3D Point Cloud End-to-end Processing

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I. INTRODUCTION

i) Background

CloudCompare is a 3D point cloud processing software which can manipulate triangular meshes and calibrated images. The software developed when the collaboration between Telecom ParisTech and the R & D department of Electricite de France. This project was started by the PhD student, Daniel Girardeau-Montaut with the research topic of "Change detection on 3D geometric data", the research purpose is to acquire laser scanners to detect changes in 3D high density point clouds in industrial facilities. Next, CloudCompare developed the advanced 3D data processing and open source software. CloudCompare provides advanced processing algorithms by performing 3D point cloud and triangular meshes such as distance and statistics computation, projections, segmentation, registration and geometric features estimation. This report will illustrates the segmentation and rendering animation video of different types of cellular towers' point cloud data using Cloud Compare software.

ii) Objectives

Objectives of this project are:

- To analyse different type of lidar point cloud data of cellular towers
- To install the snap application package and run on Linux distributions on a single build.
- To build the segmentation and animation video for point cloud data of cellular towers with different class attributes of segments

II. METHODOLOGY

i) Point Cloud Data

In this project, there will be 5 lidar point cloud data files used for demonstration: Baran.las, Gladiol.las, Kaliancar,las, Kalisapu.las and Ngombak.las. The lidar point cloud data is saved in LAS file format as an archive for the lidar point cloud data.

ii) Installation of CloudCompare Software

For creating animation video of lidar point cloud data, the animation plugin of CloudCompare is needed. The plugin is not available in CloudComPy, the Python wrapper for CloudCompare. Therefore, A complete version of CloudCompare needed to be installed.

The complete version of CloudCompare software is available on the Snap Store of Ubuntu (Linux) system. The software can be installed through entering the commands below in Ubuntu terminal:

[Line 1] snap install core
[Line 2] sudo snap install cloudcompare

iii) Launching CloudCompare Software

After the CloudCompare software is installed from Snap Store. The software can be run by entering commands below in Ubuntu terminal:

[Line 1] cloudcompare.CloudCompare

iv) Class Attribute of Point Cloud

To divide the point cloud data to several elements, segment tool can be used. A part of the point cloud data can be cut and labelled with a different name by drawing a polygon to cut the point cloud data out from the original point cloud data.

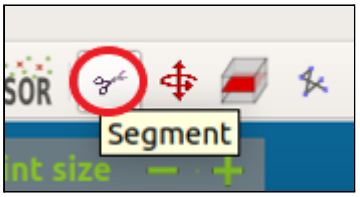

Figure 1: Segment tool

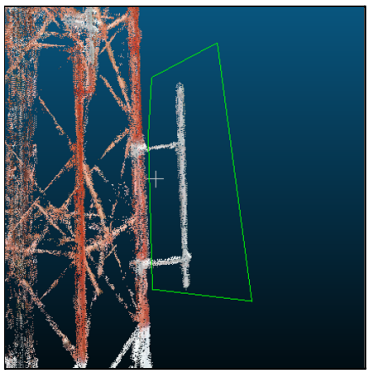

Figure 2: Polygon drawn using segment tool

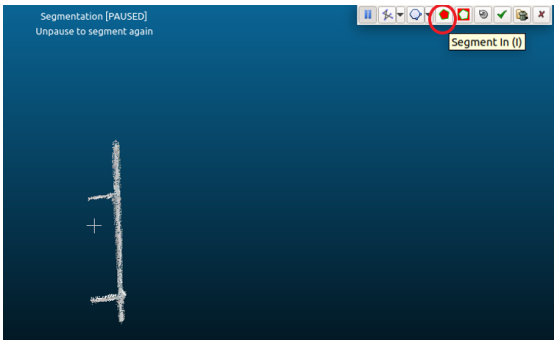

Figure 3: Point cloud data cut as a segment

The segment cut from the original point cloud data can be renamed by double clicking the file name of segment. To have the segment labelled with its name, user can toggle the 3D name of the segment by right-clicking the segment file.

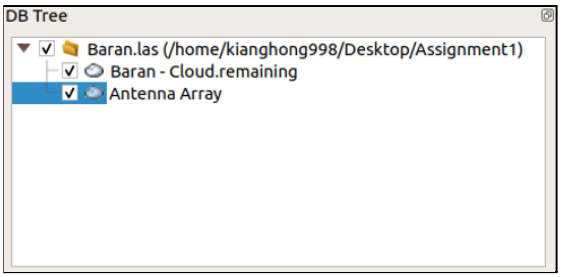

Figure 4: Segment renamed to “Antenna Array”

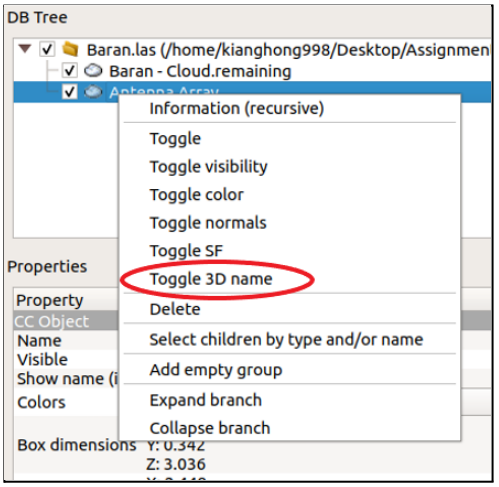

Figure 5: Toggle 3D name of segment

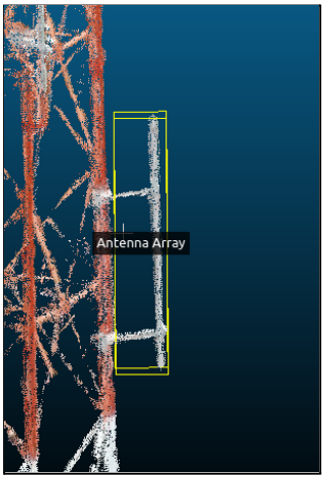

Figure 6: Toggled 3d name of segment

The segmentation process can be applied to other parts of original point cloud data to divide the point cloud data into more segments that have unique class attributes.

v) Generate scalar field of Point Cloud

A scalar field is the information associated to each point on the point cloud data, included colours of the points. As the point cloud data is cut into many segments, every segments will have their own data, they will have different colours when they are merged as a scalar field object.

To make the point cloud into a scalar field object, the segments of the point cloud needed to be merged into one object again. To merged the point cloud data into one object, all segments in the point cloud data needed to choosed and merged using the merging tool in the CloudCompare Software. To merged the point clouds data into a scalar field object, the 'yes' option needed to be selected when the cloud compare software asked "Do you want to generate a scalar field with the original cloud index".

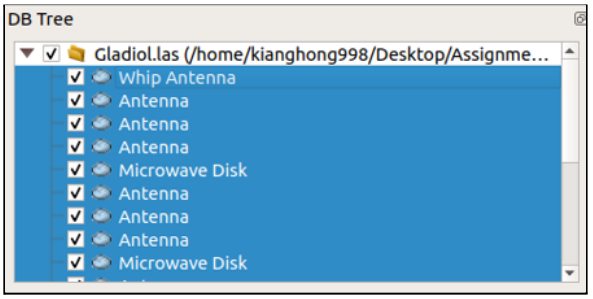

Figure 7: All segments in the point cloud file is selected

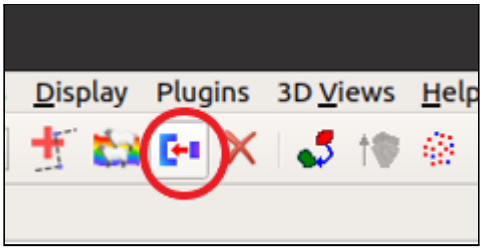

Figure 8: Merging tool

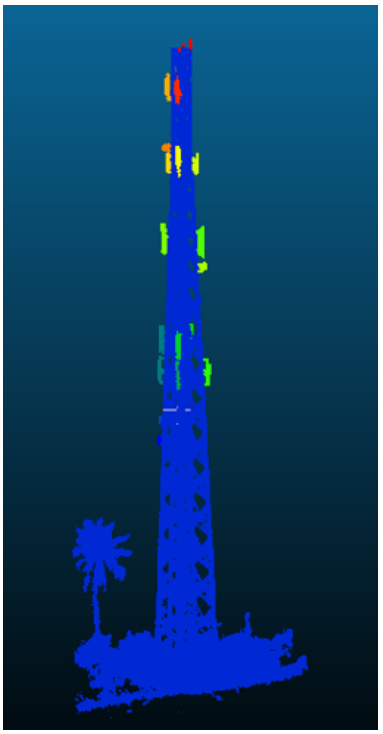

Figure 9: Example of merged point clouds

vi) Animation of Point Cloud

To make an animated video of point cloud data using cloud compare software, the Animation plugin is needed. The process can be started by adjusting the view of point cloud data and save the viewpoint as an object through the 'Display' toolbar.

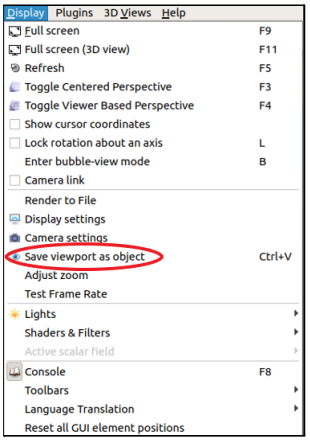

Figure 10: Saving viewpoint as an object

To generate an animation, there are more than one viewpoints needed. After selecting multiple viewpoints, the animation video of the point cloud data can be generated by connecting the saved viewpoints using the Animation plugin.

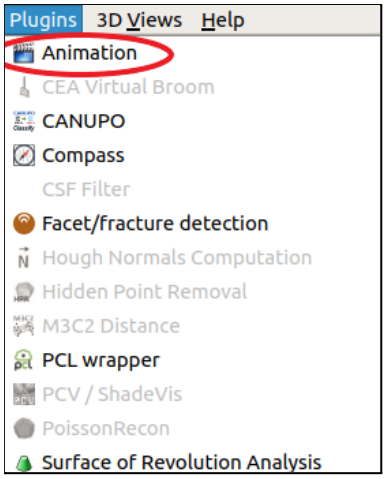

Figure 11: Animation plugin of CloudConpare

User can adjust the settings of the animation video such as choosing the step of viewpoint, frame rate, resolution and so on in the Animation plugin's window. To save the video, user can render it to a specific directory as figure below:

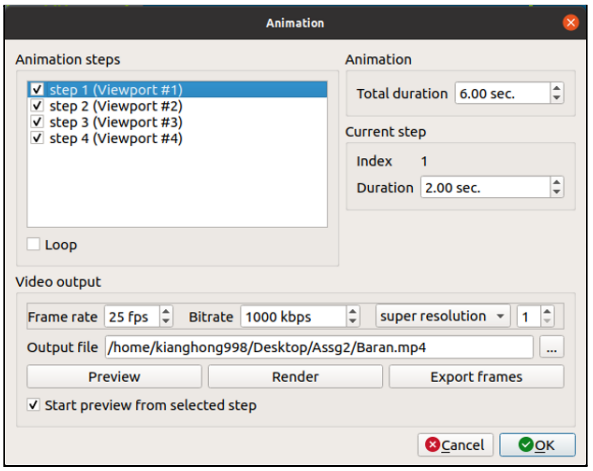

Figure 12: Animation plugin window

III. RESULTS AND DISCUSSION

i) Class attribute of Point Cloud

The results of class attribute being put on the point cloud data is shown as below:

Figure 13: Baran.las with class attributes

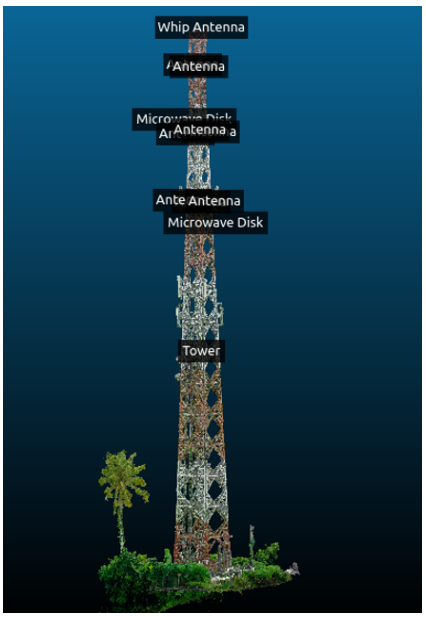

Figure 14: Gladiol.las with class attributes

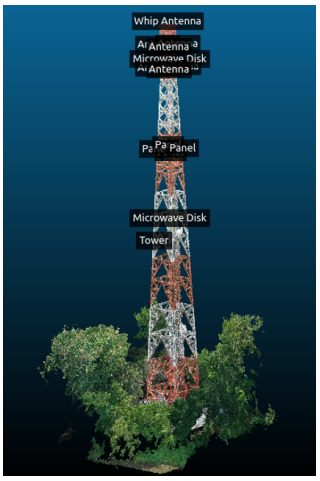

Figure 15: Kaliancar.las with class attributes

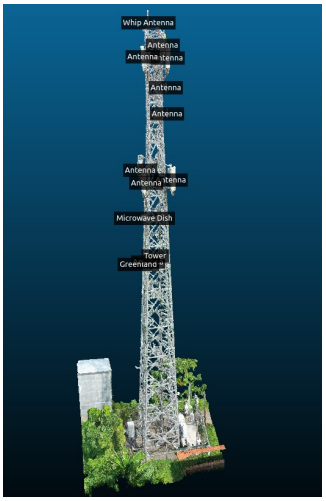

Figure 16: Kalisapu.las with class attributes

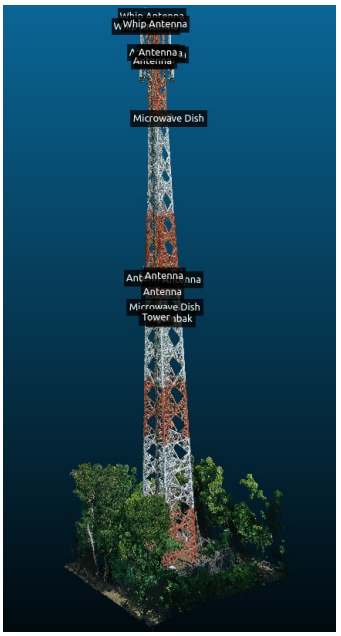

Figure 17: Ngombak.las with class attributes

ii) Scalar field of Point Cloud

The scalar fields objects generated from the point cloud data can be viewed as below:

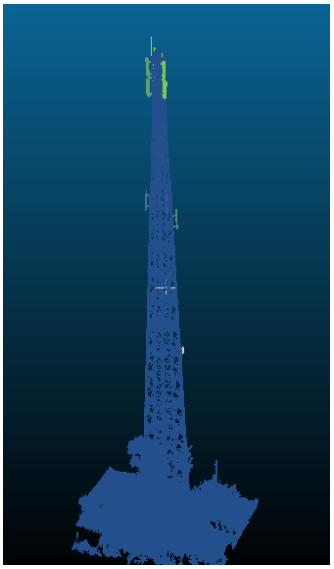

Figure 18: Baran.las scalar field

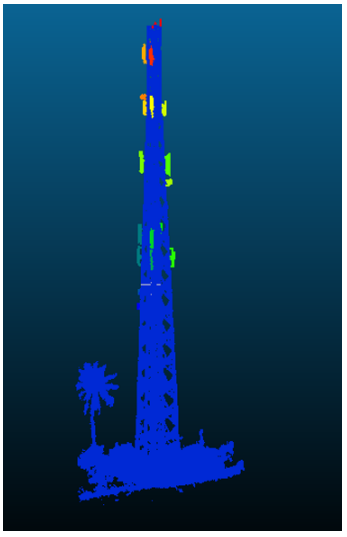

Figure 19: Gladiol.las scalar field

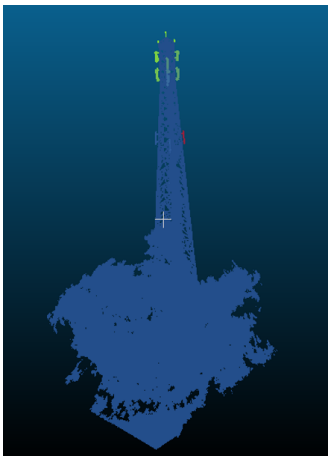

Figure 20: Kaliancar.las scalar field

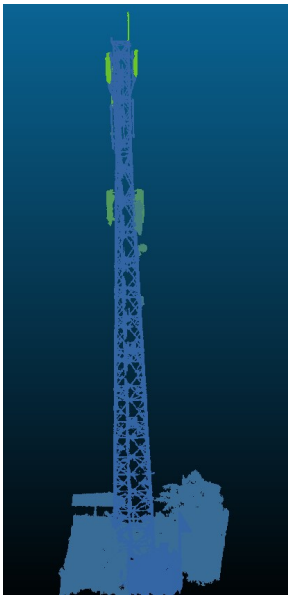

Figure 21: Kalisapu.las scalar field

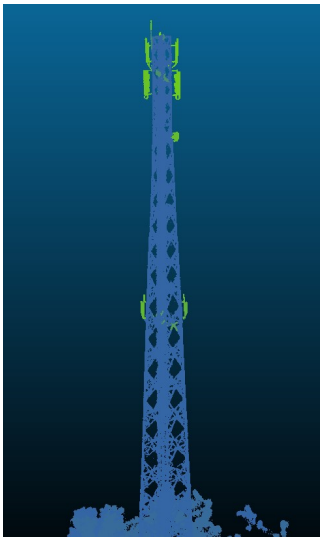

Figure 22: Ngombak.las scalar field

iii) Animation of Point Cloud

The animated video of the point cloud data rendered with CloudCompare software can be viewed through links below:

Baran.las: https://drive.google.com/file/d/1FogbaRBmUZnOS0mbLQrkGu3aUZtkS1oX/view?usp=sharing

Gladiol.las: https://drive.google.com/file/d/1D8aAaymt-Nl-6QhXseczARPXtSONDOoK/view?usp=sharing

Kaliancar.las: https://drive.google.com/file/d/1TgTFQcKHPvBgcQncHEBSxPq2JrLfhLG_/view?usp=sharing

Kalisapu.las: https://drive.google.com/file/d/1zM26VEJFGLsXgg8-HuviyWLeBNBlcmKd/view?usp=sharing

Ngombak.las:https://drive.google.com/file/d/12j8x8BjkSfscV5lc8lplddxKCtlUA2qI/view?usp=sharing

IV. CONCLUSION

The CloudCompare application had been installed and ran on Ubuntu (Linux) system to analyze lidar data files. Through the processes, objectives of this project were successfully achieved by carry out segmentation of the lidar point cloud data with different class attribute, turing the point cloud data into scalar field object and render the point cloud data into animation videos.

V. REFERENCES

CANUPO (plugin). Retrieved 10 December 2021 from https://www.cloudcompare.org/doc/wiki/index.php?title=CANUPO_(plugin)

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3D Forensics (2012). *Introductory video on CloudCompare*. [Video]. YouTube. https://www.youtube.com/watch?v=MQiD4HjhpAU&t=1s