Assessment of Remote Data Capture Systems for the Characterisation of Rock Fracture Networks within Slopes

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ABSTRACT

The use of remote techniques to capture the geometrical characteristics of rock masses has seen increased use and development in recent years. Apart from the obvious improved Health and Safety aspects, remote techniques allow rapid collection of digital data that can be subsequently analysed to provide input parameters for a variety of geomechanical applications. Remote data capture is a new technique used to collect geotechnical data and little independent work has been done concerning the comparative limitations and benefits of photogrammetry and laser scanning. Photogrammetry and laser scanning produce three dimensional digital representations of a studied rock face which can then be mapped for geotechnical data using specialist software.

Research conducted at Camborne School of Mines, University of Exeter has focussed on developing robust and flexible methodologies for remote data capture techniques, namely photogrammetry and laser scanning. Geotechnical characterisation for photogrammetry was tested using the CSIRO Sirovision software and laser scanning was used with SplitFX from Split Engineering. A comparative method of assessing the error between orientation measurements was developed based on calculating the pole vector difference between remotely captured and traditionally hand-mapped data. This allowed for testing of the benefits of the remote data capture systems and limitations whilst comparing them with conventional hand-mapping. The thesis also describes the results of detailed comparisons between hand-mapping, photogrammetric and laser scanned data collection for discontinuity orientation, roughness, discontinuity trace lengths and potential end-use applications.

During fieldwork in Cornwall, Brighton Cliffs and northern France it was found that remote data capture techniques struggled to collect orientation data from intensely fractured rock masses where features are primarily represented as discontinuity traces.

It was found that both photogrammetry and laser scanning produce orientation data comparable to traditionally mapped data, with an average pole vector difference less than 12° from data mapped from the Tremough Campus road cutting to the University of Exeter’s Cornwall Campus. Set analysis on 151 comparable data points yielded a maximum set pole vector difference of 9.8°, where the closest difference was 2.24°. Testing the accuracy of discontinuity trace orientations captured by photogrammetry
using the pole vector difference methods indicate that planar derived orientations are more accurate, with an average difference of 16.67° compared to 37.72°.

This thesis contains the reviews and analyses of photogrammetry and laser scanning for use in characterising natural and manmade rock slopes. Improved field and post-processing methodologies have been developed to aid the safe, efficient and suitable geotechnical characterisation of rock fracture networks. The continual development and use of remote mapping techniques, whilst supplementing their unique qualities with traditional mapping, have the capability to revolutionise rock mass mapping. Particular development needed is the implementation of ISRM guidelines to standardise photogrammetric and laser scanning fieldwork and post-processing data analysis.
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