

Dynamic Analysis of Soil-Structural Interaction Using Optimized Neural Network with Genetic Algorithm

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Mostly, in designing and analyzing the structures, the soil under the structure is considered to be rigid, and interaction effect between soil and structure is ignored. However, the fact is that the soil is not rigid, and leads to make changes in the dynamic properties of structure and consequently changes the structural response. The soil-structure interaction effects are important for massive and stiff structures built on relatively soft ground due to the changes it makes in the dynamic characteristics of structure. Therefore, the effects of soil-structure interaction should be considered in dynamic analysis. In comparison with others, systems with soil-structure interaction have two distinct properties including being nonlinear and infinitely unlimited. The common and traditional methods for solving the nonlinear soil-structure interaction problems are time consuming and costly. This is while it is not possible to consider the nonlinear behavior of soil efficiently. Consequently, using these methods is limited and these solutions are only applicable to structures with simple geometry. In recent years, using data based methods has become an effective tool for solving complex problems, particularly for those without an exact analytical model. The purpose of this study is to investigate the application of one of the most important data-oriented methods called the artificial neural network to solve the complex problems of soil-structure interaction. In this research, classification methods based on Cross validation and K-fold cross validation and optimization approaches on bias and weight values using the genetic algorithm are used to improve the performance of the neural network. Additionally, results of a series of experimental studies on soil-structure interaction including centrifuge studies are utilized to estimate the natural period, the damping ratio, and the dynamic response of the system. Results of this research reveal that the neural network optimized by the genetic algorithm has been successful in accurately as well as rapidly solve the complex problem of nonlinear dynamic soil-structure interaction and estimate desirably the response characteristics.

Keywords:

Artificial neural network, optimization, genetic algorithm, soil-structure interaction, soil-pile structure interaction.