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Prediction of Longitudinal Wave Speed in Rock Bolt coupled with Multilayer Neural Network (MNN) Algorithm

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ABSTRACT

Non-destructive methods are extensively utilized for assessing the integrity of rock bolts, with longitudinal wave speed being a crucial property for evaluating rock bolt quality. This research aims to propose a method for predicting reliable longitudinal wave velocities by leveraging various properties of the rock surrounding the rock bolt. The prediction algorithm employed is the Multilayer Neural Network (MNN), and the input properties includes elastic modulus, shear wave speed, compressive strength, compressional wave speed, mass density, porosity, and Poisson's ratio, totaling seven. The implementation of the MNN demonstrates high reliability, achieving a coefficient of determination of 0.996. To assess the impact of each input property on longitudinal wave speed, an importance score is derived using the random forest algorithm, with the elastic modulus identified as having the most significant influence. When the elastic modulus is the sole input parameter, the coefficient of determination for predicting the longitudinal wave speed is observed to be 0.967. The findings of this study underscore the reliability of selecting specific properties for predicting longitudinal wave speed and suggest that these insights can assist in identifying relevant input properties for rock bolt integrity assessments in future construction site experiments.

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