UNIVERSITY of DAYTON

VISION LAB

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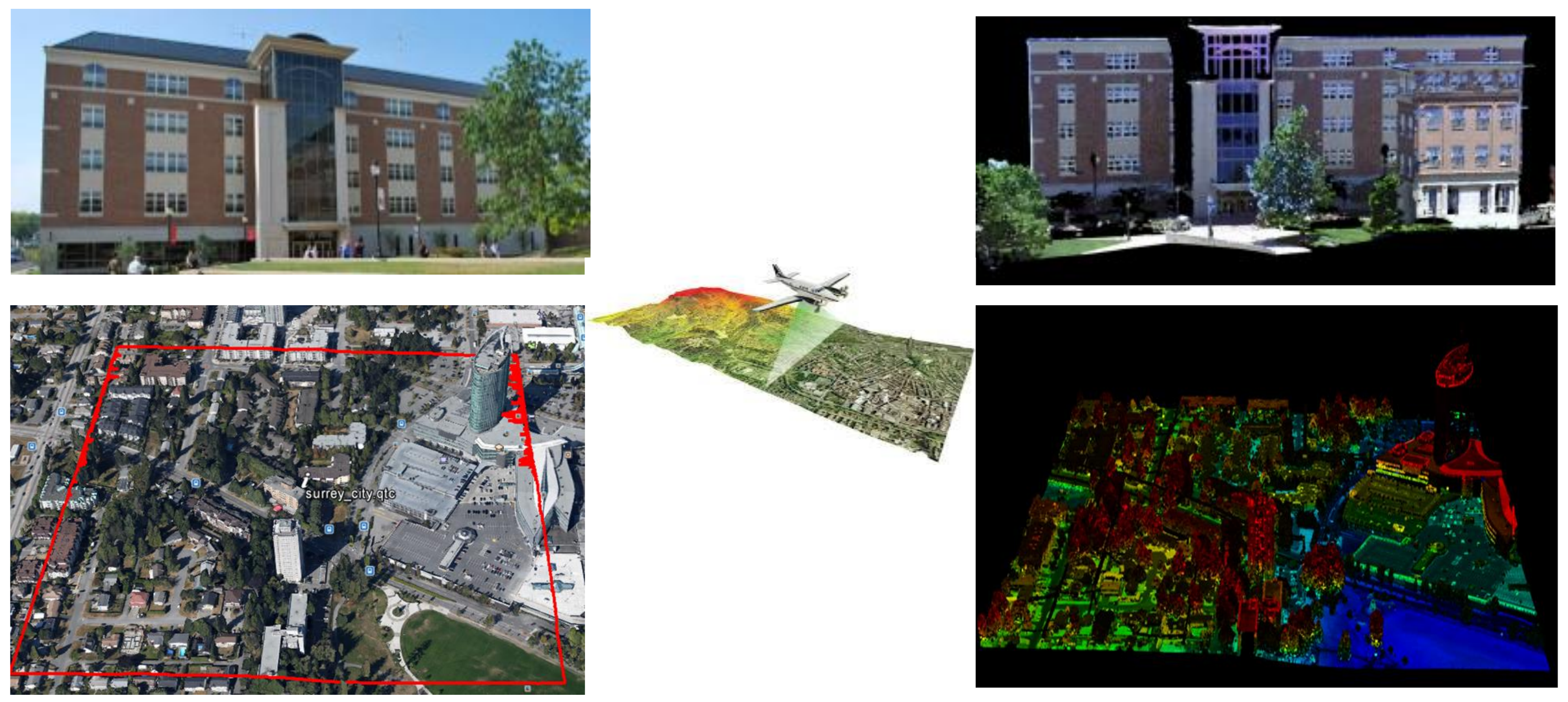
Automatic Target Detection in LiDAR Point Clouds

Background



LIght Detection and Ranging (LiDAR) data is a set of geospatially located points which contains X, Y, Z and possible RGB and intensity information that can be used to construct a 3D scene

Sensor

All campus data was collected using the FARO Focus X330 ground-based scanner

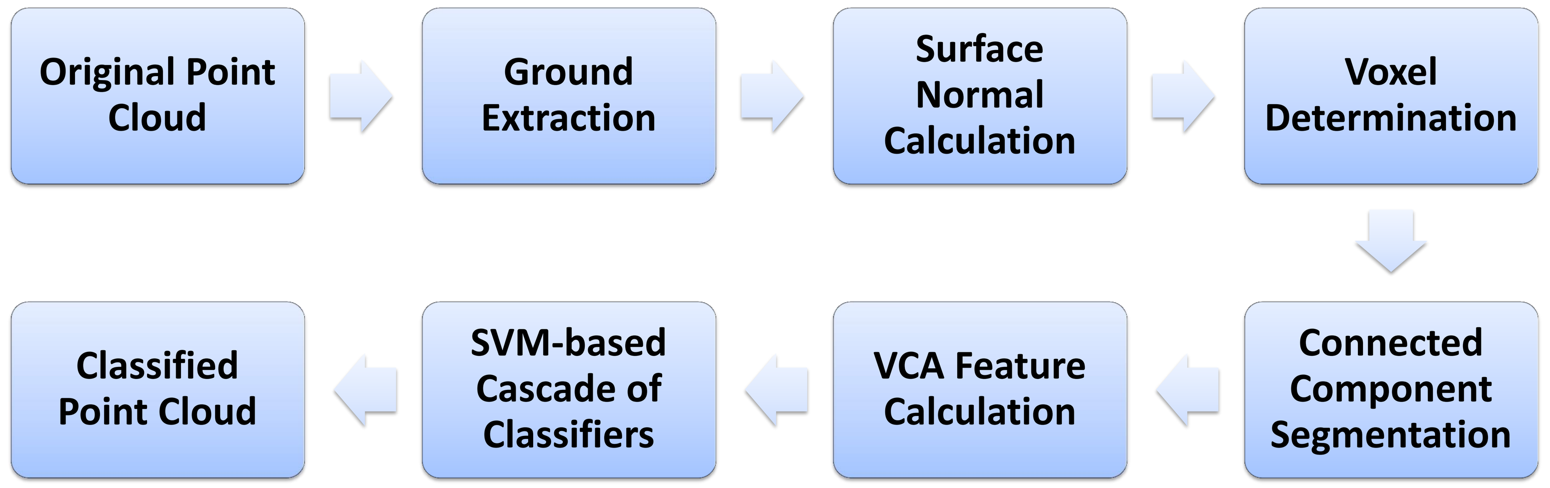
- +/- 2mm distance accuracy
- .06 – 330m range
- 50% noise reduction

Objective

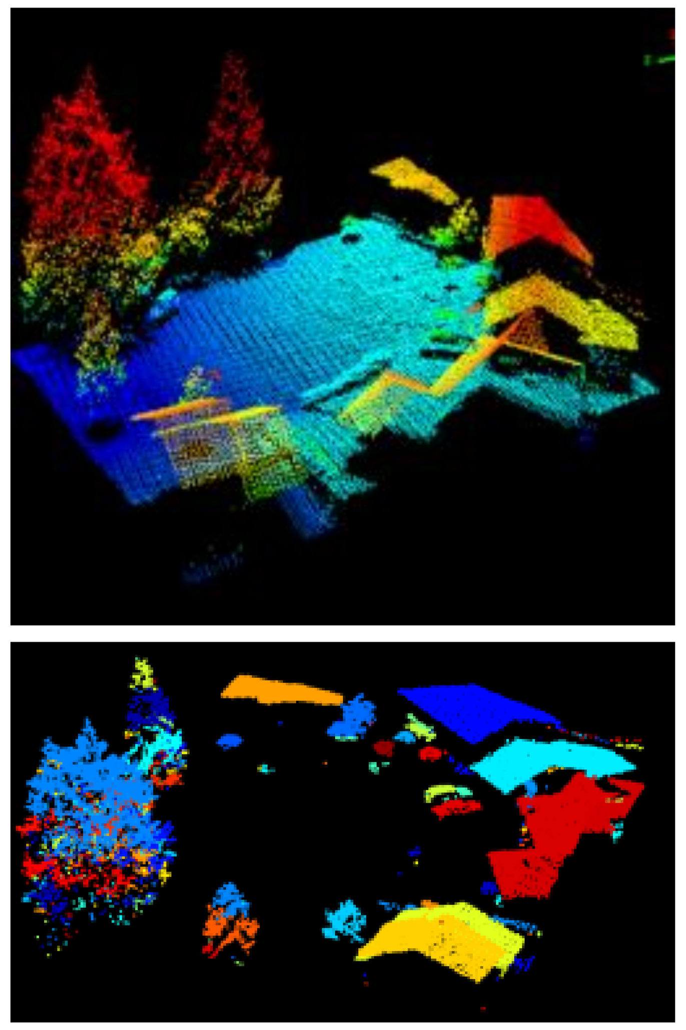
The goal of this project is to aid analysts in the task of understanding LiDAR data. In order to perform this task, we aim to achieve automatic perception of objects within the scene. This can be broken down into three main parts

- Developing a digital terrain model (DTM),
- Segmentation of individual objects within the scene
- Accurate classification of the identified objects.

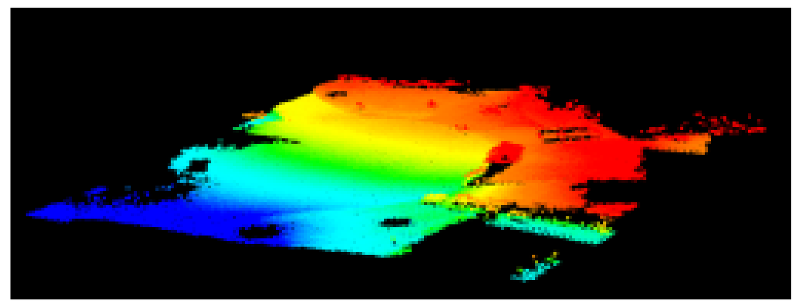
Methodology



3D Object Classification

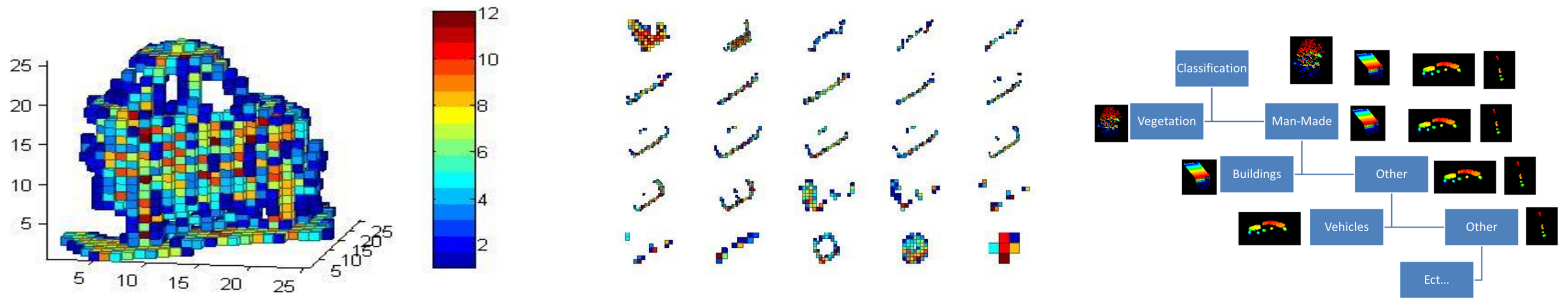


The original data is a series of scenes collected from Surrey, British Columbia in 2013

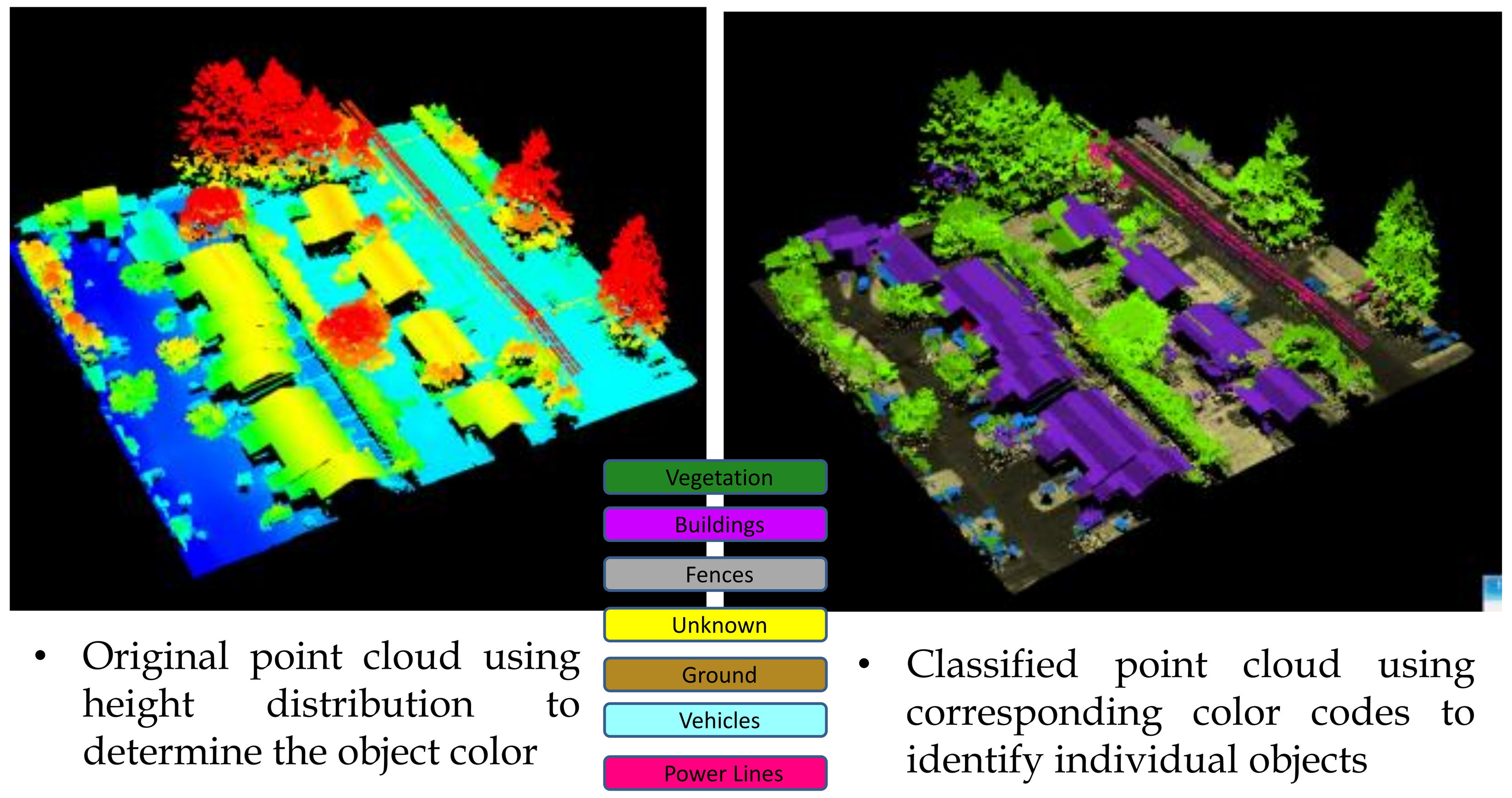


- RANSAC plane estimation is used to find the ground points for each scene
- By calculating the connected components of each voxel, individual objects can be segmented out within the scene.
- Each individual object is represented by a distinct color

- Volume component analysis is then used as a feature extraction method
- A cascade of support vector machines functions as our classifier



Target Detected Point Clouds

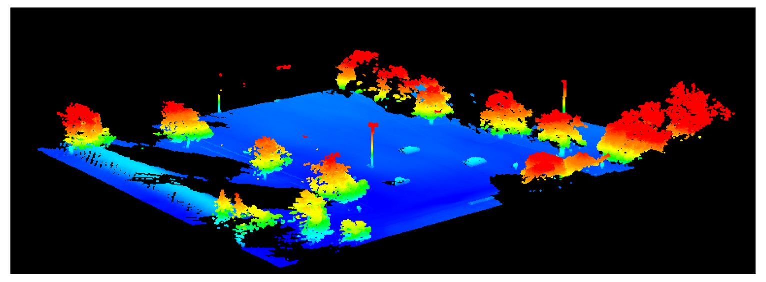


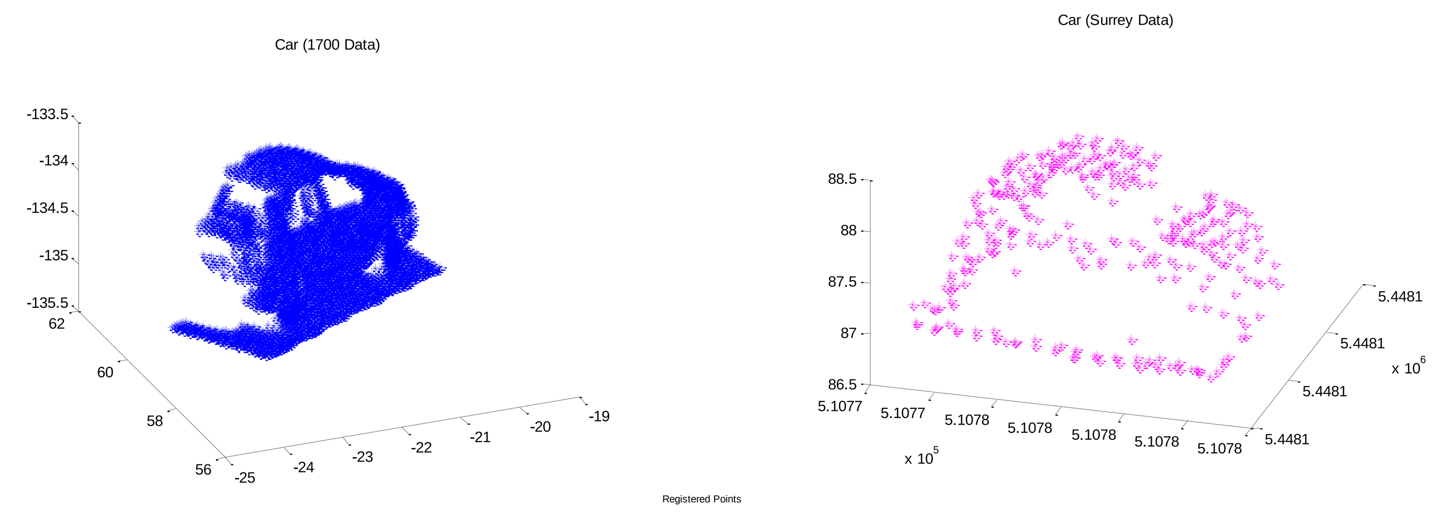
- Original point cloud using height distribution to determine the object color
- Classified point cloud using corresponding color codes to identify individual objects

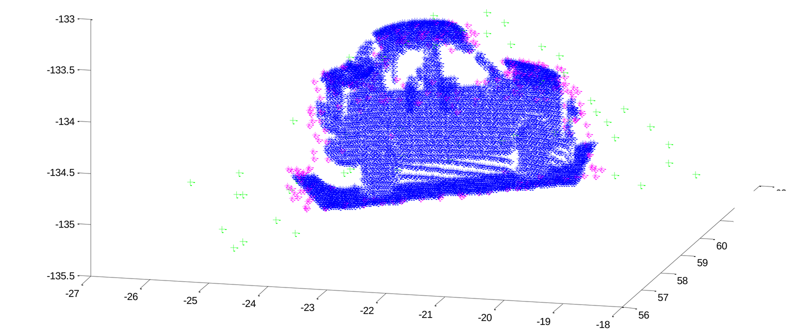
In-Class Target Detection

Once the data is separated into distinct classes, we begin the challenging task of performing precise object classification. For this particular application, the focus is on distinguishing between different vehicle classes, specifically sedans, mid-sized vehicles, trucks and military and construction equipment

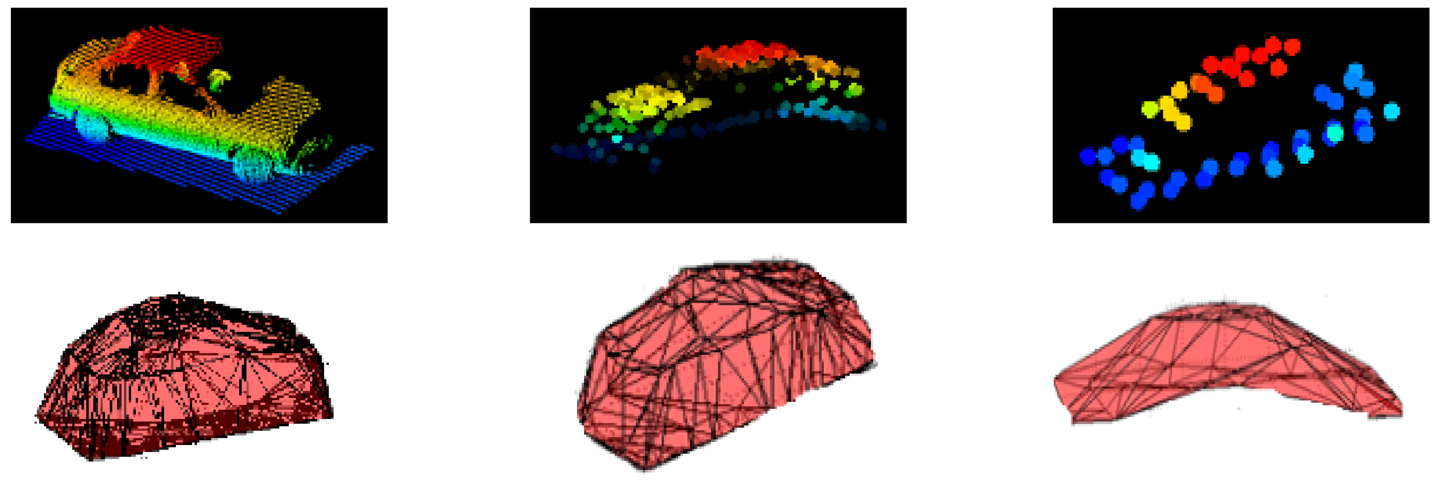
- Registration is performed using an iterative closest point algorithm







- Alpha shapes are used to triangulate between points and a volume is calculated.
- Volumes remain within the same range of 7.5 to 12 cubic meters regardless of resolution



Continuing Work

•Use LiDAR data to analyze changes in volume over time
•Expand 3D classification methods to 3D Structure from Motion models

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