Geological Evaluation Technology for Rock Tunnelling Using ICT
— Smart Face Watcher —

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■ Overview

In tunnel construction, it is very important to choose appropriate support systems according to geological conditions to ensure quality and safety. However, in the daily excavation cycle, it is difficult to predict the geological conditions and to fully grasp conditions of the tunnel face without overlooking any problems. To prevent any geological troubles, we developed the system "Smart Face Watcher". It consists of two analysis methods: "3D real-time geology forecasting system" and "rock fall risk assessment system".

■ 3D Real-Time Geology Forecasting System

Figure 1 shows the procedure of the forecasting system. All drilling data acquired by the auto-controlled face drilling rig is automatically transmitted to a computer located in a field station. Then, the function to predict the geological conditions ahead of tunnel face is activated automatically. It estimates the distribution of drilling energy in the analysis area by geostatistics within ten minutes and the prediction results can be confirmed in the field. The results can be used to decide on the next cycle including auxiliary methods.

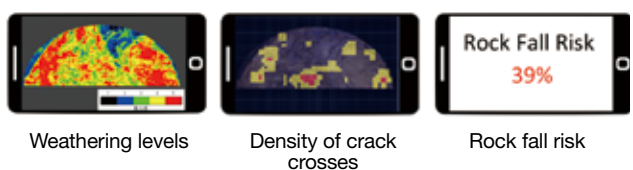## ■ Rock Fall Risk Assessment System

We focused on the weathering and crack situations of the rock mass which seemed to be highly related to the occurrence of rock fall from the face. This system quantitatively evaluates the degree of weathering of the rock mass and the density of crack crosses by image analysis. The system is installed on the smartphone. After the face is photographed with a smartphone, analysis automatically gets started, and after 10 seconds, the results are confirmed as shown in Fig.2. The results can be used to determine the appropriate thickness of the face shotcrete to prevent rocks from falling.
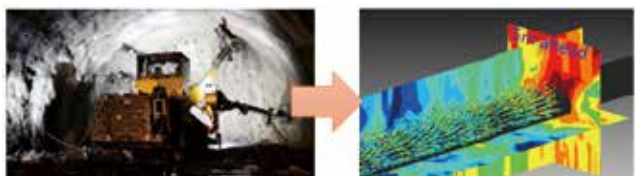
Drilling by auto-controlled face drilling rig

Prediction by ordinary kriging

Fig.1 3D real-time geology forecasting system

Weathering levels

Density of crack crosses

Rock fall risk

Fig.2 Rock fall risk assessment system