F1-20

Study on Noise Removal Method of Range Data for Vehicle Detection Using a Range Image Sensor

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Abstract: Traffic volume is counted by automatic measurement equipments on the road traffic censuses. However, existing automatic measurement equipments cannot measure for multiple lanes and dark colored vehicles. This study focuses on a range image sensor in order to solve above issues. But it is a critical problem on range image sensor how a noise due to sunlight can be removed. In this study, the reflection intensity data was used for noise removal and extraction of vehicles. By setting the threshold on reflection intensity data according to shutter speed, it was able to remove almost noise and extract vehicle from range image data.

１． Introduction

Traffic volume is counted by automatic measurement equipments on the road traffic censuses. Automatic measurement equipments used for the investigations has been developed in various devices [1]. However, existing automatic measurement equipments cannot measure for multiple lanes and dark colored vehicles.

This study focused on a range image sensor to solve the both issues. Sato [2] conducted vehicle detection for black colored vehicles using reflection intensity data. Ichimi [3] conducted vehicle detection for multiple lanes using range data. However, the method of this study, it could only under the limited that condition without sunlight.

In this study, the purpose is to develop method to remove noise, and extract vehicle.

２． Methods

２－１． Setting a range image sensor

A range image sensor of ZC-1050U-HP (Figure 1.) employs the principle TOF (Time of Flight) method as shown in Figure 2. Reflection intensity data and range data are outputted, Range data are distance between the sensor and a object. Reflection intensity data means light strength reflection from object. These data were measured on each pixel of horizontal 160 × vertical 120 image.

The measurement conditions of a range image sensor is shown in table 1. In this study, shutter speed is set 8 sec and 20 sec because noise data as sunlight is change by setting of shutter speed.

２－２． Multiplication processing method

In order to remove noise on range data, reflection intensity data was used. The method had three steps. First, threshold (R) for each pixel of reflection intensity data was set.

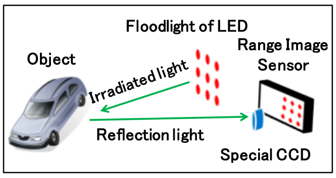

Figure 1. Range image sensor　　Figure 2. Principle of TOF

Table1. Measurement conditions of a range image sensor

	data acquisition condition
Shoot mode	Normal
Shutter speed	8sec・20sec
frame per second	30fps

Second, if less than the threshold (R), reflection intensity data was set to 0, and it more than threshold (R), reflection intensity data was set to 1. Third, if multiplying reflection intensity data and range data, noise on range data is removed. The multiplication processing method is shown in Figure 3.

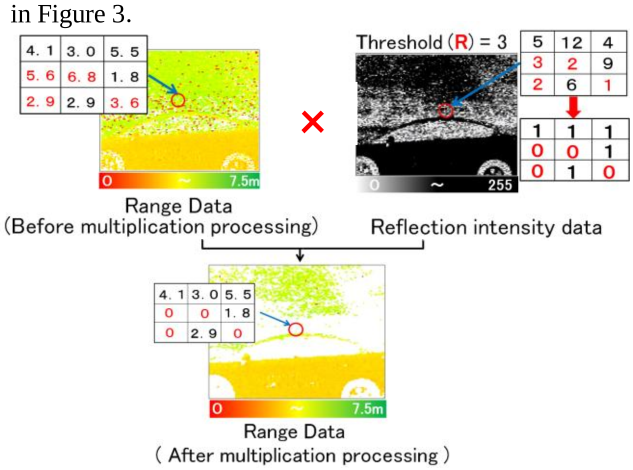

Figure 3. Multiplication processing method

２－３． Outline of experiment

In order to verify for the effect of multiplication processing method, a range image sensor was setup to gather reflection intensity data and range data. The outline of experiment is shown in figure 4. The lane from 3 – 6m distance is named “Lane A” , and the lane from 6 – 9m distance is named

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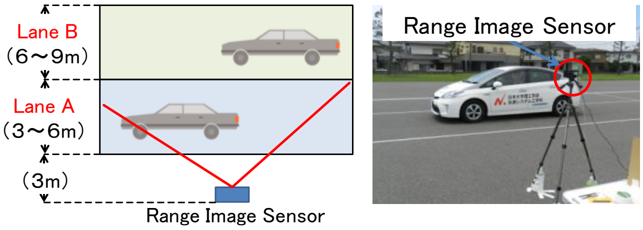

Figre4. Status of the experiment

“Lane B”. Colored of vehicle was white, and a range image sensor was set at a height of 1.25m.　The illumination was measured with 80,000 lx.

３．Results

Describe results of after multiplication processing of range data using reflection intensity data. The result of Lane A and shutter speed 8 sec is shown in Figure 5,　and result of Lane B and shutter speed 8 sec is shown in Figure 6.　R means a threshold of reflection intensity data.　if R more than 2,　noise data could removed.　But if R more than 3,　some data of vehicle was deleted.　Therefore,　If the shutter speed is set to 8 sec, the optimal threshold (R) value is 2.

The result of Lane A and shutter speed 20sec is shown in Figure 7, and the result of Lane B and shutter speed 20sec is shown in Figure 8. From R 1 to R 4, noise data could not be removed completely. When the R was set to 5, almost noise data was removed,　and vehicle data was only extracted. Therefore, if the shutter speed is set to 20 sec　, the optimal threshold(R) value is 5.

４．Conclusion

１）In order to remove a noise data according to a setup of shutter speed, the optimal threshold of reflection intensity data was determined.

２）This method is removed noise data on range data,　and extract vehicle using reflection intensity data.

５．References

[1] T.Azuma, T.Takada, S.Itsubo, J.Uchida, “Development of a next generation information gathering system for road traffic censuses” , Journal of Japan Society Civil Engineering Ser.F3,　Vol.15,　pp.103-110 ,　2006.10

[2] Y.　Sato,　T.Sada,　K.Ichimi,　“Study on the Detection of Moving Vehicle by Range Image Sensor using Reflection Intensity”,　Journal of Japan Society Civil Engineering,　2012.3

[3] K.Ichimi,　T.Sada,　T.Ishizaka,　H.Chiba,　“A New Method for Traffic Flow Measurement using Range Image Sensor”,　Journal of Japan Society Civil Engineering ,　2012.6

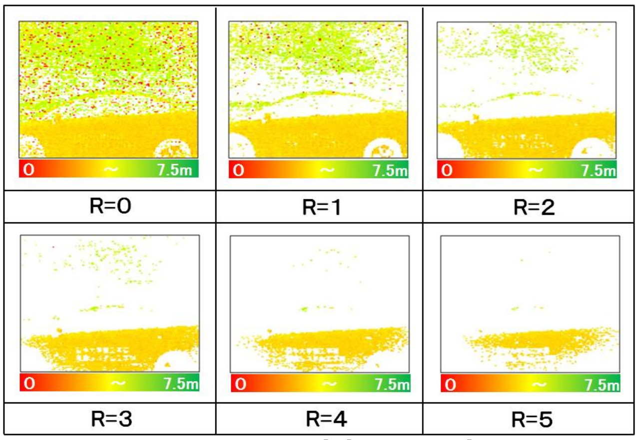

Figure 5.　Lane A and shutter speed 8msec

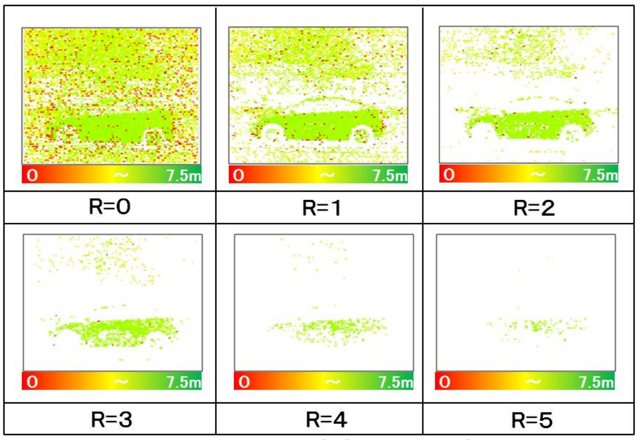

Figure 6.　Lane B and shutter speed 8msec

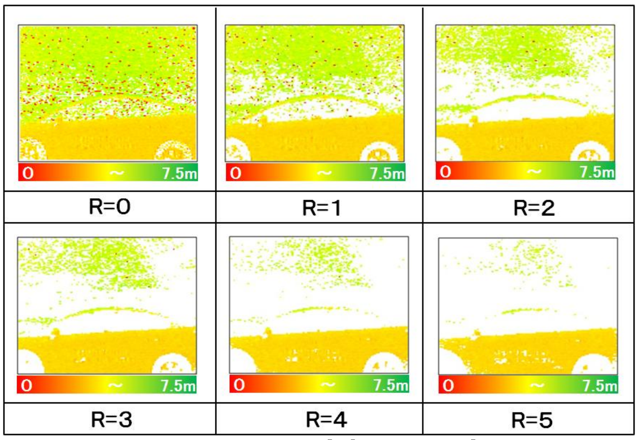

Figure 7.　Lane A and shutter speed 20msec

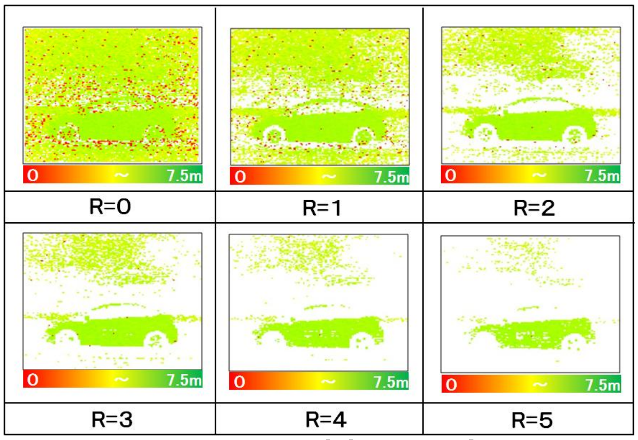

Figure 8.　Lane B and shutter speed 20msec