# REDBACK NMP 2021 T3 – AV PERCEPTION

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1. **Downsampling**

Downsampling involves the generation of a standard grid within a point cloud. Points within a particular grid space are collected into a singular voxel to minimise the points in the point cloud. With a lower voxel size, the following operations will take longer, while a larger voxel size may not provide enough resolution for an autonomous vehicle to safely navigate.

Multiple voxel sizes were trialed until a suitable balance was found. A voxel size of 0.2 was used, although voxels up to 0.5 in size also produced satisfactory resolution.

1. **Crop/FOV trimming**

The first process was to remove any statistical outliers. An aggressive outlier trimming was applied to also remove the clusters on the edge of the LIDAR scan, which displayed low point density and is redundant to the autonomous vehicle. The two variables that determined the extent of outlier removal were neighbours and standard deviation.

I attempted to crop the point cloud to remove unwanted clusters that were not in the immediate view of the vehicle. However, this turned out to be very difficult to execute as the Open3D library does not provide a scale

1. **Segmentation**

Segmentation using the RANSAC Algorithm was carried out and made up the majority of the processing time. This is due to it being an iterative process, and a high iteration count was used such that the plane was completely segmented out. I prioritised this as an unsegmented section of the plane can cause the autonomous vehicle to identify it as an obstacle, and potentially swerve to avoid it unnecessarily.

The variables that affected the quality of the process were the threshold distance that determined the voxels that fit the plane, the minimum number of data points required to estimate model parameters, and the number of iterations run by the algorithm. The threshold distance was interpreted to be the “thickness” of the plane segment, which was kept to the voxel size (0.2) to prevent any road obstacles from being segmented out. Meanwhile,

1. **Clustering**

The DBSCAN algorithm was used to separate the point cloud into clusters. This process depended on two variables, epsilon and min\_points

Conclusion and Reflection

The resultant visualisation of the 3D radar data showed distinct clusters that can be easily interpreted as cars, buildings and other street obstacles.

I attempted to optimise the processing time of the perception program as much as possible. Each process was timed using python’s timeit module. A low processing time is important to autonomous vehicles as a large amount of data has to be processed in real time to safely navigate an area. As mentioned earlier, the RANSAC Segmentation took up majority of the processing time. This can be improved upon with potentially a more efficient segmentation algorithm.

Future iterations of AV perception programs could also use a compiled language such as C++ to further reduce processing time per dataset. In addition,