CE676A Lab Report 1

(Familiarizing with LiDAR Data)

Aman Kumar Singh
200100
Civil Engineering Dept.
Email: amanks20@iitk.ac.in

Introduction

The overall objective of the lab is to learn about LiDAR Data, what all information LiDAR Data have like (X,Y,Z,Intensity) or (E,N,H,Intensity) and visualize the LiDAR Data.

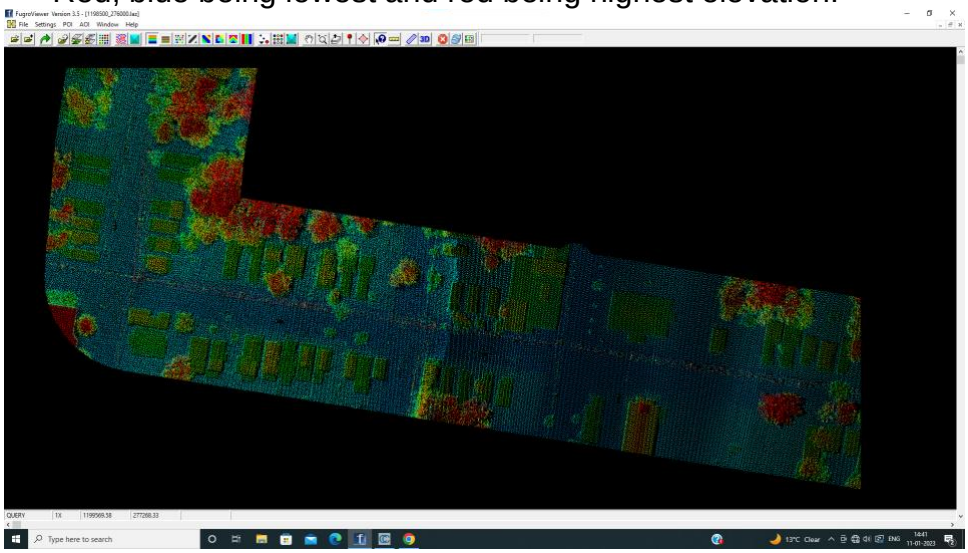
FugroViewer: It is a software that is used to view and make operation with geospatial data. It can collect and edit point-of-interest and generate area-of-interest polygons to facilitate effective problem solving and discussion. It is more focused on just viewing and performing basic operation with the lidar data.

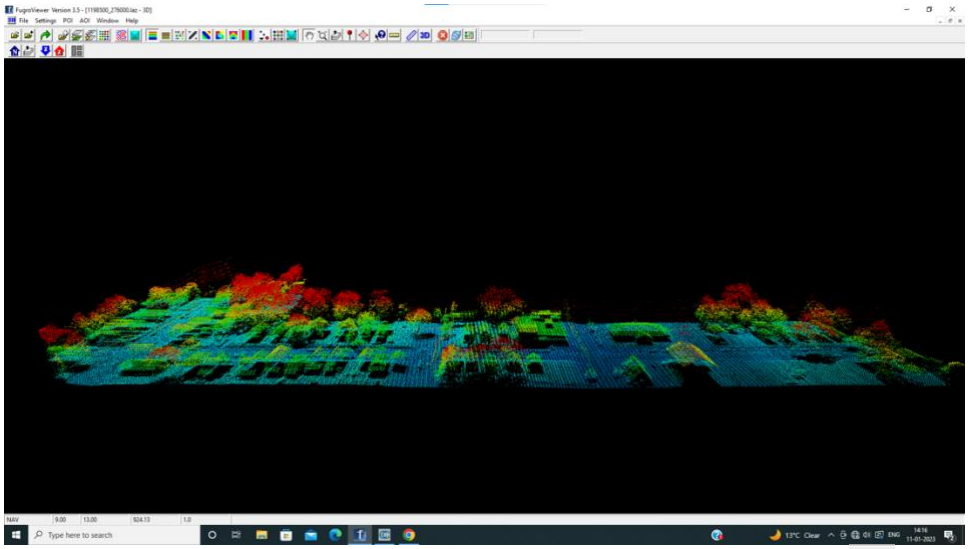
CloudCompare: It is a 3D point cloud processing software which can be used to view and process the data obtained with laser scanners. It is more advanced than the FugroViewer and focused on the proessing of LiDAR Data as well. Varioud point clouds can be combined, segmented out and labelled using this software.

Methodology (FugroViewer)

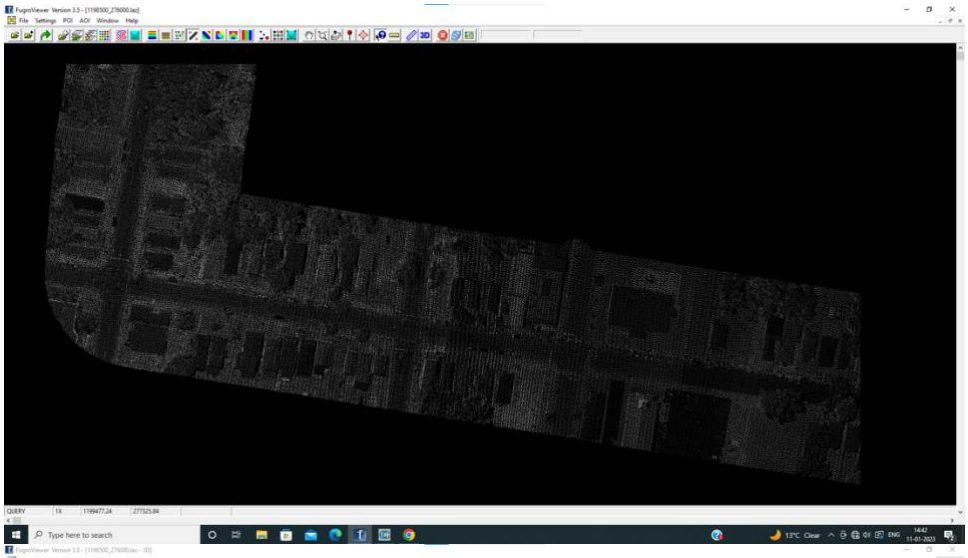
1. Open FugroViewer and open the .laz file in the software.
2. View the data in 3D by clicking on 

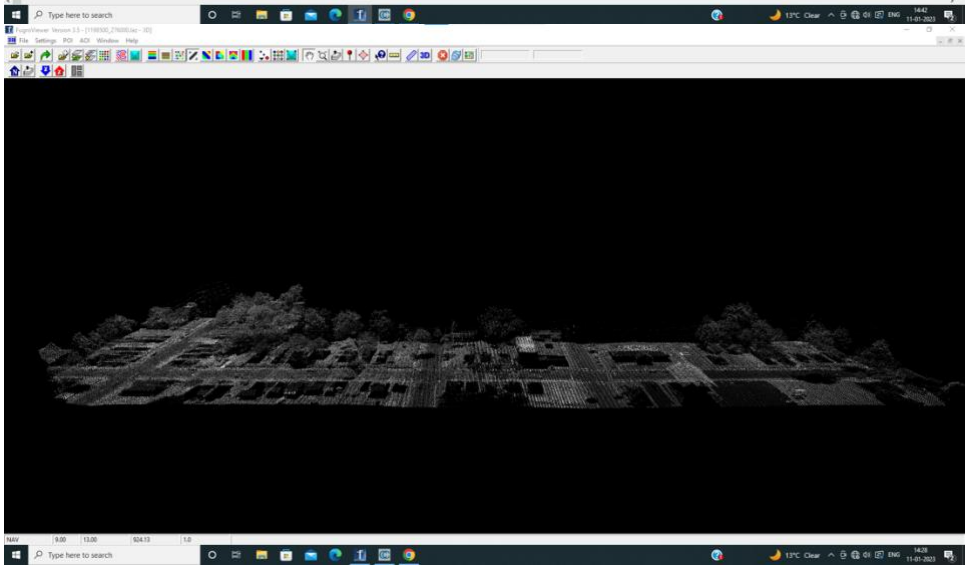
3. Change the display to Colour Point by Elevation (Blue to Red) 
4. The colours in this are indicating the elevation of different points ranging from Blue to Red, blue being lowest and red being highest elevation.





5. Now, put the display as Colour Points by Intensity using 
6. Here the colour is indicating the intensity of the point with respect to the wavelength of the laser that was fired. It tells us the extend up to which the photons of the laser pulse fired has been absorbed/ reflected.

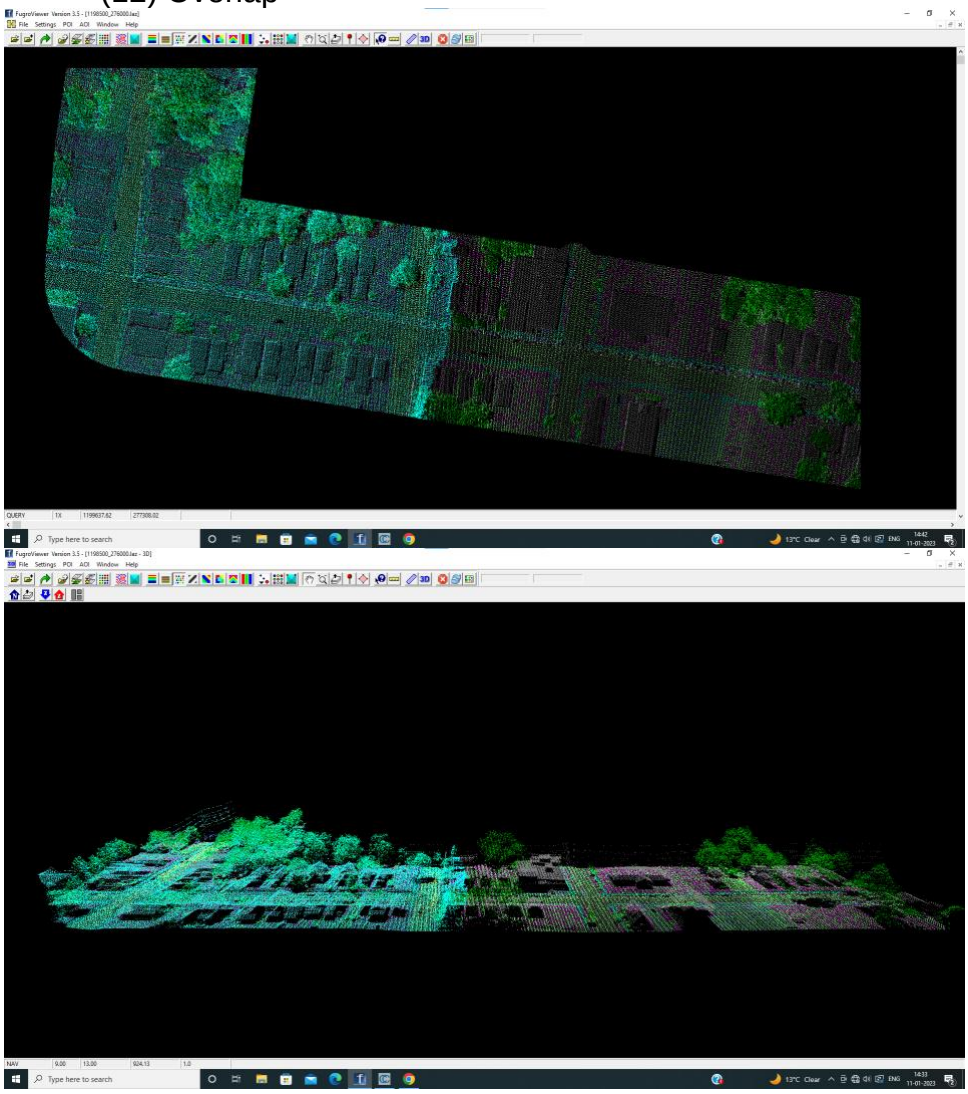




7. Now change the display to Colour Points by Classification by using 
8. The colour in this indicates various kinds of classes. In classification we give each point a class and that is how based on that class the data has been displayed by giving a distinct colour to a different class of data points.

Some of the classes that are there are :

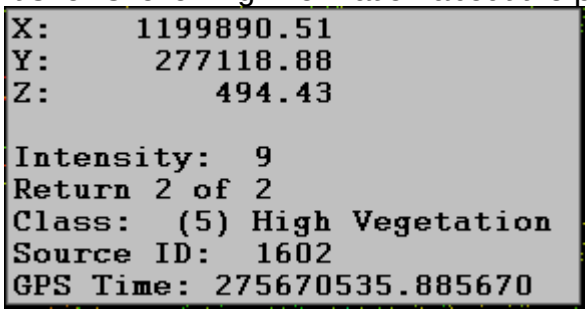
(2) Ground
(3) Low Vegetation
(4) Mid Vegetation
(5) High Vegetation
(12) Overlap

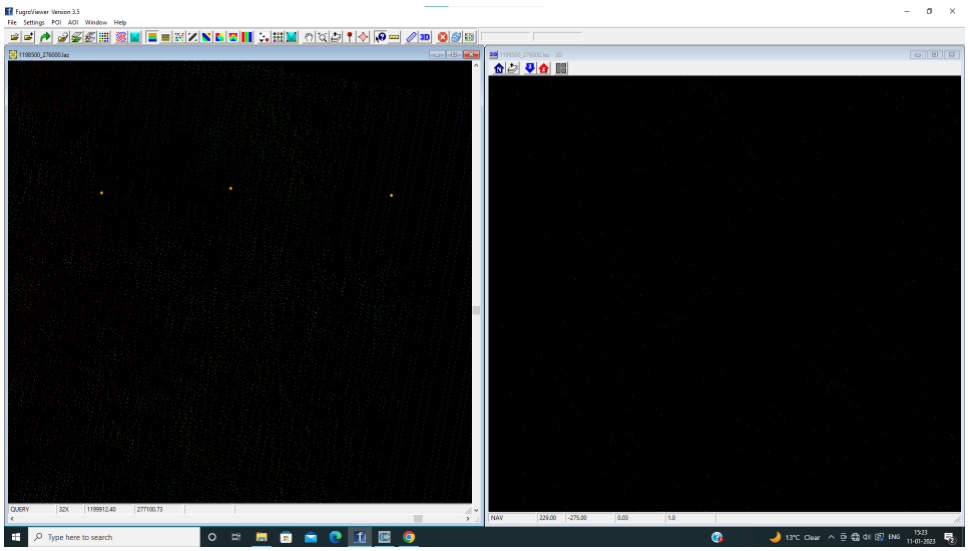


9. **Query Point Tool** 

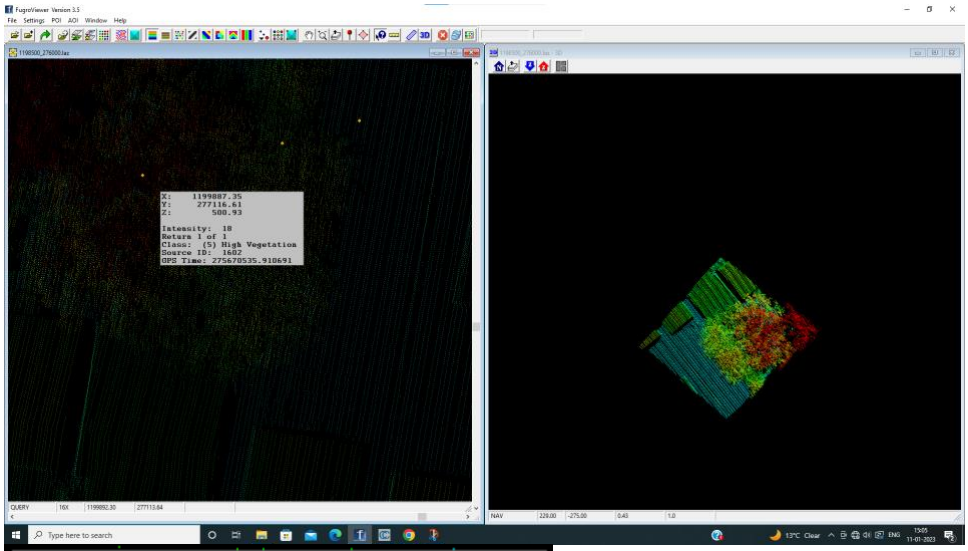
The use of Query Point Tool is to know different attributes (characteristics) of the point selected.

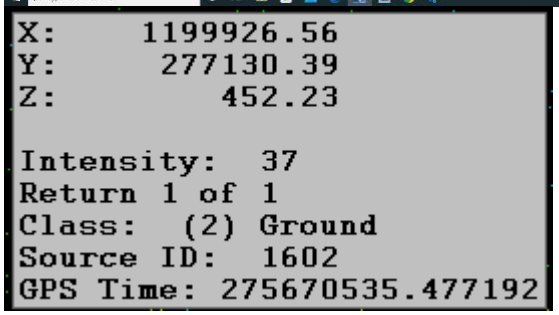
It shows following information about the point selected.



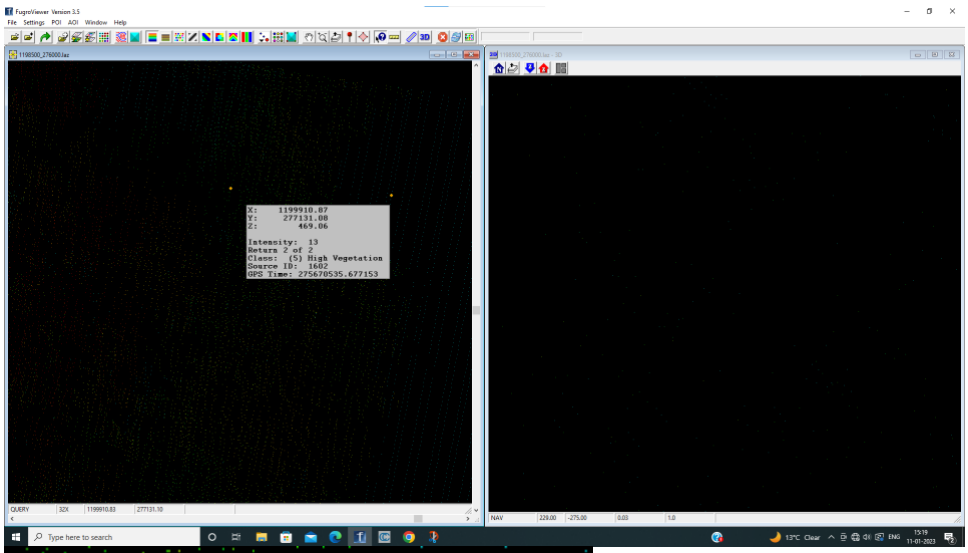


Three Points of different colour in the ‘ Colour by Elevation’ view. (Blue, Green, Red)

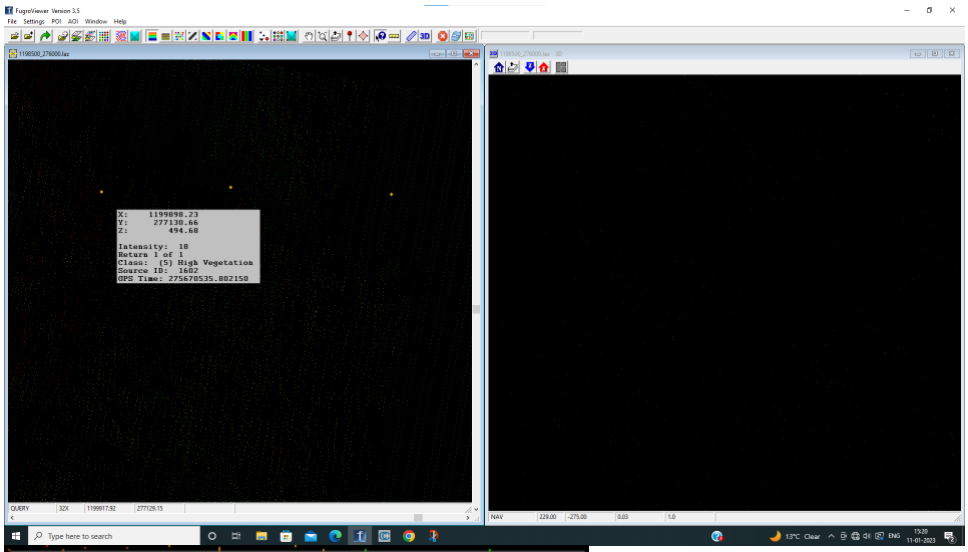




Blue Color Point

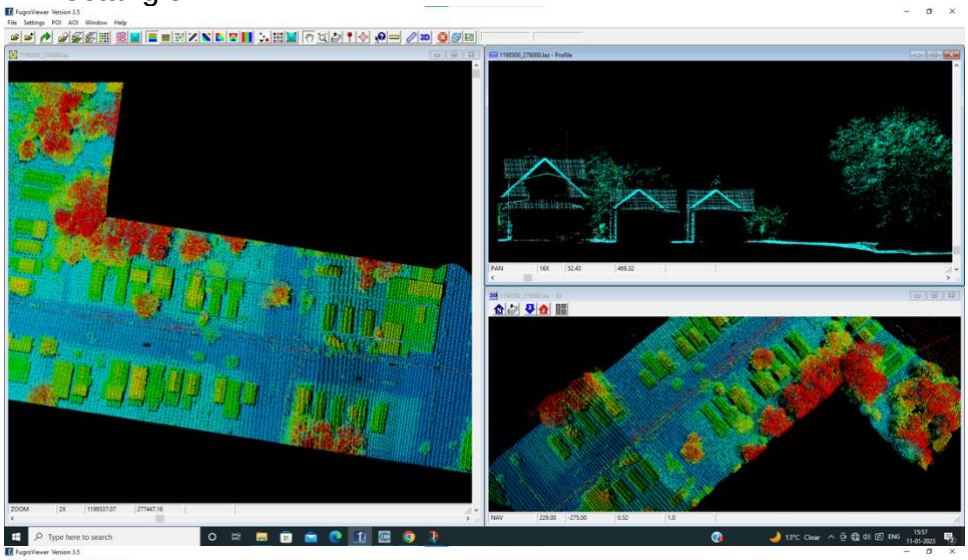


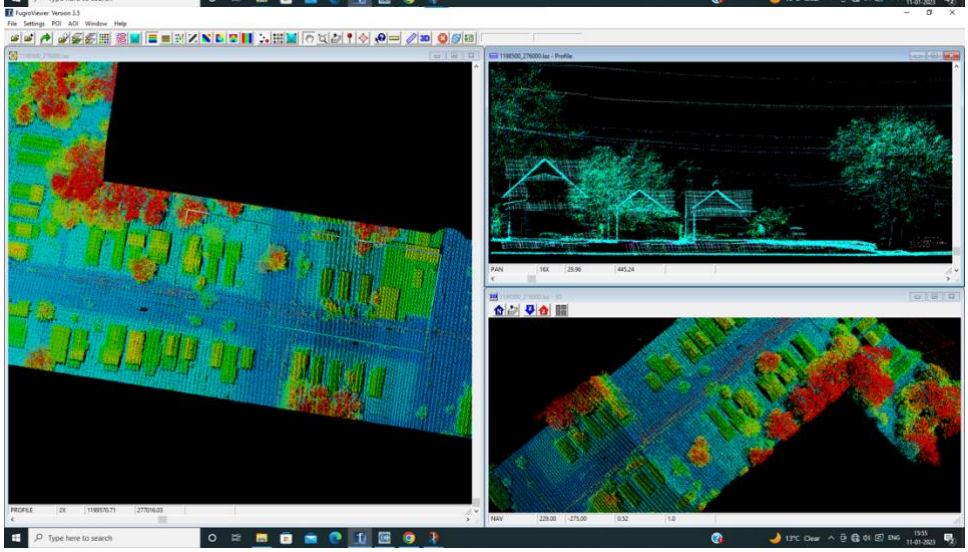
Green Color Point



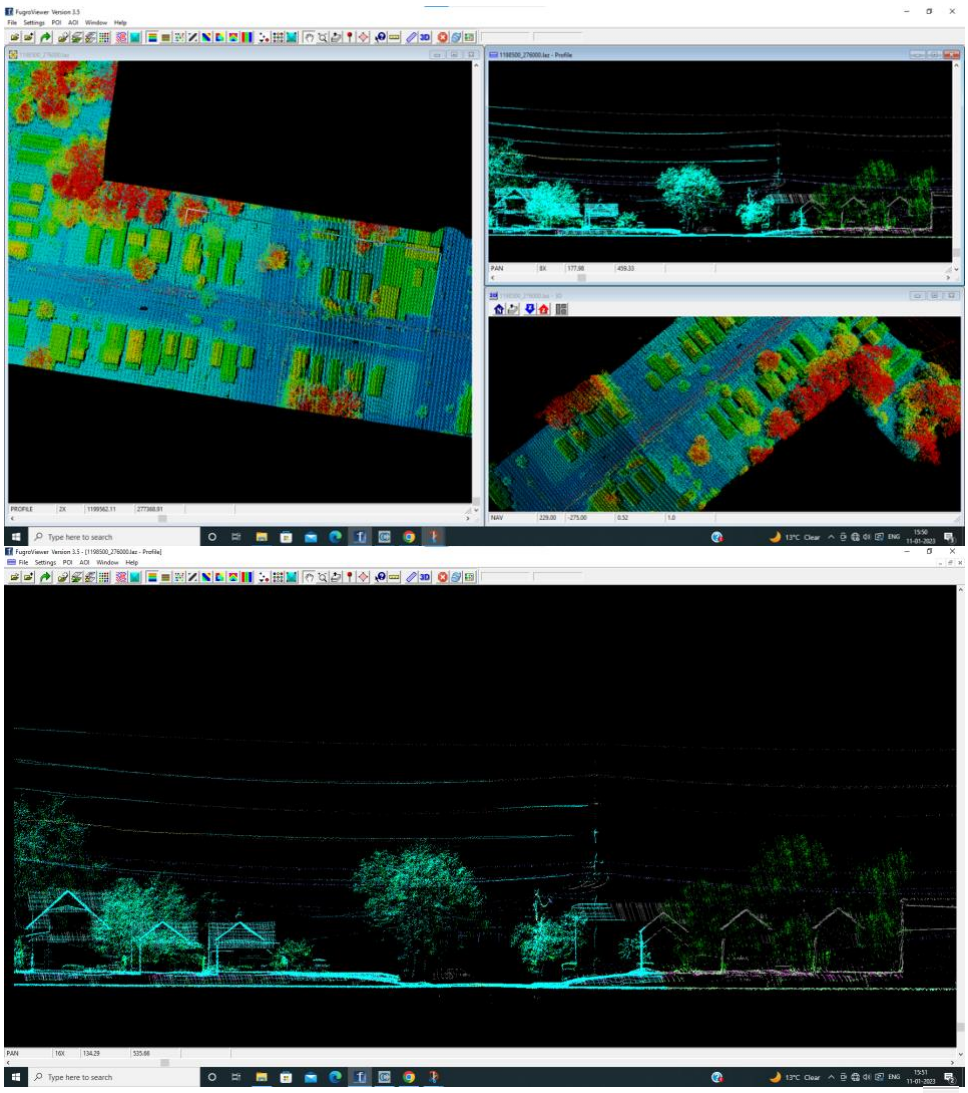
Red Color Point

10. **Profile Tool** 
    Profile Tool is used to create profile. A profile is a kind of outline of the 3D model as seen from the side. It gives an idea about the elevations (Z) of different points in our data in that particular section.
    Once tool is selected, create a profile on top view by first clicking at point and then extending the section line and then providing this a little width to make a rectangle in cyan colour. Once it is completed, an additional profile view will open.
11. What happens when the width of the rectangle is more or less?
    When the width of the rectangle increases, the profile will cover more area in it and will contain more no. of points and features information. As visible from the below two images more the width, more the features and points are visible in the profile view. The width of the rectangle gives a depth to the 2D profile that is created using that rectangle.

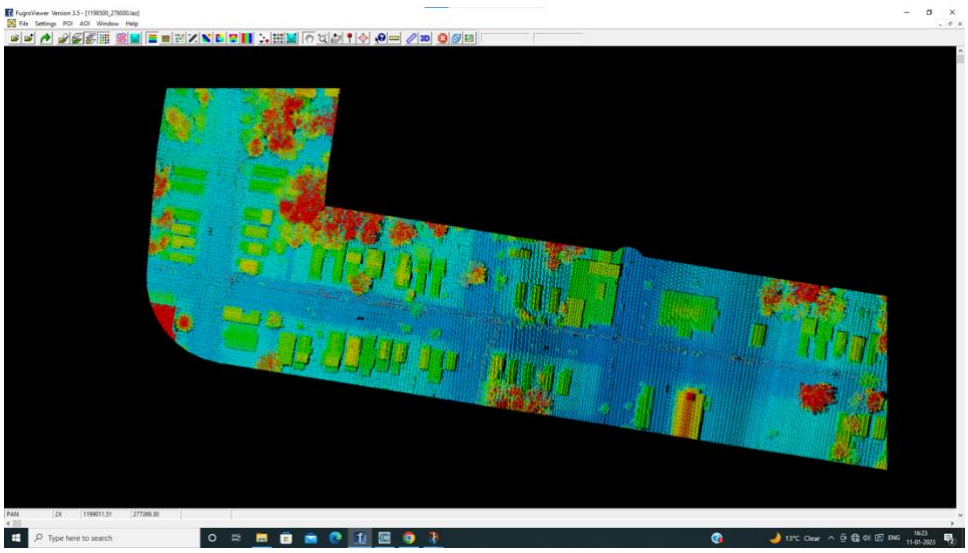




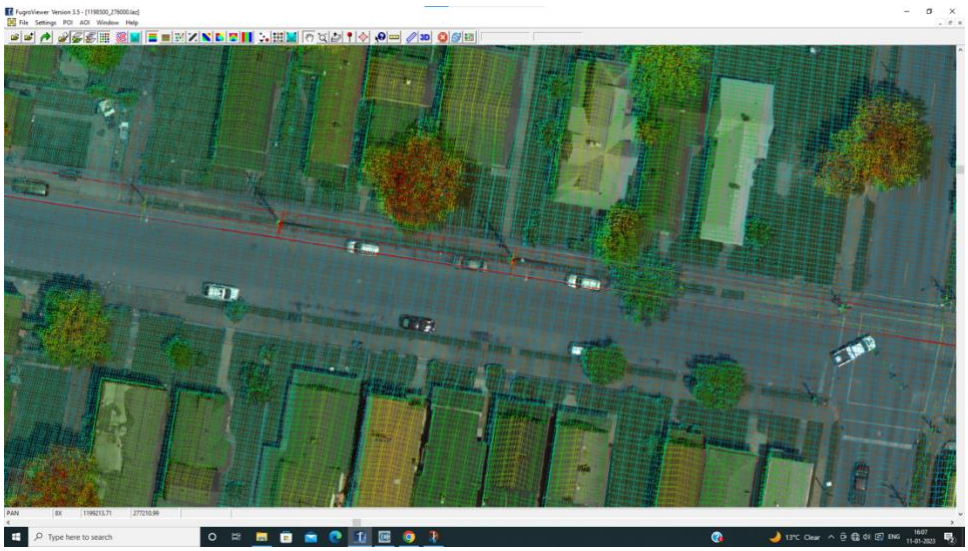
12. Screenshot of a profile view having trees, powerlines and house.



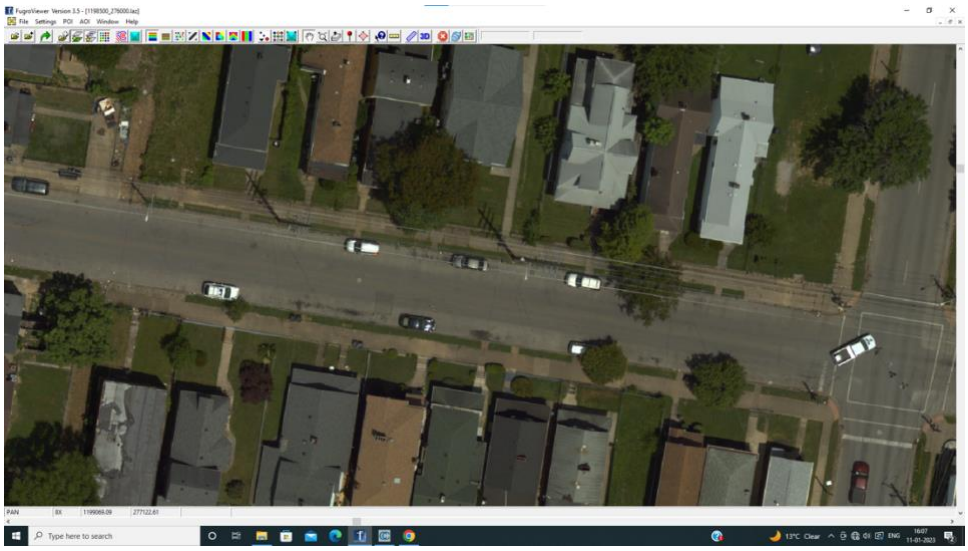
13. While the display is in use click on the “Open Reference File” 
14. Select the reference .tif file of the lidar data.
15. A layer of the reference image has been added underneath the lidar data.
16. Use  tools to view image and lidar data iteratively. The different features can now be easily observed as a car, tree, roads, etc.



(LiDAR Data with reference image)



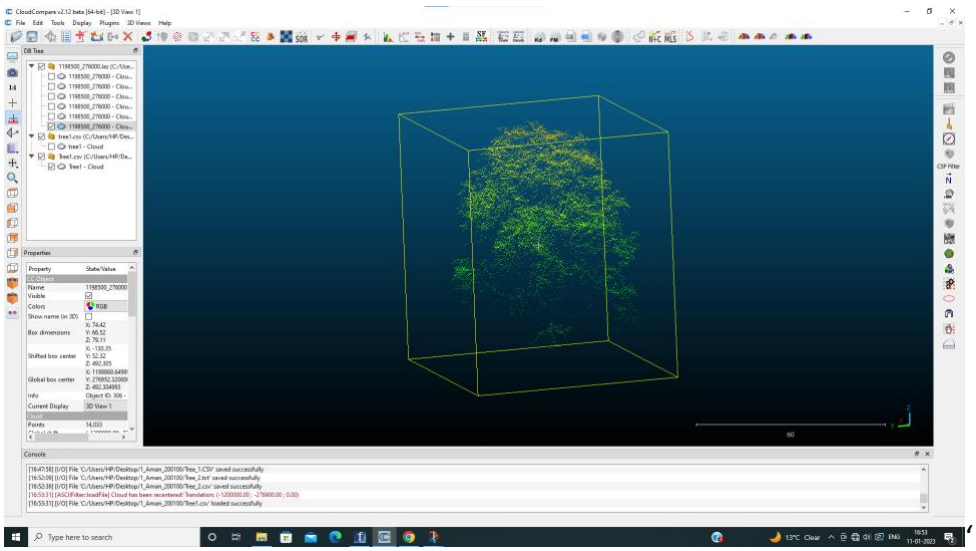
(LiDAR Data with Display background reference – zoomed view)



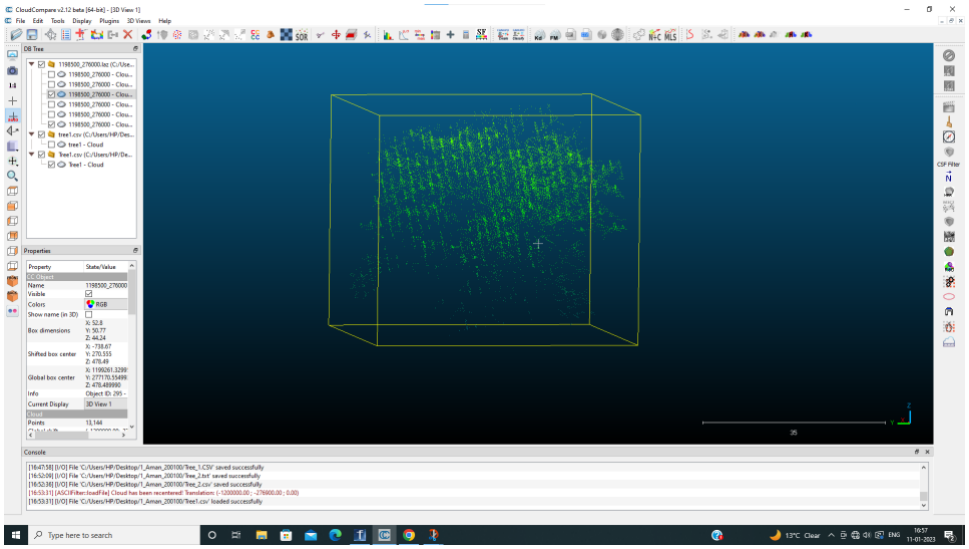
(LiDAR Data with Display Overlay reference – zoomed view)

Methodology (CloudConvert)

1. Open the .laz file in CloudCompare.
2. Segment out two trees using the Segment Tool.



Tree 1 Segmented Out



Tree 2 Segmented Out

Steps to Cut point cloud:

- Once you have opened .las file in CC, use segment feature  to cut the point cloud.
- Form a polygon using the mouse, to select an area to cut.
- After selection use  button to finalize cutting and save the data.
- In save dialog box, select 'ASCII cloud' type and save as .csv file.

3. Now to calculate the height of the trees we can make use of the Z value of the points.

$$Height\ of\ tree = Z_{max} - Z_{min}$$

Height of Tree 1 = 79.11 m
Height of Tree 2 = 44.24 m

4. Bounding Box Volume for each tree can also be calculated by making use of X, Y & Z value of the points.

$$Volume\ of\ the\ Bounding\ Box = (X_{max} - X_{min}) * (Y_{max} - Y_{min}) * (Z_{max} - Z_{min})$$

Bounding Box Volume of Tree 1 = 74.42 x 66.52 x 79.11 = 391627.599624 m^3
Bounding Box Volume of Tree 2 = 52.8 x 50.77 x 44.24 = 118592.22144 m^3

Discussion

The LiDAR Data can have information like Easting, Northing, Elevation, Intensity, GPS Time, Red, Green, Blue, Return Number, Number of Returns, Classification, Scan Angle Rank, etc.

Conclusions

1. LiDAR Data was studied and visualized using the software FugroViewer & CloudCompare.
2. LiDAR Data contains (E, N, H, Intensity) information in it along with certain other kind of information such as classes, return number, etc.
3. Two individual trees were cut from the LiDAR Data and saved as a separate LiDAR Data.
4. Basics of visualizing LiDAR data was understood.
5. Get hands on experience of using the software(s) Fugroviewer and CloudCompare.

References

- https://www.fugro.com/about-fugro/our-expertise/technology/fugroviewer

Question

1. It is desired to create labelled data for deep learning purpose using either of the above software. Suggest a method that how a file as provided can be converted to a format in .csv where each data point record also contains a label value, i.e., label corresponding to the object it represents.

Ans: We can follow the following steps to do so

- Segment out a part of the LiDAR data that we want to label.
- After Segmenting out, save it as a separate csv file.
- Open the csv file in some software such as Excel.
- Now we can add a new attribute to the csv file by adding a new column and giving it a property say Label.
- We can put the value as the one we want to associate that point with. (Say Tree)
- After that when we will import the same point cloud data then it will have a new attribute Label which tells okay this point belongs to a label ‘Tree’ and this point belongs to ‘Car’, this point belongs to ‘Building’ and so on.
- That may be one way to label the data.

2. It is desired to extract DBH (Diameter at Breast Height) from point cloud of individual trees. Suggest a suitable method for extracting DBH from point cloud using either Fugro Viewer or Cloud Compare or both.

Ans: DBH (Diameter at Breast Height) is the tree diameter measured at 4.5 feet above the ground.

- Using the Point Pick Tool  in CloudCompare, and then picking two points we can find the distance between any two points.
- To find the DBH of tree, we can move at an elevation of 4.5 feet (or 1.3716 m) and after that we can select any two farthest points and calculate the distance between them.

- We can repeat the same thing but this time taking the other two farmost points of tree’s trunk.
- Measure all the possible distances and take the average of those values of the distance between those 2 farthest points.
- Our DBH will be the average of these distances.