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Application of Modern Regression Techniques and Neural Network on Rigid Pavement Backcalculation

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Abstract :

Artificial Neural Network (ANN) and statistical regression techniques have been utilized in pavement analysis for many years. The primary objective of this study is to investigate the fundamental differences of backcalculation algorithms using these techniques for a single rigid pavement slab resting on a dense liquid foundation. According to the literature, using neural network analysis often implies the need to directly use pertinent input parameters to generate an enormous database, requiring tremendous amount of time and efforts in network training and testing. To overcome these shortcomings, this study strives to illustrate the benefits of integrating the principles of dimensional analysis into neural network analysis. In a case study under interior loading condition, a deflection database was generated from a series of ILLI-SLAB finite element runs and deflection ratio predictive models were developed. The convergence characteristics of various transfer functions were studied. The resulting ANN model using all dominating dimensionless parameters was proved to have higher accuracy and less network training time than the other counterpart using purely input parameters.

In addition, a modern regression technique (local regression) was introduced to develop predictive models using the same database. The resulting model was compared to an existing predictive model using Projection Pursuit Regression (PPR) technique as well as the aforementioned ANN model. For all the cases analyzed, reasonable good accuracy can be achieved using the principles of dimensional analysis together with either ANN technique or modern regression techniques. Subject related knowledge and statistical regression techniques are excellent tools to assist in developing more reliable pavement predictive models. The proper use of ANN technique is cautioned and guidelines are prepared to increase the model accuracy and reduce the network training time. Consequently, an existing rigid pavement backcalculation procedure was modified and proposed for future implementation and verifications.

Keywords:

Rigid Pavements, Nondestructive Deflection Testing (NDT), Dimensional Analysis, Artificial Neural Network, Local Regression, Predictive Model, Backcalculation.