Research on Computer Aided Graphic Design Image Processing Technology

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Abstract: With the continuous progress of modern science and technology, it has become more and more common to use computer-aided technology to achieve better visual aesthetic effect in graphic design. Computer-aided software has greatly promoted the innovation of graphic design methods and the improvement of design efficiency, and brought into full play the role of visual aesthetics in design. In this paper, a technical scheme of graphic design image processing based on wavelet is proposed. On the basis of two-dimensional image modeling, the discrete wavelet method is used to transform the image, and the threshold design of wavelet coefficients is improved and quantified. At the same time, the corresponding wavelet coefficients are used to reconstruct the processed image, and finally a complete graphic design image processing scheme is formed. The simulation results show that the proposed algorithm has better denoising effect than the amplitude-based matched filtering algorithm.

1. Introduction

With the development and popularization of the Internet, computer technology has been widely used in all walks of life. Computer-aided technology refers to the process of designing and testing products by using computer platform, which is widely used in graphic design. Due to the influence of various factors such as transmission environment, the image is often distorted, which affects the effect of graphic design. Therefore, image denoising has been widely studied [1-2].

Computer aided technology is used in graphic design, mainly relying on related computer platforms and computer drawing software. To show the visual aesthetic effect of graphic design, designers not only need strong aesthetic ability and creativity, but also need the help of computer-aided technology, so as to make graphic design more perfect and efficient [3]. Based on the chaotic permutation of high-resolution wavelet, this paper uses the decomposition algorithm of two-dimensional wavelet transform to give the calculation formula of image on multiple wavelet components. Using the correlation between these components, the phase filtering algorithm is implemented, and the high-quality image with sufficient noise reduction is obtained, and a feasible denoising scheme for graphic design image is proposed.

2. Computer aided graphic design

Graphic design pays attention to the geometric visual beauty, that is, the prominent elements such as mathematical symmetry and golden section. Therefore, in graphic design, it is the key to construct visual aesthetics to pay attention to the prominence of geometric elements and the effective collocation of each element [4].

In the appreciation of graphic design, the harmony of geometric elements is the direct factor that reflects the value of graphic design. Therefore, the geometric element construction in graphic design largely needs to systematically process the design elements based on computer-aided technology [5], especially the balance of the proportion and position relationship of the design elements, which is the key to build the visual beauty in graphic design.

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3. Research on image deformation technology

Image deformation plays an important role in graphics and image processing system. In many applications, it is required to transform an image of a certain shape and size into another shape and size naturally or even accurately. The filling of the deformed image area is the key to deformation, and the quality of the filling algorithm depends on the filling efficiency in the process of filling the deformed image effect.

Establish the mapping relationship between rectangles between the regions before and after image deformation to achieve the purpose of fast filling; The mapping relationship between irregular shapes is established between regions before and after image deformation, so as to achieve the purpose of accurate filling [6].

3.1. Image deformation based on grid

Mesh-based image deformation method is the earliest method used in image deformation. In the morphing queue, all intermediate frame images can be generated by the following steps:

Linearly interpolate meshes M_s and M_d to obtain mesh M .

According to the transformation defined by grids M_s and M , the source image is distorted to the intermediate frame image I_0 .

According to the transformation defined by grids M_d and M , the target image is distorted to an intermediate frame image I_1.

Linear interpolation is performed on the color value of the same point of image I_0 and I_1 to obtain the intermediate frame image.

However, the mesh-based image deformation method is not commonly used because it is inconvenient to use. Firstly, it is the problem of grid selection. For a given image, it is difficult for us to choose a suitable grid representation. Secondly, all the control points have the same influence on the whole image, and changing one grid node requires adjusting all the grid nodes, which makes local modification difficult. Furthermore, in some special occasions, the grid method can not completely describe the object.

3.2. Deformation technology based on regional boundary

The method based on grid distortion establishes the distortion function by dividing the feature grid in the source image and the target image and specifying the feature correspondence of the grid lines. This method is easy to establish the distortion function, but the feature specification is too complicated [7]. The method based on characteristic line segments specifies the characteristic line pairs in the source image and the target image, and combines the distortion function of the characteristic line segments into the distortion function of the image, thus realizing image deformation.

In image deformation, it is difficult to establish a unified distortion function to realize the accurate mapping from the source image to the target image. Therefore, we divide the whole mapping region of the source image and the target image into multiple regions $\Omega_i(i=1,2,\cdots,n)$, and establish their own distortion functions in each region. The division of areas shall meet the following conditions:

$$\begin{aligned} &\Psi \bigcup \Omega_i(i=1,2,\cdots,n) \\ &\Omega_i \bigcup \Omega_j(i,\ j=1,2,\cdots,n; i \neq ij) \end{aligned} \tag{1}$$

The division of regions is arbitrary, and its type can be single connected or multi-connected. The shape can be any polygon.

4. Graphic design image processing technology

In graphic design, most designers usually use the principle of image composition as the basic theoretical support, apply the golden section line and some numerical values generated in the application of aesthetic properties, so that the works can have stronger visual impact, give the appreciator a higher visual experience and improve the visual value of the works. The application of visual aesthetics in computer-aided graphic design, on the one hand, shows that through the understanding and analysis of aesthetic principles, the value of works can be further improved.

4.1. Image modeling

In order to further improve the performance of image denoising, wavelet method is applied to image processing. Similar to the filtering algorithm, there is also some research on threshold setting in wavelet denoising algorithm [8]. Hard threshold function method and soft threshold function method have been applied due to low complexity, but the denoising performance has lost a lot.

In order to denoise and optimize the image using wavelet theory, it is necessary to model the image at first. Generally, two-dimensional plane images can be modeled in the form of two-dimensional array $f(x,y)$, which is shown as follows:

$$F=\begin{bmatrix} f(1,1) & \cdots & f(1,N) \\ \vdots & \ddots & \vdots \\ f(N,1) & \cdots & f(N,N) \end{bmatrix} \tag{2}$$

Binary images can be represented by a two-dimensional array of 0 and 1, with 0 representing black and 1 representing white. For complex gray images, it can be represented by 8-bit binary numbers. In the process of image transmission and processing, images are easily affected by additive noise and multiplicative noise. While that pixel value affect by noise can be expressed as:

$$F=(x,y)=f(x,y)\cdot(1+n(x,y))+N(x,y) \tag{3}$$

Where: $n(x,y)$ represents multiplicative noise; $N(x,y)$ represents additive noise.

4.2. Fast decomposition and reconstruction of images based on

Mathematically, wavelet is defined as a function with a finite interval and zero average value, which has a finite duration and abrupt frequency and amplitude. Wavelet analysis method is a time-frequency localization analysis method with fixed window area but changeable shape, time window and frequency window. In many fields of wavelet analysis application, image processing is one of the fields where wavelet transform is widely used.

Among many wavelets, it is a crucial problem to choose which wavelet to analyze the signal. Because even for the same problem, using different wavelets will produce different results, which will directly affect whether the wavelet analysis can achieve the analysis purpose.

Haar wavelet is the earliest orthogonal wavelet function used in wavelet analysis. Because of its simple calculation, it is often used in image analysis.

Haar wavelet is defined as:

$$g(x)=\begin{cases} 1 & 0\le x<1/2 \\ -1 & 1/2\le x<1 \\ 0 & other \end{cases} \tag{4}$$

The process of haar wavelet decomposition is as follows:

(1)Calculate the average value of adjacent pixel pairs, and get a new image with only 4 pixels. The resolution of the image is 1/2 of the original image, and the pixel value is [21,37,5,15].

(2)Calculate the difference. There are only four pixels in the new image after average calculation, which results in partial loss of image information. If you want to reconstruct the original image of

eight pixels from the image composed of four pixels, you need to subtract the average value of each pixel pair from the first pixel value of each pixel pair, which is called the detail coefficient of the image, and its function is to find the lost information during image reconstruction. After the above calculations, the original image can be expressed as: [21,37,5,15,11,28,1,8].

(3)Repeat steps (1) and (2) for further decomposition of the image obtained by the first layer transformation, and the process is shown in Table 1.

Table 1 Haar wavelet transform process

Resolution ratio	Average value	Detail coefficient
8	[33,2,9,5,4,7,24]	
4	[20,38,5,14]	[10,-27,-1,-8]
2	[28,15]	[-8,-5,-10,-27,-10]
1	[18,6]	[-9,-7,-5,-11,-24,-1,-9]

For a 2-D image, it can be regarded as a two-dimensional matrix composed of many pixel values. When the image is decomposed by haar wavelet, considering that the haar matrix is an orthogonal matrix with separable transformation property, the two-dimensional pixel matrix can be realized by using one-dimensional haar wavelet transform twice in a row, that is, the average and difference values of adjacent pixel pairs are calculated for each row of the pixel matrix, and the two-dimensional haar wavelet transform can be obtained by doing the same transformation for each column.

4.3. Filtering algorithm of phase diagram

Wavelet multi-resolution analysis only further decomposes the low-frequency space, which makes the frequency resolution higher and higher. It decomposes the low-frequency part with scale j into four parts: the low-frequency part with scale $j+1$ and the high-frequency part in three directions (horizontal direction, vertical direction and diagonal direction).

There are a lot of noise signals in the phase diagram after eliminating the flat effect. Let the noise in the real part and imaginary part of the interference phase diagram be Gaussian white noise with constant standard deviation.

According to the characteristics of noise under wavelet analysis, because wavelet analysis can effectively distinguish the abrupt part of the signal from noise, filtering the interference phase diagram by wavelet analysis can not only filter out noise, but also keep the phase value when the phase is abrupt. Apply multiplicative noise model.

$$x = s \cdot n \tag{5}$$

Where s represents the signal, which is a Gaussian random process, and the mean and variance are μ_s, σ_s respectively; n represents noise, which is a Gaussian random process with a mean value of 1, and they are independent random processes. x represents raw data. The formula (4) is:

$$\left.\begin{aligned} \mu_x &= \mu_s \\ K_s^2 &= \frac{K_x^2 - K_n^2}{1 + K_n^2} \end{aligned}\right\} \tag{6}$$

Where $K_s = \sigma_s / \mu_s, K_n = \sigma_n / \mu_n, K_x = \sigma_x / \mu_x$ is the normalized standard deviation. Therefore, the local estimation of K_x can be used to distinguish whether K_s is a uniform region or a non-uniform region.

For the sake of simplicity, because the circular median filtering method can keep the continuity of phase fringes well, this paper uses each high-frequency component after wavelet decomposition to filter. The steps of filtering are: taking the real part and imaginary part of interferogram to form two data sets.

5. Experimental results and analysis

Using the final processed data of these two algorithms, this paper calculates and compares the output peak signal-to-noise ratio and mean square error of the two denoising algorithms, and the results are shown in Figure 1.

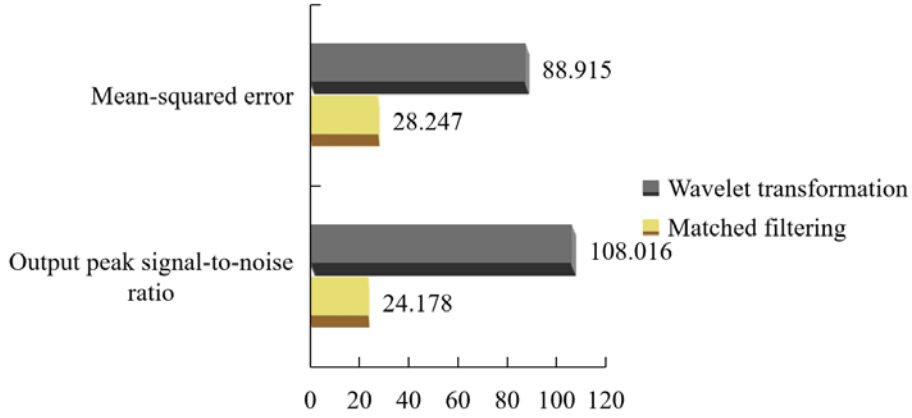

Figure 1 Parameter comparison of output results of two image processing algorithms

As can be seen from Figure 1, compared with the matched filtering algorithm, the algorithm proposed in this paper has higher signal-to-noise ratio and lower mean square error, which proves that the image denoising effect of wavelet chaotic permutation algorithm is better from the data level, and the execution stability of the algorithm is also better. To sum up, this algorithm is superior to amplitude-based matched filtering algorithm.

6. Conclusions

To sum up, the application of computer-aided technology in graphic design is mainly based on the basic principles that are widely used in graphic design and the related concepts and data of geometric aesthetics, and adopts the methods of intelligent analysis and functional assistance to improve the appreciation angle value of graphic design works in visual aesthetics. In order to meet the needs of high-quality image denoising and restoration, this paper proposes a graphic design image processing technology based on wavelet. Through the digital modeling of the image, the discrete wavelet transform is used for denoising, and the wavelet coefficient threshold quantization scheme is improved. In this paper, a high-resolution wavelet chaotic permutation algorithm is proposed, which is superior to the matched filtering algorithm. The simulation of classic images proves the effectiveness and superiority of this algorithm.

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