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A Smoothed Particle Hydrodynamics approach for poroelasticity

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Within the framework of the SHynergie project we look to investigate hydraulic fracturing and crack evolving in poroelastic media. We model biphasic media assuming incompressible solid grain and incompressible pore liquid. Modeling evolving fractures and fracture networks in elastic and poroelastic media by mesh-based numerical approaches, like X-FEM, is especially in 3-dim a challenging task. Therefore, we propose a meshless particle method for fractured media based on the Smoothed Particle Hydrodynamics (SPH) approach.

SPH is a meshless Lagrangian method highly suitable for the simulation of large deformations including free surfaces and/or interfaces. Within the SPH method, the computational domain is discretized with particles, avoiding the computational expenses of meshing. Our SPH solution is implemented in a parallel computational framework, which allows to simulate large domains more representative of the scale of our study cases.

Our implementation is carefully validated against classical mesh-based approaches and compared with classical solutions for consolidation problems. Furthermore, we discuss fracture initiation and propagation in poroelastic rocks at the reservoir scale.