

NONLOCAL CONTINUUM MODELS: THEORY, COMPUTATION AND APPLICATIONS

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ABSTRACT

Nonlocal models offer a robust framework for understanding and addressing complex real-world challenges where classical theories prove inadequate, particularly in the study of materials and structures characterized by discontinuities, singularities, and long-range interactions. Peridynamics, a reformulation of continuum mechanics based on integral equations, offers a mathematically sound framework that avoids spatial derivatives and naturally enables the modeling of crack initiation, propagation, and other discontinuous phenomena.

Capturing the dynamics of such systems poses significant computational and analytical challenges due to their nonlocality and inherently multiscale nature, for which high-order methods could be beneficial. In addition to exhibiting discontinuous solutions, these problems are characterized by non-sparse stiffness matrices and singular convolution kernels. These intrinsic features lead to a significant increase in computational complexity and motivate the development of efficient and innovative solution strategies.

This mini-symposium aims to address recent advances in both the theoretical and computational aspects of nonlocal methods and high-order approximations with a focus on applications to multiscale problems involving fracture and material discontinuities.

The mini-symposium will bring together contributions spanning a broad range of methodologies and approaches, including, but not limited to, material failure, variational methods, robust and high-order numerical methods for complex structural analysis, finite and virtual element methods for crack simulation, multiscale modeling techniques, hybrid data-driven and physics-based approaches, reduced-order

modeling and innovative techniques for uncertainty quantification and optimal control.

SPEAKERS

1. Florin Bobaru (University of Nebraska-Lincoln): “Peridynamic Investigation of Cascading Crack Branching in Dynamic Brittle Fracture”.
2. Massimo Frittelli (Università del Salento): “Battery modelling through morphochemical reaction-diffusion systems and phase-field models”.
3. Erdogan Madenci (University of Arizona): “Reduced-Order Modeling via Peridynamics with Two-Level Grid Discretization”.
4. Paweł Przybyłowicz (AGH University of Science and Technology): “On approximation of SDEs with jumps and discontinuous drift coefficients”
5. Giuseppe Vacca (Università degli Studi di Bari Aldo Moro): “Virtual Element Method for Nonlocal Diffusion Problems: Stability Analysis”.
6. Yue Wu (University of Strathclyde): “Randomised Euler-Maruyama method for SDEs with Hölder continuous drift coefficient”.