Efficiency of a Posteriori Error Estimates and Adaptive EF-VF Method for Elliptic Problems

Tarek GHOUDI, Fayssal BENKHALDOUN
Paris 13 University
ghoudi@math.univ-paris13.fr, Fayssal@math.univ-paris13.fr

Abstract

FE-FV method is commonly used to approach complex problems in several physical phenomena. In many of these applications, adaptive techniques using a posteriori error estimators have become very useful. These estimators measure the quality of the computed solution and provide information to control the mesh adaptation algorithms. Our work is divided into two steps :

On one hand, we take the example proposed by M. Vohralik of a simple diffusion equation with discontinuous coefficients for the computation of the a posteriori error :

$$\begin{cases} -\nabla \cdot (a(X)\nabla u(X)) = f & \forall X \in \Omega \\ u(X) = 0 & \forall X \in \partial\Omega \end{cases}$$

Where $\Omega \in \mathbb{R}^2$, is a polygonal domain(open, bounded and connected set), $f \in \mathbb{L}^2(\Omega)$ is a source term, $a : \Omega \to]0, +\infty[$ bounded, continuous piecewise fonction.

Then we realize several tests on various types of meshes (regular, irregular) to calculate the curves of efficiency, exact and estimated errors.

On the other hand, we compute the execution time for a given precision using either mesh uniformly refined an adapted one. The coupling made between the M. Vohralik estimator and our method of mesh adaptation (Adapt-Newest) allows us to have an important gain in term of CPU time.

References

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