PERFORMANCE OF A SUBDOMAIN-BASED RESIDUAL METHOD FOR A POSTERIORI ERROR ESTIMATION

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In this paper we analyze a subdomain-based residual error estimator for finite element approximations inspired from the work of Carstensen and Funken [1] and Morin, Nochetto, and Siebert [2], and presented in [3]. It is obtained by solving local problems on patches of elements in weighted spaces and provides for an upper bound on the energy norm of the error when the local problems are solved in sufficiently enriched discrete spaces. A guaranteed lower bound on the error is also derived by a simple postprocess of the solutions to the local problems.

This method presents several advantages over other existing error estimation methods. First, it does not require to compute flux jumps at the element interfaces for the calculation of the residual, even less, to compute boundary conditions of Neumann type for the local problems such as in the equilibrated element residual method [4,5]. This simplifies somewhat the implementation of the error estimator in finite element codes, in particular in those designed for three-dimensional applications. We also show that reasonable estimates can be obtained by using polynomial test functions of same degree as the ones used to compute the finite element solution. This is actually an important consideration as the technology can then be implemented in any existing finite element codes without having to introduce new polynomial shape functions of higher degrees, in other words, without having to drastically modify the existing data structure.

We also investigate the use of this error estimator for mesh adaptation. From our preliminary numerical experiments, the estimator shows very good effectivity indices for the upper and lower bounds and a strong reliability even for coarse meshes.

References

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