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An experimental essay to detect small displacements on rockslopes

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Terrestrial laser scanning (TLS) is one of the most relevant remote sensing techniques on rockslope characterization and monitoring. Variations of the 3D geometry (i.e. landslides, rockfalls) can be clearly detected by means of multi-temporal comparison of scans. One of the present challenges on remote sensing of rockslopes consists not only on rockfall detection and analysis after the event but also on temporal and spatial prediction of rockfall. In order to advance on the latter, following questions need to be solved first: Is it possible to detect some displacement on a rockslope prior that a rockfall occur? Is the instrumental error small enough to detect these displacements on rockslopes? In an affirmative case and for a given range, which is the minimum detectable change with TLS?

An outdoor essay with controlled conditions of range and deformation is performed in order to solve these questions. The essay consists on an induced displacement of three objects, i.e. a plane, a half-sphere and an irregular form, relative to a fixed, stable part. The displacements range between 0 and 25 mm, with an increment of 5 mm between each scan. The essay was done at Lausanne University campus with a distance between the TLS and the object of 50, 100, and 200 m. In order to know the instrumental precision on displacement detection, TLS measurements were compared with simple calliper readings that can be considered as the real displacement.

Results show that millimetrical changes on the rockslope cannot be detected using conventional methodologies, i.e. the analysis of single points only. This is due to the

fact that those technologies are not fully exploiting one of the main advantages of the TLS: the high density of information. However, displacement measurements are considerably improved by taking into account the measurements of the neighbour, since the instrumental error gets filtered. Results using this methodology are up to 20 times more precise than on a single point comparison. Based on these results, millimetrical displacements can be measured on rockslopes using TLS. The detection of small displacements and crack opening prior to rockfalls is thus possible.