www.cadanda.com
Computer-Aided Design
AND APPLICATIONS

Simulation Analysis of 3D Animation Enhanced Image Processing Effect Based on Collaborative CAD

Xiali Wei[1*]

[1]College of Art and Design, Shanghai Jianqiao University, Shanghai 201306, China

Corresponding author: Xiali Wei, 17029@gench.edu.cn

Abstract. The research on optimizing 3D animation enhancement image processing based on collaborative CAD effect can improve viewers' visual perception. To enhance the three-dimensional animation, it is necessary to normalize the brightness uniformity of the three-dimensional animation, calculate the minimum magnification factor for the contrast enhancement of the characteristic information, and complete the enhancement of the three-dimensional animation. Traditional methods calculate image nonlinear transformation parameters to suppress the enhancement of characteristic information noise but neglect to calculate the minimum amplification factor for contrast enhancement of distinct information, resulting in unsatisfactory image processing effects. A three-dimensional animation enhancement method based on gray uniformity is proposed. The first step of image enhancement processing for 3-D animation is to flatten the feature information in the 3-D animation through a filter and calculate the degree of discrete change of gray value in the local area of the 3-D animation and the 4th moment of the brightness distribution; The brightness uniformity of the characteristic area of the stereoscopic animation is normalized; finally, the minimum magnification factor for the contrast enhancement of the distinct information is calculated to realize the enhanced image processing effect of the three-dimensional animation. The simulation results prove that the above method can obtain an ideal three-dimensional animation enhancement effect.

Keywords: three-dimensional animation; enhanced image; effect;simulation; 3D Animation; Collaborative CAD
DOI: https://doi.org/10.14733/cadaps.2025.S5.126-139

1 INTRODUCTION

In today's digital media era, the rapid development of computer technology with digital information technology as the core has provided artists with a new platform for all-round creation. Digital media intervenes in the field of art, drawing a newer and more beautiful artistic picture for us. Three-dimensional animation art has emerged with the development of digital media technology. Three-dimensional animation is the crystallization of the combination of computer three-dimensional animation technology and art in the digital media era[16]. The three-dimensional animation technology in digital media technology allows artists to have a platform for displaying their artistic creativity. Every time, three-dimensional animation technology Technological innovations have excited three-dimensional animation artists, and the three-dimensional animations they produced have given the audience a new visual experience[9].

Humans' knowledge of the world increasingly depends on the explosive transmission of information. The primary way most people understand the world is through the visibility of the eyes and everything that the human eye sees can be transformed into images. Various conditions will naturally affect image acquisition, generation, compression, storage, and transformation. The operation of the image quality will cause different degrees of damage to the image quality[22]. Using different algorithms to enhance and restore the damaged image is undoubtedly a "repair" work on the damaged image to meet various needs. Image enhancement adapts to the characteristics of the human eye, which helps recognize images from humans and machines. Image enhancement is becoming more and more suitable for more industries, including remote sensing satellite imaging, medical imaging, film and television photography, and other fields. For the overall effect of the image, the contrast of the characteristic information in the image needs to be strengthened first and then related. The algorithm processes the irrelevant filtering of the image, thereby reducing the noise generation and processing the "degraded" image; then, for the enhanced image, it avoids local enhancement discomfort and affects the viewing mode of the human eye.

Computer 3D animation technology is a relatively advanced part of computer graphics. In the dynamic field of computer graphics, the fusion of 3D animation and advanced image processing is a leading edge of innovation. This simulation explores the synergy of cutting-edge 2D and 3D image manipulation methods, aiming to achieve heightened realism. Integrating dynamic 3D animation with advanced image processing techniques like HDR imaging and morphological operations aims to create a cohesive visual framework that goes beyond traditional boundaries. Countries continue to innovate and develop 3D animation technology. To achieve advanced development, we must solve the key technologies of 3D animation, including 3D modeling technology, 3D animation material rendering technology, 3D animation character and environment design technology, and 3D animation image enhancement technology[17]. Only the beginning of the development of various technologies can promote the innovation of the 3D animation industry. This article focuses on three-dimensional animation-enhanced image processing technology. The focus of this article is to enhance the image of the blurred scene and the parts that need special processing in the three-dimensional animation through the research of the improved image algorithm and simulation technology to eliminate the useless or influence. The images people watch and the enhancement of the device's ability to recognize information contribute to the image's clarity [4].

2 OVERVIEW AND CLASSIFICATION OF 3D ANIMATION-ENHANCED IMAGES

2.1 Three-Dimensional Animation Characteristics

Computer 3D animation technology is a kind of 3D pre-rendering playback technology. First, perform 3D pre-rendering to obtain a complete 3D animation video, then use the player to play the 3D animation video. Computer three-dimensional animation is a new technology that integrates computer science, psychology, mathematics, physics, and other sciences based on computer graphics. It realizes the transformation from traditional graphics technology to real-time graphics technology[5]. Corresponding to two-dimensional animation, three-dimensional animation enhances the sense of three-dimensionality and space. It is no longer limited to the movement effects of up and down, left and right. Three-dimensional animation has the following characteristics:

1. Superb modeling ability

Producers use computers and a series of mathematical methods to realize the design and production of animations. They are not restricted by objective existence. They can not only realistically simulate objects or landscapes that exist in reality but also can simulate objects that do not exist in reality. Or landscape. This function is beyond the reach of real-time shooting methods and hand-painted methods. Specifically, computer animation can generate the following shapes:

2. Unconstrained animation realization ability

In three-dimensional animation, objects' change and movement are not restricted by objective existence. We can arbitrarily specify the movement direction and trajectory of the object, grasp the shooting angle and the characteristics of the lighting arbitrarily, and let the object change arbitrarily[1].

3. Abundant texture performance ability

Three-dimensional animation can vividly show the texture of objects through the selection of materials and lighting design. The texture of an object depends on the color, the brightness of the surface, the transparency characteristics, the reflection characteristics, etc., and the meaning of these attributes depends on the material that composes the shape. Three-dimensional animation production software provides a rich material library, such as glass, metal, water, marble, wood, fabric, rubber, skin, and other materials. 3D animation production staff can choose a particular material for modeling at will and assign different materials to the same body[14]. 3D animation production software can also change material characteristics flexibly over time. Changes in material properties include color, transparency, and brightness. The 3D animation production software can also repeatedly modify the material of the shape by changing various parameters to produce ideal effects. In a three-dimensional animation, the characteristics of a material are determined by a series of mathematical parameters. Different parameters have different effects on the resulting material.

2.2 Overview of Image Enhancement

With the continuous development of computer technology, people continue to enhance the ability of various forms of image processing, which makes the image processing technology get a driving development, and the three-dimensional animation enhanced image processing effect technology is one of the key technologies in image processing. Under normal circumstances, the transmission and conversion of data can easily lead to the degradation of the quality of the three-dimensional animation. The three-dimensional animation is adjusted according to the image's gray value range, and the image's quality is repaired. The overall level of image quality can be improved by processing computer algorithms, and the viewer can obtain a clearer picture. Not all grayscale differences can be distinguished by the human eye when observing an image, so there is information loss in this process. The flow chart of the human eye observing image enhancement is as in Figure 1. The traditional three-dimensional animation, based on a self-adaptive method to enhance the image processing effect, first performs median filter processing on the three-dimensional animation; then uses the histogram segmentation method to divide the three-dimensional animation into two parts, the target feature and the background[19]; finally, it is superimposed by linear weighting Suppress the redundant information of the background and enhance the target feature information of the three-dimensional animation[12].

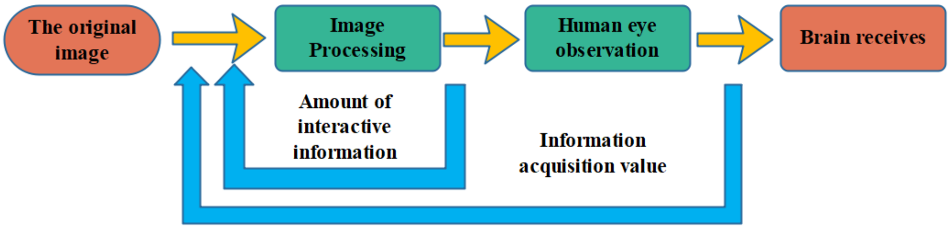

Figure 1: The flow chart of human eye observation image enhancement.

This method has the problem of poor enhanced visual effects. For this reason, many enhancement methods have been proposed. One is a method for improving the image processing effect of 3D stereo animation based on bilateral filtering. First, the characteristic information of 3D stereo animation obtained by interpolation is used as input to construct different output depth layers; and then, through an iterative process for each characteristic information output layer, the energy term is constructed; finally, the depth layer with the characteristic information of the smallest energy term is selected by joint bilateral filtering to obtain a three-dimensional animation with enhanced image processing effect[6]. Due to the need for iteration, this method has the problem of being time-consuming and taking up extended amounts of time. The other is a method for enhancing the image processing effect of three-dimensional animation based on the weighted gradient direction. First, the available feature information in the three-dimensional animation is divided into low-frequency component information, weak edge information, and strong edge information; secondly, the gradient image histogram is adaptive. Calculate the nonlinear transformation parameters to enhance the image processing effect; then use the main direction of the area and the gradient direction to suppress the enhancement of the characteristic information noise; finally, use the gradient direction weighting method to realize the enhancement of the three-dimensional animation characteristic information[21]. The enhancement effect of this method is poor. Some scholars have studied a method for enhancing the image-processing effect of three-dimensional animation based on structural features. First, the structural features of three-dimensional animation are extracted to obtain standard global features; then, joint bilateral filtering is performed on the obtained structural feature information; finally, Markov random field theory enhances the characteristic information of three-dimensional animation. This method has the problem of severe loss of characteristic information details[7]. Aiming at the problems caused by the above methods, a method for enhancing image processing effects of three-dimensional animation based on gray uniformity is proposed, and simulation proves that the proposed method can obtain three-dimensional animation-enhanced image processing effects that are more in line with human vision.

2.3 Image Enhancement Classification

According to the technical processing methods of image enhancement, it can be divided into the following two categories:

1. Airspace enhancement method

The principle of this method is to process the image's pixels by changing the image's gray level to achieve the purpose of image enhancement. It is called the spatial enhancement method, which aims to change the image pixels by changing the spatial space composed of pixels. The algorithm of this method is expressed as follows:

$$h(x,y) = BH[m(x,y)] \tag{1}$$

$h(x, y)$ and $m(x, y)$ represent the image function before and after the algorithm is enhanced.

Airspace enhancement can be divided into pixel-based and template-based methods, according to different classification methods. By processing the pixels based on pixels, the processing does not involve other factors that have nothing to do with the pixels; the small sub-images (templates) are processed on each image processing based on the template.

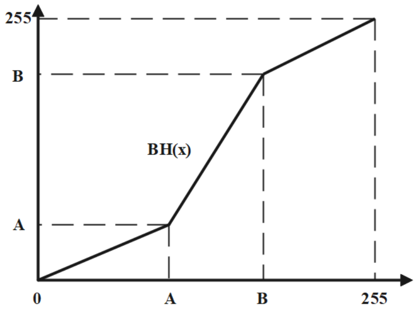

Figure 2: Direct grayscale transformation.

Spatial enhancement methods mainly include direct grayscale transformation, histogram correction, and inter-image operations. Direct grayscale transformation means transforming the grayscale X of each pixel on the image into grayscale X according to a specific function BH(x).

The principle of spatial filtering for image enhancement is accomplished by modifying each pixel in the image according to the existing template. The specific calculation process calculates the value of adjacent pixels in the existing template through the input pixel[20]. There are many kinds of spatial filters. Their essential characteristics are suppressing the components of the image in a specific range of Fourier space while keeping other components unchanged, thereby changing the frequency distribution of the output image and achieving the purpose of enhancing the image. Although the types of various filters are different, template convolution is used to achieve these functions in the spatial domain[8]. Convolution is a neighborhood operation that makes each output pixel value the weighted sum of the input and neighborhood pixel values. The specific weight is defined by a convolution kernel (also called a filter).

2. Frequency domain enhancement method

The algorithm of frequency domain enhancement is to transform the image to be enhanced into another space through a specific known algorithm; through the algorithm that has been transformed into the space and its enhanced form, the image is improved, and the transformed image is replaced into the original space[3],[10]. The frequency domain enhancement method mainly processes images through various forms of aluminum filtering. The principle is to use the nature of filtering to perform frequency division processing on the image, thereby effectively blocking the filtering that affects the image quality and obtaining an enhanced image.

3 ANALYSIS OF THE PRINCIPLES OF THREE-DIMENSIONAL ANIMATION ENHANCED IMAGE

When enhancing the 3D animation feature information, first use the global histogram equalization algorithm and the local histogram equalization algorithm to equalize the 3D animation feature information; then calculate the objective function of the 3D animation to enhance the image processing effect[13],[2]; finally according to The enhanced objective function calculation result uses the histogram specification operation method to realize the enhancement of the three-dimensional animation feature information.

Suppose a three-dimensional animation I with a size of M×N contains L gray levels, and the gray value of n feature information pixels is r. The three-dimensional animation is mapped as follows using the global histogram equalization algorithm operation:

$$\begin{cases} s = T(r) \\ 0 \le r \le L-1 \end{cases} \tag{2}$$

Supposing that the size of the sliding window of the three-dimensional animation feature information of the adaptive histogram equalization algorithm is expressed as W × W, the expression of the local mapping function of the three-dimensional animation feature information is

$$m(i) = \frac{255 \times cdf(i)}{W \times W} \tag{3}$$

The cdf(i) in the formula represents the cumulative distribution function of the three-dimensional animation feature information through the local histogram; its derivative is expressed as the hist(i) of the three-dimensional animation feature information.

First, to obtain enhanced images, a histogram processing of the feature information in the three-dimensional animation is performed, and the calculation is made by setting the objective function. It is assumed that the input amount of feature information in the three-dimensional animation is h_{input}; h_{HE} represents the feature information of the three-dimensional animation. After the global histogram processing amount, h_{CLAHE} represents the amount of the 3D animation feature information processed by the local histogram, $_{and\, h\, output}$ represents the output amount of the histogram after the 3D animation enhances the image processing effect. The objective function of the 3D animation enhanced image processing effect is:

$$h_{output} = argmin\left\|h - h_{input}\right\| + \alpha\|h - h_{HE}\| + \beta\left\|h - h_{output}\right\| \tag{4}$$

In the formula, ɑ and β represent the regularization coefficients of the three-dimensional animation feature information. Using the sum of squares of the Euclidean norm, the above formula (3-3) can be simplified to:

$$h_{output} = argmin\left\|h - h_{input}\right\|_2^2 + \alpha\|h - h_{HE}\|_2^2 + \beta\left\|h - h_{output}\right\|_2^2 \tag{5}$$

According to the calculation of the above formula, the input three-dimensional animation I and the three-dimensional animation enhanced image processing effect histogram output is standardized operations. Finally, the feature information of the three-dimensional animation is enhanced.[15]

In summary, the principle of the method for enhancing the three-dimensional animation's image-processing effect is obtained. According to this principle, the three-dimensional animation image is improved.

4 THREE-DIMENSIONAL ANIMATION ENHANCES THE IMAGE PROCESSING EFFECT METHOD

4.1 Smoothing of 3D Animation Feature Information Based on Bilateral Filtering

Firstly, perform value domain filtering and spatial filtering preprocessing on the three-dimensional animation feature information; secondly, calculate the discrete form of bilateral filtering of the three-dimensional animation feature information to obtain the Gaussian kernel function of the three-dimensional animation feature information; then eliminate according to the Gaussian kernel function calculation result the noise contained in the feature information of the 3D animation[11].

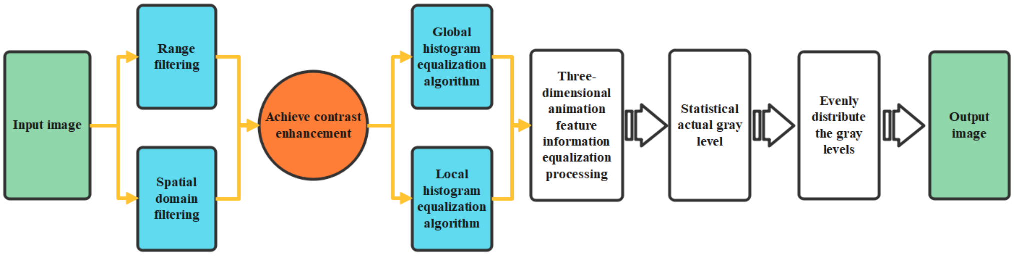

Figure 3: Algorithm flow chart.

The specific description process is as follows:

The expressions of value domain filtering of 3D stereo animation and spatial domain filtering of 3D stereo animation are, respectively:

$$h(x) = \frac{1}{k_{b},(x)} \int_{-\infty}^{+\infty} f(x)\,\delta(f(\xi), f(x))d\xi \tag{6}$$

$$h(x) = \frac{1}{k_{b},(x)} \int_{-\infty}^{+\infty} f(x)\,c(\xi, x)d\xi \tag{7}$$

Among them, δ(f(ξ), f(x)) represents the brightness similarity of the three-dimensional animation feature information; кb, (x) and кd, (x) represent the normalization coefficient of the three-dimensional animation feature information; c(ξ,x) represents the distance between two different points in the feature information of the three-dimensional animation; d represents the weight ratio between the correlation calculation coefficients in the three-dimensional animation.

Assuming that the input and output functions of the three-dimensional animation feature information are expressed as R and R'respectively, the expression of the discrete form of bilateral filtering of the three-dimensional animation feature information is as follows：

$$R' = [k, j] = \sum_{m=-p}^{p} \sum_{n=-p}^{p} B[m, n, k, j] R[k-m, j-n] \tag{8}$$

Among them, p represents a pixel of the three-dimensional animation feature information; m represents the variance of the three-dimensional animation feature information; n represents the standard deviation of the three-dimensional animation feature information; B [m, n, к, j] represents the three-dimensional animation feature information The Gaussian kernel function of, its calculation expression is as follows：

$$equalB[m, n, k, j] = \frac{exp(-\frac{m^2+n^2}{2\sigma_{\delta}^2} - \frac{R[k-m, j-n]}{2\sigma_{\xi}^2})}{R = (k, j)} R \tag{9}$$

In the formula, σ represents the scale parameter of the three-dimensional animation feature information. Use the above formula (3-4) to smooth the feature information of the three-dimensional animation from the geometric and photometric domains, eliminate the effect of noise, and maintain the feature detail information of the three-dimensional animation.

4.2 Method of Enhancing Image Processing Effect Based on Gray Uniformity

Based on the smooth processing of 3D stereo animation feature information, first calculate the discrete change degree of gray value in the local area of 3D stereo animation; secondly, calculate the 4th moment of brightness distribution of 3D stereo animation feature information; The brightness uniformity is calculated and normalized; finally, the minimum magnification factor for the contrast enhancement of the three-dimensional animation feature information is calculated[18]. Finally, the minimum magnification factor for contrast enhancement of the three-dimensional animation feature information is calculated.

Suppose gij is the gray value of the characteristic information pixel ρ(i,j) in the three-dimensional animation A×B and represents the pixel window of the image in the three-dimensional animation. Four values represent the uniformity of the three-dimensional animation feature incendiary of the region of interest of the three-dimensional animation feature information, the standard deviation of the feature information, the feature information entropy, and the feature information 4-order matrix. Using the Sobeil operator, Laplacian operator, and Canny operator to extract the boundary value of the three-dimensional animation feature information, the calculation expression of the discrete change degree of the gray value in the local area of the three-dimensional animation is as follows :

$$\begin{cases} u_{ij} = \sqrt{\frac{1}{d^2}\sum_{\rho-i-(a-1)/2}^{i+(a+1)/2} \sum_{\rho-j-(a-1)/2}^{j+(a-1)/2} (g_{pq} - \mu_{ij})^2} \\ i \geq 0, j \geq 0, p \geq A-1, q \geq B-1 \end{cases} \tag{10}$$

In the formula, (p,q) represents the pixel coordinates of the three-dimensional animation feature information; μij represents the average value of the feature information grayscale in wij. The feature information entropy describes the distribution change of the gray value in a region of the three-dimensional animation. The entropy calculation expression of the feature information pixel ρ(i,j) of the three-dimensional animation is :

$$h_{ij} = -\frac{1}{2\log d}\sum_{e'=1}^{\Sigma_e'} \rho_e' log \tag{11}$$

The formula represents the probability of the gray value hierarchy in the 3-D animation feature information, which can be calculated by the formula ne'/d2;n_e' represents the number of pixels of all feature information in the gray level of the three-dimensional animation Number; $represents$ resents different levels of grayscale. Then, the formula for calculating the 4th moment of the brightness distribution of the three-dimensional animation feature information is as follows :

$$Gamma\gamma_{4ij} = \frac{\sum_{p-i-(a-1)/2}^{i+(a+1)/2} \sum_{q-j-(a-1)/2}^{j+(a-1)/2} (g_{pq}-\mu_{ij})^4}{B-1} \tag{12}$$

In the formula B=a×a, the uniformity of the three-dimensional animation feature information is defined as a function of the above four parts, and the calculation expression is as follows:

$$MO(g_{ij}, w_{ij}) = \overline{M(g_{ij}, w_{ij})} \times \overline{P(g_{ij}, w_{ij})} \times \overline{Q(g_{ij}, w_{ij})} \times \overline{T_4(g_{ij}, w_{ij})} = (1 - M(g_{ij}, w_{ij})) \times (1 - \overline{P(g_{ij}, w_{ij})}) \times (1 - Q(g_{ij}, w_{ij})) \times (1 - T_4(g_{ij}, w_{ij})) \tag{13}$$

In the formula, M(gij, wij) represents the function of the boundary of the region of interest for the three-dimensional animation feature information; P(gij, wij) represents the function of the standard deviation of the three-dimensional animation feature information; Q(gij, wij)represents the three-dimensional animation feature The function of information entropy; T4(gij, wij) represents the function of the 4th moment of the three-dimensional animation feature information; and MO(gij, wij)∈[0,1], the uniformity of the three-dimensional animation feature information MO(gij, wij) The larger the value, the more uniform the brightness of the three-dimensional animation feature area. It needs to be normalized to reduce the calculation amount of the above formula. Therefore, the normalized formula of MO(gij, wij) is obtained as:

$$\beta_{\text{ij}} = \frac{MO(g_{ij}, w_{ij})}{MO(g_{ij}, w_{ij})_{max}} MO(g_{ij}, w_{ij})\, max\{MO(g_{ij}, w_{ij})_i\}_{max} \tag{14}$$

According to the above calculation and definition, a method for enhancing the image processing effect of 3D stereo animation is given.

1. Calculate the non-uniformity of the three-dimensional animation feature information through (4-10):

$$\varpi_{\mathrm{ij}} = 1 - \varsigma_{\mathrm{ij}} \tag{15}$$

2. After the three-dimensional animation has passed the non-uniformization processing of the feature information, its calculated value needs to be averaged. The averaging processing formula applied in this article is:

$$\begin{cases} \varsigma_{\mathrm{ij}} = \dfrac{\sum_{\rho-i-(a-1)/2}^{i+(a+1)/2} \sum_{\rho-j-(a-1)/2}^{j+(a-1)/2} (g_{pq}-\psi_{ij})}{\sum_{\rho-i-(a-1)/2}^{i+(a+1)/2} \sum_{\rho-j-(a-1)/2}^{j+(a-1)/2} \psi_{ij}} \\ i \geq 0, j \geq 0, p \geq A-1, q \geq B-1 \end{cases} \tag{16}$$

3. Calculate the contrast of the characteristic information pixel ρ(i,j) of the three-dimensional animation and perform the conversion calculation to obtain

$$C_{\mathrm{ij}} = \left|\frac{g_{\mathrm{ij}}-\varsigma_{\mathrm{ij}}}{g_{\mathrm{ij}}+\varsigma_{\mathrm{ij}}}\right| = C_{ij}^{\xi} ij \tag{17}$$

ξij: the contrast magnification factor of the characteristic information.

4. The three-dimensional animation feature information pixel is calculated by the expression in (4-13):

$$g_{\mathrm{ij}} = \varsigma_{\mathrm{ij}} + \frac{1-C_{\mathrm{ij}}}{1+C_{\mathrm{ij}}} \tag{18}$$

5. The above steps need to be repeated to process the overall 3D animation characteristic information. To determine the comprehensiveness of the gray level of the 3D animation characteristic information from gmin to gmax, Calculate the minimum contrast magnification factor of the 3D animation characteristic information. The specific calculation steps are as follows: Step 1-Step 5.

Step 1: Determine the maximum value through the histogram algorithm of the 3D animation characteristic information. The specific calculation formula is as follows:

$$M_{\max}(g1), M_{\max}(g2), \cdots, M_{\max}(gn') \tag{19}$$

Step 2: The peak value of the histogram of the three-dimensional animation characteristic information calculated in step 1 is averaged, and the following formula obtains the average value of the peak value:

$$\overline{M_{\max}} = \frac{\sum_{i=1}^{n'} M_{\max}(gi)}{n'} \tag{20}$$

Step 3: compare the peaks in the histogram of the three-dimensional animation feature information to obtain a peak greater than Hmax.

Step 4: Based on the peak value larger than Hmax calculated in step 3, sort the obtained three-dimensional animation feature information histogram peak values to obtain the first and last peak values and assign the gray values to g1 and gn'.

Step 5: According to the formula (4-16) and the above calculation results, obtain the minimum contrast magnification factor ξmin of the three-dimensional animation feature information. The calculation formula is as follows:

$$\xi_{\min} = \frac{g_n - g1}{g_{max}} \tag{21}$$

After obtaining the minimum contrast magnification factor through (4-16), it is also necessary to calculate the algorithm contrast magnification factor ξij, and use (4-17) to calculate:

$$\xi_{\text{ij}} = \xi_{\min} + \frac{\xi_{\max} - \xi_{\min}}{\varsigma_{\max} - \varsigma_{\min}} \times (\varsigma_{\text{ij}} - \varsigma_{\min}) \tag{22}$$

Through the calculation and reasoning of the above various algorithm formulas, the theoretical calculation before the 3D animation simulation is completed. According to the above theory, the enhanced image processing of the 3D animation can be realized.

5 SIMULATION RESULTS AND ANALYSIS

The correctness of the algorithm in this article and its applicability in real life are simulated and discussed, and we verify it through simulation experiments. The simulation experiment of image enhancement in this article uses a three-dimensional animation with 600*800 pixels, which contains 600 characteristic information pixels. As shown in Figure 4, to highlight the effectiveness of the three-dimensional animation enhancement image processing method based on gray uniformity proposed in this article, it compares the double histogram enhancement of the image (this method is marked as method 1) and the enhancement of wavelet transform. Image method (this method is marked as method 2), through the analysis of different enhanced image processing methods of the same three-dimensional animation screen, the processed image is shown in Figures 5, Figures 6, and Figures 7.

By comparing the image effects of three different image enhancement processing methods, the following results can be obtained: The processing method of processing method one can enhance the 3D animation feature information to a certain extent, but in the case of improving the 3D animation feature information At the same time, the redundant 3D animation background information is also enhanced, which is prone to over-enhancement, which leads to serious loss of feature information and details, which interferes with subsequent further analysis and research; adopts super-resolution based on improved wavelet transform The small feature enhancement method of the image enhances the feature information of the three-dimensional animation. Enhancing the target feature information effectively suppresses the interference of the background information, and the enhancement effect is better than the processing method 1. Compared with processing methods 1 and 2, the image enhancement effect and the suppression of invalid characteristic information are better than the other two methods. Therefore, the enhanced image processing proposed in this article is adopted. The method helps the presentation form of the three-dimensional animation image to be clearer and more delicate.

There needs to be more than the effect of image enhancement through different processing methods to show the superiority of the proposed algorithm. The processing time of the device operation also plays a crucial role in enhancing the image. To realize the proposed algorithm in terms of running time to be better than the running time of other algorithms, the time-consuming comparison with the super-resolution image small feature enhancement method using improved wavelet transform and the three-dimensional modeling method combining deterministic modeling and random modeling is at this moment compared, and the following figure 8 is obtained—time-consuming comparison results of different techniques to enhance the image processing effect.

Through the time-consuming polyline trend of the three enhanced image processing methods and the comparison between the three, we can get the simulation time of image processing using the small feature enhancement method of super-resolution image based on improved wavelet transform increases with the feature information pixel.

Figure 4: Original image.

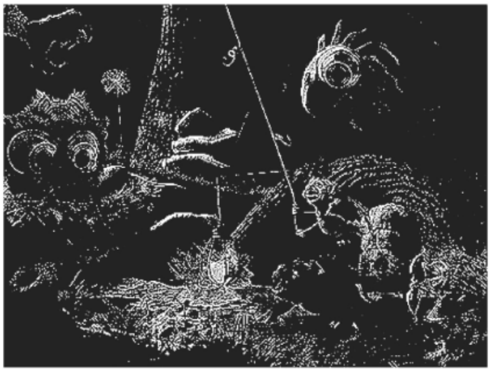

Figure 5: Small feature enhancement of super-resolution image based on improved wavelet transform.

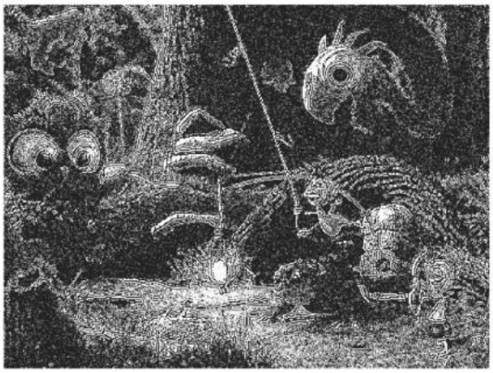

Figure 6: Image enhancement of double histogram equalization based on mathematical morphology.

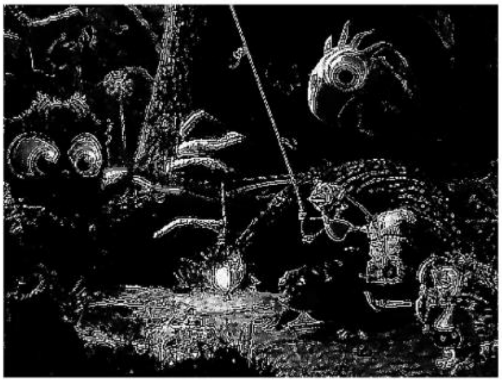

Figure 7: The enhanced image mentioned in this article.

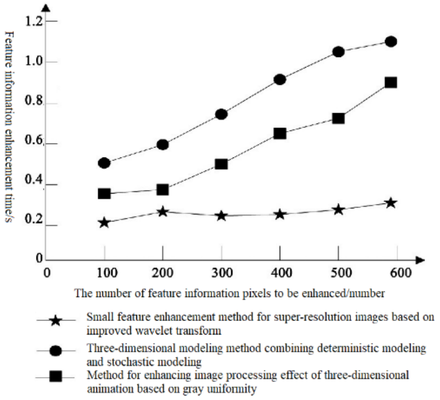

Figure 8: Time-consuming comparison results of enhanced image processing effects of different methods.

The rise in the number of points increases, and it takes the longest time; the three-dimensional animation of the three-dimensional modeling method combining deterministic modeling and random modeling is time-consuming to enhance the image processing effect, although compared with the super-resolution image based on improved wavelet transform. The small feature enhancement method is shorter in time but still shows an increasing trend; only the three-dimensional animation-enhanced image processing effect of the proposed method does not change with the number of pixels in the image feature information, and the image enhancement speed is faster. It's better than the other two comparison methods.

6 CONCLUSIONS

Through the time-consuming polyline trend of the three enhanced image processing methods and the comparison between the three, it can be obtained: the simulation time of image processing using the enhanced image method based on small features of wavelet transform increases with the increase of the number of feature information pixels However, it takes the longest time to increase; the three-dimensional animation enhancement of the three-dimensional animation method of the combination of deterministic modeling and random modeling is time-consuming, although compared with the small feature enhancement of super-resolution images based on improved wavelet transform The time-consuming method is relatively short, but it still shows an increasing trend; only the three-dimensional animation enhanced image processing effect of the proposed method does not change with the number of pixels of the image feature information, and the image enhancement speed is faster, which is obviously better than others. Two comparison methods.

Xiali Wei, https://orcid.org/0009-0000-2226-6158

REFERENCE

[1] Acharya, T., and Tsai, P. S.: Edge-Enhanced Image Up-Sampling Algorithm Using Discrete Wavelet Transform: US, US6377280B1[P]. 2002.
[2] Bale, B.; Pollock, T.; Petzold, L.: Segmentation-Free Image Processing and Analysis of Precipitate Shapes in 2D and 3D, Modelling and Simulation in Materials Science and Engineering, 2017. https://doi.org/10.1088/1361-651X/aa67b9
[3] Dale-Jones, R.; Tjahjadi, T.: A Study and Modification of the Local Histogram Equalization Algorithm, Pattern Recognition, 26(9), 1993, 1373-1381. https://doi.org/10.1016/0031-3203(93)90143-K
[4] De-Bing, L. I.: Simulation Research on 3D Animation Enhanced Image Processing Effect, Computer Simulation, 2018.
[5] Fenster, A.; Dunne, S.: Enhanced Image Processing for a Three-Dimensional Imaging System, WO, 2002.
[6] He, B.: Application of 3D GeologicalModeling Techniquein Huang Jindai Oil field, Bulletin of Science and Technology, 2016.
[7] Hong, Z.: Analysis of Computer Graphics System and Graphic Image Processing Technology, China Computer & Communication, 2017.
[8] Huang, S. C.; Cheng, C.; Chiu, Y. S.: Efficient Contrast Enhancement Using Adaptive Gamma Correction With Weighting Distribution, IEEE Transactions on Image Processing a Publication of the IEEE Signal Processing Society, 22(3), 2013, 1032-1041. https://doi.org/10.1109/TIP.2012.2226047
[9] Kim, T.; Pai, K.; et al.: Adaptive Contrast Enhancement Using Gain-Controllable Clipped Histogram Equalization, Consumer Electronics IEEE Transactionson, 2008. https://doi.org/10.1109/TCE.2008.4711238
[10] Lee, C.; Lee, C.; Kim, C. S.: Contrast Enhancement Based on Layered Difference Representation, IEEE, 2013. https://doi.org/10.1109/ICIP.2012.6467022
[11] Liu, H.P.; Zheng, M.J.; Hou, X.D.: et al. Enhancement Algorithm of Fractional Differential Medical Images Based on Local Binary Pattern Variance, Laser & Optoelectronics Progress, 56(9), 2019, 091006. https://doi.org/10.3788/LOP56.091006
[12] Liu, Y.; Zhang, G.; Jing, A.N.: Double Histogram Equalization Image Enhancement Algorithm Based on Mathematical Morphology, Computer Engineering, 2016.
[13] Men, G. Z.; Yang, J. L.; Jie, Z.: Fuzzy Contrast Enhancement for Remote Sensing Image Based on Fuzzy Set in Nonsubsampled Contourlet Domain, International Conference on Machine Learning & Cybernetics, IEEE, 2010. https://doi.org/10.1109/ICMLC.2010.5580569
[14] Min, S.W.; Park, K. S.; Lee, B.: etal. Enhanced Image Mapping Algorithm for Computer-Generated Integral Imaging System, Japanese Journal of Applied Physics, 45(28), 2006, L744-L747. https://doi.org/10.1143/JJAP.45.L744
[15] Nan, L. D.; Rui, H.; Zhuo, W. W.: et al. Research on Infrared Image Enhancement and Segmentation of Power Equipment Based on Partial Differential Equation, Journal of Visual Communication & Image Representation, 64(Oct.), 2019, 102610.1-102610.8.

https://doi.org/10.1016/j.jvcir.2019.102610
[16] Ooi, C. H.: Adaptive Contrast Enhancement Methods with Brightness Preserving, IEEE Transactions on Consumer Electronics, 56(4), 2010, 2543-2551. https://doi.org/10.1109/TCE.2010.5681139
[17] Rajavel, P.: Image Dependent Brightness Preserving Histogram Equalization, IEEE Transactions on Consumer Electronics, 56(2), 2010, 756-763. https://doi.org/10.1109/TCE.2010.5505998
[18] Subr, K.; Majumder, A.; Irani, S.: Greedy Algorithm for Local Contrast Enhancement of Images, International Conference on Image Analysis & Processing Springer Berlin Heidelberg, 2005. https://doi.org/10.1007/11553595_21
[19] Wang, L.: Study on the Method of Super-Resolution Image Little Feature Enhancement and Simulation, Computer Simulation, 2016.
[20] Xiaopeng, F.; Tiefeng, C.; Feng, Z.: Image Enhancement Algorithm for Achieving Maximum of Perceived Grayscale Information of Human Visual System, Journal of Computer-Aided Design & Computer Graphics.
[21] Yi, Z.: Research on the Key Technology of Computer Graphics Image Processing, China Computer & Communication, 2018.
[22] Zuo, C.; Chen, Q.; Sui, X.: Range Limited Bi-Histogram Equalization for Image Contrast Enhancement, Optik-International Journal for Light and Electron Optics, 124(5), 2013, 425-431. https://doi.org/10.1016/j.ijleo.2011.12.057