

Using Terrestrial Laser Scanning Point Cloud for Block Volume Analysis in a Hazardous Rock Slope

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Due to the significant risk involved, rockfalls are among the most extensively studied natural phenomena in the field of geomechanics. Risk is defined in terms of the hazard posed by the phenomenon and the potential impact on exposed elements (i.e., human lives, buildings). Moreover, hazard is function of the propensity to detachment (estimated frequency), the magnitude (volume) and intensity (velocity or kinetic energy) of the expected event.

The former identifies the predisposing condition and the probability for the phenomenon to manifest in form of planar sliding, wedge sliding, or toppling in relation to the main discontinuity sets recognized. The last factors refer to the most probable volume of the block prone to detachment and its potential propagation path.

The traditional approach used in geo-structural surveys involves defining the block volume based on the spacing measured as the distance between discontinuities belonging to the same main set. Other approaches are focused on deterministic response, which, however, cannot be generalized to the entire slope. However, the definition of volume remains an area of ongoing exploration. The factors defining rockfall hazard are typically determined through direct data acquisition on the investigated rock mass. However, in recent decades, indirect approaches to rock mass characterization have gained prominence, optimizing acquisition times and enabling data collection in difficult to access and hazardous areas.

This study aims to assess the hazard derived by a rock slope in the mountain system of Palermo (southern Italy). Frequent rockfalls in this area have occasionally led to restrictions on vehicular traffic on the roads around or over it. Given the risk conditions, the authors opted for an indirect approach to rock mass characterization using a Terrestrial Laser Scanner. This method allowed for the acquisition of a high-resolution 3D Point Cloud. Based on the data acquired the authors propose a probabilistic approach to block volume definition, based on the statistical analysis of a database of unstable blocks on the rock front. The database is created using an available tool in a 3D point cloud

40 processing software that allows for the direct definition of volumes once they
41 have been isolated on the point cloud.

42 **Keywords:** Rockfalls, Remote Sensing, 3D Point Cloud, Volume Analysis,
43 Hazard Assessment