Modeling Void Ratio Characteristics of Soil Mixed with Recycled Tire Chips Using Artificial Intelligence

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Maximum and minimum void ratios are key characteristics which affect volume change tendency, the hydraulic conductivity and mechanical behavior of the geomaterials [2]. Due to unique physical and mechanical properties of Scrap Tire Derived Materials (STDM) like low unit weight and high hydraulic conductivity, they are being adopted in civil engineering applications with an advance growing interest each year [2]. Recently, Gravel tire chips mixtures (GTCM) as a new Tire derived Geomaterial has been introduced to solve drawbacks of using sand-tire chips mixture in geotechnical applications such as low hydraulic conductivity and low bearing capacity of that geomaterials.

The minimum and maximum packing density of soil-Scrap Tire Derived Materials are often estimated based on limited laboratory test results or to some extent, an empirical correlation. However precise modeling of void ratio characteristics of such materials is complex and usually involves many parameters which might be beyond the capability of most of common physically based engineering methods.

The objective of this study is to introduce new model using two different Artificial Intelligence method (AI), Artificial Neural Network (ANN) and Adaptive Neuro-Fuzzy Interface system (ANFIS) that can simulate complex void ratio characteristics of granular mixture taking into account important features of granular materials. The performance of proposed models are also presented and compared with each other.

A series of maximum and minimum void ratio tests were conducted (according to JGS 0162 Standard) on GTCM with different fraction of gravel in mixture (GF=V_G/V_T) at different mean particle size ratio of tire chips to gravel ($D_{50,R}/D_{50,G}$). The obtained data is used to build ANN and ANFIS models.

The outcome of this study shows that both ANN and ANFIS approach can be used to build alternative intelligent information based models for estimating packing density of granular mixtures with high prediction accuracy (Fig.1).

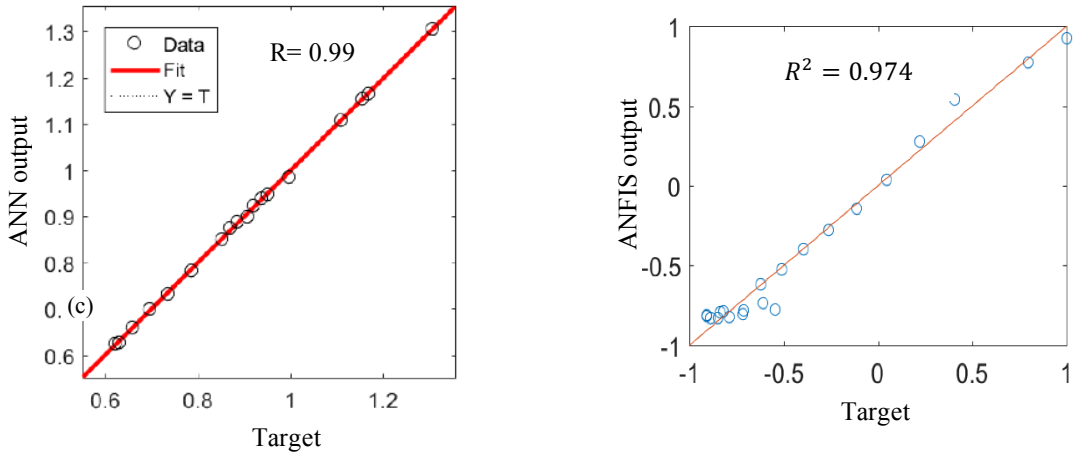

Figure 1. Performance of the (a) ANN model (b) ANFIS model over independent testing data sets

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