ENHANCED MATERIAL POINT METHOD FOR DISASTER SIMULATION

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ABSTRACT

Several recently developed enhancements to material point methods (MPMs) are presented to increase the reliability and predictability of disaster simulations. The details of the enhanced techniques are as diverse as those listed below.

A. EBS-MPM [1]: Extended B-splines (EBS) and the Nitsche's method are incorporated into an implicit MPM to achieve numerical stability and properly impose boundary conditions.

B. F-bar projection-enhanced EBS-MPM [2]: F-bar projection method is incorporated into the EBS-MPM to suppress both volumetric locking and pressure oscillation due to quasi-incompressibility constraints, which is relaxed by adequate modification of volumetric deformation.

C. MPM for saturated soil: Coupled hydromechanical MPM are improved to increase the accuracy, stability, and convenience in analysing the large deformation of saturated soils in quasi-static and dynamic states.

D. Semi-implicit MPM for unsaturated soil: Fractional-step method is applied to the coupled hydromechanical MPM to solve the pore water pressure implicitly using the pressure Poisson's equation, which suppress the numerical instability and improves computational efficiency.

E. Hybrid MPM–FEM [3]: 2D–3D coupling strategy is devised to bridge 3D MPM-FEM hybrid and 2D shallow water simulations with a view to simulating the entire process of a landslide-triggered tsunami with relatively low computational costs.

REFERENCES

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