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ABSTRACT

Point cloud segmentation is a key prerequisite for object classification recognition. We propose a fast region growing algorithm by using the neighborhood search, filter sampling, Euclidean clustering and region growth. Segmentation experiment on point cloud data in indoor environment demonstrated that segmentation accuracy and efficiency were improved by the proposed algorithm.

Keywords: *point cloud segmentation, Euclidean clustering, regional growth*

1. INTRODUCTION

The indoor environment is usually a complex point cloud environment composed of various planes and objects, often with a mass of noise and incomplete data [1]. With the continuous research of point cloud processing technology, more and more methods for point cloud segmentation emerged. However, most of them have low segmentation accuracy and high segmentation complexity with much time cost, such as, regional growth algorithms, random sampling consistency algorithms, etc. [2]. To address the above problems, kinds of new point cloud segmentation methods were proposed. By converting point cloud data into distance images, fast algorithm was proposed to speed up the segmentation process by distance neighborhood of range image [3]. With sacrificed speed, a high-accuracy point cloud segmentation method based on region growing algorithm is proposed to increase the segmentation accuracy [4]. But few point cloud segmentation algorithms can make good compromise between accuracy and efficiency. In this paper, we proposed a fast region growth algorithm based on the growth of traditional regions to realize accurate segmentation at reasonable speed. We used this algorithm to segment the point cloud data in indoor environment. The results show that the proposed algorithm can quickly realize the point cloud segmentation of the target object in the indoor environment, and also improve the accuracy of the segmentation. The algorithm in this paper would have great potential applications in home robots.

2. FAST REGION GROWING ALGORITHM

Our proposed a fast region growth algorithm that involves main implementation steps of voxel grid down sampling, kd-kNN near neighborhood search, Euclidean clustering and region growing algorithm. The implementation flow of the fast region growth algorithm is shown in Fig 1.
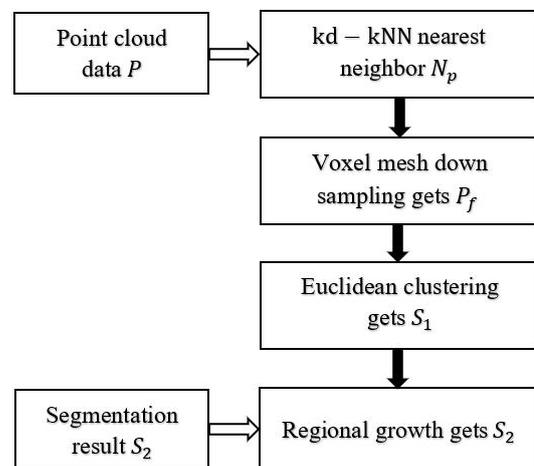

Fig 1. Algorithm process

The basic steps of the algorithm are described below:
S1: Establish a kd tree search path mode for the input point cloud data, and perform a near-neighbor field N_p of the search point through kNN.
S2: Using the voxel grid down sampling algorithm for point cloud filtering and down sampling processing, and obtaining the filtered point cloud set P_f.
S3: For the filtered point cloud set P_f, the clustering result set S_1 is obtained by performing Euclidean clustering.
S4: Performing a region growing algorithm on the obtained S_1 based on the angle and the curvature to obtain a final point cloud segmentation result S_2. The result output is completed to complete point cloud data segmentation.

3. RESULTS AND CONCLUSION

To verify the proposed segmentation are algorithm, we used the RealSense depth camera to collect indoor environment point cloud data. The range image of point

cloud data is shown in Fig. 2.a, and the original data of point cloud is shown in Fig. 2.b. The point cloud data have a total of 201408 points. First, we looked up the neighborhood of the point cloud data, and got a set of neighbors of k points. Second, the neighboring domain set was filtered and down-sampled by voxel mesh down-sampling, and got a filtered sample data set. Third, the Euclidean clustering was performed on the filtered sampling data set according to the Euclidean distance of the point, and got a cluster set. Finally, the clustering set was segmented by region growth, and got the final point cloud segmentation results. The time required for segmentation is 12 seconds, and the result of the segmentation is shown in Fig 2.c. The result graph of the segmentation shows that when we proposed the algorithm to segment point cloud data, there are no error segmentation of the object, and no over-segmentation of point clouds. At the same time, we also used the traditional regional growth algorithm to segment the collected point cloud data. The time required for segmentation is 96 seconds, and the final segmentation result is shown in Fig 2.d. The segmentation result graph shows that the traditional regional growth algorithm to segment the point cloud data, there are many mis-segments and over-segments occur, and the time complexity of segmentation is high. Compared with the traditional region growing algorithm, our proposed algorithm can reduce error segmentation of point cloud, and reduce the time complexity of segmentation.

a. Range image b. Original point cloud data

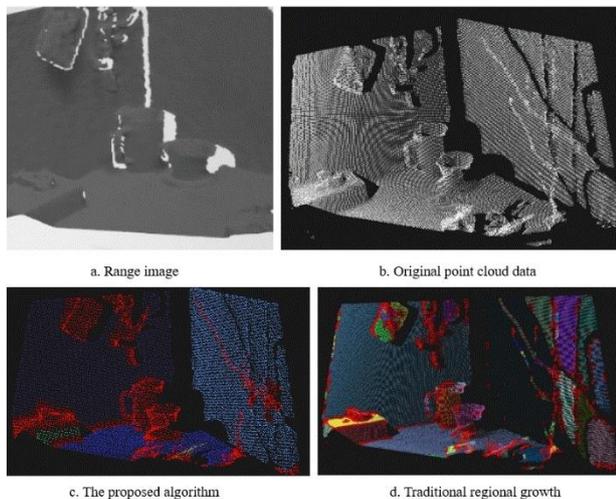c. The proposed algorithm d. Traditional regional growth

Fig 2. Experimental results

In summary, a fast point cloud segmentation method based on region growing algorithm was proposed. The algorithm was applied on the segmentation of the indoor environment point cloud. Compared with the traditional regional growth algorithm, the required processing time is reduced by 7-8 times. From the segmented point cloud image, the segmentation accuracy is obviously improved. Thus, the fast region growth algorithm proposed in this paper provides an implementation method for realizing fast segmentation and classification of point clouds in complex indoor environments.

5. REFERENCES

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