PLANE DETECTION IN POINT CLOUDS VIA RANSAC

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Abstract: Plane detection from 3D-point cloud data is developed rapidly for photogrammetric applications which is important for acquiring, monitoring assessment of a wide variety of applications. In the current report, we implement the plane detection algorithm, ''Random Sample Consensus'' (RANSAC), which during a repetitive procedure choose the best fitting planes for the dataset.

1. INTRODUCTION

A well-known algorithm to detect planes is "Random Sample Consensus (RANSAC)", capable to extract a variety of different types of primitive shapes, whilst retaining the generality and simplicity (Schnabel et al. 2007). It is used in numerous applications in computer vision which use planes. 3D-reconstruction, grouping, scene analysis, object recognition, segmentation [Yang, Forstner,2010]

The basic principle of algorithm is that, from the dataset, is picked randomly three points which is calculated the parameters of formed plane. Then the remain points are testing with a repetitive procedure if belongs in a specific tolerance value in order to detect the desired plane. The process is repeated for new set of random points till to detect every possible plane.

In the current paper, we will represent the use of RANSAC to detect planes with a given 3D-point cloud dataset and the effect on the performance of RANSAC on different datasets and thresholds is investigated

2. METHODOLOGY AND APPROACH

RANSAC algorithm was implemented and tested for two different datasets. For "Charite-2planes.ptx" with approximately 30.000 points and "Charite-large.ptx" with approximately 400.000 points.

For the implementation, the input data was:

- The 3Dpoint cloud (X, Y, Z)
- The minimum number of points that will form a plane
- The minimum number of points that remain as outliers
- The threshold of a random point and the potential plane
- The maximum number of algorithm tries to detect a possible plane

The outline of the implemented RANSAC algorithm are:

1. The 3D point cloud
2. The random selection of three points with distances greater than the selected threshold value.
3. The parameters of the formed plane.

4. Calculated the normal vector of the formed plane.
5. The selection of the points that the distance from the potential plane is within the threshold.
6. The points which belong to the plane saved in a different dataset and they erased from initial one.
7. We repeat the procedure till to find all possible planes

It should be mentioned that the value of the threshold and parameters occurred after repetitions of the algorithm and considering which results fits better.

3. RESULTS AND CONCLUSION

3.1 Small Dataset

Firstly, we use a smaller dataset (figure 1), so as to check the properly proceed of the algorithm with two different distance thresholds, which consists of two planes.

Figure 1: Original image with 2 planes

Two different thresholds 1cm and 0,1cm are used during the running of algorithm. Figure 2 and Figure 3 show respectively the resulting images.

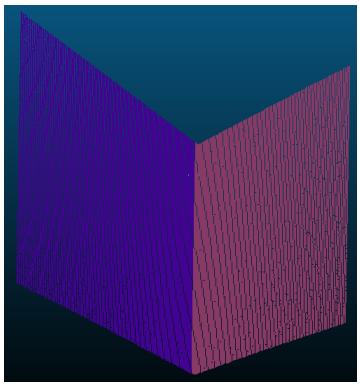

Figure 2: Detected Planes, (0.01m)

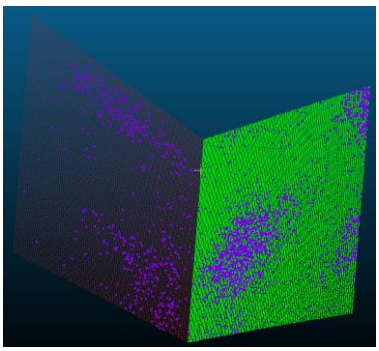

Figure 3: Detected Planes, (0.001m)

Observing the data of points, we conclude that the two planes formed correctly. The second plane which has more restrict criterion divided more accurately the two regions. Also, we should mention that the remain points in the second case are much more than in the first one, which means that the roughness on the planes are discarded and the plane getting smoother.

3.1 Large Dataset

At the second trial, we use a larger dataset point cloud acquired from the building of Charite Hospital. The major problem using RANSAC algorithm for big data is the big amount of time that it takes to proceed and analyze the data so as to detect the individual planes.
In the current paper compared two different threshold values, a big one with value of 10cm and a smaller with value 2cm. The parameter of minimum number of points that form a plane are one twentieth of the whole dataset. We observe some worth mentioned results.

The result of tolerant distant 10cm is in figure 4. The algorithm detects five planes which we can take many information of the shape.

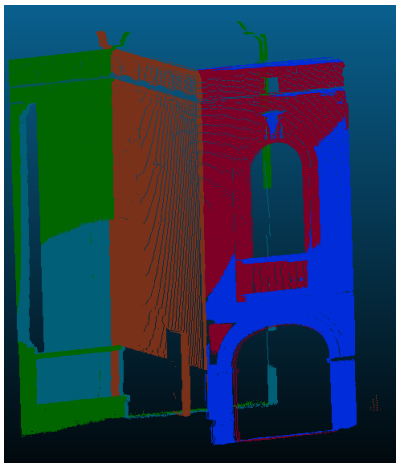

Figure 4: threshold:0.1m, 5planes formed

Decreasing the threshold to 2cm the detection planes increasing to six, although the planes cover smaller areas with less details and a big area without information (Figure 5).

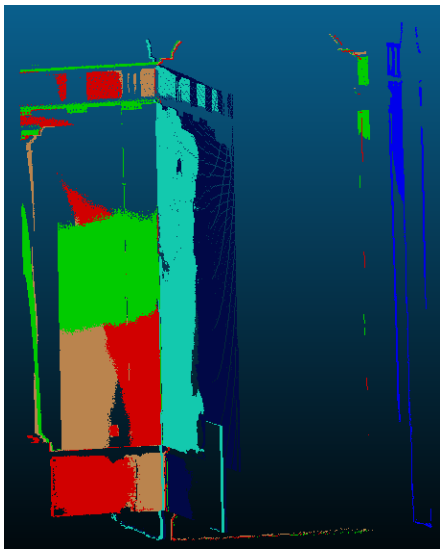

Figure 5: threshold:0.2cm, 6planes formed

Comparing the data of figure 4 and 5 we can conclude that as the threshold increased more detailed are the results and occur a better representation of the existing facades. We can conclude also, looking the remain points, in the first case are around 105000 and in the second are around 210000. In general, to specify the threshold, we should be aware of the purpose of the detected planes because the produced image using lower tolerance value extracts more accurate results, smother planes and steeper edges. Despite the fact that we lose information, with a bigger tolerance value occur a better consideration of the planes and the general shape of the point cloud.

4. SUMMARY-CONCLUSIONS

In the current report, we implement an experimental algorithm following the RANSAC principle, which proved to be a simple approach for plane detection. Modifying the initial parameters extracted different information to the planes such as windows, walls etc.

The testing of the algorithm using two different datasets, is implemented as well as an evaluation of the results.

Furthermore, better noise manipulation and a faster processing can be achieved by octree approach, which structures 3D Models into eight even parts, that can be adjusted to the desired level of detail. [Meagher, 1982]

5. References

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