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A unified framework for optimal a posteriori error estimation in different numerical methods

We present a unified framework which allows for optimal a posteriori error estimation in approximation of linear second-order elliptic partial differential equations by different numerical methods. In particular, the continuous and discontinuous Galerkin finite element, mixed finite element, finite volume, and finite difference methods are considered. Fully computable upper bounds are derived, so that the estimators allow for the overall energy error control in addition to the adaptive mesh refinement, which is supported by the local efficiency of the estimators. Some robustness results and the case of inexact solution of the associated linear systems are also mentioned. Numerical results illustrate the theory.