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Hydraulic fracturing – an attempt of DEM simulation

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Hydraulic fracturing is a technique widely used in oil, gas
and unconventional reservoirs exploitation in order to enable the oil/gas to flow more easily and enhance the production. It relays on pumping into a rock a special fluid under a high pressure which creates a set of microcracks which enhance porosity of the reservoir rock. In this research, attempt of simulation of such hydrofracturing process using the Discrete Element Method approach is presented.
The basic assumption of this approach is that the rock can be represented as an assembly of discrete particles cemented into a rigid sample (Potyondy 2004). An existence of voids among particles simulates then a pore system which can be filled out by fracturing fluid, numerically represented by much smaller particles.
Following this microscopic point of view and its numerical representation by DEM method we present primary results of numerical analysis of hydrofracturing phenomena, using the ESyS-Particle Software. In particular, we consider what is happening in distinct vicinity of the border between rock sample and fracking particles, how cracks are creating and evolving by breaking bonds between particles, how acoustic/seismic energy is releasing and so on.

D.O. Potyondy, P.A. Cundall. A bonded-particle model for rock. International Journal of Rock Mechanics and Mining Sciences, 41 (2004), pp. 1329–1364.