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Application of Artificial Neural Networks (ANN)to Predict Geomechanical Properties of AsmariLimestones

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Abstract

A number of common laboratory rock mechanics tests are carried out in all geotechnical projects such as dams, to determine parameters such as porosity, density, water absorption, sonic velocity, Brazilian tensile strength, uniaxial compressive strength, and triaxial compressive strength. In this paper, data obtained from two dams in Asmari Formation including Khersan 1 and Karun 4 - both located in Chahar-MahalVaBakhtiari Province, Iran - have been subjected to a series of statistical analyses. Then, using Multivariate Linear Regression (MLR) and Artificial Neural Networks values of UCS, E, C, and φ were predicted using the input parametersincludingdepth, compressionultrasonic velocity, porosity, density, and Brazilian tensile strength. The designed ANN in this research was a feedforwardbackpropagation network which is powerful tool to solve prediction problems. Designed network had two hidden layer (hidden layer 1: 18 neurons and hidden layer 2: 20 neurons). Via comparing designed MLR and ANN models, it was revealed that ANNs (R^2_{UCS}= 0.91, R^2_E = 0.87, R^2_C =0.78, R^2_{phi} = 0.61) are more efficient than MLR models (R^2_{UCS}= 0.69, R^2_E= 0.69, R^2_C = 0.66, and R^2_{phi} = 0.50) in predicting strength and shear parameters of the intact rock. Also, to enhance the credibility of this study, some extra tests were carried out to evaluate the efficiency of network designed for prediction of strength parameters. The results obtained from this network were as: R^2_{UCS}= 0.85, R^2_E = 0.81.

Keywords: Artificial Neural networks (AAN), FeedforwardBackpropagation; Multivariate Linear Regression (MLR); Asmari Formation; Uniaxial Compressive Strength (USC); Modulus of Elasticity (E); Cohesive Strength (C); φ (Internal Friction Angle)