Coupled Soil-Structure Interaction Modeling and Simulation of Landslide Protective Structures

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ABSTRACT

Within the past two decades, mass movements hazards involving fast and large soil deformation have increased significantly in frequency and magnitude due to their strong relation to climate changes and global warming. These phenomena often bring along rocks, debris, and heavy materials that can extensively damage and destroy the landscape and infrastructures, causing devastating economic loss, and often, human casualties. The risk of future disasters continues to escalate with the increase of real estate development in sub-urban areas, including mountainous regions. Further assessment and prediction on such disasters and their countermeasures are, therefore, in high economic demands. One of the most intuitive ways is to install protective structures in mountain slopes and valleys that can hold the materials brought by the moving landslides. While the current state of the art of landslide prediction using numerical methods has been mainly dominated by the development of advance geomechanical models suited for different types of soil materials, e.g. multi-phase unsaturated soil model, this study focuses more on the interaction of such phenomena with the installed protective structures. Here, an implicit formulation of material point method (MPM) is implemented to model the landslides considering finite strain assumption. Furthermore, a staggered coupling scheme with traditional Finite Element Method is proposed to simulate accurately and robustly the dynamic force and displacement coupling of soil-structure interaction. All developments of the method are implemented within the *Kratos-Multiphysics* framework [1] and available under the BSD license. In the future works, a more adequate consideration of coupling scheme and material models considering damage and fracture will be investigated before conducting a real-scale landslide simulation.

REFERENCES

[1] Pooyan Dadvand, Riccardo Rossi, Eugenio Oñate. An object-oriented environment for developing finite element codes for multi-disciplinary applications. *Archives of computational methods in engineering* (2010). **17(3)**:253-297.