Goal-oriented adaptivity for the Generalized Multiscale Finite Element Method

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ABSTRACT

Goal-oriented adaptivity is introduced within the framework of the Generalized Multiscale Finite Element Method (GMsFEM) for problems of high-contrast flow. GMsFEM is a flexible framework for approximating solutions to problems with multiple scales and high contrast. The methodology is based on two mesh partitions: a coarse mesh over which the global problem is considered, and a subordinate fine mesh over which only local problems are considered. First, multiscale basis functions are computed through the solution of local fine-scale problems to capture the fine-scale heterogeneities. Then, an ordered selection of these basis functions in each coarse neighborhood is used to approximate the global solution.

The role of a posteriori error estimation and adaptivity in GMsFEM is to identify which coarse neighborhoods to enrich with additional multiscale basis functions, in the interest of both accuracy and efficiency. Goal-oriented error indicators are introduced to increase the performance of the simulation when seeking a given quantity of interest, which is generally a localized function of the weak solution. Our results show that in both standard and mixed formulations, goal-oriented error estimation outperforms standard adaptivity in the approximation of the quantity of interest.

Here we will discuss the formulation of goal-oriented a posteriori error indicators within GMsFEM. We will consider how both residual-based and dual-weighted residual methods can be extended to this framework. The techniques will be illustrated with numerical examples.

REFERENCES

