Only thickness is essential in the Thick Level Set approach

Nunziante Valoroso[♯,*], **Claude Stolz**[♯,♭]

[♯] Institut des Sciences de la Mécanique et Applications Industrielles
Université Paris Saclay, Palaiseau, France

[*] Dipartimento di Ingegneria
Università di Napoli Parthenope, Napoli, Italy
e-mail: nunziante.valoroso@uniparthenope.it

[♭] Institut de recherche en Génie civil et Mécanique (GeM)
Ecole Centrale de Nantes, Nantes, France
e-mail: claude.stolz@ec-nantes.fr

ABSTRACT

Regularized damage formulations have become increasingly popular in the last decades for dealing with problems in Mechanics suffering from spurious mesh sensitivity induced by strain softening [1]. In short, the idea underlying almost all such models is that of using some extended constitutive equations in which a length scale parameter brings to the macro level information about material microstructure.

Classical regularized constitutive relationships are formulated via gradient or averaging operators. They provide globally smoothed solutions by enforcing a greater regularity either on strains or internal variables that are no longer defined at the quadrature point level but are established at a larger scale, i.e. the scale of the structural model.

The same concepts are present into the so-called Thick Level Set (TLS) approach to quasi-brittle fracture [2], whereby progressive damage that takes place in a region of finite thickness is defined as an explicit function of the distance to the undamaged portion of the domain under consideration. Within this framework one possible way to follow the evolution of damage in the structure amounts to continuously tracking the position of the moving layer where the transition between the damaged material and the undamaged one occurs. In the original implementation of the model [2] this was achieved based on distance functions and level sets, which basically amounts to solve the eikonal equation.

In the present contribution the eikonal-based approach to the TLS modeling is abandoned in favor of an implicit representation of the damage field and tools of convex analysis [3]. This allows to drop out the level sets from the formulation and to achieve a greater flexibility in the implementation of the model that is recast in the format of a *non-local Generalized Standard Model* in which the damage field is subject to convex constraints.

Numerical results for representative test cases will be presented to demonstrate the capabilities of the proposed approach.

REFERENCES

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