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# Rockfall hazard assessment using a stochastic bouncing model

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The use of trajectory analysis software that really account for the stochastic nature of the trajectory of falling rocks is necessary to make relevant hazard maps and to optimize the design of protective structures such as nets and dams. In this paper, a stochastic trajectory analysis model providing a stochastic prediction of the trajectory of falling rocks is exposed. This model is used in order to position and design protective structures.
The stochastic trajectory analysis model is based on the definition of a stochastic bouncing model relating the block kinematics parameters before and after its interaction with the granular soil. The parameters of the stochastic bouncing model are defined further to a complete statistical analysis of numerical results using Bayesian inference. The numerical simulations of the impact of a rock used for the statistical analysis are performed using a Discrete Element Method with the software PFC2D for varying impact points and boulder incident kinematics parameters. The parameters of the model are determined for different impacting particle and medium characteristics in order to provide sets of parameters valid for several impact conditions.
The stochastic bouncing model is integrated into a trajectory analysis model in order to develop a global stochastic framework for rockfall hazard prediction and protection. The stochastic trajectory analysis model developed allows characterizing probability distributions functions that quantify hazard levels on endangered slopes. In addition, a methodology is proposed for the optimization of protective structures design. The proposed methodology also allows defining probability distribution functions of the impact energy on the protective structures leading to the statistical characterization of the structural efficiency of the protective structure.