3D Point Cloud and Modeling (NPM3D)
TP 5: Modeling

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Question 1

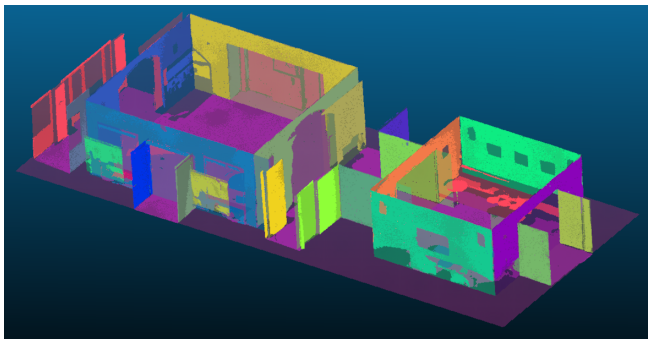

Figure 1: Plane segmentation with RANSAC Shape Detection plugin

Figure 1 shows a result of segmenting `indoor_scan.ply` into planes by using RANSAC Shape Detection plugin in CloudCompare. The result contains 31 planes and is obtained with the following parameters:

- Min support points per primitive: 10000
- Max distance to primitive: 0.101
- Sampling resolution: 0.201
- Max normal deviation: 10°
- Overlooking probability: 0.01.

It can be seen that the number of segmented planes increases as the number of min support points per primitive gets lower. The latter in this case is set to a high value so as to obtain few segmented planes that corresponds to actual planes and not the ones that group noises.

Question 2

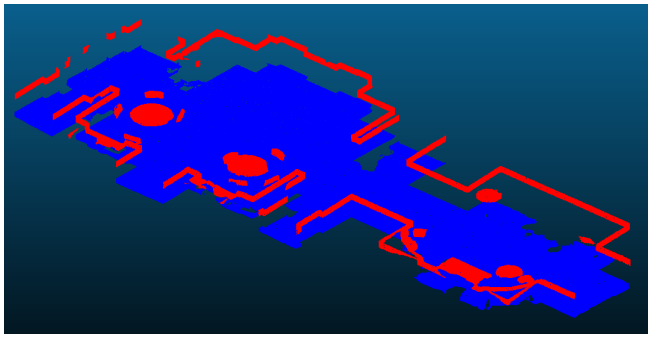

Figure 2: Two planes extracted by RANSAC

Figure 2 shows two planes extracted by the implemented RANSAC. It is clear that the second extracted plane (in red) is not an individual flat plane but rather a group of small planes. This is mainly because of the condition that checks whether points belong to a certain plane; only the distance is considered and not the orientation. In the case of figure 2, the plane computed by RANSAC is somewhere parallel to the first plane (in blue) and the red strips of points are points that are close to that computed plane within the given threshold (0.1).

Question 3

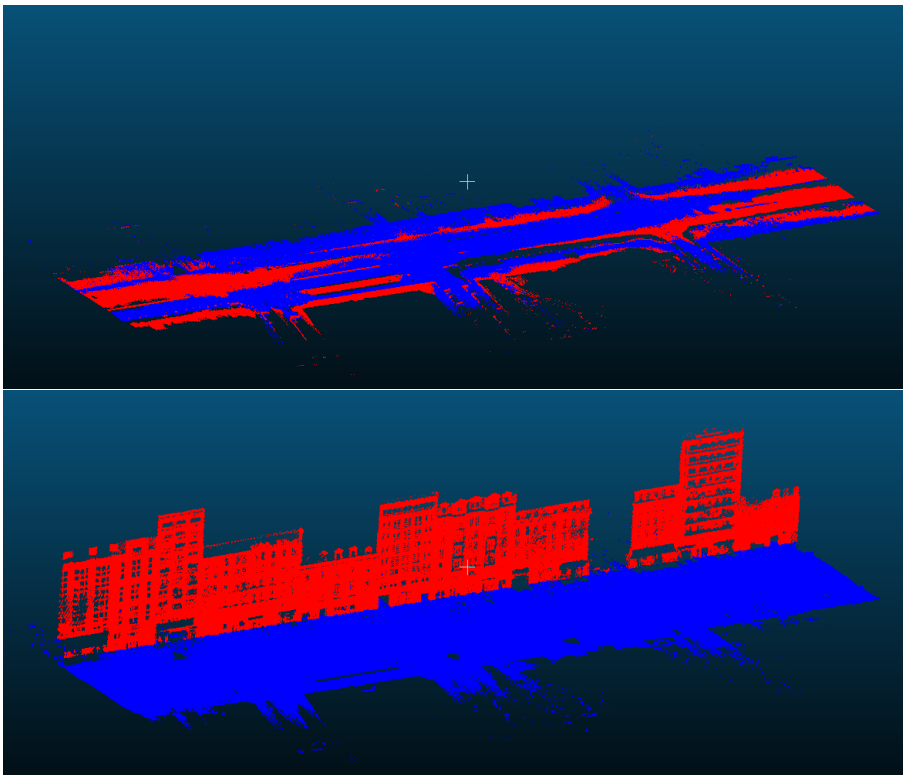

Figure 3: Two planes extracted from Notre-Dame des Champs point cloud with RANSAC with threshold 0.1 (top) and 0.5 (bottom)

Figure 3 shows two results of two planes extracted from the Notre-Dame des Champs point cloud from previous TP by the implemented RANSAC. Both results are obtained with 100 times of draws, while the only difference is with the distance threshold. The 0.1 threshold gives a wrong segmentation as it considers the road to be two different planes. The higher 0.5 threshold gives a significantly better result, with the road as one plane and the buildings as another.

Question 4

Figure 4 shows a result of plane segmentation with a variant of RANSAC. This new version of RANSAC considers normals in addition to the distance of points when checking if the points belong to a certain plane. Specifically, it also checks whether the angle between the normal of a point and the normal of the plane is within a certain threshold.

The result in figure 4 is obtained with the distance threshold equals to 0.1 and angle threshold equals 0.2 radian. The normals are computed using spherical neighborhood with a radius of 0.5.

With the consideration of the normals, it appears that this new algorithm manages to capture some part of the different walls but still not the whole wall, possibly because of some errors exist in the computed normals.

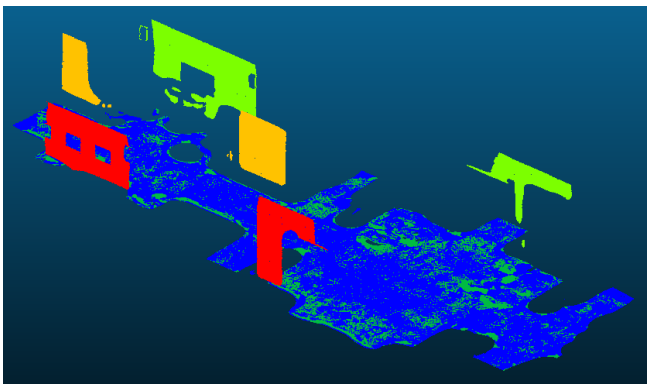

Figure 4: Five planes extracted by RANSAC using normals

Bonus question

One improvement that can be applied to RANSAC is with the choice of points when computing for the best plane that fits the cloud. Instead of randomly choosing points, one can try choosing points that are close to each other (using KDTree for example) since they generally belong to the same plane.