Explicit Mixed Formulation in Nonlinear Solid Mechanics. Softening, localization and stabilization in plasticity.

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1 Abstract

Keywords : *explicit, mixed formulation, softening, localization, stabilization.*

This paper presents a stabilized mixed explicit strain/displacement finite element formulation (SMEX-FEM) for the solution nonlinear solid mechanics problems involving plasticity. A Central Difference Method is employed for temporal integration of the equation of motion. Only the solution of diagonal systems of equations is required and the algorithm is purely explicit. Comparing to the standard, displacement based, irreducible formulation, the mixed formulation provides an enhanced rate of convergence for the strain and stress field. This papers investigates the effect of improved strain and stress fields in problems involving strain softening and localization leading to failure, using low order finite elements with continuous strain and displacement field in conjunction with frictional Mohr Coulomb and Drucker-Prager plastic models. The variational multiscale stabilization introduced allows the use of equal order interpolations. Numerical experiments show the capacity of the mixed formulation to predict the ultimate load, failure mechanisms and localized patters of strain which are virtually free from any dependence mesh directional bias without the need of any auxiliary crack tracking technique.

References

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