Prediction of the Production Rate of Chain Saw Machine using the Multilayer Perceptron (MLP) Neural Network

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Abstract

The production rate in rock cutting machines is one of the most influential parameters in designing and planning procedures. Complete understanding of the production rate of cutting machines help experts and owners of this industry to predict the production expenses. Therefore, the present study predicts the production rate of the chain saw machine in dimensional stone quarries. In this research, the method of artificial neural networks was used for modeling and predicting the production rate. In addition, in this modeling, 98 data were collected from the results obtained from field studies on 7 carbonate rock samples as the dataset. Four important parameters, including uniaxial compressive strength (UCS), Los Angeles abrasion (LAA) Test, equivalent quartz content (Qs), and Schmidt Hammer (Sch) were considered as input data and the production rate was considered as the output data. The model was evaluated by the performance indices for artificial neural networks, including the value account for (VAF), root mean square error (RMSE), and coefficient of determination (R^2). For simulation, 10 models were created and evaluated. Finally, the best model, i.e. model No. 3, was selected with a $4 \times 3 \times 1$ structure, including 4 input neurons, 3 neurons in the hidden layer and 1 output neuron. The results obtained from the model's performance indices show that a very appropriate prediction has been done for determining the production rate of the chain saw machine by artificial neural networks.

Keywords: Chain Saw Machine; Production Rate; Artificial Neural Network; Carbonate Rocks.

1. Introduction

With the significant increase of construction, dimensional stones as one of the key parameters in this industry have gained a special place among construction materials. Furthermore, with the expansion of the construction industry, the increase in the production of dimensional stones is inevitable. On the other hand, taking the required measures for increasing the efficacy and productivity of the dimensional stones industry is significantly important. The proper evaluation and estimation of the rocks' production rate are among the most important factors influencing the accurate planning procedure in the production area, enhancing the productivity. Therefore, numerous studies have been conducted on the rocks' properties in terms of cutting operations and cutting machines used in this industry [1-2].

In a research carried out by Tumac et al., the performance of chain saw machines was evaluated and examined using factors such as shore hardness and other characteristics of construction rocks. This study was conducted on six different construction rocks from six quarry mines in the west of Turkey based on some physical and mechanical properties of