Parallel Simulator of Multidimensional Fracture Flow and Transport

J. Březina, P. Rálek, M. Hokr

The granite rock represents one of the suitable sites for a nuclear waste deposit. Water in the granite massive is conducted by the complex system of fractures of various sizes. In our approach the small fractures are modeled by an equivalent permeable continuum, while the preferential flow in large geological dislocations and their intersections is considered as a 2D flow on corresponding manifolds and 1D flow on lines respectively. Hydraulic conductivity in the domains of lower dimension can be several orders of magnitude larger then effective conductivity of the 3D domain. We use mixed-hybrid discretization for the flow problem and simple finite volume up-wind scheme for the transport.

The mixed-hybrid discretization leads to a symmetric indefinite system with block diagonal leading submatrix. This allows explicit construction of the Schur complement and significant reduction of the matrix size as well as its condition number. We will show scalable parallel construction of the Schur complements and solution of the system by a two-level Schwartz domain decomposition method using the PETSC library. We will also discuss parallel solution of the transport equation.