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# A NEW FRAMEWORK OF ITERATIVELY ADAPTIVE MULTISCALE FINITE ELEMENT METHODS

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We proposed a new framework of multiscale finite element methods (MsFEM) [1] or solving the second order partial differential equations (PDEs) exhibiting multiscale behavior. Our target applications include elliptic interface problems, convective-diffusive equations, and Helmholtz equations. The key ingredient of the MsFEMs is a set of multiscale basis functions, which is constructed by solving locally the original PDE problem with some proper boundary conditions. The selection of boundary conditions plays an important role on the overall performance of MsFEM. Finding an appropriate boundary condition setting for some particular application is the current topic in the MsFEM research. Either using purely local information or purely global information are two popular classes of MsFEMs in the available literature. In the proposed framework, namely iteratively adaptive MsFEM (or i-ApMsFEM), the local-global information exchanges through updated local boundary condition for these multiscale basis functions. Once the multiscale solution is recovered from the solution of global numerical formulation on coarse grids, which couples these multiscale basis functions, it provide a feedback for updating the local boundary conditions on each coarse element. As the approach iterates, the quality of MsFEM solutions get improved, since these adaptive basis functions are expected to be able to more accurately capture the multiscale feature of the approximate solution. Some numerical results for the convective-diffusive problems and interface problems are reported and some suggested research topics along this direction are also included.

## REFERENCES

[1] Efendlev Y, Hou T.Y. *Multiscale Finite Element Methods: Theory and Applications.* Springer, 2009.