Survey of Corner Detection Techniques in Image Processing

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Abstract— Corner detection is important in many applications, such as image registration, mobile robots, and computer vision. This paper discusses several important corner detectors. More recent developments in corner detection techniques are also presented.

Index Terms—Corner detector, Harris corner detector, SUSAN corner detector, and Contour-based corner detector.

I. INTRODUCTION

Corner detection is a popular research area in image processing and therefore many corner detectors have been presented. Some of them are widely used in industries. In this paper, we will first group different corner detectors and then discuss some important corner detectors, such as Harris detector and SUSAN detector. Finally, recent developments in corner detection are also provided. This paper does not try to provide comprehensive survey of all corner detectors. Instead, this paper only discusses important corner detectors and presents some recent research trends to help newcomers be familiar with the corner detection area.

II. TYPES OF CORNER DETECTORS

According to [1][2], common corner detection methods can be divided into three groups: 1) Template based corner detection; 2) Contour based corner detection; 3) Direct corner detection.

As presented in [1], template based corner detection methods use different representative templates to match the image. Correlations between templates and the image are used to detect corners. However, this category of methods has several drawbacks. For example, the representative templates cannot cover all possible corner situations. Therefore, the detection performance highly depends on the choice of appropriate templates. Furthermore, after the correlations between the templates and the image are determined. An appropriate threshold should be carefully chosen to determine the existence of corners. Contour based corner detection methods are based on edge detection. In this category of methods, edges in the image are detected first. Then, the corner is detected along the contour. Direct corner detection methods use mathematical computations to detect the corner. This category of methods usually applies some statistical operations to the image first. Then, corners are detected based on statistical information.

III. FAMOUS CORNER DETECTORS

Some famous corner detection methods include SUSAN detector, Harris detector, wavelet based detector and blob detector. Harris detector was original presented in [3]. Harris detector is based on local auto-correlation function. It is also a combined edge and corner detector. The core idea of Harris detector is calculate the eigenvalues and eigenvectors of a small region [3][4]. Then, use the largest two eigenvalues to calculate some functions. Finally, use the function value and a threshold to detect the corner.

SUSAN corner detector was originally presented in [5]. SUSAN corner detector does not require derivative. That is why it can work well when the noise is present [5]. The main idea of SUSAN is the usage of a mask to count the number of pixels having the same brightness as the center pixel [2]. By comparing the number of pixel having the same brightness as the center pixel with a threshold, the detector can determine whether the center pixel is a corner. Interested readers can find the information about wavelet based detector in [2] and blob detector in [4].

Since SUSAN detector and Harris detector are the two most famous corner detector, the authors in [6] compared the performance of those two detectors in terms of complexity, stability, execution time, and so on. The simulation results showed that Harris detector is better than SUSAN detector. As explained in [6], SUSAN uses a fixed global threshold instead of an adaptive threshold. Moreover, the anti-noise capability of SUSAN detector is worse than Harris detector.

IV. RECENT DEVELOPMENT OF CORNER DETECTOR

Recently, using the multi-scale topological features, an improved Harris method was presented in [7]. The authors used topological features to reduce the range of Harris corner detector. Details can be found in [7]. Moreover, most Harris corner point detectors use only the grayscale information of an image. However, the color information of an image is wasted. To employ the color information, a new Harris corner point detector method was proposed in [8]. In this method, Harris corner detector is applied both to the grayscale image using gray level intensity information and to the color image using the RGB information. After corner points are detected in both the grayscale image and the color image, cross correlation and Random sample consensus are used to find matching corner points. Details can be found in [8]. Furthermore, the widespread use of mobile robot demands better image processing techniques. Better corner detection techniques are especially important.

To accommodate the special situations in mobile robots, the authors in [9] used both the intensity-based corner detector and the contour-based detector to detect corners. Simulation results showed that this hybrid corner detection method can improve corner detection performance. Moreover, in [10], authors compared many contour-based corner detectors in terms of corner detection performance. Interested readers can find more details in [10].

Wireless sensor networks have been a popular research area [11]-[22]. In the future, image corn detection techniques can be combined with wireless sensor networks to provide remote corn detection for many interesting applications, such as corn detection in remote health care.

V. CONCLUSION

This paper introduced some important corner detectors. Moreover, some recent developments in the corner detection area were also presented. This paper provides new researchers in this area some useful information.

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