A posteriori error estimates for a mixed-FEM formulation of a non-linear elliptic problem

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Araya, Rodolfo, Barrios, Tomás P., Gatica, Gabriel N., Heuer, Norbert. A posteriori error estimates for a mixed-FEM formulation of a non-linear elliptic problema. Computer Methods in Applied Mechanics and Engineering, vol. 191, no. 21-22 (Mar. 2002), pp. 2317-2336.

Abstract

We consider the numerical solution, via the mixed finite element method, of a non-linear elliptic partial differential equation in divergence form with Dirichlet boundary conditions. Besides the *temperature u* and the *flux* σ, we introduce ∇*u* as a further unknown, which yields a variational formulation with a twofold saddle point structure. We derive a reliable a posteriori error estimate that depends on the solution of a local linear boundary value problem, which does not need any equilibrium property for its solvability. In addition, for specific finite element subspaces of Raviart–Thomas type we are able to provide a fully explicit a posteriori error estimate that does not require the solution of the local problems. Our approach does not need the exact finite element solution, but any reasonable approximation of it, such as, for instance, the one obtained with a fully discrete Galerkin scheme. In particular, we suggest a scheme that uses quadrature formulas to evaluate all the linear and semi-linear forms involved. Finally, several numerical results illustrate the suitability of the explicit error estimator for the adaptive computation of the corresponding discrete solutions.