11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20–25, 2014, Barcelona, Spain

HIGH-ORDER X-FEM TO HANDLE GEOMETRICAL DETAILS : IMPROVED CONVERGENCE FOR QUASI-SINGULAR SOLUTIONS

Grégory Legrain[1] **and Nicolas Moës**[2]

[1] LUNAM Université, Ecole Centrale Nantes, GeM Institute, UMR CNRS 6183 - 1, rue de la Noë F-44321 Nantes - gregory.legrain@ec-nantes.fr

[2] LUNAM Université, Ecole Centrale Nantes, GeM Institute, UMR CNRS 6183 - 1, rue de la Noë F-44321 Nantes - nicolas.moes@ec-nantes.fr

Key words: *High-Order, X-FEM, Singularities, Enrichment, h-p adaptivity*

This contribution deals with the treatment of quasi-singular solutions with non-conforming high-order finite elements, such as higher-order X-FEM [3] or the Finite-Cell method [2]. It is well known that stress fields near reentrant corners exhibit a singular behaviour. This singularity bounds the convergence rate of finite element methods below the regular one. On the opposite, the field becomes regular if a fillet is introduced at the corner. This is of great importance in practice, as these geometrical features are common in industrial structures. In this case, a regular rate of convergence is expected (exponential for high-order methods).

The objective of this contribution is to study the influence of these geometrical details in the convergence of non-conforming methods when the radius of the fillet is small with respect to the size of the structure. From a derivation of the asymptotic mechanical fields near a reentrant fillet, its influence on the convergence of the approach is monitored. It is shown that depending on the curvature radius, two different strategies could be considered (i) enriching the approximation by means of the PUM [1], or (ii) increasing the polynomial order of the approximation. The criteria for choosing one of these two strategies among the other are highlighted through a parametric study. Finally the approach is applied on a model example.

REFERENCES

[1] I. Babuška and J. Y. Melenk. The partition of unity finite element method. *International Journal for Numerical Methods in Engineering*, 40(4):727–758, 1997.

[2] A Duster, J Parvizian, Z Yang, and E Rank. The finite cell method for three-dimensional problems of solid mechanics. *Computer Methods in Applied Mechanics*

and Engineering, 197(45-48):3768–3782, 2008.

[3] N. Moës, J. Dolbow, and T. Belytschko. A finite element method for crack growth without remeshing. *International Journal for Numerical Methods in Engineering*, 46:131–150, 1999.