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Formulation and computation of geometrically nonlinear gradient damage. (English)

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Summary: We extend a small strain and small deformation formulation of gradient enhanced damage to the geometrically non-linear case. To this end, non-local stored energy densities (NSE) are introduced as primary variables. Fluxes conjugated to the gradients of NSE are then computed from balance laws which in the small strain limit correspond to the averaging equation well-known in the literature. The principal task is then to establish constitutive laws for these newly introduced NSE-fluxes. Thereby, four different options are investigated which are motivated from Lagrange and Euler averaging procedures together with changes of metric tensors. Issues of the corresponding finite element formulation and its linearization within Newton-Raphson procedure are addressed in detail. Finally, the four different formulations are compared for a bar in tension, whereby large strains are truly envisioned.

MSC:

74A45 Theories of fracture and damage
74S05 Finite element methods applied to problems in solid mechanics
74K10 Rods (beams, columns, shafts, arches, rings, etc.)

Keywords:

gradient enhanced damage; non-local stored energy densities; balance laws; constitutive laws; averaging procedures; finite element formulation; linearization; Newton-Raphson procedure; bar in tension; large strains

Full Text: DOI

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