TP6 - Modelling

NPM3D - M2 MVA

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1 RANdom SAmple Consensus

Q1. We use the RANSAC algorithm to extract the prominent plane in the point cloud *indoor_scan.ply*. We find the floor in the point cloud which contains 119082 points. We show the promonent plane and the remaining point cloud below.

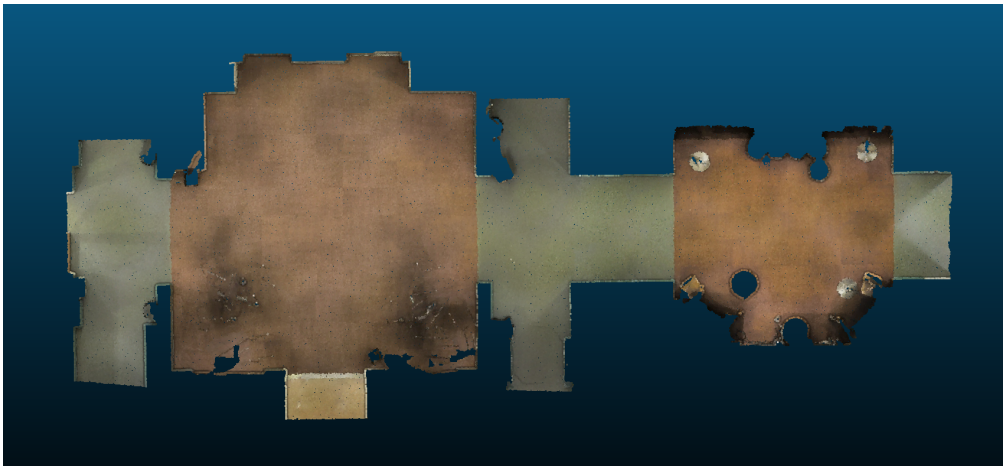

Figure 1: The prominent plane found by RANSAC

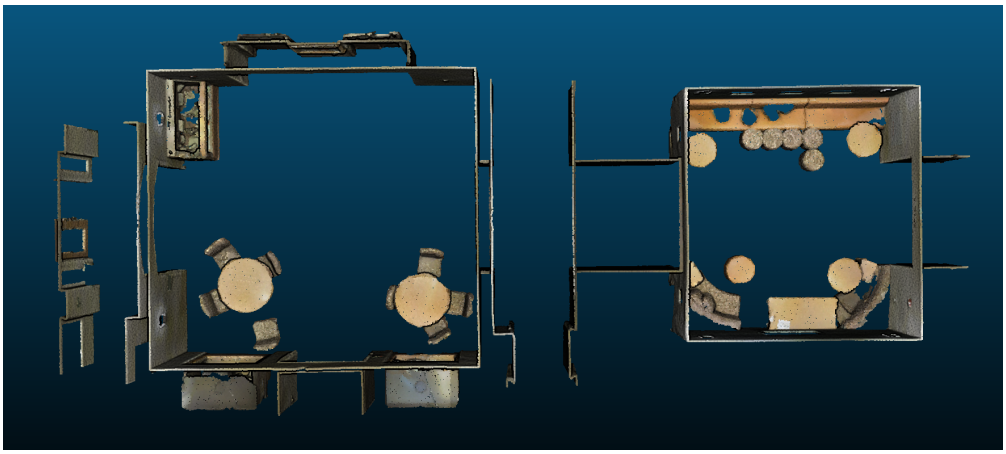

Figure 2: The remaining points left by RANSAC

Q2. In order to calculate the minimum number of trials T to get 99% chance of finding this prominent plane, we need to solve the following equation:

$$0.99 = 1 - \left(1 - (\frac{119052}{412756})^3\right)^T$$

and the solution is $T = 190$.

Q3. We extracted 5 planes successively by RANSAC algorithm. The result is shown below.

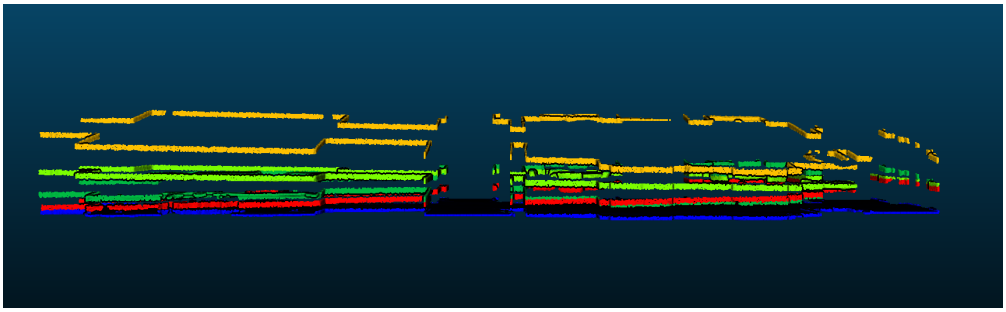

Figure 3: The prominent planes found by RANSAC

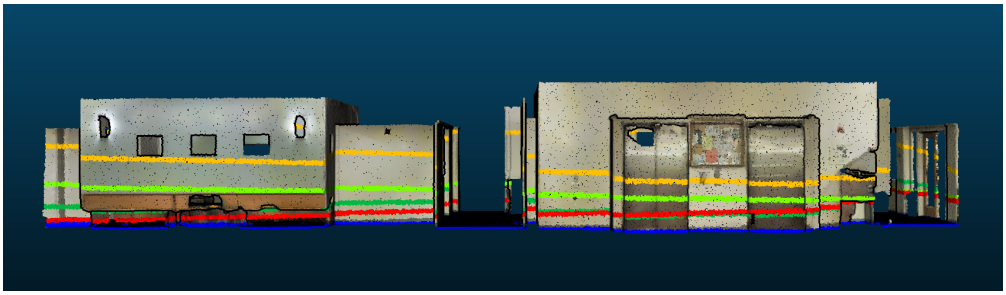

Figure 4: The remaining point left by RANSAC

We can find obviously that some of the extracted planes are not continuous. Instead they correspond to a point set sitting on a same level set. This is due to the calculation of the number of points in the plane. We don't consider at all the connectivity, thus the extracted planes might have no meaning.

2 Region Growing

Q4. The thresholds decide the effect of the algorithm.

- s_1 **for distance criteria**: represents the maximum distance from a point to the plane passing through the reference point and being perpendicular to the reference normal. A large value is suitable for a noisy point cloud, while a small value is expected for a clean point cloud.
- s_2 **for normal criteria**: represents the maximum angle between the normal of a point and the one of the reference point. If it is too large, we may found a plane containing several connected planes, which causes a big issue.

- s_3 **for planarity criteria**: decides the checking queue. If the threshold is too small, we may add some points on the border. Once we look at its neighbors, we may introduce another plane. So in brief, the parameter controls the border where we stop searching.
- r **for neighbor selection**: decides the potential candidates for all previous criterion. If it is too small, we are not able to find connected points around the reference point, which stops the propagation of the plane. However if it is too large, we may introduce another planes.

By using $s_1 = 0.1$, $s_2 = 10$, $s_3 = 0.85$ and $r = 0.2$, we obtain the following result:

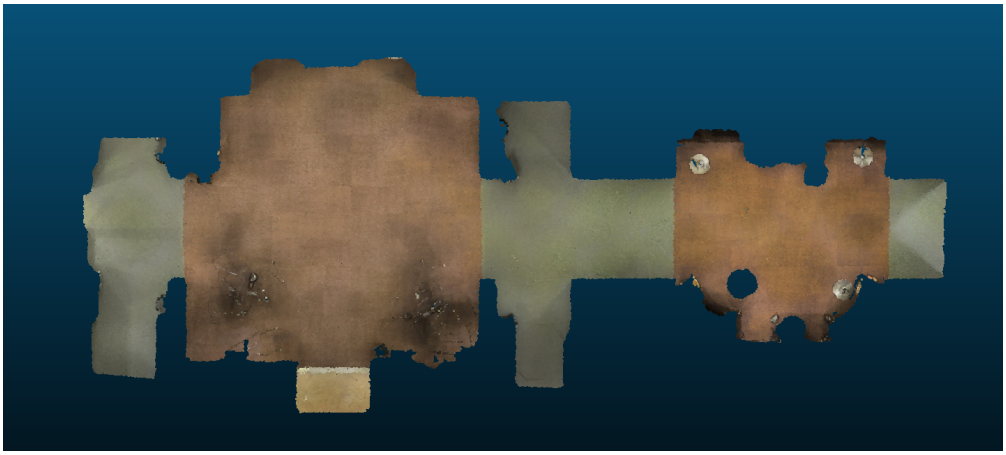

Figure 5: The prominent plane found by Region Growing

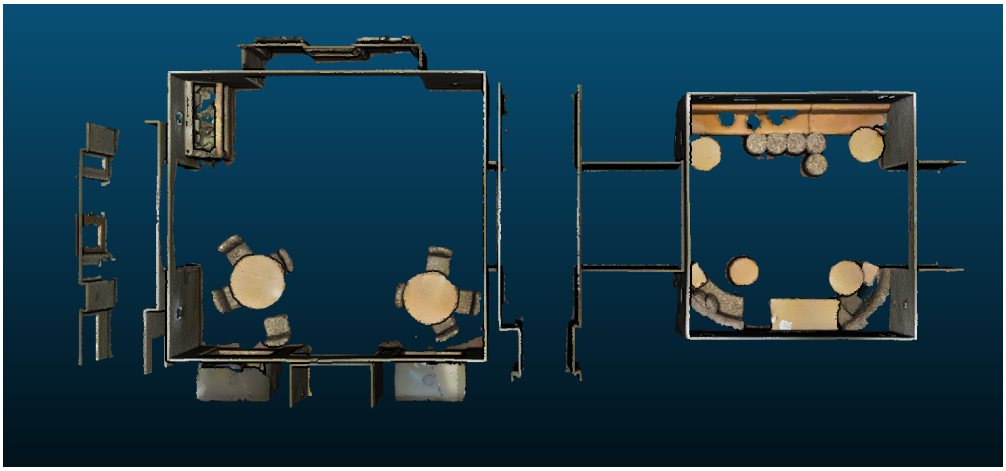

Figure 6: The remaining point left by Region Growing

We can observe that the border is not clear enough.

Q5. We simply choose each time the point whose planarity is highest among all points.

Q6. By using the same parameters, we extracted 10 planes from the point cloud. The screenshot is shown as below.

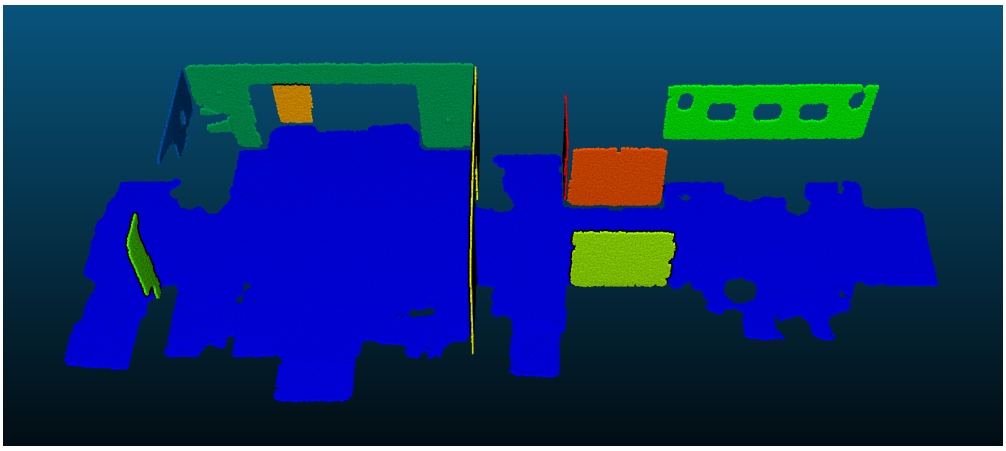

Figure 7: The prominent planes found by Region Growing

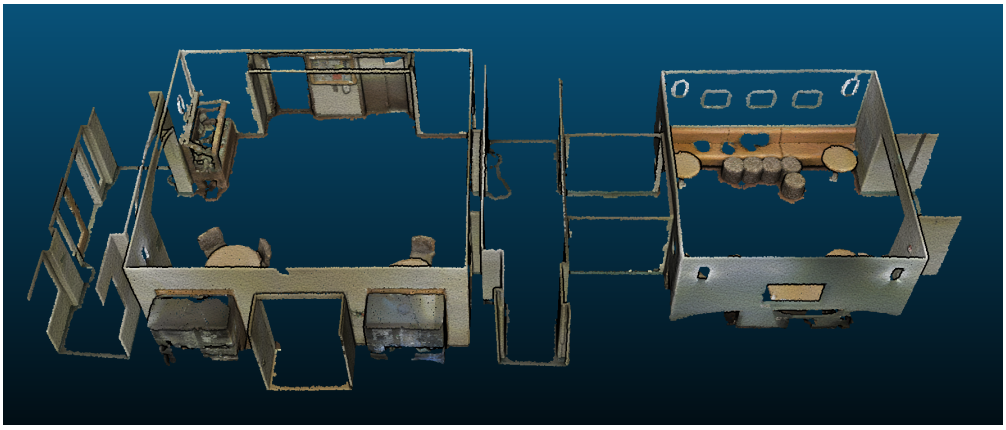

Figure 8: The remaining point left by Region Growing

Compared to RANSAC, the advantages of Region Growing are:

- We take into consideration the connectivity while propagating the plane
- The algorithm is flexible. We can design our own criterion and seed points according to our application scene.

The shortcomings are:

- The computational complexity is high.
- The parameters need to be well chosen and they may vary a lot when the application changes.
- It is hard to find the border of the plane perfectly, especially in the existence of noise.
- Region growing is a local method without a global view of the whole point cloud.