University cluster 1:5 FP Fracture initiaton

Publieke samenvatting / Public summary

Summary

Hydraulic fracturing or fracking involves articially connecting subsurface reservoirs that are too tight to allow fluid transport. Injecting fluids at high pressures creates artificial pathways (fractures) that allow trapped gas and oil reserves to flow to the production well. This artificial connectivity is also important in Enhanced Geothermal Systems, where hot water is used for green electricity generation. In both cases, fracking needs to be well designed to optimise production rates and minimise environmental impact. This research project developed a new model to simulate hydraulic fracturing in porous materials. The model set out in this paper model circumvents some of the most prominent drawbacks of previous models and it has been extended to simulate multiple, interacting cracks. Finally, the code has been parallelised to run large simulations.

Background

In unconventional tough gas reservoirs, fractures, natural or hydraulically induced, are almost always a prerequisite for economic hydrocarbon productivity. Tough gas production in Europe is more expensive than in North America due to geology, population density, licences and safety protocols. For fracking-based shale production to be economically viable in Europe requires new knowledge, innovation and production protocols, including better characterisation of shale lithology and fracture geometries.

Projectinformatie / Project information

Projectnummer / Project number
TKITOET2015-08-UG
Subsidiebedrag / Grant amount
€ 85.600,00

Algemene informatie / General information

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Project objective

This dissertation project paves the way towards more sustainable energy production by improving subsurface fracture control. It uses numerical XFEM techniques to study the formation of fractures in tough gas reservoir rocks. Numerical techniques should lead to a better understanding of fracking in heterogeneous tough gas reservoir rocks, improve predictability for fracking applications and develop innovative strategies for fracking.

Project results

An Enhanced Local Pressure (ELP) model: Using advanced numerical techniques, the project developed a Partition of Unity (PU) based cohesive zone model for hydraulic fracturing.

Fracture interactions: Fracture interaction is an important phenomenon to consider in the simulation of hydraulic fracturing, and the numerical model developed here uses the concept of two-fracture merging in X-FEM to correctly calculate the impact when two fractures interact.

Parallel computing: Hydraulic fracturing simulations that span a large length scale create large meshes with many degrees of freedom. Computational limits make solution times slow. Parallel computing, however, can accelerate calculation speed and this model applied the domain decomposition method to achieve a 100-fold increase in speed using just a moderate number of cores.

De data in deze applicatie is afkomstig van de Rijksdienst voor Ondernemend Nederland (RVO) en wordt in samenwerking met de Topsector Energie ontsloten.
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