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Probabilistic back analysis of constitutive model parameters based on monitoring data of ground deformation induced by excavation

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ABSTRACT

Construction of underground infrastructure is often heavily instrumented to monitor ground deformation and structure safety. It is essential to make full use of in-situ monitoring data (e.g., ground settlements and lateral displacement of soil retaining structures) to guarantee construction safety and to assess construction risk. This can be accomplished by combining monitoring data with finite element analysis, in which constitutive model parameters are required. For this purpose, constitutive model parameters are often inferred inversely from monitoring data. Such an inference is nontrivial because it can be ill-posed, leading to a locally identifiable or even unidentifiable problem. This problem is further complicated by significant computational efforts needed in the inverse analysis and difficulties caused by numerical convergence. To address the above issues, this study develops an efficient probabilistic back analysis method based on artificial neural network and Bayesian learning technique to calibrate constitutive model parameters from monitoring data of ground deformation induced by excavation. The proposed approach not only provides the probabilistic distribution of constitutive model parameters for a given model, but also allows identifying a proper model among a pool of candidate models.

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