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Extension of Ordinary State-Based Peridynamic Model for Nonlinear Analysis

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ABSTRACT

Peridynamic is a nonlocal theory that uses integral forms of governing equations, making it suitable for describing objects with discontinuous states such as cracks. After more than two decades of development, peridynamic has been effectively applied to numerous solid mechanics studies. However, in the field of ordinary state-based peridynamic modeling nonlinear deformation, a more comprehensive model that can establish a general connection with continuum mechanics and allow for the selection of different influence functions is still lacking. As a consequence, a further extension to existing models is promising, and it represents a substantial addition to the current peridynamic model. In this study, an extended model of ordinary state-based peridynamic for nonlinear analysis is constructed, along with the basic definition of nonlinear peridynamic volumetric strain, and strain energy function. Based on the principle of virtual displacement, the complete derivations of the peridynamic parameters are presented for two-dimensional and three-dimensional conditions. After that, the specific numerical scheme and algorithm implementation are summarized. Its capability and accuracy are shown by contrasting the proposed nonlinear model's predictions of film tensile fracture with experimental observations. Finally, several other numerical examples are provided to demonstrate further the applicability of the proposed model and its implementation.

KEYWORDS

Nonlinear analysis; peridynamic; finite deformation; fracture simulation

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