# Implicit MPM-FEM Coupling Strategy for Simulation of Landslide Hazards Interacting With Protection Structure.

**Bodhinanda Chandra***, **Antonia Larese**†, **Roland Wüchner***, **Philipp Bucher***

* Chair of Structural Analysis, Department of Civil, Geo, and Environmental Engineering
Technical University of Munich, Arcisstr. 21, D-80333 München
email: bodhinanda.chandra@tum.de, wuechner@tum.de, philipp.bucher@tum.de, website:
http://www.st.bgu.tum.de/en/home/

† Department of Mathematics ”Tullio Levi Civita”
University of Padova, Torre Archimede, via Trieste 63, 35131 Padova
email: antonia.larese@unipd.it

## ABSTRACT

In recent years, natural hazards involving large mass movements such as landslides, debris flows, and mudslides have significantly increased in frequency due to the influence of global warming and climate change. These phenomena often carry huge rocks and heavy materials that may, directly or indirectly, cause damage to structures and the landscape. They are, therefore, extremely dangerous and often bring huge losses of lives and properties, resulting in a great economic loss, in particular, in rainy mountainous regions or in major earthquake zones. The risk of future disasters is predicted to continue to escalate with the increase of real estate development in suburban areas, including mountainous regions. Even if nothing can be done in a short time to avoid the disasters, protection structures should be designed, or improved, as such that it can minimize the damage induced by the dynamic soil forces.

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 the 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.