Random Field Modelling of Subsurface Stratigraphy and its Potential Applications in Site Investigations

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Abstract

It is estimated that around 80% of problems discovered on construction projects are attributable to unexpected ground conditions. The use of random field modelling can be used in all phases of site investigations to help reduce this uncertainty, by modelling the stratigraphic boundaries in subsurface stratigraphy. Although there has been increasing research in this area, the use of it in geological engineering and geotechnical projects is still an open question.

The random field modelling in this research will use the Markov random field theory, which in general terms is a graphical model of a joint probability distribution. The first step for producing the model is to input four types of site investigation data, including elevation, ground surface soil types, boundaries of different soil layers at each borehole log location, and strata orientation information. This information is discretised and used to construct a neighbourhood system. The spatial correlation in the local neighbourhood system is divided into two components: ψ (orientation information of geological formations) and a (ratio of the strength of tangential correlation and normal correlation). During the simulation stage, known data from the boreholes are used to predict the lithology across the whole domain. After this, the uncertainty of the predicted lithological profile is assessed by the information entropy.

Site investigations for construction projects are usually in three phases. The first phase involves a desk study and preliminary assessment, the second phase involves

physical investigation at the site and the third phase involves designing a strategy for the site. The proposed modelling technique in this research has the potential to be applied at any of these phases.

Keywords: Geological modelling, Markov random field, Site investigations, Stratigraphic uncertainty