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Dynamic nonlinear analysis using the smoothed finite element method

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Dynamic nonlinear analysis is a subject of great engineering importance and can practically be handled only by numerical methods due to its complexity. The aim of this paper is to develop the smoothed finite element method (SFEM)to perform the dynamic analysis of elastoplastic structures under plane stress or plane strain conditions. For SFEM, the problem domain is first divided into elements as in the finite element method (FEM), and the elements are further subdivided into several smoothing cells. Cell-wise strain smoothing operations are used to obtain the stresses, which are constants in each smoothing cells. Area integration over the smoothing cell becomes line integration along its edges, and no gradient of shape functions is involved in computing the field gradients and nor in forming the internal force. No mapping or coordinate transformation is necessary so that the element can be used effectively for model with very irregular meshes. The predictor-corrector form of the Newmark algorithm is used for the time-marching process and iterations are performed at every time step. The applied loads can have any transient time variation. Comparative results are presented at the end to illustrate the eff ectiveness of the proposed method and demonstrate its accuracy.

Keywords: Numerical method, SFEM, Dynamic response, Elastoplasticity

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