A multiscale method with Robin boundary conditions for the porous media equations

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Abstract

The design of accurate multiscale domain decomposition methods for channelized, high-contrast porous media remains as an important challenge for the numerical simulation of typical problems posed by the oil industry. Here we investigate an improved version of the recently proposed Multiscale Robin Coupled method (MRCM) [1], which is a generalization of the Multiscale Mixed Method (MuMM) [2]. This method ensures weak continuity of both normal fluxes and pressure through the imposition of Robyn-type boundary conditions at the skeleton of the domain decomposition where the interface spaces $\mathcal{P}_h$ and $\mathcal{U}_h$ for the pressure and fluxes, respectively, can be chosen independently. Numerical simulations are presented aiming at illustrating several features of the MRCM. We shown that the MRCM can also be seen as a generalization of two well know multiscale procedures, the Multiscale Mixed Mortar Finite Element method (MMMFEM) [3] and the Multiscale Hybrid Method (MHM) [4].Then, we compare the accuracy of the above mentioned multiscale procedures given a fixed computational cost for interface spaces spanned by polynomial and informed functions [5]. Our results illustrate how one can take advantage of the built-in flexibility of the MRCM to produce more accurate approximations when compared to the MMMFEM and MHM.

References

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