Proceedings of the 10th World Congress on Mechanical, Chemical, and Material Engineering (MCM'24)
Barcelona, Spain - August 22-24, 2024
Paper No. MMME 118
DOI: 10.11159/mmme24.118

New High Speed, High Accuracy Underground Scanning Equipment

Lluís Sanmiquel[1], Marc Bascompta[1], Nor Sidki[1], Mohammad Yousefian[1], Marc Vallbé[1]
[1]Department of Mining Engineering, Industrial and ICT.
Polytechnic University of Catalonia (UPC), Avenue Bases de Manresa, 61-73, 08242-Manresa Spain
lluis.sanmiquel@upc.edu; marc.bascompta@upc.edu; nor.sidki@upc.edu;
mohammad.yousefian@upc.edu; marc.vallbe@upc.edu

Extended Abstract

Increasingly, underground activities, especially in mining, require monitoring of the movement or convergence of tunnel sections in order to model and characterise these movements and thus take preventive measures to eliminate or minimise the risk of collapse. Laser scanning is one of the most efficient ways of doing this. For this reason, it has been used in recent years for modelling and monitoring underground spaces [1], [2]. Its working method is based on the collection of geospatial information through repeated measurements over a period of time. This makes it possible to define very precisely the horizontal and vertical displacements of the monitored space [3].

Currently, in order to achieve the highest possible accuracy with laser scanners, measurements are carried out by an operator on foot, parking the laser scanner on a tripod approximately every 10 metres in a given section of the gallery to be scanned, until the entire section of the gallery to be measured has been completed. The problem with this system is that it exposes the operator to the risks present in the gallery, such as dust, gases, possible being run over or spontaneously falling stones [4].

In order to avoid or reduce as much as possible the operator's exposure to these risks, a laser scanner measurement method is proposed, based on the "stop & go" method applied to an all-terrain vehicle, where the laser scanner is attached to the roof or another part of the vehicle using a suitable coupling. This coupling system must have certain characteristics in order for the scanner measurement to be safe and accurate [5].

From here, the driver has a device to control the laser scanner via a wifi connection generated by the scanner itself. The vehicle then drives away from the first section of a gallery to be monitored, where on both sides of the gallery, or at least on one of the two sides, there is a topographical point or target materialised by a nail and reflective paint around it. The operator starts the laser scanner and takes a measurement of this first section of the gallery. Once this first measurement has been completed, he drives the vehicle forward for about 10 metres, stopping at the level of another target on the right and/or left wall, where he starts the laser scanner again to measure the second section of the gallery. This is repeated until the entire length of the gallery has been surveyed.

The tests carried out on sections of mine gallery using laser scanners and the method described above have shown that it is a good method, since it has been possible to avoid exposing the operator of the scanner to the risks of an underground gallery, with the same precision as if the measurements had been carried out by the operator on foot.

References

[1] K. Pukanská., K. Bartoš, P. Bella, J. Gašinec, P. Blistan, L. Kovanič. "Surveying and high-resolution topography of the Ochtiná Aragonite cave based on TLS and digital photogrammetry," *Applied Sciences*,10(13), pp. 1–19, 2020.

[2] J. Gallwey, M. Eyre, J. Coggan. "A machine learning approach for the detection of supporting rock bolts from laser scan data in an underground mine," *Tunelling and underground space technology*, 107, pp. 103656, 2021.

[3] N. Sidki, M. Bascompta, L. Sanmiquel. "Study of the geomechanical behaviour of different saline typologies in the Catalan basin," *in Proceedings of the 6th World Congress on Mechanical, Chemical, and Material Engineering (MCM'20),* Virtual Conference, 2020.

[4] L. Sanmiquel, M. Freijo, J. Edo, J.M. Rossell. "Analysis of work related accidents in the Spanish mining sector from 1982–2006,". *Journal of Safety Research*, 41, pp. 1–7, 2010.

[5] S. Singh, B. Banerjee, S. Raval. "A review of laser scanning for geological and geotechnical applications in underground mining," *International Journal of Mining Science and Technology*, 33(2), pp. 133-154, 2023.