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A microstructurally-based internal length for strain localization problems in dynamics

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Abstract

Classical finite element method including strain-softening materials suffers from a mesh-dependency solution. The thickness of the bands in which strains are localized is arbitrarily narrow and may lead to a rupture without energy consumption. This is the case in quasi-static as well as in dynamics problems. The present paper uses a two-scale dynamic damage law that is based on an intrinsic length at micro-scale, corresponding to the inter-distance between two adjacent micro-cracks, that regularizes the strain localization problem in dynamics. The material response is time-dependent due to the inertial effect of the micro-crack propagation. This produces a natural, microstructurally-based, delayed response of the material that, in turn, removes the mesh-sensitivity in dynamics. As a consequence, the size of the strain localization band is controlled by the internal length of the material.

Keywords: Damage, Softening, Strain localization, Regularization, Internal length