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ON THE USE OF RECOVERY TECHNIQUES FOR ACCURATE ERROR ESTIMATION AND ERROR BOUNDING IN XFEM

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ABSTRACT

A posteriori implicit residual-type estimators have traditionally been the most commonly used techniques to provide bounds of the error of the finite element method, FEM. Recovery-based error estimators based on the ideas of Zienkiewicz and Zhu have been often preferred by practitioners, due to their simple implementation and robustness, but they were unable to provide guaranteed bounds, which is especially desirable in the context of goal-oriented adaptivity. In 2007, Diez *et al.*[1] circumvented this problem by means of the use of a nearly statically admissible stress field and correction terms, proposing the first recovery-based technique used to evaluate upper bounds of the error in energy norm for FEM. Then, in 2010, Ródenas *et al.* [2] enhanced this technique and adapted it to the extended finite element method, XFEM. In this paper we will show: *a)* how these techniques can also be applied to obtain sharp upper bounds in *goal-oriented* error estimation; and *b)* new enhancements of the recovery technique that provide sharp upper bounds of the error in energy norm avoiding the use of correction terms. The numerical results show that these kind of techniques are a clear alternative to the use of residual-type estimators in error bounding.

REFERENCES

[1] P. Díez, J.J. Ródenas and O.C. Zienkiewicz. Equilibrated patch recovery error estimates: simple and accurate upper bounds of the error. *International Journal for Numerical Methods in Engineering.* Vol. **69**, 2075-2098, 2007.

[2] J.J. Ródenas, O.A. González-Estrada, P. Díez, F.J. Fuenmayor. Accurate recovery-based upper error bounds for the extended finite element framework. *Computer Methods in Applied Mechanics and Engineering.* Vol. **199**, 2607-2621, 2010.