Estimation of granular flow impact force on rigid wall using Generalized Interpolation Material Point Method

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ABSTRACT

Landslides and avalanches cause loss of lives as well as generate significant economic cost. Protection barriers help reduce the impact of such events. However, the design of the barriers requires estimation of impact force as well as prediction of the landslide flow trajectory. Particle based numerical methods appear to have great potential for making such estimation since they can account for large displacement nature of sediment flows and their nonlinear behavior. Therefore, these methods should be able to capture the complex interaction of the landslide or avalanche with the ground and structures.

 This study focuses on simulating granular flows with Material Point Method. In particular, it combines Generalized Interpolation Material Point Method and Bagnold theory of granular flow [1] to model sand landslide / avalanche experiment [2]. In the simulations, sand is treated as a nonlinear elastic-plastic material [3]. Shown simulations aim was to replicate the experiment. In particular, the paper focuses on estimation of the impact force of sand flow on a fixed rigid wall. Such force estimation is a first step to validate the Generalized Interpolation Material Point Method for use as a tool for design of barriers defending against landslides and avalanches.

REFERENCES

[1] Duran, Jacques. *Sands, powders, and grains: an introduction to the physics of granular materials*. Springer Science & Business Media, 2012.

[2] Moriguchi, Shuji, et al. "Estimating the impact force generated by granular flow on a rigid obstruction." *Acta Geotechnica* 4.1 (2009): 57-71.

[3] Oztoprak, S., and M. D. Bolton. "Stiffness of sands through a laboratory test database." *Géotechnique* 63.1 (2013): 54.