Static fracture in non-local simulation using adaptive DGFEM

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ABSTRACT

Non local models are interesting for objective simulation of failure. Promising results have been obtained for brittle material [1], in impact analysis [2] and for damage in composite material [3]. However, these non-local approaches are computationally intensive, because they result in complex matrix assembly and non-sparse stiffness matrices.

A possible way to limit the cost of such models is to limit their usage to parts of the structure where a non-local model is necessary, and to adapt the discretization according to the phenomenology.

We propose here a new computational method for the simulation of non-local static fracture. An non-local continuum is used in the vicinity of the crack initiation while the rest of the structure is solved as a classical local continuum. These two models are coupled through the Morphing method [4]. Discontinuous Galerkin Finite Element Method (DGFEM) is used in the fracture zone to allow crack growth, while classical Finite Element Method (FEM) is used in the reminder of the structure. An adaptive implicit algorithm is used to follow crack growth during the static fracture analysis to limit computational cost. Simulations are performed in three dimensions with a parallelized code. Special attention is given to the conformity of the method and to the numerical convergence of the algorithm.

References

[1] B. Killic, E. Madenci, Prediction of crack paths in a quenched glass plate by using peridynamic theory, *International Journal of Fracture*, Volume 156, 165-177 (2009)

[2] P.N. Demmie, S.A. Silling, An approach to modeling extreme loading of structures using peridynamics, *Journal of Mechanics of Materials and Structures*, Volume 2, Issue 10, 1921-1945 (2007)

[3] E. Askari, J. Xu, S.A. Silling, Peridynamic analysis of damage and failure in composites, *44th AIAA Aerospace Sciences Meeting and Exhibit*, Reno, Nevada (2006)

[4] G. Lubineau, Y. Azdoud, F. Han, C. Rey, A. Askari, A morphing strategy to couple non-local to local continuum mechanics, *Journal of the Mechanics and Physics of Solids*, Volume 60, Issue 6, 1088-1102 (2012)