Computational studies of nonlocal and local models related to Peridynamics in a generalized finite element setting

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ABSTRACT

Peridynamics is a popular nonlocal formulation of elasticity. It allows for the natural inclusion of material failure in the material model. However, the relationship to local formulations of elasticity are not fully understood. Analytical convergence results are known mostly for simplified, related nonlocal models.

Generalized finite element methods obtain their approximation power from the use of problem dependent enrichment functions. This allows for the straightforward inclusion of knowledge obtained via a nonlocal model in a local model. Also, it allows us to numerically check the consistency and convergence of local and nonlocal models related to Peridynamics. We check, whether convergence in the nonlocal limit is indicative of the possibility of using
solutions of nonlocal models as enrichments in the local model. In particular, we study, if the local models can be effectively used to coarsen the nonlocal models in a computational setting.

We provide results from numerical experiments. We use solutions from collocation discretizations of nonlocal models as enrichments in generalized finite element solutions to local models. Thus, we examine the compatibility of chosen and nonlocal models. We include influence from factors such as support of the local model and discretization parameters. Also, we present numerical evidence of convergence of Peridynamics in the nonlocal limit.

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