Methods of calculating the backbreak index and backbreak prediction

Law, Security

Explosion turns explosive materials into high temperature and high pressure gases. 15% of the explosion released energy crushes the rocks while 85% is mainly dissipated due to such processes as ground vibration, air vibration, rock deformation, and backbreak. Rock crushing is limited to the last row of the blasting holes in an ideal case. Rock damages beyond the last row are known as backbreak. The distance between the damaged zone and the last row of the blasting holes are called backbreak distance.

For preventing backbreak during the blasting operations, the geo-mechanical features of the rock mass, properties of explosive materials and blasting patterns need to be studied at the early stage of mine design. Unlike the geo-mechanical properties of rock mass, the two latter sets of variables can be manipulated to effectively reduce the backbreak potentials in a mine.

Attempts have been made to quantify the effects of different parameters on the intensity of backbreak. Bhandari studies the effects of rock geo-mechanical properties on the backbreak potential. Konya proposed the burden and stemming length as two elements that have the most significant roles in backbreak intensity. Gate et al. reported that backbreak is a byproduct of improper blasting delays and high number of blasting hole rows. Aghajani Bazzazi et al. effectively used pre-split controlled blasting with high diameter holes for reducing the backbreak in the Sarcheshme cooper mine in Iran. Konya and Walter argued that the bench stiffness ratio can tremendously control the backbreak in an operation. Using numerical simulation, Jia et al. reported that joint sets with slopes lower than the rock friction angle can significantly affect backbreak.

Backbreak prediction can improve blasting pattern and reduce the operation costs; however, due to the huge number of variables affecting the backbreak phenomenon, its study and prediction accompanies significant level of complexity. Multivariable regression analyses, artificial intelligence, rock engineering systems, and Mont Carlo simulations are methods that are mostly used for studying backbreak. Empirical methods and artificial intelligence methods are applied to data acquired from several blasting processes within a certain area where cannot be generalized for different geological conditions. Also a neural network is a black box in the sense that while it can approximate any function, studying its structure won't give any insights to structure of the function being approximate. This paper first used SPSS software to conduct a statistical analysis for the backbreak prediction. Then, the MI method is adopted to calculate the backbreak index and backbreak prediction.

The MI method investigates the volume of information that is shared between two variables in an analysis. This method provides natural interpretations along with a low number of random variables as the weight percent of the parameters can be obtain from the existing data. Recently, RES method is used for developing evaluation models for blasting potential of rock mass. RES is also used for underground excavation stability analyses, ground risk evaluation for TBM tunneling, and so on. Codding is commonly used for obtaining the interaction matrix. However, the human prejudice is involved in the process of using Codding so that the results can be some time out of the range of real observations. In addition, these methods do not account for the effects of input data while in the MI method, we use the input data to find the weight percent of the parameters, resulting in a lower error in the results.