Mapping Rock Fractures Using a Miniature Structured-Light Sensor: A Case Study from the Canadian Wollastonite Mine

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The structured-light sensor is a miniature (119.2 mm x 27.9 mm x 29 mm; mass: 95 g) and inexpensive (~$500) instrument that attaches to a computer tablet and captures the reflection pattern of projected infrared laser light as a point cloud. The sensor software processes the raw data points internally and outputs a 3D image as a triangular mesh. The instrument has an acquisition rate of 30 frames per second, an image resolution of 320 × 240 voxels, and horizontal and vertical fields of view of 58° and 45°, respectively. It performs best under diffuse lighting conditions. We are piloting the use of the miniature structured-light sensor to image geological scenes from a distance of ~3 m. At that distance, the precision of the instrument is ~30 mm. The main objective is to determine the preferential orientation of fractures in the rock mass to facilitate geological structural mapping. On December 8th, 2015 the structured-light sensor was taken to the Canadian Wollastonite open-pit mine located in Seeley's Bay, approximately 26 km north of the City of Kingston for its first field test. The purpose of this test was to image two freshly blasted gneiss rock walls (one facing northeast that was approximately 6 m long and 3 m high and another facing southwest that was approximately 10 m long and 3 m high). The weather was sunny, but the rock walls were oriented such as they were in the shade during imaging. A total of 95 scans were taken using the structured-light-sensor, which includes duplicate scans acquired to fill in gaps in coverage due to occlusion effects. The MeshLab open source software was used to align and merge the scans into a single triangular mesh containing ~1 million triangles with each triangle covering an average surface area of ~2 cm^2. An additional 26 strike and dip measurements were taken from the two rock faces using a Brunton compass for later comparison. In post-processing, the orientation of each triangle in the mesh was calculated, and the results reported through a stereonet. These results were compared to the compass measurements to assess the applicability of the structured-light sensor for mapping rock fractures. The mesh was also color-coded to highlight features of interest.