Tai Chi Detection Algorithm Based on Image Detection

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ABSTRACT: It is significant for its development and application to launch tai chi image and video detection, and the current image detection is hard to meet the needs. For the accuracy of multi-resolution tai chi image detection, the study put forward a novel estimation method of multi-resolution tai chi image nonparametric kernel density. Firstly, based on the theorem distribution of multi-resolution difference images, kernel density estimation algorithm is used to finish the obtaining of fitting degree optimum value, confirm current test parameters, and differentiate the matching degree of image distribution function in various samples. From a mathematical point of view, that is, we can obtain the optimal value of the wide window of the current difference image in the form of the application of the integral mean-square error, improve the smoothness of kernel density function image curve, reduce the loss of estimation accuracy led by wide window fitting, and get the result of kernel density function by adopting gk kernel function as an initial function for optimal wide window value, thus completing final estimation. After analysis and experiments, it can be determined that, because of adding several optimization programs, the proposed kernel density function evaluation method has higher accuracy and smoother image curve, and it has important application value for capturing tai chi image detection.

1. Introduction

As an important inheritance of Chinese traditional culture, Tai Chi is an important treasure of Chinese traditional culture. Practicing Tai Chi is able to effectively strengthen the physical quality and generally understand China's traditional philosophy, which is a great help to the physical and mental health of Chinese people. There are many schools of Tai Chi, do people generally believe that the Mandarin of Tai Chi is complex with a higher learning threshold, to a certain extent, which also puts a mysterious veil on Tai Chi. However, with the development of modern technology, Tai Chi learning can be perfected with the help of information image technology. In recent years, with the continuous development of PC network technology with computer vision and image detection technology as the core, it is gradually applied to various fields, including image splitting, image analysis, and image reorganization, and so on. To sum up, the so-called image vision detection is a comprehensive image processing technology that takes the computer network vision technology as the core to analyze and arrange according to the current image's own conditions and characteristics. Its content information includes image texture, image gray, image color, image area, and image contour lamp. The related personnel needs to extract key information in the current image data to construct a new image detection algorithm, which not only effectively improves image accuracy, but also meets various special needs, such as high accuracy calibration. With the rapid progress of Tai Chi online teaching mode and effective combination between them, it can effectively improve the comprehensive quality of Tai Chi video materials, reduce the difficulty of Tai Chi online teaching and advance the promotion of Tai Chi.

1.1 Kernel Density Detection Algorithm for High Resolution Tai Chi Image

According to the research data, it can be determined that many Tai Chi image information materials can not complete high-precision registration and detection. The core reason is that most video images only pay attention to the frame difference, but ignore the similarity difference of video

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frame content and body structure. In the process of image selection, the key algorithm is the evaluation and detection algorithm of its nonparametric kernel density. Based on this context, the study takes Tai Chi video image data as the study object, and constructs a new Tai Chi image kernel density detection and estimation algorithm as a new Tai Chi detection algorithm based on the traditional image detection algorithm. The core idea is as follows:

Generally speaking, in practical applications, there are different linear relationships in low and high dimensions for multi-resolution images, which are non-decomposable. The process of data detection can be viewed as the process of mapping low dimensions data to a series of higher dimensions. Then, if you want to directly use nonlinear image data, you need to determine the dimension of image feature space and a series of equivalent conditions, among which the biggest problem is that the model dimension is too large and the amount of calculation is increasing.

If the kernel density detection and evaluation algorithm are adopted, the Tai Chi image could be processed in the form of a specific kernel function to avoid the problem. The variable density of the image can be solved by parametric estimation and nonparametric estimation. Because the density function of random variables needs to be determined in advance, the difference between the density function of random variables and the estimated density function will be too large in the market, resulting in a large error in the final function estimation. Therefore, nonparametric kernel density estimation is gradually proposed. On this basis, the design sets the input variables and the optimal window width selection, and completes the kernel density correlation prediction estimation according to the given and calculated data values, thus completing the image detection. The overall process is as follows:

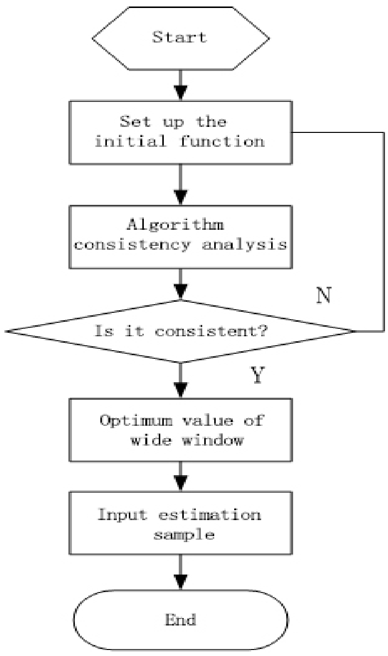

Fig.1 Estimation Flow-Process Chart

2. Tai Chi Image Collection and Preprocessing

KS test is required for image collection and preprocessing. The process is mainly based on multi-resolution Tai Chi image Kolmogoiov theorem distribution and fitting degree optimization to determine the parameter test algorithm. By comparing the cumulative frequency distribution of the current two groups of Tai Chi image data under different image backgrounds, this method tests whether the sample distribution function and hypothetical distribution function are in the current unified background. In a word, the processing of the KS test is to differentiate the matching degree of different Tai Chi sample image distribution functions, which is for determining future image background of nonparametric kernel density estimation.

KS test belongs to nonparametric hypothesis test with high adaptability and stability, so the test process does not need distribution management condition and sample basis of data sample.

A one-dimensional single sample data of multi-resolution Tai Chi image pixels is designed to test and process. In other words, by comparing the distribution function of sample experience, that is, the current original hypothesis function and the cumulative distribution function of kernel density, the adaptability of the background fitting of the current nonparametric kernel density estimation method is determined. The specific detection steps are as follows:

step1:set the original hypothesis image function as $F_n(x)$,cumulative distribution function of kernel density as $G(x)$,it will get:

$$H_0 : F_n(x) \equiv G(x); H_1 : F_n(x) \neq G(x) \tag{1}$$

step2:Construct image sample test statistics according to formula (1):

$$KS = \max(|F_n(x) - G(x)|) \tag{2}$$

If the data of H0 is real, KS has small trend extension data, which indicates that the fitting degree of the current hypothetical original function and kernel density accumulation distribution function is good; On the contrary, if H0 is false, KS has a large trend extensibility value, which indicates that the current hypothetical original function and kernel density cumulative distribution function have poor fitting [11]. If G (x) is in continuous distribution and H0 is true, the limit distribution function can be obtained as follows:

$$\lim_{n\to\infty} P(\sqrt{n}KS \le t) = 1 - 2\sum_{i=1}^{\infty}(-1)^{i-1} \tag{3}$$

step3:Set the obvious function level threshold value as a, that is, the critical value of sample data and the boundary of image pixel rejection domain is a.

step4:Calculate the value p of the test sample, compare the data with the threshold value a, and depict it by the H value;

step5:Analyze and judge the sample data to determine the results of acceptation acceptance and rejection of the hypothesis. When the p p-value is greater than a value, the original hypothesis is accepted; on the contrary, when the p p-value is less than or equal to a value, the original hypothesis is rejected. The detailed process is as follows:

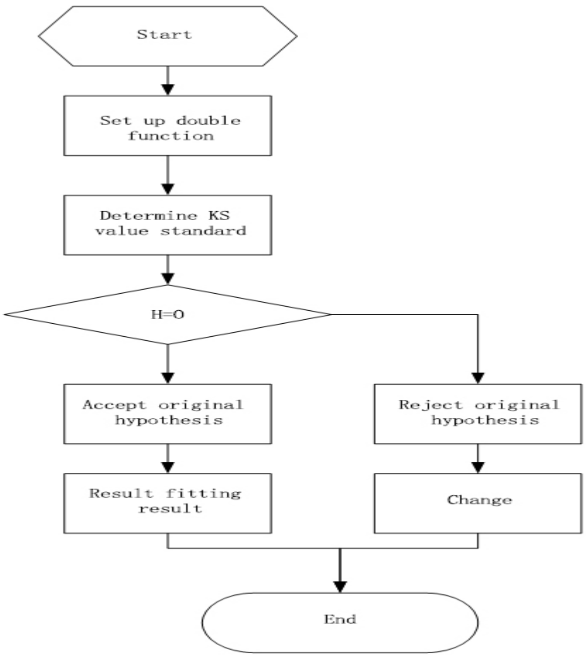

Fig.2 Tai Chi Image Flow-Process Chart

3. Tai Chi Image Storage

It is necessary to select the optimal window width data for processing image storage, which will directly affect the evaluation result of Tai Chi image kernel density. Theoretically, the h value will decrease with the increase of Tai Chi image sample data n. When n tends to infinity, the h value tends to 0. When the consistency of the Tai Chi image is determined, if the value of window width is too small, the sample points in the sample interval will be reduced, which will increase the influence of randomness. The obtained probability density function can reflect the sample point information of multi-resolution difference, but its curve is an unsmooth broken line; On the contrary, if the wide window h value is too big, the sample points in the sample interval will continue to increase, which can lead to the narrowing of the gap between the pixels of the Tai Chi image and the kernel function value, and the influence of the averaging of the density function values without sample points will increase. At this time, although the density function curve is smooth and the result resolution is low, it is unable to intuitively reflect all the information contained in the data, and the final storage effect is not ideal.

For the purpose of selecting the optimal wide window data value, the sample fitting method is used to obtain the optimal window width value. Because this design is programmed in MATLAB simulation, the mathematical principle of obtaining the optimal wide window value is mainly extracted by using the minimized risk function, that is, the average integral square difference error function. Minimizing the risk function can obtain the difference between the evaluated density function $\overline{f}_h(x)$ and the image real density function $f(x)$. The specific expression formula is as follows:

$$MISE\overline{f}_h(x) = E\left[\int\left\{\overline{f}_h(x) - f(x)\right\}^2 dx\right] \tag{4}$$

MISE mainly obtains the optimal window width solution from a mathematical point of view. Generally, the extreme point of the partial derivative of the value corresponding to the minimum h value of MISE is the peak point of the current image data. The derivation process is as follows:

$$\begin{aligned} MISE\overline{f}_h(x) &= E\left[\int\left\{\overline{f}_h(x) - f(x)\right\}^2 dx\right] \\ &= \int E\left[\overline{f}_h(x) - f(x)^2\right]dx \\ &= \int E\left\{\overline{f}_h(x) + E\left[\overline{f}_h(x)\right] - E\left[\overline{f}_h(x)\right] - f(x)\right\}^2 dx \\ &= \int E\left\{\overline{f}_h(x) - E\left[\overline{f}_h(x)\right] + E\left[\overline{f}_h(x)\right] - f(x)\right\}^2 dx \\ &= \int\left[\left\{Bias\left[\overline{f}_h(x)\right]\right\}^2 + Var\left[\overline{f}_h(x)\right]\right]dx \\ &= \int\left[Bias\left[\overline{f}_h(x)\right]\right]dx + \int Var(\overline{f}_h(x))dx \end{aligned} \tag{5}$$

In formula (5), $Bias\left[\overline{f}_h(x)\right]$ and $Var\left[\overline{f}_h(x)\right]$ respectively stands for the deviation value and variance value of current estimated density function $\overline{f}_h(x)$,The value can directly reflect the estimation effect of kernel function density. Substitute formula (6) into

$$f_h(x) = \frac{1}{nh}\sum_{i=1}^{n} K(\frac{x - X_i}{h}) \tag{6}$$

It can be further deduced that:

$$\begin{aligned} E\left[\overline{f}_h(x)\right] &= E\left[\frac{1}{nh}\sum_{i=1}^{n} K(\frac{x - X_i}{h})\right] \\ &= E\left[\frac{1}{h}K(\frac{x-y}{h})\right] \\ &= \int\left[\frac{1}{h}K(\frac{x-y}{h})f(y)\right]dy \end{aligned} \tag{7}$$

For the convenience of calculation, set $A = Bias(\overline{f}_h(x))$, $B = Var(\overline{f}_h(x))$;Firstly, A is deduced, and the overall derivation process is as follows:

$$\begin{aligned} A &= E\left[\overline{f}_h(x)\right] - f(x) \\ &= \int\left[\frac{1}{h}K(\frac{x-y}{h})f(y)\right]dy - f(x) \end{aligned} \tag{8}$$

let $z = \frac{x-y}{h}$,it will obtain $y = x - hz$. Substituting it into the formula has:

$$A=\int\left[\frac{1}{h}K(\frac{x-y}{h})f(y)\right]dy-f(x)$$
$$=\int\left[K(z)f(x-hz)\right]dz-f(x) \tag{9}$$

After expanding and simplifying the intermediate term $f(x-hz)$ in the above formula (9), the following formula can be determined

$$A=\frac{1}{2}h^2 f(x)\int t^2K(t)dt+o(h^2) \tag{10}$$

After determining the value of A, continue to calculate the value of B, and the derivation process is as follows:

$$B=\int E\left\{\left[\bar{f}_h(x)\right]-E\left[\bar{f}_h(x)\right]\right\}^2$$
$$=E\left[\bar{f}_h(x)\right]^2-E\left[\bar{f}_h(x)\right]^2$$
$$=E\left[\frac{1}{nh}\sum_{i=1}^{n}K(\frac{x-X_i}{h})^2\right] \tag{11}$$

To sum up, by substituting the above formulas (10) and (11) into formula (4), it can be determined that the final derivation expression is:

$$MISE(\bar{f}h)=\frac{1}{nh}\left[\int K^2(z)dz+h^4\right]\int f(x)^2dx \tag{12}$$

Formula (12) is called progressive integral variance error algorithm. When MISE is the minimum value, the corresponding h value is the final optimal window width value derived. And save the following equation relationship:

$$h_{opt}=\frac{\int K^2(t)dt}{n\left[\int t^2K(t)dt\right]^2\int\left[f``(x)^2\right]dx} \tag{13}$$

The above derivation process is mainly the data calculation process of obtaining the window width optimal value of the current Tai Chi image in the form of integral mean square error. The design solves the optimal wide window value through MATLAB, which is mainly based on the integral mean square error algorithm. The obtained window width value is optimal. At this time, the data can be stored, and its final kernel density evaluation result is the best.

4. Detection and Estimation of Tai Chi Image

A large number of experimental data confirm that if the processed Tai Chi image sample is enough large, the specific form of kernel function under kernel density estimation will reduce the impact on the current probability density evaluation results of the Tai Chi image. However, because the study object is multi-resolution Tai Chi video images, the design uses the GK kernel function as the initial function to realize the final evaluation:

$$k(x)=\frac{1}{\sqrt{2\pi}}\exp(-\frac{x^2}{2}) \tag{14}$$

The coordinate value M is introduced to obtain the function:

$$k(x)`=\frac{3}{4}(M-x^2)M \tag{15}$$

Further derived as:

$$k(x)``=\frac{15}{16}(M-x^2)^2M \tag{16}$$

According to the above initial kernel function, the kernel density function is evaluated in the form of unconditional quantile regression. Design the basic model with RIF as unconditional quantile regression:

$$q_0(y)=\int RIF(q_0,y,F_y)dF_r(y) \tag{17}$$

In formula (17), $RIF(q_0,y,F_y)$ is the executive quantile of the explained variable distribution function F at the corresponding dividing point. According to the central influence function and the description definition, the final data value can be obtained as

$$RIF(q_0,y,F_y)=q_0+\frac{-(y\leq q_0)}{fy(q_0)} \tag{18}$$

Formula (18) q_0 represents unconditional quantile. The following formula can be obtained by data iteration using the conditional expected value of Tai Chi image:

$$q_0(y)` = \int E(RIF(q_0, y, F_y)dF_X(x)) \tag{19}$$

Arrange relevant formulas:

$$UQPE = \int \frac{\partial E(RIFq_0, y, F_y)}{\partial x} dFx \tag{20}$$

Using RIF unconditional quantile regression generally has the following judgment, and the simulation evaluation is completed by relying on the following steps. Firstly, the regression score of the current Tai Chi image that can be obtained by statistics is uniformly evaluated and calculated, and then the partial derivative is obtained by the following formula:

$$\int \frac{\partial E(RIFq_0, y, F_y)}{\partial x} \bigg| X = \frac{F_X(x)}{2} \tag{21}$$

Finally, calculate in the corresponding formula to obtain the final evaluation result:

$$\frac{1}{n}\sum_{i=1}^{n} \frac{\partial E(RIF(qr, y, Ey)}{\partial x} \bigg|_{x=xj} \tag{22}$$

The high-precision detection of Tai Chi images can be realized by bringing the results of the above evaluation algorithm into the image detection platform.

5. Experimental Data Analysis

Considering the theme of this study is the detection of multi-resolution Tai Chi images and the experimental environment factors, this experiment uses a neural network system to build a simulation evaluation information feedback platform and obtains 200 quantiles of predicted Tai Chi video images as input variables for kernel density estimation. By calculating and comparing the probability density curve of predicted Tai Chi images, it can obtain the detection data of front and back scenes and movements of Tai Chi images, and the final evaluation results can be determined.

5.1 Experimental Image Process

In the current simulation system, digital elevation preprocessing module, pre-matching module, pixel overall offset determination module, spectrum analysis module, and enhanced registration module are applied respectively. The application of each module in the laboratory is as follows:

The digital elevation preprocessing module mainly uses the external DEM operation of the simulation experiment software to process the image InSAR. Firstly, the main image needs to be registered to generate SAR numerical image, simulate the radar coordinate information of the numerical image, and obtain the simulated phase mass based on the track information.

The pre-configuration module firstly needs to merge all Burst images in the image and determine the elevation information after the ICC refining result coordinate radar according to the corresponding image value of the registration method.

The overall pixel offset module is applied to find the corresponding sequence table to sample and investigate the current auxiliary image. What's more, image registration is completed based on the phase difference between the experimental image and the auxiliary image. Because of the long period of this process, it is necessary to ensure that the experimental platform will not introduce abnormal interference signals. To reduce the experimental consumption, data offset can be completed only in phase position. Finally, the image is enhanced and registered, the registration error is introduced according to the image compensation information, the main image processed by the current module is sampled, the BURST tilt processing is obtained, and the upper and lower frequency images are divided. After the auxiliary processing for the lower frequency image, the BURST pixel differential interferogram is generated, and the pixel point registration operation is carried out one by one. Through the ESD algorithm, the parameter registration error caused by the current precision orbit is compensated, and the auxiliary image is generated for interference operation. The overall application model is shown as follows:

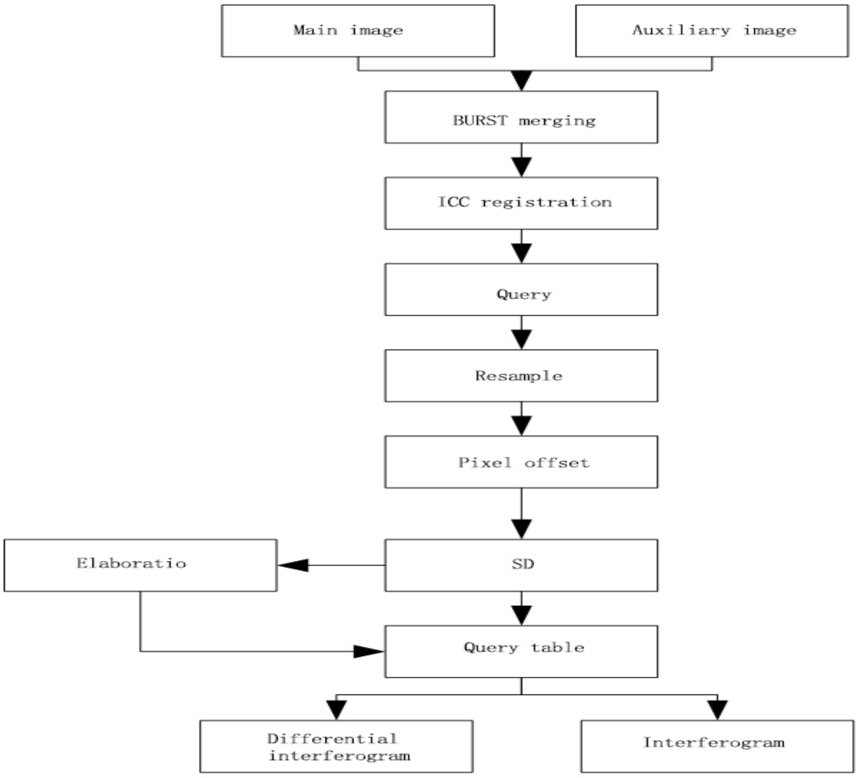

Fig.3 Experimental Image Processing

5.2 Experimental Result Analysis

In order to verify the effectiveness of the above above-designed image detection method, the study takes the traditional inter inter-frame difference detection method as the comparison group, applies the experimental processing image, and determines the experimental function image through image simulation, as follows:

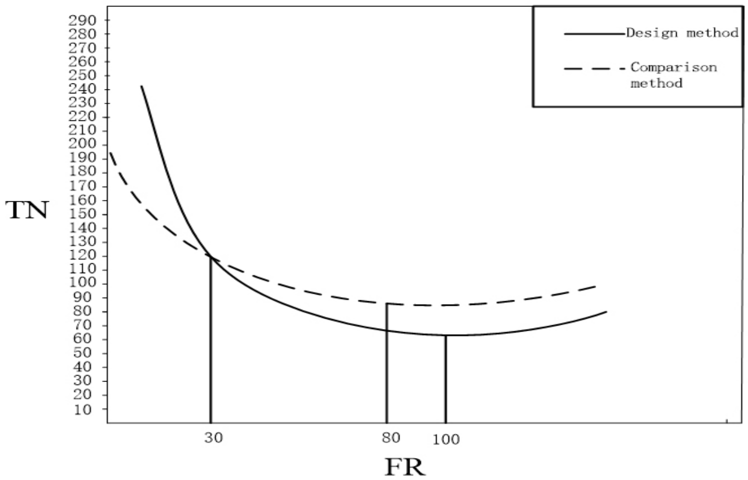

Fig.4 Experimental Comparison Drawing

According to the generated experimental comparison images, it can be determined that the displacement curvature of the image curve of the design method is significantly higher than that of the curve image generated by the traditional method. It shows that the obtained kernel density function is more accurate and the evaluation results are more convincing. According to the above images, the frame difference comparison image is produced: cutting the front and back view:

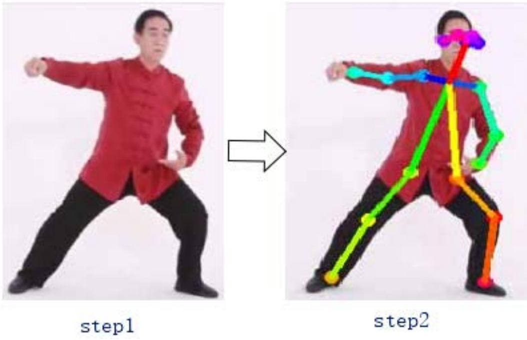

Fig.5 Partial Experimental Comparison Drawing

As can be seen from the above figures, the currently designed Tai Chi image detection method has high motion-capture performance, and the generated time series is clear, which is enough to show the superiority of the new method.

6. Conclusion

As one of the Chinese traditional fitness sports, Tai Chi not only possesses extremely high learning and application value but also contains the development of folk culture in China. Currently, the existing image and video detection technology mainly use feature trajectory and frame difference for detection and registration, which has been difficult to meet its needs. In this regard, the design takes the evaluation and detection algorithm innovation of parameter kernel density as the core and regards Tai Chi video image data as the study object to construct a new Tai Chi image detection algorithm based on the traditional image detection algorithm. Its core work is as follows:

(1)Finish the pre-processing of the image by KS detection algorithm

(2)Select the optimal wide window data h and finish the image storage

(3)Take the GK kernel function as the initial function to realize the final estimation detection

After experimental verification, the comprehensive effect of the algorithm is the best that is valuable to be promoted and applied.

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