Numerical modelling with discrete elements of rockfall protection systems

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ABSTRACT

Some important infrastructures like roads, railway tracks or dams were constructed in places threatened by natural hazards. With the purpose of preserving these infrastructures from landslides and rock-falls, different containment systems are installed, and one of the most popular are the flexible metallic fences [1].

The development of full-scale laboratory tests to evaluate the behaviour of flexible metallic fences is unfunctional, accounting to the huge magnitude of the event [2]. On the other hand, small-scale testing may lead to inaccurate results, due to the distortion in the contours (e.g. anchors of the metallic fences). These problems in laboratory testing have led to the popularization of the use of numerical methods.

In this study, the bonded Discrete Element Method (DEM) is used for the analysis of the behaviour of flexible metallic fences for rockfall protection. The bonded DEM is a modification of the classical DEM which assumes that bonds exist between particles, resisting their separation [3]. In this case, the net cables are represented using rigid spheres joined by bond elements that are deformed according to an elasto-plastic law.

Calculations were carried out using the DEMPack program, a specific software developed in CIMNE for modelling with the bonded DEM [4]. This software allows considering the inter-action between discrete and finite elements [5], which can be useful to represent the boundaries of the domain, such as the surface of the slope.

The code is firstly validated reproducing benchmark tests available in the literature [1]. Finally, full-scale tests are computed in order to evaluate the energy dissipation capacity of the fence during a rockfall event.

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