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Soft Computing Approach to Evaluate and Predict Blast-Induced Ground Vibration

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Drilling and blasting is still one of the major economical operations to excavate a rock mass. The consumption of explosive has been increased many folds in recent years. These explosives are mainly used for the exploitation of minerals in mining industry or the removal of undesirable rockmass for community development. The amount of chemical energy converted into mechanical energy to fragment and displace the rockmass is minimal. Only 20 to 30% of this explosive energy is utilized for the actual fragmentation and displacement of rockmass and rest of the energy is wasted in undesirable ill effects, like, ground vibration, air over pressure, fly rock, back break, noise, etc.

Ground vibration induced due to blasting is very crucial and critical as compared to other ill effects due to involvement of public residing in the close vicinity of mining sites, regulating and ground vibration standards setting agencies together with mine owners and environmentalists and ecologists. Also, with the emphasis shifting towards eco-friendly, sustainable and geo-environmental activities, the field of ground vibration have now become an important and imperative parameter for safe and smooth running of any mining and civil project.

The ground vibration is a wave motion, spreading outward from the blast like ripples spreading outwards due to impact of a stone dropped into a pond of water. As the vibration passes through the surface structures, it induces vibrations in those structures also. Sometimes, due to high ground vibration level, dwellings may get damaged and there is always confrontation between mine management and the people residing in the surroundings of the mine area.

There is number of vibration predictors available suggested by different researchers. All the predictors estimate the PPV based on mainly two parameters (maximum charge used per delay and distance between blast face to monitoring point). However, few predictors considered attenuation/damping factor too. For the same excavation site, different predictors give different values of safe PPV vis-à-vis safe charge per delay. There is no uniformity in the predicted result by different predictors. All vibration predictor equations have their site specific constants. Therefore, they cannot be used in a generalized way with confidence and zero level of risk.

To overcome on this aspect new soft computing tools like artificial neural network (ANN) has attracted because of its ability to learn from the pattern acquainted before. ANN has the ability to learn from patterns acquainted before. It is a highly interconnected network of a large number of processing elements called neurons in an architecture inspired by the brain. ANN can be massively parallel and hence said to exhibit parallel distributed processing. Once, the network has been trained, with sufficient number of sample data sets, it can make reliable and trustworthy predictions on the basis of its previous learning, about the output related to new input data set of similar pattern.

This paper deals the application of ANN for the prediction of ground vibration by taking into consideration of maximum charge per delay and distance between blast face to monitoring point. To investigate the appropriateness of this approach, the predictions by ANN have been also compared with other vibration predictor equations.