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Research on the dynamic properties of piled structures using the neural networks and the support vector machines

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Abstract

A simplified method is proposed to analyse the dynamic properties of piled structures. Superstructures are modelled as generalized single degree of freedom systems using the virtual displacement principle, and the impedance functions of pile groups are solved based on the thin-layer method. Six dimensionless parameters are selected to characterize the soil-pile-structure systems and extensive parametric analyses are performed. A mathematical model for the seismic analysis of soil-pile-structure system is built in the neural network based on the outcomes of parametric analyses. The data of the analyses are divided into three different parts which are used for training, testing and validating of the artificial neural network(ANN) model. In order to validate the accuracy of ANN model, another analysis technique of the support vector machine is used. The outcomes show that the model can predict the dynamic properties of the soil-pile-structure system with good accuracy and less time which contribute to solve the dynamic characteristics of piled structures without performing complex analysis.

Keywords: soil-pile-structure interaction, dynamic property, artificial neural network, support vector machine

1 Introduction

Over the past 40 years, different ways for studying the soil-pile-structure interaction (SPSI) have been adopted, theoretical, numerical analyses and experiment. It has been validated by many researchers that SPSI plays an important role in structural design and has great influence on the dynamic properties of the structures (Wolf,1985; Mylonakis,1995;Medina et al,2013). It's not a simple task for engineers to perform a rigorous assessment of seismic SPSI considering both kinematic and inertial effects. These analyses are highly complex and require knowledge and it's necessary to propose a simplified method to analysis soil-pile-structure interaction.

A data-based method (DBM) is an efficient mathematical method that makes use of extensive data to train, evaluate and validate itself. These methods are usually developed in an artificial neural networks (ANN) environment. Use of the DBM will reduce the analysis time of SPSI because the DBM doesn't deal with solving the equations of motion and this method has been applied in analyzing the dynamic properties and the

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