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Coupling photogrammetric data with DFN-DEM model for rock slope hazard assessment

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Structural and mechanical analyses of rock mass are key components for rock slope stability assessment. The complementary use of photogrammetric techniques [Poropat, 2001] and coupled DFN-DEM models [Harthong et al., 2012] provides a methodology that can be applied to complex 3D configurations. DFN-DEM formulation [Scholtès & Donzé, 2012a,b] has been chosen for modeling since it can explicitly take into account the fracture sets. Analyses conducted in 3D can produce very complex and unintuitive failure mechanisms. Therefore, a modeling strategy must be established in order to identify the key features which control the stability.
For this purpose, a realistic case is presented to show the overall methodology from the photogrammetry acquisition to the mechanical modeling. By combining Sirovision and YADE Open DEM [Kozicki & Donzé, 2008, 2009], it can be shown that even for large camera to rock slope ranges (tested about one kilometer), the accuracy of the data are sufficient to assess the role of the structures on the stability of a jointed rock slope.
In this case, on site stereo pairs of 2D images were taken to create 3D surface models. Then, digital identification of structural features on the unstable block zone was processed with Sirojoint software [Sirovision, 2010]. After acquiring the numerical topography, the 3D digitalized and meshed surface was imported into the YADE Open DEM platform to define the studied rock mass as a closed (manifold) volume to define the bounding volume for numerical modeling. The discontinuities were then imported as meshed planar elliptic surfaces into the model.
The model was then submitted to gravity loading. During this step, high values of cohesion were assigned to the discontinuities in order to avoid failure or block displacements triggered by inertial effects.
To assess the respective role of the pre-existing discontinuities in the block stability, different configurations have been tested as well as different degree of fracture persistency in order to enhance the possible contribution of rock bridges on the failure surface development.
It is believed that the proposed methodology can bring valuable complementary information for rock slope stability analysis in presence of complex fractured system for which classical “Factor of Safety” is difficult to express.

References

• Harthong B., Scholtès L. & F.V. Donzé, Strength characterization of rock masses, using a coupled DEM-DFN model, Geophysical Journal International, doi: 10.1111/j.1365-246X.2012.05642.x, 2012.
• Kozicki J & Donzé FV. YADE-OPEN DEM: an open–source software using a discrete element method to simulate granular material, Engineering Computations, 26(7):786-805, 2009
• Kozicki J, Donzé FV. A new open-source software developed for numerical simulations using discrete modeling methods, Comp. Meth. In Appl. Mech. And Eng. 197:4429-4443, 2008.
• Poropat, G.V., New methods for mapping the structure of rock masses. In Proceedings, Explo 2001, Hunter Valley, New South Wales, 28-31 October 2001, pp. 253-260, 2001.
• Scholtès, L. & Donzé FV. Modelling progressive failure in fractured rock masses using a 3D discrete element method, International Journal of Rock Mechanics and Mining Sciences, 52:18-30, 2012a.
• Scholtès, L. & Donzé, F.-V., DEM model for soft and hard rocks: role of grain interlocking on strength, J. Mech. Phys. Solids, doi: 10.1016/j.jmps.2012.10.005, 2012b.
• Sirovision, Commonwealth Scientific and Industrial Research Organisation CSIRO, Siro3D Sirovision 3D Imaging Mapping System Manual Version 4.1, 2010