Research on the Adaptive Tracking Method for the Tracking of the Track of the Long-Jump Athletes

Yi-de Liao(✉) and Qiang Huang

Huali College Guangdong University of Technology, Guangzhou 511325, China
liaoyide893@163.com

Abstract. In order to improve the accuracy of long jump in long jump, combined with computer vision image processing method to correct the long jump trajectory in long jump, an adaptive tracking method of long jump trajectory tracking image based on machine vision tracking detection is proposed, and the video point frame scanning method is used to collect the long jump trajectory tracking image. The image of long jump athletes is segmented by adaptive pixel fusion method, and the automatic tracking and recognition of long jumpers' motion trajectory tracking image is carried out based on dynamic feature segmentation. The grey feature quantity of long jump trajectory tracking image is extracted, and the neighborhood distribution model of long jump in long jump is constructed. According to the dynamic evolution characteristic distribution of the long jump trajectory, the dynamic characteristics of the long jump trajectory are analyzed, and the image segmentation of the long jump track tracking is realized by combining the spatial neighborhood enhancement technology, and the adaptive tracking of the long jump trajectory in the long jump is realized according to the image segmentation results. The simulation results show that this method has high accuracy in adaptive tracking image of long jump athletes, and improves the accuracy of long jump in long jump.

Keywords: Long jump · Corner ball · Long jump · Image · Adaptive tracking

1 Introduction

With the development of the intelligent vision image information processing technology, the computer image information processing technology is adopted to carry out the track analysis of the long jump motion in the long jump motion, the motion track tracking image information fusion model of the long jump athlete is constructed, the automatic follow recognition of the track is carried out in combination with the visual evolution characteristic distribution of the moving track tracking image of the long jump athlete, and the identification capability of the long jump athlete motion track tracking image is improved [1], the method of self-adaptive tracking of moving track tracking images of long jump athletes is of great significance in the correction and attitude adjustment of the track of long jump. The method for tracking the track of the moving track of the long jump athlete is based on the automatic segmentation and characteristic information extraction of the image [2], the gray feature quantity of the

Y.-D. Zhang et al. (Eds.): ICMTEL 2020, LNICST 326, pp. 225–235, 2020.
https://doi.org/10.1007/978-3-030-51100-5_20

moving track of the long jump athlete is extracted, the image segmentation and the information fusion are carried out according to the edge contour distribution of the image, in the traditional method, the tracking method for tracking the moving track of the long jump athlete mainly adopts the pixel point tracking method, and the segmentation performance of the image is not good as the gray scale of the pixel distribution is changed [3]. Aiming at the above problems, a method for tracking the moving track of the long jump athlete based on the machine vision tracking detection is proposed, the video point frame scanning method is adopted to carry out the motion track tracking image acquisition of the long jump athlete, and the acquired long jump athlete moving image is divided and processed, Finally, the self-adaptive tracking simulation of the image is carried out, and the validity conclusion is obtained.

2 Imaging and Preprocessing of Track Tracking Image of Long Jump Athletes

2.1 Imaging of Track Tracking Image of Long Jump Athletes

In order to realize the information fusion and feature detection of track tracking images of long jump athletes, the long jump track tracking detection is carried out by combining the image segmentation method, and the feature separation processing of track tracking images of long jump athletes is carried out by using adaptive feature separation and information fusion technology.

The visual image multi-layer grid area distribution model of long jump trajectory planning is constructed. The multi-dimensional video tracking sampling method is used to collect the visual features of the long jump trajectory space [4]. Combined with the video frame point scanning and tracking technology, the spatial visual features of the long jump trajectory are collected distributed. The three-dimensional visual sampling image of the long jump trajectory space is $s(X, Y)$, using the beam scanning method of related frames. The pose distribution mode of multi-frame image with long jump trajectory is obtained as follows:

$$Ncut(A, B) = \frac{cut(A, B)}{assoc(A, V)} + \frac{cut(A, B)}{assoc(B, V)} \tag{1}$$

Wherein, $assoc(A, V)$ is the amplitude of pixel intersection in the pixel subset G of the spatial vision image of long jump trajectory under machine vision. $assoc(B, V)$ is the 3D edge outline feature quantity of the visual image of long jump trajectory space, and the correlation feature solution of spatial visual feature matching of long jump trajectory is expressed as follows:

$$W_u u(a, b_m) = \frac{1}{\sqrt{a}} \int_{-aT/2+b_m}^{T/2} \left| \frac{1}{\sqrt{T}} \right|^2 dt = \frac{1}{\sqrt{a}T} (\frac{T}{2} + \frac{aT}{2} - b_m) \tag{2}$$

The histogram of the moving track space visual image of the long jump and the reference feature point are visually tracked and matched, and a multi-layer segmentation model of the long jump motion track space visual image is established in the local area of the 4 × 4 sub-block, and the description is as follows:

$$\begin{aligned} d_{i+1} &= 2F(x_{i+1} + \frac{1}{2}, y_i + 2) \\ &= \begin{cases} 2[\Delta x(y_i + 2) - \Delta y(x_{i,r} + \frac{1}{2} - \Delta xB)] & d_i \leq 0 \\ 2[\Delta x(y_i + 2) - \Delta y(x_{i,r} + 1 + \frac{1}{2} - \Delta xB)] & d_i > 0 \end{cases} \end{aligned} \tag{3}$$

In the fuzzy region, the spatial visual information acquisition of the long jump motion track is carry out, and the acquired output is as follows:

$$\begin{aligned} P(y_{w_3}|x_{w_3}, \theta, \beta) &\propto P(y_{w_3}|x_{w_3}, \theta)(y_{w_3}|\beta_i) \\ &\propto \prod_{k=1}^{K} \alpha_k \frac{1}{\sqrt{2\pi\sigma_k^2}} \exp\left\{-\frac{(x_i - \mu_k)^2}{2\sigma_k^2}\right\} \cdot \frac{1}{Z(\beta_i)} \exp\left(-\sum_{c \subset C} V_c(Y, \beta_i)\right) \\ &\propto \prod_{k=1}^{K} \frac{\alpha_k}{Z(\beta_i)\sqrt{2\pi\sigma_k^2}} \cdot \exp\left\{-\left[\sum_{k=1}^{K} \frac{(x_i - \mu_k)^2}{2\sigma_k^2} + \sum_{c \subset C} V_c(Y, \beta_i)\right]\right\} \end{aligned} \tag{4}$$

In summary, the video point frame scanning method is used to collect the motion trajectory tracking image of long jumpers, and the adaptive pixel fusion method is used to segment the image trajectory of long jumpers, so as to improve the adaptive tracking and recognition ability of long jumpers' motion trajectory tracking image [5].

2.2 Image Trajectory Segmentation and Information Enhancement Processing

The grid segmentation of each template in the visual space of the long jump trajectory is carried out, and the binary reconstruction of the correlation frame of the long jump trajectory is carried out in the *m***n* region. The fuzzy region high resolution feature extraction model of the visual image of the long jump trajectory space is constructed [6–9]. The regional feature distribution points of the spatial visual image of the long jump trajectory are obtained as follows:

$$J(x) = \frac{I(x) - A}{\max(t(x), t_0)} + A \tag{5}$$

Wherein, t_0 represents the structural similarity of the spatial visual image of the long jump trajectory, carries on the template matching in the neighborhood structure of the image 3*3, carries on the spatial segmentation through the acquisition result of the visual image of the long jump trajectory space, considers the common view degree of the new feature point to carry on the spatial visual planning of the long jump trajectory

[10], and the rotation and translation output of the long jump trajectory space are as follows:

$$\overline{W_i P} = \left\| \overline{W_i S_k} \right\| \times \cos \partial \times \frac{\overline{W_i W_j}}{\left\| \overline{W_i W_j} \right\|} \tag{6}$$

The output of the pixel subset of the spatial distribution of the long jump trajectory is expressed as follows:

$$I(x) = J(x)t(x) + A(1 - t(x)) \tag{7}$$

Wherein, the A is the three-dimensional scale information of the long jump motion track space vision, and $t(x)$ is the edge contour value of the long jump motion track space vision, and the quantitative characteristic distribution set of the long jump motion track space visual image area segmentation is as follows:

$$w(i,j) = \frac{1}{Z(i)} \exp\left(-\frac{d(i,j)}{h^2}\right) \tag{8}$$

Wherein, $Z(i) = \sum\limits_{j \in \Omega} \exp(-\frac{d(i,j)}{h^2})$ is the spatial visual gradient feature of long jump trajectory. The adaptive pixel fusion method is used to segment the trajectory of the collected long jumpers' motion image, and the automatic tracking and recognition of the long jumpers' motion trajectory tracking image is carried out based on the dynamic feature segmentation [11], and the fuzzy regional gradient mode features of the input spatial visual image of the long jump trajectory are obtained.

$$\min_c \left(\min_{y \in \Omega(x)} \left(\frac{I^c(y)}{A^c} \right) \right) = \tilde{t}(x) \min_c \left(\min_{y \in \Omega(x)} \left(\frac{J^c(y)}{A^c} \right) \right) + (1 - \tilde{t}(x)) \tag{9}$$

Wherein, $\tilde{t}(x)$ is the matching set of image frame feature points, A^c is the statistical feature quantity of spatial visual distribution of long jump trajectory, and the image trajectory segmentation and information enhancement processing are realized by comprehensive analysis [12].

3 Adaptive Tracking and Optimization of the Track of the Long-Jump

3.1 Long Jump Track Feature Extraction

On the basis of the above adaptive tracking image design of long jumpers based on the video point frame scanning method, the adaptive tracking image of long jumpers is designed. In this paper, an adaptive tracking method of long jumpers' trajectory tracking images based on machine vision tracking detection is proposed, and the spatial vision planning model of long jumpers is constructed [13]. Combined with visual conduction technology, the position and pose adjustment and attitude correction of long jump motion are carried out, and the quantitative conduction tracking recognition of spatial vision of long jump trajectory is carried out by using modular feature matching technology. The pixel eigenvalues of spatial visual distribution of long jump trajectory are obtained as:

$$w\left(d_{ij}\right) = f\left(\left|x_i - x_j\right|\right) = \frac{1}{\sqrt{2\pi}}\exp\left\{\frac{\left(x_i - x_j\right)^2}{2}\right\} \tag{10}$$

The scene coordinates in the spatial visual distribution area of the long jump trajectory are $M \times N$, according to the spatial rotation and attitude adjustment of the long jump trajectory, the piecewise area planning is carried out, and the feature points of the long jump dynamic trajectory distribution are added to the reconstruction scene [14]. The visual feature quantity extraction and 3D reconstruction of the long jump trajectory are realized, and the reconstruction output is obtained as follows:

$$\beta_i = \exp\left\{-\frac{\left|x_i - x_j\right|^2}{2\sigma^2}\right\}\frac{1}{\mathrm{dist}\left(x_i, x_j\right)} \tag{11}$$

The visual image multi-layer mesh distribution model of the long jump motion track planning is constructed, and according to the difference of the acquisition environment of the long jump motion track space visual image, the spatial visual pose offset of the long jump motion track space is obtained as follows:

$$u(x, y; t) = G(x, y; t) \tag{12}$$

$$p(x, t) = \lim_{\Delta x \to 0}[\sigma\frac{u - (u + \Delta u)}{\Delta x}] = -\sigma\frac{\partial u(x, t)}{\partial x} \tag{13}$$

Wherein, Δu is the frame of long jump track tracking image with local correlation pixel point, and F is the spatial visual difference distribution characteristic quantity of long jump track. The grey feature quantity of track tracking image of long jump athletes is extracted [15], and the automatic spatial planning neighborhood distribution model of long jump motion is constructed. The similarity characteristic value of long jump track space is obtained as follows:

$$s(k) = \phi \cdot s(k - 1) + w(k) \tag{14}$$

Wherein

$$\phi = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix}, w(k) = \begin{pmatrix} N(0, \sigma_{\theta(k)}) \\ 0 \\ N(0, \sigma_{x(k)}) \\ 0 \\ N(0, \sigma_{y(k)}) \end{pmatrix} \tag{15}$$

The diffraction R, G, B components of the spatial visual feature distribution of the long jump trajectory are extracted, and the adaptive tracking image of the long jump track is carried out according to the results of feature extraction [16].

3.2 Trajectory Segmentation and Adaptive Tracking of Long Jump

The fuzzy constraint optimization function for strengthening the tracking image information of long jumpers is as follows:

$$\begin{array}{ll} \text{min}\textit{imize} & f(\vec{x}) \quad \vec{x} = (x_1, x_2, \ldots, x_n) \in \Re^n \\ \textit{subject to} & g_j(\vec{x}) \le 0, j = 1, \ldots, l \\ & h_j(\vec{x}) = 0, j = l+1, \ldots, p \end{array} \tag{16}$$

The statistical feature distribution model of the track tracking image of long jumpers is obtained as:

$$L_0(r) = \frac{L(r/2)}{2}, H_0(r) = H(\frac{r}{2}) \tag{17}$$

Wherein, r and θ are the coordinates of the frequency domain feature distribution of the long jump trajectory tracking image, and the dynamic characteristics of the long jump trajectory are analyzed in combination with the dynamic evolution feature distribution of the long jump trajectory [17]. The feature high resolution detection of the long jump track tracking image is carried out, and the detection function is obtained as follows:

$$\Omega = \left\{ \begin{array}{l} \vec{x} \in s | g_j(\vec{x}) \le 0, j = 1, \ldots, l; \\ h_j(\vec{x}) = 0, j = l+1, \ldots, p \end{array} \right\} \tag{18}$$

It is assumed that the fuzzy correlation constraint characteristic component of the tracking image of the moving track of the long jump athlete is expressed as follows:

$$c_1 = \{i | i \in S\}, \quad c_2 = \{\{i, i'\} | i' \in N_i, i \in S\}, \quad C = c_1 \cup c_2 \tag{19}$$

In the above formula, $i = 1, 2, \ldots, T$, it represents the length of pixel sequence, divides each template in the visual space of long jump motion, merges and filters the visual image of long jump motion space output by frame scanning, and obtains the image enhancement output as follows:

$$G_j(\vec{x}) = \begin{cases} \max\{0, g_j(\vec{x})\}, & 1 \le j \le l \\ \max\{0, |h_j(\vec{x})| - \delta\}, & l+1 \le j \le p \end{cases} \tag{20}$$

It can be simplified as:

$$G(\vec{x}) = \sum\nolimits_{j=1}^{p} G_j(\vec{x}) \tag{21}$$

By adopting the Harris corner point detection technology to carry out the track tracking and the information marking of the long jump, the motion track tracking image segmentation of the long jump athlete is realized, the self-adaptive tracking of the long jump motion track is realized according to the image segmentation result [18], and the implementation process of the algorithm is shown in Fig. 1.

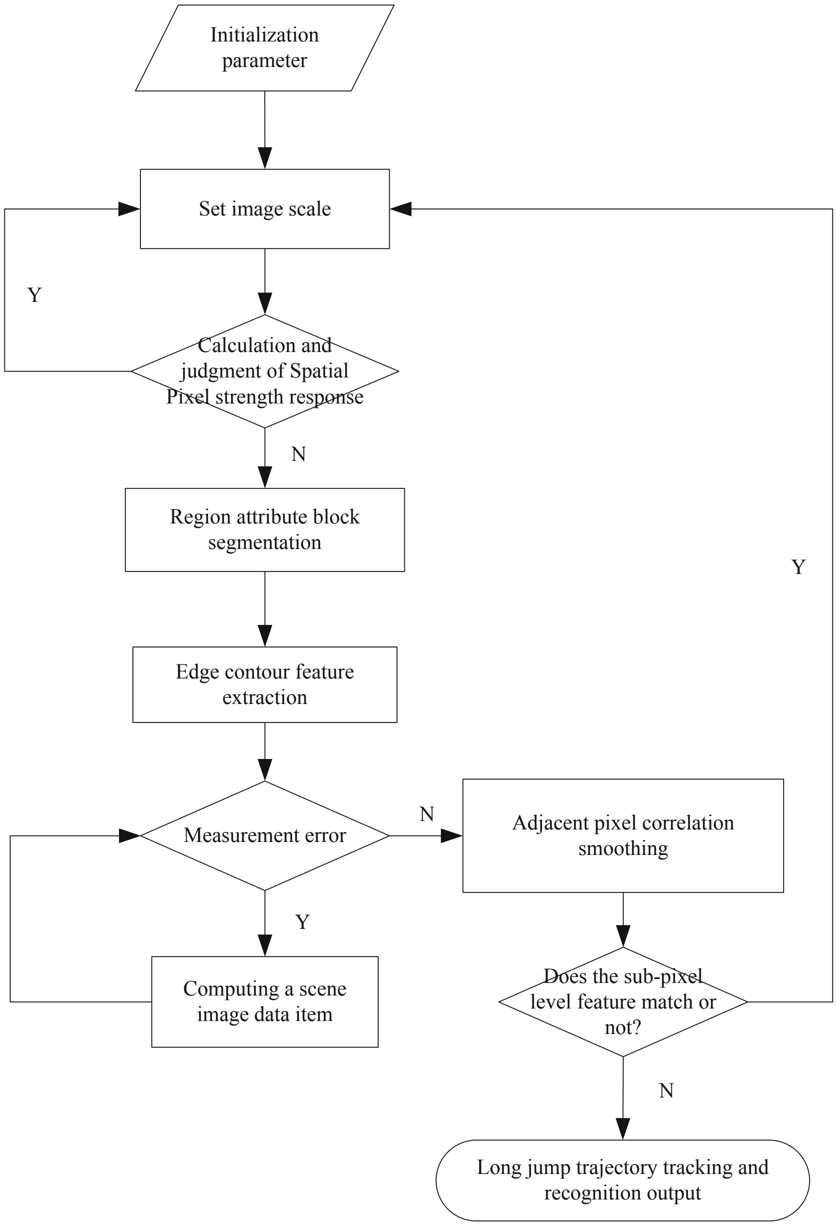

Fig. 1. Implementation flow of improved algorithm

4 Simulation Experiment and Result Analysis

In order to test the application performance of this method in the adaptive tracking and recognition of long jumpers' motion trajectory tracking image, the experimental test and analysis are carried out. Combined with Visual C++ and Matlab, the simulation algorithm of long jumper trajectory tracking image tracking image is designed. The pixel set intensity of adaptive tracking image of long jumpers' motion trajectory tracking image is 200, and the distribution of edge outline features is 400 $\leq$ 400. The number of iterations of image adaptive tracking learning is 1600 times, and the segmentation coefficient is 0.21. According to the above simulation environment and parameter setting, the adaptive tracking image of long jumpers is carried out, and the original tracking image of long jumpers is obtained as shown in Fig. 2.

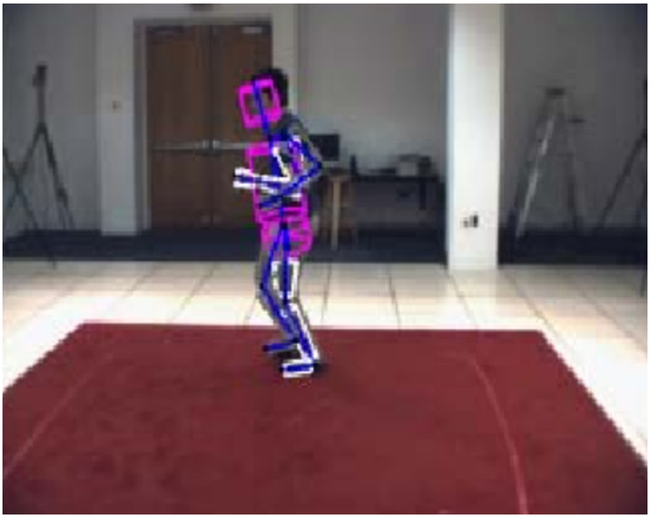

Fig. 2. Original long jump athlete's motion track tracking image

Taking the trajectory tracking image of long jumpers as the research sample, the neighborhood distribution model of automatic spatial planning for long jump motion is constructed. Combined with the dynamic evolution feature distribution of long jump trajectory, the dynamic characteristics of long jump trajectory are analyzed, and the segmentation and adaptive tracking of long jump trajectory tracking image are realized, and the tracking results are shown in Fig. 3.

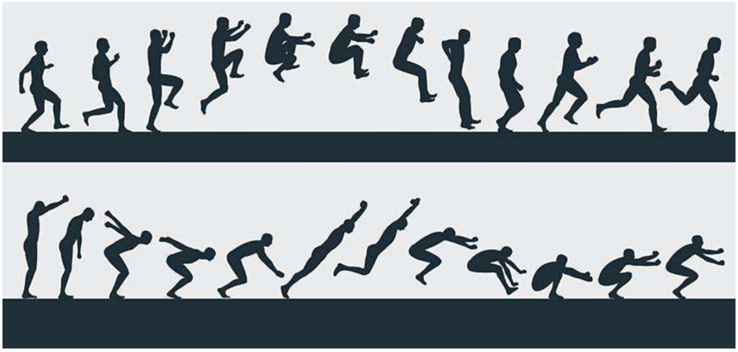

Fig. 3. Tracking adaptive tracking results

The method can effectively realize the self-adaptive tracking of the track-tracking images of the long-jump athletes by adopting the method, and the long-jump precision after the self-adaptive tracking of the moving track of the long-jump athletes is analyzed by adopting different methods, and the comparison result is shown in Fig. 4.

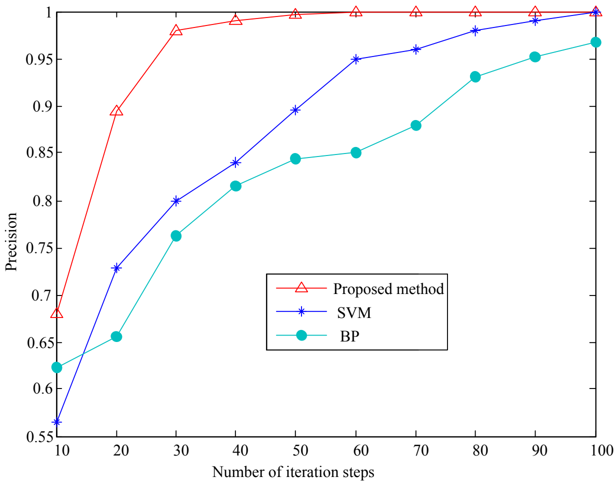

Fig. 4. Precision comparison

The analysis of Fig. 4 results show that the SVM and BP methods are compared with the proposed method, and the adaptive tracking accuracy and adaptive performance of the proposed long jump athlete's tracking image are high. The proposed method has better performance of adaptive tracking image for the long jump athlete.

5 Conclusions

The information fusion model of long jumper trajectory tracking image is constructed, and the visual evolution feature distribution of long jumper trajectory tracking image is automatically followed and recognized, so as to improve the identification ability of long jumper trajectory tracking image. In this paper, an adaptive tracking method of long jumper motion trajectory tracking image based on machine vision tracking and detection is proposed. The video point frame scanning method is used to collect the long jumper motion trajectory tracking image. The collected long jumper motion image is segmented by adaptive pixel fusion method, and the grey feature quantity of the long jumper motion trajectory tracking image is extracted. The automatic spatial planning neighborhood distribution model of long jump motion is constructed. according to the dynamic evolution feature distribution of long jump trajectory, the dynamic characteristics of long jump trajectory are analyzed, and the image segmentation of long jump track tracking is realized by combining spatial neighborhood enhancement technology, and the adaptive tracking of long jump trajectory is realized according to the image segmentation results. It is found that the proposed method has good adaptability to track the long jump trajectory and improves the accuracy of the long jump.

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