Estimation of rock mass qualities for grouting design using Artificial Intelligence

Utvärdering av bergmassans kvalitet för injekteringsdesign med hjälp av Artificiell Intelligens

Chunling Shan, Tyréns

Summary

Drill and blast are the most widely used techniques for tunneling projects in Scandinavian hard rocks. Accordingly, the cost of underground projects can be increased due to the effect of drill and blast on water leakage and the poor conditions of unforeseen sections. Grouting is applied to serve and improve the sealing, strength, and stability of the surrounding ground. In this process the injected cement-based slurries with several additives and fillers can impose considerable impact on the environment which is a big concern for Trafikverket in Sweden. Clients are therefore usually interested in continuous forecasting of the ground conditions ahead of the tunnel face during construction. However, providing a generalized predictive model covering the complexities and nonlinearity of subsurface conditions from aquifers to challenging rock situations even with extensive preliminary investigation is a very complicated task and almost impossible. Nowadays, in tunneling projects analyzing the acquired measurement-while-drilling (MWD) data has been demonstrated to be an objective and reliable method for assessing the rock mass conditions ahead of the tunnel face. Besides the MWD data, after-excavation, geological mapping is usually done to assess rock mass qualities for the tunnel perimeter. However, analysis of the large amount of generated data not only is time-consuming but also currently is not of full use in daily work. To make MWD data become a more important and meaningful tool in design the tunnel support system i.e. reinforcement planning and sealing work, a greater degree of automation is required. To overcome on limitation of traditional time-consuming methods and provide automated process to handle big data, artificial intelligence techniques (AIT) in the form of different machine and deep learning structures can be a promising tool because they have shown significant degree of success in a variety of geoengineering areas to provide solutions for geo-environmental challenges. Referring to use of MWD in Sweden and the lack of modern computational analysis system, this proposal is highly motivated to develop AI-based modeling procedure using MWD and geological mapping data for hard rock tunneling applications. Due to flexibility of AI in using different variables, the possible adding of other potential resources is an open window. We aim to provide a new method of data analysis and to investigate the capability of MWD data in predicting rock mass quality parameters and consequently decision making for more appropriate grouting design systems.