Enhanced Material Point Method for Soil-Object Interaction

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Key Words: Material Point Method, Hybrid Continuum-Discrete Framework, Soil-Object Interaction

Soil-object interactions are central to a wide range of engineering problems from infrastructure construction to geohazards mitigation to mobility systems. Accurate and efficient simulation of these soil-object interactions poses significant challenges for the standard material point method (MPM). Two of the major challenges are: (i) efficient representation of stiff objects, and (ii) robust simulation of frictional contact at soil-object interfaces. In this talk, we present an MPM framework enhanced to address these two challenges. First, it makes use of the level set method, an implicit way to represent interfaces, to capture the geometric information of complex objects in both accurate and efficient manners (Zhao et al. 2023). Second, it leverages a mapping technique that reparameterizes the problem domain at the interfaces, to alleviate sharp gradients arising in frictional contact at soil-object interfaces (Zhao et al. 2024). The enhanced MPM is verified and validated through a variety of soil-object interaction problems.

References

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