Towards the Influence of the Angle of Incidence and the Surface Roughness on Distances in Terrestrial Laser Scanning

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SUMMARY

Terrestrial laser scanner allow nowadays the determination of changes of the structure's geometry with millimetre accuracy. To ensure the achievement of this accuracy level it is necessary to account for systematic deviations, as they can cause apparent deformations or rigid body movements.

The errors of the reflectorless distance measurement have an essential contribution to the error budget of terrestrial laser scanner measurements. In the major part of current research these errors are obtained by means of deviations from approximating surfaces. In contrast to this, we present in this contribution an approach to obtain the systematic errors of single measured distances. It is based on the direct comparison of a scanned distance with a reference distance. The basis for the determination of the reference distances is a high-accuracy geodetic network that extends over the entire range of the measured distance. One endpoint of the reference distance corresponds to the station of the terrestrial laser scanner. Its coordinates are determined by spatial resection from the network points. The other endpoint of the reference distance is determined by industrial measurement techniques from a high-accuracy point cloud.

The approach is used to study the impact of the angle of incidence on scanned distances. Based on the obtained results we discuss two perspectives on the influence of the angle of incidence. In the global perspective, adopted up to now in most research, the angle of incidence is the angle between the laser beam and the approximated surface. The presented results additionally sustain a local perspective on the angle of incidence as an angle between single rays of the laser beam with particles of the rough surface. The two perspectives are compared with respect to their relevance for the assessment of systematic deviations of scanned distances under special consideration and quantification of the surface roughness.