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Modeling hydraulic fracturing in pre-fractured porous media by using the extended finite element method

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ABSTRACT

In this paper, a coupled hydro-mechanical formulation is developed for studying deformable porous media subjected to crack interfaces in the framework of the extended finite element method. Governing equations for the porous medium consist of momentum balance equation of the bulk together with combined equations of momentum balance and continuity of the fluid phase, known as (,) u p formulation. Multiple discontinuities of crack type are assumed in two phase medium, where highly pressurized fluid is injected into one interface while the other interfaces are prone contact phenomenon. The crack inflow is assumed to be viscous and is modeled by employing Darcys law in which permeability of the interface is calculated by an aperture dependent relation known as the cubic law. Contact condition is handled by taking advantages from a penalty method embedded in Newton Raphson algorithm. The effect of contact on fluid phase is also considered in the modeling as no leak-off flow from/into the media.Both cases of opening or closing of the interface cause high nonlinearity in the problem and require iterative solution procedures.

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