

Jens Meinderts - Clearance Measurement Validation For Highway Infrastructure With Use of LiDAR Point Clouds

Date

2023

Abstract

The Dutch highway network contains more than 3.000 kilometers of roads. Along these roads are thousands of overhead objects such as viaducts and traffic sign gantries. It is essential to have recent and accurate data on the clearances under these objects. This data is important for maintenance and routing oversized transports. Obtaining clearance measurements can be time consuming, costly and involves a lot of manual labor. The aim of this study is to develop a method that automatically estimates vertical and horizontal clearances of highway viaducts and gantries from Mobile Laser Scanning (MLS) point clouds. The proposed method takes a point cloud of an infrastructure object as input, and as output provides the user with a concise overview of the estimated horizontal and vertical clearances under the object.

A point cloud of a highway viaduct or gantry is segmented into different clusters relevant for determining the clearances. The discrete points in these clusters are then used to approximate their corresponding surfaces with B-splines. Subsequently the minimal clearances can be estimated. These clearances are estimated at certain pre-specified locations according to guidelines from the highway authority, Rijkswaterstaat. To validate the proposed method a case study is performed on two sections of Dutch highway containing a total of 20 viaducts and 50 gantries. For the viaducts and gantries along these highway sections there are clearance measurements available from third-party contractors. After processing the point clouds in the case study, the obtained clearance estimations are compared to the third-party measurements. This comparison gives a quantitative analysis of the estimated clearances and shows that the proposed method produces similar results to the third-party measurements. On average the proposed method overestimates the vertical clearances and underestimates the horizontal clearances. A sensitivity analysis is performed to confirm that the proposed method can produce consistent results. When performing clearance estimations on a different dataset containing point clouds with an up to 20 times higher point density, the estimation differences with the third-party measurements become even smaller.