Isogeometric Analysis of Fracture in Fluid-Saturated Porous Media

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ABSTRACT

Since the pioneering work of Terzaghi and Biot the flow of fluids in deforming porous media has been given considerable attention. Nevertheless, flow in fractured or fracturing porous media has received less attention, although the physics of the flow within such discontinuities can be very different from that of the interstitial fluid in the surrounding deforming bulk.

Herein we develop a general model for flow in progressively fracturing porous media, including non-Newtonian flows and multiphase flows. Since the cross-sectional dimension of the fracture is small compared to its length, the flow in the crack can be averaged over the width. A two-scale model results, including momentum and mass couplings between the subgrid scale and the macroscopic scale.

The two-scale model imposes requirements on the interpolation of the displacement and pressure fields. Because of the flexibility in increasing and lowering the order of continuity, isogeometric analysis is a versatile discretisation method for handling this kind of problems. Exploiting the above multiscale approach, we develop an isogeometric formulation for porous media, such that it is possible to have fluid transport in the cracks[1]. Crack initation and propagation can be modelled in two ways: either via lowering the order of the interpolation, or by using isogeometric interface elements[2].

REFERENCES

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[2] J. Vignollet, S. May, and R. de Borst, "On the numerical integration of isogeometric interface elements", *Int. J. Numer. Meth. Eng.*, **102**, 1733 – 1749 (2015).