Performance analysis of an evolutionary LM algorithm to model the load-settlement response of steel piles embedded in sandy soil

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Abstract

This study was implemented to examine pile load-settlement response and to develop a rapid, highly efficient predictive intelligent model, using a new computational intelligence (CI) algorithm. To achieve this aim, a series of experimental pile load tests were performed on steel, closed-ended pile models consisting of three piles with aspect ratios of 25, 17, and 12 in an attempt to make site in-situ pile-load tests unnecessary. An optimised, evolutionary, supervised Levenberg-Marquardt (LM) training algorithm was used for this process due to its remarkably robust performance. The model piles were penetrated and tested in three sand relative densities; dense, medium, and loose. Applied load (P), pile effective length (lc), pile flexural rigidity (EA), pile slenderness ratio (lc/d) and interface friction angle (d) were identified, based on a comprehensive statistical analysis, as these parameters play a key role in governing pile settlement. To evaluate the efficiency and the generalisation ability of the proposed algorithm, graphical comparisons were made between the proposed algorithm and the experimental results with further comparisons made with conventional prediction approaches. The results revealed outstanding agreement between the targeted and predicted pile-load settlement with a coefficient of correlation of 0.985 and a Pearson's correlation coefficient, P = 2.22 _ 10_32 and root mean square error (RMSE) of 0.059 respectively. This, in parallel with a non-significant mean square error level (MSE) of 0.002, validates the feasibility of the proposed method and its potential in future applications.