Retraction Notice

The Editor-in-Chief and the publisher have retracted this article, which was submitted as part of a guest-edited special section. An investigation uncovered evidence of systematic manipulation of the publication process, including compromised peer review. The Editor and publisher no longer have confidence in the results and conclusions of the article.

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Computer-aided three-dimensional animation design and enhancement based on spatial variation and convolution algorithm

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Abstract. Computer-aided technology is a system of personal confidential interaction between computer and users under the guidance of people. Due to the continuous development of computer technology, this technology has been used in many fields. Computer-aided design is the use of computer systems to assist designers in engineering or product design. It is a technology to achieve the best design effect. Three-dimensional (3D) animation is not limited by time and space. It uses various forms of expression to express complex and abstract program content, scientific principles, and abstract concepts in centralized and simplified forms. The creative feature of animation is that the author does not use the advanced 3D technology to present the real world to the audience. Here, we aim to study the 3D animation image design and image enhancement based on computer-aided technology, hoping to make the 3D animation more realistic and make the film and television picture clearer with the help of computer-aided technology. We expound the current situation of 3D graphics research. We analyze the current development of the 3D animation industry. We propose an extreme value constraint based on spatial variation and a convolution algorithm based on learning a ringing images. The experimental results show that after Retinex method processes the image, the matching feature points of the target image in the scale-invariant feature transformation algorithm are 55. The correct matching rate of feature points after homomorphic filtering is 0.85. The number of correct matching points of the image processed by Retinex method changes greatly, and the change of homomorphic filtering is small. © *2022 SPIE and IS&T* [DOI: 10.1117/1.JEI.32.1.011215]

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1 Introduction

With the continuous development of computer technology, industries are increasingly combined with computer technology. In the development process of film and television industry, it also develops from two-dimensional (2D) film and television to three-dimensional (3D), especially in animation film and television. Each picture is depicted frame by frame and then played successively, which is the characteristic of 2D animation technology. Since the 1990s, a large number of 3D technologies have been used in animation, film, and television. In its production process, some small defects appeared on the picture. For example, when the expression picture is still, the effect of complete stillness cannot be achieved, and the start and stop of the character's movement just change with the river head at the same time. Therefore, we combine vision technology with computer technology. It is expected that with the support of computer technology, it can improve the image quality, make the film and television picture smoother, and the visual effect more realistic.

Image is the basis of human vision and an important medium and means for human to transmit information. It is of great significance to daily life and production practice. Enhancing the image can make the unclear image become a clear image, to improve the image quality, improve the visual effect, and obtain more information. The emergence of 3D animation expands the

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application scope of computer technology, meets people's pursuit of art, and promotes the progress of film and television industry.

Each pixel of the image can determine an adaptive gain coefficient, which will make the video image achieve a very appropriate enhancement effect through subsequent processing. Combined with the theory of scale space, this paper realizes the extraction and matching of image features by SIFT algorithm.

2 Related Work

With the continuous development of computer technology, animation, film, and television are more closely combined with it. The combination of digital elevation model and high-quality raster graphics can provide a realistic 3D representation of the earth (Virtual Earth). And it provides an amazing navigation experience on the terrain through the earth browser. However, it is mainly based on the combination of geographic information system functions and all visualization functions. For example, the animation effect of selected areas of terrain texture and the motion effect of 3D objects moving in a dynamically defined geo-referenced terrain path are not widely supported by open geospatial applications or development frameworks. To this end, Evangelidis et al. developed and provided an open geospatial software application prototype to the research community. It provides advanced capabilities for the creation of virtual web-based spatial worlds that are dynamically user-defined.[1] The existing image enhancement algorithms can hardly deal with multiple types of degraded images. Ju and Zhang proposed a fast image enhancement algorithm based on prior knowledge and atmospheric scattering model. Atmospheric scattering, the phenomenon that electromagnetic waves interact with atmospheric molecules or aerosols so that the incident energy is redistributed in all directions with a certain law. First, he proposed an innovative image a priori through experimental statistics, which is called bright channel a priori. It shows that in high-quality clear images, white dots are more likely to exist near each pixel. Then, the scattering model is improved and the reflectivity image calculation formulas of bright channel a priori, dark channel a priori, and improved scattering model are derived. Finally, he proposed a fault-tolerant mechanism based on reliability prediction to deal with the situation that the dark channel a priori does not work. Experimental results show that the algorithm can not only highlight the texture details but also restore the hue. It can process many types of degraded images.[2] Hou et al. proposed a new method for underwater color image enhancement based on hue preservation. He first converted the degraded image from a red-green-blue color model to a hue, saturation, intensity (HSI) color model. The difficulties of color image processing include the imperfection of vector-valued color signal theory and the hardware limitations of imaging equipment and processing equipment. The H component also remains unchanged, and he applied the capital harness system algorithm to the S and V components. Moreover, experimental results show that this method outperforms several other state-of-the-art algorithms.[3] Park et al. proposed a spatially adaptive image enhancement based method. Since the proposed weight map assigns smaller weight values in bright and edge regions, weak noise reduction can be performed to preserve edges and textures. Experimental results show that the proposed method can provide better results.[4] Ravisankar et al. constructed Gaussian and Laplacian pyramids to represent images at different resolutions. The contrast of each image in the Gaussian and Laplace pyramid is improved by histogram equalization and unsharpening masking. Performance measurements and peak signal-to-noise ratio show that the unsharpening masking method applied to the Laplace pyramid difference images is better than other image enhancement methods.[5] Aiming at unmanned aerial vehicle (UAV) reconnaissance images under fog and haze conditions, combined with the characteristics of UAVs, Huang et al. proposed an image defogging method by combining the characteristics of UAVs. Automatic white balance and contrast enhancement are followed by defogging. The experimental results show that the image evaluation index is improved, which proves that the method can obtain well.[6] To improve the contrast and restore the color of underwater images while avoiding lack of detail and color bias, Ma et al. proposed a histogram equalization contrast limited adaptive histogram equalization (CLAHE) fusion algorithm. The algorithm applied CLAHE in YIQ and HSI color spaces to obtain two different enhanced images, respectively. When the red, green, and blue (RGB) components are not consistent in the YIQ-RGB or HSI-RGB images, these three components must be consistent with the CLAHE algorithm in the RGB space.[7] By combining a novel dynamic inertia weight, an improved bat algorithm (BA) is proposed for Dhal and Das, and an adaptive algorithm for algorithm parameters is proposed. BA is an optimization technology based on iteration. It is initialized with a set of random solutions, and then the optimal solution is searched through iterations. The local new solution is generated by random flight around the optimal solution, which strengthens the local search. In BA, chaotic sequences and the developed population diversity measures were used to perform a local search and generate an improved initial population. The correct setting of these parameters is time consuming, but it is important for the image enhancement capability of WTBHE. The experimental results show that the BA proposed by him is better than the simple BA in convergence speed, robustness, and objective function maximization. Moreover, WBTHE is superior to some well-known VARIANT[8] in brightness preserving image enhancement. Although these theories describe computer-aided and image enhancement to a certain extent, they are less combined and lack practicability.

3 Computer-Aided 3D Animation Image Design and Image Enhancement Method

3.1 *Overview of 3D Animation*

With the continuous development of modern science and technology, increasingly manufacturing fields integrate science and technology with products to produce more intelligent products.[9] In the 21st century, the economic level is rising, and people's pursuit of art is also increasing. It has been asserted that the future art form will combine various artistic means to create more wonderful art products.[10] 3D animation art is a new art form produced by the combination of digital technology represented by computers and traditional dynamic visual art. 3D animation perfectly verifies this. It perfectly presents science and technology and visual art, creates its own unique characteristics, occupies a place in the catering industry with a strong development speed, and is deeply loved by the audience.[11,12] Figure 1 shows the basic process of film and television product visualization:

3D animation is what we usually call 3D animation. The film and television industry develops with the development of computer technology and belongs to an emerging art industry.[13] Dimension is the concept of describing space while 3D animation is the result of the combination of high-tech means and visual art. 3D animation immerses the audience with a realistic sense of picture. It uses digital means to convey pictures to the audience and provide 3D feelings for the audience.[14,15] In addition, 3D animation also includes many levels of simulation settings, such as actors, sets, graphical layout, skin texture, material, lighting, color, sound effect, and so on. In 3D film and television pictures, each scene has its own rules, and each picture is under the control of the system. With the continuous development of 3D technology, this technology is not only widely used in film and television but also appears frequently in the field of games and advertising.[16,17] Figure 2 shows the 3D scene management:

From the perspective of the whole animation film and television industry, the United States occupies the vast majority of the world animation film and television market. In terms of technology and other aspects, the United States is in a leading position in the world. In particular, the films made by Disney are loved by fans all over the world.[18,19] With the rise of the 3D animation industry, the United States has gradually abandoned 2D animation. In recent years,

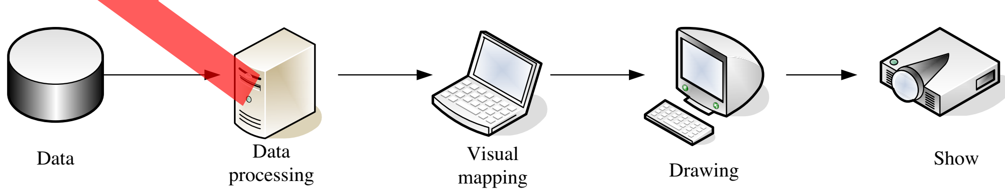

Fig. 1 The basic process of film and TV product visualization.

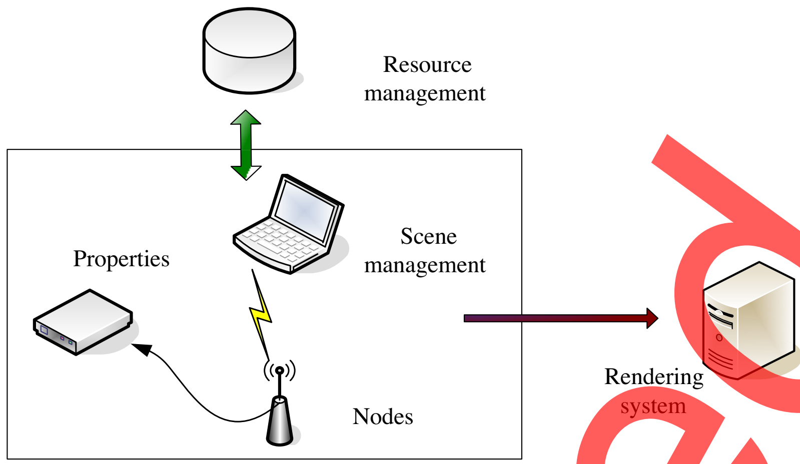

Fig. 2 3D scene management structure.

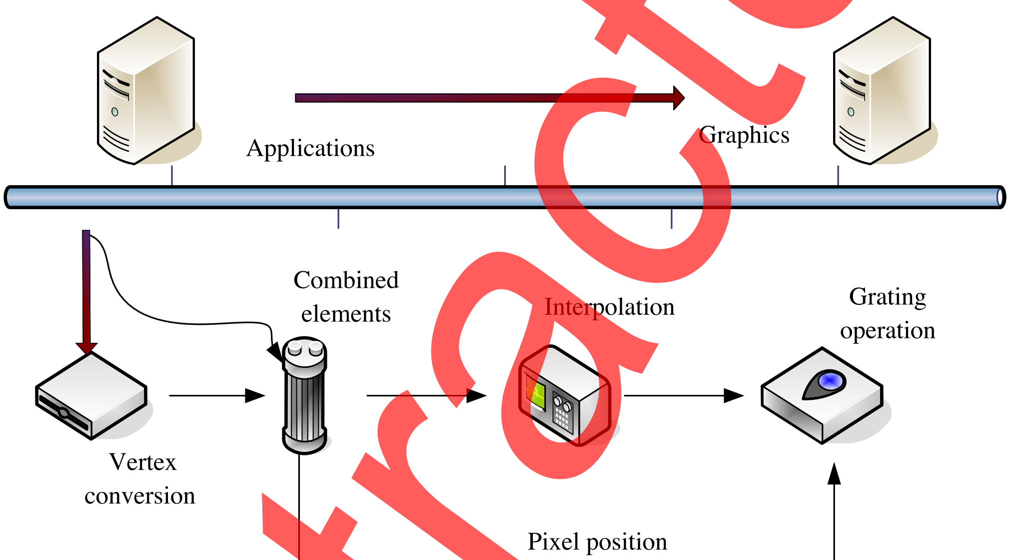

Fig. 3 3D image engine rendering process.

the achievements of the United States in the 3D film and television industry are obvious to all, which are inseparable from the support of scientific and technological means.[20] China's 3D industry began to develop at the end of the last century. At the beginning of this century, the 3D animation industry began to develop rapidly, but due to the short development time, the whole industry also had some problems. Figure 3 shows the rendering process of the 3D image engine.

3.2 *Overview of Image Enhancement*

When collecting images, the image effect will change differently due to the change of external environment and equipment quality. In this case, the image needs to be processed, and the quality of the image should be improved. In imaging theory, a complete image is the product of reflection and external light, and its functional expression is as follows:

$$Q = TY \times U^3. \tag{1}$$

In Eq. (1), Q represents the observed image, T represents the reflection of the target image, and Y represents the illumination of the target image

$$q = t + y \times u^3. \tag{2}$$

To make the image easy to process, we will convert the product into the form of sum in the process of processing, but in this case, $t < 0$ and $y > q$ must be guaranteed

$$\min\left(\int_\alpha |\nabla y|^3 + \eta \int_\alpha |\nabla(y - t)|^3 + \kappa \int_\alpha |\nabla(y - t)|^3\right). \tag{3}$$

In Eq. (3), η and κ represent positive parameters and $t = q - y$

$$A_\beta = \int_Q \frac{|\beta(\theta)|}{\theta} \mathrm{d}\theta < \infty. \tag{4}$$

Among them, $\beta(\theta)$ is the limiting condition

$$G = \frac{0.5[(A - B) + (A - C)]}{[(A - B)^2 + (A - B)(B - C)]^{0.5}}, \qquad A \neq B, \quad B \neq C, \tag{5}$$

$$G = 2\pi - \frac{0.5[(A - B) + (A - C)]}{[(A - B)^2 + (A - B)(B - C)]^{0.5}}, \qquad C > B, \tag{6}$$

$$Q = 1 - \frac{3}{(A + B + C)} \min(A, B, C), \tag{7}$$

$$R = \frac{1}{3}(A + B + C). \tag{8}$$

The above formula represents the conversion of RGB color space. Among them, G represents the chromaticity component, A, B, and C represent three primary colors, R represents the luminance component, and Q represents the comprehensive conversion

$$\beta_{z,x}(q) = \left|\frac{1}{\sqrt{z}}\right| \beta\left(\frac{q - x}{z}\right). \tag{9}$$

Among them, z represents the expansion variable, represents the function width, and x represents the translation, which determines the translation distance. Therefore, for any function, its wavelet transform can be expressed as

$$T_{zx}(q) = \langle f, \beta_{z,x} \rangle = \int_{-\infty}^{+\infty} f(q) \frac{1}{\sqrt{z}} \beta\left(\frac{q - x}{z}\right) \mathrm{d}q. \tag{10}$$

Among them, $T_{z,x}(q)$ is the convolution of functions $f(q)$ and $\beta_{z,x}(q)$, which exists in the frequency domain:

$$\beta_{z,x}(\varepsilon) = \sqrt{z} e^{-j\varepsilon} \beta(z\varepsilon). \tag{11}$$

In the process of operation, we can adjust the frequency of z observation signal. The larger z is, the higher the frequency domain resolution is, and the smaller z is, the higher the time domain resolution is.

Histogram addition can be calculated simply and quickly to suppress background interference. We define it as

$$y_{ui}(S, T) = 1 - \sum_{i=1}^{m} \min(s_i, t_i). \tag{12}$$

Normalizing this formula to obtain:

$$y_{ui}(S,T) = 1 - \frac{\sum_{i=1}^{m} \min(s_i, t_i)}{\min(\sum_{i=1}^{m} s_i, \sum_{i=1}^{m} t_i)}. \tag{13}$$

χ^2 distance can be expressed by the following formula:

$$L_{\chi^2}(S,T) = \sum_{i=1}^{m} \frac{(s_i - n_i)^2}{n_i}. \tag{14}$$

Among them, $n_i = (s_i + t_i/2)$

$$\min\left(\int_{\varpi} |\nabla c| + \varphi^{-2} \int_{\varpi} (c-a)^3\right). \tag{15}$$

Equation (15) represents the expression of image denoising function, a represents the noise of target image, and c represents the denoised target image.

$$\frac{\partial c}{\partial p} = \mathrm{div}\left(\frac{\nabla c}{|\nabla c|}\right) + \varepsilon^{-2}\left(2 - \frac{a}{c}\right). \tag{16}$$

The model can guarantee the integrity of the boundary while dealing with denoising, but it can not guarantee the texture.

The sparse denoising algorithm is based on the development of K-means. In fact, we can generally regard it as K-means algorithm. K-means algorithm is an iterative clustering analysis algorithm, which randomly selects K objects as the initial clustering center, then calculates the distance between each object and each seed clustering center, and assigns each object to the nearest clustering center. When we use atoms to approximate signals in the algorithm, we can express the expression as

$$\min_{F.K} \|Q - FK\|_T^2, we\|k_i\|_0 \leq w, \qquad \forall\ i. \tag{17}$$

Through calculation, we divide the above algorithm into two stages. In the evaluation process, we use the idea of alternating iterations and the thinking of control variables to optimize the expression, as shown below:

$$\min_{ki}\{\{\|q_i - Fk_i\|_2^2\}, w.e\|k_i\|_0 \leq w, \qquad \forall i. \tag{18}$$

The expression in the column is the first stage, which uses the matrix for inversion. In the second stage, the method is to update the values of each column. The optimization in this stage can be expressed as

$$\|Q - FK\|_2^2 = \|Q - \sum_{i=1}^{v} d_i k_R^i\|_T^2 = \|(Q - \sum_{i \neq v} d_i k_R^i) - d_v k_R^i\|_T^2 = \|W_v - d_v k_R^i\|_T^2. \tag{19}$$

k_R^i represents the i'th line of K, and FK is divided into two parts, $\sum_{i \neq v} d_i k_R^i + d_V k_R^V$. In the process of solving, because there are not too many constraints, it is easy to cause errors in solving. Therefore, when using a, we default its definition domain as

$$\mu_v = \{i | 1 \leq i \leq v, k_v^T(i) \neq 0\}. \tag{20}$$

In this case, the index of the sample constitutes a new set, which is expressed by the following expression:

$$Q_W^V = Q_R^V \Omega_V, K_W^V = K\Omega_V, E_V^W = E_V \Omega_V. \tag{21}$$

Among them, Ω_v is 1 at this time and other values are 0.

3.3 *Overview of Image Processing*

With the continuous development of computer technology, we will combine image and computer when processing images. In this case, we call image processing digital image processing. In terms of concept, a digital image is composed of pixels, which is the basic unit of image. Digital image processing is aimed at digital images. In short, $Q3$ is to convert the information of the target picture into the corresponding digital information, and then calculate the obtained information. Figure 4 shows the basic steps of digital image processing.

Digital image processing technology includes a very basic function, that is, the enhancement of digital image information. This takes up a lot of space and the processing process is very complex for pictures without any intervention. Therefore, before formal processing, it needs to convert the target image in the spatial domain or frequency domain. After conversion, no matter pasting, copying, storing, or cutting the picture, it will not cause damage to the image itself, which cannot be achieved by other technologies. Image compression technology is often used in this process. The purpose of restoring or enhancing the target picture is to enhance some information features of the target picture. Segmentation technology is to extract the information that needs to be used in the target picture. Figure 5 shows the basic structure of digital image processing.

Due to the in-depth development of computer technology in recent years, digital image processing has made great progress. In recent years, due to the increasing demand for agriculture, forestry, animal husbandry, sideline, fisheries, aerospace, military, and medical technology, these continue to force the development of digital image technology. At present, the development of digital processing technology can be described from three aspects. The first is the improvement of traditional technology. With the continuous development of technology, it contains increasingly fields. Due to the continuous development and improvement of their own technology in various fields, the requirements for digital image processing technology are becoming increasingly strict. The continuous development of digital image technology requires the continuous improvement of traditional technology as a new experimental technology. The second type is image technology. In short, what is input is image. The third type is data to image type. Figure 6 shows the schematic diagram of the data processing structure.

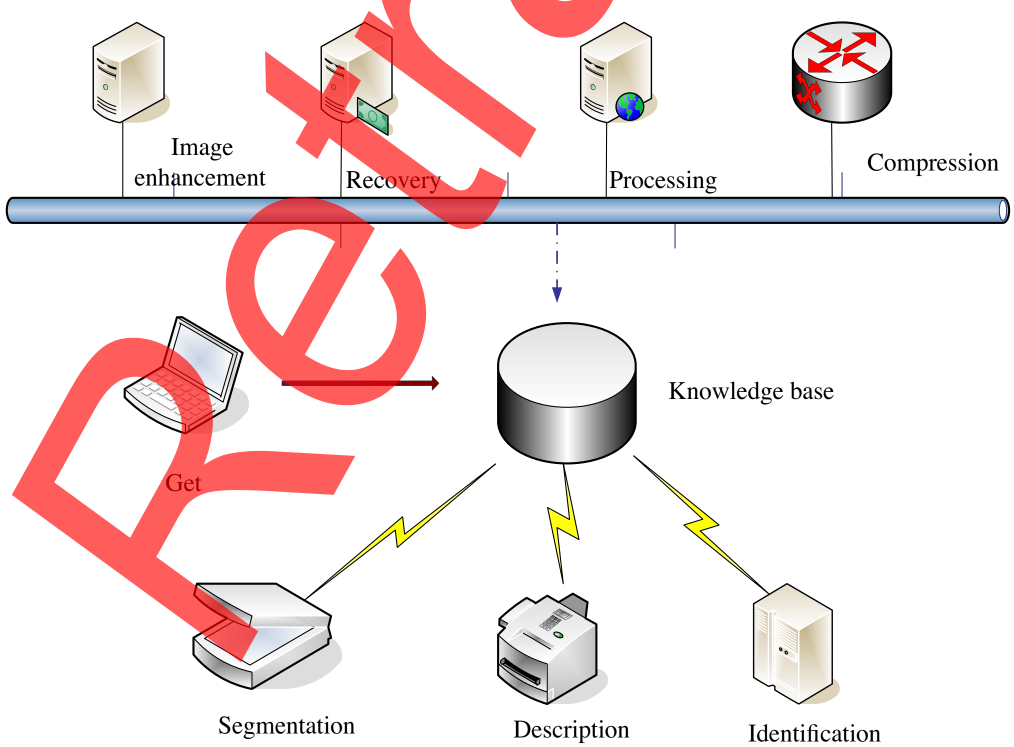

Fig. 4 Basic steps of digital image processing.

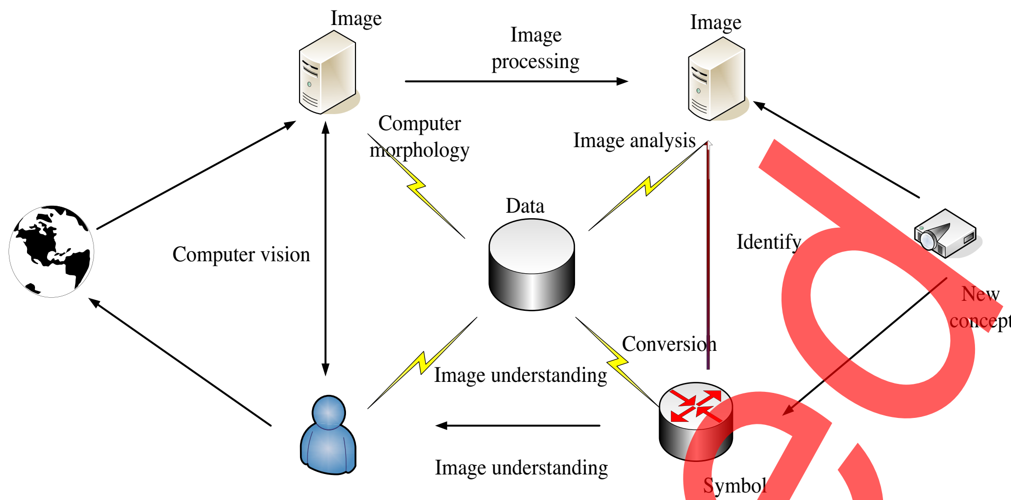

Fig. 5 Schematic diagram of digital image processing.

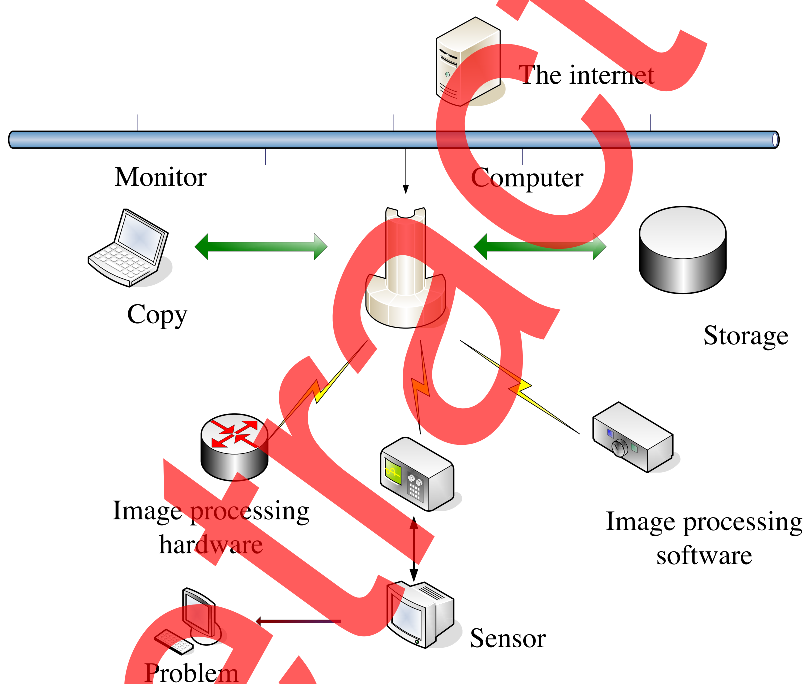

Fig. 6 Data processing structure diagram.

4 Computer-Aided 3D Animation Image Design and Image Enhancement Experiment

4.1 *Image Enhancement and Feature Matching*

Image matching is an important means in image recognition. From image processing to image analysis, it plays an extraordinary role. Moreover, the matching of image features has stability, less external interference, and wide application range. Therefore, this technology is widely used at present.

According to the data in Table 1, to process the target image, we use different algorithms to enhance the target image. According to the experimental data, we used four different methods for processing. The matching feature points of the original image in the scale-invariant feature transformation algorithm are 137. The feature points matched by the robust feature algorithm in the

Table 1 Blurred image 1 and 2 feature matching analysis.

Category	Scale invariant feature conversion algorithm	Accelerated version of feature algorithm	Robustness local features algorithms
Original image	137	220	5423
Homomorphic filtered images	114	199	5174
Retinex method of image processing	47	45	2563
Histogram processed images	177	372	7200

accelerated version are 220. The feature points matched in the local feature algorithm are 5423. After homomorphic filtering image processing, the matching feature points of the target image in the scale-invariant feature transformation algorithm are 114. The feature points matched by the robust feature algorithm in the accelerated version are 119. The feature points matched in the local feature algorithm are 5174. After the image is processed by Retinex method, the matching feature points of the target image in the scale-invariant feature transformation algorithm are 47, the matching feature points in the robust feature algorithm in the accelerated version are 45, and the matching feature points in the local feature algorithm are 2563. After histogram processing, 177 feature points are matched by the scale-invariant feature transformation algorithm of the target image. The feature points matched by the robust feature algorithm in the accelerated version are 372 and 7200 in the local feature algorithm. According to the data, there is no obvious change between the image processed by homomorphic filtering and the original image.

According to the data in Table 2, the matching feature points of the original image in the scale invariant feature transformation algorithm are 150, the matching feature points in the robust feature algorithm in the accelerated version are 185, and the matching feature points in the local feature algorithm are 20,500. After homomorphic filtering image processing, the matching feature points of the target image in the scale-invariant feature transformation algorithm are 130, the matching feature points in the accelerated version of the robust feature algorithm are 190, and the matching feature points in the local feature algorithm are 20,000. After the image is processed by Retinex method, the matching feature points of the target image in the scale-invariant feature transformation algorithm are 55, and the matching feature points of the robust feature algorithm in the accelerated version are 59. The feature points matched in the local feature algorithm are 18,500. After histogram processing, the matching feature points of the target image in the scale-invariant feature transformation algorithm are 180, the matching feature points in the robust feature algorithm in the accelerated version are 340, and the matching feature points in the local feature algorithm are 31,700. According to the data, the number of correct matching points of the image processed by Retinex method is quite different from the original image.

Table 2 Blurred image 1 and 3 feature matching analysis.

Category	Original image	Homomorphic filtered images	Retinex method of image processing	Histogram processed images
Scale invariant feature conversion algorithm	150	130	55	180
Accelerated version of feature algorithm	185	190	59	340
Robustness local features algorithms	20500	20000	18500	31700

4.2 *Matching of Illumination Change Image Feature Points*

In the actual operation process, the effect of the image is closely related to the illumination and the position of the sensor and camera. To explore the relationship between them and image feature point matching, we analyze them. This experiment takes illumination as an example, and the specific conditions are as follows:

According to the data in Table 3, under the condition of controlling the illumination, the matching feature points of the original image in the scale invariant feature conversion algorithm are 77, the matching feature points of the robust feature algorithm in the accelerated version are 132, and the matching feature points of the local feature algorithm are 1300. After homomorphic filtering image processing, the matching feature points of the target image in the scale-invariant feature transformation algorithm are 40, the matching feature points in the accelerated version of the robust feature algorithm are 95, and the matching feature points in the local feature algorithm are 770. After the image is processed by Retinex method, the feature points of the target image matched by the scale invariant feature transformation algorithm are 77, the feature points matched by the robust feature algorithm in the accelerated version are 70, and the feature points matched by the local feature algorithm are 1700. After histogram processing, the matching feature points of the target image in the scale-invariant feature transformation algorithm are 280, the matching feature points in the robust feature algorithm in the accelerated version are 500, and the matching feature points in the local feature algorithm are 6300. According to the data, the change of feature points matched by local feature algorithm is very large. In addition, the difference in the number of correct matching points between the first image processing and the second image processing and the original image is relatively small.

According to the data in Table 4, in the case of controlling the illumination, the matching feature points of the original image in the scale invariant feature conversion algorithm are 110, the matching feature points of the robust feature algorithm in the accelerated version are 170, and the matching feature points of the local feature algorithm are 2700. After homomorphic filtering image processing, the matching feature points of the target image in the scale-invariant feature transformation algorithm are 75, the matching feature points in the accelerated version of the

Table 3 Light change images for 1 and 2 feature point matching analysis.

Category	Scale invariant feature conversion algorithm	Accelerated version of feature algorithm	Robustness local features algorithms
Original image	77	132	1300
Homomorphic filtered images	40	95	770
Retinex method of image processing	77	70	1700
Histogram processed images	280	500	6300

Table 4 Light change images for 1 and 3 feature point matching analysis.

Category	Original image	Homomorphic filtered images	Retinex method of image processing	Histogram processed images
Scale invariant feature conversion algorithm	110	75	92	290
Accelerated version of feature algorithm	170	130	100	490
Robustness local features algorithms	2700	1500	2377	7500

robust feature algorithm are 130, and the matching feature points in the local feature algorithm are 1500. After the image is processed by Retinex method, the matching feature points of the target image in the scale-invariant feature transformation algorithm are 92, the matching feature points of the robust feature algorithm in the accelerated version are 100, and the matching feature points of the local feature algorithm are 2377. After histogram processing, the target image has 290 feature points matched in the scale invariant feature transformation algorithm, 490 feature points matched in the robust feature algorithm in the accelerated version, and 7500 feature points matched in the local feature algorithm. According to the data, the conclusion of this part is the same as that of the first time. It shows that the feature points matched by the local feature algorithm change clearly and have advantages in image processing.

5 Computer-Aided 3D Animation Image Design and Image Enhancement

5.1 *Image Enhancement Feature Matching*

To investigate the feature matching of fuzzy images, we investigated the images under different algorithms. The details are as follows.

According to the data in Fig. 7, under the scale-invariant feature conversion algorithm, the matching accuracy of the original image is 0.86, and the matching accuracy of feature points after homomorphic filtering is 0.95. Under the robust feature algorithm of the accelerated

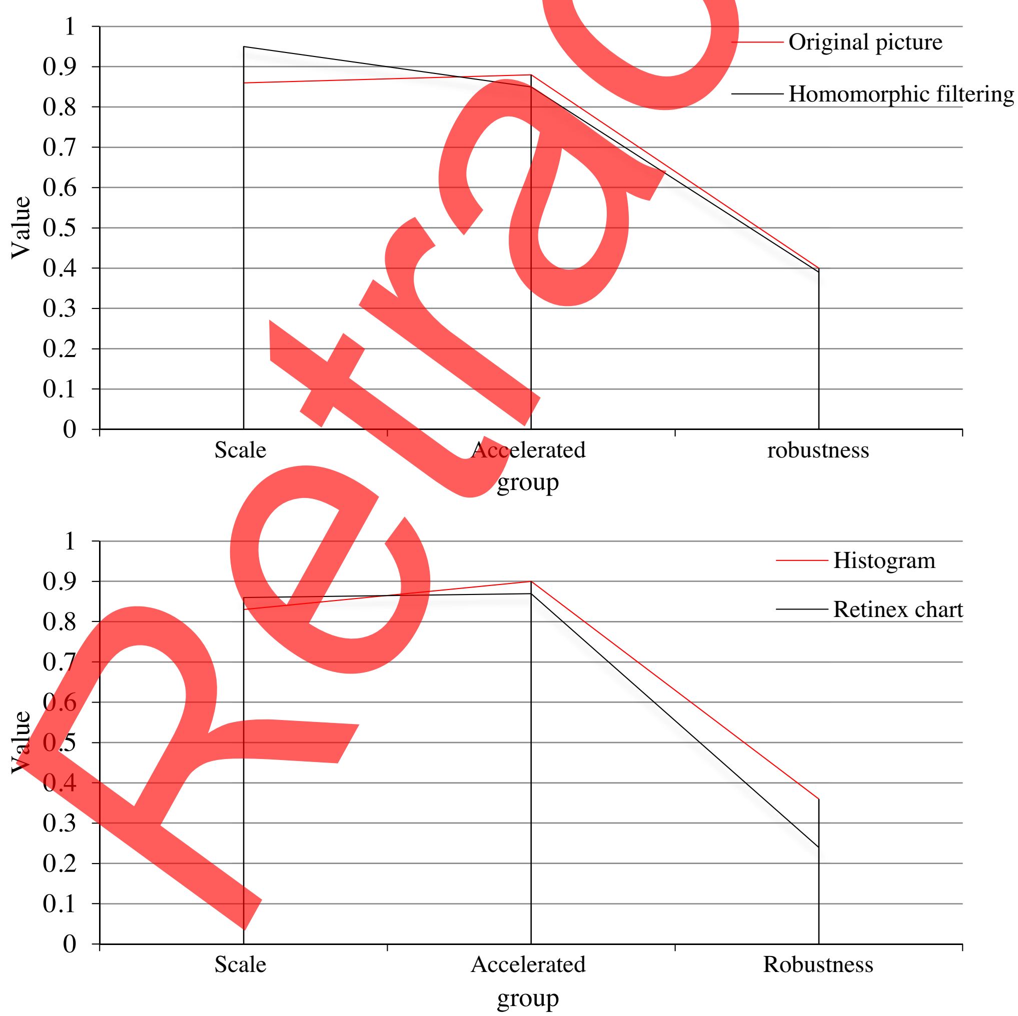

Fig. 7 Blurred image matching analysis.

version, the matching accuracy of the original image is 0.88, and the matching accuracy of feature points after homomorphic filtering is 0.85. Under the local feature algorithm, the matching accuracy of the original image is 0.4, and the matching accuracy of feature points after homomorphic filtering is 0.39. According to the data, the accuracy of homomorphic filtered image processing is not significantly different from the original image.

Under the scale-invariant feature transformation algorithm, the matching accuracy of histogram is 0.83, and the matching accuracy of feature points after homomorphic filtering is 0.86. Under the robust feature algorithm of the accelerated version, the matching accuracy of the original image is 0.9, and the matching accuracy of feature points after homomorphic filtering is 0.87. Under the local feature algorithm, the matching accuracy of the original image is 0.36, and the matching accuracy of feature points after homomorphic filtering is 0.24. According to the data, the feature matching accuracy of histogram is higher than that of Retinex image.

According to the data in Fig. 8, under the condition of ensuring the same illumination and under the scale-invariant feature conversion algorithm, the matching accuracy of the original image is 0.44, and the matching accuracy of feature points after homomorphic filtering is 0.36. Under the robust feature algorithm of the accelerated version, the matching accuracy of the original image is 0.5, and the matching accuracy of feature points after homomorphic filtering is 0.5. Under the local feature algorithm, the matching accuracy of the original image is 0.37, and the matching accuracy of feature points after homomorphic filtering is 0.32. According to the data, the accuracy of feature point matching after homomorphic filtering image processing is much higher than that of the original image.

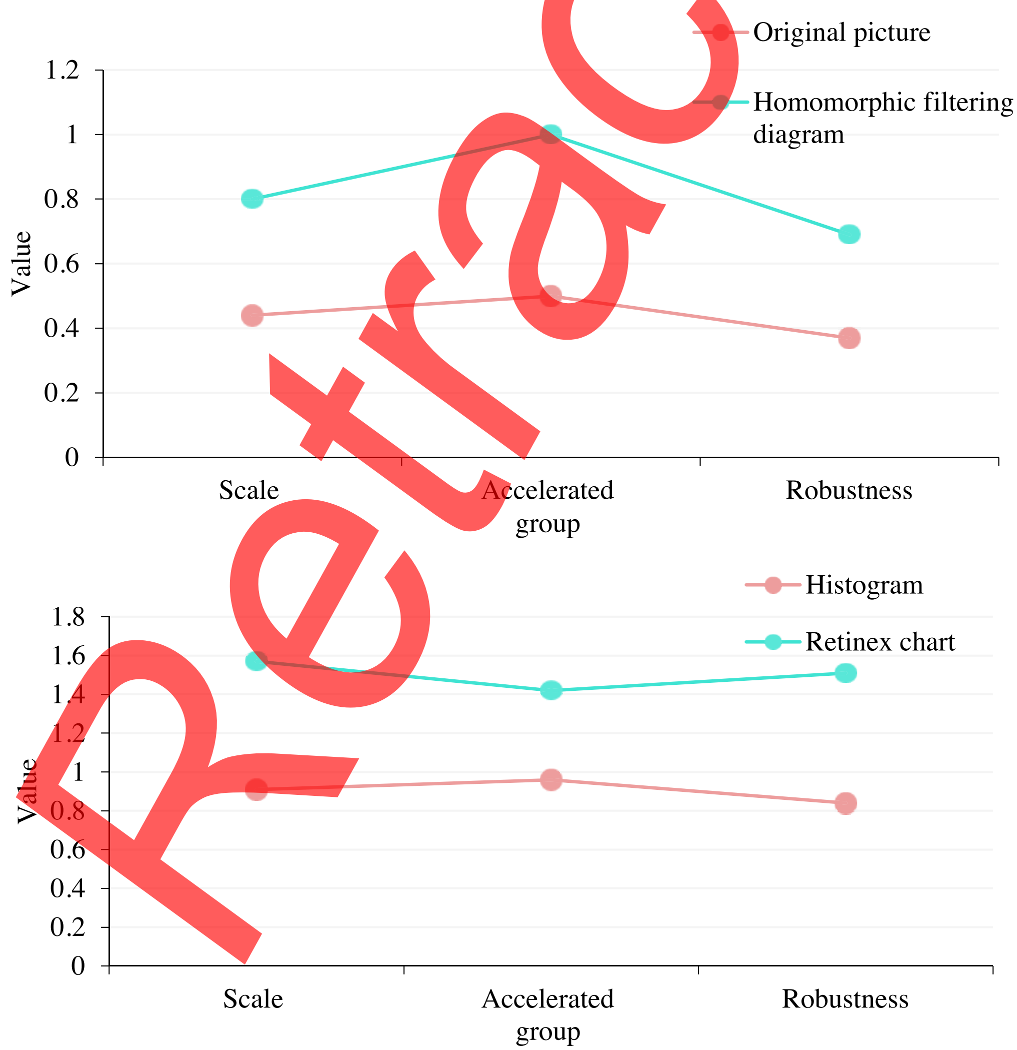

Fig. 8 Light change image matching rate analysis.

Under the scale-invariant feature transformation algorithm, the matching accuracy of histogram is 0.91, and the matching accuracy of feature points after homomorphic filtering is 0.66. Under the robust feature algorithm of the accelerated version, the matching accuracy of the original image is 0.96, and the matching accuracy of feature points after homomorphic filtering is 0.46. Under the local feature algorithm, the matching accuracy of the original image is 0.84, and the matching accuracy of feature points after homomorphic filtering is 0.67. According to the data, the feature point matching accuracy of Retinex image is higher than that of histogram.

5.2 *Image Stability*

Stability is an important basis to ensure the video effect. To verify the stability of different methods, we have verified and analyzed them. The details are as follows:

According to the data in Fig. 9, we have analyzed the stability cost of different algorithms. According to the experimental data, under the original method, we set the stability cost of the image as 1. In the first and second experiments, the cost of the conventional method is 1, and in the third experiment, the cost of the conventional method is 3. The stability costs of the next two experiments are 3, 4, and 5, respectively. When Panasonic method is used, the cost and stability

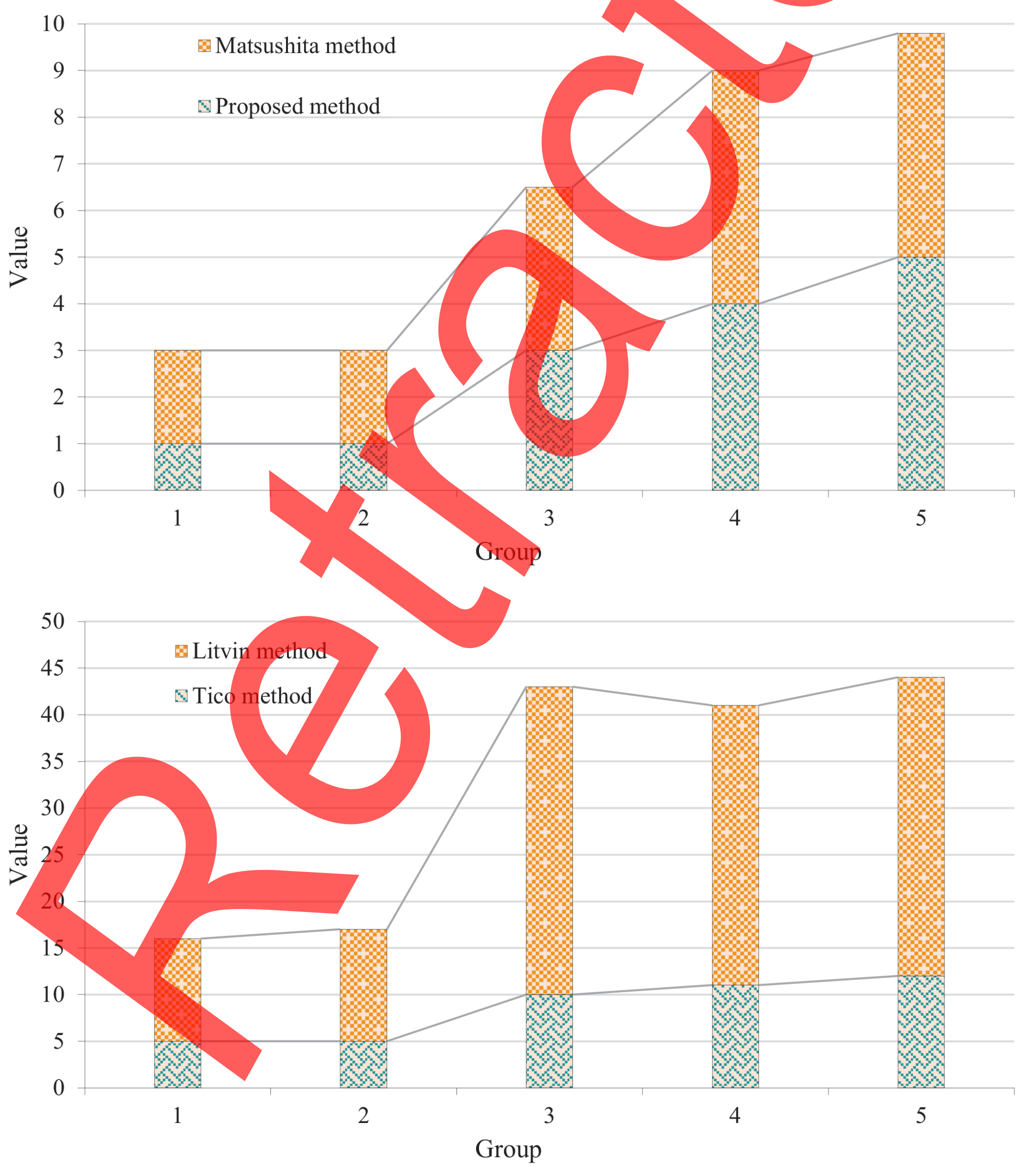

Fig. 9 Image stability analysis.

costs of five different experiments are 2, 2, 3.5, 5, and 4.8, respectively. According to the data, in the first two experiments, the cost of the same method is stable and the cost is the same, and then there is a rising trend.

When the transformation invariance and covariance (TICO) method is used in the experiment, the cost of the first two images is 5. In the next three experiments, the cost of cost stability is 10, 11, and 12, respectively. When we use the LinusTechTips grammar, the cost stability cost of the image in the first experiment is 11, the cost stability cost of the image in the first experiment is 12, and the cost stability costs of the image in the last three experiments are 33, 30, and 32, respectively. According to the data, the cost stability cost of LITT grammar is much higher than that of TICO method.

5.3 *Evaluation of Image Enhancement Algorithm*

According to the data in Fig. 10, in the first test, the SSIM value of the image is 0.9, in the second test, the SSIM value of the image is 0.93, in the third test, the SSIM value of the image is 0.95, and in the fourth test, the SSIM value of the image is 0.94. In the following tests, the SSIM value of the image is between 0.85 and 1. According to the data, the SSIM value obtained by the algorithm is relatively stable.

When testing the PSNR value of the image, we conducted several experiments on the image. In the first experiment, the PSNR value of the image was 25 dB. In the second test, the PSNR value of the image is 30 dB. In the third test, the image's PSNR value is 33 dB, and in the fourth test, the PSNR value of the image is 27 dB. In the following experiments, the PSNR value of the

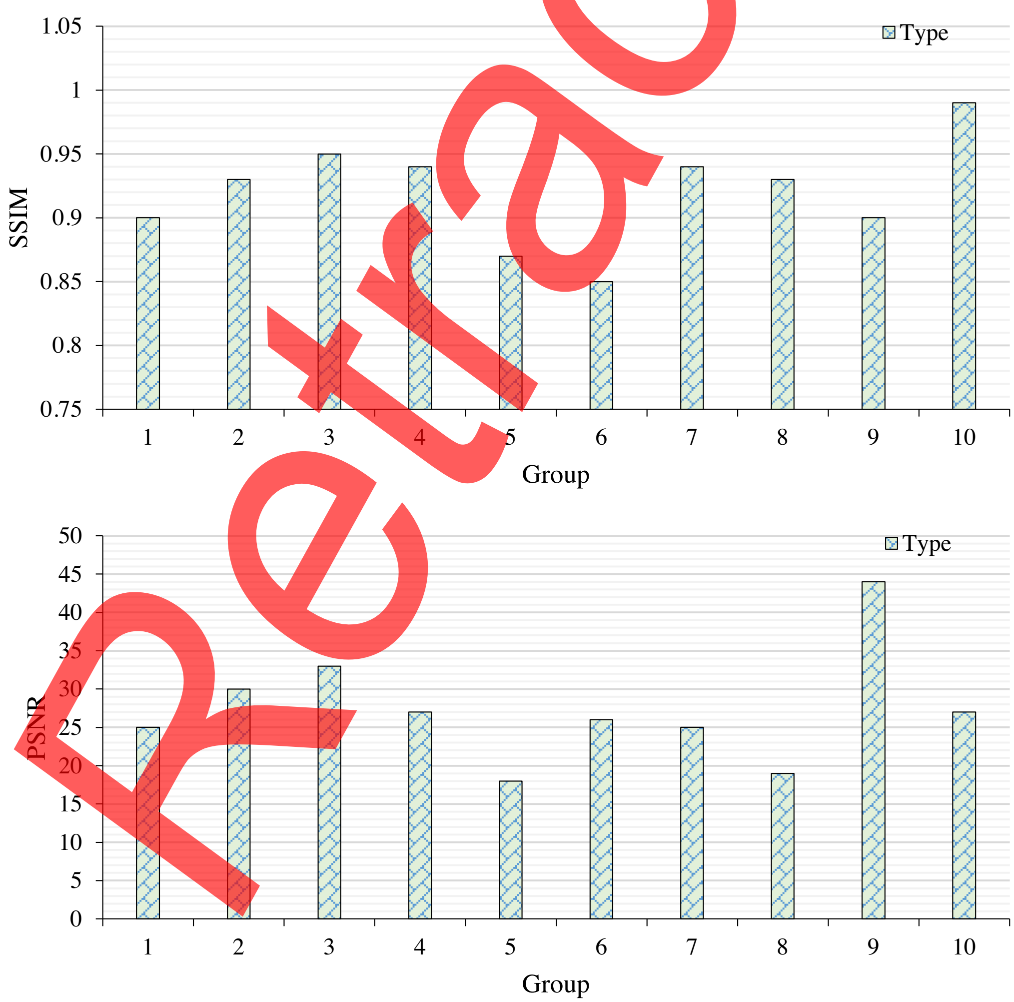

Fig. 10 Image enhancement algorithm evaluation analysis.

image is between 18 and 44 dB. From this data, we can see that PSNR is more sensitive to image changes and needs further improvement.

6 Conclusion

With the continuous improvement of economic level, people have higher requirements for the pursuit of art. Taking animation film and television as an example, China's film and television industry is developing continuously. However, there is still room for improvement in 3D film and television. This paper aims to study the 3D animation image design and image enhancement based on computer-aided technology, hoping to make the 3D animation more realistic and make the film and television picture clearer with the help of computer-aided technology. Although this paper has discussed it to some extent, there are still deficiencies: as for the target foreground extraction of the sequence image set, it still needs to manually calibrate some images, and the effect is not ideal.

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Code, Data, and Materials Availability

Data sharing was not applicable to this article as no datasets were generated or analyzed during the current study

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