The measurement and visualization of tunnel structures is the main competence of Dibit Messtechnik GmbH (Innsbruck, Austria). As the inventor of modern 3D tunnel surveying at the end of the 1990s, Dibit is a leader in global surveying projects and develops innovative software and hardware tools for geological applications in tunnelling.

In tunnel construction, the trend is towards the comprehensive, digital 3D recording and mapping of tunnel faces, especially to measure and quantify geological structures, and to document geological conditions. This must be done under the pressure of time and the harsh conditions of progressive mining and result in objective, reproducible data. On the one hand, these data should permit a standardized assessment of the rock conditions and on the other hand they should be analysed, archived and virtually viewed in a digital workflow.

At the 2nd tube of the Perjentunnel at the S16 Arlberg Expressway ILF Consulting Engineers has been responsible for the geologic documentation and Dibit for the geotechnical measurements. For described reasons Dibit has developed a geological 3D recording and analysis system, which is unique in this form. The system has been supported and tested by ILF during the excavation works in 2018. It consists of three main components:

1) Photogrammetric 3D recording unit "Handheld": With this compact and robust device, the tunnel face is recorded or measured in just two minutes (Figure 1).
2) Geological annotation software "geological tool": The software is used on a tablet computer in-situ for the geological assessment of the tunnel face. The recorded lithologies, microstructure measurements and rock characterization are incorporated into the processing of the 3D model (Figure 2)
3) 3D analysis software "Dibit": With the software, the 3D reconstruction of the tunnel face and the further analysis of structural, rock and geometric features is done.

With the system, geological investigations of tunnelling can be carried out very quickly, economically and comprehensively. The photorealistic 3D models enable the identification and analysis of relevant geological features in a virtual environment. 3D measurement data (microstructure, exposure, area measurements, point annotations, etc.) can be managed in a structured way in the database Dibit-TIS (tunnel information system) and statistically evaluated. An export to common BIM and CAD programs is possible.

Furthermore, on the basis of the geometry measurements, profile characteristics of the outbreak, such as over and under profiles are determined. Based on a reference geometry, or on subsequent 3D measurements, it is possible to calculate the volume of shotcrete and other installations. Thus, the geometric-thematic data provide valuable information for the construction and later maintenance of tunnel structures.

After the initial phase at the Perjentunnel the system is now used at different lots of the Brenner Base Tunnel and for the 2nd tube of the Karawankentunnel between Slovenia and Austria.