Corner Detection using Slit Rotational Edge-feture Detector

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Edges in images include useful information and consequently they play an important role in computer vision (e.g., segmentation, feature-extraction). Particularly, corner points where some edges intersect include useful information, and therefore detecting the corner in images is a important role. However, stable and accurate corner detection is difficult, because edges break easily around a corner.

For this reason, many corner detection methods have been proposed. The existing methods can be divided into two approaches: one is region-based approach; and the other is edge-based approach. In the region-based approach, an image is segmented into regions by using edge detection method and segmentation method, and corners are detected by extracting the pixels that have local maximum curvatures in region boundaries. However, because of the rounding effect of boundary, it is difficult for the region-based approach to detect corners at the exact position (pixel). To avoid this problem, most of the recent attempts in corner detection use the edge-based approach, which works directly on the image. In the edge-based approach, edges in the image are extracted, and corners are detected by analyzing edge-connectivity on the basis of corner model. Nevertheless, it is difficult for this approach to detect corners stably, because a corner is composed of intersection of edges and extracted edges break easily around a corner. For these difficulties, a corner detection method using slit rotational edge-feature detector (SRED) has been proposed. By evaluating the certainties of edges for all directions at each pixel, this method can detect corners stably. However, in this method, the accuracy of corner detection varies with the directions of edges, and the corners in the region of low contrast cannot be detected. In this paper, I propose a new stable and accurate corner detection method by adjusting these two problems.

To solve the first type problem, we propose a new corner detection method using weighted

and interpolated SRED (WI-SRED). To acquire the accurate edge-feature for all directions at each pixel, WI-SRED is modified from the original SRED in two points: the first one is to interpolate the pixels in a slit, and the other is to weight the pixels in a slit. To compute the accurate edge-feature and prevent its accuracy from depending on the edge direction, it is necessary for every direction of a slit to complete the apparent number of pixels contained in the slit. For this purpose, in the proposed method, the pixels in the slit are interpolated with the neighboring pixels by the bilinear interpolation method. For acquiring accurate (i.e., high-resolution) directions of edges, it is profitable to use a long slit. Therefore, to extend the apparent length of the slit, the pixels in a slit are weighted by the weight function whose weight is made proportional to the distance from the center of slit rotation.

The next step is to determine the edge directions at each pixel, the direction-feature is computed from edge-feature by using . direction-feature detector (DFD). In original corner detection method using SRED, when edge directions are determined, the value of threshold for direction-feature is set to a large value to avoid the noise on images. However the accurate posion of edges cannot be decided, because the direction-features is few in the region of low contrast. As the result, the corners cannot be detected. In fact, there is own properties for the value of parameter in DFD: When the value of paramater of DFD is large, its detection accuracy is robust for noise on images, however its direction is lack of accuracy. Adversely, when the value of paramater of DFD is small, its direction accuracy is improved, however its detection accuracy depend on the noise on images. To avoid the second major problems from these properties, DFD is applied to edge-feature by changing the mask size of DFD.

Firstly, the parameter of DFD is set to a large value, then the edge directions are extracted. Secondly, the paramater of DFD is set the value of smaller than the value of the first step, then the edge directions are extracted. Then, the edge directions are extracted by combining these two values. The edge directions are improved by continuing this process.

However, these directions are determined on the basis of the derivatives of intensities, therefore, they include many false edge directions caused by the noise in images. In the proposed method, to reduce the false edge directions, the edge certainties based on region separabilities are used. This region separabilities are computed by using the pixels around such extracted edge. By detecting the directions whose the separability is greater than a threshold value, edge directions for each pixel can be determined.

After the deciding of the edge directions, when the following two conditions are satisfied, the respective pixels are regarded as detected corners. (these conditions are (1) let an angle between the adjacent edges, at least one angle is not equal to π, (2) for each edge at the pixels, the edge certainty is computed, the mean of the separability at the such pixel is greater than a threshold value.) Finally, we carried out several corner detection experiments for synthetic images and real images. In these experiments, original corner detection method using SRED

and corner detection method using SUSAN operator are used to compare with the proposed method. It was appear to be the proposed method using WI-SRED achieves stable corner detection compared to the corner detection results from the other methods. Futhermore, stable corner detections for the region of low contrast can be achieved.