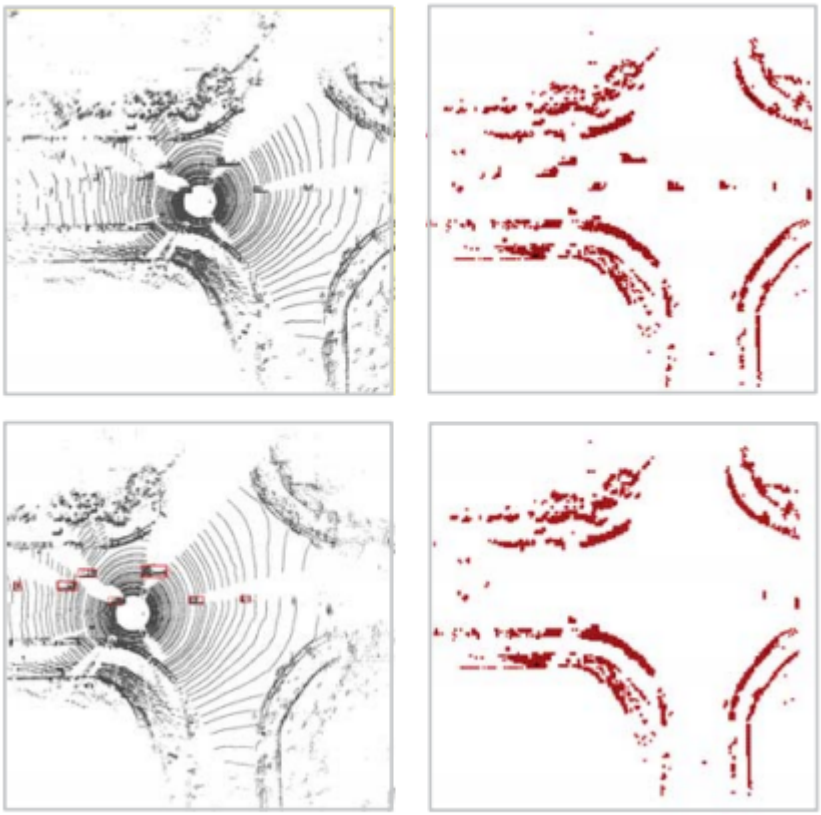
B_3_2

The Point Cloud Based Algorithm is an algorithm used to identify types of junctions. This works by using a LiDAR to read normalized length from objects and then plots it against the beam's serial number to gain a scatter graph with peaks. The number of peaks determine the number of free paths that the vehicle can take.

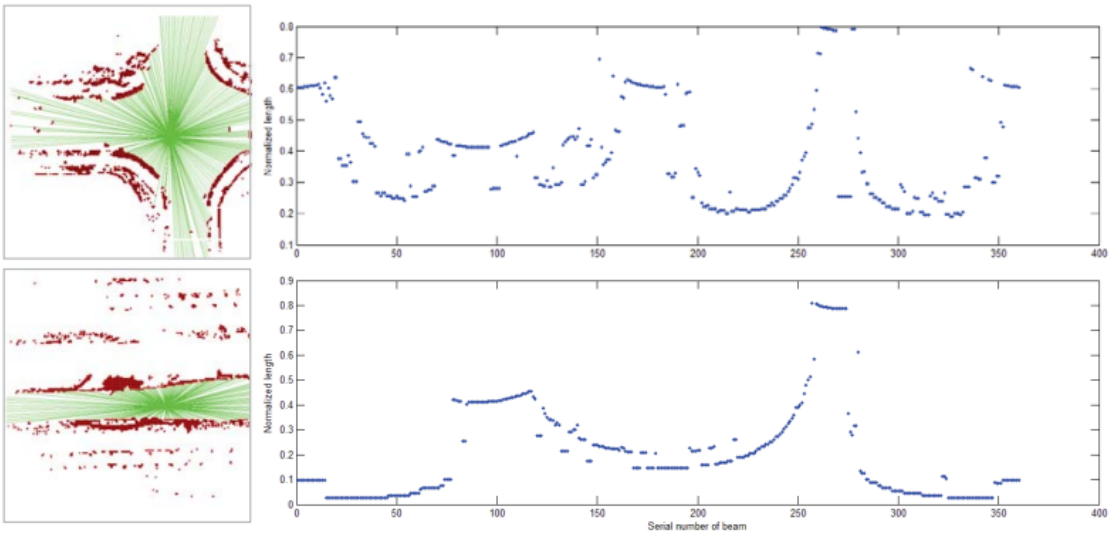
Before the graph can be created first there needs to be pre-processing done to the LiDAR data to remove all the unnecessary readings for vehicles,passengers, and other obstacles/intrusions. For this we use a Beam-Based Feature Construction that follows these steps:

1. Create a grid map for a frame of data each with quadratic cell size r×r; calculate variance of elevation of the points in corresponding cell.
2. Based on the variance of the elevation we use a threshold on the grid map; if the variance of the elevation is greater than the given threshold, the corresponding entry of the grid is set as 1, otherwise it is set to 0. Then the grid map forms a 2D image which is similar to binary image of the scene in birds-eye view.
3. Traverse all the cells of the grid map. We assemble all the connected cells whose 4-connected regions are all 1 as a connected region. Afterwards, we rebuild these connected regions to surround a cube.
4. Using the length and high of the cube, we detect the vehicles and pedestrians.
5. Clear the cells which is belong to vehicle and pedestrian, the remaining grid map will be used for intersection recognition.



This is the step by step pre-processing where it removes all the unnecessary readings of various kinds of obstacles.

Now that the data has been pre-processed we calculate the normalized length (D = 5*v*t) and plot it against the serial number of it’s beam to gain scatter plots.



This is the final result which shows the difference between a road and a 4 way intersection. The 4 way intersection graph(above) has 4 peaks indicating free path to move. Similarly the road shows 2 peaks.

Once the graphs have been procured, the next step is to use a SVM based classifier to compare the current intersection graph against to determine the type of intersection it is.

TABLE I

SVM PERFORMANCE ON INTERSECTION AND ROAD SEGMENT CLASSIFICATION

	TPR	TNR	Accuracy	AUC
Test Data 1	91.25%	96%	93.625%	0.987
Test Data 2	81%	84%	82.5%	0.938

TABLE II

SVM PERFORMANCE T-SHAPED AND +-SHAPED INTERSECTION CLASSIFICATION

	TPR	TNR	Accuracy
Test Data 1	93.382%	80.681%	85%
Test Data 2	85.714%	79.545%	83%

From the implementation of the algorithm with the SVM classification we get a very good accuracy to detect types of intersections as shown above.