Mobile LiDAR for mining applications

S.K. Singh[1], S. Raval[2] and B.P. Banerjee[3] (initials and surnames only)

1.PhD Candidate, School of Minerals and Energy Resources Engineering, UNSW Sydney, NSW 2052. Email: sarveshkumar.singh@unsw.edu.au
2.Senior Lecturer, School of Minerals and Energy Resources Engineering, UNSW Sydney, NSW 2052. Email: simit@unsw.edu.au
3.Research Scientist, Agriculture Victoria, Grains Innovation Park, Horsham, VIC 3400. Email: bikram.banerjee@agriculture.vic.gov.au

Keywords: Laser scanning, Structure mapping, Object identification, Change detection

ABSTRACT

Light detection and ranging (LiDAR), popularly known as laser scanning in the construction industry, has revolutionised the way of mapping and monitoring underground spaces. LiDAR offers the flexibility of being mounted on a mobile platform, such as drones, ground vehicles or wearable backpacks, or can be used in a static manner to produce a digital twin of the scanned underground space in the form of a 3D point cloud. The obtained digital data usually has ample spatial resolution required for various mining applications; and offers the flexibility of remote data processing. In this paper, three critical challenges associated with underground mine has been addressed using point cloud data obtained from a mobile LiDAR. The first challenge attempted is to obtain a spatially accurate multi-temporal map in a GPS denied environment for monitoring various change such as diversions and conversions of roadways. The results show that for a scan length of around 850 m, the error in georeferencing and coregistration of point clouds can be within one meter. The second challenge was focused on developing a machine learning based algorithm to automatically identify objects, such as roof bolts, from the point cloud. The algorithm developed to automatically identify roof bolts achieved 90% precision. Finally, the third challenge relates to the identification of the structural features in an underground mine such as rock mass discontinuities. To this end, a new automated algorithm based on a modified region growing approach was developed. All the analysis were performed on point clouds acquired from an underground coal mine which is one of the most challenging environments for imaging. In summary, point cloud data when acquired and processed tactically could provide a better solution to various routine mine site challenges. Most of the point cloud associated processing workflow could be automated that in turn reduces human-induced biases in the results. Going forward, LiDAR scanning will be an increasingly integral part of interactive human-machine applications where any solutions could be improvised on-the-fly.