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hp-AFEM: CONVERGENCE, OPTIMALITY, *p*-ROBUSTNESS

We describe a recently proposed adaptive *hp*-type finite element algorithm, termed *hp-AFEM*, for the solution of operator equations such as, e.g., elliptic boundary value problems. The algorithm produces a sequence of *hp*-partitions of the domain and corresponding Galerkin discrete solutions, for which the energy norm decays at a fixed rate, and is instance optimal. In particular, if the solution admits *hp*-type approximations for which the error decays exponentially fast in the number of activated degrees of freedom, the same exponential behavior occurs for the Galerkin approximations built by our algorithm.

hp-AFEM consists of an alternance of two stages: one is devoted to the generation of a new *hp*-partition, which is near optimal for the current level of accuracy, and a corresponding polynomial approximation of the data; the other provides the reduction of the Galerkin error by a fixed amount. In the latter stage, the use of residual estimators, which are *p*-sensitive, introduces an optimality degradation. As an alternative, equilibrated flux estimators guarantee optimality provided suitable uniform saturation conditions are satisfied; *p*-robust saturation is numerically checked for triangles, and proven for quadrangles.