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Accurate multiscale finite element methods for two-phase flow simulations. (English)

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Summary: We propose a modified multiscale finite element method for two-phase flow simulations in heterogeneous porous media. The main idea of the method is to use the global fine-scale solution at initial time to determine the boundary conditions of the basis functions. This method provides a significant improvement in two-phase flow simulations in porous media where the long-range effects are important. This is typical for some recent benchmark tests, such as the SPE comparative solution project [*M. Christie, M. Blunt*, Tenth spe comparative solution project: a comparison of upscaling techniques, SPE Reser. Eval. Eng. 4, 308–317 (2001)], where porous media have a channelized structure. The use of global information allows us to capture the long-range effects more accurately compared to the multiscale finite element methods that use only local information to construct the basis functions. We present some analysis of the proposed method to illustrate that the method can indeed capture the long-range effect in channelized media.

MSC:

76M10 Finite element methods applied to problems in fluid mechanics
65M60 Finite element, Rayleigh-Ritz and Galerkin methods for initial value and initial-boundary value problems involving PDEs
76S05 Flows in porous media; filtration; seepage

Keywords:

multiscale; finite element; finite volume; global; two-phase; upscaling

Software:

GSLIB

Full Text: DOI

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