Journal of Young Scientist, Volume VII, 2019
ISSN 2344 - 1283; ISSN CD-ROM 2344 - 1291; ISSN Online 2344 - 1305; ISSN-L 2344 – 1283

IDENTIFICATION OF CRITICAL AREAS ON POWER LINES USING LIDAR AND ARCGIS PRO SOFTWARE

Cristina - Elena MIHALACHE

Scientific Coordinators: PhD Eng. Andreea CĂLUGĂRU, Assist. PhD Eng. Cristian MOISE

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Blvd, District 1, 011464, Bucharest, Romania, Phone: +4021.318.25.64, Fax: + 4021.318.25.67

Corresponding author email: mihalachecristina19@gmail.com

Abstract

Transmission line corridor clearance management plays a critically important role in power line risk management and is an important task of the routine power line inspection of the grid company.
Airborne Light Detection and Ranging (LIDAR) technology brought a new reformation for measurement technology, and the airborne LIDAR technology provides a new way for power line inspection. Compared with the traditional measurement system, airborne LIDAR measurement system has its unique technical advantages, which can directly obtain the power line corridor point cloud and get the high precision of 3D spatial information, then obtain the whole information of the 3D power lines corridor.
This study proposes an extraction method of critical areas from power lines using LIDAR point cloud data.
The corridor monitoring mainly includes the inspection of the overhanging trees in the corridor and the existence of the bird's nest and other routes, this study, introduce the working principle and application of LIDAR system in power line inspection. LIDAR system's advantage is that can accurately restore the 3D spatial information of line corridors, and then we can get along the more accurate and more comprehensive information of the line and route area.

Keywords: *critical areas, LIDAR, power lines, Romania, 3D.*

INTRODUCTION

Unmanned aerial vehicles (UAVs) as alternative platforms for laser scanning provide a good choice to overcome the aforementioned issue. Currently, many researches have been done, from preliminary schematics and prototypes of UAV-borne LiDAR systems to more comprehensive systems (Lin, 2011).
The UAV obtain high-precision 3D point cloud data which is equipped with LIDAR system, and then carry out line model reconstruction and hazard detection. The application of LIDAR technology in power line inspection is greatly promoted.
The UAV technology has evolved very much and this can be utilized in power line inspection for the development of the power sector inspection technology.
On this line the UAV power line inspection has a lot of conveniences, such as low inspection cost, small investment in equipment, automation, quick result, etc.
The management of power line corridors is very important and is mainly focused on identifying issues of the overhanging trees in the corridor and the existence of the bird's nest, identifying the trees which could fall and contact the power lines structure.
Therefore, using this systems, UAV and LIDAR can solve any problems such as safety or high technical requirement. For instance, the corridors of power lines can be keep clearance, between conductor and vegetation.
Thus, 3D power line model can easily provide a multifaceted analysis for the risk management of power-line keeping safety and saving time and cost (Chaput, 2008).
From the dense point clouds generated from UAV-LIDAR systems with high range accuracy could provide 3D power line models which can generate semantic information.

MATERIALS AND METHODS

A. Data

The LIDAR points cloud was obtained using UAV System DJI MATRICE M600 PRO – LIDAR SCOUT SENSOR.

Figure 1. Flight planning

For this study we used the ArcGIS PROsoftware application. The main component of SCOUT System is LIDAR sensor. This is Velodyne VLP-16 Puck Lite which can capture between 300.000 and600.000 points on seconds.

The quality of the LIDAR cloud point, such as position accuracy and point density are very important. Usually the performance of algorithm for classification and modeling power line depends on the quality of the LIDAR measurements.

The point cloud post-processing flow is figured below.

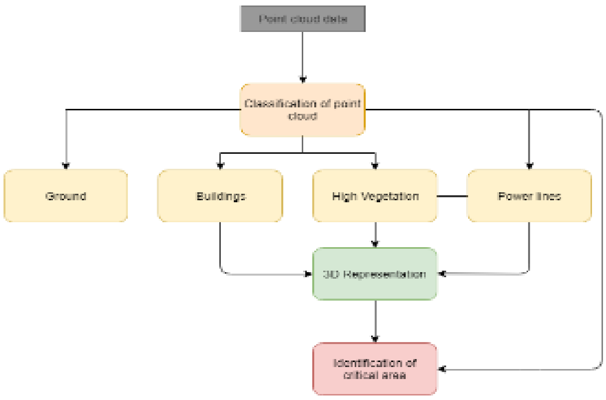

Figure 2. Post – processing flow

B. Initial classification

The raw LiDAR point cloud data and is shown in Figure 3. First of all I classified the LIDAR point cloud data. In order to classify the data according to the ASPRS (American Society for Photogrammetry and Remote Sensing) standards, it will first classify noise points, ground points, points corresponding to their constructions, vegetation and their electrical lines (non ground points).Because the automatic classification of ground points does not integrate all the points of the ground, the user is required to part of these points manually classify them. Prior to their manual classification, the Auto-Classify Non-Ground Points are automatically classified. This classification involves identifying the points that belong to the buildings, the points that define the vegetation (small, medium or high), the points that define the areas with water, etc. as well as points that are framed as noise. Assisted Classification is done by selecting points belonging to a particular class of objects and assigning the corresponding class according to ASPRS specifications.

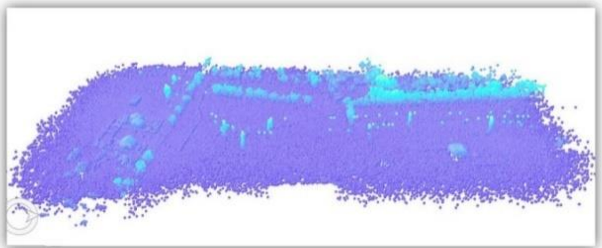

Figure 3. Unclassified point cloud

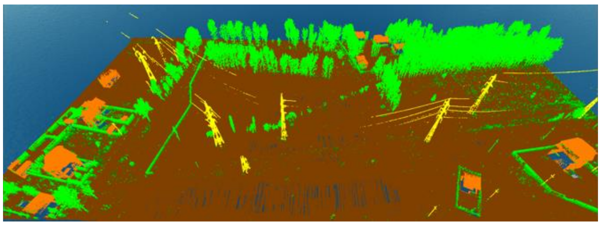

Figure 4. Classified point cloud

C. Extracting 3D Buildings and Trees

In raw LIDAR data, both ground and non-ground objects, such as low vegetation, high vegetation, buildings, and vehicles, generate backscatter (Meng et al., 2009).

Non-ground points need to be identified and filtered out from LIDAR data before Digital Terrain Model interpolation. Likewise, ground points need to be eliminated before extracting non-ground objects, such as vegetation and buildings to generate Digital Surface Model.

The proposed building extraction algorithm has been implementing by using “Extract roof form Tools”. Utilizing the DTM, DSM, nDSM and the building footprints we obtained information from building like flat roof form, roof height, area of buildings. Finally, for generating the 3D building we run the “Apply Symbology from Layer” tool.

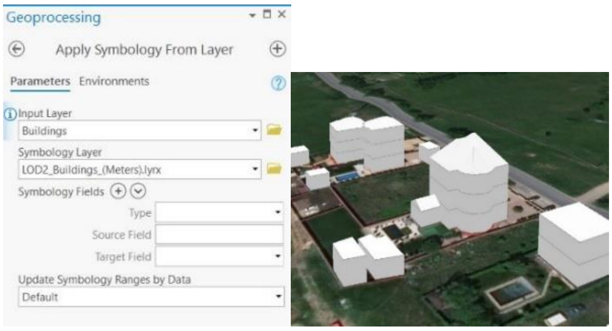

Figure 5. Parameters and 3D buildings

This paper proposes two methods for representing 3D trees.
First of all, we used the “Extract Values to Points” Tool, setting by input parameters the point features and the Normalized Digital Surface Model.
As shown in Figure 6, the trees do not have the values in the attribute table and they are representing with the same height, it is not the real height.

Figure 6. D trees (results of first method)

The second way on which we use to represent trees is by running the “Tool for Create 3D Trees”. Thus, we set up by input the LAS Dataset and then we introduce the parameters for Vegetation Class Codes, Minimum canopy height and Maximum canopy height, Digital Terrain Model and the Point Spacing.
The result of this method is better than the other.

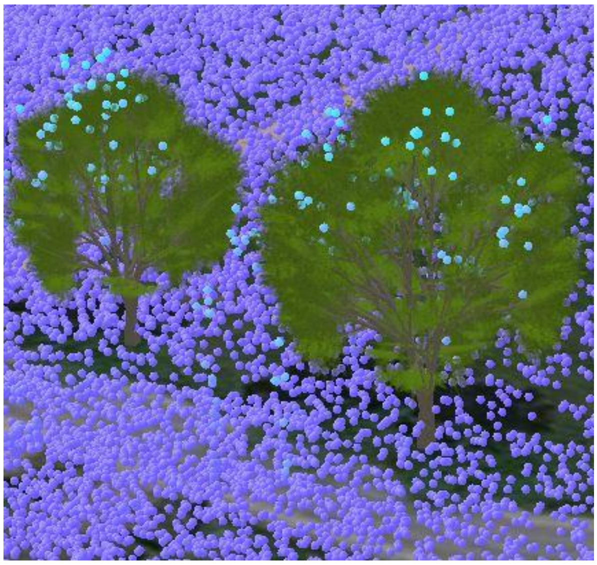

Figure 7. 3D trees (the second method)

RESULTS AND DISCUSSIONS

Extracting Transmission Line Spans and tower models

In this section, the transmission line spans and the tower models were extracted from point cloud dataset. The first step for reconstructing power lines is to extract a power line candidate point that indicates a possible presence of power lines. This step would be greatly helpful for reducing scene complexity.
Then we continued this process by following the steps from 3D Tools for Power Lines. In this sense created the transmission line and the distribution lines setting the Voltage, Conductor parameters, Tower Configuration, Pole Configuration etc.
The second step in this process is creating the Sway surface that represents the area where the spans can swing. Hence, by setting the maximum angle where the power lines can swing and using the 3D lines that were created before, we will obtain the Sway surface areas that represent a protection area for power lines.
The aim of this study is to identify in a semi-automatic mode the areas where the vegetation can is too close on the power lines. For detecting the critical areas we measured the distance measure between power line and the trees in the cases where we visual identified the possible anomaly. In this paper we considered the anomaly the areas where we measured the distances less than 2 m. T his areas was marked by a point namely “Critical point” and then to

view the entire problem area we generated a 3D buffer for all the “Critical point”.

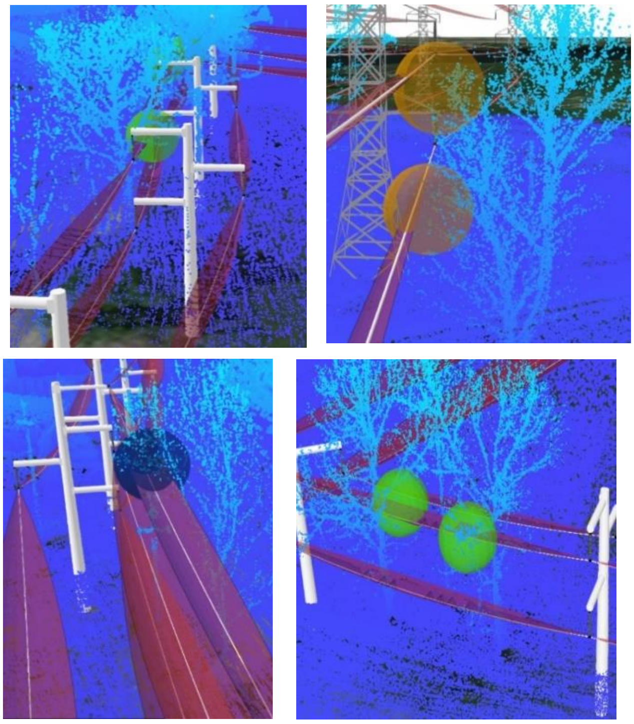

Figure 8. Critical areas

This experiment was implemented to validate the capability and accuracy of the proposed method for the identification anomaly on power lines using point cloud dataset.

The inspected area is located in a semi-residential region, there are few buildings and also few electrical power lines. Further research work should mainly focus on this method to increase automatic detection of critical areas on transmission lines.

CONCLUSIONS

This paper presented an efficient workflow for identifying the critical areas on power lines using LIDAR. There are a number of conclusions that can be drawn from the information presented in the case study compared to the classic realistic representation and monitoring procedures.

At present, the mentions automatic detection refers to the identifying the problems on a Transmission line using Locate by Proximity method. This process takes full advantage of the LIDAR 3D, developing the accuracy and reducing human labour in the identification process. This method for automatic detection of critical area can determine automatically the points which are in the Catenary Surface. Unfortunately, using this point cloud we cannot implement this automatic method because we need to have a very dense point cloud dataset.

The entire project and the results can be visualize in the applications on the ArcGIS Onlinehttps://bit.ly/2SXx7nv

ACKNOWLEDGEMENTS

I would like to express my very great appreciation to PhD Eng. Andreea CĂLUGĂRU for her valuable and constructive suggestions during the planning and development of this research work. Her willingness to give her time so generously has been very much appreciated.

REFERENCES

Chaput, L.J., 2008. Understanding LiDAR data – How Utilities can get Maximum Benefits from 3D Modeling, International LiDAR Mapping Forum (ILMF), Denver, CO, USA, Feb.21-22, (On CD-ROM).

Shan J., Toth C. K., 2017. Topographic Laser Ranging and Scanning: Principles and Processing, CRC Press.

Meng, X., Wang, L., Silván-Cárdenas, J., L., et al., 2009. A multi-directional ground filtering algorithm for airborne LIDAR. ISPRS Journal of Photogrammetry and Remote Sensing, 64(1): 117-124.

Lin Y., 2011. MINI-UAV borne LiDAR for fine scale mapping. IEEE Geosci. Remote Sens. Lett., vol.8, no. 3. pp.426-430