The Moving Target Tracking Algorithm Based On D&E Feature

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Abstract

Moving object tracking is an important research content in the field of machine vision. Aiming at the problem that the SIFT algorithm has poor matching accuracy in the moving region, this paper proposes a moving object tracking algorithm which is based on the D&E feature. Firstly, the feature points of the moving objects are extracted by the DoG operator. Then, in the neighborhood of feature points, according to the principle of gray consistency, the gradient direction histogram is produced, which constitutes the D&E feature of the feature points. At last, according to the minimum absolute difference, the feature points of the moving object are matched to realize the tracking of moving objects. The experimental results show that the proposed algorithm has good tracking performance for the moving objects in natural scenes.

Keywords

Target tracking, DoG operator, D&E features, principle of gray consistency.

1. Introduction

Target tracking technology is one of the core issues in the field of computer vision, which has a wide range of applications in security, intelligent transportation, human-computer interaction and so on. It has great research value and significance [1]. Target tracking is the process of automatically acquiring the moving objects in image sequences by computer, and continuously locating the target. Corner is a kind of important image feature points, which contains an important feature of the image with rotation invariance and does not vary with changing illumination conditions, in some applications using corner feature can reduce the calculation of the amount of data involved in, improve information content, and no loss the gray information of image. Therefore, tracking algorithm based on features often use corner to represent object. For example, Y. Wu [2] et al proposed a tracking method based on scale invariant feature transform (SIFT), which has better robustness in the rotation, light, scaling, small angle change; L.M. Zhong [3], who proposed a tracking method based on sift the dynamic background, which realized the automatic tracking of moving target under the continuous state, and has better robustness in occlusion. However, the SIFT feature points matching has poor matching accuracy in the moving region, which affects the accuracy of target tracking.

Aiming at the problem that the SIFT algorithm is prone to error matching in the moving region, this paper proposes a moving object tracking algorithm which is based on the D&E feature. Firstly, the feature points of the moving objects are extracted by the DoG operator. Then, in the neighborhood of feature points, according to the principle of gray consistency, the gradient direction histogram is produced, which constitutes the D&E feature of the feature points. At last, according to the minimum absolute difference, the feature points of the moving object are matched to realize the tracking of moving objects.

2. Extract DoG feature points

2.1 Construct DoG space

Scale space can be used to simulate multi-scale features of image data [4]. The basic idea of scale space is that, firstly, introducing a scale parameter in the image information processing model, then obtaining image information in different scales by continuous variation of the scale parameter, finally, using of these information to dig the nature of the image features.

If the input image is defined as I (x, y), the two dimensional Gauss function is defined as:

$$G(x, y, \sigma) = \frac{1}{2\pi\sigma^2} e^{-(x^2+y^2)/2\sigma^2}. \quad (1)$$

Here, σ represents the variance of the normal distribution of Gauss, then a pair of two-dimensional images at different scales in the scale space function $L(x, y, \sigma)$ can be obtained by the input image and Gauss function:

$$L(x, y, \sigma) = I(x, y) * G(x, y, \sigma). \quad (2)$$

In type (2), (x, y) represents the pixel position of the image, σ is called the scale space factor, the smaller the value, the smaller the image is smoothed, and the size of the image is small.

In order to effectively detected the stable key point in scale space, Lowe [4] proposed the Gauss difference scale space(Difference of Gaussian, DOG), which is generated by the convolution between Gauss differential nuclei at different scales and images, i.e:

$$D(x, y, \sigma) = L(x, y, k\sigma) - L(x, y, \sigma) = I(x, y) * (G(x, y, k\sigma) - G(x, y, \sigma)). \quad (3)$$

k is a constant factor. DoG space is shown in Fig.1

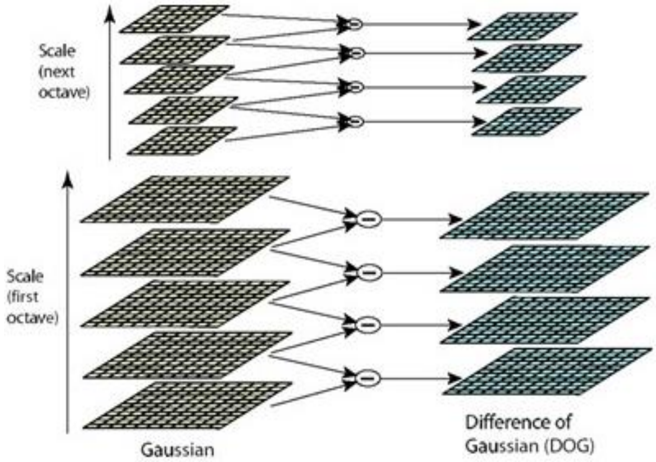

Fig. 1 DoG space

2.2 Spatial extreme point detection

In order to find the extreme points of the scale space, comparing every sampling point and all of its neighboring points, to see whether it is larger or smaller than the adjacent points of the image domain and the scale domain, such as Fig.2 in the middle of the detection point and it with the scale of eight adjacent points and adjacent scales corresponding to a total of 26 points compared to ensure in the scale space and the 2D image space are detected extreme point [5].

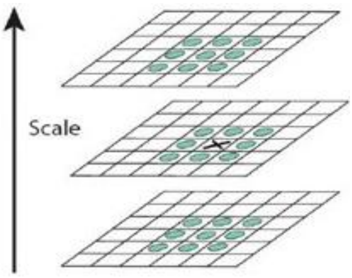

Fig. 2 Spatial extreme point detection

2.3 Precise point positioning

In the last step to get the space extreme points, it is necessary to do further processing of these extreme points to obtain the stable characteristic points. First, the extreme points of low contrast are filtered out. Then filter out the edge points on the edge of the [5].

Taylor expansion of the scale space function $D(x, y, \sigma)$, up to two times, the approximate writing

$$D(X) = D + \frac{\partial D^T}{\partial X} X + \frac{1}{2} X^T \frac{\partial^2 D}{\partial X^2} X . \tag{4}$$

Among them, $X = (x, y, \sigma)^T$ is the sample point offset. By seeking the derivative of this function and setting the value to 0, you can get the extreme value of $\hat{X}$ X. Then, judge whether the value of $D(\hat{X})$ is less than the threshold value, then we can get rid of the extreme points of low contrast.

For the feature points in the image edges, it in the Gaussian difference at the peak and the cross edge functions have a larger main curvature value, but in the vertical direction curvature value is smaller, using this property the low contrast feature points at the edge can be filtered out.

3. Extract D&E features

After obtaining the feature points by the DOG operator, the gradient direction of the feature points in the neighborhood of the feature points is calculated according to the principle of the consistency in the gray scale 16x16. The direction of the gradient range 0 to2pi was divided into 36 sections, then counting gradient direction histogram. The maximum value of the histogram represents the main direction of key point.

In order to ensure the rotation invariance of feature point, firstly, the principal direction of the feature points is first rotated by the coordinate axes, then taking the characteristic point as the center and taking 16 x16 window, and calculating the gradient direction in the window according to the principle of gray level consistency. The direction of the gradient range 0 to2pi was divided into 36 sections, then counting gradient direction histogram. The farther the distance from the center point, the smaller the contribution of the neighborhood to the histogram. Then the histogram is weighted by the Gauss function, and generating 36 dimensional gradient direction vectors.

The final feature points include the position (DoG) and the gradient (Edge) direction information, which constitutes the D&E feature of the feature points.

4. Experimental results and analysis

In this paper, the programming language is C++ Visual, test environment is the CPU 3.20GHz computer and Windows7 operating system, and compiler environment is Studio2012 Visual. In order to verify the effectiveness of this algorithm, this paper carries out experiments on the girl data of SegTrackv2 database, the video image size is 400x320, and compared with the LK optical flow method. The experimental results are shown below.

7th frames, 18th frames, 34th frames, 49th frames from the left to the right.

Fig. 3 Partial video original image sequence

Fig. 4 LK optical flow tracking results

Fig. 5 Algorithm tracking results are presented in this papers

Experimental results show that the proposed algorithm is effective in solving the tracking of moving objects.

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