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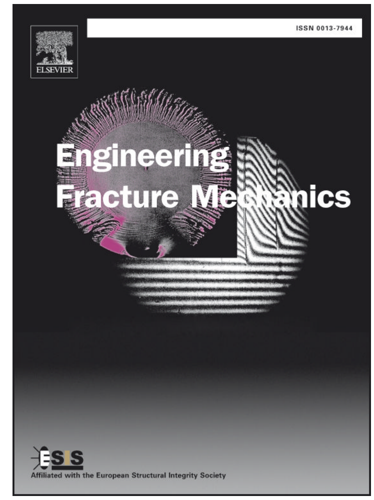

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Revisit of non-ordinary state-based peridynamics

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The force density vector in the Non-Ordinary State-Based (NOSB) PeriDynamics (PD) replaces the internal force vector derived from the divergence of the stress tensor in the classical (local) stress equilibrium equations. It involves only the non-local form of the first order derivatives of stress and displacement components. Inherent in the NOSB PD formulation is the presence of oscillations especially in the regions of steep displacement gradients. This study introduces an alternative form of the force density vector by considering the internal force vector derived directly from the displacement equilibrium equations. It involves only the non-local form of the second-order derivatives of the displacement components. The numerical results from this form of the force density vector do not present any oscillations. Therefore, it is referred to as the Refined NOSB (RNOSB) – PD. The simulations concern the comparisons of NOSB and RNOSB PD predictions for an isotropic plate with or without a notch or a crack under quasi-static and dynamic tensile loading. The RNOSB PD proves to be effective and accurate for cracking and fracture analysis without any numerical instability.

Keywords: peridynamics, non-ordinary state-based, correspondence, differential operator

1. Introduction

The PeriDynamic (PD) theory introduced by Silling [1] and Silling et al. [2] is a nonlocal reformulation of the classical continuum mechanics. It incorporates the interactions of material points within a finite region. The extent of this region (interaction domain) is defined by an internal length parameter referred to as the "horizon" of a material point. This parameter serves as a bridge between different length scales. The PD theory has been demonstrated to be convergent to the classical local elasticity model as the length scale (horizon size) approaches zero [3, 4]. PD also replaces the spatial derivatives appearing in the classical form of the equilibrium equations with an integral whose integration domain is defined by the