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Hydromechanical modeling of hydraulic fracturing in poroelastic media using the extended finite element method

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ABSTRACT

The process of hydraulic fracturing involves pumping a viscous fluid down a well into the underground formation at a high enough injection rate to fracture the formation and drive the fracture hydraulically. Interest in hydraulic fracturing is mainly because of its practical applications in a broad range of engineering areas. Hydraulic fracturing is the most commonly used stimulation technique of potential reservoirs. Although the main industrial use of hydraulic fracturing is to enhance the extraction of natural resources from hydrocarbon-bearing reservoirs, this technique is also applied for waste disposal, geothermal energy production, and so on. Obviously, investing in improving our scientific understanding of hydraulic fracturing not only enables greater access to formerly inaccessible resources, but also helps ensure that natural resources extraction does not come at the expense of public health and environment. Aiming at this goal, the objective of this research is to devise a reliable and robust simulation tool for hydro-mechanical modeling of hydraulic fracturing. For this purpose, a fully coupled numerical model is developed using the extended finite element method in conjunction with a cohesive crack model, which provides an effective means to describe the coupled hydro-mechanical processes occurring during the hydraulic fracture propagation and the nonlinear fracture processes developing along the fracture process zone.