

AUTOMATIC EXTRACTION OF CROSSROADS POSITION FROM MMS DATA

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Review system is necessary for large-size truck to pass through urban area, while the process usually takes a significantly long time, which causes heavy damage to the social productivity. One effective solution of this situation is to develop an automatic system that can extract the characteristics of the crossroads. Mobile Mapping System (MMS) is widely used to obtain the detailed road data, but the origin data is difficult to be used directly due to large number of unnecessary points. The purpose of this study aims to develop an automatic process to determine the position of crossroads from a road MMS data.

Key Words: land transportation, terrestrial LiDAR, MMS data, RANSAC, road extraction

1. INTRODUCTION

Due to the increasing need of land transportation, more and more large-size trucks are put into use in Japan. Nevertheless, a review system is necessary to guarantee such vehicles can move smoothly in the urban area. Therefore, an automatic process that can determine the position and characteristics of each crossroads in the urban area will be efficient to review the pass ability.

This paper mainly introduces the method of extracting the position information of crossroads from the MMS data of a long road curve.

2. STUDY AREA

Study area is a 1.3 km road MMS data scanned in Naruto City, Tokushima Prefecture. The original data was obtained by Ministry of Land, Infrastructure, Transport and Tourism, Japan. The original data consists of two parts, because MMS data is scanned two directions of the road. Data of two directions will be processed separately in the study.

3. METHODOLOGY

Process of the extraction is illustrated in **Fig.1**. The general idea is to eliminated all the non-road part point clusters and leave a clear road curve so that if there is a crossroads area, it will have a larger width compared with the road area as shown in **Fig.2**.

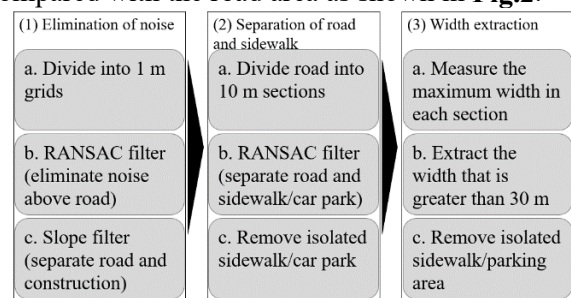


Fig.1 Flow chart of extraction process

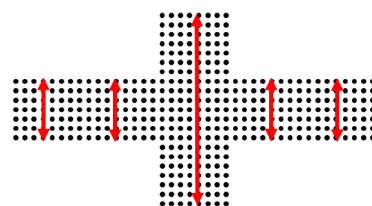


Fig.2 Use width difference to extract crossroads area

(1) Noise elimination

Firstly, the flatness and continuity of road plane is utilized to eliminate the noise, which mainly consists of on-road vehicles and constructions alongside the road. The whole data is divided into grids of 1 m side length. In each grid, a RANSAC¹⁾ plane approximation is applied with inlier threshold of 0.05 m so that the noise above the road grid will be eliminated as shown in Fig.3. Then, manually determine a road seed point and apply a slope filter²⁾ with a threshold of 0.05 m to compare the average height in surrounding grid so that the road plane can be generally extracted and the constructions and isolated areas will be eliminated as shown in Fig.3.

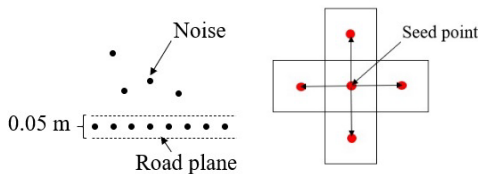


Fig.3 RANSAC filter (left) and slope filter (right)

(2) Separation of road and sidewalk

After the previous step, almost all the noise points which are far from and isolated with road plane will be eliminated. However, if there is a planar area such as parking space or sidewalk, alongside the road, sometimes it will be misrecognized as a road area. To reduce the effect of such area, the drainage gutter will be utilized to separate two areas. As previous mentioned, two directions of scanned data are utilized and for each direction the point density will be greater in the scanning direction side. Therefore, we can consider that both directions only have one side data of the road. Moreover, the original road is not always in the same plane, but if we divided the road curve into small sections along the curve, each section can be considered as the same height. If the road is divided into small sections along the road curve, each section can be considered as a

As shown in Fig.4, two kinds of situations are possible in a section. If the road is wide enough, road area will have significantly more points than the side area. Since RANSAC algorithm always try to find the model that fits the points as much as possible, the road plane will be extracted directly. On the other side, if the road is not wide enough, RANSAC will extract the sidewalk and road area but ignore the drainage gutter. In this situation, the road plane is separated with sidewalk area by an empty space. The RANSAC filter threshold is set as 0.04 m in the step.

Then if the isolated sidewalk area is removed the road curve is extracted completely.

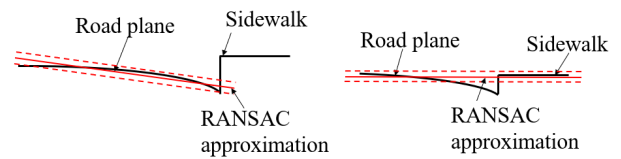


Fig.5 Cross-section of wide road (left) / narrow road (right)

(3) Width extraction

Finally, if the maximum width is measured in each section and set a threshold, the position of crossroads can be determined. The threshold is set to 30 m and there are 5 sections' width over the threshold. The result is shown in Fig.5. Position (1), (2), (3), (5) are crossroads area in reality. Position (5) is misrecognized because this area has two parking area on both side of the road and the height difference is too small.

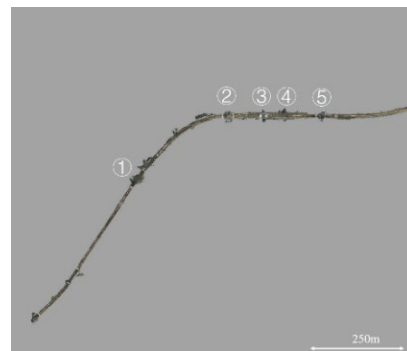


Fig.6 Result of crossroads position

4. DISCUSSION AND CONCLUSION

In this study, an automatic process is developed to determine the position of crossroads from the MMS data of a long road curve. The result was quite promising, in the 1.3 km long road, there are 4 crossroads in total and all of them was extracted successfully except of one parking area which was extracted incorrectly.

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