Preconditioning of XFEM quadratic elements

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ABSTRACT

The extended finite element method developed by Moes et al. [1] allows the modeling of crack discontinuities while avoiding the task of re-meshing. In fracture mechanics, there are commonly 2 types of enrichment functions : the “Heaviside” function for the modeling of the discontinuity and asymptotic “crack-tip” functions for the modeling of the singularity and discontinuity at the vicinity of the crack tip.

In EDF software Code_Aster, Heaviside and crack-tip enrichments are implemented with linear and quadratics elements. In the latest case, conditioning issues [2] cannot be treated with the convenient fit-to-vertex strategy [3]. There are plenty of strategies to improve the condition number of XFEM [2] [4]. In fact, the real concern is the computational cost of any new implementation taking into account that an additional preconditioner comes with a counter-part on performances. Then the question is: which preconditioner shall be affordable for industrial applications?

We will present cheap preconditioning strategies, in order to compute accurate solution at a minimum cost. On one hand, we introduce a “local preconditioning” working as an improvement of the formulation of local enrichment functions and on the other hand, a “global preconditioning” which comes as an improvement of the solver in order to compute approximate Moore-Penrose inverse [5].

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