# Manual Pre-processing of Monitoring While Drilling Data: State of Practice

## Robert Wenighofer[*1], Marlene Villeneuve[1]

[1]Chair of Subsurface Engineering, Montanuniversität Leoben, Leoben, Austria

[*] presenting author (email: robert.wenighofer@unileoben.ac.at)

**Keywords:**   pdf, geology, MWD, drilling jumbo, data acquisition

## 1   INTRODUCTION

During tunnel excavation, the rock mass ahead of the tunnel is often drilled for exploratory or intervention purposes, such as grout injections or dewatering. Most drilling equipment records operational parameters via a data acquisition system, monitoring while drilling (MWD), presenting the opportunity relate the drilling performance to the rock mass characteristics. This has been used to interpret the rock mass ahead of the tunnel face for decision making regarding excavation, support and grouting [e.g. 1, 2, 3, 4]. The large quantity of time-series and spatial data lends itself well to interpretation via machine learning methods.

One of the key challenges to applying machine learning to these datasets is that MWD and grouting data are not collected specifically for machine learning, and in order to derive meaningful interpretations information from a variety of data sources must be manually related to each other in terms of time and/or space.

## 2   DATA TYPES AND PRE-PROCESSING METHODOLOGY

The MWD data themselves consist of time series of machine parameters, for example rate of penetration (ROP), feed, damper and rotation pressure (Fig. 1, top), organised into separate data files for each drilled hole. These first need to be filtered to remove non-rock mass associated noise to highlight changes in the parameters in response to rock mass changes (Fig. 1, bottom). A second key step is locating the boreholes in time and space. This required developing scripts that related time stamp and hole collar survey data to develop a chronological model of when each hole is drilled with respect to the other holes (Fig. 2). Finally, the MWD data are manually related to grouting data by assigning the MWD data file to a grouting data file.

## 3   DISCUSSION AND CONCLUSIONS

In order to reduce the amount of manual pre-processing needed to apply machine learning techniques to MWD and injection data, the time and location of the boreholes must be included in the metadata. A data structure for MWD and injection data should be constructed before the project start to ensure that borehole numbers are systematically assigned regardless of equipment so they can be automatically related to each other.
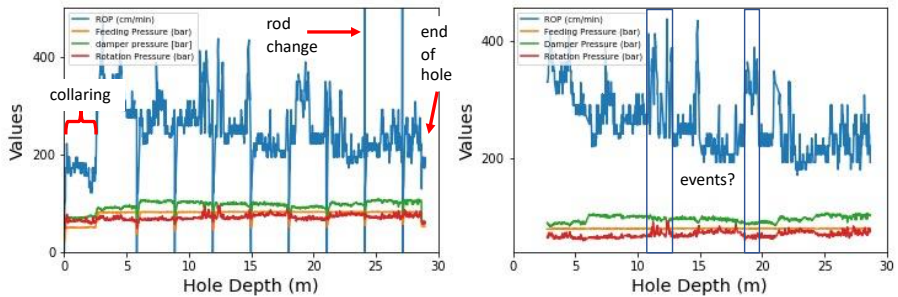
**Figure 1:** Example time series of MWD data showing (left) raw signal with operation-related noise and (right) filtered signal showing rock mass-related events.
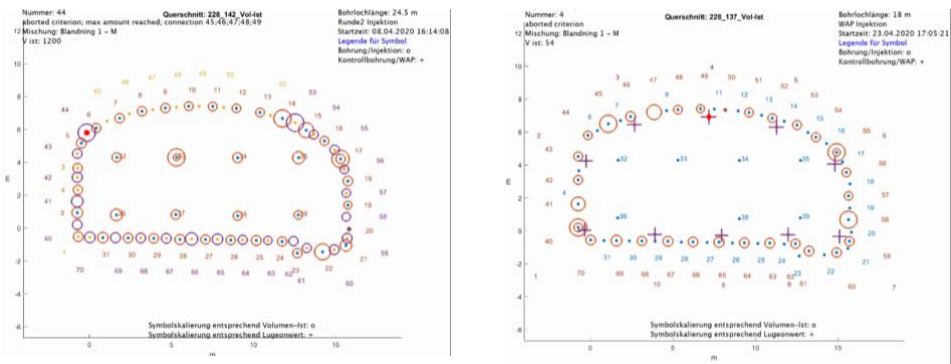


**Figure 2:** Screenshots of video-based chronological models of borehole locations

## ACKOWLEDGEMENTS

## REFERENCES

[1] van Eldert, J., Funehag, J., Schunnesson, H., Saiang, D.,. Drill Monitoring for Rock Mass Grouting: Case Study at the Stockholm Bypass. Rock Mechanics and Rock Engineering. (54), pp 501–511, 2021.

[2] Galende-Hernández, M., Menéndez, M., Fuente, M.J., Sainz-Palmer, G.I. Monitor-While-Drilling-based estimation of rock mass rating with computational intelligence: The case of tunnel excavation front. Automation in Construction. (93), pp. 325-338, 2018.

[3] He, M.M., Li, N., Yao, X.C., Chen, Y.S.,. A New Method for Prediction of Rock Quality Designation in Borehole Using Energy of Rotary Drilling. Rock Mechanics and Rock Engineering. (53), pp. 3383–3394, 2020.

[4] Schunnesson, H. RQD predictions based on drill performance parameters. Tunnelling and Underground Space Technology. 11(3), pp. 345–351, 1996.