

Retraction

Retracted: Film and Television Animation Sensing and Visual Image by Computer Digital Image Technology

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Manipulated or compromised peer review

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

- [1] L. Lian and T. Lei, "Film and Television Animation Sensing and Visual Image by Computer Digital Image Technology," *Journal of Mathematics*, vol. 2022, Article ID 6331233, 8 pages, 2022.

Research Article

Film and Television Animation Sensing and Visual Image by Computer Digital Image Technology

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In order to study the application of computer digital image processing technology in film and television (FAT) animation visual sensing expression, by studying the principle of digital image processing technology and visual sensing technology, a spatial image adaptive steganography image enhancement algorithm by multiscale filters is proposed to carry out enhancement processing of the original image in FAT production. This algorithm can provide more high-quality and refined original materials for FAT animation production, which is convenient for FAT animation postproduction to produce higher-resolution and clear FAT works. Finally, the algorithm is verified. The results show that the spatial image adaptive steganography image enhancement algorithm has high security, and the highest average detection error rate is 25.06%. When $\alpha = 0.4$, the security of the spatial image adaptive steganography image enhancement algorithm is up to 34.62% and the image distortion rate is low. The established image enhancement algorithm can significantly improve the security of the existing spatial image steganography algorithm under different embedding rates, especially at a high embedding rate; the improvement of the spatial domain steganography algorithm is greater. The proposed steganographic image enhancement algorithm by image preprocessing has higher security and better image enhancement effect.

1. Introduction

Computer digital image technology not only builds a new medium and carrier for artistic creation but also connects artistic creation and daily life [1–3]. Film, television, and animation production are closely related to life. As representatives of the cultural industry, film and television (FAT) are becoming more and more popular for daily consumption by the general public. The development of FAT industries has also received more and more attention from consumer groups [4]. Since rich video production experience, how to better serve FAT special effects production and visual communication technology for FAT content is an eternal topic for contemporary FAT producers [5]. In the era of rapid development of FAT animation technology, the visual requirements of movie and television screens have become higher and higher for the movie-watching group. Watching a movie is no longer just about the plot. Aestheticism, shock

and other visual effects, and visual impact are also the criteria for the audience to judge the quality of a movie [6]. Computer graphics technology is widely used in FAT production of original pictures and image processing by virtue of its refined image processing capabilities [7].

The advantages of artificial intelligence (AI), machine learning, and deep learning are reflected in image, video processing, natural language processing, and speech recognition. AI algorithms overcome many shortcomings, which help provide state-of-the-art results in computers and other fields. Deeba et al. [8] used artificial neural networks (ANNs) to detect the presence of sensitive information and extract information from the source image. When the appropriate machine learning algorithm is trained, retrained, and adapted to some new applications, the performance is relatively stable. Collins et al. [9] traced the evolution of a series of industries and supporting institutions in the FAT industry in one of the most fringe regions in Europe. Chen

et al. [10] pointed out a stereo calibration method by the correlation of stereo digital images. Because the flexible number of control points has high matching registration accuracy and strong sturdiness, the stereo calibration method that uses the synthetic spot pattern to calibrate the target provides higher calibration accuracy than the calibration accuracy by the calibration target. The target has a limited number of designated functions. The application fields of digital image processing technology are very wide, and there are many research results. However, the previous research content is relatively small in the field of FAT production. The content being studied can fill this technological gap.

The methods of literature research and algorithm verification are adopted. The application of computer image processing technology in the production of FAT animation has been studied. The innovation is that, by the original steganographic image processing algorithm, a spatial image steganography enhancement algorithm by multiscale filters is proposed. Besides increasing the security in the image enhancement process and reducing the distortion, the algorithm also guarantees a higher image resolution, provides high-quality original materials for FAT animation production, and can enhance the visual expression effect of FAT images. The remainder of the paper is organized as follows: Section 2 is about the material and methods where we explained the material, methods, algorithms, and other related topics to our study. In Section 3, the results of different tests are analysed, and the discussion is carried out. In Section 4, the conclusion of our study is presented, and the paper ends with a list of references.

2. Materials and Methods

In this section, we present some of the methods used for image processing. We talk about different aspects of digital image processing, such as its quality, distortion, security, resolution, and filter (smooth image, binary image, sharpened image, and many more). In addition, the materials used for the purposes are also described. To be specific, we shall talk about the cameras and digital camcorders that acquire digital images. Moreover, the animations and videos are also discussed in detail.

2.1. Digital Image Processing. Digital Image Processing (DIP) is a method and technology for removing noise, enhancing, restoring, segmenting, and extracting features of an image through a computer [11]. It contains 5 modules. Image input module refers to image input, also called image acquisition or image digitization. It uses image acquisition equipment (such as digital cameras and digital camcorders) to acquire digital images and digital equipment (such as image scanners) to convert continuous images to be processed into digital images suitable for computer processing [12]. The image storage module is mainly used to store image information. The image output module displays the images before and after processing or saves the processing results permanently. The image communication module is to

transmit or communicate image information [13]. Image processing and analysis modules include processing algorithms, implementation software, and digital computers. These modules work together to complete all functions of image information processing [14]. The number of pixels or dots per unit length in an image is the image resolution. The higher the resolution, the more the number of pixels contained in it and the clearer the image display [15]. The digital image processing process is shown in Figure 1.

The amount of information contained in an image can reflect the richness of image information [16]. After the analogue image is discretized, the digital representation of the image is obtained, which is the process of image digitization. Image digitization includes sampling and quantization, where sampling interval and sampling aperture are two important parameters that determine resolution. Sampling is the operation of transforming a spatially continuous image into discrete points with continuous grey levels, and quantization is the process of converting pixel grey levels into discrete integer values. Image enhancement is a very important part of digital image processing. By purposefully emphasizing the overall or partial characteristics of the image (such as improving the colour, brightness, and contrast of the image), the image with low definition can be made clear or emphasize these important features. It can magnify the difference between the features of different types of objects in the image, suppress the uninteresting features, and improve the visual effect of the image.

Traditional image enhancement methods are divided into three categories. The spatial image enhancement method is to directly process the pixel value, such as Histogram Equalization and Gamma Transformation. The frequency domain method is to operate in a certain transform domain, such as wavelet transform. The hybrid domain method is a combination of the spatial domain and the frequency domain. Traditional image enhancement methods are generally simpler and faster, but because the context information in the image cannot be fully considered, the effect is usually very general. Convolutional Neural Networks (CNNs) have made great breakthroughs in many low-level computer vision tasks, including image superresolution, deblurring, dehazing, denoising, and image enhancement. Compared with traditional methods, CNN-based image processing methods greatly improve the quality of image enhancement. Most of the existing methods are supervised learning. For an original image and a target image, the mapping relationship between them is learned to obtain an enhanced image. However, such data sets are relatively small, and many of them are artificially adjusted. Therefore, personal supervision or weak supervision is required to solve this problem.

2.2. Visual Sensing in Movie and TV Animation. Vision sensing technology is one of the sensing technologies. The visual sensor refers to the sensor that calculates the feature quantity of the object by performing image processing on the image taken by the camera and outputs the data and the judgment result [17]. The vision sensor is the direct source of

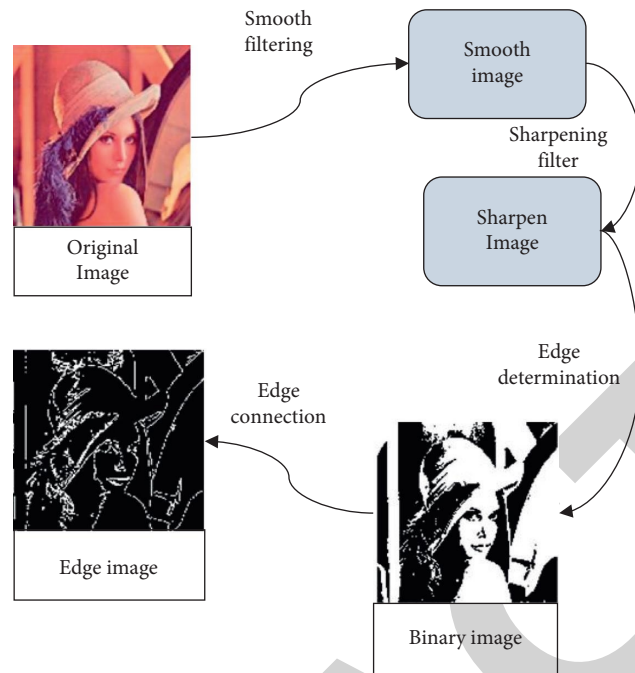


FIGURE 1: Digital image processing process.

information for the entire machine vision system, which is mainly composed of one or two graphic sensors, sometimes with a light projector and auxiliary equipment [18–20]. The main function of the vision sensor is to obtain enough original images to be processed by the machine vision system. Vision sensors can capture thousands of pixels of light from an entire image. The clarity and fineness of an image are usually measured by resolution, expressed in the number of pixels. After capturing the image, the vision sensor compares it with the reference image stored in the memory for analysis.

During the filming and production of FAT animation, the application of 3D vision sensor technology in vision sensor technology can obtain high-resolution image materials. 3D vision sensing technology combines image acquisition, image processing, and information transmission functions. It integrates image sensors, digital processors, communication modules, and other peripherals into a single camera. Due to this integrated design, the complexity of the system can be reduced, and reliability can be improved. This design provides more high-quality and refined original materials for FAT action production, which is convenient for FAT animation postproduction to produce higher-resolution and clear FAT works. The image acquisition unit of the vision sensor is mainly composed of Charge Coupled Device (CCD) or Complementary Metal-Oxide Semiconductor (CMOS) camera, optical system, lighting system, and image acquisition card. The vision sensor can convert the optical image into a digital image and pass it to the image processing unit. The working process of the visual sensor is shown in Figure 2.

The camera is the eye of the machine vision system. The heart of the camera is the image sensor. The choice of sensor depends on accuracy, output, sensitivity, the cost of the

machine vision system, and full understanding of the application requirements. A basic understanding of the main performance of the sensor can help developers quickly narrow the search range and find the right sensor. The dynamic range, speed, and responsiveness of the sensor are indicators of sensor performance. The dynamic range determines the quality of the image that the system can capture and is also called the ability to reflect details. The speed of the sensor refers to the output of the image that the sensor can produce and the image that the system can receive per second. Responsivity refers to the efficiency with which the sensor converts photons into electrons. It determines the brightness level at which the system needs to capture useful images. These indicators determine the quality of FAT output.

2.3. Steganography Enhancement Algorithm for the Spatial Image by Multiscale Filter. Steganography is a means of safely transmitting secret information. Pictures, movies and TV works, audio, and even text on the Internet can all be used as objects to hide secret information. These digital media have a huge amount of data and are a natural carrier library for steganography. The classic model of the steganography algorithm is shown in Figure 3.

The more the positions that are modified to the carrier object are, the easier it is for the hidden object to be detected by the steganography algorithm. The adaptive steganography image enhancement algorithm can embed the complex area and edge area of the image according to the image content of the image carrier itself. It does not embed in flat areas that are relatively easy to model. This process consists of two steps, distortion function calculation and coding embedding. The distortion function can be used to calculate

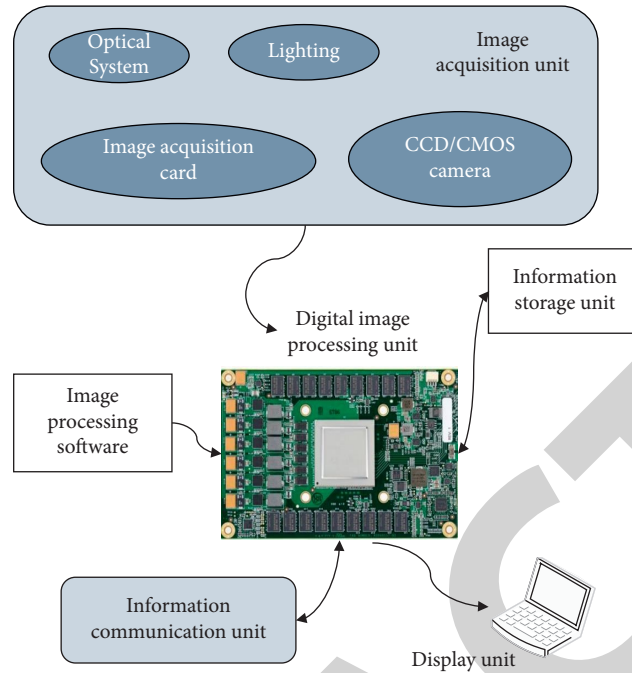


FIGURE 2: The working process of the visual sensor in the FAT animation production process.

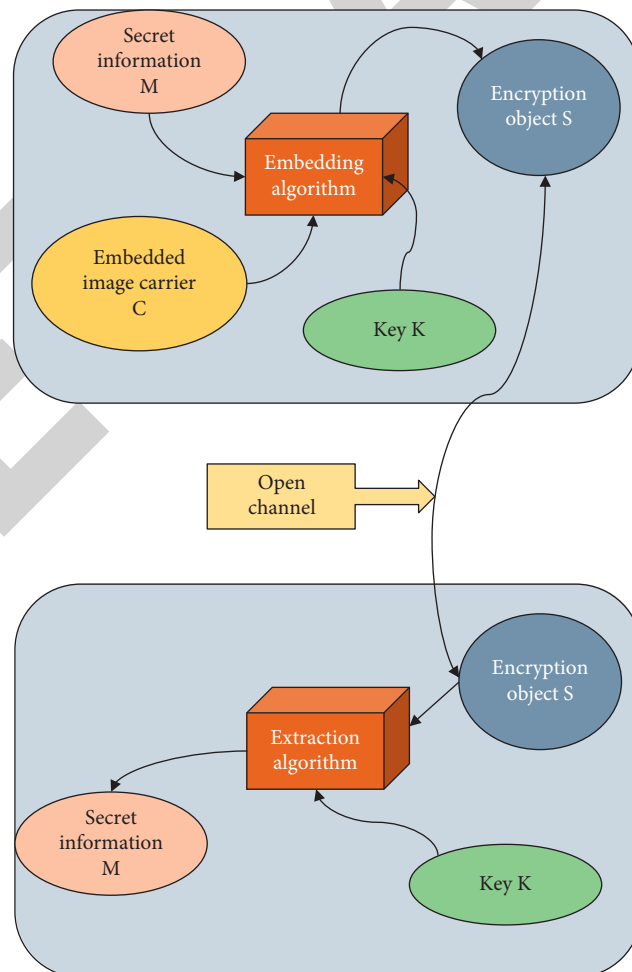


FIGURE 3: Classic model of steganography algorithm.

the distortion cost value that measures the embedded security of each pixel in the image. The smaller the distortion cost value, the smaller the distortion effect of the modification of this pixel on the image and the smaller the probability of image distortion caused by the modification here. The basic framework of the algorithm is shown in Figure 4. A good distortion function can accurately measure the embedded security of each pixel, making the entire algorithm more secure.

The coding embedding method determines whether it is possible to modify fewer positions to embed as much information as possible and improve the security of the algorithm. Generally, when the distortion function is designed, a smaller distortion cost is given to pixels in a complex texture area and an edge area, and a higher distortion cost is given to a flat area. The adaptive steganography image enhancement algorithm for the spatial image by minimizing distortion can adaptively select these complex texture regions and edge regions. For the additive distortion cost, the calculation method for the sum of the image distortion cost is shown in the following equation:

$$D(X, Y) = \sum_{i=1}^n \sum_{j=1}^n \rho_{ij} |X_{ij} - Y_{ij}|, \quad (1)$$

where X represents the carrier image cover, Y represents the secret image Stego, and ρ_{ij} represents the distortion cost of the pixel (i, j) at the carrier image.

Most of the distortion functions used in the existing spatial image adaptive steganography image enhancement algorithms are hand-designed heuristic distortion functions. The security measurement method of each pixel is calculated by using the distortion cost of each pixel of the distortion function. However, the hand-designed distortion function cannot well measure the distortion value of each pixel, and it is not accurate enough to capture some pixels. It may appear that there are some pixels in areas with complex textures that have higher distortion costs, but some pixels in flat areas have lower distortion costs; that is, abnormal points of distortion costs appear. This is because the distortion function is not accurate enough to capture the pixels in some areas of the image. To solve the problem of abnormal points and improve the security of adaptive steganography image enhancement algorithm for spatial image, the method of finding these abnormal points can be used to increase the distortion cost of abnormal pixels in flat areas and reduce the distortion cost of abnormal pixels in areas with complex textures so that the embedding is concentrated in the texture complex area.

A multiscale filter obtained by combining a multiscale Gaussian filter and a high-pass filter is proposed. Use this filter to extract image details at different scales. By adjusting the weight value of each filter, it is ensured that while enhancing the complex texture area, the enhancement of the flat area is minimized as much as possible. However, when a filter is used to enhance the image texture area, all the texture areas in the image cannot be enhanced by only one filter. This is because the texture area in the image has a difference in scale; there are large-scale image edges and texture areas

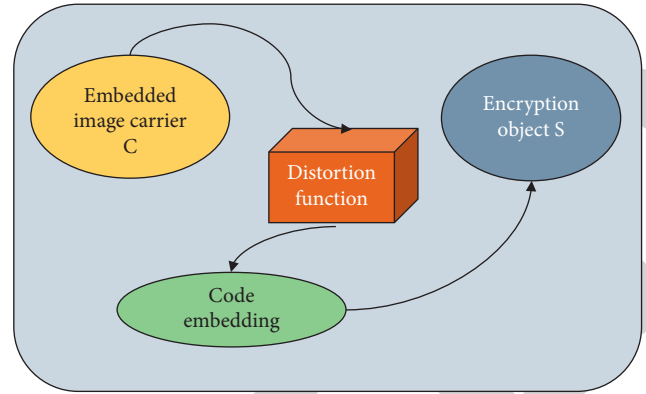


FIGURE 4: Basic framework of adaptive steganography image enhancement algorithm for the spatial image.

composed of many pixels and small texture areas and noise areas composed of a small number of pixels in the same image. Therefore, multiscale Gaussian filters are used to extract texture details of different scales in the image.

The multiscale Gaussian filter is composed of multiple Gaussian filters of different sizes. These Gaussian filters can extract image details at different scales. When using a multiscale Gaussian filter to enhance an image, the first step is to use 3 Gaussian filters of different sizes to convolve the entire image to obtain a smooth image after 3 filters, expressed as follows:

$$\begin{aligned} L_1 &= G_1 \otimes X, \\ L_2 &= G_2 \otimes X, \\ L_3 &= G_3 \otimes X, \end{aligned} \quad (2)$$

where \otimes represents the convolution operation, $G_1, G_2,$ and G_3 represent 3 Gaussian filters with different sizes, and $L_1, L_2,$ and L_3 represent the smooth image X obtained after filtering the carrier image. Since there may be repeated enhancements to some areas during image enhancement, in order to obtain more precise sharpening details, the difference operation is performed on the three image details obtained by filtering, as shown in the following equations:

$$\begin{aligned} H_1 &= X - L_1, \\ H_2 &= L_1 - L_2, \\ H_3 &= L_2 - L_3, \end{aligned} \quad (3)$$

where $H_1, H_2,$ and H_3 represent image details of different scales. The global details of the carrier image X are composed of the weighted sum of the three image details $H_1, H_2,$ and H_3 as shown in the following equation:

$$h = (1 - \omega \text{sgn}(H_1))H_1 + \omega_2 H_2 + \omega_3 H_3, \quad (4)$$

where $\omega_1, \omega_2,$ and ω_3 represent the weight of image details of different scales. $\text{sgn}()$ represents a symbolic function. When $H_1 > 0$, the return value of the function is 1; when $H_1 < 0$, the return value of the function is -1 ; when $H_1 = 0$, the return value of the function is 0. The multiscale Gaussian filter

integrates the image details of different scales in the form of a weighted sum. The purpose is to extract the details of the image texture area more completely and avoid the enhancement of noise in the flat area as much as possible.

In order to verify the effectiveness of the proposed algorithm, a confirmatory experiment is designed. The 10,000 greyscale images in the Bossbase1.01 image database are selected as the carrier image, and the Subtractive Pixel Adjacency Matrix (SPAM) feature is used as the steganalysis feature. These are compared with the existing mainstream adaptive steganography image enhancement algorithm for spatial image (such as spatial-universal wavelet relative distortion (S-UNIWARD)). The embedding rate is 0.1 bpp and 0.4 bpp, and Maximum Mean Discrepancy (MMD) is used as the measurement standard. The suffix Multiscale Gaussian (MSG) is a spatial image adaptive steganography image enhancement algorithm that uses a multiscale Gaussian filter for image enhancement.

In addition, in order to enhance the texture details of different scales in the image, a spatial image steganography enhancement algorithm by multiscale filters is designed. It consists of two parts: image enhancement and distortion cost calculation. The algorithm flow is divided into six steps:

Step 1: use the multiscale Gaussian filter of equation (4) to enhance the carrier image X to obtain the enhanced part.

Step 2: use a high-pass filter to sharpen the carrier image X to get the sharpened part E_s .

Step 3: get the final enhanced image X_s :

$$X_s = \alpha E_g + (1 - \alpha)E_s + X, \quad (5)$$

where α represents the weight and X represents the carrier image.

Step 4: use the distortion function of the adaptive steganography image enhancement algorithm for spatial image to calculate the distortion cost ρ of the enhanced image X_s .

Step 5: use the mean filter to smooth the distortion cost ρ to obtain the smoothed distortion cost ρ_s .

Step 6: use syndrome trellis codes (STC) to embed the necessary secret information into the carrier image X to obtain the final secret object Stego.

The enhancement algorithm is still verified by experiment, and the sample set and comparison algorithm are the same as the above method. The security of the algorithm here is evaluated using the following equation:

$$P_E = \min_{P_{FA}} \frac{1}{2} (P_{FA} + P_{MD}), \quad (6)$$

where P_{FA} and P_{MD} represent the false detection rate and the missed detection rate. The false detection rate indicates the probability that the carrier sample is misjudged as a secret sample. The missed detection rate indicates the probability of misjudging a confidential sample as a carrier sample. In order to ensure that the experimental results are valid, the result uses an average of 10 training and testing \bar{P}_E .

3. Results and Discussion

3.1. Performance Comparison of Spatial Image Steganography Enhancement Algorithms by Multiscale Filters. The MMD detection results of different adaptive steganography image enhancement algorithm for spatial image are shown in Figure 5.

Figure 5 shows that the existing adaptive steganography image enhancement algorithm for spatial image S-UNIWARD uses a multiscale Gaussian filter for enhancement and has a lower MMD value than that without enhancement. This shows that the enhanced steganography algorithm has more high security.

The value of the 3 Gaussian filters is selected according to the ratio of n , $2n - 1$, and $4n - 1$. The standard deviations corresponding to the 3 filters are 1.0, 2.0, and 4.0. During the experiment, the embedding rate is set to 0.4 bpp, the parameter is $2 \leq n \leq 9$ and then the results of the algorithm security test with different values of n are shown in Figure 6.

From Figure 6, it is clear that, for $n = 3$, the average detection error rate is about 25.06%. Thus, it shows that the algorithm currently has the highest security. In subsequent experiments, the value of n is fixed at 3, and the sizes of the corresponding three Gaussian filters are 3×3 , 5×5 , and 11×11 , respectively.

The embedding rate is 0.4bpp, the parameter is $0.2 \leq \alpha \leq 0.7$, and the value step is set to 0.1. Comparison of the three parameters of the multiscale Gaussian filter $\omega_1 = 0.5$, $\omega_2 = 0.5$, and $\omega_3 = 0.25$, and the changes in the security of the algorithm under different α values are shown in Figure 7.

Figure 7 shows that, at the time of $\alpha = 0.4$, the security of the spatial image adaptive steganography enhancement algorithm by multiscale filters is up to 34.62%, so $\alpha = 0.4$.

In order to compare the performance of the enhanced algorithm and the existing algorithm S-UNIWARD, two mainstreams' spatial steganalysis features, SRM (Spatial Rich Model) and max Spatial Rich Model (max SRM), are used to compare algorithm security. Among them, the suffix Multiscale Gaussian (MSG) represents the spatial image adaptive steganography image enhancement algorithm that uses a multiscale Gaussian filter for enhancement. The suffix MiniMum_Support (MS) represents the MS image enhancement algorithm proposed in literature [21]. The comparison results are shown in Figures 8 and 9.

Figures 8 and 9 show that the established image enhancement algorithm can significantly improve the security of the current spatial image steganography image enhancement algorithm at different embedding rates. Especially under a high embedding rate, the improvement of spatial image steganography image enhancement algorithm is greater. This is because when the embedding rate is high, the texture complex area with lower distortion cost has been embedded. At this time, the spatial image steganography image enhancement algorithm will select some noise points in the flat area for embedding. That is, abnormal points with lower distortion costs in the established flat area will reduce the security of the algorithm. After the carrier image is preprocessed by the proposed enhancement algorithm, the

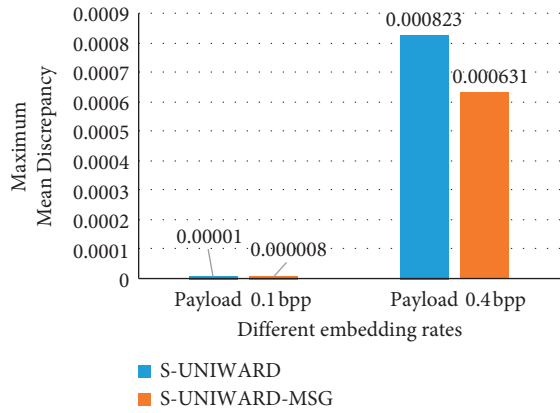


FIGURE 5: MMD detection results of different adaptive steganography image enhancement algorithm for spatial image.

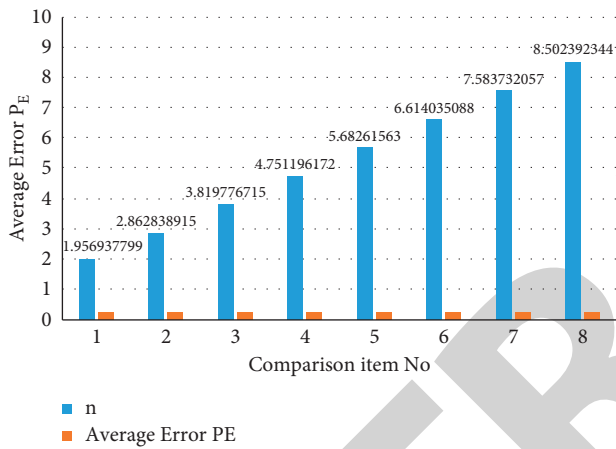


FIGURE 6: The influence of different values of filter size n on algorithm security.

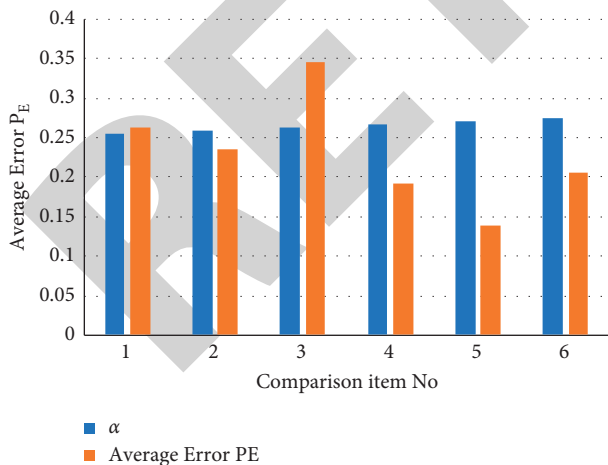


FIGURE 7: The influence of different values of parameters on the security of the algorithm.

pixels in the complex texture area are enhanced. Meanwhile, it suppresses the noise in the flat area so that the embedding of the spatial image steganography image enhancement algorithm is more concentrated in the embedding of the

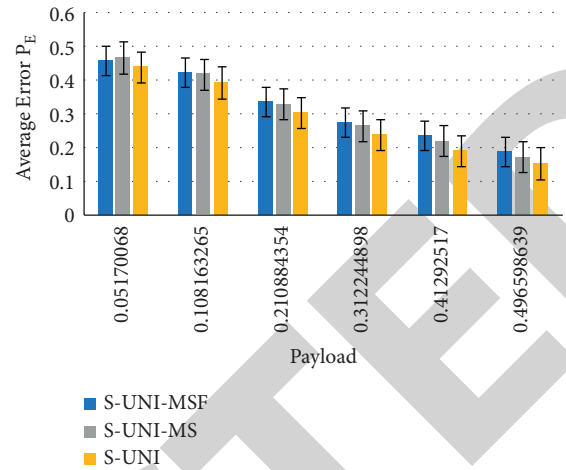


FIGURE 8: Performance comparison of image enhancement algorithms on feature set SRM.

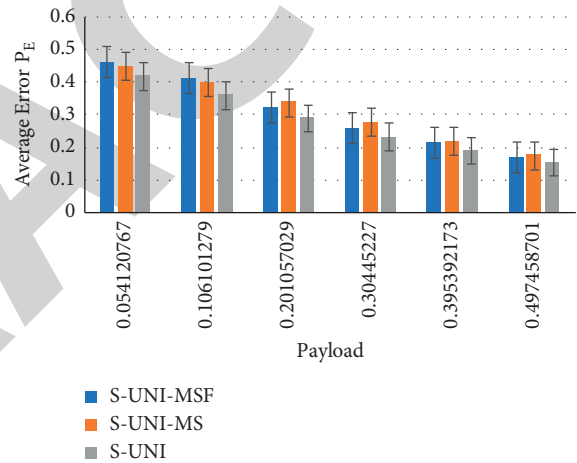


FIGURE 9: Performance comparison of image enhancement algorithms on feature set max SRM.

texture complex area, and the influence caused by the abnormal points in the flat area is less. The proposed algorithm improves the security of the algorithm, and the image enhancement effect will be better.

4. Conclusions

With the rapid development of computer image processing technology, the scope of Internet information has gradually changed from graphic communication to image communication, creating conditions for network platforms and radio and television platforms to compete. Firstly, advanced computer image processing methods are used in the field of FAT animation production. In view of the current traditional steganography algorithms that do not pay attention to the image content, the generated image quality is low. Aiming at the current situation that there are two types of abnormal points in spatial image steganography, an adaptive steganography algorithm is proposed. In the process of embedding, more fully consider the content of the image

itself. The embedding method is concentrated in places that are not easy to model, such as the image texture area and edge area, which makes the detection of the steganalysis algorithm more difficult and improves the security of the steganography image enhancement algorithm. To a large extent, the quality of the original materials for FAT animation has been improved, providing higher-resolution original images for visual image performance. However, some shortcomings still exist. Due to the rapid development of the image enhancement field, there may be more effective algorithms for filtering texture areas and flat areas, and the extraction of image texture details can be more accurate. In the future, the proposed spatial image steganography enhancement algorithm will be applied to the processing of more image types, and further research is needed.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

Acknowledgments

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