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Discrete modelling of drapery systems

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Drapery systems are an efficient and cost-effective measure in preventing and controlling rockfall hazards on rock slopes. The simplest form consists of a row of ground anchors along the top of the slope connected to a horizontal support cable from which a wire mesh is suspended down the face of the slope. Such systems are generally referred to as simple or unsecured draperies (Badger and Duffy 2012). Variations such as secured draperies, where a pattern of ground anchors is incorporated within the field of the mesh, and hybrid systems, where the upper part of an unsecured drapery is elevated to intercept rockfalls originating upslope of the installation, are becoming more and more popular. This work presents a discrete element framework for simulation of unsecured drapery systems and its variations.

The numerical model is based on the classical discrete element method (DEM) and implemented into the open-source framework YADE (Šmilauer et al., 2010). The model takes all relevant interactions between block, drapery and slope into account (Thoeni et al., 2014) and was calibrated and validated based on full-scale experiments (Giacomini et al., 2012).The block is modelled as a rigid clump made of spherical particles which allows any shape to be approximated. The drapery is represented by a set of spherical particle with remote interactions. The behaviour of the remote interactions is governed by the constitutive behaviour of the wire and generally corresponds to a piecewise linear stress–strain relation (Thoeni et al., 2013). The same concept is used to model wire ropes. The rock slope is represented by rigid triangular elements where material properties (e.g., normal coefficient of restitution, friction angle) are assigned to each triangle.

The capabilities of the developed model to simulate drapery systems and estimate the residual hazard involved with such systems is shown.

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