

Improved rock mass documentation in tunnelling using JointMetriX3D

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ABSTRACT:

For an economical and safe construction of a tunnel, continuous adaptation of the excavation and support method to the actual ground conditions is required. This observational approach requires the continuous collection of information on rock mass type, structure, and quality, as well as the system behaviour. Very important in this context are geometric properties of the rock mass as observed at every tunnel face and subsequently a rock mass model as well as descriptive parameters. Common practice is to draw sketches and to measure a few discontinuity orientations with a compass-clinometre device. This method has a number of shortcomings, like required access for getting measurements, no reference for orientation measurements, time limitations for the survey on site, and a strong dependency on individual capabilities and willingness. In addition the necessary physical contact to the face is a hazard for the documenting geologist. In most cases, data not recorded immediately are lost as excavation proceeds or support is applied.

The presented JointMetriX3D system overcomes those problems and opens new possibilities for optimisations on the tunnel site. JointMetriX3D basically consists of the generation of a high resolution 3D image of every tunnel face which is then analysed and assessed on a computer. This way the visible rock mass structures are completely recorded, joint orientations are easily measured at an arbitrary number and data are instantly available for further processing. Analyses are possible even if a specific rock face is no longer present.

The data in front of the tunnel face are acquired using a panoramic image scanner that takes high resolution images which means that also small rock mass features are recorded. Within a typical tunnel face for example structures in the mm range are captured. From the high resolution images a referenced 3D image is computed, providing a true metric model of the tunnel face within a given tunnel co-ordinate system. This model is then analysed by special tailored software that allows to view the 3D image from all sides including a zooming mechanism and to annotate geotechnically significant locations by setting graphical marks. A simple mouse click applies an orientation measurement, as well as quantifies a distance or an area. All data are in 3D within the tunnel co-ordinate system.

Obvious benefits using JointMetriX3D are:

- (i) the detailed documentation of the rock mass conditions
- (ii) the possibility of contact-free measurements
- (iii) the constant time need independent from rock mass complexity
- (iv) the option of for later review and analyses
- (v) the instant availability of the 3D model and parameters ready for further

KEYWORDS: Rock mass characterisation, complete documentation, measurement, optimisation, JointMetriX3D