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Computer-Aided Design AND APPLICATIONS

Optimization of 3D Animation Design Based on Support Vector Machine Algorithm

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Abstract. 3D ink animation is not only a form of animation art, but also a vital way to spread China traditional art. Based on SVM (Support vector machine) algorithm, this article explores the optimization method of 3D animation CAD (Computer aided design) for ink painting effect. In this article, a feature selection algorithm of ink painting image based on SVM is proposed, and SVM is applied to the defect identification of ink painting tomography image. At the same time, the 3D virtual image of ink painting is reconstructed in the computer, and the 3D defects of ink painting are further identified by SVM. The final simulation results show that the accuracy of this method is high and the error is low. The highest accuracy can reach 94.89%, and the error is only about 0.27. In addition, the response speed of this method is fast, generally only 0.37s. Compared with GA (genetic algorithm) and PSO (particle swarm optimization), the improved SVM method in this article highlights many advantages, which can provide certain technical support for 3D animation CAD optimization of ink painting effect.

Keywords: Artificial Intelligence; Support Vector Machine; Ink Painting; 3D Animation; Computer Aided Design
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1 INTRODUCTION

In recent years, people's material living standards have gradually improved, and they pay attention to pursuing a higher level of spiritual enjoyment. Among them, animation, as an excellent art, has been widely loved by the public. The impact of computer painting based on 3D printing on freeze frame images is enormous. Abdrashitov et al. [1] constructed an efficient boundary model for 3D curve printing animation segmentation network. It analyzes the optimization of original animation automation deviation calculation in graphic cutting technology. In CAD software, suitable materials and lighting conditions can be set for facial models. The material should be able to simulate the texture of a real face, while lighting should be able to

produce realistic light and shadow effects. This can make the printed Stop motion more realistic and visually attractive. After the animation design is completed, the facial model is exported to a printable file format and printed using a 3D printer. The selected material should have sufficient strength and flexibility to adapt to the shape and expression changes of the face. After printing, the facial model can be taken into a series of freeze frame photos. These photos should include different facial expressions and movements, which can be used for subsequent animation production. With this efficient CAD 3D printing freeze frame facial animation system, you can efficiently create Stop motion, while ensuring the high quality and realism of animation. This has important application value in fields such as animation production, film production, and advertising marketing. At present, more and more ink paintings appear in the network. Ink animation combines China ink painting with animation media with the most national characteristics, showing a unique artistic conception and charm of the picture, forming a unique animation expression form, and infiltrating a profound national cultural heritage. Dvorožňák et al. [2] provided an organic shape mesh processing method for the production of 3D animation. It provides a multi view model and animation experience for a 3D inflatable animated deformation equipment specification. By integrating the animation of a rigid mesh model with the perspective of 3D expansion, an efficient animation experience in the 3D environment was determined. Ink animation is an art form based on traditional ink painting, which organically combines animation with ink painting. With the help of scientific design methods, the animation works can be combined with China ink painting, and the animation works can be used to effectively carry forward China culture. The algorithm has a large amount of calculation and the effect is easily affected by image quality. As a new method of data mining, SVM has attracted extensive attention of researchers. This method has a strict theoretical basis and overcomes the local minimum solution and over-learning problems existing in other algorithms. Computer aided art design and production based on video stream is a comprehensive task involving computer graphics, animation design, video processing and other fields. Guo and Li [3] conducted a composite frame scene analysis in the field of digital information and media information. By decompressing the minimum auxiliary units of different video network art designs, it has constructed an art design platform applied to advantageous art categories. In the process of art design and production, computers can play an important auxiliary role. By using computer graphics and animation design software, virtual 3D models, scenes and characters can be created, and details can be adjusted and precisely controlled. These virtual objects can be rendered and previewed in real-time on the computer screen. By using computer-aided animation design software, various types of animation effects can be generated, such as object motion, character actions, and scene transitions. Designers can control the rhythm and smoothness of animation through methods such as keyframe setting and interpolation algorithms. After the animation is generated, further adjustments and embellishments can be made using video editing software.

A powerful virtual brush can effectively simulate the painting characteristics of a real brush. Huang et al. [4] constructed the traditional simulation effect of brush modeling and conducted virtual analysis by analyzing the impact of virtual human-computer interaction devices on the model construction of virtual brushes. The research progress on the modeling of virtual brushes in digital calligraphy and painting mainly involves simulating the behavioral characteristics of real brushes and enhancing the realism of the rendering process and effect. This modeling method mainly simulates the actual physical characteristics of the brush, such as stroke, material, and tip, to reproduce the behavioral characteristics of the real brush. This type of model usually takes into account physical factors such as the weight, balance, and friction of the brush to simulate the effect of a real brush in calligraphy and painting creation. However, such models may encounter challenges in computational efficiency and accuracy when simulating complex brush behavior. This modeling method mainly relies on the simulation of practical experience and techniques in calligraphy and painting creation. This type of model can reflect the painter's style and techniques, such as the width, thickness, speed, and frequency of strokes, and can also simulate details such as changes in the stroke tip and ink penetration. However, this model may require learning from a large amount of sample data, while also addressing the issue of how to convert complex empirical

rules into computable models SVM is a learning method based on the principle of structural risk minimization, which is derived from the optimal classification hyperplane in linear separable mode. It puts forward the concept of soft interval instead of hard interval, and solves the linear inseparable problem caused by isolated points with the idea of allowing a small number of mis-classification. At present, it has achieved good learning results in the fields of pattern recognition, computer vision, data mining and biological information. However, the matrix storage calculation is limited by the number of training samples in the process of solving quadratic programming, which increases internal friction and time complexity, relaxes the extensiveness of variable constraints and the arbitrariness of penalty parameter assignment, and also easily leads to blind judgment of offset fault samples. Therefore, it is necessary to deeply study SVM theory and related algorithms, and optimize and improve the training model of SVM.

CAD can be used to create 2D and 3D models of buildings. These models can be used as backgrounds or scenes in animations, adding more realistic environmental settings to the animation. CAD can also be used to create 2D and 3D models of characters. By drawing the outline and details of a character, the basic appearance of the character can be constructed, and further animation can be produced by combining other techniques. Jing and Song [5] created the shape Scale model character of the virtual 3D world for the animation character modeling of 3D computing. Through the design of virtual motion parameters for animated characters, it has made great efforts to improve the animation feature analysis of material lighting, and compared the animation feature education analysis system of 3D characters. It summarizes the practical educational theoretical guidance of character models in 3D animation. By combining 3D reality technology and CAD, a higher level of realism and detail expression can be achieved in animation design, bringing a more captivating visual experience to the audience. The application of these technologies not only improves the quality of animation production, but also provides designers with broader creative space. Spline curves have important application value in computer-aided animation design. In computer graphics, shape design is an important application. Appearance design is the use of certain algorithms to describe, calculate, and display curves and surfaces based on the position of a given type value point. In this process, spline curves are widely used. The research on the development of approximate threshold of curves and surfaces is one of the important research objects of industrial product design in the current research and development of Computer animation. Li [6] conducted accuracy analysis on surfaces approximated by interpolation splines using different animation computers. It constructs common control schemes for architectural design and product appearance. A spline curve is a type of curve used to fit type value points, which requires the generated curve to pass through each given type value point. In CAD software, it is necessary to define the ink elements that need to be projected. These elements can be graphic objects in CAD software, such as a polygon, a circle, or a free form. Liang and Kim [7] create projections of ink elements by using the projection function of CAD software. Move the ink element from its current position to the projection plane. Determine the position and size of ink elements on the projection plane. Use projection parameters for projection calculation and generate projection images. After the projection is completed, interactive adjustment can be used to adjust the projection effect. This process can include adjusting projection parameters, adjusting the position and size of ink elements, and editing projected images. Finally, render and output the projected image. You can use the rendering function of CAD software to render the projected image into a water ink style rendering. Then, the rendering can be output to the desired device or platform, such as a printer, computer screen, or internet. Through the above steps, the forced perspective interactive projection mapping of CAD ink elements can be achieved, thereby artistically displaying and applying ink elements in CAD software. This technology can be applied in various fields, such as design display, advertising creativity, artistic creation, etc.

With the maturity of 3D modeling technology and the rapid growth of Internet technology, the number of 3D models has exploded. 3D model plays a very important role in many fields, such as molecular biology, cultural heritage protection, CAD and manufacturing. Various models can be designed through 3D technology, and these models are usually classified according to data structure, which are mainly divided into five types: wireframe model, surface model, surface

model, solid model and feature model. Effective integration of China ink painting is an important choice for 3D animation design and an important direction for the future growth of 3D animation design. In the application of China ink painting in 3D animation design, it is necessary to pay attention to the study of brush strokes. In the 3D animation design, we should explore the specific application of China ink painting, and provide strong support for good design work. Based on SVM algorithm, this article explores the optimization method of 3D animation CAD for ink painting effect. Its innovations are as follows:

(1) In this article, integer parameters are used to train SVM. Because the input vector of SVM is the pixel value of digital image, it is not necessary to integer the training samples, and only the Lagrangian parameters in the standard SVM algorithm need to be normalized to integer values in a certain range. It improves the training and classification speed of SVM.

(2) In this article, orthogonal Chebyshev kernel function is introduced into SVM algorithm, and the input space of samples is mapped from low dimension to high dimension and from nonlinear to linear by using the special properties of kernel function. It not only solves the problem of dimension disaster, but also does not increase the complexity of the problem.

(3) In this article, SVM is applied to the defect identification in the tomographic image of ink painting, and the 3D virtual image of ink painting is reconstructed in the computer, and the 3D defects of ink painting are further identified by SVM. Compared with the traditional method, the generalization performance of SVM method is better.

According to the needs, this article is mainly divided into five sections, and each section is arranged as follows: The first section is the introduction part, which discusses the background and significance of the topic selection; The innovation and organizational structure of the article. The second section summarizes the relevant research results of the existing literature. The third section is the method part. Based on SVM algorithm, the optimization method of 3D animation CAD for ink painting effect is explored. In the fourth section, the model is simulated. Section V: Conclusion. This part summarizes the research results.

2 RELATED WORK

Liang et al. [8] analyzed the consumption of 3D feature edges in 3D mesh models. It solves the folding cost problem of an error measure of Gaussian curvature. This mechanism simplifies the error analysis of edge operation folding for the optimal operation sequence. It uses whale optimization algorithm for mesh simplification. This algorithm simulates the behavior of whales swimming in the ocean, iteratively searching and optimizing on the grid to find a balance point, so that the simplified grid can achieve the best compression effect while maintaining features. Based on the whale optimization algorithm, Differential evolution is used for further optimization. Differential evolution searches and improves the current optimal solution through random selection and cross operation to obtain better simplified results. By using the whale optimization algorithm and differential evolution-based 3D mesh simplification method with feature preservation, a simplified model can be obtained that achieves the best compression effect while preserving features. This has important application value for processing large-scale 3D data, improving computational efficiency, and maintaining critical geometric information. Animation can express the perceptual experience of art practitioners with visual loss by creating visual effects and emotional experiences. By designing unique visual effects such as dark scenes, blurry images, distorted colors, etc., to express the feeling of visual loss. It expresses the psychological experience of visual loss by designing the emotional changes of characters after visual loss, such as panic, unease, loneliness, etc. Virtual reality provides a more realistic perception experience by simulating states of visual loss, such as blackness, blurring, blindness, etc. McSwan [9] simulates the perceptual experience of visually impaired individuals by providing interactive operations, such as guiding users through sound or tactile feedback. Artistic expression can express the feeling of visual loss through creative means. Express the feeling of visual loss through artists' paintings, sculptures, music, and other forms. By telling a story, such as the difficulties and challenges

experienced by a visually impaired art practitioner in seeking creative inspiration, to express the feeling of visual loss. By exploring these directions, one can better understand the perceptual experience of art practitioners with vision loss, and present this experience through animation and virtual reality technology. This will help enhance the audience's understanding and attention to visually impaired individuals, while also providing richer inspiration and expressions for artistic creation.

Mori and Bao [10] conducted a visual advantage analysis of 3D animation, which constructed a virtual quality inspection arrangement with high-resolution periodic patterns. Firstly, it is necessary to create a Moire pattern with a specific structure for display on the LCD. This pattern should contain regular textures or lines to create a sense of depth. Next, display the moire pattern on the LCD. In order to achieve automatic stereoscopic display, special glasses are needed to view this pattern. These glasses can be equipped with a transparent LCD display to control the viewing angle as needed. By controlling the angle of the LCD screen, automatic stereoscopic display can be achieved. According to the principle of the Moore effect, different perspectives will lead to different depth perception. Therefore, the depth effect can be adjusted by controlling the angle of the LCD screen. To achieve a smooth viewing experience, it is necessary to synchronize the display of the Moire pattern with the angle of the LCD screen. This means that the angle of the LCD screen needs to be adjusted in real-time during animation playback to maintain consistency with the depth perception of the Moire pattern. Najafi [11] analyzed the animation production performance in virtual experiments. The change in body language is an important aspect in the process of character identity transformation. The 3D Motion capture technology can accurately capture and transform the details of the character's movement, posture, expression and so on, so as to present a more realistic role identity conversion effect. The application of animation technology is also an important aspect in the process of character identity transformation. Computer animation technology and virtual reality technology can be used to achieve a more realistic and vivid role identity conversion effect. Through the above heuristic exploration methods, we can better understand and present the identity transformation in the animated narrative short film based on 3D Motion capture. At the same time, it can also provide more inspiration and guidance for future animation creation. The depth of server processing in the current 3D image visual texture communication process is insufficient, resulting in a lack of visual communication effect. Shan and Wang [12] constructed the depth features of image projection propagation factor changes conveyed by 3D animation by continuously projecting video images of 3D images. By animating the number of image frames at different grayscales, a visual transmission scheme for 3D visual animation design was completed. It achieved frame rate feature analysis of image videos in a short period of time. In a 3D model, suitable materials can be added to different surfaces and appropriate lighting conditions can be set. This can help students better understand the light and shadow effects of animation scenes, as well as the impact of different materials on lighting. After the 3D model is established, animation design can be carried out. By utilizing techniques such as keyframing and interpolation, various types of animations can be created, such as displacement, rotation, scaling, etc. In addition, motion controllers and expressions can also be used to control the actions and behavior of characters. Wang et al. [13] analyzed the data model construction of 3D printing of hand foot soft tissue transplantation scanning analysis under CAD Assistive technology. Through the use of Computer-aided design (CAD) software, the collected image can be converted into a three-dimensional digital model. This process requires precise measurement and positioning of the positions and shapes of various bones, joints, and soft tissues to ensure the authenticity and accuracy of the model. Once the precise migration design is completed, the model can be exported to a printable file format such as STL or obj. Then, use a 3D printer to print the model. During the printing process, it is necessary to select appropriate materials and processes to ensure the strength and accuracy of the model. After printing, the model needs to be evaluated and adjusted. This includes testing and optimizing the appearance, size, proportion, and functionality of the model. If further adjustments are needed, you can return to the CAD software for modification and reprint. Ink and wash rendering in stylized landscape painting is an important research direction of non-realism.

Yan et al. [14] constructed rendering effects from 2D models to 3D models based on Eastern aesthetics and retrograde ink strokes. It conducted 3D virtual simulations of spatial mountain models using the proposed rendering style model. Introducing the distortion diffusion feature effect of grid, the dynamic brush appearance processing texture features in terms of temporal coherence were analyzed. Prepare the 3D mountain model that needs to be drawn. This can be a digital model created through 3D modeling software, or a 3D model extracted from existing data. Simulate the painting effect of ink painting by applying brush and ink effects to the material. You can use texture editing tools in the software to apply pen and ink effects to materials, including strokes, ink color, fly white, etc. During the drawing process, pay attention to creating an atmosphere of Chinese ink painting. By adding natural elements such as clouds, birds, waterfalls, and adjusting colors and shadows, the atmosphere and artistry of the picture can be enhanced. The design of indoor three-dimensional art space has high requirements for the ratio of materials and colors. Yang [15] analyzed the optimization simulation design of 3D Computer-aided design curriculum space. It explores the simulation optimization of interior design courses using 3D computers. By utilizing virtual reality (VR) technology, students can perform simulation operations in a three-dimensional environment. They can browse and modify interior designs, observe the effects of different design schemes, and obtain a more realistic experience through a first-person perspective. In a 3D model, suitable materials can be added to different surfaces and appropriate lighting conditions can be set. This can help students better understand the lighting and shadow effects of indoor spaces, as well as the impact of different materials on lighting. By analyzing students' data and performance during the simulation process, teachers can better evaluate teaching effectiveness. This includes students' design abilities, problem-solving methods, and their mastery of design principles. Yang et al. [16] analyzed the geometric characteristics of Chinese style ink wash paintings with the help of Computer-aided design. Its dramatic expression of the style of ink painting and the process of painting. In animation production, keyframes are a fundamental technique. By setting keyframes, which are the most important time points in the animation, and then interpolating between these keyframes, the animation can be generated. For Chinese ink painting, the position and shape of the strokes can be controlled by setting keyframes for the strokes, thereby achieving dynamic effects on the screen. Through 3D modeling software, it is possible to create 3D models of elements such as landscapes and characters in Chinese ink painting. Traditional modeling tools can be used, as well as image-based modeling methods such as deep learning-based image segmentation, edge detection, and other technologies. In the virtual world, the effect of Chinese ink painting can be simulated by setting materials and lighting.

Yu et al. [17] conducted character reconstruction for 3D environment interaction. It has made a certain contribution to the spatial sharing of augmented reality user virtual interaction environments. CAD implementation technology can provide interactive operations, allowing viewers to have a deeper understanding of ink painting. For example, 3D models can be operated and adjusted through mouse or gesture control in CAD software, including rotation, scaling, dragging, and other operations. This interactivity can allow the audience to have a deeper understanding and experience of the connotation and artistic value of ink painting. CAD implementation technology can provide various artistic expressions, allowing the audience to have a more diverse perception of ink painting. For example, customization of ink painting materials and textures can be achieved through the texture editing function in CAD software; You can achieve richer artistic effects through rendering and post-processing functions. In summary, the impact of CAD implementation technology on the perception of ink painting in 3D asymmetric remote presentation can be comprehensively reflected in visual effects, spatial perception, interactivity, and artistic expression. By utilizing CAD implementation technology reasonably, the artistic characteristics and cultural connotations of ink painting can be presented more realistically, vividly, and deeply, enhancing the audience's perception experience and artistic appreciation value. Yuan et al. [18] analyzed an oil painting model based on colorants used in 3D printing materials. When creating a 3D model, it is necessary to accurately depict the structure and shape of the stairs as much as possible. This ensures that the details and structure of the stairs can be accurately presented during the printing process, thereby reducing the appearance of staircase effects.

During the spraying process, colors and textures can be gradually adjusted to achieve more natural transitions and detail handling. This can help reduce the staircase effect caused by sudden color or texture changes. During the printing process, the level of detail can be adjusted appropriately as needed to achieve better results. For example, for parts that need to be emphasized, a high level of detail model can be used, while for parts that are farther or blurrier, a low level of detail model can be used. By using the above methods, the staircase effect in 3D printing of oil paintings based on material spraying can be reduced to a certain extent. However, it should be noted that in artistic creation, sometimes the staircase effect can also become a unique form of artistic expression, so it is necessary to handle and control it appropriately according to specific needs and creative style.

Based on the previous research results and SVM algorithm, this article explores the optimization method of 3D animation CAD for ink painting effect. In this article, a feature selection algorithm of Chinese ink painting image based on SVM is proposed, and SVM is applied to defect recognition in Chinese ink painting tomography image. The final simulation results show that the improved SVM has better generalization performance.

3 METHODOLOGY

3.1 Feature Selection of Ink Painting Image Based on SVM Algorithm

Ink painting image is an art form with strong Chinese cultural characteristics, and its application in the field of computer graphics is also increasingly concerned. Support Vector Machine (SVM) algorithm is an effective solution for feature extraction and classification of ink wash images. This article will analyze the features of ink wash images based on SVM algorithm, including feature extraction and classification. Feature extraction of ink wash image is a Committed step of classification. The characteristic of ink painting lies in its unique stroke and line effects, which can be reflected through the texture, color distribution, edges and other features of the image. The texture features of ink wash images are one of their most important characteristics. By extracting texture information from an image, it can be determined whether the image has the characteristics of ink painting. Common texture feature extraction methods include wavelet transform, Gabor filter, and Fourier transform. Ink painting usually uses black and white or near black and white colors, and the color distribution is uneven. You can determine whether an image has the characteristics of ink painting by extracting color distribution information such as grayscale values, histograms, etc. The lines of ink painting are one of its main characteristics, and it can be determined whether the image has the characteristics of ink painting by extracting the edge information of the image. After extracting the features of ink wash images, classification algorithms need to be used to classify them. Support Vector Machine (SVM) algorithm is an effective classification algorithm that can solve high-dimensional feature space problems and exhibits excellent performance in solving small sample and nonlinear problems. For the features of ink wash images, linear SVM can be used for classification. Linear SVM separates samples of different classes by finding an optimal Hyperplane. For ink wash images, a linear SVM classifier can be trained by extracting texture, color, and edge features. Due to the possible non-linear characteristics of ink and water images, nonlinear SVM algorithms can be used for classification. Nonlinear SVM maps samples to a high-dimensional space, allowing samples that are difficult to linearly separate in a low-dimensional space to be linearly separated in a high-dimensional space. For ink wash images, a nonlinear SVM classifier can be trained through some nonlinear features such as texture shape, color distribution density, etc.

SVM is a new type of learning machine, which is a limited sample learning machine based on statistical theory, and its learning ability and generalization ability are optimized together. Its core idea is to make the input space and a high-dimensional feature space have a mutual mapping relationship through kernel function, and then construct the optimal classification hyperplane by maximizing the classification interval in this high-dimensional feature space, that is, the key problem of SVM is to obtain the optimal classification hyperplane. The former ensures the

minimum empirical risk, and the latter minimizes the confidence range of generalization, thus minimizing the real risk. The basic classification algorithms of SVM include linear separable binary classification algorithm, linear inseparable, nonlinear separable and multi-classification algorithm. Most of the classification problems encountered in real situations are multi-class classification situations, and the solutions to the multi-class classification problems are mainly divided into two types: (1) One is to classify samples at one time by constructing multi-class classifier functions. (2) The multi-class classification problem is divided into two-class classification problems to solve, and the multi-class classification problem is solved by constructing multiple two-class classification functions. Make the sample set:

$$B=\left\{\left(x_j,y_j\right)\middle|\, j=1,2,3,\ldots,m\right\}\quad x\in R^d, y_j=\pm 1 \tag{1}$$

The linearly separable hyperplane can be defined as follows:

$$f\left(x\right)=\left(w\cdot x\right)+b\quad w\in R^d, b\in R \tag{2}$$

Where w is the weight vector and b is the threshold. And:

$$\begin{cases}\left(w\cdot x\right)+b\geq 1 & y_j=+1\\ \left(w\cdot x\right)+b<1 & y_j=-1\end{cases}\quad f\left(x\right)<0, y=-1;\ f\left(x\right)>0, y=+1 \tag{3}$$

At this time, the classification decision function can be expressed by symbolic function as follows:

$$y=\mathrm{sgn}\left(f\left(x\right)\right) \tag{4}$$

SVM has a concise expression in mathematical programming, which can be reduced to a convex quadratic programming problem, thus obtaining a global solution, thus avoiding the local minimum solution problem in neural network and having a very intuitive geometric explanation. Generally speaking, if a linear function can completely and correctly separate two different types of samples, then the two types of samples are said to be linearly separable, otherwise they are said to be nonlinear separable. This classification function is collectively called hyperplane in high-dimensional space. Based on SVM algorithm, this article explores the optimization method of 3D animation CAD for ink painting effect. And based on SVM algorithm, the features of ink painting images are extracted. Figure 1 shows 9 frames of original animation for feature selection of ink painting images.

Figure 1: Nine frames of original animation for feature selection of ink painting image.

By using SVM based feature extraction and classification methods for ink wash images, we can classify and recognize real ink wash paintings. For an ink wash painting, the first step is to extract texture features to determine whether it has the texture characteristics of ink wash painting. For example, wavelet transform methods can be used to extract texture information from images, and trained linear or nonlinear SVM classifiers can be used to classify them. By extracting color distribution information from the image, such as grayscale values and histograms, an SVM classifier with color distribution features can be trained to determine whether the image has the color characteristics of ink painting. For the line characteristics of ink painting, edge detection algorithms can be used to extract the edge information of the image, and then trained SVM classifiers can be used to determine whether it has the line characteristics of ink painting. From the above analysis, it can be seen that the feature analysis method of ink wash images based on SVM algorithm can effectively extract and classify the features of ink wash paintings, which helps to achieve automatic recognition and classification of ink wash images. However, in practical applications, it is also necessary to consider issues such as sample data collection and preprocessing, model selection and optimization, and how to apply this analysis method to specific application scenarios.

In this article, the layout of ink painting is taken as the overall feature, and the feature vector obtained by Gabor wavelet transform of the segmented small ink painting image is taken as the local feature of ink painting image. The whole and local features are input into SVM, and the final result is obtained by combining their respective proportions in the classification system. The high frequency component of the ink-wash image reflects the abrupt part of the edge of the ink-wash image, and the low frequency component reflects the flat part of the edge of the ink-wash image. There are few effective coefficients after Fourier transform, but the original ink painting image can be well reproduced after inverse transform of these effective Fourier coefficients. Because the quality of feature selection directly affects the efficiency and accuracy of model retrieval, the feature descriptor in this article has the following characteristics: feature uniqueness; Easy to express, less calculation; Occupy small storage space; Good robustness; Satisfy topological invariance. In addition, starting from the main concept of a kind of self-sustaining vector machine, this article compares one painter's ink animation with other painters' ink animation works, and maps the works of other painters into a kind of space by using the asymmetric relationship between their numbers. The works of a specific painter are regarded as outlier mapped into a small space centered on the origin, and a multi-machine parallel classifier is constructed with this kind of SVM as the basic unit.

3.2 Optimization of 3D Animation CAD for Ink Painting Effect

A 3D model is a polygonal representation of an object. It can be a real-world entity or a fictional object, which can be as small as an atom or as large as a large size. 3D model can represent objects more realistically than 2D graphics, and it has more information about the real world, including a huge amount of data. The working procedure of 3D animation with ink painting effect is to first simulate an event scene in the computer, and then the designer establishes the corresponding model in this virtual scene according to the external dimensions of the main object to be represented. Then, according to the event content, the motion trajectory of the model is set, and the virtual camera lens and other animation parameters are built in the scene. Finally, assign the specified material map to the model and light the scene and characters. Ink-and-wash painting is based on lines, through which the outline, texture and volume are drawn. The traditional production technology of ink-wash animation is mainly based on the production technology of animation, with the help of effective photography methods. After completing the relevant basic operations, we need to do further detailed operations with the help of the photography department. In the process of coloring, the animation or characters on the animation paper need to be colored in layers. The fundamental difference between ink painting effect 3D animation and traditional ink painting animation is that 3D ink painting animation is not "painted"-it is "made" through modeling and other processes with the help of some 3D animation production software.

In the 3D animation CAD optimization model of ink painting effect based on SVM, in order to construct the optimal hyperplane when the samples are linearly inseparable, the inequality constraints must be relaxed to adapt to the linearly inseparable data. It can be realized by adding a relaxation variable to the constraint of the optimization problem. The number of wrongly classified samples can be roughly described by using relaxation variables, so the restriction conditions of the optimal classification hyperplane can be modified by using relaxation variables as follows:

$$y_i\left[\left(w\cdot x\right)+b\right]-1+\xi_i\geq 0 \quad i=1,2,3,\ldots,n \tag{5}$$

It can be seen that there are two requirements for the generalized optimal classification hyperplane: the maximum classification interval and the minimum misclassification sample number, that is, the solution of the generalized optimal classification hyperplane is transformed into the solution of the optimization problem. The principle of SVM classification and recognition is as follows (as shown in Figure 2).

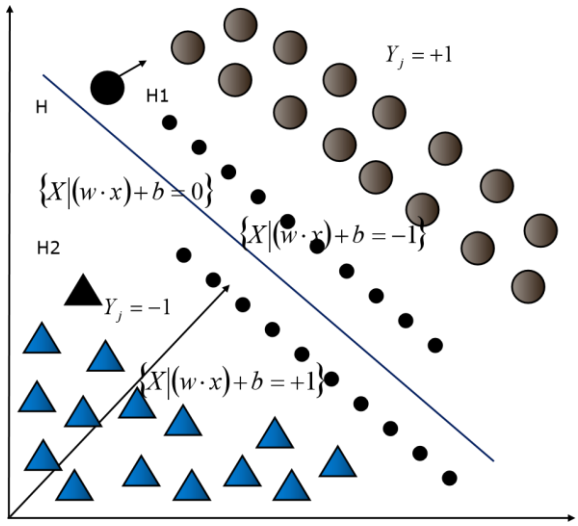

Figure 2: Schematic diagram of SVM classification recognition.

In this article, integer parameters are used to train SVM. Because the input vector of SVM used is the pixel value of digital image, it is not necessary to integer the training samples. Instead, the Lagrangian parameters in the standard SVM algorithm need to be normalized to integer values in a certain range, which are used as the parameters to be optimized in the training process, and the improved sequential minimum optimization algorithm is adopted. It improves the training and classification speed of SVM. In the 3D animation software, by adjusting the material parameters of the model and drawing the corresponding maps, and using many methods such as layered rendering technology, the 3D ink animation effect with the artistic characteristics of traditional ink painting in China can be obtained after rendering. In order to improve the efficiency and accuracy of retrieval, 3D models must be standardized and preprocessed to make similar models in different coordinate systems have the same similarity. In addition to 3D model coordinate normalization preprocessing, isotropic preprocessing is also one of the preprocessing technologies to improve the efficiency and accuracy of 3D model retrieval. The efficiency and accuracy of retrieval can be improved by isotropic pretreatment of 3D model and normalization of the model into isotropic model. Suppose there are l samples randomly and independently extracted from the unknown probability distribution function to form a training sample set:

$$\{(x_i, y_i), i = 1,2,3,\ldots,l\} \quad x_i \in R^d \tag{6}$$

Among them, $y_i \in \{+1,-1\}$ is the category identification of two types of samples. The goal of learning is to construct the following optimization problems:

$$\min_{w,b,\xi} \frac{1}{2} w^T w + C\sum_{i=1}^{l} \xi_i \tag{7}$$

$$s.t. \quad y_i\left(w^T x_i + b\right) \geq 1 - \xi_i \tag{8}$$

$$\xi_i \geq 0, \quad i = 1,2,3,\ldots,l \tag{9}$$

Where C is the penalty parameter, the greater the value, the greater the punishment for classification errors, thus emphasizing the classification accuracy.

Smoothing filtering will weaken or even eliminate the high-frequency components in the image, and at the same time remove the noise. Enhancing the low-frequency components in the image will smooth the whole image, and at the same time, the outline in the image will become relatively blurred, which is mainly used to eliminate all kinds of noise in the image. Smoothing filter uses a smoothing filter to filter the whole image. Kernel function plays a key role in nonlinear SVM, and the generalization performance of SVM is closely related to kernel function. The introduction of kernel function makes SVM method successfully apply the idea of optimal classification surface to nonlinear classification, so SVM can solve the classification problem of high-dimensional samples. Kernel function can be selected according to different requirements of data processing. If there is no special requirement, RBF kernel function is generally recommended because RBF kernel function can show good performance in practical processing. The SVM constructed by choosing different kernel functions has different results for sample operation. The formula of RBF kernel function is as follows:

$$K(x, y) = \exp\left(-\frac{\|x - y\|^2}{2\sigma^2}\right) \tag{10}$$

The selection of kernel function and its parameters is particularly important to the performance of SVM. In this article, the orthogonal Chebyshev kernel can improve the accuracy simply by increasing the number of terms of the kernel function, but the increase of the number of terms will also increase the amount of calculation, and the number of terms should generally not exceed 10. Orthogonal Chebyshev kernel is a kernel function that is not inferior to RBF kernel, and has good generalization ability and application prospect. Using orthogonal Chebyshev kernel function technology, its algorithm complexity has nothing to do with the sample dimension, which skillfully solves the "dimension disaster", overcomes the nonlinear problem and reduces the identification difficulty caused by nonlinear factors. As long as an operation satisfies Mercer conditions, it can be applied as a kernel function, and it can be used as a mapping inner product of low-dimensional transformation here, and complex nonlinear classification can be realized through it; Moreover, it does not increase the computational complexity of the problem, but the inner product form is different from the linear separable form. In this article, SVM is applied to the defect recognition in the ink-wash tomographic image, which can automatically identify all kinds of defects in the ink-wash image and reconstruct the 3D virtual image of the ink-wash image in the computer. At the same time, SVM is further used to identify the 3D defects of ink painting.

4 PARAMETER SETTING AND ALGORITHM SIMULATION

The colorful virtual world of ink painting is represented by 3D animation technology, and the artistic style of ink painting is applied to the creation of modern animation. In this article, based on

SVM algorithm, the 3D animation CAD optimization model of ink painting effect is constructed, and the feature selection algorithm of ink painting image is proposed. In order to verify the effectiveness of the algorithm model, the following simulation experiments are carried out. There is an adjustable space between classification accuracy and classification loss of SVM. The selection of penalty factor and kernel function parameters affects the performance of SVM, and they affect confidence risk and experience risk to some extent. Therefore, adjusting the penalty factor and choosing appropriate kernel parameters can make the generalization ability of the classifier reach the best. In order to test the classification accuracy of the proposed algorithm under different parameters, experiments were carried out respectively, and the results are shown in Table 1.

Algorithm	*Parameter Setting*		*Test Accuracy*
GA		$C=0.2,\sigma=1$	95.84%
Improved algorithm	D=0.014	$C=0.2,\sigma=1$	95.97%
GA		$C=100,\sigma=0.5$	97.08%
Improved algorithm	D=0.508	$C=100,\sigma=0.5$	97.93%

Table 1: Influence of different parameters on the algorithm.

As can be seen from the above table, reducing σ and increasing the penalty parameter C, the GA and the improved algorithm in this article can minimize the classification error and increase the test accuracy; By setting an appropriate D value, the improved algorithm in this article can get a better classification accuracy than the classical GA, and has better stability.

The model is preprocessed in order to improve the efficiency and accuracy of retrieval. In practical application, corresponding preprocessing techniques should be adopted according to different feature selection methods. In addition, the selected data samples have a very important influence on the learning of SVM regression model. Appropriate data samples can not only provide good support for improving the accuracy of the model, but also make the algorithm less affected by noise data and improve the operation speed. Therefore, the selection of samples should be considered comprehensively from many aspects, so that the data samples can reflect the parameter characteristics of the research object as comprehensively as possible. In this experiment, the Fourclass data set is selected as the test case of the real data set, as shown in Figure 3.

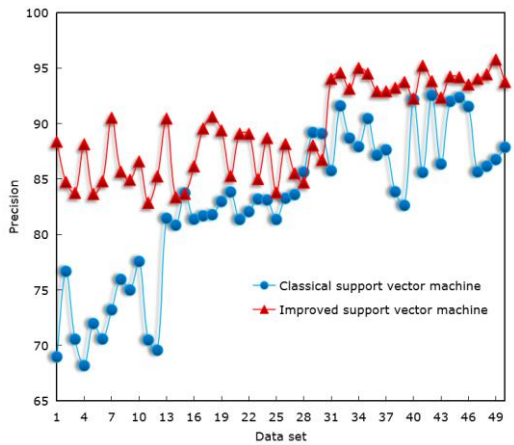

Figure 3: Data experiment result chart.

In this article, floating-point operation is transformed into fixed-point integer operation, which reduces the complexity of operation, improves the speed of operation, and brings the rapidity of data calculation in training process with a certain loss of accuracy.

In this article, orthogonal Chebyshev kernel function is introduced, and the input space of samples is mapped from low dimension to high dimension and from nonlinear to linear by using the special properties of kernel function. This method not only skillfully solves the problem of dimension disaster, but also does not increase the complexity of the problem, and the complexity of the algorithm has nothing to do with the dimension of the sample. Figure 4 shows the relationship between kernel parameter ρ and evaluation function.

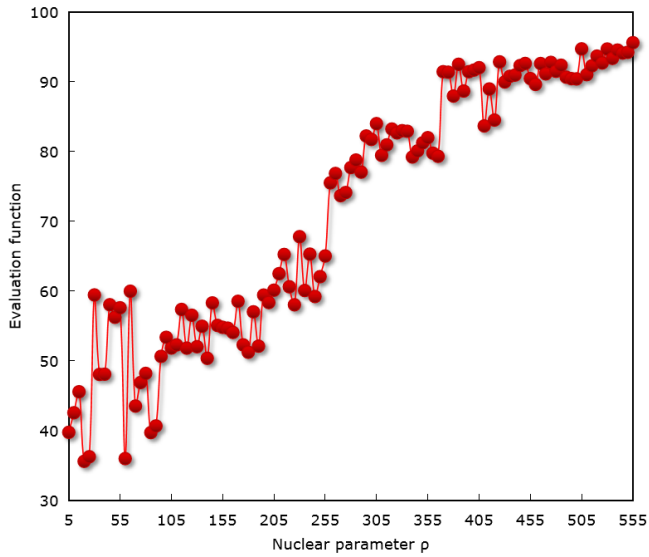

Figure 4: Relationship between kernel parameter ρ and evaluation function.

The classification hyperplane corresponding to the optimal solution ρ obtained by the algorithm in this article makes the classification hyperplane generated by SVM divide the training set correctly, and the classification hyperplane obtained by the algorithm can better reflect the distribution trend of samples and the classification interval is more reasonable.

In this article, fewer variables are used to replace the original data set, and these fewer variables should reflect the original data set as much as possible, and at the same time they are independent of each other. That is, orthogonal transformation is carried out on the 3D model, and the 3D model is adjusted to the principal component direction. Any point in a high-dimensional data set is represented by the linear combination of its neighboring points, and the low-dimensional manifold is reconstructed in the embedded space by minimizing the error of local nearest neighbor relation, and the topological structure of the whole is maintained by using local linearity, so that any data point and its neighboring points are invariant to rotation, translation and expansion, and the inherent regularity of the distribution of high-dimensional data sets can be effectively discovered. In the experiment, the errors of GA, PSO and SVM are shown in Figure 5. The accuracy comparison of the algorithm is shown in Figure 6.

The experimental results in Figure 5 and Figure 6 show that the method in this article has high accuracy and low error. The highest accuracy can reach 94.89%, and the error is only about 0.27. The above results verify the superior performance and reliability of the proposed method.

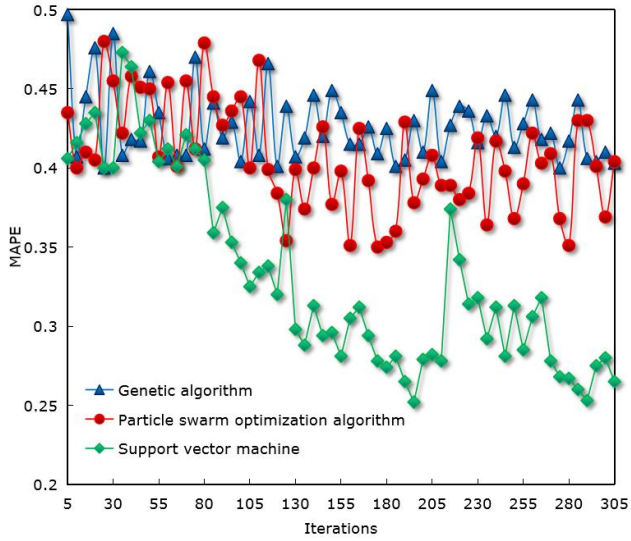

Figure 5: Algorithm error situation.

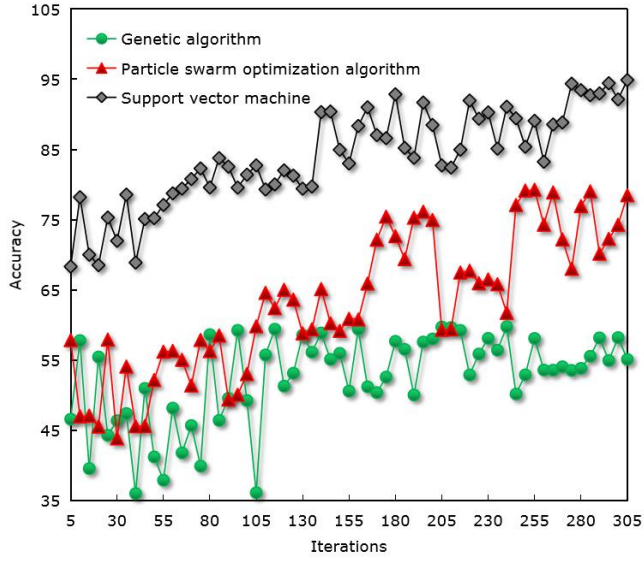

Figure 6: Accuracy of algorithm.

In order to objectively evaluate the algorithm and verify its feasibility, this section uses the images in the unified ink animation database as the original training and testing data to test and experiment the classification algorithm proposed in this article and a parallel SVM classifier. In order to maintain consistency, the experiment uses the same database. The comparison results of response speed of GA, PSO and SVM are shown in Figure 7.

The experimental results show that the response speed of this method is fast, generally only 0.37s s. In this article, the kernel generated by orthogonal Chebyshev polynomials is used to reduce the correlation between data and data redundancy. TCompared with GA and PSO, the improved SVM method in this article highlights many advantages, which can provide certain technical support for 3D animation CAD optimization of ink painting effect.

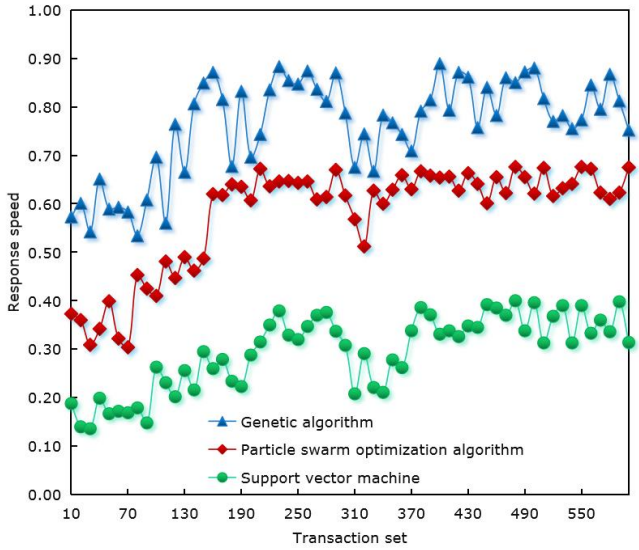

Figure 7: Comparison results of algorithm response speed.

5 CONCLUSIONS

At present, with the continuous growth of network information technology, people's pursuit of spiritual level is increasing. New requirements are put forward for the growth of animation, and the artistic conception of ink animation in the past cannot meet the actual needs of social development. Based on the reality of 3D animation design, the application of China ink painting has a positive impact on improving animation quality. Combining the characteristics of 3D animation design and China ink painting, it not only greatly enriches the presentation of 3D animation, but also promotes the animation industry in China to have more prominent national characteristics. In this article, SVM algorithm is used to optimize the 3D animation CAD of ink painting effect, which is based on structural risk minimization, has a more solid theoretical foundation, stronger generalization ability and better performance. At the same time, a kernel function and a new orthogonal Chebyshev kernel function are constructed, which take into account the similarity between sample space and feature space. The final simulation results show that the accuracy of this method is high and the error is low. The highest accuracy can reach 94.89%, and the error is only about 0.27. At the same time, the response speed of the proposed algorithm is fast, generally only 0.37s s. The above results verify the superior performance and reliability of the proposed method. Compared with GA and PSO, the improved SVM method in this article highlights many advantages, and the generalization performance of SVM method is better. It is hoped that this research can further promote the growth of Chinese ink animation industry.

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