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Terrestrial laser scaning for rockslope monitoring & joint orientation: the influence of the point density

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Laser scanning is increasingly being adopted as a technique for characterizing natural rock faces, extracting their morphometric information and undertaking change detection with the aim of greater understanding rockfall processes and mechanisms. The ability of a laser scan data set to represent the surface under examination is strongly influenced by the point density of the survey, and, with the absence of a standard approach for determining an adequate survey density, a best guess approach is commonly employed.

This paper addresses the influence of variable survey resolution on the ability of laser scan data to precisely measure rock surfaces, and explores the reasons and implications of this. The paper addresses the basic question of how densely do you need to scan any given rock face to obtain the required results. Our data suggest that commonly what appears to be the correct result can be obtained for the wrong reason; a problem attributed to scan data 'looking good' either due to the similarity between survey error and natural surface variability, or by taking simple measures of instrument precision as model accuracy in the absence of any better alternative survey. Here we develop an analysis which uses randomly selected sub-sets of various densities of a series of high resolution scans of distinctly jointed columnar basalt at Castellfollit de la Roca (Catalonia, Spain). This is used to test the ability of the scan to derive morphometric data at a range of scales, from joint geometry, roughness and spacing. The results are considered in the context of a parallel control survey of a regular built structure, which we treat in the same way as the facets of a rock mass. The research demonstrates that the measurement precision of the scanner is such that the highest

obtainable resolution does not always give the best available result. This has significant implications for our ability to constrain joint geometry, and also has an influence on the confidence with which any change can be detected. With millimetric point spacing, the instrumental error causes random noise in the value of TIN orientations. By contrast, decimetric point spacing causes erroneously smoother surfaces due to oversimplification. Our results suggest that relationship between point spacing and dimensions of the discontinuities should define the point spacing in data acquisitions of future campaigns.

The paper concludes with data illustrating acceptable errors associated with various survey resolutions, which has the potential to act as a tool in survey design, and is critical for the use of high resolution DEMs for landslide and rockfall study. In conclusion the results imply that a measure of surface texture or roughness should define the point spacing in future data acquisitions