A Generalized Multiscale Finite Element method for modeling unsaturated filtration in fractured media

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Abstract

In this work, we consider a mathematical model for modeling unsaturated flow problems in fractured porous media. The presence of fractures has a significant effect on filtration processes, since fractures are channels of high conductivity. The mathematical model is described by Richards equation for a porous medium and fractures. For the fine grid approximation, we use a finite element method with Discrete Fracture Model(DFM) approach. Discrete Fracture Model allows to resolve fractures at the level of a fine grid and to set thus corresponding properties. Applying the superposition method, we obtain a general system of equations for fractures and background.

Fracture grid resolution leads to the large system of equations and some coarse grid approximations should be constructed. We use a Generalized Multiscale Finite element method (GMsFEM) to reduce size of the system. In GMsFEM, we construct a local multiscale basis functions to capture detailed interactions between the fractures and the background medium. Numerical implementation based on open-source library FEniCS. We present numerical results for fractured heterogeneous porous medium and compared relative error for different number of the multiscale basis functions. good performance.