6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11 – 15 June 2018, Glasgow, UK

DISCONTINUITIES IN ISOGEOMETRIC ANALYSIS: INTERFACE ELEMENTS AND ENRICHED APPROACHES

Farshid Fathi[1]* and Rene de Borst[1]

[1] Department of Civil and Structural Engineering, University of Sheffield, Sheffield S1 3JD, UK,
{ffathi1, r.deborst}@sheffield.ac.uk

Key Words: *Isogeometric Analysis, Extended Finite Element Method, Interface elements, Fracture.*

The C^0-based formulation of standard finite elements results in a jump in the derivatives, and subsequently in a poor estimate of the stresses across the element boundaries. The higher-order continuity provided in Isogeometric Analysis, which exploits B-splines and NURBS as basis functions, allows to remove this jump in the derivatives, and thus to produce of continuity also for the stress field [1]. The benefit of having a continuous, and therefore much more accurate stress field becomes important especially around crack tips, and Isogeometric Analysis can result in a superior stress calculation locally. This can yield an improved prediction of the onset of further crack propagation as well as of the direction of crack propagation. A drawback of Isogeometric Analysis is that it seems more limited to flexibly adapt the discretisation to the path of a freely propagating crack.

For cracks where the crack path is known a priori, interface elements have long been the method of choice. This is also the case for Isogeometric Analysis, and interface elements have also been developed within this framework [2, 3]. As an alternative to full remeshing and adaptivity, XFEM has been developed, and extended to Isogeometric Analysis, named XIGA [4, 5].

Herein, we set out to simulate crack propagation using Isogeometric Analysis via the two aforementioned approaches: isogeometric interface elements and XIGA. Regarding the latter, a succinct summary of the XFEM formulation is presented as an ouverture to XIGA, followed by a discussion of some numerical aspects of XIGA. The paper is concluded with examples of comparisons between both approaches.

REFERENCES

[1] J.A. Cottrell, T.J.R. Hughes, Y. Bazilevs, *Isogeometric analysis: toward integration of CAD and FEA*, 1st Edition, Elsevier, 2009.

[2] F. Irzal, J. J. C. Remmers, C. V. Verhoosel, R. de Borst, An isogeometric analysis Bézier interface element for mechanical and poromechanical fracture problems. *Int. J. Numer. Meth. Engng*., Vol. **97**, pp. 608–628, 2014.

[3] J. Vignollet, S. May, R. de Borst, On the numerical integration of isogeometric interface elements. *Int. J. Numer. Meth. Engng.*, Vol. **102**, pp. 1733 – 1749, 2015.

[4] E. De Luycker, D.J. Benson, T. Belytschko, Y. Bazilevs, M.C. Hsu, X-FEM in isogeometric analysis for linear fracture mechanics. *Int. J. Num. Meth. Eng.*Vol. **87**, pp. 541 – 565, 2011.

[5] V. P. Nguyen, C. Anitescu, S. P. A. Bordas, T. Rabczuk, Isogeometric analysis: An overview and computer implementation aspects. *Math. Comput. Sim.*, Vol. **117**, pp. 89–116, 2015.