Contribution ID: **495** Type: **Poster + 3 Minute Pitch**

Simulation of flow properties in geological-based Discrete Fracture Networks

Wednesday, 16 May 2018 14:00 (25 minutes)

Fractures are crucial in the physics of geological media and have specific characteristics different from the surrounding rock matrix. Addressing their bulk hydraulic behavior is challenged by the multiscale fracture heterogeneities without any obvious homogenization scale and persistent high-flow channeling. Predictive flow simulations based on geological characterization are essential but face involved geometrical and computational issues. We propose here new combinations of advanced mesh generation methods and robust numerical schemes together with vectorization to solve the flow problem at a moderate cost.

Our approach relies on advanced methods for geometric modeling and mesh generation that are implemented in the BLSURF_FRAC software. It first builds an analytic model of the intersecting fractures. Then, using BLSURF [1], it discretizes the intersections and fracture contours and generates corresponding surface meshes. Automatic corrections are added to ensure valid meshes for any fracture structures. Mesh generation is performed either by BAMG [2] or BL2D [3]. Meshes can be adaptively refined to optimize flow computations.

On top of it, the Geofracflow software provides hydraulic simulation capacities with an optimized implementation of the mixed hybrid finite element method with vectorization [4] to reduce computational times. It handles either matching or non-matching meshes at the intersections between fractures [5], sink/source terms and high contrasts of transmissivities between fractures.

We benchmark our proposed methods by computing flow properties of geological-based Discrete Fracture Networks [6, 7] including correlations between fractures (UFMs) [8]. They are large-scale DFNs where the fracture size distribution matches the observations and where fractures are organized so that large fractures inhibit the growth of smaller ones, creating T-termination configurations. We also show possible optimization capacities offered by optimal combinations of mesh generation methods (BAMG or BL2D) and the mixed hybrid finite element method.

Bibliography

[1] H. Borouchaki, P. Laug, P.L. George. Parametric surface meshing using a combined advancing-front – generalized-Delaunay approach, International Journal for Numerical Methods in Engineering, 49 (1-2), 233–259 (2000).

[2] F. Hecht, BAMG: Bidimensional Anisotropic Mesh Generator, https://www.ljll.math.upmc.fr/hecht/ftp/bamg/bamg.pdf (2006).

[3] P. Laug, H. Borouchaki, The BL2D Mesh Generator –Beginner's Guide, User's and Programmer's Manual, Inria Technical Report RT-0194 (1996).

[4] F. Cuvelier, C. Japhet, G. Scarella, An efficient way to assemble finite element matrices in vector languages, BIT Numerical Mathematics, 56(3), 833–864 (2016).

[5] G. Pichot, J. Erhel, J.R. de Dreuzy, A generalized mixed hybrid mortar method for solving flow in stochastic discrete fracture networks, SIAM Journal on Scientific Computing, 34(1), B86–B105 (2012).

[6] P. Laug, G. Pichot, J.R. de Dreuzy. Realistic geometric modeling of fracture networks. ADMOS (2017).

[7] de Dreuzy, J.R., Pichot, G., Poirriez, B., Erhel, J.: Synthetic benchmark for modeling flow in 3D fractured media. Computers & Geosciences, 50, 59–71 (2013).

[8] P. Davy, R. Le Goc and C. Darcel. A model of fracture nucleation, growth and arrest, and consequences for fracture density and scaling. Journal of Geophysical Research: Solid Earth, 118 (4), 1393–1407 (2013).

References

Acceptance of Terms and Conditions

Click here to agree

Primary authors: PICHOT, Géraldine (Inria); Prof. LAUG, Patrick (Inria); LE GOC, Romain (Itasca Consultants SAS, France); DARCEL, Caroline (Itasca Consultants SAS, France); Prof. DAVY, Philippe (University of Rennes 1, France); Prof. DE DREUZY, Jean-Raynald (University of Rennes 1, France)

Presenter: PICHOT, Géraldine (Inria)

Session Classification: Invited 3 (Room C) - Géraldine Pichot

Track Classification: MS 2.13: Advances in numerical modelling of multiphase flow and transport in fractured porous media