Error estimation of recovered solutions in FE analysis. Higher order h-adaptive refinement strategies.

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Abstract

The recovery type error estimators introduced by Zienkiewicz and Zhu [1] use a recovered stress field evaluated from the Finite Element (FE) solution. Their accuracy depends on the quality of the recovered field. In this sense, accurate results are obtained using recovery procedures based on the Superconvergent Patch Recovery technique (SPR) proposed in [2]. These error estimators can be easily implemented and provide accurate estimates. Another important feature is that the recovered solution is of a better quality than the FE solution and can therefore be used as an enhanced solution.

We have developed an SPR-type recovery technique that considers equilibrium and displacements constraints, based on the ideas presented in [3] and the references therein, to obtain a very accurate recovered displacements field from which a recovered stress field can also be evaluated. We propose the use of these recovered fields as the standard output of the FE code instead of the raw FE solution. Techniques to quantify the error of the recovered solution are therefore needed.

In this paper we present an error estimation technique that accurately evaluates the error of the recovered solution both at global and local levels in the FEM and XFEM frameworks. We have also developed an h-adaptive mesh refinement strategy based on the error of the recovered solution. As the converge rate of the error of the recovered solution is higher than that of the FE one, the computational cost required to obtain a solution with a prescribed accuracy is smaller than for traditional h-adaptive processes.

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ACKNOWLEDGEMENTS

This work has been carried with the support of the Ministerio de Ciencia e Innovación (Spain) DPI2010-20542, Universitat Politècnica de Valencia, Generalitat Valenciana and FPU program (AP2008-01086). Supported by the EPSRC grant EP/G042705/1.