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# Simulation of quasi-static hydraulic fracture propagation in porous media with XFEM

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Hydraulic fracturing is the injection of a fracking fluid at high pressures into the underground. Its goal is to create and expand fracture networks to increase the rock permeability. It is a technique used, for example, for oil and gas recovery and for geothermal energy extraction, since higher rock permeability improves production.

Many physical processes take place when it comes to fracking; rock deformation, fluid flow within the fractures, as well as into and through the porous rock. All these processes are strongly coupled, what makes its numerical simulation rather challenging.

We present a 2D numerical model that simulates the hydraulic propagation of an embedded fracture quasi-statically in a poroelastic, fully saturated material. Fluid flow within the porous rock is described by Darcy's law and the flow within the fracture is approximated by a parallel plate model. Additionally, the effect of leak-off is taken into consideration. The solid component of the porous medium is assumed to be linear elastic and the propagation criteria are given by the energy release rate and the stress intensity factors [1].

The used numerical method for the spatial discretization is the eXtended Finite Element Method (XFEM) [2]. It is based on the standard Finite Element Method, but introduces additional degrees of freedom and enrichment functions to describe discontinuities locally in a system. Through them the geometry of the discontinuity (e.g. a fracture) becomes independent of the mesh allowing it to move freely through the domain without a mesh-adapting step.

With this numerical model we are able to simulate hydraulic fracture propagation with different initial fracture geometries and material parameters. Results from these simulations will also be presented.

References

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