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A VMS-stabilized mixed formulation for non-linear incompressible solid mechanics problems using the implicit Material Point Method

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ABSTRACT

Keywords: *Particle methods, Nonlinear Finite Element Method, Implicit MPM, Mixed formulation, Variational subgrid-scales (VMS), Incompressible solid mechanics*

In our work, two different stabilization techniques, both based on the Variational Multiscale (VMS) method, are employed to solve the dynamic non-linear solid mechanics problem in mixed formulation and in nearly-incompressible conditions.

We use an implicit Material Point Method to deal with large material deformation. This hybrid technique uses a fixed background grid to perform the calculations in a FEM fashion, and a collection of material points (MP) to store all the historical variables. MPM has all the advantage of classical Lagrangian Finite Element formulations, avoiding the need for remeshing.

We propose a Variational Multicale Stabilization techniques adapted for the implicit MPM mixed UP formulation. VMS method is compared with other stabilization techniques such as the Polynomial Pressure Projection [1], to assess their accuracy.

The proposed mixed formulations are tested through classical benchmarks in solid and geomechanics.

REFERENCES

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