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The gene expression programming method for estimating compressive strength of rocks

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Abstract

Uniaxial compressive strength (UCS) is a critical geomechanical parameter that plays a significant role in the evaluation of rocks. The practice of indirectly estimating said characteristics is widespread due to the challenges associated with obtaining high-quality core samples. The primary aim of this study is to investigate the feasibility of utilizing the gene expression programming (GEP) technique for the purpose of forecasting the UCS for various rock categories, including Schist, Granite, Claystone, Travertine, Sandstone, Slate, Limestone, Marl, and Dolomite, which were sourced from a wide range of quarry sites. The present study utilized a total of 170 datasets, comprising Schmidt hammer (SH), porosity (n), point load index ($Is(50)$), and P-wave velocity (Vp), as the effective parameters in the model to determine their impact on the UCS. The UCS parameter was computed through the utilization of the GEP model, resulting in the generation of an equation. Subsequently, the efficacy of the GEP model and the resultant equation were assessed using various statistical evaluation metrics to determine their predictive capabilities. The outcomes indicate the prospective capacity of the GEP model and the resultant equation in forecasting the unconfined compressive strength (UCS). The significance of this study lies in its ability to enable geotechnical engineers to make estimations of the UCS of rocks, without the requirement of conducting expensive and time-consuming experimental tests. In particular, a user-friendly program was developed based on the GEP model to enable rapid and very accurate calculation of rock's UCS, doing away with the necessity for costly and time-consuming laboratory experiments.