An Extraction Approach to Building Straight Lines Based on Hough Transform

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Abstract. Detecting lines in a digital image is a crucial step in many applications, such as visual navigation, feature recognition. In this paper, an algorithm which is based on part Hough transform is proposed for extracting straight lines from building images. Firstly, edges are detected based on Canny detector. Secondly, an algorithm that follows image boundary categorizes edges. Thirdly, Hough transformation extracts straight lines to each classification of image. Experiment results shows that the proposed algorithm is better than Hough transform. It can detect lines correctly in building images with high accuracy, low false detection and low missing detection.

1 Introduction

For a long time, Hough transform is the main method of straight lines detection because of pattern noise and robustness of straight lines discontinuities. The basic idea of Hough lies in the duality between straight lines and points. That is to say, collinear points in image space correspond to intersecting lines in parameter space or all straight lines that intersect at the same point in the parameter space have corresponding collinear points in the image space. It is based on these relationships that Hough transform transforms detection problems from image space to parameter space where the detection is finished by simple cumulative statistics [1].

However, the straight lines in building images are various in number and densely distributed. So, if conventional Hough transform [2] extraction is applied to detect straight lines in a global scope, the following two problems will occur. First, only long straight lines can be detected but many short straight lines will be

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omitted. Second, false straight line detection may occur because a plenty of dense points that are on different lines may be incorrectly identified as the points on the same line. In terms of the partial defect of Hough transform, this paper comes up with this algorithm. When detecting a straight line, in the first place, edges can be detected by Canny operator; then, an effective boundary following can be used to classify the edges; lastly, Hough transformation extracts straight lines from each classification. This algorithm is effective in improving the accuracy of straight lines detection in building images and reducing the phenomenon of missing detection and false straight line detection.

2 Algorithm Description

The algorithm mainly consists of four steps. First, use the operator that is of high noise immunity to extract and refine edges. Second, extract continuous edges by means of boundary following and classify those edges. Each type of edges is actually a connected set of points. Third, use Hough transform to detect straight line for each connected set of points. At last, use peak detection to detect all possible peaks and take them as candidates of straight lines.

2.1 Edge Extract and Refinement

A good algorithm of edge extraction is supposed to include the following three qualifications [3]. First, real edge points should be detected. Second, the location of edge points should be precise. Third, it should be of high noise immunity. Among a variety of edge detection operators in the research, Canny operators and SUSAN operators are the most effective. But since the efficiency of Canny operators are slightly higher than that of SUSAN operators, they are adopted to detect edges in the experiment. Canny operators keep down noise with convolution and have the edge points well located, remedying the missed details of other operators in edge extraction and refinement.

2.2 Edge Classification Based on Boundary Following Algorithm

2.2.1 Edge Classification

This paper employs an effective boundary following method on the basis of the features of building image—forming one after another connected set of points after classifying continuous edges by Canny algorithm detection. This method is much more efficient and takes less time to perform.

The most common boundary following algorithm is Eight Neighborhood. Its basic principle is as follows: every next edge point must be in the eight neighborhood field of the present point. In the first place, start with the edge point in the upper left corner of the bitmap. Then, search its eight neighborhood counterclockwise from top to bottom and left to right to find the next edge point. Lastly, repeat the process until you return to the starting point [4].