HIERARCHICALLY ENHANCED ADAPTIVE FINITE ELEMENT METHODS FOR PDE EIGENVALUE/EIGENVECTOR APPROXIMATIONS

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Abstract

Although adaptive approximation methods have gained a recognition and are well-established, they frequently do not meet the needs of real world applications. In this talk we present a hierarchically enhanced adaptive finite element method for PDE eigenvalue problems. Starting from the results of Grubišić and Ovall on the reliable and efficient asymptotically exact a posteriori hierarchical error estimators in the self-adjoint case, we explore the possibility to use the enhanced Ritz values and vectors to restart the iterative algebraic procedures within the adaptive algorithm. Using higher order hierarchical polynomial finite element bases, as indicated by Bank and by Ovall and Le Borne, our method generates discretization matrices whose compressions onto the complement of piecewise linear finite element subspace (in the higher order finite element space) are almost diagonal. This construction can be repeated for the complements of higher (even) order polynomials and yields a structure which is particularly suitable for designing computational algorithms with low complexity. We present some preliminary numerical results for both the symmetric as well as the nonsymmetric eigenvalue problems.