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A SIMPLE RECOVERY BASED ERROR ESTIMATOR FOR THE GFEM INCLUDING BLENDING

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Abstract. The generalized finite element method (GFEM) allows setting good conditions of local approximations by means of enrichments functions with special features. One major advantage of this method is the mesh independence for crack simulations. Moreover, the strong gradients typical of linear elastic fracture mechanics problems can be faced by customized enrichments. In spite of the good performance presented by the method on several numerical simulations it is very important to assess error estimates from the obtained results. In this context, a new a posteriori error estimator for the generalized finite element method is hereby considered aiming mainly to guarantee the more accurate and reliable stress distribution. A secondary aim is to employ the error estimates as indicator in hp-adaptive strategies. The proposed estimator is then based on the superconvergent patch recovery (SPR) technique, a widely used technique for evaluating recovered stress fields from the conventional finite element solutions. The GFEM-SPR procedure explores the clouds and partition of unity concepts to obtain recovered stress fields from interpolation polynomials. Such functions are identified using the singular value decomposition (SVD) strategy over superconvergent point values defined in each cloud in coincidence with the quadrature integration points. A particular issue that appears when enrichment is imposed over a localized region of the solid domain is related to the so called blending elements. Such elements blend nodes with and without enrichment, however presenting lack of partition of unity property and, hence, also losing the reprodutibility feature. Thus, the accuracy and convergence ratio of the GFEM can be affected. In this paper a modification in the standard GFEM proposed in literature to properly account for blending elements is adopted and the error estimator is also improved. Some benchmarks problems discretized by two-dimensional triangular and quadrilateral element meshes are presented in order to assess the efficiency and computational performance of the procedure hereby proposed. The energy norms of the recovered solutions, as well the effectivity index of the estimator are presented by comparing numerical and analytic solutions when available.