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RECOVERY BY COMPATIBILITY IN PATCHES IN FINITE ELEMENT ELASTOPLASTIC ANALYSIS

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ABSTRACT

In the last years, much attention has been focused on recovery procedures aimed at improving the accuracy of finite element solutions (see for example [1] and the references therein). Recovered solutions are useful in many contexts, such as the estimation of the finite element discretization error. The error, generally in stress based norms, is estimated by comparing the original finite element solution with the recovered one. The major step forward in using recovery procedures was taken in 1992, when Zienkiewicz and Zhu developed the Superconvergent Patch Recovery (SPR) procedure [2]. Recently, a new super-convergent procedure called Recovery by Compatibility in Patches (RCP) has been proposed by one of the authors [3] and shown to provide an excellent basis for error estimation in linear elastic problems [4, 5].

The key idea of RCP is to improve stresses by enforcing compatibility over local patches of elements. Each patch is broken out as a sub-model subjected to displacement boundary conditions, derived from the original finite element solution. Hence, improved local stresses are computed by minimizing the complementary energy of the patch, among an assumed set of equilibrated stress fields. This procedure is very promising since it has been shown to be simple, efficient, robust and numerically stable. Moreover, it does not need any knowledge of super-convergent points.

In this work the RCP procedure is extended to elastoplastic problems. The new procedure enforces the compatibility condition, together with the load-unload conditions, over the generic patch. This allows to recover a new and more accurate stress field together with a new plastic strain field, so that elastoplastic consistency is satisfied. Given the strong analogy between the RCP procedure and the mixed stress methods, the above extension is conducted using techniques similar to those used for the development of mixed stress finite elements for elastoplastic analyses, like those recently proposed in [6].

Some numerical experiments are presented to illustrate the arguments discussed in the paper.

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