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A New Feature Extraction Method for Gait Inspection

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Abstract

In order to extract gait features and achieve better classification and recognition accuracy, a gait energy image method based on joint points is proposed in order to express the complete gait features, and then the characteristics of the image are extracted by the local two-value pattern feature extraction method (LBP), and finally the final gait recognition is carried out using the SVM. Experiments show the methods based on the gait energy map GEI and the gait energy map PGEI image with the relevant nodes respectively, has the correct rate of 47.85% to 56.52% and 83.33% to 91.67% using the CASIA B gait database.

Keywords: Carbonate Rock, Fracture Cavity System, Fracture Cavity Aggregate, Evaluation.

1. Introduction

Compared with other biological features the other techniques of using static biometrics for identification, gait identification has the advantages of non-contact, not easy to imitate and camouflage. Gait features are the only biometric features that can be received and acquired over long distances, and subsequent analytical recognition requires lower pixel resolution for video images. In addition, the acquisition of gait sequence is often carried out through a wide range of long-distance video surveillance, video recording, for the object under test has non-inviolability, not easy to detect and so on. Besides, gait behavior is a habitual behavior, this characteristic is difficult to hide.

Gait features are the most spatial biological characteristics of long-distance identification technology. Although the research on gait recognition is still in the theoretical level of exploration at this stage, in the study target detection of identity identification, through the optimization of feature extraction and identification methods to improve the recognition accuracy.

2. A feature extraction method based on gait energy image

2.1. Construction of a gait energy map with joint points

The idea of gait energy image (GEI) is induced because the alignment of the image is crucial to further feature extraction and recognition, considering that the head will not change as the body swings during walking, and it is less influenced by the clothing and other external factors. In this paper, the center of gravity of the head is considered for the matching point. Gait profiles with the nodes concerned are extracted. Since the hip point is proportionally positioned during walking and is basically the same position as after the image match, we constructed a gait energy map with joint points using a profile with only two knees and two ankles.

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Fig.1 Gait energy image with points

Figure 1 is an inter-frame gait energy image constructed from an outline chart with joint points, which shows that the image can reflect the accumulation of energy over time, and indicates the frequency at which the pixels change in this gait motion period with different pixel values. A high brightness point indicates that a joint or contour pixel is more likely to appear at that position during this gait cycle than at any other location. Compared with GEI, the biggest advantage with PGEI is that for the same image not only the movement of various parts of the human body is expressed, but also the movement trajectory of knee and ankle point is expressed. Thus the characteristics of joint points, such as rate, frequency, etc. can be well tracked. Moreover, the features of human contours in GEI images can also be fully reflected in PGEI, thus providing more effective information for subsequent gait feature extraction.

2.2. Gait energy with LBP feature extraction with joint points

The 3-by-3 rectangular LBP solver has a smaller coverage in the image and can contain only a small area, which is not fully extracted for texture features of different sizes and frequencies. Through the changed LBP solver, you can freely select any number of pixels in a circular neighborhood with a radius of R, such as 16, 25, and so on, not only limited to 8 neighborhood pixels. Figure 4 shows the improved LBP calculation.

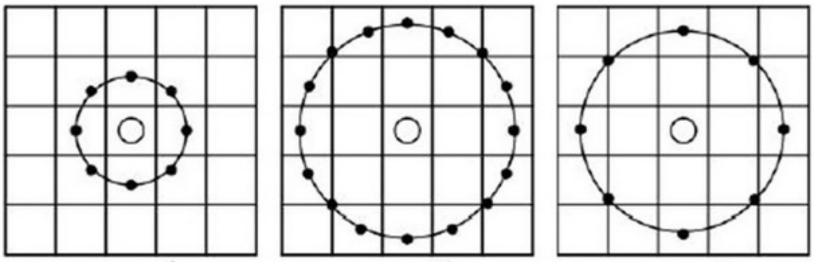

Fig.1 Circular LBP operator with radius of *R* containing *P* sampling points

The LBP calculator is calculated as follows

$$LBP_{P,R}(x_c, y_c) = \sum_{p=0}^{P-1} s(g_p - g_c) \times 2^p \qquad s(x) = \begin{cases} 1 & x \geq 0 \\ 0 & x < 0 \end{cases} \tag{1}$$

The center pixel is the neighborhood pixel. P is the number of sampling points and R is the radius of the neighbor collected.

2.3. Feature extraction based on inter-frame gait energy image

For each frame image, the image adjacent to it is divided into front and back frames. The complete inter-frame energy map should contain all the information about the change between the current frame and the two frame images. Here we take the head center of gravity of the original image before the difference as the matching point, and perform the image differential operation. First of all, the forward-inter-frame energy map F-FGEI (Forward-inter Frame Gait Energy Image) should be extracted and assumed F_f, the formula is:

$$F_f = \begin{cases} 0 & I(x,y,t) - I(x,y,t-1) = 0 \\ 1 & otherwise \end{cases} \tag{2}$$

Where t represents the t-frame image, which represents the pixel value of the point (x, y) in the t-frame image.

Fig.2 Forward-frame gait energy image

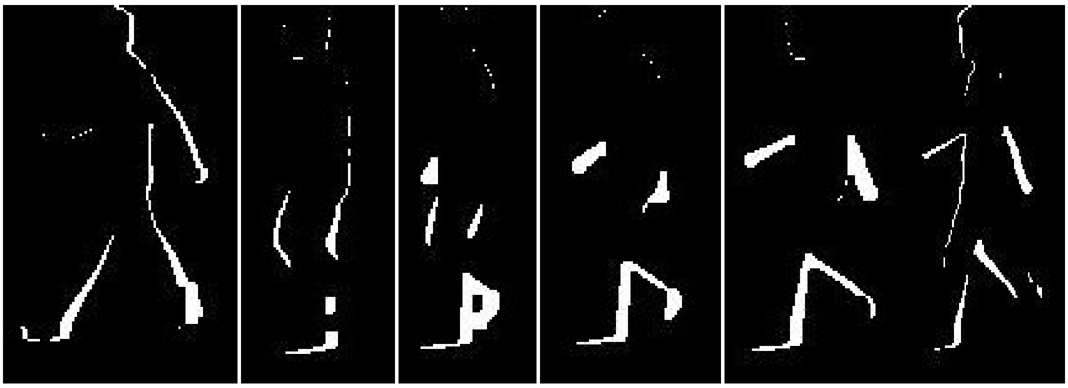

Fig.3 Back-inter-frame gait energy image

The back-to-frame energy map B-FGEI (Back-inter Frame Gait Energy Image) is set to be calculated in a similar way to F-FGEI, as follows

$$F_b = \begin{cases} 0 & I(x,y,t+1) - I(x,y,t) = 0 \\ 1 & otherwise \end{cases} \tag{3}$$

Figure 3 is a partial image of the gait energy map between the back frames in a gait cycle.

F-FGEI or B-FGEI can only represent a one-way gait change, and cannot fully reflect the association of the current image with adjacent frames. Thus we will forward frame gait energy map and back frame gait energy map overlay, where the alignment point is the same as PGEI, still choose the head center of gravity, by this method to form a complete inter-frame energy map to express gait characteristics.

The formula for calculating FGEI for the inter---------frame gait energy map as follows

$$F(x,y,t) = F_f(x,y,t) + F_b(x,y,t) \tag{4}$$

Where t represents the t-frame image. Figure 4 shows a partial image of the gait energy map between frames during a gait cycle.

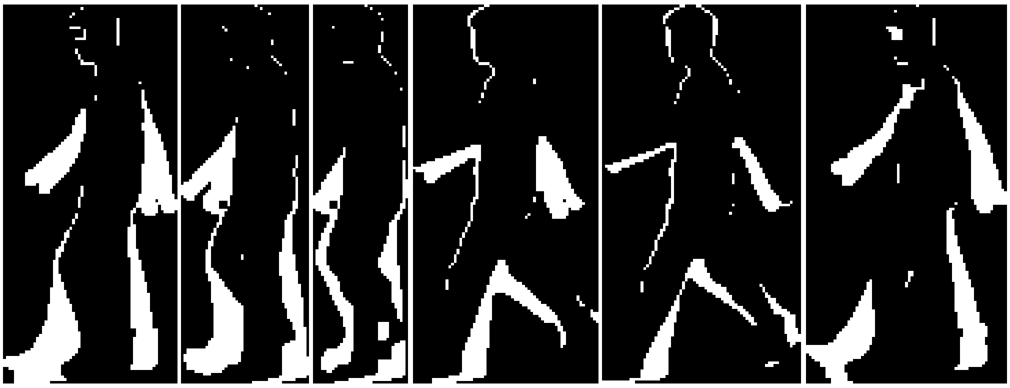

Fig.4 Inter-frame gait energy image

For a two-dimensional gait image, rows and columns express the characteristics of the image from different dimensions. For gait behavior, it is obtained by coordinating various parts of the body. Because different times each part of the limb assumes different roles in different states. The row mass vector characteristics of the gait energy map between frames can not only reflect the change of pedestrian limb parts in a gait period from the horizontal dimension of the image, but also reflect the change of motion between the current frame and adjacent frames, as well as the motion trend of subsequent actions. The line mass vector of the gait energy map between frames is calculated as follows:

$$L(t) = [l_1(t), l_2(t), l_3(t) \cdots \quad R^n \tag{5}$$

The mean of $l_n(t) = \sum_n I(x,y,t)$, $I(x,y,t)$ is the Pixel in the t frame point $I(x,y)$, and $l_n(t)$ express that the value of the nth row pixel in the image, which is the number of pixels in the row with a pixel value of 1.

2.4. Gait Recognition Algorithm Based on Multi-feature Fusion

We use the decision level fusion algorithm to combine the row quality vector and the column quality vector extracted from the inter-frame gait energy graph. Here we use the addition fusion algorithm for feature fusion. However, the influence of different gait features on the recognition rate is different. An improved addition fusion algorithm is used to obtain the discriminant of feature classification and recognition as the basis for the final gait recognition. The formula of gait feature fusion is as follows:

$$V = \alpha_1 \times L + \alpha_2 \times C \tag{6}$$

Where L is the row quality vector feature and C is the column quality vector feature. The corresponding feature weights are respectively. Determination of the size of each feature weight requires calculating its reparability. In this paper, the recognition performance of each feature is used to determine their feature weights. The recognition performance is divided according to the error classification rate of the algorithm. If the error rate is larger, the recognition effect of the feature is worse, and the credibility of the feature is lower during the fusion process. Then the proportion of fusion is lower, vice versa. The specific steps of the algorithm are as follows:

(1) Let the number of test samples be n and the m gait features be fused. If the error rate of each gait feature is e_x, the weight value corresponding to the n feature is ω_n.

$$\omega_n = \frac{\sum_{n=1}^{m} N \times e_n}{N \times e_n} \tag{7}$$

(2) The weight ratio of each gait feature is obtained by normalizing of ω_n. It can be known that the weight ratio of the feature is inversely proportional to the error rate e_n.

$$\alpha_n = \frac{\omega_n}{\sum_{n=1}^{m} \omega_n} \tag{8}$$

(3) The weight ratio is applied to the addition fusion method, and the total eigenvalue used for identification is obtained.

3. Experiments and results

The experimental datasets are from the Institute of Automation CASIA B. (Chinese Academy of Sciences). The database contains 11 visual gait images of 124 people with three walking gestures. In this paper, 96 video sequences of 20 people were selected for image preprocessing, including 60 training samples (3 for 1 person) and 36 test samples. 36 samples are randomly selected from gait database, in which at least one sample is included in each object.

For comparing the effectiveness of gait energy map and inter-frame gait energy map feature extraction based on joint points, a gait recognition method based on gait energy map and gait energy map extracted with LBP is applied. The gait recognition methods based on row quality vector and column quality vector are tested. In order to compare the effect of feature fusion on gait recognition algorithm, we also make experiments with gait recognition methods based on feature fusion. The kernel function in the experiment adopts polynomial and radial kernel function. The experimental results are shown in Table 1.

In this paper, the classification recognition rate of single row mass vector and column mass vector using radial kernel function is higher. The two recognition rates are used for feature fusion. The recognition rates of row quality vector and column quality vector are 83.33% and 91.67%, respectively.

4. Conclusion

In summary，A new method of gait recognition is presented. The overall operation are implemented by LBP algorithm, GEI algorithm and FGEI algorithm. The experimental results show that the recognition rates of 47.83% and 91.67% are obtained by the PGEI feature extraction method and the FGEI column quality vector fusion method, respectively. Compared with other algorithms, the recognition rate is improved greatly.

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