Image Segmentation Technology of Marathon Motion Video Based on Machine Learning

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Abstract. In order to improve that segmentation quality of the video image of the marathon, a video image segmentation algorithm based on machine learning is proposed. Constructing the edge contour feature detection and the pixel feature point fusion reconstruction model of the marathon moving video image, carrying out multi-level feature decomposition and gray pixel feature separation of the marathon moving video image, and establishing a visual feature reconstruction model of the marathon moving video image, the feature segmentation and the edge contour feature detection of the marathon moving video image are carried out in combination with the block area template matching method, the similarity information fusion model is used for carrying out the video information fusion awareness and the block area template matching in the process of the marathon moving video image segmentation, the fuzzy feature quantity of the moving video image of the marathon is extracted, and the machine learning method is adopted to realize the fusion awareness and the segmentation quality evaluation of the marathon moving video information. The simulation results show that the method is good in image segmentation quality and high in image recognition, and the output signal-to-noise ratio of the motion feature reconstruction of the marathons moving video is high.

Keywords: Machine learning · Marathons · Sports · Video images · Segmentation

1 Introduction

With the development of the computer vision information processing technology, the visual image processing method is adopted to analyze and extract the motion video of the human body, and the segmentation model of the marathon moving video image is established, and the motion characteristic identification and the reconstruction capability of the human body motion are improved. the feature reconstruction of the motion of the human body is established on the basis of the segmentation of the moving video image of the marathon, the non-marked point tracking recognition method is adopted for carrying out the marathon moving video image segmentation processing, and the geometric characteristic analysis model of the marathon moving video image is extracted, through the three-dimensional reconstruction method of the computer vision feature, the method realizes the segmentation and the geometric recognition of the marathon moving video image, extracts the key feature quantity of the marathon

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moving video image, adopts the pixel tracking and fusion technology, and realizes the image recognition of the marathon moving video [1]. The research on the method of video image segmentation and evaluation of the related marathons is greatly concerned by people [2].

In that traditional method, The method for segmenting the video image of the marathon moving video mainly comprises a HU moment segmentation method, a geometric invariant moment segmentation method, an adaptive edge contour feature segmentation method and the like, a three-dimensional reconstruction model of a marathon moving video image is constructed, a key feature point three-dimensional reconstruction method is adopted [3], the method comprises the following steps of: realizing the segmentation and identification of a marathon moving video image, and acquiring a good marathon moving video image segmentation effect; and a real-time extraction method of a marathon moving video image based on a monocular video is presented in the document [4], In that method, the human motion video follow-up recognition is carried out by adopting a monocular video acquisition method, and the human motion video segmentation is carried out in combination with the correlation fusion method, but the calculation cost of the method is large and the real-time performance is not good [5]. A motion image segmentation method based on a sharpening template enhancement technology is presented in the document, and the segmentation detection and the information fusion processing of the two-dimensional marathon moving video image are carried out in combination with the partial region feature matching method, and the image segmentation is realized by extracting the block feature quantity of the marathon moving video image. However, the method has poor self-adaptability and strong anti-interference ability [6].

Aiming at the above problems, this paper proposes a marathon motion video image segmentation algorithm based on machine learning. Firstly, the edge contour feature detection and pixel feature point fusion reconstruction model of marathon motion video image are constructed, the multi-level feature decomposition and gray pixel feature separation of marathon motion video image are carried out, then the visual feature reconstruction model of marathon motion video image is established. Finally, simulation experiments are carried out to demonstrate the superior performance of this method in the evaluation of marathon motion video segmentation.

2 Feature Detection of Marathon Motion Video Image and Reconstruction Model of Pixel Feature Point Fusion

2.1 Edge Contour Feature Detection of a Marathon Moving Video Image

In order to realize the image segmentation quality evaluation design of a marathon moving video image based on machine learning, a pixel space fusion model of a marathon moving video image is constructed, and a feature matching method is adopted for carrying out a marathon moving video image characteristic detection, First, the spatial sparsity feature reconstruction of the marathons moving video image is carried out, and the feature point matching of the marathon moving video image is carried out by using the Atanasov extension method, and the template matching model for constructing the marathon moving video image segmentation is shown in Fig. 1.

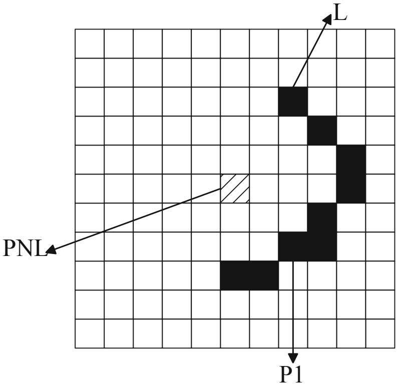

Fig. 1. Template matching model for image segmentation

Assuming that the gray-scale pixel set of the marathon moving video image is (i,j) as a pixel center, a characteristic segmentation model of the marathon moving video image is constructed by adopting a sharpening template block combination method, and the gray value I_{swk} of the marathon moving video image acquired in the k sub-band is determined, in the gray pixel characteristic distribution space [7], the corresponding marathon moving video image gradient characteristic component is obtained as follows:

$$P_{rk} = \left(\frac{\sum_{j=1}^{c} I_{swk}(1,j)}{c}, \frac{\sum_{j=1}^{c} I_{swk}(2,j)}{c}, \ldots, \frac{\sum_{j=1}^{c} I_{swk}(i,j)}{c}, \ldots, \frac{\sum_{j=1}^{c} I_{swk}(r,j)}{c} \right) \tag{1}$$

$$P_{ck} = \left(\frac{\sum_{i=1}^{r} I_{swk}(i,1)}{r}, \frac{\sum_{i=1}^{r} I_{swk}(i,2)}{r}, \ldots, \frac{\sum_{i=1}^{r} I_{swk}(i,j)}{r}, \ldots, \frac{\sum_{j=1}^{c} I_{swk}(i,c)}{r} \right) \tag{2}$$

Wherein, c is the number of columns of the LGB vector quantization matrix of the marathon moving video image, and r is the motion blur feature quantity. in combination with a pixel feature point fusion reconstruction method, a human body motion video feature distribution pixel set distribution is obtained, and a video information fusion awareness and a three-dimensional reconstruction are carried out on a marathon moving video image, the feature segmentation and the edge contour feature detection of the marathon moving video image are carried out in combination with the block area template matching method, the gray-scale pixel feature reconstruction of the human motion video is carried out [8], a monocular visual tracking method is adopted, the low-resolution human motion video image is subjected to noise reduction processing, and a sparse characteristic segmentation model of the marathon moving video is constructed, and the output characteristic amount is obtained as follows:

$$G_j(\vec{x}) = \begin{cases} \max\{0, g_j(\vec{x})\}, & 1 \le j \le l \\ \max\{0, |h_j(\vec{x})| - \delta\}, & l+1 \le j \le p \end{cases} \quad (3)$$

The video information fusion perception and information fusion tracking of human motion are carried out, and the edge outline features of marathon motion video image are detected [9].

2.2 Pixel Feature Point Fusion Reconstruction Model

The edge outline feature detection and pixel feature point fusion reconstruction model of marathon motion video image is constructed, the multi-level feature decomposition and grey pixel feature separation of marathon motion video image are carried out, and the visual feature reconstruction model of marathon motion video image is established. The visual feature distribution of marathon motion video image is as follows:

$$G(\vec{x}) = \sum\nolimits_{j=1}^{p} G_j(\vec{x}) \quad (4)$$

The adaptive fusion tracking and recognition method is used to mark the key action feature points, and the image segmentation is carried out. The edge segmentation model of marathon motion video image is constructed, and the fuzzy closeness function of human motion video image is obtained as follows:

$$fitness(\vec{x}) = f(\vec{x}) + (Ct)^{\alpha} \sum\nolimits_{j=1}^{p} G_j^{\beta}(\vec{x}) \quad (5)$$

The bilateral filtering method is used to reduce the noise of marathon motion video image, and the perceptual fusion model of video information fusion is constructed, and the fitness function is obtained as follows:

$$ftiness(\vec{x}) = \begin{cases} f(\vec{x}), & if\ feasible \\ 1 + rG(\vec{x}), & otherwise \end{cases} \quad (6)$$

Considering the gray level pixel level of the marathon moving video image, the multi-dimensional histogram distribution model of the marathon moving video is constructed by adopting a gray-scale invariant moment characteristic decomposition method [10], and the image segmentation model obtained by the fusion of the marathon moving video information is as follows:

$$\begin{aligned} W_u u(a,b) = {} & e^{j2\pi K \ln a} \times \frac{K}{\sqrt{a}} \\ & \left\{ \left[\frac{a e^{\frac{j2\pi f_{\min}}{a}(b-b_a)}}{f_{\min}} - \frac{e^{j2\pi f_{\max}(b-b_a)}}{f_{\max}} \right] \right. \\ & + j2\pi(b-b_a)\left[Ei(j2\pi f_{\max}(b-b_a)) \right. \\ & \left. \left. - Ei\left(\frac{j2\pi f_{\min}}{a}(b-b_a) \right) \right] \right\} \end{aligned} \quad (7)$$

Wherein, $b_a = (1-a)\left(\frac{1}{af_{\max}} - \frac{T}{2}\right)$, $Ei(\bullet)$ represents the optimal minimum solution of the visual feature distribution of marathon motion video. Under the action of pixel mean, marathon motion video image segmentation is carried out.

3 Evaluation and Optimization of the Segmentation Quality of the Video Image of the Marathons

3.1 Fuzzy Feature Extraction of a Marathoner's Moving Video Image

The edge contour feature detection and the pixel feature point fusion reconstruction model of the marathon moving video image are constructed, and the multi-level feature decomposition of the marathon moving video image and the basis of the gray pixel feature separation are carried out, In this paper, the segmentation quality assessment and optimization of the video images of the marathons are carried out, and the image segmentation algorithm based on the machine learning is presented in this paper. the feature segmentation and the edge contour feature detection of the marathon moving video image are carried out in combination with the block area template matching method, and the information fusion model of the marathon moving video is constructed based on the local feature adaptive feature matching method [11], the video information fusion sensing model of the image of the marathon moving video is constructed, and the expression of the video information fusion awareness function is obtained as follows:

$$g = k \otimes f + n \quad (8)$$

Wherein, $\otimes$ represents convolution operator, merges the captured marathon motion video image with vector set, and constructs the edge outline feature decomposition model of marathon motion video [17]. The best resolution eigenvalues of marathon motion video are obtained as:

$$s_{PPM}(t) = \sum_{i=-\infty}^{\infty} \sum_{j=0}^{N_p-1} p\left(t - iT_s - jT_p - c_j T_c - a_i \varepsilon\right) \quad (9)$$

$$s_{PAM}(t) = \sum_{j=-\infty}^{\infty} d_j p(t - jT_s) \tag{10}$$

The T_s is the spatial pixel gain of volume video motion. The feature reconstruction and reconstruction of marathon motion video is carried out by using similarity reconstruction method. The image pixel decomposition model of marathon motion video is established as follows:

$$x(t) = \sum_{m=1}^{M} \sum_{k=1}^{K(m)} w_{nk} s(t - T_m - \tau_{mk}) + v(t) \tag{11}$$

In the formula, w_{mk} is the fuzzy characteristic component of the marathon moving video, and the image enhancement method is adopted to realize the reconstruction of the gray histogram of the marathon moving video image, and the output is as follows:

$$\begin{cases} x = R\sin\eta\cos\phi & 0 \le \phi \le 2\pi \\ y = R\sin\eta\sin\phi & 0 \le \eta \le \pi \\ z = R\cos\eta & R = D/2 \end{cases} \tag{12}$$

In which, η represents an edge division function, ϕ represents an angle function of a human motion video image segmentation, R represents a template matching coefficient, a gray-scale pixel feature decomposition method is adopted [12], and the feature segmentation and high-resolution reconstruction of the marathon moving video image are carried out, and the output is as follows:

$$\begin{aligned} \mathbf{D}_{(i+1)} &= \mathbf{B}_{(i+1)}\mathbf{C}_{(i+1)} \\ &= \mathbf{B}_{(i)}\mathbf{C}_{(i)} - \beta_{i+1}^{-1}\left(\mathbf{B}_{(i)}\mathbf{C}_{(i)}\mathbf{w}_{i+1}\right)\frac{\mathbf{w}_{i+1}^{T}\lambda_i^{-1}\mathbf{C}_{(i)}}{\lambda_i^{-1}\beta_{(i+1)}^{-1}\mathbf{w}_{i+1}^{T}\mathbf{C}_{(i)}\mathbf{w}_{i+1}+1} \\ &+ \beta_{i+1}^{-1}\mathbf{x}_{i+1}\left(\lambda_i^{-1}\mathbf{w}_{i+1}^{T}\mathbf{C}_{(i)}\right) - \beta_{i+1}^{-1}\mathbf{x}_{i+1}\frac{\beta_{i+1}^{-1}\lambda_i^{-1}\mathbf{w}_{i+1}^{T}\mathbf{C}_{(i)}\mathbf{w}_{i+1}}{\beta_{i+1}^{-1}\lambda_i^{-1}\mathbf{w}_{i+1}^{T}\mathbf{C}_{(i)}\mathbf{w}_{i+1}+1}\mathbf{w}_{i+1}^{T}\lambda_i^{-1} \end{aligned} \tag{13}$$

Based on sparse representation, the fuzzy feature extraction of marathon motion video image is realized. According to the result of feature extraction, the optimal segmentation template matching function of sub-block $G_{m,n}$, with $M \times N$ 2×2 in gradient direction is obtained as follows:

$$G_{m,n} = \begin{pmatrix} g_{(m,n)}(1,1) & g_{(m,n)}(1,2) \\ g_{(m,n)}(2,1) & g_{(m,n)}(2,2) \end{pmatrix} \qquad m = 1,2,\ldots,M; n = 1,2,\ldots,N; \tag{14}$$

Wherein, the u is the edge pixel point of the marathon moving video image, the $p(i,j)$ represents the gray pixel value of the marathon moving video in the sharpening area, the (i,j) is the image gray scale deviation, and the fuzzy feature extraction of the marathon moving video image is realized through the algorithm design, and performing image segmentation according to the feature extraction result [13].

3.2 Image Segmentation Video Information Fusion Awareness

Setting δ_l^2 as the local variance of the moving video image of the marathon, δ_η^2 is the optimization coefficient of the marathon moving video image, the $\beta = \max\left[\frac{\delta_l^2 - \delta_\eta^2}{\delta_l^2}, 0\right]$, the region block division of the marathon moving video is carried out by using the gradient descent method, so that the sparse characteristic value of the marathon moving video image meets the $C \in S$, According to the sparse prior representation result, the optimal segmentation threshold value at the $F_m(x,y)$ frame m of the marathon moving video image (x,y) is obtained. the template matching of the marathon moving video image is carried out based on the approximate sparse representation method, and the matching coefficient is obtained as follows:

$$g_i^* = \begin{cases} Rs_j, & z \le i \le x - y \\ g_i, & otherwise \end{cases} \tag{15}$$

Wherein, the feature segmentation and edge outline feature detection of marathon motion video image are carried out by combining block region template matching method, and the video information fusion perception is carried out in the process of marathon motion video image segmentation by using similarity information fusion model [14], and the grey edge eigenvalues of local area of marathon motion video image are calculated, in which the maximum gray value of marathon motion video image is as follows:

$$n_{pq} = \frac{\mu_{pq}}{(\mu_{00})^\gamma} \tag{16}$$

By adopting the sparse representation and the super-resolution reconstruction method to carry out the segmentation processing of the marathon moving video image, the machine learning method is adopted to realize the fusion awareness and the segmentation quality assessment of the marathon moving video information, and the sparse segmentation model of the marathon moving video image is expressed as:

$$g(x,y) = f(x,y) + \varepsilon(x,y) \tag{17}$$

Among them, $f(x,y)$, $g(x,y)$, $\varepsilon(x,y)$ represents the original human motion video image, reconstructed image and gray image respectively. Based on the analysis, machine learning method is used to realize the fusion perception and segmentation quality evaluation of marathon motion video information [15].

4 Simulation Experiment and Result Analysis

In order to test the performance of this method in realizing marathon motion video image segmentation, the experimental simulation tool is matlab 7. the sampling data of marathon motion video image is taken from usc-sipi image database. the training sample set of marathon motion video image is 600. the edge contour pixel distribution set of marathon motion video image is 400 * 400. the feature resolution of video information fusion perception is 2000, the edge contour feature decomposition coefficient is 0.34,0.75, and the pixel step size value is 20. According to the simulation parameters, the marathon motion image segmentation is set.

Fig. 2. Marathons moving video images to be segmented

Taking the marathon motion video image of Fig. 2 as the test sample, the information fusion is carried out, the edge outline feature detection and pixel feature point fusion reconstruction model of the marathon motion video image is constructed, the multi-level feature decomposition and gray pixel feature separation of the marathon motion video image are carried out, the automatic segmentation of the marathon motion video image is realized, and the marathon motion video image segmentation is carried out by different methods. The segmentation results are shown in Fig. 3.

(a) PCA method

(b) Proposed method

Fig. 3. Matching result of image pixel spatial fusion characteristics

The analysis of Fig. 3 shows that the quality of the video image segmentation by the method is good, and the error of image segmentation is tested by different methods, and the result of the comparison is shown in Fig. 4.

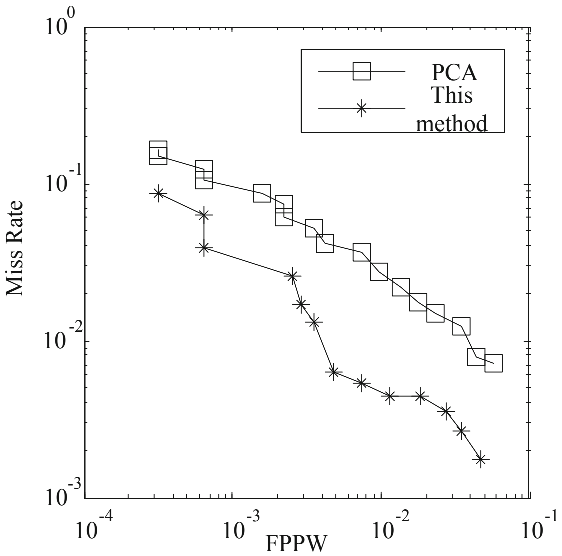

Fig. 4. Error comparison of image segmentation

The test results of Fig. 4 show that the error of memorizing image segmentation is low, and the output peak signal-to-noise ratio (PSNR) of marathon motion video image segmentation is tested by different methods. The results are shown in Table 1. The analysis shows that the output peak signal-to-noise ratio of marathon motion video image segmentation by this method is high.

Table 1. Comparison of psnr for video image segmentation of the line of line marathon(db)

Iterations	Proposed method	Wavelet analysis method	Principal component analysis method
100	43.67	22.89	32.46
200	48.65	25.65	35.56
300	51.52	26.76	37.94
400	54.67	35.43	39.43

5 Conclusions

In this paper, a video image segmentation algorithm based on machine learning is proposed. Constructing the edge contour feature detection and the pixel feature point fusion reconstruction model of the marathon moving video image, carrying out multi-level feature decomposition and gray pixel feature separation of the marathon moving video image, and establishing a visual feature reconstruction model of the marathon moving video image, the feature segmentation and the edge contour feature detection of the marathon moving video image are carried out in combination with the block area template matching method, the similarity information fusion model is used for carrying out the video information fusion awareness and the block area template matching in the process of the marathon moving video image segmentation, the fuzzy feature quantity of the moving video image of the marathon is extracted, and the machine learning method is adopted to realize the fusion awareness and the segmentation quality evaluation of the marathon moving video information. The simulation results show that the method is good in image segmentation quality and high in image recognition, and the output signal-to-noise ratio of the motion feature reconstruction of the marathons moving video is high. This method has good application value in the video analysis of Marathon Sport.

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