Mathematical analysis for the peridynamic continuum theory

Mathematical and numerical analysis of peridynamics for multiscale materials modeling

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Abstract

My presentation reviews the peridynamic continuum theory and ensuing mathematical analysis. The peridynamic balance laws allow the consideration of discontinuous motion, or deformation, by relying on integral operators. These operators sum forces and power expenditures separated by a finite distance and so represent nonlocal interaction. The integral operators replace the differential divergence operators conventionally used so obviating special treatment at points of discontinuity. I also review the state of the mathematical theory by demonstrating the well-posedness of the

- peridynamic equilibrium equation for linear materials;
- steady-state nonlocal diffusion equation;
- nonlocal, nonlinear advection equation.

The analysis is facilitated by a nonlocal vector calculus including identities and integral transforms forming a basis for variational formulation. The calculus also leads to a finite element formulation and a-posteriori error analysis.

This is joint work with Qiang Du (PSU) and Max Gunzburger (FSU).