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Verification of Building Constructions Surroundings Based on Airborne Laser Scanning Data

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1 Introduction

Light Detection and Ranging, as an active Remote Sensing Technology, enables gathering accurate, three-dimensional point cloud of scanned objects. Laser scanning might be provided on the terrestrial level for construction like architectural heritage, buildings, bridges, and on the airborne level (Airborne Laser Scanning - ALS) using flying platform (airplane, helicopter, unmanned aerial vehicle - UAV), for aerial objects like forests, environmental heritage, as well as for linear objects: power lines, roads, railways, etc. Using a multi-sensors mounted on a moving platform, as a Mobile Mapping Technology (MMT), is currently the most efficient way of obtaining in a short time, accurate positions of billions of points as a representation of a scanned area (Tao and Li, 2020). Based on this kind of dataset it is possible to perform three-dimensional analysis of the safety of scanned objects without additional measurements in the field.

2 Materials and Methods

Point cloud data from ALS for this experiment was provided by Vimap company. Data was acquired in 2016, in Poland, near Ostróda city, for the MV power line corridor, as a test data for test flights before launching a commercial power lines ALS project. The sample test flight was done for about 400 m of power line in an urban area. The average flight altitude of the flying unit was approximately 40-50 m from ground level. The accuracy of the measurement of horizontal coordinates (X, Y) RMSE = 0.05m, accuracy of point height measurement (Z) RMSE = 0.10m. The point cloud density equals 55 pts/m^2.

LiDAR data were classified into classes: ground, building, vegetation, power line wires, power line pylons pipeline, paved road, unpaved road, water, railway and not classified. Based on point cloud, electrical network was digitized.

Classified LiDAR data and digitized 3D model of MV power line, are the basic inputs for 3D analysis in vMatic software. The collision searching mechanism in vMatic is based on releasing a virtual cylinder with a radius specified by the user, along the course of the 3D model object and detecting whether the cylinder encounters points of the particular class.

Based on ALS data of the middle voltage power line, the detection of collisions with buildings was performed for digitized phase cables of the line for seven spans, from 14th pole to 19th pole (total length: 367m).

3 Results

Tool for automatic detection of building collision in 5m 3D range buffer from the power line conductors found in total 9 building obstacles. Two buildings were in a really close area to the power line, with the closest 3D distance equals 2.64m (span from 16th pole to 17th pole) and 2.77m (span from 17th a pole to 18th pole). One building was detected in 3.00 – 3.99m collision range, six buildings in a range from 4.00 m to 5.00m. The other fifteen buildings in the analyzed area weren't found due to 3D distance from power line wires to the building bigger than 5m. The results of the performed analysis with division into ranges of a 3D collision distance shows Table 1.

Table 1. Results of performed buildings detections with a power line on LiDAR data.

Collision ranges distances	Found building collision	Span name with a distance of collision
0.00m - 1.99m	0	-
2.00m - 2.99m	2	16-17 2.64m 17a-18 2.77m
3.00m - 3.99m	1	15-16 3.85m
4.00m - 4.49m	2	18-19 4.12m 18-19 4.40m
4.50m - 5.00m	4	17a-18 4.56m 15-16 4.81m 15-16 4.84m 18-19 .97m

4 Conclusions

LiDAR data allows the performance of three-dimensional analysis for building constructions without any additional measurements in the field. Based on data gathered by remote sensing technology, verification of any construction surroundings can be performed in dedicated software to ensure the safety of the objects.

Performed in this article analysis of the power line obstacles were detected in vMatic software. The analysis took less than 20 seconds for the detection of buildings points (closer than 5m from conductors) for almost 400m length of the MV power line. vMatic software detected nine buildings that are too close to the power line.

The results of the analysis performed on LiDAR data are reliable. Providing distance verification on 3D point cloud data is the fastest way to obtain a hazard awareness in a short time.

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References

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