MULTISCALE PETROV-GALERKIN FINITE ELEMENT METHOD FOR ACOUSTIC SCATTERING

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Abstract. This talk presents a pollution-free Petrov-Galerkin multiscale finite element method for the Helmholtz problem with large wave number κ. The method employs standard continuous Q_1 finite elements at a coarse scale H as trial functions, whereas the test functions are computed as the solutions of local problems at a finer scale h. The diameter of the support of the test functions behaves like mH for the coarse-grid mesh-size H and some oversampling parameter m. Provided $m \log(\kappa)$ is bounded by a generic constant and the fine-scale mesh-size h is sufficiently small, the resulting method is stable and quasi-optimal in the targeted regime of only $\mathcal{O}(1)$ degrees of freedom per wavelength. In homogeneous (or more general periodic) media, the fine scale test functions depend only on local mesh-configurations. Therefore, the seemingly high cost for the computation of the test functions can be drastically reduced on structured meshes. The talk presents numerical experiments in two and three space dimensions.

Keywords: pollution effect, finite element, multiscale method, numerical homogenization.

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