Multi-field modelling and simulation of large deformation ductile fracture

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ABSTRACT

In the present contribution we focus on a novel computational framework for the simulation of ductile fracture in elastoplastic solids. In particular, a fully non-linear formulation of gradient plasticity is applied together with a higher order phase-field approach to fracture to account for large elastic and/or plastic deformations along with three dimensional crack propagation.

The proposed formulation is based on a multiplicative decomposition of the deformation gradient into elastic and plastic contributions and a subsequent multiplicative decomposition of the elastic part into a fracture sensitive and a fracture insensitive contribution, see Hesch and Weinberg [1] for further details. To obtain a physically realistic modelling of fracture, the latter decomposition includes an anisotropic split of the principle stretches such that fracture occurs only in tension. The resulting system consists of the displacement field, the gradient hardening field and the phase-field and can be solved within a monolithic or a staggered solution scheme, see Dittmann et al. [2].

Eventually, a number of numerical examples and applications will demonstrate the capabilities of the proposed multi-field approach to ductile fracture. For example, the application to contact and impact problems is of high interest and will also be considered in this contribution, see Dittmann [3] and Hesch et al. [4] for the simulation of multi-field contact problems.

REFERENCES

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