Terrestrial Laser Scanning for the Documentation of Heritage Tunnels: An Error Analysis

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SUMMARY

Terrestrial Laser Scanning (TLS) has been operational for more than a decade with applications ranging from engineering as-built surveys, volume calculations, deformation monitoring to heritage site documentation and modelling. The advances in instrumentation now allow for large, precise 3D point cloud data that can be captured at up to a million points per second, with each point recording an X, Y, and Z coordinate, an intensity value, and RGB colour through integrating an internal camera or supplementing the point cloud data with external camera imagery.

Individual scan station point cloud data is registered with respect to a single station. This relative coordinate system is referred to as the Intrinsic Reference System (IRS). The relative coordinates are georeferenced in order to give the point cloud data real world coordinates in terms of a Ground Reference System (GRS).

This paper presents an analysis of the point cloud accuracy for the previously unmapped network of underground World War One (WWI) tunnels known as the Ronville Sector, Arras, France. An initial test accuracy assessment of point cloud data was analysed for the National School of Surveying prior to the fieldwork undertaken in France. Various registration and georeferencing scenarios were tested and investigated, providing a framework to undertake the TLS survey in France.

The test results show that the geometry of the Ground Control Points (GCPs) have more of an influence on the accuracy of the point cloud data compared to the amount of GCPs used. With optimising the spatial coverage of GCPs, there is little difference between using three and eight GCPs and the influence this has on the accuracy of the point cloud data. The test was necessary to undertake in order to understand what results may have been achievable for the documentation of

the WWI tunnels.