An accurate method for the extraction of structured light stripe

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Abstract

In order to obtain the highest measurement accuracy in the On-line measurement of rail profile with a line structured light based on machine vision, the extraction of structured light stripe is a necessary step. An accurate extraction method is proposed for the structural light stripe extraction in practical applications. The noise in the captured image can be removed with region segmentation method. The structured light stripe is separated and extracted accurately based on the characteristics of the structure light stripe in the binary image. The method was verified in laboratory conditions. Experiment results show that the method can effectively solve the problem of real-time and accurate extraction of structured light stripe.

Keywords: Structured light; region segmentation; light stripe

1. Introduction

The On-line measurement of rail profile with a line structured light based on machine vision need collect and manipulate the captured image to obtain the structured light stripe. The structured light stripe stands for the measured rail profile. By comparing the extracted contour lines with the standard rail profile, the on-line measurement of the rail profile can be accomplished. In order to ensure the accuracy of measurement, the accurate extraction of structured light stripe becomes very important. The traditional method[1] includes the threshold method and the extreme value method. Those are simple, but low precision. In light of the above problems, an accurate method for the extraction of structured light stripe is proposed. The noise in the captured image can be removed with region segmentation method. According to the characteristics of the structure light stripe, the target is extracted from the specified region, so as to achieve the accurate extraction of structural light stripe.

2. Measurement principle

Two image acquisition devices A and B are arranged on the upper and lower sides of the rail, as shown in Fig.1.The image acquisition device is composed of a line structured light emitter and an industrial camera Because of the projection relationship, the stripe of the light can represent the rail profile. So the outline dimension of the rail can be calculated by the collection and analysis of the line structured light stripe.

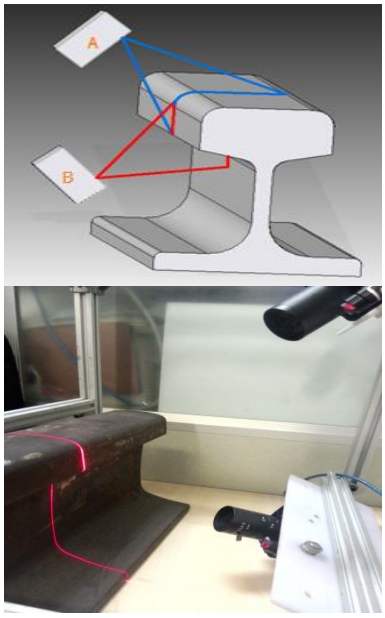

Fig.1.Measurement method

3.1 Regional intelligent segmentation

First of all, the line structure light contour line is collected, shown in Fig.2. And then binarization is shown in Fig.2. The calibration of the connected region of the image is carried out, and the result is to separate the discontinuous regions[2]. Since the characteristics of the spot is obvious, it can be easily removed. Only the line structured light contour lines and a small part of the noise was left, as shown in Fig.3.

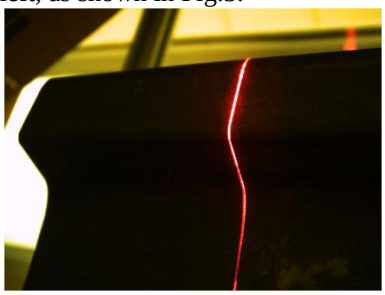

Fig.2. Structured light profile

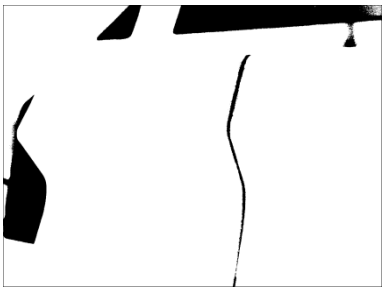

Fig.3.Binary image

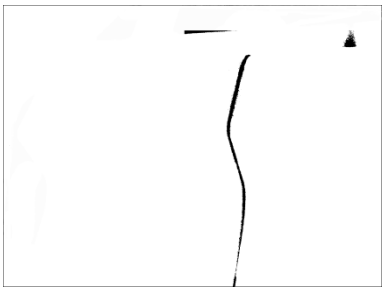

Fig.4. remove the noise

3.2 Identifying Geometric Feature

Illumination conditions and mirror reflection and other factors affecting the contour extraction of line structured light. In order to eliminate these effects, the structural light area is studied as a whole object. It can be used to directly extract the light area of the line structure by pattern recognition technology. In this area, the outer boundary and inner boundary of the line structure light contour are calculated. By analyzing the characteristics of the shape, the size of the structure and the luminance gradient of the binary image, we can determine the position of the structure light stripe. Through continuous scanning of the structured light stripe of along the X direction and the Y direction coordinate values in ascending order， structured light stripe of the outer boundary and inner boundary can be accurately extracted. Because of the method is completely combined with the imaging characteristics of the structured light on the rail tracks surface which can reduce the extraction of target range and reduce the influence of interferents, thus improving the reliability of line structured light contour extraction, stability and accuracy.

3. Analysis

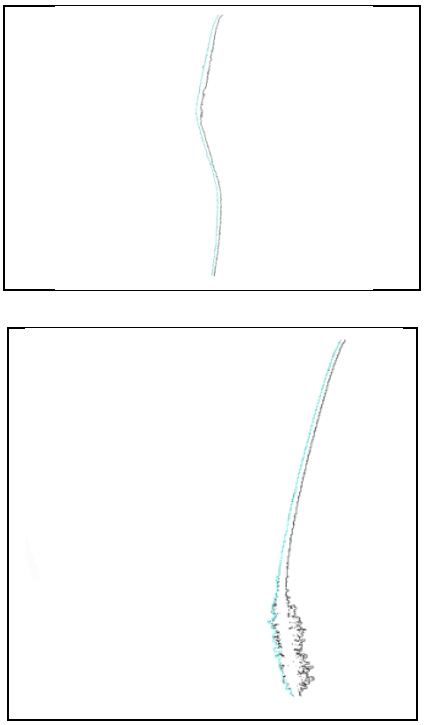

Fig.5. Fringe extraction results

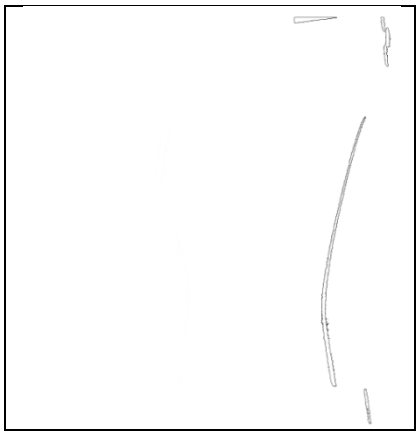

Fig.6. Edge detection operator

Line structured light stripe extraction results are shown in Fig.5. The accurate extraction of line structured light can be achieved by using region segmentation and geometrical feature recognition technology. The outer edges and inner edges of two structured light stripes are extracted respectively as shown in the Fig.5. It can be seen that the extraction of the stripe is continuous and stable. By comparing with common edge detection operator such as Roberts operator, Canny operator, Sobel operator, the common edge detection operator has no pertinence in the binary image and can't effectively remove the noise in the image. And the result is a closed circle which can't distinguish the inner and outer edges, as shown in Fig.6. The method used in this paper can effectively eliminate the noise according to the geometrical features of the stripe and can extract the edge and the outer edge respectively. The inner boundary or outer boundary is used as the extraction result. The extraction result is used to measure the rail profile[3].

4. Conclusions

By using the method of region segmentation and geometric feature extraction, the line structured light stripe can be extracted. Compared with the traditional edge detection operator, it can effectively eliminate the interference of the noise, and can extract the edge and the outer edge of the structured light stripe. It effectively solves the problem of real-time extraction of structured light stripe, which is convenient for the following contour matching.

References

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