Automatic and Efficient Quality Assessment of Terrestrial Laser Scans

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SUMMARY

Today's state-of-the-art laser scanners are multi-sensor systems (MSS) that combine 3D point recording with color information captured by an integrated camera. Due to its high data acquisition rate, high spatial resolution and contactless measurement, terrestrial laser scanning (TLS) has become one of the standard methods in 3D point cloud acquisition. In some fields of application, such as engineering geodesy, the recorded 3D point clouds must meet high quality requirements, making automatic quality assessment and cleaning of the point cloud essential.

This work addresses the topic of a fully comprehensive quality modelling of TLS point clouds, including different quality measures such as uncertainties, resolution and completeness. For this purpose, the term "quality" is first defined in more detail in the field of TLS. The focus is placed on the uncertainty modelling of 3D point clouds. In the process, an overview of the total uncertainty budget of the TLS is provided, which is at the current phase classified into six influence factors. The contribution then demonstrates the impact of some of these influence factors, including i.e. the angle of incidence, spot size and edge points.

As well known, it is illustrated that the distance precision can be derived from raw intensity values and how this is used to calculate the local 3D point precision by means of a variance-covariance propagation (vcp). In addition, inaccurate points, such as edges and points with poor angles of incidence, can be identified. These can be removed so that they are not included in further processing steps, such as registration by means of iterative closest points (ICP) or plane-based techniques. Furthermore, it is presented how the uncertainties of transformation parameters (three rotations, three translations, one scale), e.g. from a registration or georeferencing and the uncertainty of the local 3D points are transferred to the global 3D points. In summary, after quality modelling, information is obtained about the precision of the 3D points in the local and global

coordinate system. At the end of this work the entire quality modelling process is demonstrated using a real TLS point cloud (40 million points) and its practicability is further proven (run time < 10 min).