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LIDAR Point Cloud Data Extraction and Establishment of 3D Modeling of Buildings

Yujuan Zhang , Xiuhai Li, Qiang Wang, Jiang Liu, Xin Liang, Dan Li, Chundi Ni and Yan Liu

Heilongjiang Institute of Technology, Harbin, 150050, China
Email: zyjamy@126.com

Abstract. This paper takes the method of Shepard's to deal with the original LIDAR point clouds data ,and generate regular grid data DSM, filters the ground point cloud and non ground point cloud through double least square method, and obtains the rules of DSM. By using region growing method for the segmentation of DSM rules, the removal of non building point cloud, obtaining the building point cloud information. Uses the Canny operator to extract the image segmentation is needed after the edges of the building, uses Hough transform line detection to extract the edges of buildings rules of operation based on the smooth and uniform. At last, uses E3De3 software to establish the 3D model of buildings.

1. Introduction

Airborne LiDAR technology has obvious advantages compared with traditional technology and methods. The traditional collection object information needs a lot of field control points , easy to be influenced by the weather , needs spend considerable manpower and material resources, and the efficiency is not accurate enough. Airborne LiDAR technology is less restricted, still can obtain the three dimensional spatial structure information. Compared with the traditional 3D building modeling methods, Airborne LiDAR point cloud data processing technology combined with oblique photography building model of 3 d modeling method has the characteristics of high precision, strong authenticity and high degree of automation; it will be able to greatly improve the work efficiency, greatly save manpower and material resources. [1]

2. The Data Processing

2.1. Generate the DSM[2]

D.S hepard improved inverse distance weighted interpolation method, combined the adjacent point interpolation method with the multiple regression method, deeply studied and analyzed the two methods, find some worthy of learning to form a kind of new method. Provisions of A local area and select any point in the area of A, all obtained by weighted average distance from point to point A to point A. This is a sleek difference method. As there is no regularity between the discrete points and have a different impact on the property value. And we put this kind of influence is described by using a function is called a weight function according equation (1).

$$Z_A = \frac{\sum_{i=1}^{n} Z_i / d_i^2}{\sum_{i=1}^{n} 1 / d_i^2} \quad (1)$$

Z_A: Stay plugged point A's attribute values

:$d_i$the distance between point A and the discrete points in A region

This kind of difference method is most used in GIS software, because the density of discrete points is different, the distance between a point and another can be near or far.

2.2. Least Square Interpolation Filtering Processing

The method first studied and used by Kraus, Pferfer [3] and others .Its principle is according to the different height of target feature values for elevation fitting, because of the ground points and the non ground points elevation difference is bigger, after the least squares linear fitting, residual error cannot meet the requirements of normal distribution. Through the residual value, to define all the point cloud weights in the area, realize iterative computation. Get out of a surface between the actual ground area feature and test .As a result of the ground points and the ground elevation difference is bigger, the former residual error is negative ,while the latter is on the other hand, at last .Calculate the weights of all of the points according equation 2.

$$Q_n=\begin{cases}1 & v_n \le g \\ \frac{-1}{1+a(v_n-g)^b} & g < v_n \le g+w \\ 0 & g+w < v_n\end{cases} \quad (2)$$

V: Residual value;
Q: weight;
a, b, g, w: parameters.

When Q is zero, the point is non ground point, repeat this process after eliminating these points. Can also be used to eliminate the ground points for the same operation on the ground of the secondary filter, filter results can be more accurate. In practice, due to the point and uneven distribution of the target will have uneven phenomenon, this method ignores the impact of these factors. Point out as the ground point with the ground elevation difference also corresponding change, thus the corresponding parameters appropriate adjustments shall be made suitable for the ground flat area.

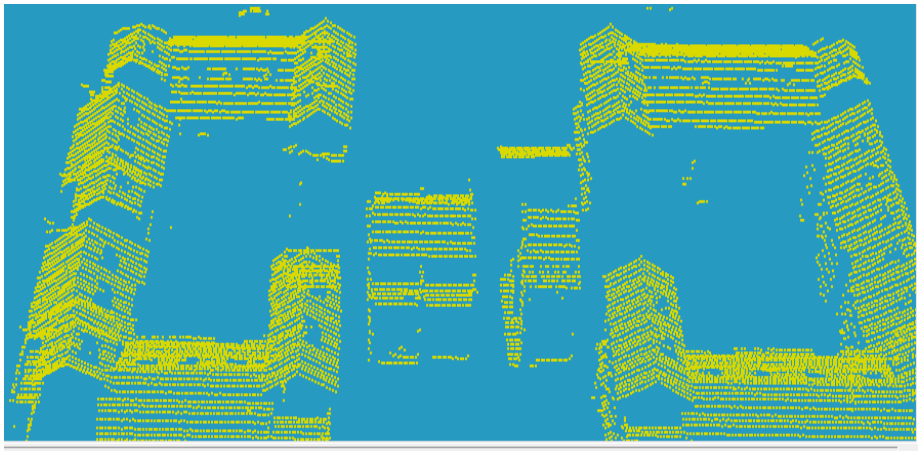

Figure 1. Building point cloud data extraction

2.3. Segment the Building Image [4]

The study uses the Regional expansion method to Segment the building image. First select a building pixel as a seed point, compare the similarity between it and the adjacent pixel to determine whether both belong to the same area, if belong to the same area ,they will be merged, the merged pixel as the new seed point to repeat appeals process. Final formation of the regional characteristics of pixels and the pixels directly the closest.

2.4. Determine the Outline of the Building [5]

The study uses Candy edge detection method and Hough transform to determine the building edge, specific practices are as follows:

(1) First, to eliminate the influence of noise of image pixels with Gaussian smoothing function, but it will cause the loss of the definition of image;

(2) Because of the uncertainty of the edge direction, edge detection need from different directions, and record the results of the convolution operation one by one to get the brightness gradient and direction;

(3) Due to the general vertical edge condition, find a local maximum in some area. Then we can determine the position of the edge, this processing method is called the maximum inhibition;

(4) Using double threshold algorithm for detection and the connection on the edge of the work.

Through the above four steps processing, buildings point cloud data can be got (refer with figure 2).

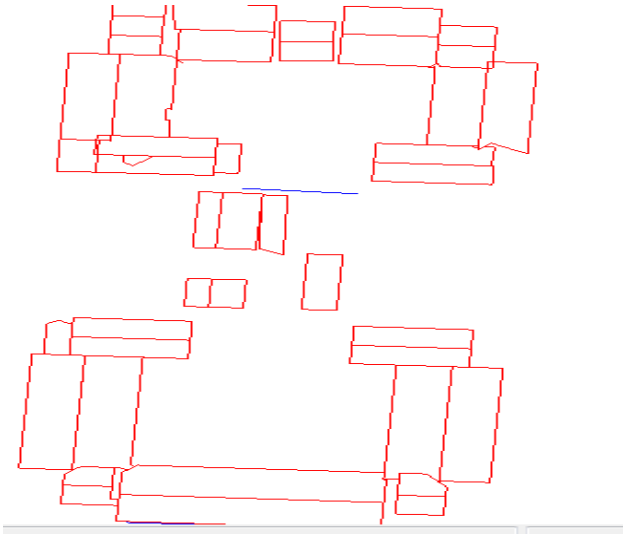

Figure 2. Results of Edge Contour Extraction

3. Establish Buildings 3D Models

E3De3.0 is the product of Exelis VIS Company. E3De3.0 can be used to build three-dimensional building model, this paper is to rely on it to achieve the three-dimensional reconstruction of buildings.

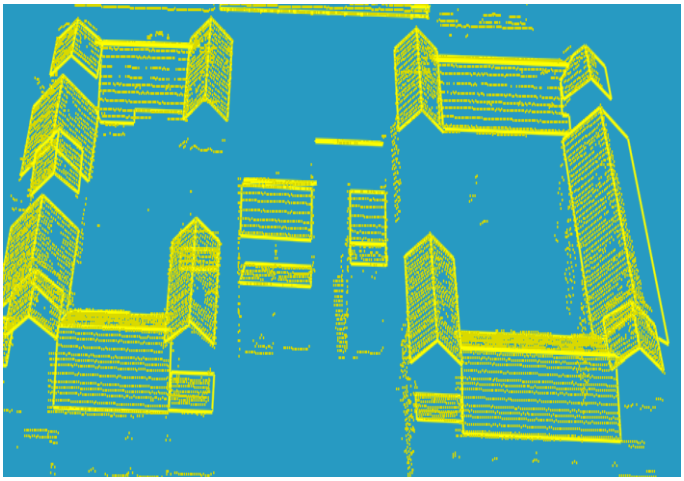

Figure 3. The top of the building after stacking

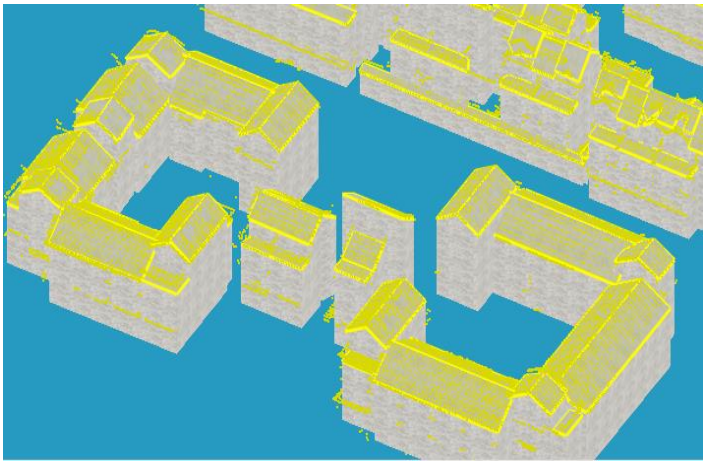

Figure 4. Building 3D model

From Figure 3 and Figure 4, we can see that most of the houses are simple herringbone houses, which makes our reconstruction easier.

4. Conclusion

In this paper, the three-dimensional model of herringbone building is reconstructed. Because of the complex changes of man-made houses, the research work in this area should be strengthened. How to evaluate the modeling effect and accuracy of the built model should be paid attention to. Whether the built model is consistent with the actual situation is the key to evaluate the modelling quality. But at present, there is no authoritative evaluation system for the reconstruction accuracy of buildings, and the evaluation of the details of buildings should also have corresponding standards.

5. Acknowledgments

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