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EDITORIAL

Meta-Heuristic Algorithms in Civil Engineering

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Artificial Intelligence (AI) is the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. This term can be applied to the project of developing systems endowed with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience. These techniques are able to solve non-linear and complex problems in science and engineering fields.

Meta-heuristic algorithms, which are considered as AI techniques, are computational intelligence paradigms especially used for complex solving optimization problems. These algorithms were developed and applied successfully and effectively in solving many real world problems. In the field of civil engineering, the mentioned techniques are sometimes used to improve the accuracy of the existing models/equations and sometimes to propose a new model/technique which is able to solve the problems. Meta-heuristic algorithms, which are developed based on the integration of different techniques, sometimes showed better performance than other AI methods. Therefore, development and application of these techniques are much required for better assessment and solving the real-world problems, especially in Civil Engineering.

Due to the increasing importance of these models, this thematic issue is aimed to shed some light on the applications of AI and meta-heuristic algorithms in solving Civil Engineering problems. The thematic issue comprises four papers, which are briefly summarized in the following paragraphs. The implemented methods in the following papers can be applied in other civil engineering problems (or other case studies) by researchers or engineers.

The first paper entitled "Prediction of Shear Strength of Soil Using Direct Shear Test and Support Vector Machine Model" presents a cost-effective approach based on Support Vector Machine (SVM) - a popular machine learning model for prediction of the shear strength of the soil. For this, a total of 500 soil data considering various variables such as clay content, moisture content, specific gravity, void ratio, liquid limit and plastic limit - input variables, and the shear strength as an output variable. The results show that SVM is a promising tool in accurate prediction of the shear strength of soil, which can be used in predicting other geotechnical properties of soil.

The second paper entitled "Soil Unconfined Compressive Strength Prediction Using Random Forest (RF) Machine Learning Model" investigates the application of Random Forest model which is one of the most popular soft computing models for prediction of soil unconfined compressive strength. A total of 118 soil data containing different variables namely clay content, moisture content, specific gravity, void ratio, liquid limit and plastic limit - input variables, and the soil unconfined compressive strength as an output variable. The results show that the RF receives a high accuracy for prediction of the soil unconfined compressive strength, which can be used in quick and accurate prediction of this parameter in practice.

The third paper entitled "Ground Movements Prediction in Shield-Driven Tunnels using Gene Expression Programming" suggests a model based on Gene Expression Programming (GEP) algorithm to predict surface settlement induced by mechanized tunneling. The GEP model is able to propose a mathematical equation for solving relevant problems. To do that, a dataset comprising of 85 datasets was prepared from numerical simulations in this study. Then, the authors constructed several GEP equations and evaluated them based on some performance indices and selected the best GEP equation for estimation of surface settlement induced by mechanized tunneling. The results confirm that the GEP model is able to provide a high accuracy level for the problem mentioned. The model developed can be used in other areas of Civil Engineering.

The fourth paper entitled "Intelligence Prediction of Some Selected Environmental Issues of Blasting: A review" is actually a review paper related to applications of AI in blasting environmental issues include the generation of flyrock, ground

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vibrations, air over pressure and rock fragmentation. In this paper, the authors reviewed various AI techniques such as Artificial Neural Network (ANN), Fuzzy Interface System (FIS), Imperialist Competitive Algorithm (ICA), and Particle Swarm Optimization (PSO) in solving blasting environmental issues. The results indicate that ANN, FIS and ANN-ICA were the best models for prediction of flyrock distance. FIS model was the best technique for predicting air over pressure and ground vibration. On the other hand, ANN was found to be the best for the assessment of rock fragmentation.