FRACTURE FLOW SIMULATIONS BASED ON GEOMETRICAL CHARACTERISTICS USING LATTICE BOLTZMANN METHOD

By Carmen Serpa

ABSTRACT

Fluid flow in fractured rock is a subject of primary importance in petroleum engineering, hydrogeology, chemical movement through bedrock, geothermal reservoir exploitation and heat storage, mining and mineralization processes, and geotechnical applications.

Modeling fluid flow through fractures is problematic, especially because their geometry is complex. This project uses the Lattice Boltzmann Method (LBM) to simulate fluid flow through fractures. LBM is a relatively new approach, which in recent years has achieved great success in simulations of fluid flows including single and multiphase flow in complex geometries. This makes LBM an ideal candidate to solve complex problems related to fluid flow in fractures and opens a new and promising perspective to simulate fluid flow in an easier way.

In this study, I focus on the behavior of fluid flow through fractures, taking special interest in the geometry of cross joints and in the intersections between these and systematic fractures. The model is validated on an idealized fracture with two parallel surfaces where pressure boundary conditions are employed, resulting in a flow field that can be compared with the analytical solution of the plane Poiseuille flow driven by pressure difference.

The various cross joints geometries used in the study are based on theoretical models of the fracturing of rock subjected to a particular stress field. Although cross joints are smaller in dimension than systematic fractures, their importance is enormous if we take into account that they provide connectivity among fractures that might otherwise be isolated.