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

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The design of accurate multiscale domain decomposition methods for channelized, high-contrast porous media remains as an important challenge in typical problems posed by the oil industry.

Here we investigate an improved version of the recently proposed Multiscale Robin Coupled method (MRCM) [1]. 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 $\mathcal{P}$ and $\mathcal{U}$ for the pressure and fluxes, respectively, can be chosen independently.

The MRCM can be seen as a generalization of two well know multiscale procedures, the Multiscale Mixed Mortar Finite Element method (MMMFEM) [2] and the Multiscale Hybrid Method (MHM) [3].

In this work, we compare the accuracy of the above mentioned multiscale procedures given a fixed computational cost for polynomial and informed spaces [4]. Our results illustrate how one can take advantage of the built in flexibility of the MRCM to produce more accurate results when compared to the MMMFEM and MHM.

References

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