

# Adaptive updating of soil properties through monitoring data for improved prediction of excavation response

Horace M.K. Lo and Andy Y.F. Leung

*The Hong Kong Polytechnic University*

## ABSTRACT

This paper presents an adaptive model updating approach for deep excavations, which considers various sources of uncertainty that lead to discrepancies between predicted and actual excavation responses. The approach utilizes field monitoring data to update the soil stiffness and strength parameters for multiple soil layers. Based on the updated parameters, the subsequent excavation responses and levels of uncertainty are represented by prediction intervals, continuously refined as the construction progresses. Furthermore, to reduce the high computational demand commonly encountered in updating algorithm, the approach incorporates machine learning techniques including surrogate modelling and principal component analysis. The proposed adaptive updating approach can be readily incorporated into commercially available finite element or finite difference packages, and is illustrated through re-analyses of the multi-stage braced excavation at the Tsuen Wan West station. The case study shows that the estimated prediction intervals can encapsulate the actual response, meanwhile providing quantitative indicators regarding the levels of uncertainty for future construction stages. The measurement data is also shown to effectively reduce uncertainty in the soil parameters, manifested as the narrower prediction intervals as the construction progresses. The approach provides an efficient modelling tool to facilitate data-driven decision making based on field measurement data, thereby contributing to the quantitative framework for the observational method.