Title:

Meshfree, Peridynamics, and Particle Methods: Contemporary Methods and Applications

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Abstract:

Meshfree and particle methods have emerged as a new class of numerical methods for solving challenging mechanics problems which are difficult to solve with traditional finite element methods. These methods utilize a point-based approximation and discretization constructed directly in the physical domain without fixed mesh connectivity. This in turn releases the strong tie between the quality of the discretization and the accuracy of the numerical solution. In addition, the approximations employed in meshfree and particle methods allow controllable orders of continuity and completeness, independent from one another. These unique properties offer versatility in constructing approximation functions, so that rough or smooth characteristics in physical problems can be captured. Similarly, peridynamics methods have been proposed to model systems with or without discontinuities, and they share many features with meshfree and particle methods. All these methods provide new paradigms for solving PDEs without being restricted to Galerkin-type procedures.

Topics of interest for this minisymposium include, but are not limited to the following:

- Fundamental developments
- Handling stationary and transient strong and weak discontinuities
- Formulations for extreme material distortion, fragmentation, contact and impact, and material instability
- Numerical integration
- Strong form collocation meshfree methods
- Rank stability, kernel stability, and other stability issues
- Simulation of classes of problems for which meshfree, peridynamics, and particle methods are superior to conventional mesh-based methods
- Parallel-computing, scalable algorithms, and large-scale simulations
- Multiple and coupled physics
- Multiple time and/or length scales
- Multi-phase (solid, fluid and gas) interactions
- Structural responses to extreme loading conditions such as blast, impact, and penetration
- Simulation of natural disasters like tsunamis, earthquakes, and landslides
- Simulation of manufacturing processes
- Simulation of bio and nano mechanics and material system responses