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EDITORIAL

Editorial: Computational modeling based on nonlocal theory

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Nonlocal theories concern the interaction of objects, which are separated in space. Classical examples are Coulomb's law or Newton's law of universal gravitation. They had signficiant impact in physics and engineering. One classical application in mechanics is the failure of quasi-brittle materials. While local models lead to an ill-posed boundary value problem and associated mesh dependent results, nonlocal models guarantee the well-posedness and are furthermore relatively easy to implement into commercial computational software.

Nonlocality requires the introduction of an internal length scale parameter, which can be determined either experimentally or through fine-scale simulations such as MD or DFT simulations. When the length scale reduces to zero, the nonlocality theory recovers the local theory. In the case of material failure, the length scale parameter is related to the width of a crack and ideally a discrete crack is captured once it tends to zero.

The focus of this SI is on nonlocal models with applications to solid mechanics. The contributions in this SI include many modern analytical and numerical methods for challenging engineering problems such as peridynamics and numerous application to complex fracture e.g. for coupled thermo-mechanical applications, granite stone and concrete due to high dynamic loading conditions, the nonlocal operator method, that is based on the dual-horizon peridynamics, meshfree methods and isogeometric analysis for microplates, functionally graded materials, solidification and multi-component alloys and a Flexibility-Based Stress-Driven Nonlocal Frame Element. The SI contains also contributions for solving fractal-fractional differential equations based on artificial neural network as well as new nonlocal models, phase field models and approaches for homogenization approaches.

Many authors also applied various nonlocal models to predict material properties of solids such as the Fracture Toughness of Metallic Materials, the flexural and compressive strength for polymeric materials and stones or the size-dependent bending and buckling response of laminated microplate. Many papers focus on the vibration response of plates and beams at the nanoscale or microscale also addressing aspects of multiscale modeling and connecting different length scales. Other applications range from complex Magneto-thermoelastic behaviour of viscoelastic solids, over smart laminates and auxetic materials to dental composites and applications in bioengineering.

Finally, we believe that the SI gives a comprehensive overview of state-of-the-art nonlocal models and associated numerical methods for challenging engineering applications. The organizers of this SI would like to thank all the authors contributing to this SI and the editorial board for this opportunity.

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