3D visibility analysis for planning of TLS networks

Pauline Speidel and Volker Schwieger (Germany)

Key words: Deformation measurement; Engineering survey; Laser scanning; Spatial planning; visibility analysis, terrestrial laser scanning, voxel, ray casting

SUMMARY

Terrestrial laser scanning (TLS) is a well-established method of capturing complex 3D objects on a large scale with high resolution. Frequently more than one scan is required to capture the whole object. In this case an optimal design of the TLS network would be very helpful. A key challenge therefor is ensuring the completeness of the resulting point cloud. This requires precisely determining visible and hidden object faces from different viewpoints. This paper presents a voxel-based algorithm for 3D visibility analysis. First, the triangulated mesh is voxelised, with edges and faces being approximated using the extended Bresenham algorithm. Afterwards, a visibility check is performed based on the principle of ray casting. The occupied voxels are examined to determine their visibility from a defined viewpoint. For this purpose, the voxels are transformed into spherical coordinates so that the relationship between the instrument viewpoint and the voxel is described directly in geometric terms and occlusions can be detected via the radial component. Normal vectors are also incorporated into the analysis, enabling a reliable distinction to be made between real and apparent self-occlusions, to prevent misclassifications caused by staircase artefacts on sloping faces.

This approach provides a foundation for the efficient planning of TLS networks and the optimisation of scan viewpoint number and coordinate.