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Geometrical characterization of blocks in fractured media

Pierre Adler (1), Ravid Rosenzweig (2), Valeri Mourzenko (3), and Jean François Thovert ()

(1) UPMC, Sisyphe, Paris, France (pierre.adler@upmc.fr), (2) Geological survey of Israel, 30, Malkhe Israel, Jerusalem 95501,Israel, (3) Institut Pprime - CNRS, SP2MI, BP 30179, 86962 Futuroscope Chasseneuil Cedex

When fractures are sufficiently dense, they partition fractured media into blocks. The determination of the statistical properties of these blocks is important for the oil industry, for instance ; the oil which is initially located in the porous medium, may flow into the fractures and this transfer is controlled by the block geometry. This problem has been so far only addressed by double porosity models.
The major purpose of the present contribution is to determine the geometrical properties of these blocks as a preliminary work to the transfer problem just described. This problem has not been addressed in the literature, except for infinite fractures which correspond to the case of finite fractures with a very large density.
Fractures of various shapes and of various densities are generated isotropically with random positions. The blocks are determined after the fractures are triangulated ; the triangles are oriented in a consistent way. Therefore, each solid block is limited by several triangulated plane faces. Then, the neighbors of a given triangle are identified. When this is done for all the triangles, the independent connected components of the triangles are identified by a pseudo-diffusion algorithm. Each independent component corresponds to a block. The block density corresponds to the number of blocks per unit volume.
Then, measurements are performed on each block such as the volume, the surface and the number of faces. The dimensionless density rho' which is equal to the average number of intersections of a fracture with other fractures, varies between 1 to 150, for three shapes, namely squares, rectangles with an aspect ratio of 4 and 20-gons which are very close to disks.
Some of the results can be summarized as follows. The block density is a power law of rho' which is independent of the fracture shape with an exponent equal to 4. The fraction of volume occupied by blocks follows a power law as well until it gets close to 1.
Somewhat unexpectedly the mean block volume and the mean surface area of the blocks start increasing with rho' and decrease for large rho' where they follow the predictions for infinite fractures. The average number of faces of a block increases until it reaches 6 as predicted for infinite fractures.

Histograms of various quantities will also be presented and analyzed.

In many cases, the results can be gathered by dimensionless relations which are convenient to apply.