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Structural analysis of cliffs using terrestrial laser scanning and field measurements

T. Oppikofer, R. Metzger, M. Jaboyedoff

Institute of Geomatics and Risk Analysis, University of Lausanne, Switzerland
(thierry.oppikofer@unil.ch; +41-21-6923534)

Terrestrial laser scanning provides high definition 3D point clouds of the topography and especially of steep, hardly accessible rock walls. Various point cloud analysis software are nowadays available to perform the structural analysis of the cliff. For this study different manual, semi-automatic and automatic approaches are tested on the Hegguraksla study site in Norway and compared with field measurements. The study site is formed by an up to 250 m high, vertical and sometimes even overhanging cliff in thin-bedded gneisses and augengneisses with a generally well developed foliation and several very persistent discontinuity sets.

The manual technique involves the selection of points forming a discontinuity using a point cloud analysis program and the fitting of a planar structure across the selection. The orientation of the plane corresponds to the one of the discontinuity. The semi-automatic procedure uses the new Coltop3D software, which represents the spatial orientation of each 3D point and its neighbours with a distinct and unique colour. Discontinuity sets become easily identifiable and their mean orientation and variability is simply obtained by selecting areas with homogeneous colour. The automatic approach in SplitFX software creates a regular mesh of the point cloud, computes patches, i.e. continuous areas with similar orientation, and calculates their orientation and surface.

All used techniques are able to identify four major discontinuity sets and the calculated orientations are very similar to field measurements although that they were not directly made on the cliff itself due to limited accessibility. On the other hand the manual and the automatic techniques do not detect some minor discontinuities even though they

are measured in the field and are clearly identifiable using the colour representation of Coltop3D. This is probably due to the rather low area of the discontinuity surface and a quite large variability of these often irregular fractures.