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Coupling local and non-local damage evolutions with the Thick Level Set Model

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It is well known that damage evolution models requires a length to avoid spurious localization. We gather these type of models under the name “non-local damage models”. In fact, non-locality is strictly needed only when the stress-strain curve starts to have a negative slope. Before this point, local models may be used. For instance, when damage exhibits some hardening, the stress-strain curve may be growing for quite some time before a peak point is reached.

Most if not all current non-local models are not able to distinguish between local and non-local zones, thus enforcing non-locality at every point and every instant. This leads to important computing times.

The Thick Level Set (TLS) model is a new non-local damage model [1,2,3] that allows to combine nicely zones in the domain where local model is used and zones where non-local model is used. This allows to reduce dramatically the computing time. Moreover, the TLS model is able to locate automatically zones fully damaged across displacement are allowed to be discontinuous.

The theoretical basis of the TLS model will be described. In short, it is a model in which the damage gradient is bounded (and not the Laplacian as in other modelling). The equation at stake is of Eikonal type (this explains the words level set is the name of the model). A 1D axisymmetric case will be fully developed both analytically and numerically to show the concurrent development of local and non-local damage zones.

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