EGU2020-20353
EGU General Assembly 2020

The RockModels Project: Rockfalls Characterization and Modelling

Nieves Lantada[1], Jordi Corominas[1], Josep A. Gili[1], **Gerard Matas**[1], Roger Ruiz-Carulla[2], Albert Prades[1], Càrol Puig-Polo[1], M. Amparo Núñez-Andrés[1], Jose Moya[1], Felipe Buill[1], and Olga Mavrouli[3]
[1]Department of Civil and Environmental Engineering. Universitat Politècnica de Catalunya (UPC.BarcelonaTech), Barcelona, Spain. (nieves.lantada@upc.edu)
[2]Centre Internacional de Mètodes Numèrics en l'Enginyeria (CIMNE), Barcelona, Spain.
[3]Faculty of Geo-Information Science and Earth Observation, ITC (ESA), University of Twente. Enschede, The Netherlands.

A rockfall is a rapid mass movement generated by the detachment of a rock volume from the slope that falls, rolls and bounces during its propagation downhill. Rockfalls have great destructive potential due to the high kinetic and impact energies that may reach during the propagation. Rockfalls are frequent instability processes in road cuts, open pit mines and quarries, steep slopes and cliffs. The initial mobilized mass can be either a single massive block or a set of blocks defined by the joints present in the massif. During the propagation, the block or blocks detached may break when impacts against the terrain, producing a distribution of fragments with independent trajectories. Knowledge of the size and trajectory of the blocks resulting from fragmentation is critical for the assessment of the potential damage and the design of protective structures.

In this contribution, we summarise the main achievements of the RockModels project (BIA2016-75668-P, AEI/FEDER,UE). This project aims at quantifying the risk induced by fragmental rockfalls, by developing quantitative risk assessment methodologies and providing tools to improve its prevention and mitigation. It has three general objectives: i) Explicit identification of unstable rock volumes and stability assessment; ii)Development and validation of a fragmentation model, iii) Rockfall propagation analysis by means of the development of a 3D simulator tool and its calibration.

The use of geomatic techniques such as terrestrial photogrammetry or from UAV allow the generation of high-resolution 3D models of cliffs and the joint system characterization based on 3D point clouds. The orientation and persistence of joints within the rock mass define the kinematically unstable rock volumes and determine the initial block size distribution. We inventoried fragmental rockfalls occurred in Spain by obtaining a 3D model, the orthophoto, specific cartographies and detailed volumes measurements to obtain the block size distribution in the deposits of each event. The fragmental rockfalls inventory have been collected in a spatial database using PostGIS and following the INSPIRE directive for natural hazards. This data can be consulted at different scales with a developed Web Map Service (WMS) (https://rockdb.upc.edu/). The inventory is the empirical data used to developed, calibrate and validate the Rockfall Fractal Fragmentation Model proposed, as well as the 3D trajectory simulator RockGIS that incorporates the fragmentation module.

More empirical data has been obtained by performing 4 real scale fragmentation test in a quarry. The impact of each block and trajectories of the fragments were recorded by several high speed cameras from different points of view. A program has been implemented to measure the kinematics of each tested block using the high-speed videos. The obtained kinematic parameters have been used for the calibration of the RockGIS simulator. An additional essay was carry out at laboratory to study the effect of the comminution among blocks. The distribution of fragments obtained confirms that the blocks undergoing greater confinement generate a greater number of fragments decreasing their maximum volume.