Abstract

The main objective of this Thesis is to present a methodology to determine the model parameters from the observed response of a deep excavation. In order to calibrate the model, an initial estimation of the parameters in terms of a probability function is needed. In addition, the quantification of the uncertainty in the model predictions together with the error in measurements is required.

The methodology combines the Bayesian inference and non-intrusive stochastic finite element (SFEM). The SFEM allows for the manipulation of the parameters as random variables and the Bayesian inference explains how to update the initial knowledge of the parameters in the light of the observations. Furthermore, the non intrusive SFEM are spectral methods which enable to construct a numerically lighter surrogate model of the original excavation model, thus facilitating the stochastic calculations, and to obtain the statistical structure of the problem. The methodology has proven to obtain at a reasonable numerical cost for service situations the maximum-likelihood model parameters along with their reliability and sensitivity. The methodology has been validated with three examples, two synthetic ones (the observations have been generated directly from a numerical model) and one real.

Keywords: *Bayesian inference, stochastic finite elements, inverse problem, spectral methods and deep excavations.*