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Prediction of geomechanical parameters using soft computing and multiple regression approach

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Abstract

The evaluation of geotechnical parameters of geo-materials are essential part of every geotechnical project. But sometimes, it is not possible to determine the all required parameter in the laboratory. Therefore, scientist and engineers used the statistical and empirical relation to determine the crucial parameters. The present study focused on the determination of parameters like uniaxial compressive strength (*UCS*), tensile strength (*TS*), point load index (*PLI*) and Young's modulus (*YM*) from very easily determinable physical parameters viz. density (*DEN*), porosity (*PORO*) and compressional wave velocity (*P-WV*) using multiple variable regression analysis (MVRA) and adaptive neuro-fuzzy inference system (ANFIS). The various ANFIS structures and MVRA models were tried for prediction of desired parameters and best one was considered based on variance account for (VAF), root mean square error (RMSE) and correlation coefficient (R^2). ANFIS structure not only depends on the input parameters and rules, but also on the output parameter as observed in case of *PLI*.

Keywords: Soft computing, multiple variable regression analysis, adaptive neuro-fuzzy inference system.

1. Introduction

The determination of geomechanical properties of the rocks is first and key step of any civil or mining project, which will affect time, cost and stability of the project. These properties are determined either by laboratory tests or by using analytical and numerical tools. The determination of uniaxial compressive strength (*UCS*), point load index (*PLI*), tensile strength (*TS*) and Young's modulus (*YM*) is rigorous, time consuming, costly and destructive. Sometimes, unavailability of standard samples for laboratory test to determine these parameters obstructs the project progress. In such conditions, investigator uses the empirical relation to estimate the requisite properties through known one.

The unavailability of standard samples necessitate researchers to establish the empirical relationship in critical and essential properties with easily determinable properties. Szlavin [1] statistically recognized noteworthy relationships between the strength and hardness properties of rock mass and found a good correlation within rational limits. Many researchers have established the relationship of *UCS* with *PLI*, Schmidt rebound number, P-wave velocity (*P-WV*), porosity (*PORO*), block punch index (*BPI*), *TS*, Density (*DEN*), percentage mineral