C03

Prediction of Pile Group Scour Hole Properties Due to Waves Using Soft Computing Methods

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Prediction of scour hole properties around a group of piles in the field exposed to oscillatory waves is very important for many offshore structure and coastal engineering projects. The scour depth around pile groups as supports of marine structures should be considered well in their design. The arrangement of piles in addition to their geometry, sediment and wave characteristics should be considered to estimate the scour depth around a group of vertical piles.

Though Prediction of wave-induced scour depth around a single pile has been studied extensively by many researchers (e.g. Kobayashi & Oda 1994), limited models have been given for the scour depth around pile groups while most of them were concentrated on a unique arrangement or did not consider the parameters controlling the arrangements of piles in pile groups.

In the laboratory experiments of Sumer & Fredsoe (1998), pile groups made various arrangements were studied. Results showed that the equilibrium scour depth was controlled by the Keulegan–Carpenter number (KC) and the gap between the piles. Their experiments also indicated the importance of the arrangement in a pile group scour.

Considering the complexity of modeling the scour process and scour hole properties around pile groups due to waves, the existing approaches are not capable of accurate estimation of the scour depth around pile groups with different arrangements. Hence, a robust model is very useful for the estimation of scour depth. One of the most common approaches as an alternative to empirical approaches is the soft computing method. Artificial neural networks (ANN) as a famous data-mining method have been widely applied in scour estimation (e.g. Liriano & Day 2001; Bateni & Jeng 2007). Results of such studies showed that ANN provides a better alternative to the statistical curve fitting. But in their studies, only a specific arrangement of pile groups was tested and the effects of geometrical parameters such as the distance between the piles and their number were not investigated.

In this study, two data mining approaches, i.e. Support Vector Machines (SVM) and Artificial Neural Networks (ANN), were applied to estimate the wave-induced scour depth around pile groups. To consider various arrangements of pile groups in the development of the models, datasets collected in the field and laboratory studies were used and arrangement parameters were considered in the models. Several non-dimensional controlling parameters, including the Keulegan–Carpenter number, pile Reynolds number, Shield's parameter, sediment number, gap to diameter ratio and numbers of piles were used as the inputs. Performances of the developed SVM and ANN models were compared with those of existing empirical methods. Results indicate that the data mining approaches used outperform empirical methods in terms of accuracy. They also indicate that SVM will provide a better estimation of scour depth than ANN. Sensitivity analysis was also carried out to investigate the relative importance of non-dimensional parameters. It was found that the Keulegan–Carpenter number and gap to diameter ratio have the greatest effect on the equilibrium scour depth around pile groups.