CONSTRAINT ENERGY MINIMIZING GENERALIZED MULTISCALE FINITE ELEMENT METHOD (CEM-GMSFEM)

Eric Chung
Chinese University of Hong Kong

In this talk, we present Constraint Energy Minimizing Generalized Multiscale Finite Element Method (CEM-GMsFEM). The main goal of this method is to design multiscale basis functions within GMsFEM framework such that the convergence of method is independent of the contrast and linearly decreases with respect to mesh size if oversampling size is appropriately chosen. We would like to show a mesh-dependent convergence with a minimal number of basis functions. Our construction starts with an auxiliary multiscale space by solving local spectral problems. In auxiliary multiscale space, we select the basis functions that correspond to small (contrast-dependent) eigenvalues. These basis functions represent the channels (high-contrast features that connect the boundaries of the coarse block). Using the auxiliary space, we propose a constraint energy minimization to construct multiscale spaces. The minimization is performed in the oversampling domain, which is larger than the target coarse block. The constraints allow handling non-decaying components of the local minimizers. If the auxiliary space is correctly chosen, we show that the convergence rate is independent of the contrast (because the basis representing the channels are included in the auxiliary space) and is proportional to the coarse-mesh size (because the constrains handle non-decaying components of the local minimizers). Finally, we present some numerical results.

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