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A GRADIENT-EXTENDED ANISOTROPIC DAMAGE-PLASTICITY MODEL IN THE LOGARITHMIC STRAIN SPACE

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Material degradation is a complex area of material modeling and for most applications requires the consideration of anisotropic damage, for both brittle and ductile materials. In addition, large strains can occur locally in the damage zone, which means that material models valid for finite strains are required. In this context, the Continuum Damage Mechanics (CDM) approach has become popular in recent decades. Unfortunately, these (local) models based on CDM suffer from pathological mesh dependence. Therefore, several strategies have been developed to overcome this drawback, one of them being the micromorphic approach [1]. This approach was used in various damage material models, for example, for an isotropic damage-plasticity model at finite strains in [2] with quite considerable success. Therefore, the micromorphic approach is also used here and the three distinct invariants of the second order damage tensor are gradient-enhanced.
The local part of the model is formulated in terms of logarithmic strains, following the concept of an additive split as discussed, for example, in [3]. Within this strain space, a 'two-surface' approach is used to treat damage and plasticity as distinct dissipative mechanisms. For numerical implementation, the transformation from Lagrangian to logarithmic strain space and vice versa is required, which usually involves spectral decomposition of the right Cauchy-Green tensor. To reduce the numerical effort resulting from such a computation, the closed-form representation of [4] with algorithmic differentiation is used.

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