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Impact of image compression on Structure from Motion photogrammetry

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The recent growth in popularity of photogrammetry for geoscientific studies has largely been driven by the development of Structure from Motion (SfM) algorithms. Their use require relatively low levels of technical expertise for the production of three dimensional point data that can subsequently be used as a primary data source. While much research has gone into optimising camera network design and parameterisation of the SfM process, little attention has been given factors associated with image collection and processing which will impact the image data. This research details the effect of image compression and, specifically, the impact of images acquired in the standard JPEG format with varying levels of compression on the SfM workflow. JPEG compression is categorized by how aggressively portions of the image are quantized by lookup tables using a metric known as 'quality'.

This research investigates the impact of image compression within an SfM photogrammetry workflow, quantitatively assessing photogrammetric outputs. To do this, two field surveys were undertaken in Norfolk, UK, where over 5000 images were captured using a Nikon D700 camera and Nikkor 35 mm lens to test a range of image compression scenarios on photogrammetric outputs. These were recorded in the Nikon NEF RAW file format before lossless compression to 16-bit uncompressed TIFF files. Contemporaneously, a control network was surveyed using a Leica total station data (TCR-805; estimated 3 mm distance accuracy) and a further point cloud was captured with a Leica terrestrial laser scanner (P40, estimated 3 mm 1-sigma accuracy).

We find that JPEG compression degrades photogrammetric results, and should not be used when accuracy is a high priority. For JPEG images produced at low levels of compression (compression 'quality' 92; typical default JPEG compression), an increase of 4.3 % in median cloud-cloud error is observed when compared to the TIFF image files. Point count is also reduced, though only slightly, with the TIFF image files producing 1 % more points. Increasing compression to a 'quality' of 50 (similar to Nikon 'basic image' compression) increases this error to 13.2 % when compared with the TIFF image files. Point count is also decreased, with the clouds containing 7.5 % less points than those produced from the TIFF image files. Whilst these results are scene-dependant, a trend in degradation of photogrammetric products with increased compression is evident across all imagery analysed within this experiment.

We conclude that image compression and data handling are important considerations within the SfM workflow and consequently RAW image data should be required for use within photogrammetric workflows where possible.