Automated Rock Quality Designation (RQD) Estimation from Digital Images of Drill Cores Using Convolutional Neural Network

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ABSTRACT

Mineral and hydrocarbon exploration relies heavily on the geological and geotechnical information extracted from drill cores. While traditional drill-core characterization is purely based on a geologist's manual time-consuming and subjective expertise, the onset of the Hylogging technology has offered automatic mineral analysis and provides high-resolution images of drill core in a non-destructive manner. However, automated rock mass characterization still presents a significant challenge because of its lack of generalization and robustness. To date, the automated estimation of rock quality designation (RQD), which is a key parameter for rock mass classification, is mostly based on digital image processing techniques that have significant user biases based on the input parameters. To tackle this, we propose to use computer vision and machine learning based algorithms for drill core characterization, specifically to determine RQD, using drill core images from a Hylogger system. A Convolutional Neural Network (CNN) is implemented under a supervised learning scheme. First, the colour images of drill core trays are automatically segregated into rows according to their assigned depth using image processing techniques. These individual core rows are used to create training data for a CNN classification model. After training, the CNN model can detect and classify fractured and non-fractured regions in the core trays. This technique also eliminates non-rock objects presented in the core trays. Finally, the model can extract geometrical information of detected fractures and intact cores to estimates RQD, which can be further used to calculate Rock Mass Rating or Q value. Using a CNN model that is trained on thousands of core images taken from different drill holes ensured that the algorithm is generalized and more robust than the current techniques available. Application of this procedure can ensure less subjective results and reduce time and cost associated with routine RQD calculation and rock mass classification.