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# PHASE-FIELD MODELING OF LARGE STRAIN DUCTILE FRACTURE: AN AT1 EFFECTIVE STRESS APPROACH

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We propose a novel formulation for the phase-field modeling of ductile fracture at large strains. While the phase-field regularization of the Griffith approach to brittle fracture can be rigorously cast into a variational framework, its extension to ductile fracture is still the object of active investigation. Here, the main challenge is how to combine the plastic dissipation mechanism, producing irreversible large deformations, with the fracture dissipation mechanism, in such a way that the latter is driven by the former.
The proposed model involves an effective stress approach, whereby the activation criterion for the plastic dissipation mechanism is controlled by the true stress acting on the undamaged portion of the material volume. The same idea was proposed in [1], while other works [2, 3] are based on a nominal stress approach where the damaged stress is used instead. The effective stress approach naturally yields to a fracture driving force containing the elastic and the hardening stored energies which, however, does not properly account for the competition between the plastic and fracture mechanisms. To circumvent the problem, we introduce a modulation function $f(\alpha)$, where $\alpha$ is the equivalent plastic strain, which multiplies the local part of the phase-field dissipation energy, postponing the onset of brittle fracture until the plastic process zone has reached a critical size. The idea is somehow in the line of the approach proposed in [3]. Finally, an AT1 phase-field dissipation is used to ensure the presence of an intial purely elastic regime.
The derivation of $f(\alpha)$ is based on the 1D homogeneous case and only two additional parameters are introduced. The model capabilities are assessed based on uniaxial and more complex 3D numerical simulations.

## REFERENCES

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