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**Bacim Alali, Robert Lipton** and **Tadele Mengesha\*** (mengesha@math.psu.edu), Penn State University, PA. *Multiscale analysis of the peridynamic equation of motion.*

We study the homogenization of the nonlocal equation of motion that models the dynamics of heterogeneous media based on 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. Moreover, 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. (Received September 21, 2011)