Damage-Based Fracture in Brittle Materials with Shape Optimization Methods

N. Van Goethem*

SISSA, Via Bonomea 265, 34136 Trieste, Italia, vangoeth@sissa.it

Damage and fracture are almost always intimately linked together. For instance, in [2] a damage model is shown to provide crack-like results in some limit case while in [3] a purely fracture-dedicated model is implemented numerically with help of an auxiliary variable which has the effect of smearing the crack.

The model discussed in this talk is based relies on Griffith's concept of crack propagation, i.e., a balance between energy released by the crack and energetical cost to propagate the crack. A damage-based approach to fracture by means of shape optimization tools will be discussed and in particular we will

- show that 2D and 3D numerical solutions of the damage problem converge to crack-like solutions (in modes I, II and III).
- emphasize the role of optimization tools such as shape derivatives for damage and crack problems [2]; the notion of topological derivative to describe nucleation of cracks will also be introduced [1].
- describe the theoretical framework to justify mathematically the above numerically-observed convergence.
- discuss a new algorithm based on the sole notion of topological derivative and a level-set method to compute the evolution of damage and cracks.
- by means of topological derivative, discuss a nonlinear damage problem, where traction and compression cracks obey to different propagation laws.

References

