Foster, J. T.; **Silling, S. A.**; **Chen, W. W.**
Viscoplasticity using peridynamics. (English) Zbl 1183.74035
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Summary: Peridynamics is a continuum reformulation of the standard theory of solid mechanics. Unlike the partial differential equations of the standard theory, the basic equations of peridynamics are applicable even when cracks and other singularities appear in the deformation field. The assumptions in the original peridynamic theory resulted in severe restrictions on the types of material response that could be modeled, including a limitation on the Poisson ratio. Recent theoretical developments have shown promise for overcoming these limitations, but have not previously incorporated rate dependence and have not been demonstrated in realistic applications. In this paper, a new method for implementing a rate-dependent plastic material within a peridynamic numerical model is proposed and demonstrated. The resulting material model implementation is fitted to rate-dependent test data on 6061-T6 aluminum alloy. It is shown that with this material model, the peridynamic method accurately reproduces the experimental results for Taylor impact tests over a wide range of impact velocities. The resulting model retains the advantages of the peridynamic formulation regarding discontinuities while allowing greater generality in material response than was previously possible.

MSC:

74C10 Small-strain, rate-dependent theories of plasticity (including theories of viscoplasticity)
74S05 Finite element methods applied to problems in solid mechanics

Keywords:

peridynamics; peridynamic states; plasticity; non-local theory; integral equations; continuum mechanics; Taylor impact

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