, multiscale modeling techniques, 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.