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DEM Modeling of rockfall rebound on Protective Embankments

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ABSTRACT

Design of Rockfall Protection Embankments and estimation of their capacity to deviate the trajectory of rock boulders are complex issues, which give considerable room for further improvement. A lack of detailed models for the simulation of block rebound dynamics is mainly due to the large number of parameters that influences the phenomenon. Therefore, the evaluation of the embankment efficiency in modifying the block trajectory, as a function of the site characteristics, is still precluded to design engineers.

In the present paper, the open-source numerical code YADE [1], based on a discrete element method (DEM) is used to improve the modelling of the bouncing of a rock block on the embankment face, while taking into account a certain number of parameters with influence on the impact.

By contrast with previously developed models (DEM, FEM or coupled approaches), and considering the specific goal of this model, the embankment is modelled as a membrane interacting with the rock block. The embankment body is not represented because it would require a large number of particles, and, consequently, a high computational time. Different Yade's options were considered to propose a membrane exhibiting realistic response to impact, in terms of rock block penetration and rebound. Among the type of elements used to model the embankment surface, PFacets, which guarantee the friction between boulder and surface, gave particularly relevant results. PFacets are an innovative type of elements implemented in YADE.

The validity of the approach is addressed comparing simulation results with the few experimental data available from the literature (e.g. [2].) The influence of characteristics of the impacting block (radius and weight) and kinematic parameters (impact angle and velocity) on the restitution coefficients is explored. In particular, the normal (R_n), tangential (R_t) and energetic (R_{TE}) coefficients of restitution are monitored with the aim of evaluating their influence in the phenomenon and defining an efficient model in a realistic range of these parameters.

REFERENCES

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[2] Heidenreich B., 2004. Small- and half-scale experimental studies of rockfall impacts on sandy slopes.