Ground Vibration Prediction Using A Machine Learning Approach

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Keywords: Peak Particle Velocity, Support Vector Machines, Deep Neural Networks

# ABSTRACT

## Background

Mining products play a critical role in our current lives for instance titanium is used in the design of surgical pins and bone plates, renewable energy technologies, use copper for wiring of solar panels. Mobile phones are powered by precious metals for example lithium. To obtain this minerals, explosives are usually applied in rock fragmentation. Ineffective use of explosive energy in an operation may result in excessive ground vibration. Extreme ground vibrations because of blasting activities can result in various problems, for instance damage to property of the nearby residents and ecological damage. The measurement of ground vibration because of blasting is essential to mitigate risks associated with adverse impacts of blasting. The peak particle velocity (PPV) is the most important parameter generally used to evaluate ground vibrations in blasting sites. There are various methods that are currently used in prediction or estimation of PPV. The Empirical approach is limited by few input variables used in the prediction of ground vibration. The statistical and mathematical modelling techniques usually require explicit knowledge and understanding of the progression of the intricate blasting dynamics. With the current paradigm shift towards automated systems in the mining industry and introduction of the fourth Industrial revolution concepts, it is imperative that other techniques for the prediction of PPV be introduced.

## Objectives

The main objectives of this research work is to conduct a comprehensive study on the application various machine learning algorithms in the prediction of PPV, recommendations which are based on input and output variables, metrics of performance, the ability of the algorithm to generalize well and not to over fit or under fit is provided.

## Method

203 observations of open source datasets are used to develop a machine learning algorithm. The following input features are used: the powder factor (kg/m3), spacing (m), stemming length (m), burden (m), maximum charge per delay (kg), blast-face distance to the monitoring point (m) and PPV is considered as the target variable. Support Vector Machines, Artificial Neural Networks and deep Neural networks are some of the machine learning algorithms that are used in this research work. Various criteria, including mean absolute error (MAE), correlation coefficient (R), and gains, were calculated to evaluate the developed models’ accuracy and applicability.

## Results

It is predicted that the machine learning algorithms chosen will provide good performance for the chosen performance metrics in the prediction of PPV.

## Conclusions

This research work presents a comparative study in the application of machine learning in the measurement and estimation of PPV. Various machine learning algorithms are applied in the measurement of PPV in order to establish the method(s) that would be best suited in the prediction of PPV.

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