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1 Sensors for an Autonomous Navigation System

Most of the Vehicles these days are made of mainly these four sensors:

- **Lidars**:aka Light detection and ranging, are sensors use beaming a laser and calculating the time it takes to come back to estimate the distance between it and the object. It's main disadvantage is the pricing, and since it depends on light, it is rendered ineffective in heavy rain and fog as most of the rays get refracted, but whatever data is received is often accurate, just that the sampling rate goes down. Advantage is that, it is highly accurate and is not affected by geometric distortions.
- **Radars**: Radio Detection and Ranging, aka, Radars send out radio waves that detect objects and gauge their distance and speed in relation to the vehicle in real time. Advantages is that they are cheap and work in fog and rain too. Low resolution power is one of the disadvantages.
- **Cameras**: These have become an integral part of any autonomous stack, since computer vision has become a thing. Image detection and manipulation software have made cameras a far more powerful sensory device than before. These devices lack data on depth, but computer softwares, and machine learning is starting to catch up to it, and cover that ground.
- **Ultrasonic Sensors**: Measuring very small distances, especially against an object is far more convenient with an Ultrasonic sensor. Though it's working principle is same as the Radar, it uses a sound wave instead of an electromagnetic wave. Accuracy is a disadvantage here.

2 Summary of 3D LIDAR Point Cloud based Intersection Recognition for Autonomous Driving

- In earlier times, intersection and road segment detection took place with GIS, GPS and INS, which are all getting redundant. To make up for it, this paper aims at using 3D point cloud based solution to solve the same.
- This detection problem is modeled as a classification problem and machine learning methods can be used to solve it.
- But to apply these methods, we need to remove obstacles out of our dataset. This can be done in a few steps:
  1.Create a grid map for a frame of data each with quadratic cell size r×r and 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 bird-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.
- We then run these data points through a machine learning classifier, which helps detect the type of road segment or intersection.