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# A Phase-field Model for Ductile Fracture in Frictional Materials

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The phase-field approach is a convenient way to describe crack initiation and propagation by means of a regularization of sharp crack discontinuities [1, 2].

In this work we propose an extension of this approach to ductile failure in frictional materials. Thereby a plasticity model based on a *non-associative* Drucker-Prager-type formulation [3] is used. A *regularization* of the non-smooth yield function and the incorporation of *friction* and *cohesion hardening* are on focus. The fracture phase field is coupled with a failure criterion based on the elastic-plastic work density [4].

A general return-mapping scheme of the non-associative elastoplasticity is developed for the algorithmic treatment of the proposed model. The algorithm is formulated in the spectral space of logarithmic principal strains and dual stresses.

By means of representative examples describing soil crack formation we show the capabilities and the algorithmic performance of the presented framework.

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