

Multiscale Analysis of Heterogeneous Media in the Peridynamic Formulation

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A methodology is presented for investigating the dynamics of heterogeneous media using the nonlocal continuum model given by the peridynamic formulation. The approach presented here provides the ability to model the macroscopic dynamics while at the same time resolving the dynamics at the length scales of the microstructure. Central to the methodology is a novel two-scale evolution equation. The rescaled solution of this equation is shown to provide a strong approximation to the actual deformation inside the peridynamic material. The two scale evolution can be split into a microscopic component tracking the dynamics at the length scale of the heterogeneities and a macroscopic component tracking the volume averaged (homogenized) dynamics. The interplay between the microscopic and macroscopic dynamics is given by a coupled system of evolution equations. The equations show that the forces generated by the homogenized deformation inside the medium are related to the homogenized deformation through a history dependent constitutive relation.