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Investigation of a Crack Attack Angle Extraction Technique to Enhance AI-Based Overbreak Prediction Accuracy in Tunnel Blasting

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Abstract

Rock blasting is widely used due to its economic and efficient nature in hard rock tunnel construction. However, "overbreak," which refers to excavation beyond the design specifications, is recognized as a problem that leads to increased construction costs and reduced safety. Multiple factors contribute to overbreak, including geological conditions, explosive charge, and drilling status, however a clear causal relationship has not yet been elucidated. Therefore, there is a need to manage overbreak and optimize blast design in tunnel excavation sites.

In recent years, researchers have proposed the Overbreak Resistance Factor (ORF) as a quantitative indicator to evaluate the relationship between geological conditions and overbreak. They are also developing a model that aims to predict overbreak volume and understand the influence of geological data using an Artificial Neural Network (ANN). However, collecting data on crack attack angle against wall, which is considered a crucial factor in ORF, is difficult in Japanese tunnels. For this reason, conventional research has employed a method of estimating angles from cross-sectional images, which has led to challenges such as data dispersion and impact on ANN model learning accuracy.

This study proposes a method for extracting cracks from point cloud data of 3D models created by Structure from Motion (SfM) to improve the versatility and practicality of the overbreak prediction model. This approach is expected to enable the stable collection of geological data and enhance the learning accuracy of the ANN model.