Comparison of Three Innovative Technologies for 3D-Acquisition, Modelling, and Visualisation of an Underground Mine

Valens Frangez, Benjamin Kramis, Florian Hübscher and Andreas Baumann (Switzerland)

Key words: Terrestrial Laser Scanning; SLAM; Indoor Mobile Mapping; Underground Mine Surveying; Virtual Reality (VR)

SUMMARY

Mobile mapping (MM) solutions represent an innovative and effective approach for acquiring geospatial information. While outdoor MM solutions are already well established, mapping large-scale indoor or underground environments with high surface complexity, detail and possibly low ambient light is still a demanding task and a variety of technological solutions start to emerge. In this contribution, we compare three such solutions empirically with respect to data quality, properties of the derived 3D models, and usability.

The analysis is based on data collected in a former gold mine using three different techniques. A FARO Focus3D X330 was used to capture approximately 360 metres of underground galleries employing terrestrial laser scanning (TLS). About 120 scans were taken within two days to cover the entire space. Additionally, the same space was mapped independently using two commercial MM systems suitable for indoor applications, namely a GeoSLAM ZEB-REVO handheld scanner and a Leica Pegasus Backpack MM system. Each of them required less than 20 minutes for acquiring the galleries in a single walkthrough. A geodetic terrestrial network was established within the mine. Spherical targets placed in the scene and connected to that network were used as a reference for the evaluation of the quality of the point clouds, in particular with respect to non-linear drift. Additionally, cloud-to-cloud and cloud-to-mesh comparisons were carried out to directly compare the point clouds. A 3D surface model was generated and visualised in a virtual reality (VR) environment using the HTC Vive headset. It was extended by fusing the model of the galleries with a digital terrain model (DTM) and geological maps in the virtual environment. The final 3D surface model of the gold mine together with a fly-through video animation have been published on a project website.

We present the workflows for model generation including VR and video animation, and give a

detailed report on the results of the assessment in terms of technical aspects (including point cloud accuracy), time consumption, complexity of the data processing, and potential use cases. The results are used to give recommendations for tackling similar mapping and modelling tasks for underground or indoor environments.