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

A Virtual Element Method For Phase Field Modeling of Brittle Fracture

Blaž Hudobivnik[1], Fadi Aldakheel[2] and Peter Wriggers[3]

[1] Leibniz Universität Hannover, 30167 Hannover, hudobivnik@ikm.uni-hannover.de
[2] Leibniz Universität Hannover, 30167 Hannover, aldakheel@ikm.uni-hannover.de
[3] Leibniz Universität Hannover, 30167 Hannover, wriggers@ikm.uni-hannover.de
https://www.ikm.uni-hannover.de

Key Words: *Virtual Element Method, Phase-Field Modeling, Brittle Fracture.*

An efficient low order **virtual element formulations** that account for isotropic brittle failure response in two-dimensional case is outlined within this work. The modeling of crack formation can be achieved in a convenient way by continuum **phase-field** approaches to fracture, which are based on the regularization of sharp crack discontinuities as rooted in [1,2]. This avoids the use of complex discretization methods for crack discontinuities, and can account for complex crack patterns.

In the presented contribution, the *recently developed* virtual element method (VEM**)** will be used, because of the flexible choice of nodes number in an element which can be changed easily during the simulation process, as addressed in [3,4]. To this end, the potential energy is formulated in terms of *suitable polynomial functions*, instead of computing the unknown shape functions for complicated element geometries, e.g. arbitrary convex or concave polygonal elements.

The modeling capabilities and algorithmic performance of the proposed formulation is demonstrated by a number of numerical examples.

REFERENCES

[1] C. Miehe, M. Hofacker, L. Schänzel and F. Aldakheel, Phase field modeling of fracture in multi-physics problems. Part II. brittle-to-ductile failure mode transition and crack propagation in thermo-elastic-plastic solids. Comput. Methods Appl. Mech. Engrg., Vol. **294**, pp. 486–522, 2015.

[2] C. Miehe, F. Aldakheel and S. Teichtmeister, Phase-field modeling of ductile fracture at finite strains: A robust variational-based numerical implementation of a gradient-extended theory by micromorphic regularization. Int. J. Numer. Meth. Engng, Vol. **11**, pp. 816–863, 2017.

[3] P. Wriggers, W. Rust and B. D. Reddy, A virtual element method for contact. Comput Mech, Vol. **58**, pp. 1039–1050, 2016.

[4] P. Wriggers, B. D. Reddy, W. Rust and B. Hudobivnik, Efficient virtual element formulations for compressible and incompressible finite deformations. Comput Mech, Vol. **60**, pp. 253–268, 2017.