Title

Peridynamic theory and multiscale methods for complex material behavior

Abstract

Simulation of complex material behavior presents huge challenges in computational science and engineering nowadays. Overcoming those challenges requires the development of novel mathematical models and computational methods. Examples of such challenges in classical solid mechanics include the characterization of the microstructure dependence of the material response, as well as the simulation of material failure and damage; similarly, the description of coupling multi-scale behaviors represents a challenge in classical theories. Peridynamics, as a new nonlocal theory, offers an alternative approach that avoids difficulties arising in classical local theories in the description of complex material behavior. Additionally, peridynamics as a nonlocal continuum model can be applied to coarse-grained molecular dynamics, potentially for bridging the atomistic scale to the continuum scale. Computational implementations of a peridynamic model, however, often cause huge computational cost and incompatibility with classical tractions-like boundary conditions. Multiscale coupling strategies that bridge local and nonlocal models seem to provide a solution to both the computational expense and the boundary treatment. Multiscale coupling methods, in general, refer to the class of mathematical and computational techniques for the problems that exhibit characteristic features at multiple scales. Several of these methods have been proposed in past years for the effective prediction of the material response in, e.g., composites and heterogeneous media. This mini-symposium invites contributions on recent developments on the peridynamic theory and multiscale coupling modeling for the simulation of complex material behavior.

Topics of interest

- Peridynamics
- Atomistic-to-continuum coupled models and algorithms
- Multiscale coupling methods for the simulation of complex material behavior
- Numerical analysis of peridynamic models and multiscale coupling methods
- Discretization schemes and software implementation of peridynamic models and multiscale coupling methods
- Interface representation methods of composite materials
- Material failure and damage
- Coupled multi-physics problems
- Fiber-reinforced composites, concretes, and other heterogeneous systems
- Practical engineering applications