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Adaptive Feature Detection for Improved Measurement of Structural Orientations Using Core Imagery

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High-quality structural measurements play a key role in building effective geological models and predicting the geotechnical behavior of an orebody. Measurements of fracture, joint, vein, foliation, and fault orientations all contribute to the evolving understanding of an ore deposit and are key to making informed geological and engineering decisions. As the number of high-quality input measurements increases, so does the accuracy of the output model. Since these measurements are typically collected manually, recent efforts have focused on the generation of larger, high-quality data sets by obtaining structural measurements from drill core imagery in an automated fashion. Doing so has the potential to expedite the otherwise lengthy and expensive process of manual measurements, and to output larger quantities of data with greatly improved consistency.

Automated methods offer a decisively convenient way to collect structural measurements and enhance geological models; however, they must be robust in order to maintain measurement accuracy even with diverse geological inputs. Parameters such as drill core texture, size, shape, and colour, along with competency and the image resolution in which data is captured, can change significantly across projects and drill hole intervals. If these factors are not considered upon deployment of an automated method, the accuracy of structural detection and measurements can be affected.

To maximize the accuracy of structural measurements acquired automatically from drill core imagery in a generalized capacity, a statistical technique was developed for automated feature detection, which can adapt the detection method to suit the input image data. This method examines image statistics localized to probable target structures and amplifies signal of the detected feature accordingly. In doing so, statistical outlier removal of a relative magnitude can be applied on a localized basis to clean structural image data while preserving accurate but weak signals elsewhere in the drill core imagery (Fig. 1). This scalable solution can be applied across data sets to account for a variety of different drill core characteristics and pixel resolutions in RGB and 3D profiler image data, ultimately reducing the rate of false positive errors and increasing the rate of true positive detections.

Here, we present how this adaptive method can be applied for improved measurement of structural orientations when faced with various types of drill core. We will demonstrate our ability to increase the accuracy of automatically measured structures from data set to data set and to generate large sets of high-quality measurements for robust geological and/or engineering solutions.

Fig. 1. Example of adaptive feature detection applied to the measurement of fracture orientations where (a) is an RGB image in which fractures and orientation line (black marker) are displayed; (b) automatically detected fractures (shown in yellow and blue representing high and low detected signal, respectively) before adaptive feature detection is applied; and (c) results of adaptive feature detection showing two fractures accurately detected and oriented in space, despite their variable signal strength (as shown in image b).