Application of SPH to Coupled Fluid-Solid Problems in the Oil Industry

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ABSTRACT

This talk addresses the application of SPH to problems of hydro-fracturing and fluid-structure interaction. Simulating a hydraulic-fracture propagating in a rock with in-situ joint sets is particularly challenging. Traditional continuum modeling techniques have the advantage of using classical non-linear material models, however they often fail to accurately capture the complexity of the geometry and path of multiple intersecting fractures. In particular, mesh dependence of the fracture path, closing of an opened fracture and shear, present difficulties using these techniques. The use of the smoothed particle hydrodynamics (SPH) method for these problems is relatively recent. Mesh free methods, such as SPH, have the potential to overcome the previously mentioned difficulties of mesh based methods. Simulation of the initiation and propagation of pressure-driven fractures in brittle rocks is presented in this study. By exploiting techniques commonly used in traditional continuum methods, we have developed an elasto-plastic SPH model, which is based on the Drucker-Prager yield criterion, and the Grady-Kipp damage model. The model is validated against Brazil test data. Results are also presented the Brazil test, uni-axial compressive fracture as well as initial results for intersection of dynamic fractures with intersecting joints.

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