Webinar on "Adaptive Updating of Soil Properties Through Monitoring Data for Improved Prediction of Excavation Response" by Dr. Andy Leung

by Ir. Dr Gue Chang Shin

Ir. Dr Gue Chang Shin is currently the Secretary/Treasurer of IEM Geotechnical Engineering Technical Division (GETD).

It was an honour for the Geotechnical Engineering Technical Division (GETD) of IEM, to have Dr. Andy Leung, Assoc. Prof. at the Hong Kong Polytechnic University (PolyU), also the current Secretary General of Hong Kong Geotechnical Society, to deliver a webinar on "Adaptive Updating of Soil Properties Through Monitoring Data for Improved Prediction of Excavation Response" on 7th April 2021. The webinar was attended by a total of 119 participants.

Dr. Andy Leung pointed out the main challenges in geotechnical engineering, are the uncertainties in soil properties and soil boundaries (geological profile). These uncertainties can have substantial impact on system response or accuracy of predictions. The current common practice is to use "moderately conservative estimates" of soil properties from soil investigation data and field measurements (response data) are then checked against predictions.

Soil data provide information on the spatial uncertainty of material properties, while data from measured response provide additional "hints" on both the spatial and model uncertainties. Rational combination of these information allows better judgement and levels of confidence.

The presentation introduced an adaptive model updating approach for deep excavations, which considers various sources of uncertainties that lead to discrepancies between predicted and actual excavation responses. The approach utilises field monitoring data to update the model bias and spatial variability features in soil stiffness and strength parameters. Based on the updated parameters, subsequent predictions on excavation responses and levels of uncertainty can be continuously refined as the construction progresses. To reduce the computational demands associated with the algorithm, the approach incorporates machine learning techniques.

Dr. Andy Leung stressed that the goal of the approach is not to bypass physics or mechanics theories; instead, it refines the elements associated with uncertainties that cannot be captured by conventional soil mechanics. He then shed lights on the use of random field modelling and surrogate modelling techniques to improve our levels of confidence during construction stage. Random field modelling utilises mathematical tools to model the inherent soil variability while surrogate modelling to simulate the response by approximating between the system response and soil properties. These were illustrated through two cases, where the approach provides an efficient modelling tool to facilitate data-driven decision making. Figure 1 shows the approach in a nutshell.

Finally, Dr. Andy Leung summarised the benefits of the approach in dealing with uncertainties in geotechnical engineering, where the techniques presented can make better use of the available soil data and improve the confidence level during construction.

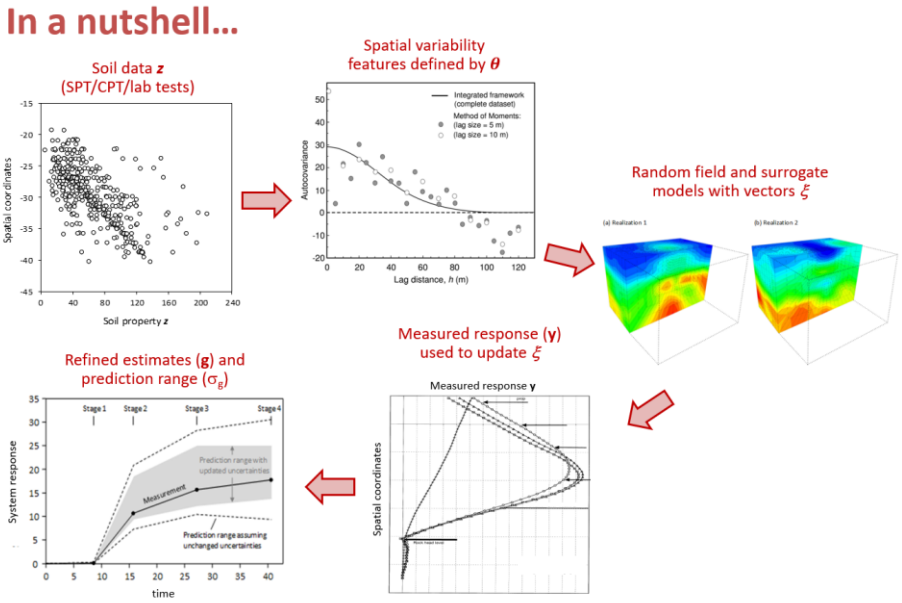

Figure 1: A nutshell of presented approach (extracted from Dr. Andy Leung's slide)