Summary: The peridynamic model is a framework for continuum mechanics based on the idea that pairs of particles exert forces on each other across a finite distance. The equation of motion in the peridynamic model is an integro-differential equation. In this paper, a notion of a peridynamic stress tensor derived from nonlocal interactions is defined. At any point in the body, this stress tensor is obtained from the forces within peridynamic bonds that geometrically go through the point. The peridynamic equation of motion can be expressed in terms of this stress tensor, and the result is formally identical to the Cauchy equation of motion in the classical model, even though the classical model is a local theory. We also establish that this stress tensor field is unique in a certain function space compatible with finite element approximations.

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