Temple University Mathematics Colloquium

Michael Parks

Sandia National Labs

will speak on

Computational Peridynamics

ABSTRACT: We provide an overview and introduction to peridynamics, a nonlocal extension of classical solid mechanics suitable for modeling the failure and fracture of engineering materials.

The classical theory of continuum mechanics is based on partial differential equations. These equations do not hold on crack surfaces and other singularities, as partial derivatives are not defined at discontinuities. In the classical theory, cracks are regarded as a pathological solution requiring special treatment. In contrast, the peridynamic theory is based on integral equations, for which discontinuous functions present no difficulty. By utilizing integral equations, the peridynamic theory avoids the need for the special techniques of fracture mechanics. In peridynamics, cracks are just another kind of solution and require no special treatment.

We survey peridynamics, highlighting several applications, before discussing the codes and numerical techniques used in the computational models. We then discuss a new nonlocal variational formulation of peridynamics, followed by a newly developed nonlocal domain decomposition method, utilizing nonlocal transmission conditions. A nonlocal Schur complement is introduced. With a view towards scalable solvers for nonlocal models, we establish condition number bounds for the nonlocal stiffness and Schur complement matrices. Supporting numerical experiments demonstrating the conditioning of the nonlocal one- and two-domain problems are presented.

Monday, 26 March 2012
Lecture at 4:00 pm
Coffee, tea, and refreshments from 3:30-5:00 pm
Room 617, Wachman Building
Department of Mathematics