**Titel:**

Assessing the Quality of LiDAR Infrastructure Point Clouds

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**Abstract**

LIght Detection And Ranging (LiDAR) imaging technology has advanced over the past two decades, being used for applications such as Digital Terrain Models (DTM) and Building Integration Modeling (BIM) integration. The resulting products, point clouds, serve diverse purposes, each demanding specific quality standards. Failing to meet the standards risks rendering the data ineffective or even unusable. Contractors, including Rijkswaterstaat, therefore, specify adherence to set requirements or standards. Current manual sampling for assessing the quality highlights the need for an automated tool.

This study proposes a workflow for automating quality validation of LiDAR infrastructure point clouds. The workflow assesses point cloud quality based on three primary components: coverage, relative accuracy, and absolute accuracy. The methodology includes:

• Point Cloud Density assessment: involves analyzing 2D horizontal cells and partial-3D spaces to ensure compliance with density requirements.

• Overlapping Regions Alignment: identifies and compares surfaces in overlapping areas of point clouds to determine relative accuracy.

• Benchmark alignment: extracts points corresponding to spherical targets, estimates the center coordinates, and evaluates adherence to absolute accuracy standards.

Quality assessments were conducted on static, mobile, and airborne point clouds. The static point cloud analysis revealed non-compliance with density requirements in 2D, with approximately half the points failing to meet standards. In 3D analysis, compliance was observed for 1 m2 horizontal cells, but individual 1-meter sections often fell short upon closer inspection. These findings highlight the need for tailored quality standards: detailed 3D analysis is crucial for complex environments like tunnels, while road environments can be effectively evaluated in 2D. Relative accuracy assessments for static and mobile datasets showed compliance with scanner specifications, with RMSE values meeting the specified requirements. Absolute accuracy assessments on static point clouds met requirements with minimal deviations in both XY and Z directions.

Recommendations include defining density requirements for different environments, establishing acceptance criteria, and defining allowable deviations for all requirements.