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**Adaptive mixed GMsFEM for flows in heterogeneous media.** (English) Zbl 1399.65322
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Summary: In this paper, we present two adaptive methods for the basis enrichment of the mixed generalized multiscale finite element method (GMsFEM) for solving the flow problem in heterogeneous media. We develop an a-posteriori error indicator which depends on the norm of a local residual operator. Based on this indicator, we construct an offline adaptive method to increase the number of basis functions locally in coarse regions with large local residuals. We also develop an online adaptive method which iteratively enriches the function space by adding new functions computed based on the residual of the previous solution and special minimum energy snapshots. We show theoretically and numerically the convergence of the two methods. The online method is, in general, better than the offline method as the online method is able to capture distant effects (at a cost of online computations), and both methods have faster convergence than a uniform enrichment. Analysis shows that the online method should start with a certain number of initial basis functions in order to have the best performance. The numerical results confirm this and show further that with correct selection of initial basis functions, the convergence of the online method can be independent of the contrast of the medium. We consider cases with both very high and very low conducting inclusions and channels in our numerical experiments.

**MSC:**

65N30 Finite element, Rayleigh-Ritz and Galerkin methods for boundary value problems involving PDEs
65N12 Stability and convergence of numerical methods for boundary value problems involving PDEs
76M10 Finite element methods applied to problems in fluid mechanics



**Keywords:**

mixed multiscale finite element methods; multiscale basis; adaptivity; online basis; flow in heterogeneous media

**Full Text:** DOI