A gradient-enhanced damage model based on smoothed displacements with vanishing length scale

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ABSTRACT

Non-local damage models of integral or differential type with a constant length parameter are known to have shortcomings such as spurious damage growth [1] or incorrect damage initiation and propagation [2].

We present here transient length extension of the gradient-enhanced damage model based on smoothed displacements proposed in [3]. The key ingredient of the proposed extension is a damage-dependent length scale that tends to zero as the damage parameter tends to one. Various expressions for this vanishing length scale are proposed and discussed.

Examples of the new model's regularization capabilities are compared to the original model with constant length scale. Contrary to similar extensions in classical gradient-enhanced damage models (i.e. based on smoothed equivalent strain), the performance of the model is flawless. We will show that the adoption of a transient length scale activity enables an efficient and robust implementation that solves the issues of the standard model: spurious damage growth is removed and realistic damage initiation and propagation are guaranteed. As shown in figue 1, these features enable the representation of failure patterns typically obtained with phase field models (i.e., thin crack-like damage bands).
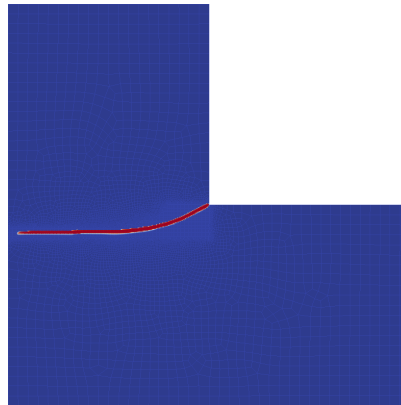
Figure 1: A vanishing length scale produces a narrow damage band

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