Digital 3D imaging in underground coal mines: A case study

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ABSTRACT

Frequent observations are key to detect any change occurring in underground mines. The conventional observation strategies include localised mapping that are often time-consuming and unscaleable to map changes happening at a large scale. Further, conditions in the underground mines such as unavailability of global navigation satellite system (GNSS) signal, suboptimal lighting conditions, limited access and intrinsic safety requirements restricts the optimum use of other technologies such as photogrammetry, terrestrial laser scanning (TLS) and RADAR.

With recent advancements in the field of simultaneous localisation and mapping (SLAM) using laser scanning technology, it has now become possible to use portable mobile mapping systems to generate large-scale 3D models. Most of the current SLAM based mobile mapping systems perform better in non-mining (ordinary indoor) environments but poses functional challenges when used in underground mines. This paper highlights a case study of customised application of a mobile mapping system in an underground coal mine. Challenges and solutions from data acquisition through to feature extractions are outlined. The laser-based MMS generates a digitised pattern of three-dimensional points that captures the geometry of the mine site including structural support systems such as rock bolts and cable bolts. The 3D point could provide unprecedented details that could be extracted automatically with the help of tailored machine learning based algorithms. Furthermore, by using time-series datasets, the changes occurring in a part of the mine can be traced and located through accurate data registration and cross-comparison. The mobile mapping system is going to be increasingly an integral part of futuristic automated mine operations.