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Abstract WTC 2023 : Athens

Title : Geostatistical modelling of geotechnical properties in the context of a tunneling project : application to the Grand Paris Express project (France)

Topic of interest : Geological, Geotechnical Site Investigation and Ground Characterization

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In recent years, geostatistical methods have proven to be very useful for the spatial analysis of subsurface properties, in particular through the production of 2D or 3D geological and/or geotechnical models. Despite the existence of examples of geostatistical modelling applications in the context of tunneling projects, their use is still underdeveloped in this field.

The study presented in this paper aims to show that large linear projects such as tunnels constitute an ideal framework for the construction of efficient geostatistical models and that there is a real interest for decision-makers to increase their use. This is shown through the application of 3D geological-geotechnical modelling to certain sections of the Grand Paris Express (France).

From the panel of geotechnical data collected, the pressuremeter tests were chosen to build the model in terms of pressuremeter modulus and limit pressure. Their regular and dense distribution along the project (on average one pressuremeter test every hundred linear metres) allows for a correct appreciation of the spatial variability of the geotechnical behaviour of the geological units present on the tunnel alignment.

After introducing the methodological process used to design the 3D model, a comparative study between deterministic geostatistical methods and sequential simulation algorithms is conducted on one of the geological unit of interest. The performance and relevance of both methods are evaluated through statistical analysis of their respective results and quantification of uncertainties.

This comparison exhibits the benefits of simulation technics over deterministic technics in this context. On the one hand, they better represent the variability of geotechnical characteristics, specially for extreme values. On the other hand, they provide a better evaluation and localisation of uncertainties and can therefore constitute a tool for optimisation and risk management during the construction phase.

Keywords : Geostatistics, 3D modelling, Tunnels, Uncertainty, Geotechnics, Geology