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Influential Parameters in Estimating Soil Properties from Cone Penetrating Test: An Artificial Neural Network Study

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Abstract : The Cone Penetration Test (CPT) is a common in-situ test which generally investigates a much greater volume of soil more quickly than possible from sampling and laboratory tests. Therefore, it has the potential to realize both cost savings and assessment of soil properties rapidly and continuously. The principle objective of this paper is to demonstrate the feasibility and efficiency of using artificial neural networks (ANNs) to predict the soil angle of internal friction (Φ) and the soil modulus of elasticity (E) from CPT results considering the uncertainties and non-linearities of the soil. In addition, ANNs are used to study the influence of different parameters and recommend which parameters should be included as input parameters to improve the prediction. Neural networks discover relationships in the input data sets through the iterative presentation of the data and intrinsic mapping characteristics of neural topologies. General Regression Neural Network (GRNN) is one of the powerful neural network architectures which is utilized in this study. A large amount of field and experimental data including CPT results, plate load tests, direct shear box, grain size distribution and calculated data of overburden pressure was obtained from a large project in the United Arab Emirates. This data was used for the training and the validation of the neural network. A comparison was made between the obtained results from the ANN's approach, and some common traditional correlations that predict Φ and E from CPT results with respect to the actual results of the collected data. The results show that the ANN is a very powerful tool. Very good agreement was obtained between estimated results from ANN and actual measured results with comparison to other correlations available in the literature. The study recommends some easily available parameters that should be included in the estimation of the soil properties to improve the prediction models. It is shown that the use of friction ration in the estimation of Φ and the use of fines content in the estimation of E considerable improve the prediction models.

Keywords : angle of internal friction, cone penetrating test, general regression neural network, soil modulus of elasticity
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