Comparison of Fracture-Tip Models for Fluid Flow in Fractured Porous Media

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ABSTRACT

Single-phase incompressible fluid flow through a fractured porous medium is considered by looking for a pressure field $p$ and a velocity field $v$ such that

$$v = -K \nabla p,$$

$$\text{div} \ v = q,$$

for a given permeability field $K$, source term $q$ and appropriate boundary conditions. The description of the fracture(s) is given by a division of the problem domain $\Omega$ into a matrix part $\Omega_m$ and a fracture part $\Omega_f$ such that the associated permeabilities $K_m$ and $K_f$ may differ by several orders of magnitude and that the transversal extension of $\Omega_f$ is very small in comparison to its lateral extension.

The main interest of this contribution is to discuss the treatment of fracture tips, i.e., fractures ending inside the matrix domain. A discrete-fracture-matrix (DFM) model combined with the extended finite-element method (XFEM) is presented that admits independent grids for the fracture and the matrix domain [2]. A concept for the coupling between fracture and matrix flow at a fracture tip is investigated that admits flow across the tip by exchanging the corresponding fluxes. By means of benchmark examples [1], the results of the approach are compared with solutions from the literature as well as with reference solutions calculated by a mimetic finite difference method on highly resolved equi-dimensional discretizations of fracture and matrix domains.

REFERENCES
