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Novel Fast Corner Detection Descriptor in Image Processing

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Abstract

Corner detection as an approach, is used within 2D image processing fields. Its aim is to locate certain types of point-features and represent the local information of an image. Corner detection is frequently employed in many hot research topics such as object motion tracking, multi-source image registration, 3D reconstruction, video frame analysis, visual slam, and object recognition. Also corner detection is the most hot topic in computer vision. In this paper, we present a novel fast corner detection method with description. Experimental validation result is performed in several images.

Keywords

Corner detection, Image processing.

1. Introduction

Although the concepts of feature point, corner point and key point are different in details, they are collectively called "feature" points here. It means that points with feature properties. In image processing, the so-called "feature point" mainly refers to being able to represent a target in an image. Then, to express it in a more straightforward way is to collect multiple pictures from different angles for the same object or scene. If the same part in the image can be identified, the feature is confirmed. These "scale invariant points or blocks" are called feature points. Feature extraction is the basic of image analysis and image recognition. It is the most effective way to simplify the expression of high-dimensional image data. From the m × n × 3 data matrix of an image, any information cannot be displayed conveniently. Therefore it is necessary to extract the key information to reduce data processing. Some basic elements and their relationships are from these data. Feature points are those points which are analyzed by algorithm and contain rich local information, which often appear in the corners, sharp changes in texture and other places in the image. The so-called "scale invariance" of feature points refers to the unified nature that they can be recognized in different pictures.

The points marked by the circle in the Figure 1 are good tracking points, while the points marked with the box - that is, the points with sharp boundary - are poor feature points. If a unique point of the same object in different pictures is located, then the object in different pictures is easily to be located. Finally, it should be noted that "feature point" is not only a point, but also a series of local information. In fact, in many cases it is a small area within an image.

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Figure 1. Feature points in an image

For the computer, an image is only the storage of data; only after the analysis of image characteristics, can we further identify the objects in the image. Therefore, feature points are widely used in recognition, location, stitching, tracking and other image processing subdivision categories, which are basic and widely used image processing knowledge.

Take splicing as an example: In the classic image mosaic, because the computer can't recognize the object in the picture at present, a unified calculation method is needed to tell the computer the feature points of the same object in different pictures. It means that the position and shape of the object are obtained; after the pure model (often RANSAC) is used to obtain the points model , two pictures can be matched. A more accurate position and posture relationship between them, is called image alignment.

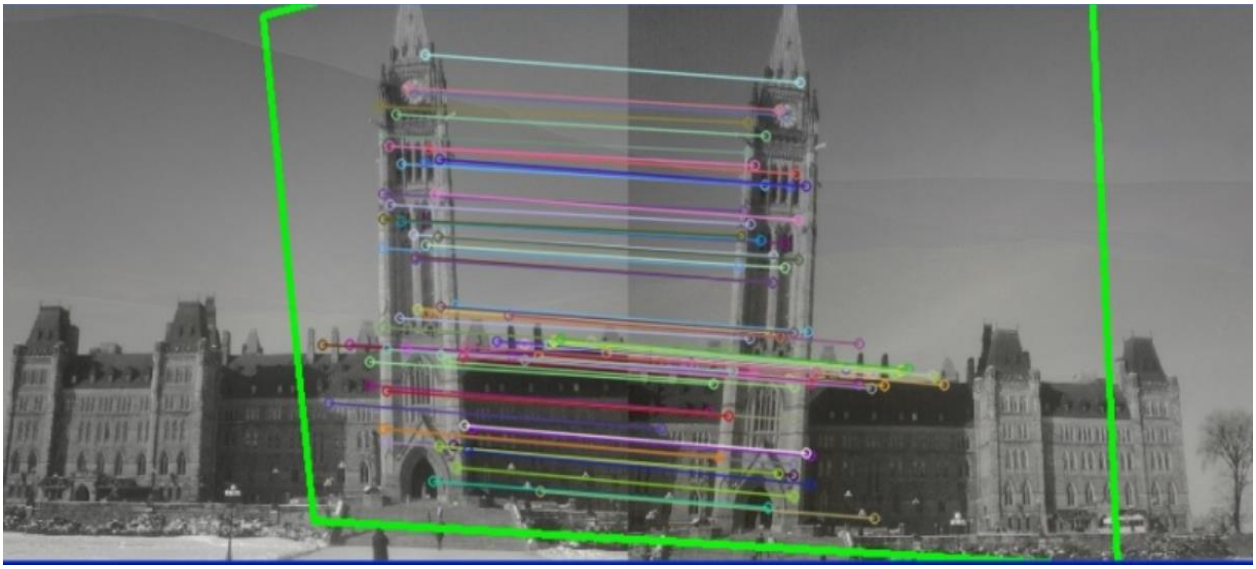

Figure 2. Feature points matching in two images

2. Methodology

With the rapid development of local feature point detection, researchers have more and more in-depth understanding of the features. In recent years, many scholars have put forward many feature detection algorithms and improved algorithms. Among many feature extraction algorithms, there are many outstanding ones. From the earliest Moravec, to Harris, to sift surf, we can say that feature extraction algorithms emerge to some extent. Various improved algorithms, such as pCa-SIFT, ica-sift, p-asurf, r-asurf, radon-sift, are also in full swing. The above algorithms, such as sift and surf, also extract

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excellent features (with strong invariance), but the time consumption is still very large. In a system, feature extraction is only a part, and following algorithms such as registration, denoising and fusion are also needed. It needs the good real-time performance and better system performance.

Within a certain image, the Fast Feature is defined as: the difference between the target pixel and surrounding pixels is larger than a threshold. Then the pixel point is regarded as a corner in the image.

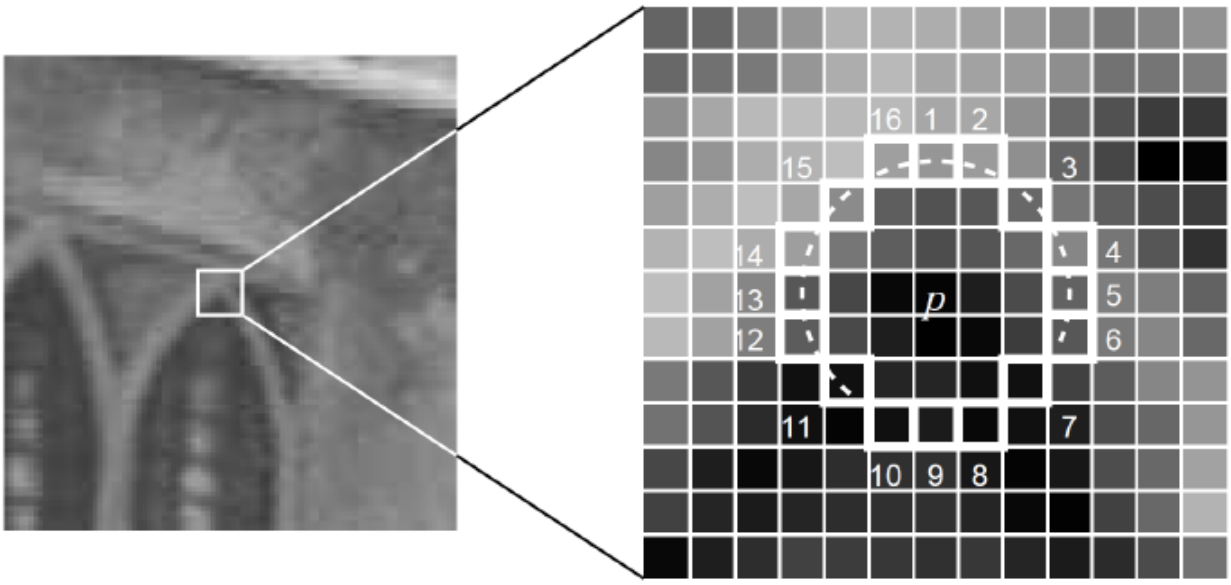

Figure 3. Fast feature detection illustration

As shown in Figure 3, there are 16 pixel points (P1, P2,..., p16) on a circle with the pixel P as the center and the radius of 3;

Defining a threshold k. Calculate the pixel difference between P1, P9, P5, P13 and center P. if at least three of their absolute values exceed the threshold value, they will be considered as candidate corner points for further investigation; otherwise, they cannot be corner points;

If P is a candidate point, the pixel difference between the 16 points P1 to p16 and the center P is calculated. If they have at least 9 consecutive points exceeding the threshold value, they are corner points; otherwise, they cannot be corner points;

Non maximum suppression of image: the fast score value (i.e. score value, i.e. s value) of feature points is calculated for judgement, in a neighborhood (e.g. 3x3 or 5x5) with feature point P as the center. If there are multiple feature points, then the s value of each feature point (the sum of the absolute value of 16 points and the center difference value) is judged. If P is the largest response value of all feature points in the neighborhood, then keep it; if not, then abort the judgement. If there is only one feature point (corner point) in the neighborhood, it is reserved. The calculation formula of score is as follows (in the formula, V represents score and T represents threshold):

$$V = \max\begin{cases}\sum (\text{pixel values} - \text{p}) \text{ if } (\text{value} - \text{p}) > \text{t} \\ (\text{p} - \text{pixel values}) \text{ if } (\text{p} - \text{value}) > \text{t}\end{cases} \tag{1}$$

By iterating each pixel of the image, all the corner pixels are extracted and marked.

The above is the process of fast feature detection, and the definition of corner is also confirmed. Fast corner feature detection algorithm is easy to implement, especially known for its fast speed.

3. Experiments

The fast corner detection algorithm designed in this paper is performed on the dataset: 256_ ObjectCategories. The dataset is downloaded from online: http://www.vision.caltech.edu/ Image_ Datasets/Caltech256/. Figure 4 shows the detection result.

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Figure 4. Fast corner feature detection results.

4. Conclusion

In this paper, we propose a novel fast corner detection method for 2D image processing. The method computes corner feature of an RGB image with high efficiency. The experiment part shows detection results of several images. All the potential fast corners are detected and marked in the related image. The method could be employed in further image algorithms to achieve better accuracy.

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