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Semi-automated discontinuity orientation extraction in complex rock masses using single-scan LiDAR data.

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In geo-engineering projects dealing with rock formations, and especially with rocky outcrops, discontinuity orientation is one of the most important parameters that should be carefully estimated. Slope stability is significantly dependent on discontinuity geometry, and even slight changes in orientation may affect the factor of safety. For this reason, joint orientation measurement is the main component of the preliminary site investigation for slopes.
The use of three dimensional models derived from LiDAR scans or photogrammetric models has seen substantial growth in the field of geosciences in the last decade, with many examples of useful application and analysis. Several authors have developed techniques and methodologies (Jaboyedoff et al. 2010; Kemeny et al. 2006; Lato at al. 2007; Riquelme et al. 2014) to semi-automatically extract geometric features including joint orientation by using LiDAR data. In this study, the Discontinuity Set Extractor (DSE) (Riquelme et al. 2014) methodology for plane detection and joint orientation extraction is examined.
DSE provides a powerful toolset for plane detection and plane orientation assessment, and has been tested in several cases (Riquelme et al. 2017; Buyer, AA & Schubert, W. 2017; Farmakis, I. 2018). However, when evaluating the stability of complex rock masses, some difficulties and uncertainties may arise. The current study demonstrates an application of the DSE methodology on a complex rocky slope in British Columbia, comprising four different lithologies and complex tectonics. In this case, The methodology was found to be problematic, in part due to the available LiDAR data set, and in part due to the complexity of the surface exposure of the joint surfaces. The method was modified as are discussed in this paper so that realistic outputs can be extracted. All of the tests, together with the different approaches, are presented in detail, and the results are compared with manually measured orientations along the point cloud for the verification of their validity.