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A viscous regularized damage growth model for ductile fracture

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We present a viscous regularized damage enhanced modeling framework for ductile fracture modeling describing the material response including damage induced degradation. In this context, we consider the modeling of impact problems, like ballistic penetration and machining process simulations. From the outset, a fundamental formulation is adopted based on the first and second laws to properly describe different components of the energy dissipation induced by the effective material response, thermal effects and damage evolution. To allow for ductile failure representation, the energy dissipation rate is formulated so that the damage driving force is shifted from elastic to in-elastically damage driving. A main prototype for the effective material is the Johnson Cook model, accounting for deformation and strain rate hardening and temperature degrading effects. Continuum damage evolution, focusing on the degradation of the shear response leading to shear failure, is specified separately from the effective material response via a viscous damage regularization introducing a finite velocity for the damage field progression and a length-scale parameter influencing the width of the fracture zone. Thereby, the model facilitates an enhanced control of the damage evolution and fracture energy dissipation, which makes total model convergent and stable in the FE-application. The modeling framework is verified for FE plane strain/stress tests, showing the convergence properties of the model. The effect of the viscous damage regularization is that it removes pathological mesh dependence, without any assumption of smeared damage representation in the FE- discretization, cf. e.g. Larsson et al. [1]. The results of the model compare favorably when validated against an impact split-Hopkinson bar test presented elsewhere in literature.

REFERENCES

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