Training of an AI for Surface Analysis

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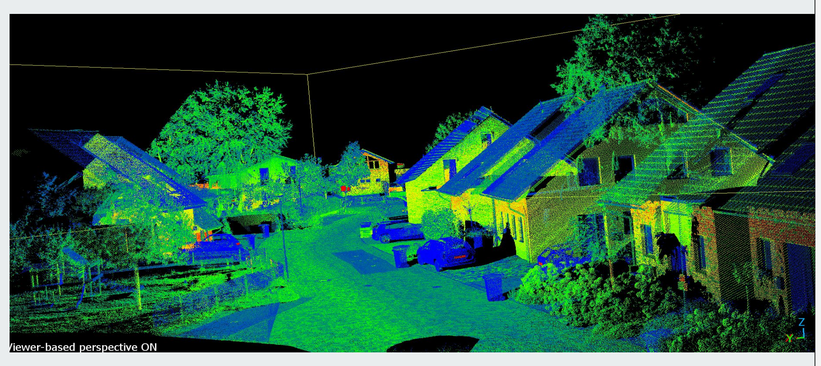
GOAL

Perform supervised classification on geospatial data and classify data into various classes such as Car, House, Road, Tree, etc.

UNLABELED POINT CLOUD



Point cloud data represents a collection of 3D points in space, often obtained from laser scanning or depth sensors, providing a detailed representation of surfaces or objects.

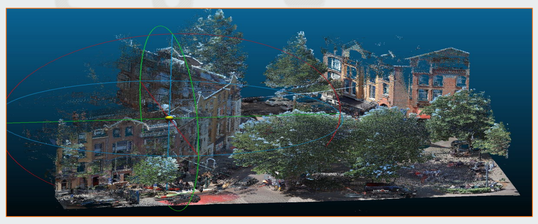
Overview → Getting to know the data → Research on feasible methods → Labeling → Training deep learning models

Tools like CloudCompare and Matlab were used to label PointClouds.
QGIS was initially used for visualizing purposes.

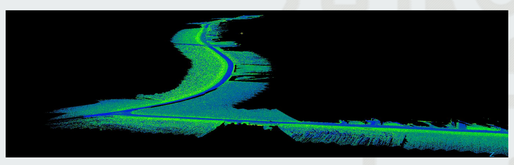
With CloudCompare

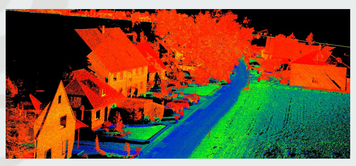
LABELING POINT CLOUD

Preprocessing: Before segmentation, preprocessing steps were performed to enhance the quality of the data. This included noise removal, outlier removal,

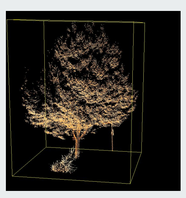


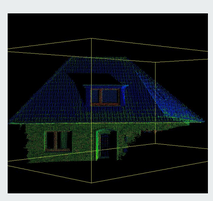
Ground Segmentation: The CSF (Cloth Simulation and segmentation) plugin was utilized to automatically classify points into ground and non-ground categories. This step is crucial for subsequent analysis, as it separates the terrain from objects of interest.

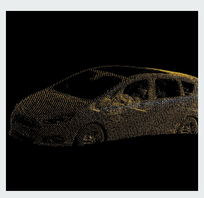


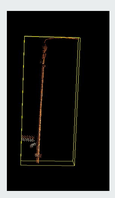


Tree Isolation: The TreeIso plugin was employed to isolate individual trees within the point cloud. This plugin utilizes advanced algorithms to detect and segment trees.







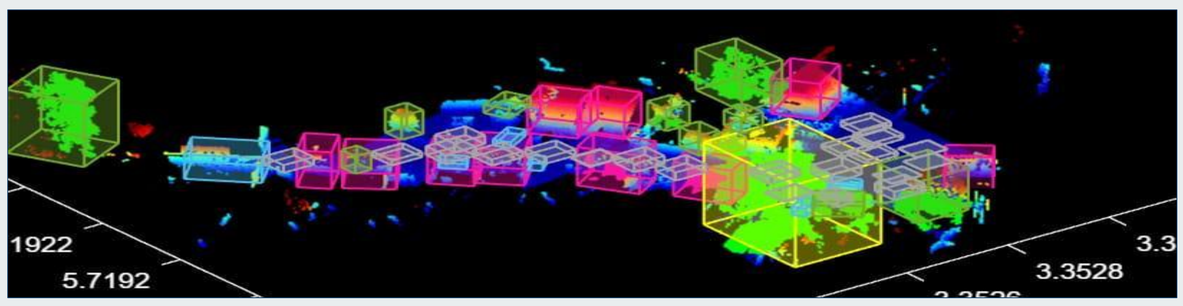


Connected components segmentation was applied to identify and label distinct objects within the point cloud, such as cars, houses, and roads. This process involves grouping adjacent points with similar properties to form coherent objects.

With MATLAB

LABELING POINT CLOUD

The LiDAR Labeler Application in MATLAB enables the visualization and labeling of objects within a point cloud. Cuboids are created around various objects to define their boundaries and attributes, which are then used to determine the association of each point with a specific object.



Labeled points are used to generate a new LAS file, where each point is assigned a specific class. This labeled LAS file can be further processed, including training classification model and segmentation model.

MODEL TEST

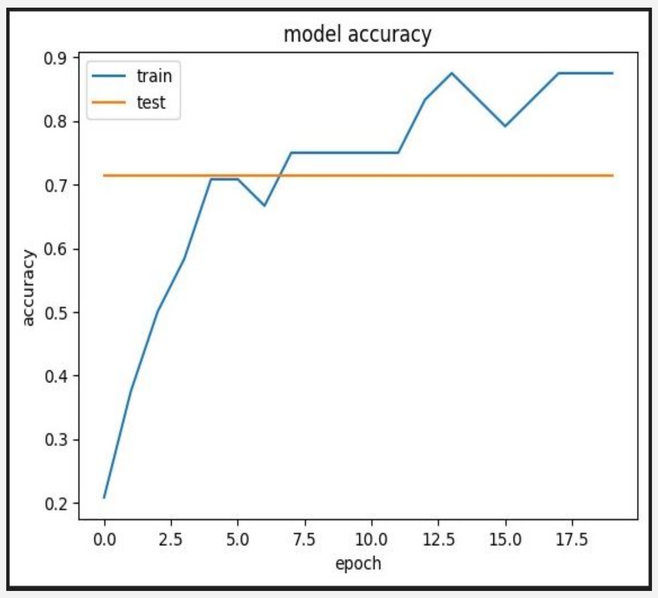
PointNet, developed by Stanford University researchers, is a deep learning model tailored for handling point clouds—collections of points representing objects or scenes in 3D space. This architecture allows for direct ingestion of raw point cloud data, enabling seamless learning of features and patterns without the need for preprocessing such as voxelization or manual feature extraction.

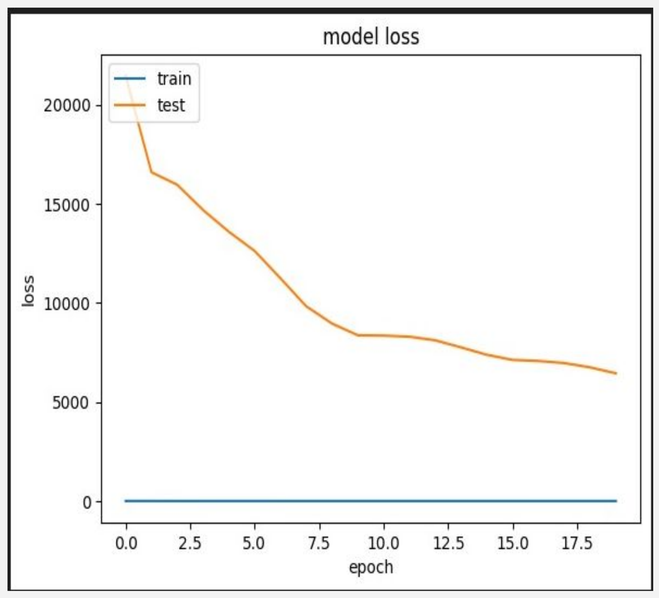
CHALLENGES

To effectively classify data using the PointNet model, a substantial dataset is required. However, our available dataset for classification is limited in scope. Consequently, instead of employing the PointNet model, we opted to test smaller models, which gave us better results.

RESULT

Our best model consists of 1D convolutional layers. we used bach normalization and max pooling layers. The best accuracy for test set is 71%.





Future Work

- **Improving the architecture of the model**
- **After labelling more data, deeper networks can be trained**
- **Try other models of Street Scene Segmentation such as PointNet++, PointCNN, RangeNet++, SparseConvNet, etc.**