CE676A Project

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Acknowledgements

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- Also, I thank to our TAs Moonis Ali & Kaustav Saha for their guidance throughout the lab work and project.

Objective

- ☐ Understand LiDAR point cloud data.

- ☐ Realize the importance of deep learning in segmenting LiDAR point cloud data.

- ☐ Adequate training with diverse labelled data crucial for optimal performance of deep learning model.

- ☐ To generate high-quality labelled data for training deep learning models that can accurately segment LiDAR point cloud data.

# LiDAR Point Data

☐ LiDAR point data is usually represented as:

Northing   *Intensity*

$$[X, Y, Z, I]$$

Easting   *Elevation*
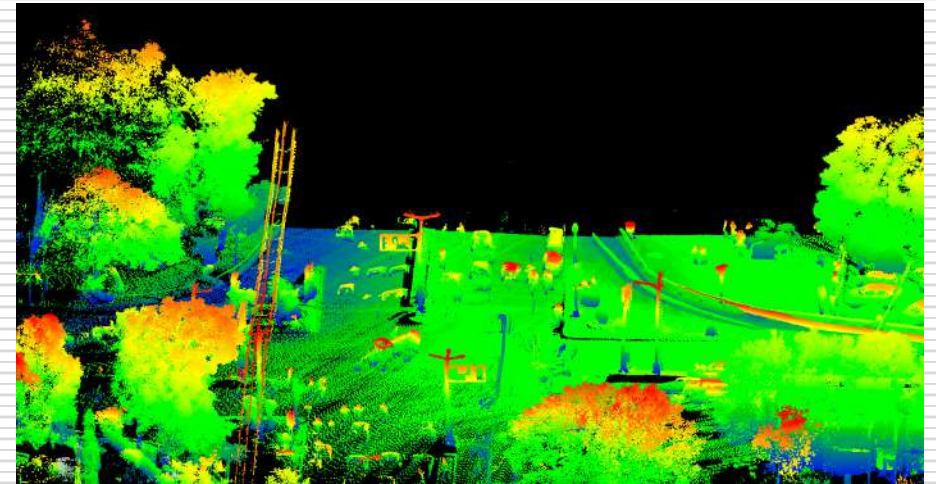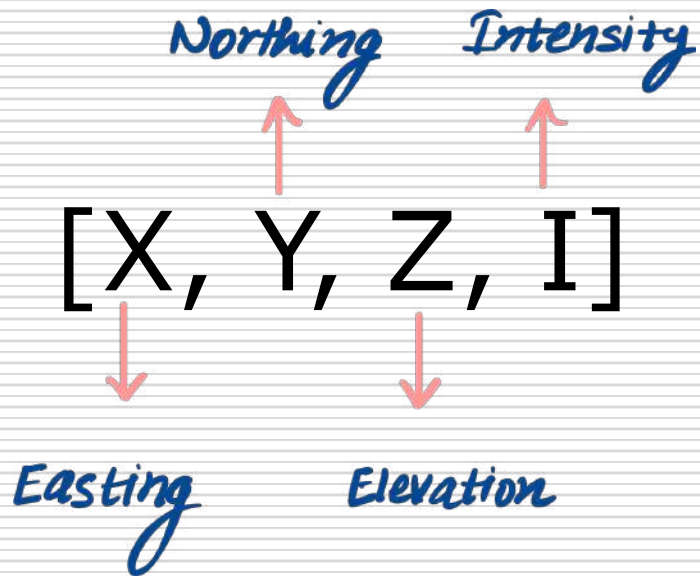
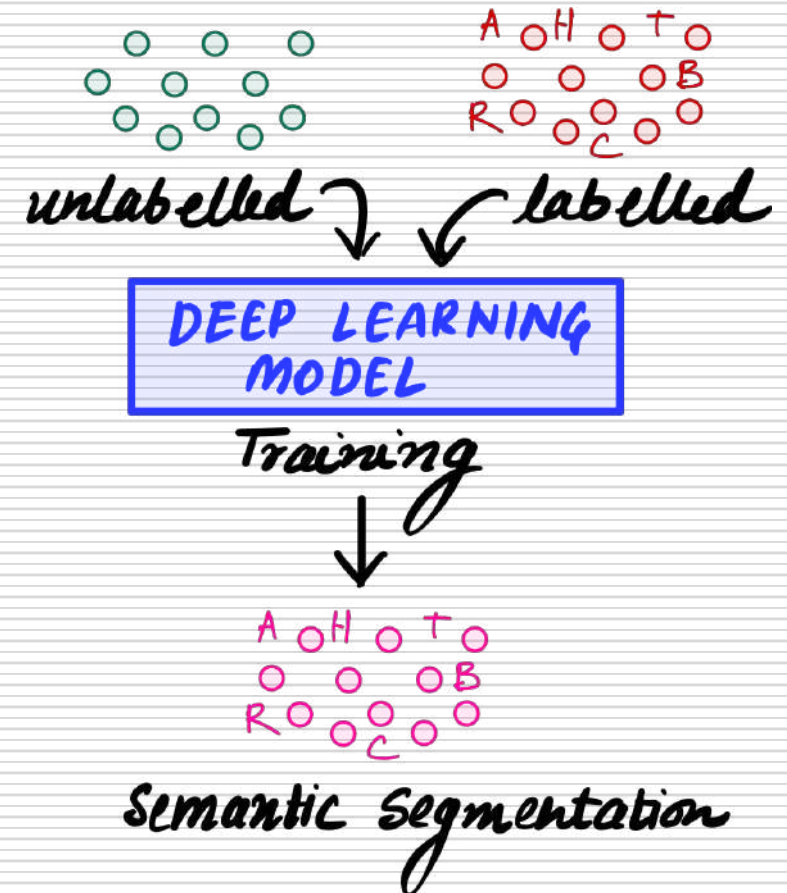| X	Y	Z	Intensity
670844.784	3399755.21	336.199	3
670844.773	3399755.21	336.191	7
670844.77	3399755.2	336.183	18
…	…	…	…

Segmentation & Labelling

- ☐ Point cloud data lacks object context/meaning.
- ☐ Segmentation groups points into objects.
- ☐ Labelling adds attributes and classification information.
- ☐ Segmentation and labelling improve LiDAR data processing.
- ☐ Labelled point cloud data helps train deep learning models.
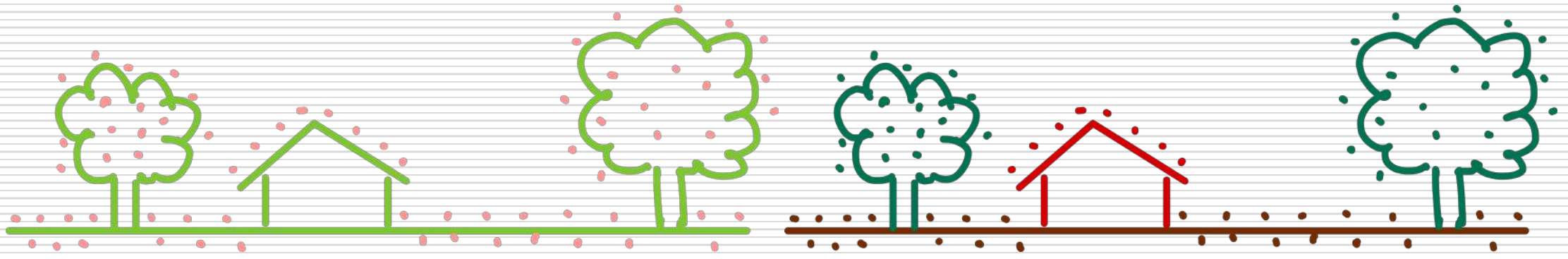
Deep Learning Model

- DL models can segment point cloud data with high accuracy
- Optimal performance requires a large amount of labeled training data.
- A classifier model assigns points to predefined categories using labeled data.
- Large and diverse datasets are required for efficient training
- Labeled data generation is challenging and requires manual or automated annotation
- The quality and quantity of labeled data directly impact DL model performance.

SoP–Extraction of Instance Groups

Extraction of Instance Groups:

1. Download raw data file from G-Drive.
2. Import structure.bin file and raw file, select RGB and intensity components only
3. Color point cloud based on height (Tools – Projection – Export coordinate to SF(s))
4. Segment out objects, merge objects of the same label class and save IG to HDD folder as .csv
5. Open setup wizard application file and assign label and sub-label values.
6. Merge classified output and upload to Drive.
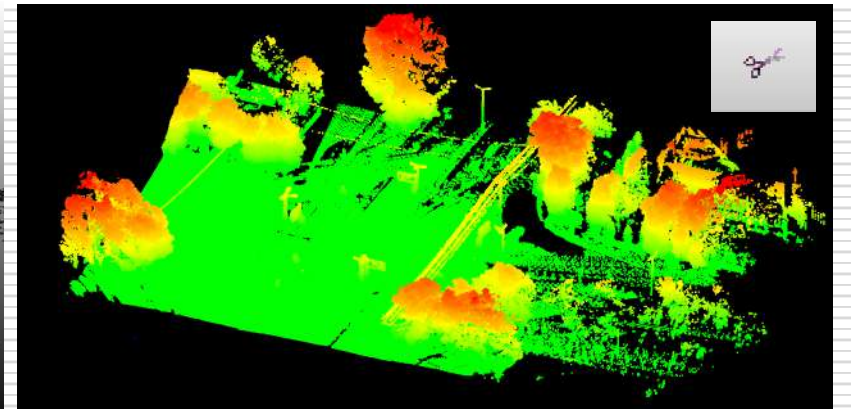
SoP–Extraction of Instance Objects

Extraction of Instance Objects:

1. Download corrected classified data

2. Extract instance objects one IG at a time and save as .csv in corresponding folder

3. Save as "Place_N_Sensor_XXZ_n_YYYYYY.csv"

4. Upload the file to Instance Object folder.

The Label Connected Components tool in CloudCompare is used to group together adjacent points that belong to the same object or surface.
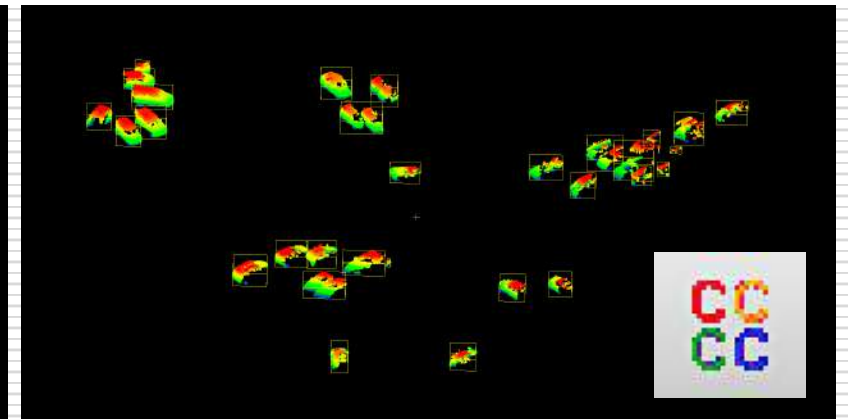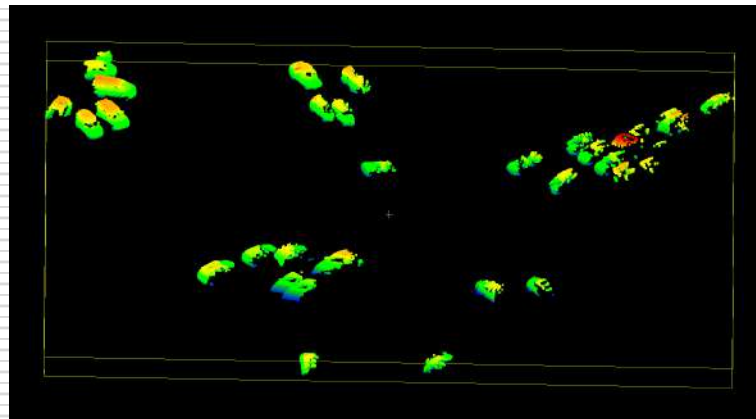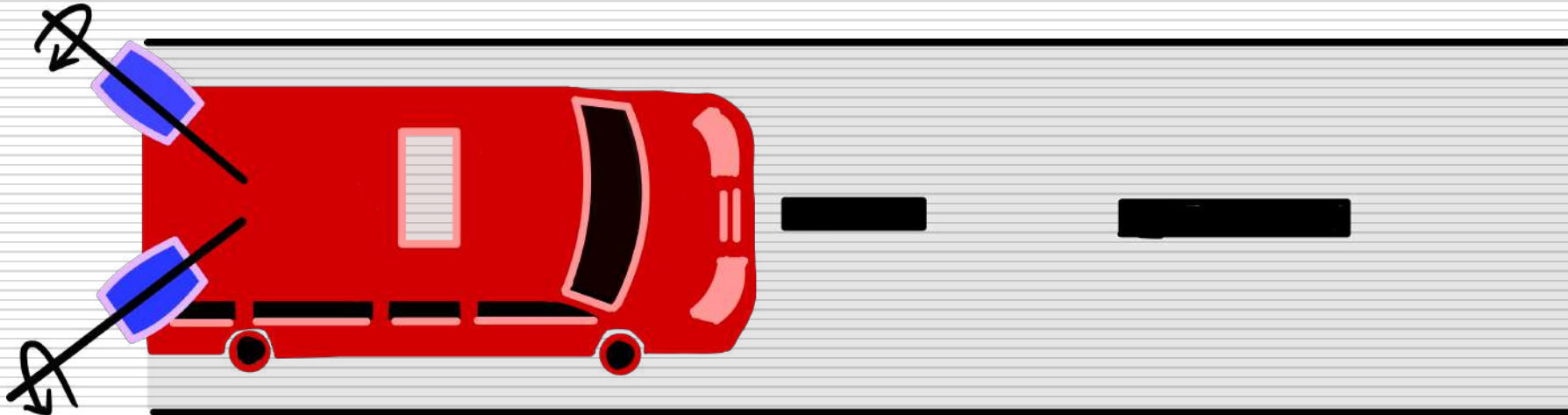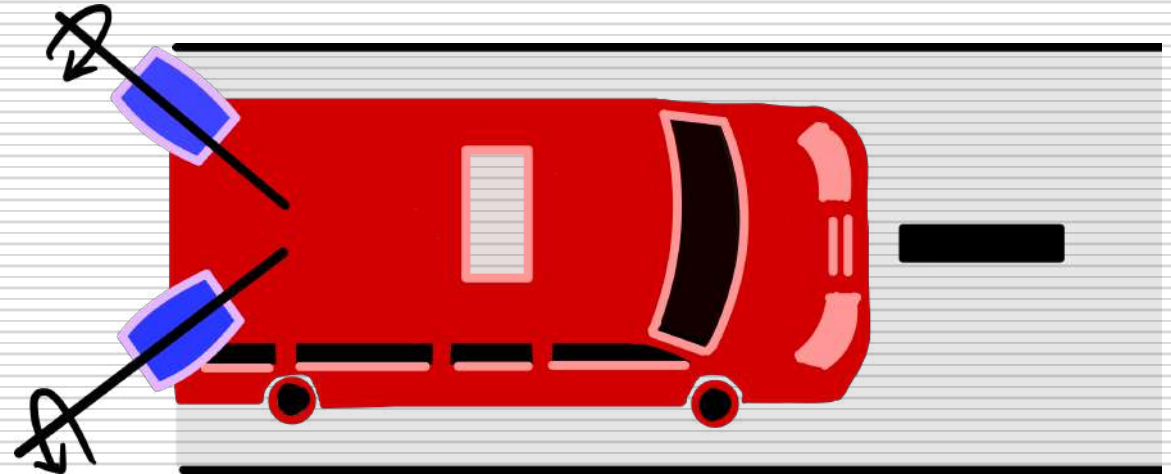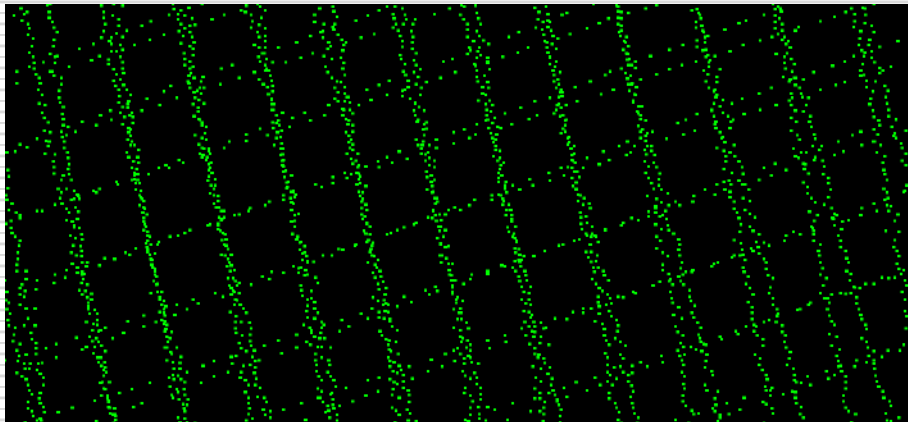
Mobile Laser Scanner (Streetmapper)

□ Mobile laser scanners (MLS) are used in land surveying and can be mounted on vehicles.

□ MLS reduces survey time and can quickly scan large areas.

□ MLS may have lower data density than static methods.

Evidence of two scanners

□ Two parallel scanning patterns at approx. 90-degree angles suggest that two scanners were used.

Challenges

Challenges:

1. Difficulty in identifying points in a group leads to labeling inaccuracies.
2. Errors may occur if some points are not marked as unlabeled during object extraction.
3. Manual classification of ground points is time-consuming and prone to errors.
4. No auto-save feature can result in work loss due to technical issues.
5. Not having an undo-redo feature increase workload in case of errors during data segmentation.
6. The Setup Wizard crashes when processing huge point cloud data.

Potential Solutions:

1. Use of filters like the CSF filter to filter out ground and non-ground points.
2. Training deep learning models to identify objects automatically segment point cloud data with improved labeling accuracy and efficiency.

10 Interesting Instance Objects

☐ Very Elongated Car

☐ Perspective Car

☐ Overlapping car and truck

☐ Man with double point cloud

☐ Man with tilted posture

☐ Car with incomplete data

☐ Dustbin with double point cloud

☐ Electric poles of varied kind

☐ Transmission lines

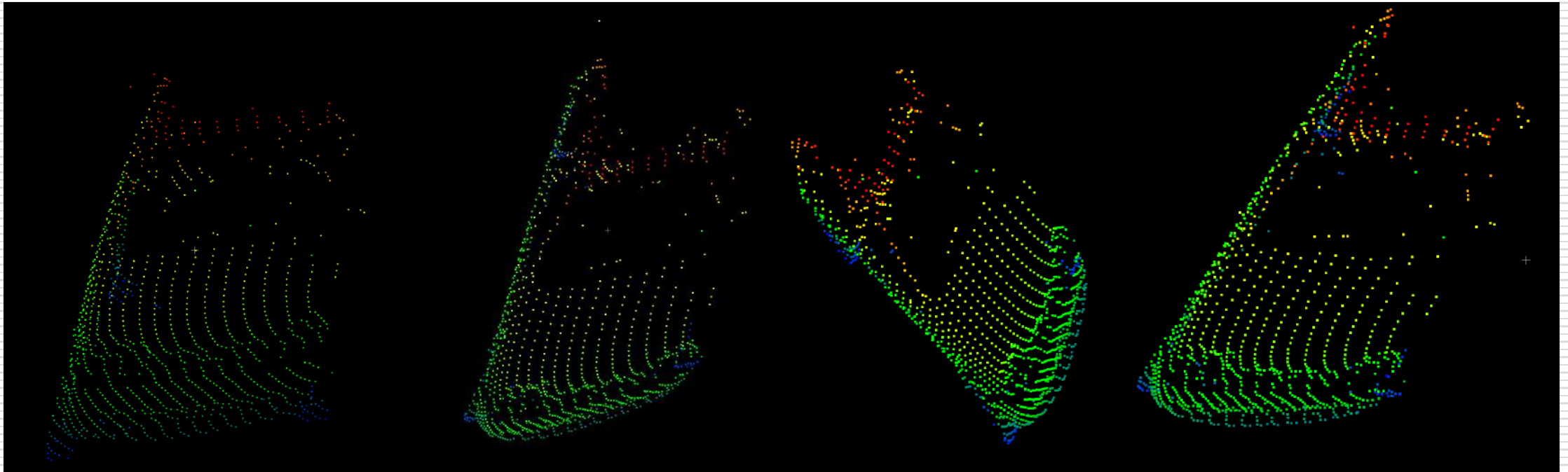☐ Overlapping vehicles

☐ Ambiguous point cloud
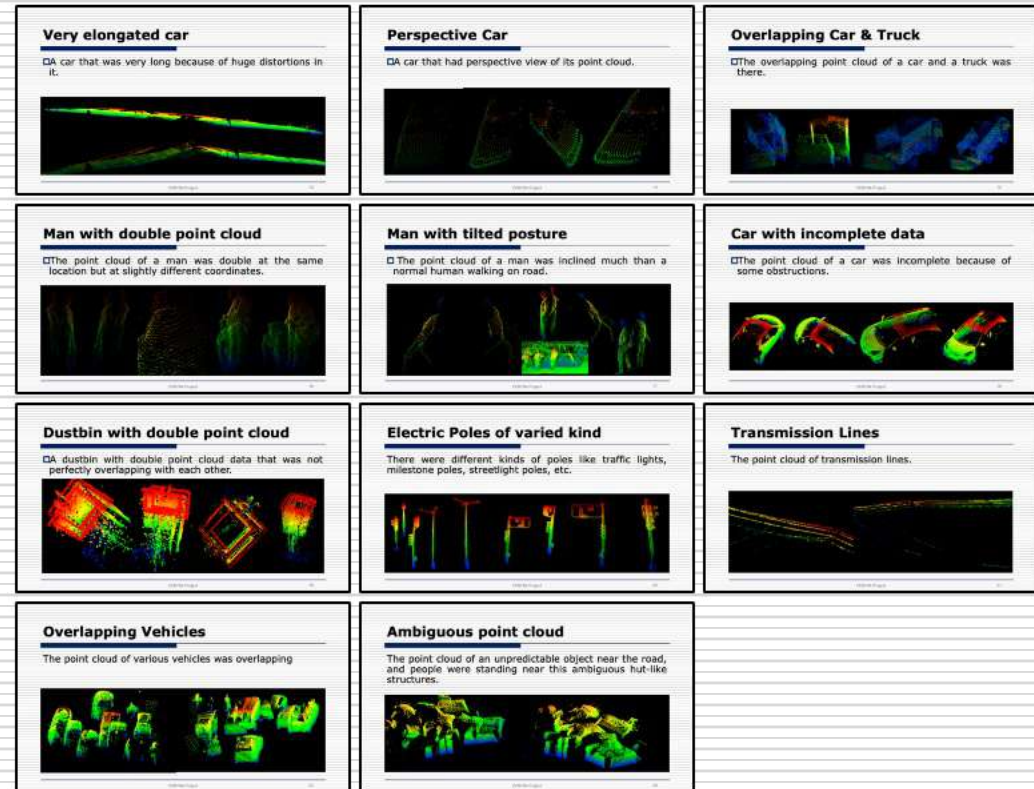
Very elongated car

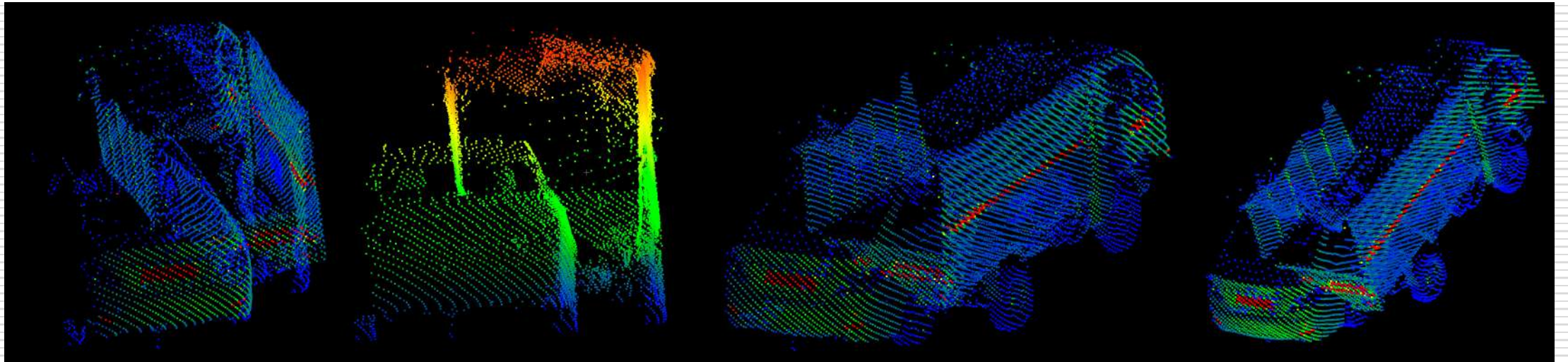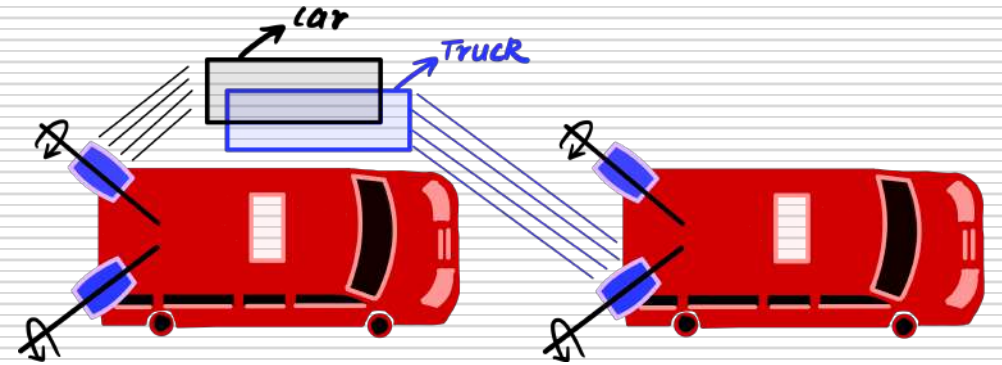□ A car that was very long and had huge distortions in it.

moving in same direction with same velocity.
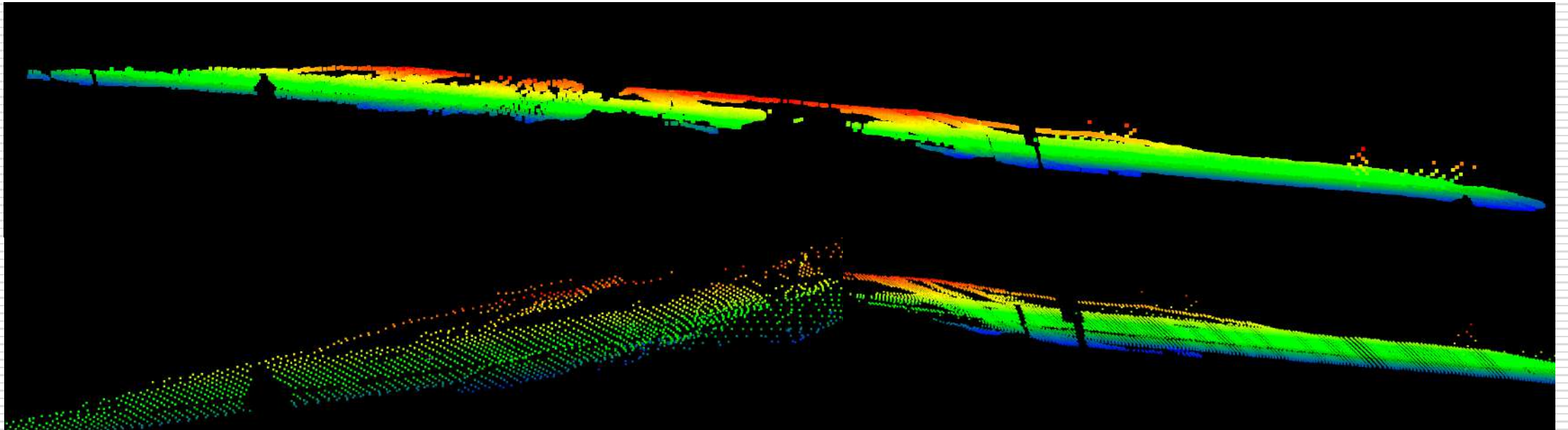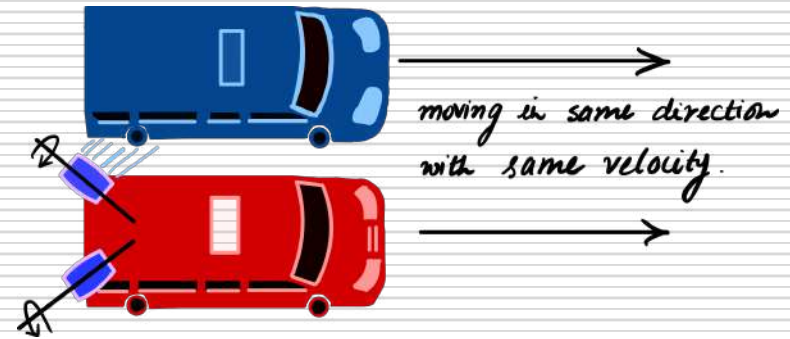
Perspective Car

A car that had perspective view of its point cloud.

Overlapping Car & Truck

The overlapping point cloud of a car and a truck was there.

Man with double point cloud

The point cloud of a man was double at the same location but at slightly different coordinates.
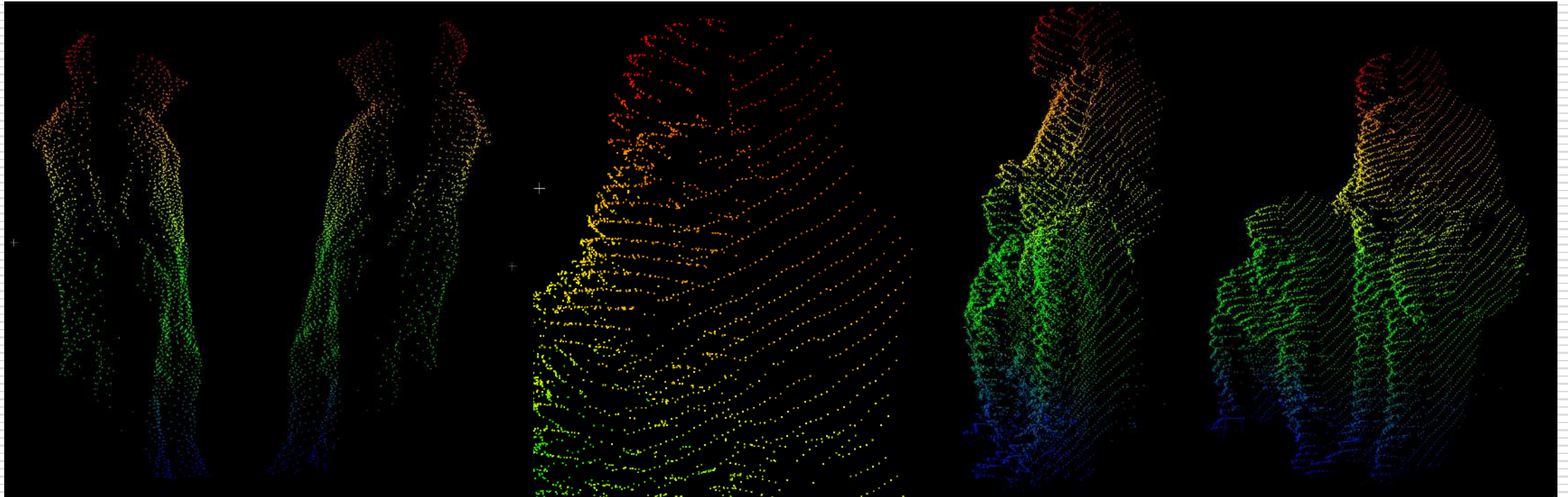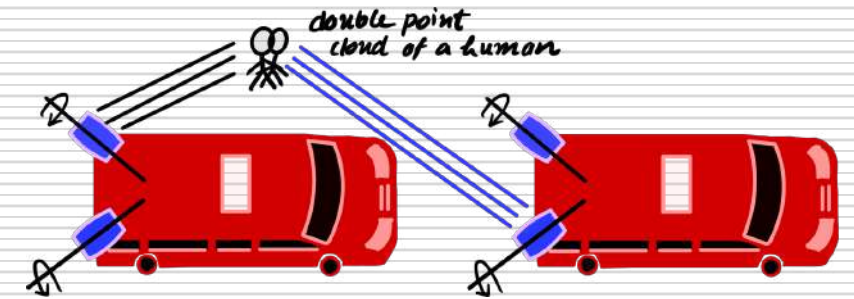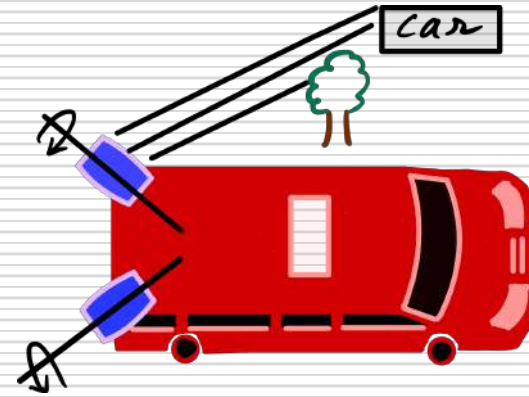
Man with tilted posture

The point cloud of a man was inclined much than a normal human walking on road.
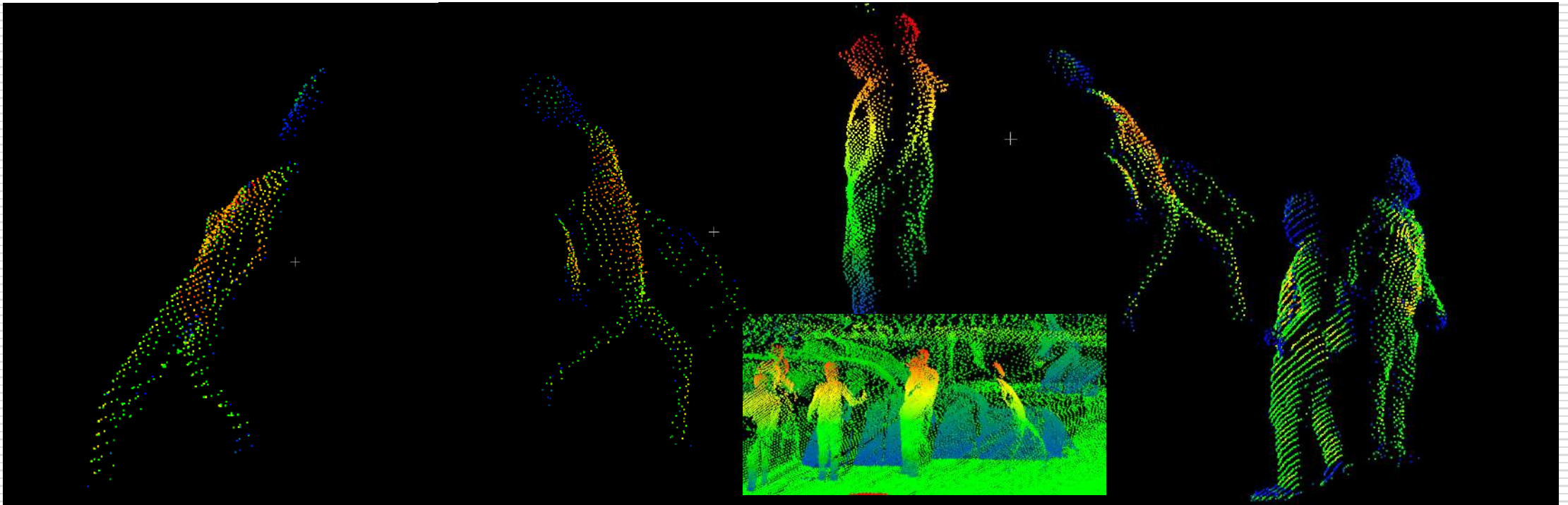
Car with incomplete data

The point cloud of a car was incomplete because of some obstructions.
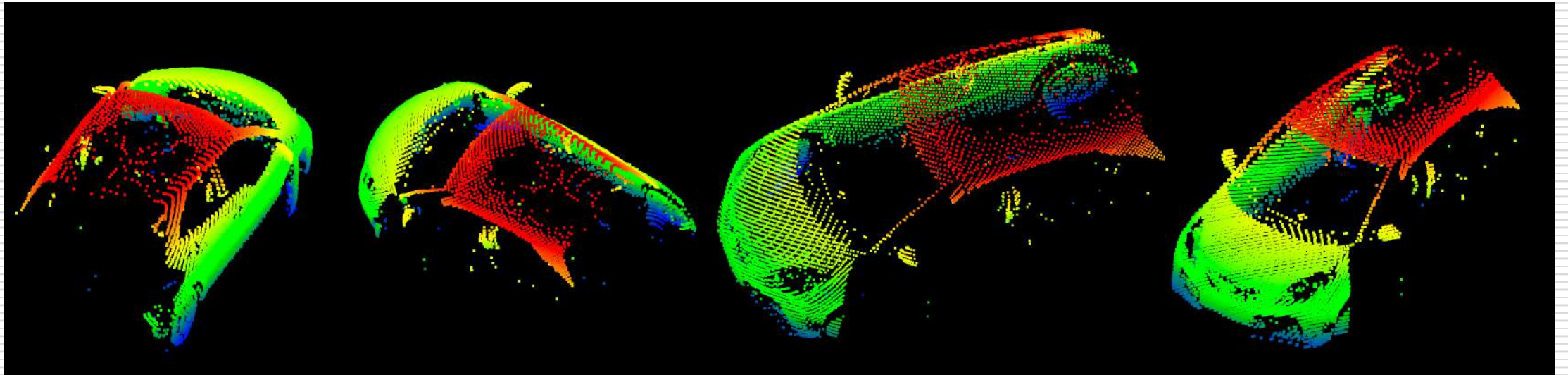
Dustbin with double point cloud

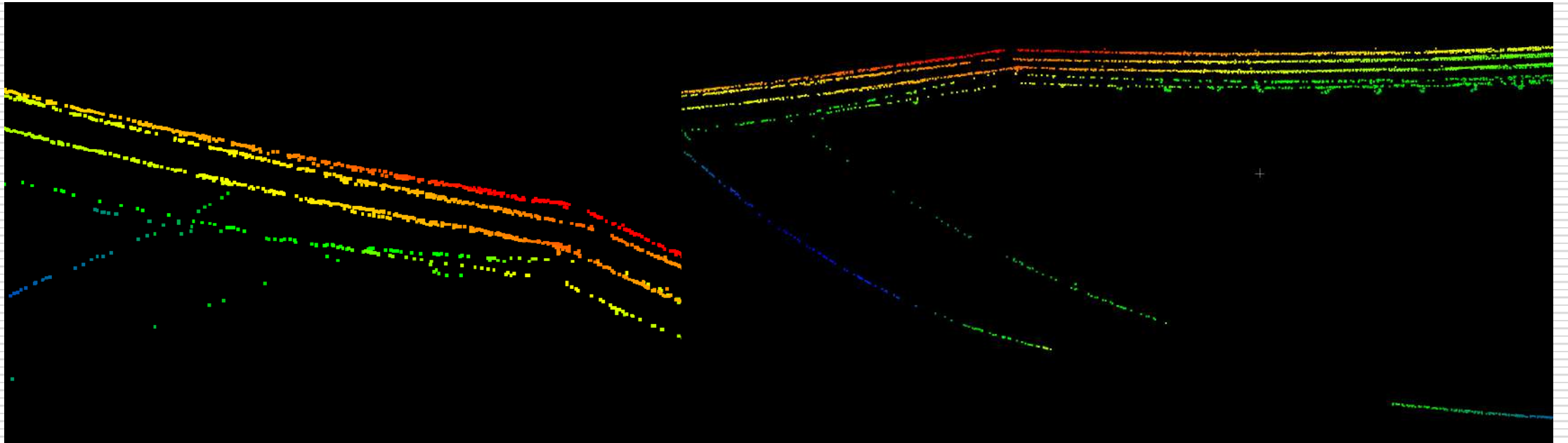A dustbin with double point cloud data that was not perfectly overlapping with each other.
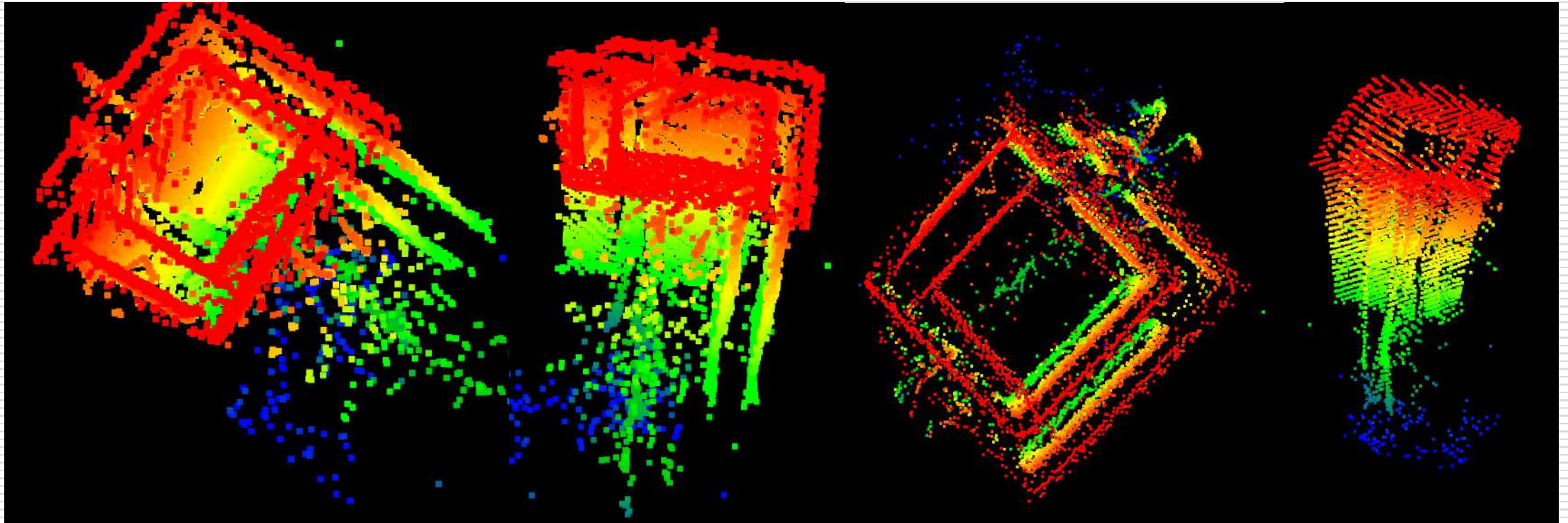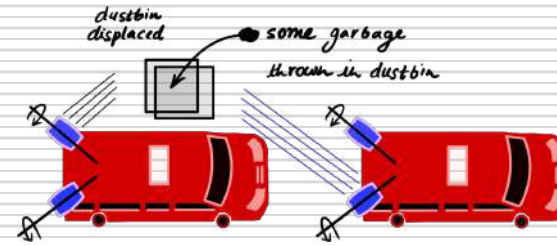
Electric Poles of varied kind

There were different kinds of poles like traffic lights, milestone poles, streetlight poles, etc.
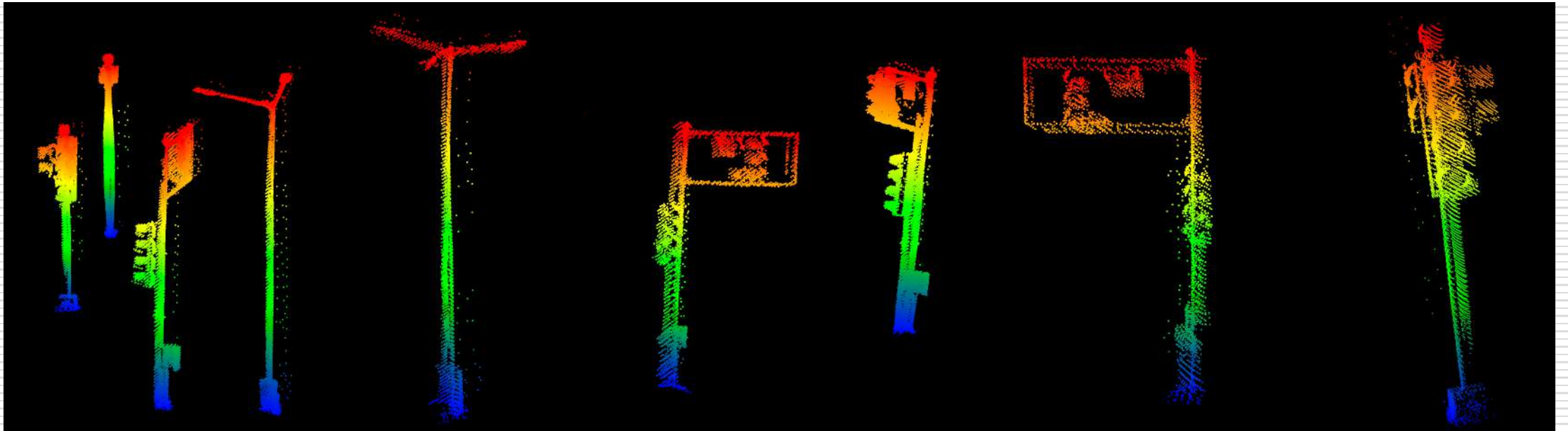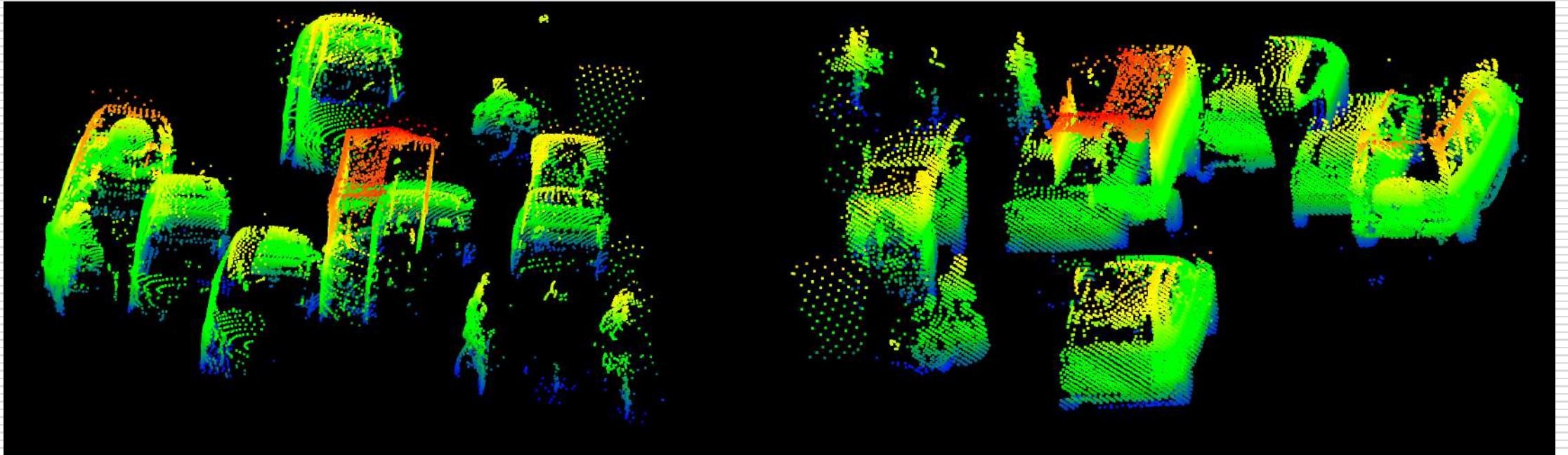
Transmission Lines

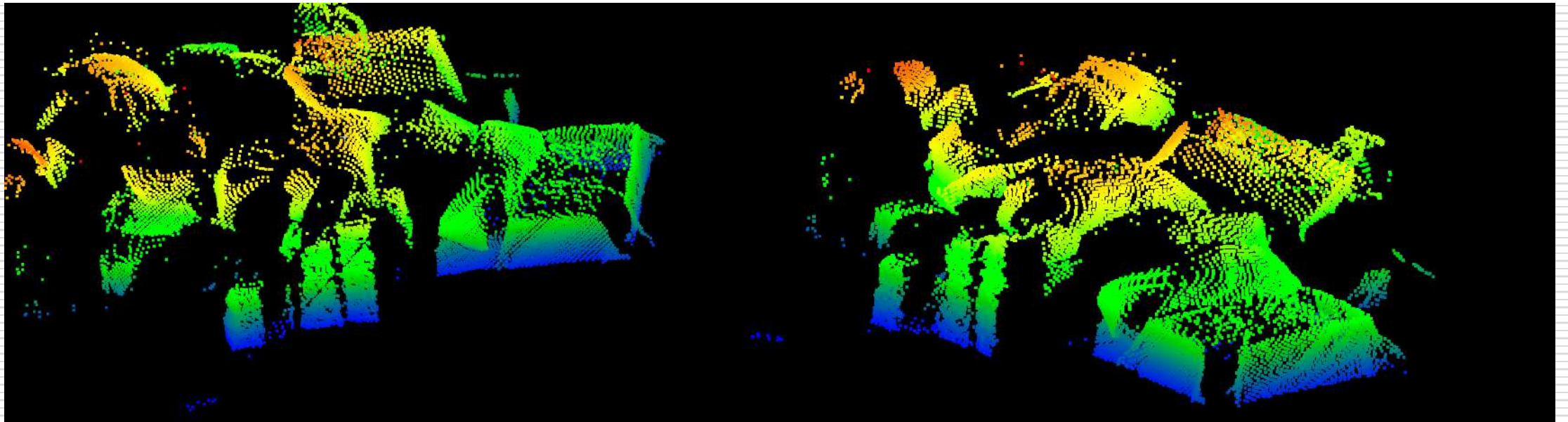The point cloud of transmission lines.

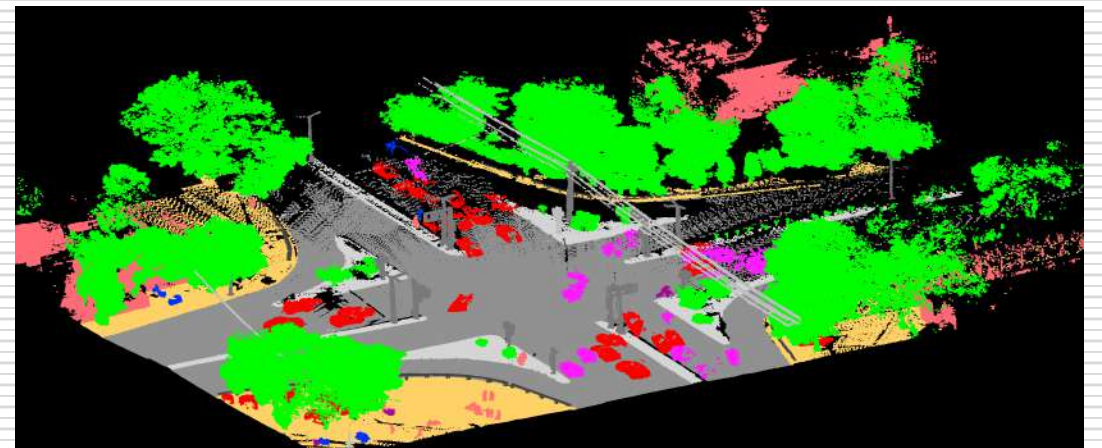# **Overlapping Vehicles**
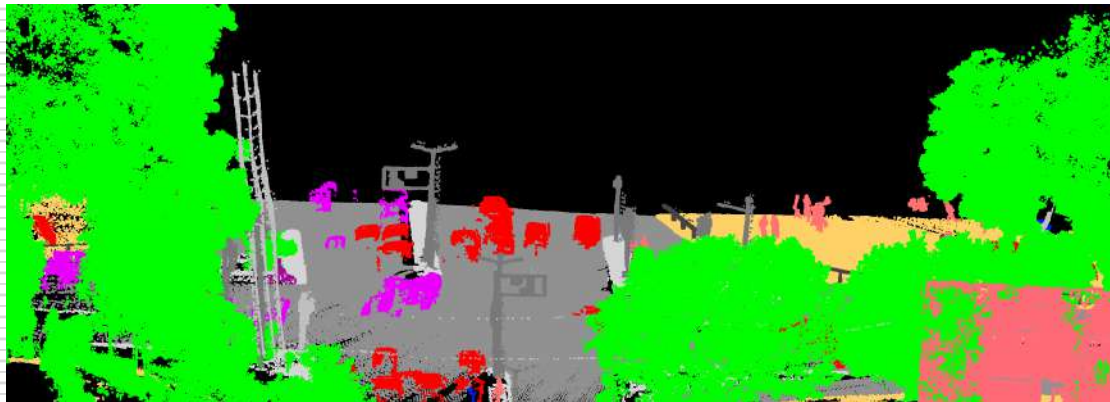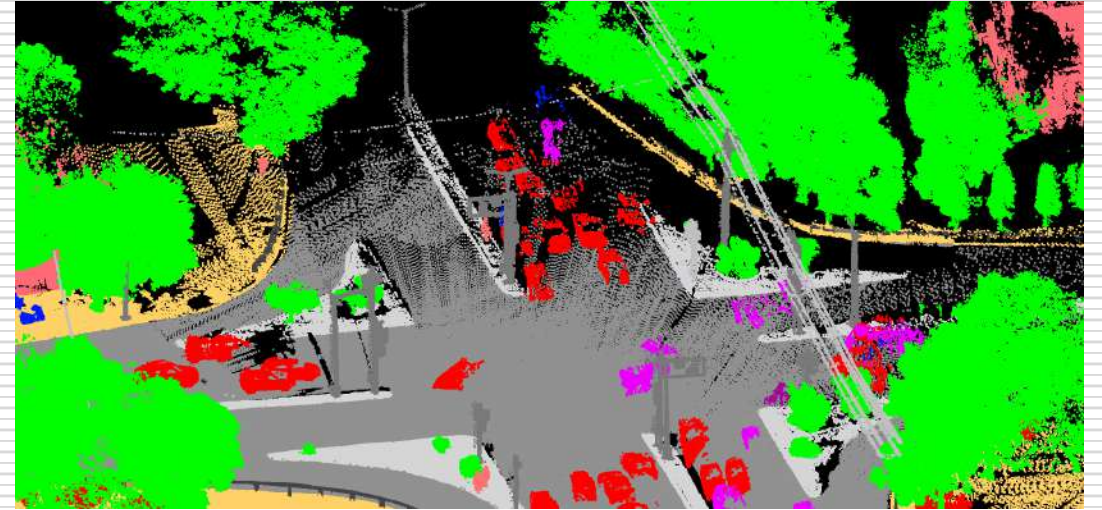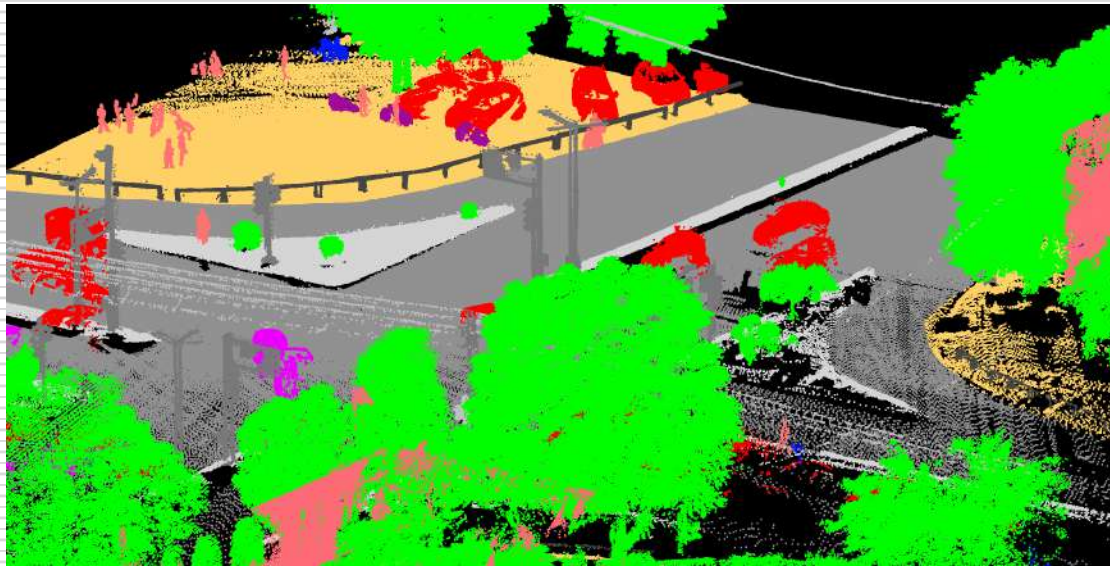
The point cloud of various vehicles was overlapping

Ambiguous point cloud

The point cloud of an unpredictable object near the road, and people were standing near this ambiguous hut-like structures.

LiDAR Point Cloud

Thank You!

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