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Article

Application of multi feature medical image fusion in biomechanics experimental teaching of sports rehabilitation

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Abstract: With the increasing demand of society for sports rehabilitation, many colleges and universities have set up the sports rehabilitation biomechanics specialty, which has been listed as a professional basic course in some colleges and universities. However, there are still many problems in the experimental teaching of this course, such as the failure to recognize the human movements in medical images in a timely manner, which makes it impossible to judge whether the movements of motion rehabilitation are standard. However, multi feature medical image fusion can become a new method, which has been widely used in the application and research of medical images, and its position and role in teaching have been further strengthened. Multi feature medical image fusion can not only eliminate redundant information, but also maintain the original image information, and achieve better fusion results. Under the background of multi feature medical image fusion, this paper proposed a support vector machines (SVM) method based on mixed kernel function. This method not only makes the motion recognition of traditional Chinese medical images of motion rehabilitation biomechanics more accurate, but also faster. The experimental results showed that the recognition accuracy and recognition rate of the kernel function were 60.2% and 53.7% when the number of samples was 800. The recognition accuracy and recognition rate of SVM were 65.5% and 53.8%. The recognition accuracy and recognition rate of SVM based on mixed kernel function were 89.9% and 86.7%. This further proved that SVM based on mixed kernel function was superior to the other two methods in recognition accuracy and recognition rate, which proved the superiority of this method in rehabilitation motion recognition.

Keywords: multi feature medical image function; support vector machines; mixed kernel function; biomechanics of sports rehabilitation

1. Introduction

The pressure at the injury site directly affects the occurrence frequency and healing speed of sports injury. The use of sports rehabilitation biomechanics can effectively study the mechanism, etiology and rehabilitation results of injury. Biomechanics and the field of sports injury have been combined to produce a new field of sports rehabilitation biomechanics, which specializes in the occurrence and rehabilitation of sports injury. The research on the rehabilitation of sports injuries using biomechanical methods has been quite mature internationally. In recent years, China has gradually combined it with sports rehabilitation. With the continuous improvement of biomechanical test equipment, the detection means and theory of biomechanics are constantly improved. The research on biomechanics of sports injury is no longer limited to bone tissue, but more and more attention is paid to cartilage, nerve and synovium. The research on biomechanics of sports rehabilitation provides strong support for the rehabilitation treatment of sports injury in the future.

With the rapid development of medical image technology, the application of medical image in sports rehabilitation biomechanics teaching is also increasing. New technologies are constantly being proposed. The rapid development of computer technology has made people step into the era of information, digitalization and rapid development. Multi feature medical image fusion is an important part of medical images. It can create more vivid and vivid medical images through various scientific and technological means. For example, digital models and three-dimensional images can be drawn through computer image design and processing software. These are all multi feature medical image fusion involved in sports rehabilitation biomechanics, which is more effective and persuasive than simple language.

2. Related work

In recent decades, people have made great progress in the research of sports rehabilitation biomechanics. According to the research of Troy et al., injuries were very common in sports, and there were many factors that would increase the possibility of injury, including biomechanics. The quality of bone would be affected by biomechanical variables. Finally, he discussed the impact of biomechanical load on bone, and also discussed how to evaluate the biomechanics of sports rehabilitation [1]. According to Migel and Wikstrom, many ankle sprains were diagnosed every year and are characterized by repeated sprains, persistent pain and hypofunction. The patient's biomechanical abnormalities were believed to be caused by these injuries. Biomechanics in sports rehabilitation has been proved to reduce the risk of ankle sprain recurrence [2]. According to DiCesare, the biomechanical analysis of sports rehabilitation was often used to quantify the biomechanical risk factors of lower limb injury, and then it was used to guide targeted treatment aimed at reducing dangerous sports patterns [3]. Sports rehabilitation biomechanics can evaluate the biomechanical defects that cause athletes' lower limb injuries, and provide a promising method for more thorough evaluation of sports skills, which would help guide the future rehabilitation and prevention work.

Multi feature medical image fusion is of great significance in the teaching of sports rehabilitation biomechanics. Bonnette et al. observed that the current biomechanical strategy of sports rehabilitation cannot reduce the high injury rate of athletes. In order to reduce the biomechanical risk factors related to injury, he used a unique, objective and real-time method to avoid the existing injury problem, which was multi feature medical image fusion [4]. According to Arhos et al. research, biomechanical asymmetry in gait becomes frequent and continuous after anterior cruciate ligament rupture. Sports rehabilitation was an important clinical sign of sports function recovery and also a standard of sports recovery. Multi feature medical image fusion can help improve the efficiency of sports rehabilitation [5]. Quintana and Hoch research showed that poor neurocognitive function may be a risk factor for lower limb musculoskeletal injury. Despite these findings, few studies have explored the relationship between exercise rehabilitation biomechanics and musculoskeletal injury. Recent studies have evaluated the relationship between lower limb biomechanics and neurocognitive performance, which may reveal the mechanism of musculoskeletal injury, and propose a new method of sports rehabilitation multi feature medical image fusion [6]. The research of the above scholars shows that multi feature medical image fusion is a basic movement to reduce the risk of long-term injury. Multi feature medical image fusion has significantly enhanced the biomechanics of sports rehabilitation in rehabilitation sports.

In the multi feature medical image fusion, the original image features should be extracted first, and then analyzed and fused comprehensively to achieve better recognition effect. Multi feature fusion is a transitional level of image fusion, which plays an important role in medical image fusion. The use of multi-feature medical images in teaching can effectively improve the teaching effect and is a good teaching method.

3. SVM multi feature medical image fusion method based on mixed kernel function

Sports rehabilitation biomechanics came into being in the 1960s with the rapid development of sports and computing technology [7]. Sports rehabilitation biomechanics is mainly used to clarify the technical principles of each project, thus providing a theoretical basis for athletes to carry out technical diagnosis and improve training methods. In addition, sports rehabilitation biomechanics has also been applied to prevent sports injuries, improve sports and rehabilitation equipment, and reconstruct anterior cruciate ligament [8]. For example, it also plays a great role in the judgment of brain injury and serious leg injury, providing reference for athletes' selection [9,10]. The content of sports rehabilitation biomechanics is shown in **Figure 1**:

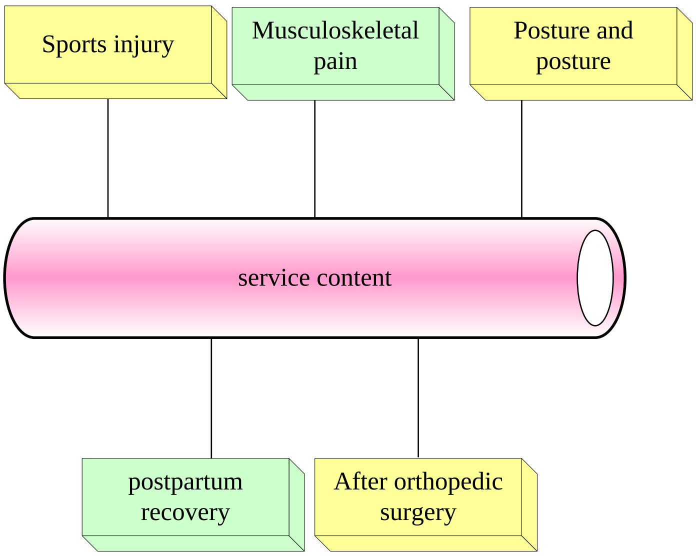


Figure 1. Contents of exercise rehabilitation biomechanics.

As shown in **Figure 1**, the biomechanics of sports rehabilitation includes postpartum rehabilitation, sports injury, posture and posture, musculoskeletal pain, and orthopedic surgery. Sports rehabilitation biomechanics is an important part of college disciplines, which is of great significance to the development of sports in China. Now, sports rehabilitation biomechanics courses have been widely applied to the health promotion of sprinters and low back pain and other fields [11,12]. Sports rehabilitation biomechanics has been recognized as a new comprehensive development trend in the prevention of injuries in dance jumping. While acknowledging the great progress in this field, people have to admit that the development of these two fields is not perfect [13,14].

3.1. Multi feature medical image fusion based on SVM

In the past decades, due to the rapid development and extensive use of medical image technology, the image data has shown an explosive growth trend. Therefore, how to effectively and accurately analyze the biomechanics and rehabilitation activities in sports injuries is the most challenging topic at present [15,16]. With the promotion of information technology, using computer technology to analyze images can not only greatly improve the analysis and diagnosis of imaging doctors, but also greatly improve the accuracy of lower limb biomechanics analysis [17]. Therefore, the application of multi feature medical image fusion has been paid more and more attention. Multi feature medical image fusion has made great progress in image recognition, target detection, and has been widely used in image processing. The schematic diagram of multi feature medical image fusion is shown in **Figure 2**:

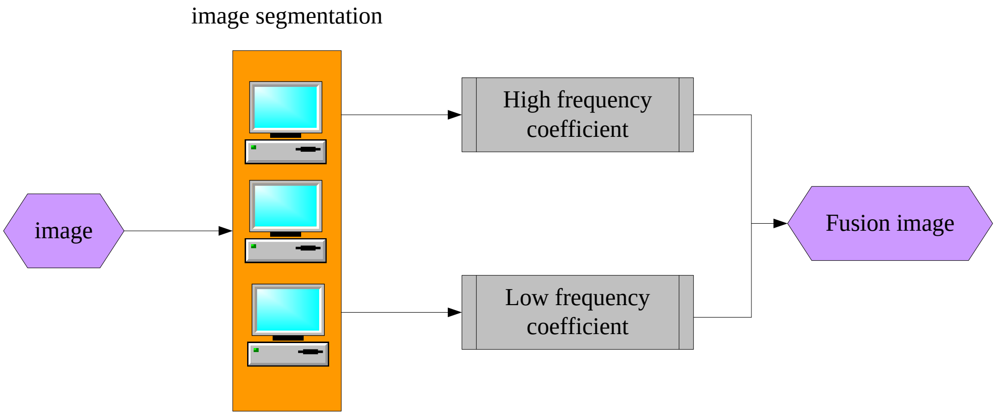


Figure 2. Schematic diagram of multi feature medical image fusion.

As shown in **Figure 2**, in the research of medical images, correct diagnosis and evaluation of biomechanics of various complex parts of human body injuries must rely on multi feature medical image fusion [18,19]. In recent decades, due to the rapid development of computer technology, this technology has also been greatly developed. It would not only produce sports injuries in sports, but also need to use biomechanics to analyze the injury site in the low back pain caused by rowing [20].

Multi feature medical image fusion mainly includes two parts: feature transformation and feature selection, and the most common one is featuring transformation. Feature conversion is to map the original feature space to the low dimensional feature space, which can effectively reduce the dimension of the feature space and eliminate the correlation between features, thus reducing unnecessary information in features.

SVM is a supervised learning model that uses mathematical methods and optimal techniques for data analysis, pattern recognition and regression analysis. It has significant advantages in dealing with nonlinear high-dimensional pattern recognition.

SVM has played a great role in medical image recognition, medical diagnosis and image segmentation [21].

From the perspective of statistical learning, it can be seen that the best classification hyperplane can minimize the structural risk, and the principle of SVM is to seek the best hyperplane, so the decision function is obtained as Equation (1):

$$f(a) = \text{sign} w \times a + b \tag{1}$$

The symbolic function is represented by $\text{sign}(\bullet)$. The process of finding the maximum classification interval is essentially the same as that of finding the optimal classification hyperplane. Therefore, Equation (2) can be used to define the optimization problem of linearly separable SVM:

$$\min I\,(w, b) = \frac{1}{2}\|w\|^2 \tag{2}$$

$\min I\,(w, b)$ is a convex quadratic optimal problem, which is also a problem to be solved by SVM. Generally, a Lagrangian multiplier α is introduced to convert it into a dual problem, and then Equation (3) is used to solve it:

$$\min W\,(\alpha) = \sum_{j=1}^{n} \alpha_j \tag{3}$$

In general, not all data are linear. In addition, no matter which hyperplane is, there would be some classification errors. People call this data linear and indivisible optimal hyperplane. The optimal hyperplane is shown in **Figure 3**:

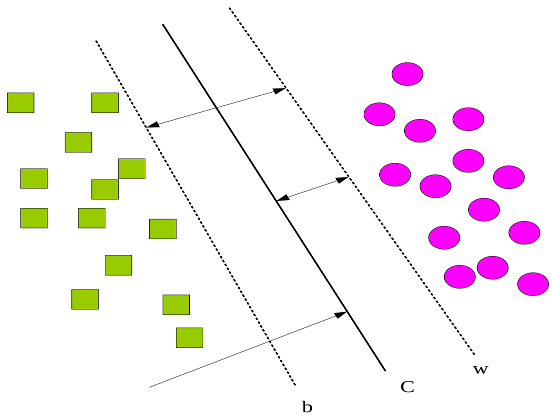


Figure 3. Optimal hyperplane of linear indivisible correspondence.

As shown in **Figure 3**, the optimal hyperplane can establish a hyperplane for a linear indivisible problem to minimize the average classification error of the training set, providing a class of nonnegative scalar variables ξ_j^δ called relaxation variables. It is used to evaluate the degree to which the sampling point deviates from the mode under ideal conditions, as shown in Equation (4):

$$\min J\,(w, b, \xi) = \frac{1}{2} w^T w + C \sum_{j=1}^{n} \xi_j^\delta \tag{4}$$

C is usually called penalty coefficient, also called penalty factor, and the probability of classification error increases with the increase of *C*.

In reality, many problems are nonlinear, so the application of SVM in solving nonlinear problems is very meaningful. On this basis, nonlinear problems are transformed into linear problems and optimized. The transformed feature space is often high-dimensional, so it is difficult to process data, so a new nonlinear SVM algorithm is proposed.

If Equation (5) exists:

$$K(a,a') = \Phi(a)(a') \quad (5)$$

The kernel function can be used to indirectly derive the linear characteristics of a in the high-dimensional feature space. The kernel function can be used to obtain the decision function $f(a)$, as shown in Equation (6):

$$f(a) = \mathrm{sign} w \times a + b \quad (6)$$

Among them

$$w = \sum_j \alpha_j K(a, a_j) \quad (7)$$

In the identification process, there are only inner products of support vectors and α_j, so the complexity mainly depends on the number of support vectors. The kernel function K is introduced into the expressions of the initial problem and dual problem, and the nonlinear objective function min $W(\alpha)$ corresponding to SVM is obtained, as shown in Equation (8):

$$\min W(\alpha) = \frac{1}{2}\sum_{i,j=1}^{n} \alpha_i \alpha_j b_i b_j K(a_i, a_j) \quad (8)$$

SVM has simple data structure, low computational complexity and strong versatility. However, when processing large amounts of data, its computing speed would become slow, and it is particularly sensitive to data interference [22].

3.2. Multi feature medical image fusion based on kernel function

Kernel function is a pattern recognition technology, which can deal with the classification problem of nonlinear SVM very well. Its advantage is to use objective nonlinear mapping to replace nonlinear learning, which makes the nature of the problem better reflected.

Compared with other methods, kernel function has a strong learning ability and can find the internal relationship between data. At present, there are some common kernel functions [23]. Because the characteristic of Gaussian kernel function is infinite space, it has become the most commonly used kernel function. The $K(a,a')$ number of Gaussian kernels is shown in Equation (9):

$$K(a,a') = \exp\left(-\|a - a'\|^2 / 2\sigma^2\right) \quad (9)$$

The Sigmaid kernel function is Equation (10):

$$K(a,a') = \tan h\big(g(a,a') + h\big), g > 0, h < 0 \quad (10)$$

Although the kernel function can not fully satisfy the positive semidefinite property, it is very useful in some practical applications. In the fields of image processing and feature dimensionality reduction, the kernel function is widely used in dimensionality reduction.

Under the condition that the kernel function criterion is satisfied, the kernel function K_{local} only uses a set of independent features for each case, and the optimal combination of coefficients can reflect the importance of sample features [24]. On this basis, this paper proposed a mixed kernel function K_{mix} based on local kernel function and global kernel function as Equation (11):

$$K_{\mathrm{mix}} = mK_{\mathrm{local}} + (1-m)K_{\mathrm{glocal}} \tag{11}$$

From the above theory, it can be seen that the linear combination conforms to the kernel function K_{glocal}, in which the parameter m is the coefficient determining the combination ratio of the two. In this paper, the representative local kernel function and the representative global kernel function, namely, Gaussian and polynomial kernel functions, are selected to form a mixed kernel function as Equation (12):

$$K_{\mathrm{mia}}(x, x_i) = mK_{\mathrm{gauss}}(x, x_i) + (1-m)K_{\mathrm{poly}}(x, x_i), 0 \leq m \leq 1 \tag{12}$$

$K_{\mathrm{gauss}}(x, x_i)$ stands for polynomial kernel function.

The choice of mixed kernel function is mainly based on its advantages in dealing with complex nonlinear data. Compared with the single kernel function, the mixed kernel function can make full use of the advantages of local kernel function and global kernel function, which makes the classifier have stronger separation ability in high-dimensional space. Local kernel functions, such as Gaussian kernel functions, perform well in dealing with local nonlinear features, while global kernel functions, such as polynomial kernel functions, perform well in dealing with global nonlinear features. By combining the two, the mixed kernel function can provide stronger learning ability and better data processing ability, so it can perform well in medical image recognition. Although traditional machine learning models such as decision tree and random forest perform well in some tasks, they often perform worse than SVM combined with mixed kernel function when dealing with high-dimensional nonlinear data. The experimental results also show that SVM based on mixed kernel function is obviously superior to other methods in recognition accuracy and recognition speed, which further verifies its superiority in the recognition of motor rehabilitation.

3.3. Multi feature medical image fusion based on mixed kernel function SVM

1) Multi feature medical image fusion method

Since many properties of SVM depend on the type of kernel function used, it is unrealistic to explain the properties of different kernel functions. The mixed kernel function can comprehensively use the advantages of different kernel functions to improve the performance of the classifier. Local kernel functions such as Gaussian kernel function have the advantage of dealing with local nonlinear features, while global kernel functions such as polynomial kernel function have significant effect in dealing with global nonlinear features. By combining these two kinds of kernel functions, the mixed kernel function can provide better separation ability and learning performance in high-dimensional space. The theoretical basis of this choice can be traced back to the principle of structural risk minimization in statistical learning theory, which aims to improve the generalization ability of the model by optimizing the balance between model complexity and training error. Therefore, this paper decomposes SVM into local and global kernel functions. The separability of the kernel function refers to whether the sample can be linearly segmented by the feature transformation defined by the kernel function under specific sample conditions [25].

Therefore, the kernel function can only be determined by experience and mutual verification. The advantages of mixed kernel functions are shown in **Figure 4**:

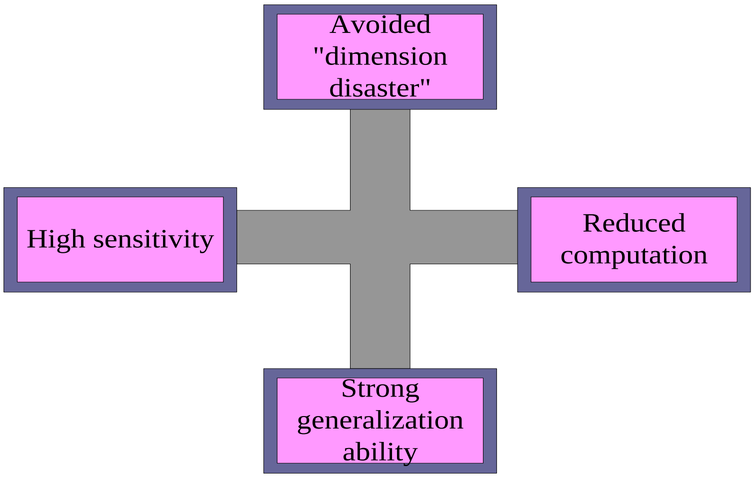


Figure 4. Advantages of mixed kernel functions.

As shown in **Figure 4**, the mixed kernel function avoids the "dimension disaster", reduces the amount of computation, has strong generalization ability, and has high sensitivity in processing data. By combining different kernel functions, the synthesized results can have better data processing ability. SVM combined with mixed kernel function enhances the separability and learning performance.

A picture is composed of hundreds or even thousands of pixels, and there is some relationship between these pixels. Average filtering refers to changing the gray value of a pixel into the average gray value of its adjacent area to achieve the purpose of blurring noise.

If the input and output images are $f(a+i)$ and $f(b+j)$, the average filter is Equation (13):

$$H(a,b) = \frac{1}{M}\sum_{i=-n}^{n}\sum_{j=-n}^{n} f(a+i,b+j) \tag{13}$$

M is the total number of *n* adjacent points. Since the processed pixels are not interfered by noise, their gray values are uneven. However, when averaging their gray values during mean filtering, their edges would become blurred.

The core idea of median filtering is to replace the local average value with the local average value. Median filtering has no effect on the kernel function, but it can have a certain effect on the excitation function.

Assuming that the impulse response function of the low-pass filter is $H(u-a+1,v-b+1)$ and the original image is $f(a,b)$, the mixed kernel function $g(u,v)$ is calculated using Equation (14):

$$g(u,v) = \sum_{a}\sum_{b} f(a,b)\,H(u-a+1,v-b+1) \tag{14}$$

On this basis, the kernel function is adopted, which not only retains the linear characteristics of human motion identification in high-dimensional environment, but also enhances its nonlinear computing ability, thus realizing effective control of the learning process. The learning algorithm using mixed kernel function does not need to be carried out in the entire high-dimensional space, thus reducing the amount of computation.

2) Selection process and expected advantages of different kernel functions

When choosing mixed kernel functions, the unique advantages of different kernel functions in data processing are considered. Gaussian kernel function performs well in dealing with local nonlinear features, while polynomial kernel function is good at capturing global nonlinear features. By combining these two kinds of kernel functions, the mixed kernel function can provide stronger separation ability and higher learning efficiency in high-dimensional feature space. The theoretical basis of this choice is derived from the structural risk minimization principle, which emphasizes that the model needs to find the best balance between complexity and training error in order to improve the generalization ability. The mixed kernel function can describe the characteristics of data more comprehensively, so as to enhance the performance of the classifier. Compared with the single kernel function, the mixed kernel function can better deal with complex and diverse data, especially in the task of medical image recognition, which can significantly improve the classification accuracy and computational efficiency.

Figure 5 shows the recognition accuracy and recognition rate of Gaussian kernel function, polynomial kernel function and their combined mixed kernel function under different sample numbers. The experimental results show that the mixed kernel function is significantly better than the single kernel function in recognition accuracy and recognition rate.

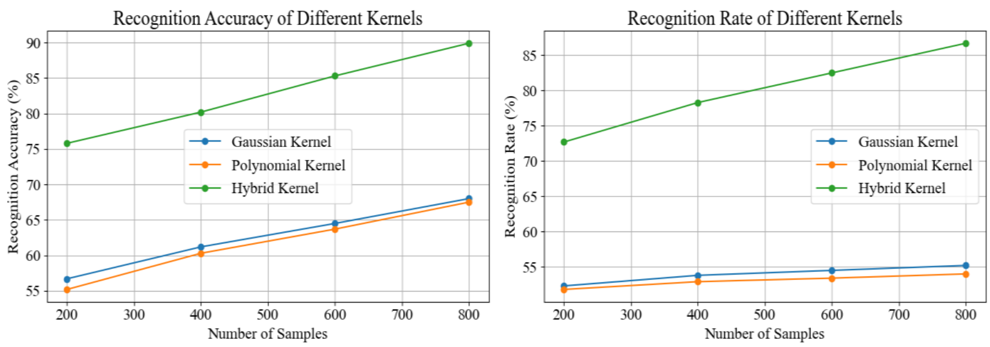


Figure 5. Recognition accuracy and rate of different kernels with varying sample sizes.

The data in the figure clearly shows the performance of Gaussian kernel function, polynomial kernel function and mixed kernel function in recognition accuracy and recognition rate under different sample numbers. With the increase of the number of samples, the recognition accuracy and recognition rate of the three kernel functions are improved. The mixed kernel function showed obvious advantages in all sample sizes, and its recognition accuracy increased from 75.8% to 89.9%, and the recognition rate increased from 72.7% to 86.7%. In contrast, the recognition accuracy and speed improvement of Gaussian kernel function and polynomial kernel function are relatively small, and the overall performance is inferior to the mixed kernel function. This shows that the mixed kernel function has stronger separation ability and higher learning efficiency when dealing with complex nonlinear data, and verifies its superiority in the task of medical image recognition.

4. Comparative experiment of different sports rehabilitation biomechanics teaching methods

4.1. Popularity of different teaching methods

Sports rehabilitation biomechanics is a course that combines practice with theoretical knowledge. In addition to students' experiments in the laboratory, they can also carry out different teaching in the classroom. It can make boring knowledge lively, change passive acceptance into active exploration, give full play to students' learning interest, enable students to better master sports rehabilitation knowledge and improve their performance.

In this paper, 700 students majoring in sports rehabilitation biomechanics were investigated and randomly divided into two groups, group A (350 students) and group B (350 students). In this experiment, the integrity, clarity and representativeness of the sample in the exercise rehabilitation were taken as the sample selection criteria. In order to avoid selection bias, this paper adopts the method of random sampling, and strictly controls the balance of samples in the selection process. This paper also considers the diversity of samples to ensure that the selected samples cover different types of exercise and rehabilitation stages. The teaching of group A did not incorporate multi feature medical image fusion, while the teaching of group B incorporated multi feature medical image fusion. This paper investigates whether they like the teaching methods of this group, as shown in **Figure 6**:

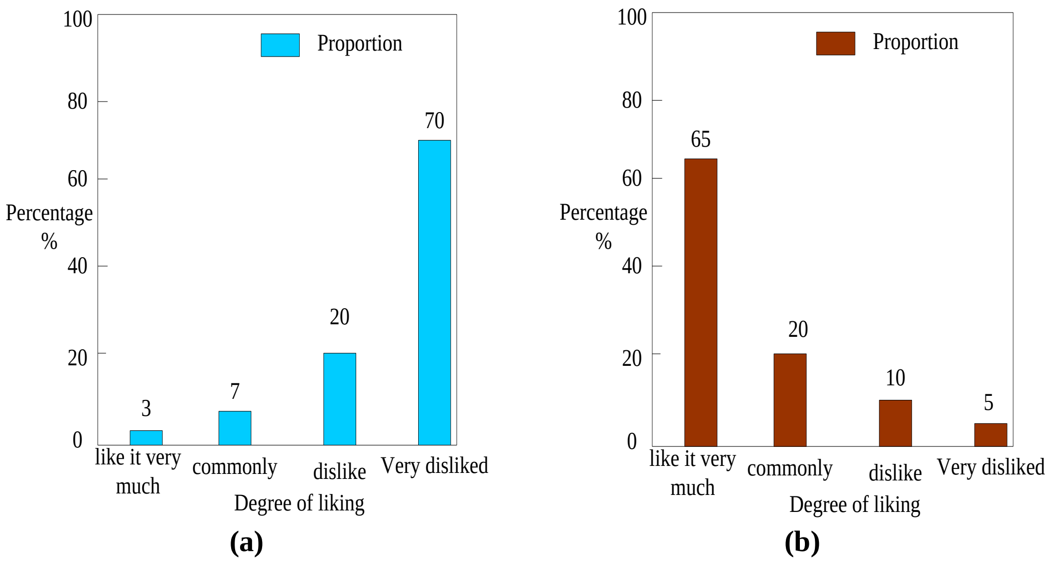


Figure 6. How much the two groups like their teaching methods. **(a)** How much group A likes the teaching methods of this group; **(b)** how much group B likes the teaching methods of this group.

As shown in **Figure 6a**, it can be seen that the teaching method without multi feature medical image fusion is not popular. Only 3% of students in group A like the teaching method of this group very much, and 7% of students generally like the teaching method of this group. 20% of the students do not like the teaching method of this group, and even 70% of the students do not like the teaching method of this group very much. It can be found that the experimental teaching method of group A is not liked by the students.

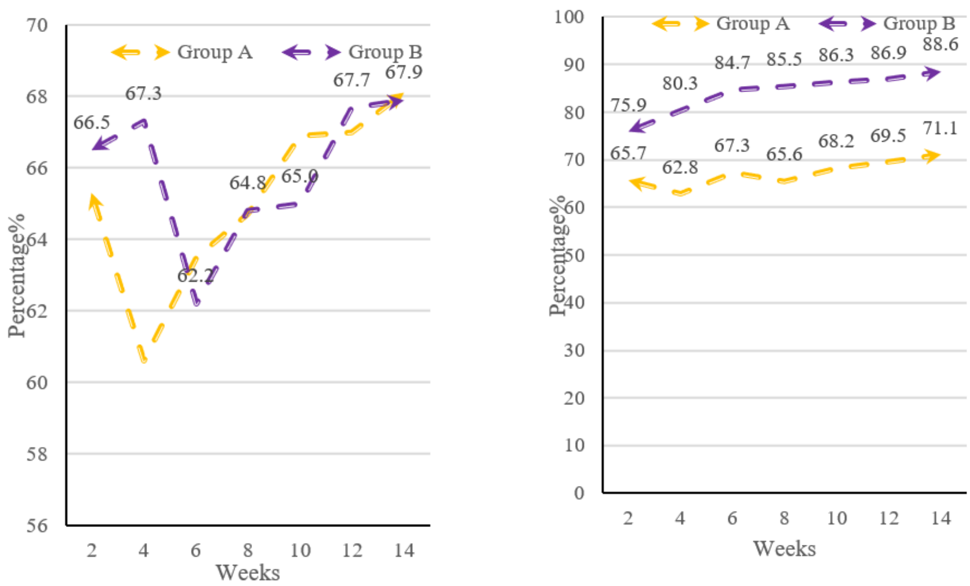
As shown in **Figure 6b**, it can be seen that 65% of the students in group B like the teaching method of this group very much, and 20% of the students generally like the teaching method of this group. 10% of the students do not like the teaching method of this group, and 5% of the students do not like the teaching method of this group very much. This shows that the experimental teaching method of multi feature medical image fusion in the course of sports rehabilitation biomechanics is very popular with students.

This shows that the application of multi feature medical image fusion in teaching can arouse students' interest in learning, enable them to listen to the teacher attentively, and focus on the teacher's demonstration and operation.

Teachers would also let students focus on learning in the form of heuristic methods. In classroom teaching, they pay attention to the cultivation of students' attention, which is the key to improve the quality of classroom teaching. Some experiments of exercise rehabilitation biomechanics are confirmatory. The confirmatory experiment is to prove that the knowledge learned is correct, and also to cultivate students' creativity and make their thinking more active.

4.2. Learning effects of different teaching methods

The medical image technology in the digital age can be completely copied in the form of geometric multiples. The use of modern image technology to reproduce human bones has been widely used in scientific research and clinical practice. In order to verify the effectiveness of the application of multi feature medical image fusion in teaching, this paper recorded the 14-week average scores of the two groups before and after the experiment, as shown in **Figure 6**:



(a) **(b)**

Figure 7. Average scores of the two groups before and after the experiment for 14 weeks. **(a)** The average score of the two groups 14 weeks before the experiment; **(b)** the average score of the two groups 14 weeks after the experiment.

As shown in **Figure 7a**, it is found that the average score of group B in the two weeks before the test is 66.5 points, and the average score in the four weeks before the test is 67.3 points. The average score 10 weeks before the experiment was 65.0 points, and the average score 14 weeks before the experiment was 67.9 points. It can be found that the average score of group B before the experiment is not very high.

As shown in **Figure 7b**, it was found that the average score of group A was 65.7 points 2 weeks after the test and 62.8 points 4 weeks after the test. The average score 10 weeks after the test was 68.2 points, and the average score 14 weeks after the test was 71.1 points. The average score of group B was 75.9 points 2 weeks after the test and 80.3 points 4 weeks after the test. The average score 10 weeks after the test was 86.3 points, and the average score 14 weeks after the test was 88.6 points. It can be found that the average scores of the two groups have risen after the experiment, but the scores of group A have risen very slowly, while those of Group B have risen very fast. The scores of group B have been more than 80 points since the fourth week.

Through the research on sports rehabilitation biomechanics, it is found that the application of multi feature medical image fusion in the classroom can effectively promote the students' initiative and initiative, so as to achieve good teaching results.

4.3. Problems in current experimental teaching

1) The experimental equipment needs to be improved

The outmoded experimental facilities in colleges and universities are a common problem faced by colleges and universities at present. The quality of teaching is closely related to the hardware conditions. This paper also investigated the degree of perfection of the experimental equipment that the two groups believed in the course, as shown in **Table 1**:

Table 1. Perfection of experimental equipment.

Perfection	Group A	Group B
Very perfect	6%	8%
Relatively perfect	12%	10%
General perfection	24%	20%
Imperfect	25%	25%
Very imperfect	33%	37%

As shown in **Table 1**, only 6% of students in group A think the experimental equipment of this course is perfect, and 12% think it is perfect. 24% of the students think it is generally perfect, 25% of the students think it is imperfect, and 33% of the students think it is very imperfect.

Only 8% of students in group B think the experimental equipment of this course is perfect, 10% think it is perfect, and 20% think it is generally perfect. 25% of the students think it is imperfect, and 37% of the students think it is very imperfect. It can be found that both groups of students think that the experimental equipment of this course is not perfect, which also leads to the teaching effect is not very good.

Sports rehabilitation biomechanics laboratory is a non-profit teaching and research place. Its instruments and equipment are expensive, and there is a lack of special funds for equipment operation, maintenance management, equipment updating, etc., so the laboratory opening hours are reduced to save operating costs. Some laboratories are mainly engaged in scientific research and occupy a large number of experimental instruments, which cannot be opened to teachers and students. Some laboratories have backward facilities and no professional laboratory personnel to supervise, which seriously affects the normal use of the laboratory. These factors have a certain impact on the experimental teaching of sports rehabilitation biomechanics and students' innovation ability.

2) The teaching content needs to be updated

This paper investigates the degree of boredom of the teaching content of the course that the two groups think, as shown in **Table 2**:

Table 2. The boring degree of teaching content.

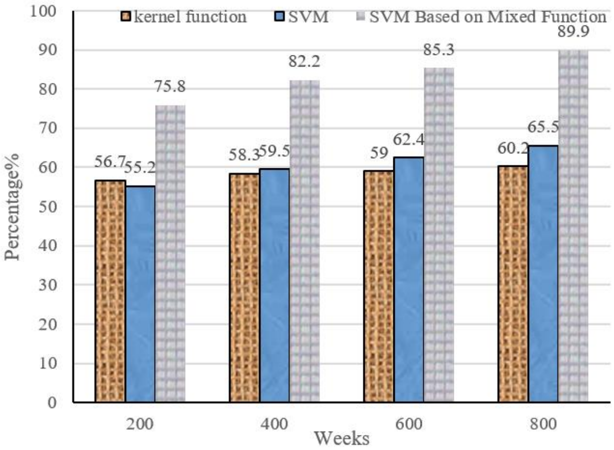
Perfection	Group A	Group B
Very boring	42%	45%
Relatively boring	23%	21%
General boring	11%	9%
Not boring	14%	17%
Interesting	10%	8%

As shown in **Table 2**, 42% of students in Group A think the teaching content of this course is very boring, accounting for nearly half of the total. 23% of the students think it is boring, and 11% of the students think it is generally boring. 14% of the students thought it was not boring, and 10% thought it was interesting.

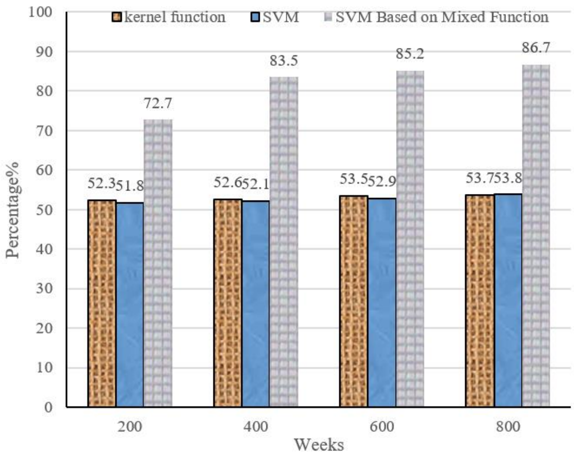
45% of the students in group B think the teaching content of this course is very boring, and 21% of the students think it is boring. It can be found that the content of sports rehabilitation biomechanics is monotonous, ignoring the relationship between courses, and lacking the characteristics of keeping pace with the times. The content of experimental teaching is mainly experimental verification. This passive teaching situation restricts the teaching level of teachers, the inheritance of knowledge and theory, and the improvement of students' ability. This situation would inevitably lead to boring and unattractive course content.

4.4. Recognition effect of different methods on medical images

The experiment was carried out in Microsoft Windows 7 environment using MATLAB r2012a and libsvm software package. The data is from hdm05 human motion database. Import and standardize the data, and then divide it into training set and test set. The SVM algorithm in libsvm is used to model the training data. The experiment compares the single kernel function SVM with the mixed kernel function SVM, and trains the model under different sample numbers (200, 600, 800). Predict the test set, calculate and compare the recognition accuracy and recognition rate of the three methods, as shown in **Figure 8**:



(a)



(b)

Figure 8. Recognition accuracy and recognition rate of three methods. **(a)** Recognition accuracy of three methods; **(b)** recognition rate of three methods.

As shown in **Figure 8a**, when the number of samples is 200, the recognition accuracy of kernel function, SVM and SVM based on mixed kernel function is 56.7%, 55.2% and 75.8% respectively. When the number of samples is 600, the recognition accuracy of the three methods is 59.0%, 62.4% and 85.3% respectively. When the number of samples is 800, the recognition accuracy of the three methods is 60.2%, 65.5% and 89.9% respectively. The conclusion shows that SVM based on mixed kernel function has the highest recognition accuracy.

In **Figure 8b**, it can be observed that when the number of samples is 200, the recognition rates of kernel function, SVM and SVM based on mixed kernel function are 52.3%, 51.8% and 72.7% respectively. When the number of samples is 600, the recognition rates of the three methods are 53.5%, 52.9% and 85.2% respectively. When the number of samples is 800, the recognition rates of the three methods are 53.7%, 53.8% and 86.7% respectively. The conclusion shows that the speed of SVM method based on mixed kernel function is also the fastest. The SVM algorithm based on mixed kernel function can be used, which only needs to extract the image and does not need to analyze each image, thus greatly reducing the identification process. It verifies the effectiveness of SVM algorithm based on mixed kernel function in motion identification.

In the statistical test, this paper calculates the mean and variance of the recognition accuracy and recognition speed of different models under different sample numbers, uses one-way analysis of variance (ANOVA) to compare the differences between the three groups of data, inputs the data of recognition accuracy and recognition speed, uses ANOVA to test whether the variance between groups is significant, and gets the p value, and judges the significance of the differences between models according to the p value, as shown in **Table 3**. If the p value is less than the significance level (usually 0.05), the difference is considered statistically significant.

Table 3. The boring degree of teaching content.

Sample size	Model	Recognition accuracy (%)	Recognition speed (%)
200	Kernel function SVM	56.7	52.3
	Standard SVM	55.2	51.8
	Mixed kernel function SVM	75.8	72.7
600	Kernel function SVM	59	53.5
	Standard SVM	62.4	52.9
	Mixed kernel function SVM	85.3	85.2
800	Kernel function SVM	60.2	53.7
	Standard SVM	65.5	53.8
	Mixed kernel function SVM	89.9	86.7
p-value		0.0020	0.0003

Table 3 shows that under different sample sizes, the mixed kernel function SVM is significantly better than the other two models in recognition accuracy and recognition speed, and the p value is less than 0.05, indicating that the difference is statistically significant.

4.5. Measures to improve teaching effect of sports rehabilitation biomechanics

1) Promote the full opening of laboratories

The open laboratory includes open visits, and students can complete the experimental teaching independently. The laboratory is not only the credit assigned by students, but also the place for project research. It also gives teachers and students more opportunities to conduct scientific research and experiments in a certain time and space, so as to improve the efficiency of the laboratory. It can give full play to the innovation ability of the laboratory and make the laboratory a base for knowledge application, skill integration and ability innovation.

A first-class laboratory must have a first-class management level. To build an innovative experimental teaching model, a relatively complete laboratory management system must be established. Institutionalization, standardization, scientization and modernization of laboratory management are important guarantees for cultivating students' independent innovation ability. Scientific and efficient management system, safe and orderly development, giving full play to the role of instruments and equipment, and rational allocation of talents are important guarantees for cultivating innovative talents.

2) Experiment course and content setting

Teachers and students should clearly understand the experimental teaching objectives of the curriculum, and establish knowledge objectives, skills objectives and practice objectives. They should evaluate basic skills, comprehensive skills and innovative skills based on students' abilities. In addition to the existing verification, skill and comprehensive experiments, design and innovative experiments should also be added. In the process of cultivating students' creative thinking, they should make full use of the advantages of experimental teaching. At the same time, the addition of relevant experiments in cross disciplines makes the knowledge system more sound, the links between disciplines more closely, and expands students' creative thinking. Teachers should introduce the latest scientific research results into the classroom and consciously guide students to explore new knowledge and new fields. In addition, the effective use of micro course resources is also a good way to convey relevant teaching information to students through the network, mobile and other ways.

The examination contents are knowledge level, skill level and creativity level. Combining the discipline characteristics of sports rehabilitation biomechanics and the relevant knowledge of sports physiology, sports anatomy, sports rehabilitation and other related disciplines, it is necessary to link experiments with the evaluation system of basic technology, comprehensive technology and creative skills. This measure brings students' creativity into the evaluation category, making up for the past practice of focusing on knowledge and lacking creativity in examinations, thus effectively improving students' awareness and ability of independent innovation.

5. Conclusions

With the continuous improvement of people's living standards, sports rehabilitation biomechanics has become an important field of concern. In this field, the principles and methods of biomechanics are used to conduct in-depth research on various fitness activities, which can reveal their biomechanical characteristics and mechanical effects on human tissues. It can guide people to choose fitness methods correctly, improve their health level and prevent sports injuries. This article uses a variety of teaching methods to comprehensively understand and master the disciplines such as medicine, biomechanics, and sports, so that sports and medicine can be organically integrated and mutually infiltrated. This provides a theoretical basis and practical guidance for sports rehabilitation and health care in the future. This paper mainly studies the SVM algorithm based on mixed kernel function in medical image motion feature recognition. The results of this study show that the application of multi feature medical image fusion technology in sports rehabilitation biomechanics experimental teaching not only improves the accuracy and speed of motion recognition, but also significantly improves the teaching effect. The results of this study echo with the application of biomechanics and medical image technology in sports rehabilitation in the existing literature, and further verify the effectiveness of multi feature medical image fusion technology. However, the improvement of experimental equipment and the update of teaching content still need to be further improved.

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