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XG Boost Algorithm to Simultaneous Prediction of Rock Fragmentation and Induced Ground Vibration Using Unique Blast Data

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Abstract: The two most frequently heard terms in the mining industry are safety and production. These two terms put a lot of pressure on blasting engineers and crew to give more while consuming less. The key to achieving the optimum blasting results is sophisticated bench analysis, which must be combined with design blast parameters for good fragmentation and safe ground vibration. Thus, a unique solution for forecasting both optimum fragmentation and reduced ground vibration using rock mass joint angle and blast design parameters will aid the blasting operations in terms of cost savings. To arrive at a proper understanding and a solution, 152 blasts were carried out in various mines by adjusting blast design parameters concerning the measured joint angle. The XG Boost, K-Nearest Neighbor, and Random Forest algorithms were evaluated, and the XG Boost outputs were shown to be superior in terms of Mean Absolute Percentage Error (MAPE), Root Mean Squared Error (RMSE), and Co-efficient of determination (R^2) values. Using XG Boost, the decision-tree-based ensemble Machine Learning algorithm that uses a gradient-boosting framework and a simultaneous formula was developed to predict both fragmentation and ground vibration using joint angle and the same set of parameters.

Keywords: rock joints; drones; XG Boost; fragmentation; PPV

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1. Introduction

The use of explosive energy in blasting affects both rock fragmentation and induced ground vibration. Rock movement may be desired, and manifests in amuck profile suitable for the loading equipment. The complete and proper utilization of explosive energy is the main objective in this process; energy used in achieving proper fragmentation automatically reduces negative aspects such as ground vibration. Positive blast results can be obtained by equalizing the energy of the explosive to the strength of the rock, optimum design parameters, and geospatial positioning of the blast holes.

There are many equations in blasting to make use of explosive energy properly to yield a safe and effective blast, but most formulas are designed based on controllable parameters such as burden, spacing, bench height, hole diameter, stemming, decking, firing pattern, and quantity of explosive, etc. Many researchers have revealed that uncontrollable parameters such as joints and bedding planes, rock compressive and tensile strengths also significantly affect the performance of the blast in terms of fragmentation and ground vibration. The daunting task of any blasting engineer is to ensure that the selected blast design parameters meet all post-blast requirements and the targeted fragmentation of an enterprise. Blast-induced ground vibrations are a major issue to be tackled.

The presence of geological discontinuities in a rock mass can significantly influence both rock fragmentation and ground vibration [1–3]. Joints are among the most common