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NUMERICAL ASSESSMENT OF THICK LEVEL SET MODELS FOR QUASI-BRITTLE MATERIALS

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Simulations of local damage models are known to be pathologically dependent on the mesh for a softening material behaviour (i.e. when the stress decreases for an increasing strain). Mesh independent solutions can be recovered using a non-local regularisation of the model (e.g. of the integral [1] or of the gradient-enhanced [2] type). With this kind of regularised models a parameter l_c representing a characteristic length of the material is added to the other parameters of the model. This parameter enforces the width of the damaged band cutting through the material and is connected to the energy that is globally dissipated by the fracturing process.

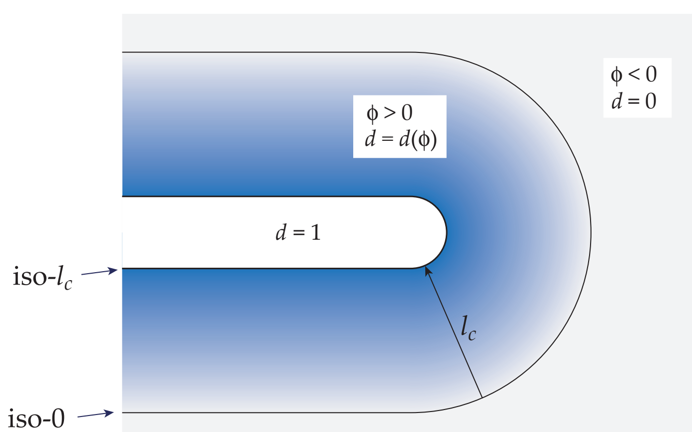

Figure 1: Computation of the damage variable d based on a distance function ϕ

Although non-local models solve the pathological mesh dependency problem, unphysical behaviours may still be observed in numerical results. In [3], the authors observe that the maximum value of the equivalent strain is obtained in advanced of the crack front, and that boundary conditions may deviate the damage from its expected path during the formation of a shear band. In addition, one often observes a disproportionate enlarging of the damaged zone in the end of the damaging process for both non-local and gradient-enhanced damage models.

Thick Level Set models (TLS, [4, 5]) were proposed recently as an alternative approach to obtain a regularisation of an existing damage model. With these models, the localized damaged zone is contained between the iso-0 and the iso-l_c of a distance function ϕ, the damage variable d being computed as a function of ϕ in the damaged band (see Fig. 1). The present work deals with the numerical assessment of the ability of these models to produce mesh-independent results and to solve the common problems of non-local regularization methods. Mesh independency is investigated based on meshes presenting favourite orientations. A particular attention is paid to the accuracy of the solution near the boundary of the domain and to the damage initiation phase.

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