Documentation:

Insights:This paper talks about a new method for identifying road segments and junctions .The junctions are further identified and classified as T shaped and cross roads.

The algorithm used here for excluding pedestrians and vehicles from 3d map:
1)Create a grid map for a frame of data of size r * r .
2)Next we find the variance of elevation(height) of points in the corresponding cell.
3)If variance is greater than the threshhold , it is assigned a value of 1 ,else 0;
4)Next , we combine 4 adjacent connected regions with value 1 as a single connected region and then rebuild these regions to surround a cube.
5)With the length and the height of the cube , we can identify vehicles and pedestrian with existing machine learning models.Now we can remove the pedestrians and vehicles from our grid map to avoid interference.

Algorithm to identify junctions and segments

1)The lidar beam is launched from a point at an adaptive distance(distance which depends on the speed of the vehicle) in front of the vehicle.

2)The beam is launched in all directions (360 degrees ) with 1 beam for each degree (i.e 360 beams ) and the width of each beam is slightly more than the width of the car.

3)If the beam is blocked by an obstacle , it is cutoff and reflected back .If it is not blocked , it will travel a maximum distance if L (constant).

4)Now if plot the histogram of the normalized travelled distance, we can see peaks in the plot.

5) If the place is a road segment , then there will be 2 local peaks(as there will be 2 sets of points where the beam can travel a maximum distance of L (i.e 2 paths possible)),for T shaped junction , there will be 3 peaks(as there will be 3 sets of points where the beam can travel a maximum distance of L (i.e 3 paths possible)) and for a cross junction , there will be 4 peaks.

6)Based on this we can choose one normalized length for all 360 beams and the region at this distance can be called the feature.
We use support vector machine (SVM) for analysing and creating machine learning models.

Results :
The algorithms were tested on 2 different data sets:
Data set 1 had 264 cross roads , 136 T shaped frames and 400 road segments.All the roads in data set 1 were relatively interference free from pedestrians and other vehicles.

Data set 2 had 44 cross roads , 56 T shaped frames and 100 road segments.These roads were more complex with more pedestrians and other vehicles.

Data set 1 has True Positive Rate(TPR) of more than 90 % and data set 2 has TPR between 80 - 90%.

The results show that the algorithm is very good and applicable for most of the roads.

Possible Pitfalls:

1)It is not very efficient when at junctions where the view of a path is blocked by encroachments ,or large buses and vehicles (large buses will be considered as wall by lidar)

2)It may also fail at places where there are stray beams that affect the reading of the lidar sensor.

Improvements:
This algorithm can be even more effective when coupled with other sensors like Sonar (at infrasonic frequencies).Sonar uses sound waves and since sound waves can pass thru obstacles like encroachments,we can get much better view along with Lidar.

Also coupling sensor also reduces possibility of stray beams affecting the sensors.