A Simple, Stable and Accurate Nodal Tetrahedral Finite Element for Transient Visco-/Elastic-/Plastic Computations: Current Developments and Future Applications in Geomechanics

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ABSTRACT

A new tetrahedral finite element for transient dynamic computations in solids is presented [1]. It utilizes the simplest possible finite element interpolations: Piece-wise linear continuous functions are used for displacements and pressures (P1/P1), while the deviatoric part of the stress tensor is evaluated with simple single-point quadrature formulas. This approach takes inspiration from previous work of the first author in the case of compressible fluid dynamics in Lagrangian coordinates [2]. The variational multiscale stabilization is used to eliminate the checkerboard instabilities affecting the pressure in the Stokes-type operator associated with solid dynamics computations. The formulation is extended to elastic-plastic, and visco-elastic solids. Extensive numerical tests are presented. Because of its simplicity, the proposed element could favorably impact complex geomechanics applications and basin-scale tectonics, which are considered as future directions of this work.

REFERENCES

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