Extended finite element methods for thin cracked plates (XFEM)

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The numerical simulation of crack propagation is an important issue for many industries (aeronautics, spatial, nuclear...). Moreover, it is a difficult problem to deal with. In the classical finite element methods (FEM), it is necessary to refine the meshe near the crack tip. It needs also to remesh after a crack propagation. Both these needs are numerically cumbersome and decrease the accuracy of the results.
In the eXtended Finite Element Method (XFEM) [1], the finite element base is enriched by the crack tip asymtotic displacements, and also by an Heaviside jump function that represents the discontinuity of the displacement caused by the crack.
Despite the fact that XFEM seems to be well-adapted to plates and shells, very few articles have been devoted to this subject. We will mainly quote [2].
The Mindlin-Reissner and Kirchhoff-Love plate theories have been considered. We will present the difficulties that arise using the first theory. Then, with the second one, we will detail two approaches, that lead to numerical methods that are accurate, for a reasonable computational cost. Some numerical experiments, carried out with the finite element toolbox Getfem++ [3], will confirm these good features.

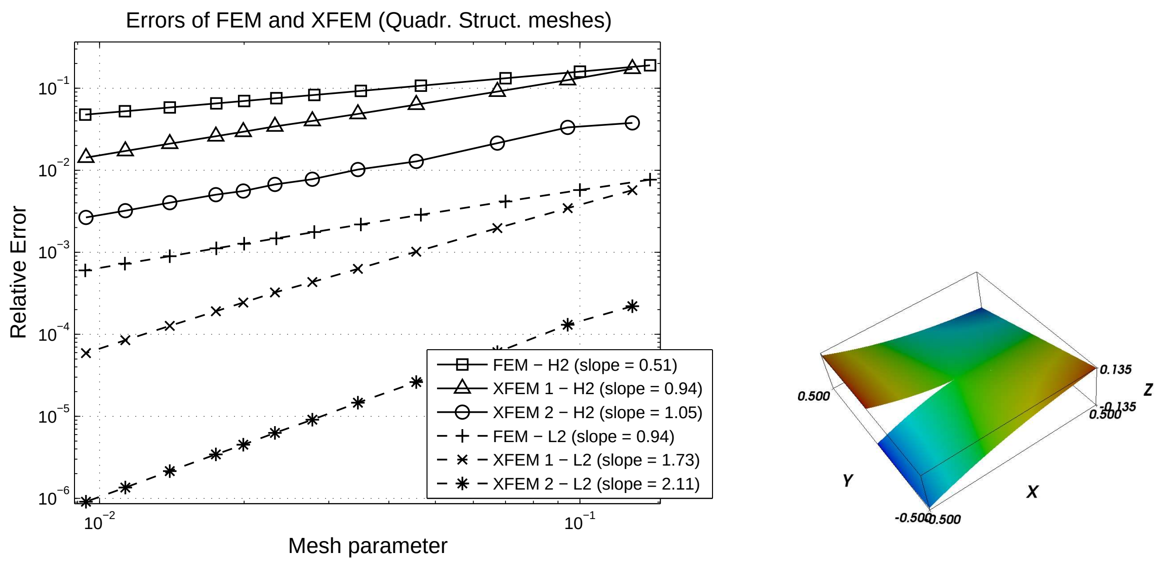

Figure 1: Left: convergence curves of MEF and XFEM. Right: exact solution.

Références

[1] N. Moës, J. Dolbow, T. Belytschko. *A finite element method for crack growth without remeshing.* Int. J. Numer. Meth. Engng, vol. 46, pp 131-150, 1999.

[2] J. Dolbow, N. Moës, T. Belytschko *Modeling fracture in Mindlin-Reissner plates with the extended finite element method.* Int. J. Solids Struct., vol. 37, pp 7161-7183, 2000.

[3] J. Pommier, Y. Renard *Getfem++, an open source generic C++ library for finite element methods.* http://www-gmm.insa-toulouse.fr/getfem.