
Contribution ID: **788**  Type: **Poster**

# FraC: a DFN conforming meshing approach used to obtain reference simulations for steady-state flow, transport and well-test simulations

*Thursday, 17 May 2018 12:15 (1h 30m)*

Although modeling transfers through naturally fractured media has been the subject of extensive investigation since the 1960's (Bear et al. 1993, Berkowitz 2002, Adler et al. 2012), it remains a challenging field of research. Applications range between management of polluted groundwater, nuclear waste storage (Fourno et al. 2004), CO2 sequestration (Verscheure et al., 2012), oil field production or geothermal energy, this challenge have to be addressed. Numerous approaches have been proposed and may be divided into two sets: i) the continuous approaches (Fourno et al., 2013) where fractures are taken into account via equivalent properties and ii) the discrete approaches where each fracture with explicit geometry is modeled within a complex discrete fracture network (DFN) (Khvoenkova and Delorme, 2011; Noetinger and Jarrige, 2011). This work focuses only on discrete models.

The main difficulty of discrete methods is to build high-quality meshes for complex DFN geometries. The cornerstone of our Fracture Cut approach (FraC) is to decompose each fracture into a number of connected closed contours in which fractures intersections are located on their boundaries. The contour boundaries shared between intersecting fractures are then discretized in a conform manner. The resulting conforming meshes closely respect the DFN geometry; even tiny fractures are taken into account to conserve the DFN connectivity. Furthermore, flexible strategies for moving or adding intersecting points are applied to ensure a good quality of the final mesh. The shortcoming of this approach is that it increases the number of fracture intersection tests and consequently the execution time. Advanced techniques like local mesh refinement or parallel computing are applied to improve the computing performance.

The FraC approach has already been tested and validated for simulating steady-state flow and transport processes (Ngo et al., 2017). The objective of this contribution is to present some new results for well-test simulations run on FraC's meshes. For this purpose, the complex fracture network from the synthetic Bloemendaal reservoir will be employed. The Bloemendaal field is a 12 ×15 km oil saturated carbonate reservoir that consists in a North/South oriented anticline structure characterized by 3 units, 3 rock types and 3 diffuse fracture sets. Bloemendaal reservoir faults are also known to be transversal barriers for fluids. In addition these faults are suspected of being longitudinal drains, which can be modeled using fault-related fractures. Our preliminary results emphasize the effect of these faults on well-test analysis.

## References

Adler, P.M., Thovert, J.F., Mourzenko, V.V., 2012. Fractured Porous Media. Oxford University Press
Bear, J., Tsang, C.F., de Marsily, G., 1993. Flow and Contaminant Transport in Fractured Rock. Academic Press, San Diego, CA, USA, 560p.
Berkowitz, B., 2002. Characterizing flow and transport in fractured geological media: a review. Adv. Water Resour. 25 (8), 861–884.
Fourno, A., Grenier, C., Delay, F., Mouche, E., Benabderrahmane, H., 2004. Smeared fractures: a promising approach to model transfers in fractured media, Developments in Water Science, 55, 1003-1014.
Verscheure, M., Fourno, A., and Chilès, J.-P. 2012. Joint Inversion of Fracture Model Properties for CO2 Storage Monitoring or Oil Recovery History Matching. OGST - Rev. IFP Energies nouvelles, 67, 221-235.

Fourno, A., Grenier, C., Benabderrahmane, H., Delay, F., 2013. A continuum voxel approach to model flow in 3D fault networks: a new way to obtain up-scaled hydraulic conductivity tensors of grid cells. Journal of Hydrology, 493, 68-80.
Khvoenkova, N., and Delorme, M., 2011. An Optimal Method to Model Transient Flows in 3D Discrete Fracture Network, IAMG.
Noetinger, B., and Jarrige, N., 2012. A quasi steady state method for solving transient Darcy flow in complex 3D fractured networks. J. Comput. Phys. 231(1), 23\-38.
Ngo, T. D., Fourno, A., Noetinger, B., 2017. Modeling of transport processes through large-scale discrete fracture networks using conforming meshes and open-source software. Journal of Hydrology 254, 66–79.

## Acceptance of Terms and Conditions

Click here to agree

**Primary authors:** NGO, Tri Dat (IFPEN); FOURNO, André (IFPEN); NOETINGER, Benoit (IFPEN)

**Presenter:** FOURNO, André (IFPEN)

**Session Classification:** Poster 4

**Track Classification:** MS 2.03: Challenges in flow and transport simulations in poro-fractured media: numerical methods and modeling