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ENRICHED FREE MESH METHOD WITH SUPERCONVERGENT PATCH RECOVERY SCHEME

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ABSTRACT

The Free Mesh Method (FMM) has been proposed to save the troublesome job of generating a global mesh, which is a bottleneck of the finite element analysis [1][2]. This is one of the node-wise procedures that require no connectivity of information between an element and a node as part of the input information. Also, since the whole process of the FMM progresses with nodes as the unit of processing, this method is effective in parallel computing technology [3][4]. Among recent FMM researches, the present authors have proposed the Enriched Free Mesh Method (EFMM) [5], which intends to establish a highly accurate method by concurrently defining the displacement field of each element and the stress/strain field of each patch.

Meanwhile, the adaptive FEM is known to overcome the mesh dependencies of the FEM by assessing the error norms after the analysis [6][7]. This methodology improves the geometrical state of elements with a large error norm. In order to calculate the error norms, Zienkiewicz and Zhu [8][9] employed the localized least squares method on the stress/strain values of multiple elements connected to a node called a “local patch”, which is known as the Superconvergent Patch Recovery (SPR). By the smoothing effects based on the least square method, the SPR has successfully obtained more accurate solutions than those of the FEM.

It is noted here that the FMM and the SPR share the following features:

(1) Based upon the FEM

(2) Intend to resolve mesh dependency problems of the FEM

(3) Calculate in node-wise manner

(4) Employ the local patch around a node

On the other hand, there are some differences between them, including:

(1) While the FMM is developed as a main-processing method, the SPR a post-

processing method.

(2) The solutions of the FMM are equal to those of the FEM, but those of the SPR are more accurate than those of the FEM.

In the present paper, it is clarified that the EFMM is a general and new scheme for shifting the post-processing of the SPR to the main-processing. In order to show the generality of the EFMM, the generalized finite elements [10] are applied to the basis element of the EFMM, the effectiveness of which has been confirmed in some applications [10][11][12].

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