Geophysical Research Abstracts
Vol. 21, EGU2019-7128-1, 2019
EGU General Assembly 2019

Influence of rock shape and tree diameter on the dynamic response of a non-spherical rock impacting on a tree stem

Adrian Ringenbach, Guang Lu, Andrin Caviezel, Marc Christen, and Perry Bartelt
WSL Institute for Snow and Avalanche Research SLF, Switzerland (adrian.ringenbach@slf.ch)

Forests are an important mitigation measure against rockfall hazards (Dorren et al. 2007). To maximize the mitigation effect of forests on rockfall damages, it is important to understand from a fundamental perspective the dynamic interaction between a single rock and a single tree stem. This is indeed the major motivation lying behind the discrete-element-method (DEM) simulations performed by Toe et al. (2017), where their numerical model incorporated the complex mechanical process during an impact of rock on a tree stem. In their sensitivity analysis they found that there are only a few the so-called leading influencing factors which determine most of the block kinematics after its colliding with a tree. However, despite these achievements many open challenges exist: on one hand, such a DEM approach is computationally very expensive and thus it is not friendly to be implemented in practices, i.e. on a slope scale; on the other hand, so far studies have been conducted only using virtual, spherical rocks but the influence of rock shape on the trajectory kinematics has not been thoroughly considered. It is certain that incorporating rock shapes into rock-tree impact investigations is a must to understand the practical significance of a forest's prevention role in rockfall hazards.
To overcome the computationally demanding nature of DEM, RAMMS::ROCKFALL will be used for this study. Its non-smooth contact dynamics approach coupled with hard contact laws (Leine et al. 2014), which was successfully implemented in rock-ground impact conditions (Lu et al. 2019 (submitted)), has been extended to rock-tree modelling in this work. The primary goal of this study is to understand in greater details the influence of rock shape on its dynamic response after impacting with a single tree stem. The analyses of a rock's translational and rotational velocity/energy changes before and after an impact are keys to elucidate the shape effects on rock behavior. Here, the different rock shapes, ranging from elongated to flattened, are primarily distinguished via using the parameter called aspect ratio, which represents the ratio between the longest and the shortest length of an elongated (flattened) rock's principal axis. For the same rock aspect ratio, different rock surface blockiness can be further quantified using the ratio between the surface area of the used rock and that of the volume-equivalent sphere. In a second step, the effect of different tree diameters (DBH) on the outgoing rock's trajectory kinematics will be investigated, i.e. at a fixed rock aspect ratio the tree diameter will be altered. This allows find the influence of the DBH on rotational and translational velocities aswell on the deflected angles of the rocks.

Keywords: Rockfall, rock shape, single tree impact, DBH, non-smooth mechanics.