Numerical manifold method for two-phase flow in fractured-porous media with non-matching mesh

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Abstract

For two-phase flow in fractured-porous media, the intersected fractures not only cause geometric discontinuity but also lead to saturation and pressure discontinuity, and thus largely increase the difficulty in the numerical simulation. In this work, an improved numerical manifold method (NMM) is developed for modeling two-phase flow in fractured-porous media with non-matching mesh. The geometric discontinuity, pressure and saturation discontinuity can be easily solved by taking advantages of NMM two-cover-mesh system. The governing equations for two-phase flow in the media are discretized on the basis of weighted residual method, and the fracture surfaces belongs to different physical covers. Cubic law is adopted to describe fluid flow along fractures, and Dirichlet or Neumann boundaries are employed in the direction normal to the fracture to exchange flux with rock matrix. The robustness and efficiency of the proposed method are demonstrated firstly based on several cases. Followed is the discussion on the effects of the mathematical covers density on computational accuracy. Finally, the method is adopted to simulate two-phase flow in a porous media with densely intersected fractures. The advantages of NMM in the simulation of two-phase flow in a fractured-porous media are revealed, which can be further developed for engineering applications.

Keywords: numerical manifold method, non-matching mesh, two-phase flow, fractured-porous media, geometric discontinuity, saturation and pressure discontinuity