Configurational Peridynamics

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Deformational and configurational mechanics provides information about the motion of a continuum body. Deformational mechanics is concerned with the response of a mechanical system to externally applied loading. These ‘standard’ forces are associated with the motion of material points in space. Configurational mechanics on the other hand studies forces responsible for the evolution of material structure, i.e., configurational forces are associated with displacements of particles with respect to the surrounding material. As a result configurational forces provides insight into the role of defects and singularities such as dislocations, inhomogeneities, inclusions, interfaces and cracks on material behavior, see e.g. [1, 2].

Peridynamics (PD) is a non-local continuum mechanics theory established by Stewart Silling [3]. PD was originally developed to overcome challenges encountered in the classical continuum mechanics formulation when discontinuities such as cracks are present. It has been extensively used to model damage and fracture. This is done using an additional constitutive equation that prescribes the interaction forces between neighbouring material points based on the distance between them. This allows the interaction forces to fade and vanishes as the distance between the points increase.

Configurational PD has the potential to offer an energy driven model for damage and fracture that is non-local and fully non-linear. Configurational PD offers a framework wherein the key characteristics of initiation and propagation of fracture can be captured; i.e., changes in the topology associated with the geometry of the body accompanying crack initiation and dissipation inside the body associated with propagation of the crack.

This contribution will present the theoretical framework for configurational peridynamics along with computational examples. These examples illustrate the potential of the formulation and highlight key differences from local configurational mechanics.

References

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