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Noether’s theorem in peridynamics. (English)


Summary: By introducing a new nonlocal argument, the Lagrangian formulation of peridynamics is investigated. The peridynamic Euler-Lagrange equation is derived from Hamilton’s principle, and Noether’s theorem is extended into peridynamics. With the help of the peridynamic Noether’s theorem, the conservation laws relevant to energy, linear momentum, angular momentum and the Eshelby integral are determined. The results show that the peridynamic conservation laws exist only in a spatial integral form rather than in a pointwise form due to nonlocality. In bond-based peridynamics, energy conservation requires that the influence function is independent of the relative displacement field, or energy dissipation will occur. In state-based peridynamics, the angular momentum conservation causes a constraint on the constitutive relation between the force vector-state and the deformation vector-state. The Eshelby integral of peridynamics is given, which can be used to judge nucleation of defects and to calculate the energy release rates caused by damage, fracture and phase transition.

MSC:
74-XX Mechanics of deformable solids

Keywords:
Noether’s theorem; conservation law; peridynamics; Euler-Lagrange equation

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References:


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