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Modeling of Large Elasto-Plastic Deformations by the Coupled FE-EFGM

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Abstract : In the recent years, the enriched techniques like the extended finite element method, the element free Galerkin method, and the Coupled finite element-element free Galerkin method have found wide application in modeling different types of discontinuities produced by cracks, contact surfaces, and bi-material interfaces. The extended finite element method faces severe mesh distortion issues while modeling large deformation problems. The element free Galerkin method does not have mesh distortion issues, but it is computationally more demanding than the finite element method. The coupled FE-EFGM proves to be an efficient numerical tool for modeling large deformation problems as it exploits the advantages of both FEM and EFGM. The present paper employs the coupled FE-EFGM to model large elastoplastic deformations in bi-material engineering components. The large deformation occurring in the domain has been modeled by using the total Lagrangian approach. The non-linear elastoplastic behavior of the material has been represented by the Ramberg-Osgood model. The elastic predictor-plastic corrector algorithms are used for the evaluation stresses during large deformation. Finally, several numerical problems are solved by the coupled FE-EFGM to illustrate its applicability, efficiency and accuracy in modeling large elastoplastic deformations in bi-material samples. The results obtained by the proposed technique are compared with the results obtained by XFEM and EFGM. A remarkable agreement was observed between the results obtained by the three techniques.

Keywords : XFEM, EFGM, coupled FE-EFGM, level sets, large deformation
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