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ISOGEOMETRIC CONFIGURATIOANL FORCE FOR BRITTLE FRACTURE

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Fracture is one of the main failure mechanisms of engineering materials and structural components. The finite element modelling of fracture propagation in man-made and biological materials can be categorised into two main approaches, namely the discrete crack models and the smeared crack models. Configurational forces are normally used within the first approach. Miehe *et al.* [1] developed a variational formulation of quasi-static brittle fracture in elastic at small strains. In their work the evolving discontinuity due to crack propagation was discretised by the doubling of critical nodes and segments accompanied by a r-adaptive segment reorientation procedure [2] with configurational force-based directional indicator. The goal of this work is to recast the aforementioned framework into an isogeometric framework to obtain high fidelity results as the linear triangle elements used in [1] are not able to capture the $r^{-1/2}$ singularity of stresses at the crack tip. To this end, an isogeometric triangular Bernstein-Bézier discretisation is utilised. Recently, a method for blending isogeometric analysis with traditional meshing techniques to create geometrically exact two dimensional meshes has been proposed by Engvall and Evans [3]. The approach departs from traditional isogeometric analysis in that their basis is not smooth across element boundaries. We use this limitation as an advantage to ease the imposition of boundary conditions and for the r-adaptivity procedure.

REFERENCES

[1] C. Miehe, Christian, E. Grses, and M. Birkle. A computational framework of configurational-force-driven brittle fracture based on incremental energy minimization. *International Journal of Fracture*Vol, **145**, pp. 245-259, 2007.

[2] A. Pandolfi, and M. Ortiz. An efficient adaptive procedure for three-dimensional fragmentation simulations. *Engineering with Computers*Vol, **18**, pp.148-159, 2002.

[3] L. Engvall, Luke, and J.A. Evans. Isogeometric triangular BernsteinBézier discretisations: Automatic mesh generation and geometrically exact finite element analy-

sis. *Computer Methods in Applied Mechanics and Engineering*,Vol **304**, pp. 378-407, 2016.