RLE Algorithm Based Image Data Coding Method of Tujia Brocade Double Knitting Pattern

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Abstract. In order to ensure the resolution of Tujia brocade double-sided woven pattern image and reduce the image storage space, a data encoding method of Tujia brocade double-sided woven pattern image based on RLE algorithm is proposed. A double-sided braided pattern image data encoder is designed as the executive component of the encoding method. Through filtering, image enhancement, illumination compensation and other steps, the pre-processing of pattern image is realized. Using the image data transformation of RLE algorithm, the image data coding of Tujia brocade double-sided woven patterns is realized. Through the performance test experiment, it is concluded that compared with the traditional coding method, the peak signal-to-noise ratio of the optimized design method is improved by about 5.7 db, the image compression ratio is improved by about 0.22, and the image data coding efficiency is significantly improved.

Keywords: RLE Algorithm · Tujia Woven Cotton · Double-Sided Woven Pattern Image · Image Data Coding

1 Introduction

Tujia brocade is also known as "Xilankapu" and "Dahua Bedding". According to the custom of Tujia nationality, when Tujia girls got married in the past, they had to cross stitch and embroider when weaving to make "Xilankapu" with beautiful patterns. After more than 4000 years of development, Tujia women have created countless brocade patterns, and have retained more than 220 patterns. The Tujia brocade has a wide range of patterns and themes, covering almost every aspect of Tujia people's life, including flowers, birds, fish and insects, scenery of mountains and rivers, auspicious characters, and the weaving of folk stories, fables and other pictures. The selection of themes is closely related to Tujia people's life and customs, and is a vivid portrayal of the relationship between Tujia people and nature [1]. Its patterns and patterns include natural image patterns, geometric patterns, and character patterns. They have the common characteristics of taking materials from life, abstract and mysterious patterns, balanced and symmetrical composition, and so on. The double-sided woven pattern of Tujia brocade belongs to China's intangible heritage and has high protection value.

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Under the background of the rapid development of modern communication technology, computer technology, network technology and information processing technology, image information processing, storage and transmission play an increasingly important role in social life, and people are more and more urgent to accept image information. Image communication will be the biggest challenge in the development of communication industry, and will also be a hot market in the future communication field. Through a large amount of statistics and visual perception research on image data, people have shown that there is a strong correlation between adjacent pixels, between adjacent lines or between adjacent frames of images, that is, image signals have redundancy in space, time, structure, vision and knowledge, Using some coding method to eliminate these correlations or redundancies to a certain extent, we can achieve image data compression coding. In a word, large amount of image information will bring huge pressure on memory storage capacity, communication trunk channel broadband and computing speed. It is unrealistic to solve this problem simply by increasing storage capacity, channel bandwidth and computer processing speed. Therefore, in the transmission and storage of image data, compression coding is imperative.

Image coding is also called image compression, refers to the technology of representing the image or the information contained in the image with fewer bits under the condition that certain quality is met. At present, more mature image data coding methods mainly include: Reference [2] designs an embedded image coding algorithm based on discrete cosine transform. Firstly, the original image is subjected to discrete cosine transform, and then the cosine coefficients in the transform domain are scanned in a specific scanning order to accurately determine the positions of each coefficient. Secondly, in order to represent the cosine coefficients in the transform domain with fewer coding bits, the scanned coefficients need to be quantified to achieve image coding. Reference [3] proposes a sparse approximation image coding method that comprehensively applies Matrix decomposition and sparse representation. By comprehensively applying Matrix decomposition and sparse constraints, a matrix optimization model is constructed for image coding. However, the above image coding methods have a problem of poor coding performance in practical operation when dealing with large amounts of repetitive information, mainly reflected in the encoding quality and encoding space of the image. Therefore, this article proposes a data encoding method for Tujia brocade double-sided pattern images based on the RLE algorithm. RLE algorithm, also known as Run-length encoding algorithm, is a compression method using spatial redundancy, and also a basic lossless compression coding method in statistical coding. The basic principle is to use corresponding symbols and string length to represent consecutive strings with the same value, thereby reducing the number of symbols and achieving compression. In the case of large amount of duplicate information, Run-length encoding stipulates that only when the data code in the row or column changes, can the specific value and continuous number of data be recorded, which plays a certain role in eliminating redundant information and realizing data compression. This article achieves preprocessing of pattern images through steps such as filtering, image enhancement, and lighting compensation. It innovatively applies RLE algorithm to eliminate redundant information, complete image data transformation, and achieve image data encoding of Tujia brocade double-sided patterns.

2 Design of Data Encoding Method for Double-Sided Woven Pattern Image

Image compression is a part of data compression, which has the basic characteristics of data compression. Data compression mainly studies the methods of data representation, transmission and conversion, and reduces data storage space and transmission time by representing the source signal with the smallest data. The classic data compression technology is based on information theory, called source coding. Information theory believes that sources contain more or less redundancy, that is, there is a great correlation between signals, or the probability distribution of sources is uneven. By removing the correlation or changing the non-uniformity of the probability distribution, the data can be effectively compressed. The basic operation process of optimizing the design of double-sided braided pattern image data coding method is shown in Fig. 1.

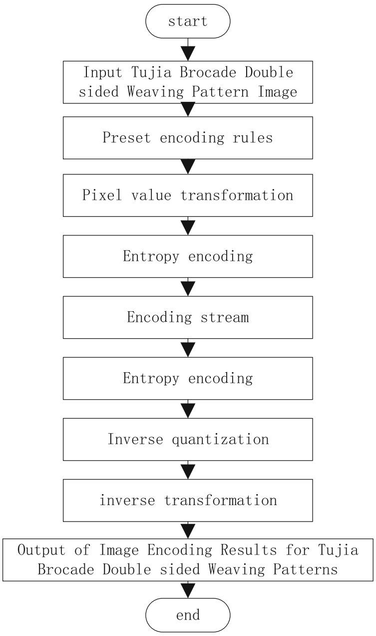


Fig. 1. Flow Chart of Double sided Braided Pattern Image Data Coding

The basic steps of image compression coding are described as follows: Step 1: First, perform some transformation on the original image. There are many transformation methods available here, which can be frequency domain transformation or spatial domain transformation, such as discrete cosine transform or wavelet transform. After transformation, a series of transformation coefficients are obtained. Step 2: Quantize the obtained transformation coefficient. The quantization method is divided into scalar quantization and vector quantization. Select the appropriate quantization method according to different needs. Step 3: The quantized data is processed by entropy coding, and then they are organized into different stream data. For this stream data, it can then be transmitted through the channel or stored using a storage device. The above is the basic encoding steps. If the image data after encoding is to be decoded, the decoding process is just the opposite of the encoding process, that is, entropy transformation is first followed by inverse quantization and inverse transformation.

2.1 Design of Double-Sided Braided Pattern Image Data Encoder

The double-sided braided pattern image data encoder is the running part of the image data coding method, including wavelet transform and zero tree coding. Its overall structure is shown in Fig. 2.

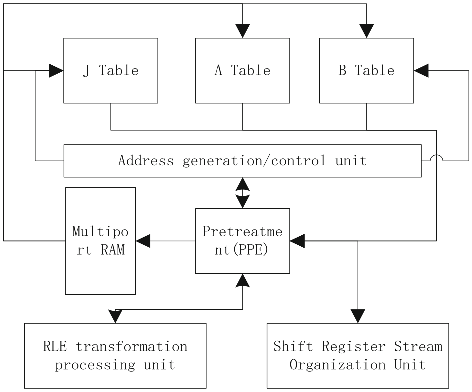


Fig. 2. Structure diagram of double-sided braided pattern image data encoder

As shown in Fig. 2, the original double-sided braided pattern image first enters the wavelet transform processing unit. After the wavelet transform is completed, the wavelet coefficients are sent to the preprocessing unit to calculate the highest bit level and the significance value of each coefficient. The main processing process carries out zero tree coding according to the wavelet coefficients and tables J, A and B, and finally outputs the compressed code stream. The pre-processing module mainly reads the wavelet coefficients generated by the wavelet transform processing unit, and generates the indexes of Table J, Table A and Table B for the main processing. Since each parent node has four direct child nodes after the wavelet transform, the preprocessing unit adopts the data packaging mode of four pixels in a group. The saliency processing can be completed by reading each pixel once. The main processing module mainly completes the sorting of wavelet zero tree and the significance judgment.

2.2 Preprocessing of Double-Sided Woven Pattern Image

2.2.1 Filtering and Denoising

Filtering and de-noising is the operation of double-sided woven pattern image, the purpose is to remove cross links, breakpoints and blurred parts in the image. Linear filtering is used to filter and denoise the double-sided woven pattern image. Linear filtering can remove some types of noise in the image. For example, the average filter using the neighborhood average method is very suitable for removing the particle noise in the scanned image. Neighborhood average method for given double-sided woven pattern image $f(x, y)$ each pixel in (i, j), take its neighborhood U. set up U contain M the average of pixels is taken as the image points after processing (i, j) the grayscale at. Replace the original gray level of a pixel with the average gray level of each pixel in the neighborhood of the pixel, that is, use the neighborhood average technology. Neighborhood U the shape and size of are determined according to the image characteristics [4]. Generally, the shapes are square, rectangle and cross, U the shape and size of can remain unchanged during the whole image processing, and can also change according to the local statistical characteristics of the image (i, j) generally located in U center, Assumption U is 3 * 3 neighborhood, then:

$$\bar{f}(x, y) = \frac{1}{3 \times 3} \sum_{i=-1}^{1} \sum_{j=-1}^{1} f(i + x, j + y) \tag{1}$$

Hypothetical noise N it is additive noise, and each point in space is uncorrelated, and the expectation is 0, and the variance is χ, $g(x, y)$ it represents the unpolluted image. After neighborhood averaging of the image containing noise, the filtering and denoising results are as follows:

$$\bar{f}(x, y)' = \frac{\sum g(x, y) + \sum n(x, y)}{U} \tag{2}$$

In the formula, $n(x, y)$ represents the original gray scale of the pixels. It can be seen from Formula 2 that after neighborhood averaging, the mean value of noise remains unchanged, and the noise variance is:

$$\chi_{new} = \frac{\chi}{U} \tag{3}$$

That is, the noise variance becomes smaller, indicating that the noise intensity is weakened, that is, the noise is suppressed. At the same time, it can be seen from the formula that the neighborhood average method also smoothes the image signal, especially the boundary of the image target area may become blurred.

2.2.2 Image Enhancement

The purpose of image enhancement is achieved by expanding the dynamic range of the image. Define the dynamic range of the color Tujia brocade double-sided woven pattern image as:

$$W(f) = \mathrm{Min}_{x \in D}\{f_R(x), f_G(x), f_B(x)\} - \mathrm{Max}_{x \in D}\{f_R(x), f_G(x), f_B(x)\} \tag{4}$$

In the above formula D represents the pixel x field, $f_R(x), f_G(x)$ and $f_B(x)$ is the R, G, B channels of the image. The image enhancement operation is realized by histogram equalization. In the histogram, if the gray level is concentrated in the high gray area, the low gray level of the image is not easy to distinguish. If the gray level is concentrated in the low gray area, the high gray level is not easy to distinguish [5]. In order to make the high and low gray levels easy to distinguish, the best way is to convert the image so that the distribution probability of gray levels is the same. This is the purpose of histogram equalization. Suppose the image is transformed as follows:

$$s = T(r), 0 \leq r \leq L - 1 \tag{5}$$

In the formula, $T(r)$ represents the gray distribution probability and L represents the gray rank. The purpose of image enhancement is to make the probability distribution of gray s level equal:

$$p(s) = \frac{1}{L - 1} \tag{6}$$

Variables in Formula 5 and Formula 6 L is grayscale. The relationship between the gray level distribution before transformation and the gray level distribution after transformation is as follows:

$$p(s) = p(r)\left|\frac{dr}{ds}\right| \tag{7}$$

Through simultaneous and integral processing of the above formula, we can get:

$$\begin{cases} T'(r) = (L-1)T(r) \\ s = T(r) = (L-1)\int_0^r p(r)wdw \end{cases} \tag{8}$$

In the formula, w represents the grayscale weights. Finally, the enhancement processing results of Tujia brocade double-sided woven pattern image are as follows:

$$s_k = (L-1)\sum_{r=0}^{w} p(r) \tag{9}$$

According to the above process, all pixels in the Tujia brocade double-sided woven pattern image are processed to complete the image enhancement operation.

2.2.3 Light Compensation

Considering that the pixel values of the double-sided woven patterns of Tujia brocade will be significantly different when photographed under different light intensities, the transformed similar images will reflect the actual situation of the double-sided woven patterns of Tujia brocade through light compensation [6, 7]. Linear brightness transformation is carried out for the original Tujia brocade double-sided woven pattern image, and the process can be quantified as:

$$f_{\text{illumination compensation}}(x, y) = \alpha f(x, y) + \beta \tag{10}$$

where parameters α and β scale and offset light compensation parameters respectively. The goal of light compensation is to make the image $f_{\text{illumination compensation}}(x, y)$ as close as possible to the real image, this is expressed by the following formula:

$$q = \min \sum_{1 \le i \le M} \left(h(x, y) - f_{\text{illumination compensation}}(x, y)\right) \tag{11}$$

among M is the number of all matching feature points i, $h(x, y)$ indicates the position of the feature point in the current image (x, y) the pixel value at. According to the calculation result of Formula 11, the specific value of the light compensation parameter can be obtained. The calculation result of the compensation parameter can be substituted into Formula 10 to complete the light compensation processing of the Tujia brocade double-sided woven pattern image.

2.2.4 Image Binarization

In digital image processing, binary images occupy a very important position, especially in practical image processing systems, there are many systems with binary image processing as the core. To process and analyze binary images, first we need to binary gray images to obtain binary images [8, 9]. The advantage of this is that when the image is further processed, the geometric properties of the image are only related to the positions of 0 and 1, not the gray value of pixels, which makes the processing simple and the data compression amount is large. The so-called image binarization refers to transforming a grayscale image into a binary image that uses only two values to represent the target and background of the image by setting a threshold value. The image binarization can be performed according to the following threshold processing:

$$g(x, y) = \begin{cases} 1; f(x, y) \ge \phi \\ 0; f(x, y) < \phi \end{cases} \tag{12}$$

In the above formula ϕ the threshold set for. the part of the binary image whose pixel value is 1 represents the target sub image, and the part whose pixel value is 0 represents the background sub image.

2.3 Image Data Transformation Using RLE Algorithm

RLE algorithm is also called run length coding, and run length is a cursor on a linear unit; The cursor can also be set under the mark of run. In this way, the cursor at the upper level is called the parent run, and the cursor at the lower level is called the child run. Figure 3 shows the basic structure of run.

In Fig. 3, Y represents the compressed data character, C represents the number of times Y repeats, and B represents the character not used in the data character set Y, which is used to indicate that there is a string with the length of C at this position in the data stream. There are intra frame data redundancy and inter frame data redundancy in the storage unit of image data. We want to eliminate redundant data as much as possible, that is, fully compress the data redundancy in time domain and space domain, so as to reduce

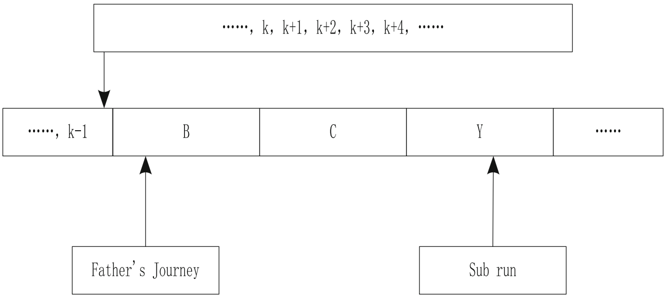


Fig. 3. Basic Structure of Run

the amount of data. Therefore, the simple run length coding principle is to form a new code [10] by moving the cursor and linearly scanning the records of consecutive cells, and saving the same cell name and number of cells. In general, the more consecutive identical records, the more redundant data removed, the smaller the amount of newly formed data, and the higher its compression ratio. In the same way, 2D or 3D data can also be encoded through multi run and linear processing. This is the basic principle of run length coding. The basic operation flow of RLE algorithm is shown in Fig. 4.

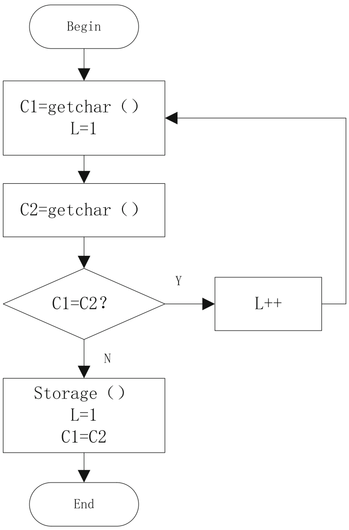


Fig. 4. RLE algorithm flow chart

According to the flow in Fig. 4, in the process of image data transformation of Tujia brocade double-sided woven patterns, set $v_1, v_1, \ldots, v_n$ if it is a row of pixels in the image, the data transformation principle of the row of pixels under the RLE algorithm is shown in Fig. 5.

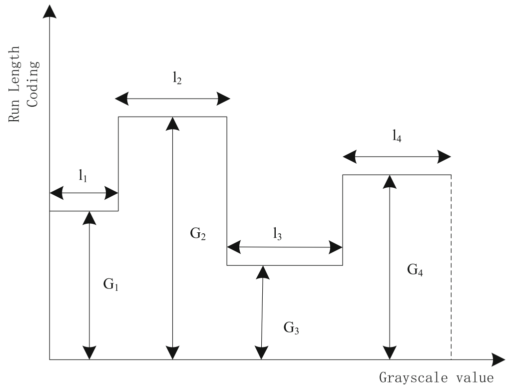


Fig. 5. Schematic diagram of RLE transformation of one line of image pixels

As can be seen from Fig. 5, each line of image is composed of k segment length is l_k, gray value is G_k the line image can be represented by even pairs:

$$(\mathrm{x}_1, \mathrm{x}_2, \cdots, \mathrm{x}_\mathrm{n}) \rightarrow (\mathrm{G}_1, l_1), (\mathrm{G}_2, l_2), \cdots, (\mathrm{G}_\mathrm{k}, l_k) \tag{13}$$

Each even symmetry is a grayscale run. Assume that the binary image line starts from the blank run. In this way, only the run length needs to be encoded. The resulting encoding is one-dimensional, and the one-dimensional transformation of image pixels can be completed [11, 12]. On this basis, the concept of wavelet transform is introduced to obtain two-dimensional image transformation results. The continuous wavelet transform process of Tujia brocade double-sided woven pattern image is as follows:

$$\varphi = \frac{1}{\sqrt{|\zeta|}} \int \psi\left(\frac{t-\delta}{\zeta}\right) dt \tag{14}$$

Among ζ the spectrum structure of the signal after wavelet analysis can be changed. By changing the size t and shape δ of the time window of the function, more detailed time-frequency analysis can be carried out on the signal. Parameters can be added $|\zeta|$ the value of makes the wavelet basis function $\psi()$ the frequency spectrum of $\psi()$ the width of is gradually increased. Conversely, by reducing $|\zeta|$ the value of makes the wavelet basis function $\psi()$ the frequency spectrum of $\psi()$ the width of decreases gradually. The multi-resolution analysis of wavelet analysis algorithm is reflected in the corresponding change of its time window when the frequency range changes. When the function time window is small, its frequency appears in the high frequency range. When the time window is large, the frequency of the signal appears in the low frequency range, so the wavelet transform algorithm has a higher resolution in the time domain or space domain. The original signal can be decomposed by Formula 14, and the image signal $f(t)$ The reconstruction is shown in Formula 15.

$$f(t) = \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} \frac{d\zeta d\delta}{\zeta^2} W_f(\zeta, \delta) \psi(t) \tag{15}$$

In formula 15, $W_f(\zeta, \delta)$ represents the transform coefficient of the image. The processing result of image data transformation is obtained according to the above flow.

2.4 Realize Data Coding of Double-Sided Woven Pattern Image

Through the above description of the algorithm principle, take an 8 bit byte to record the run, the first bit of the byte as the inter frame and intra frame flag bit, and take a piece of Tujia brocade double-sided woven pattern image area for analysis; Keep two screen images in memory. When encoding, scan the pixels at the same position of the previous frame while scanning the current frame image, and count the number of the same pixels in the current frame image frame n_1 The number of pixels that are the same as the current frame and the previous frame n_2. When coding, if n_1 value greater than n_2, record n_1 and pixel values, if n_1 the value is less than n_2 only record n_2, because another buffer has saved the pixel data value of the previous frame, and the pixel value of the current frame is the same as the pixel value at the same position of the previous frame. To speed up, a byte record is used n_1 and n_2, in order to distinguish between encoded data streams n_1 and n_2, make n_1 and n_2 different data ranges in one byte, such as n_1 occupy 0–127, n_2 after the value is increased by 128, it will occupy 128–255.The final result of Tujia brocade double-sided woven pattern image data coding is:

$$f_{\text{code}}(x, y) = \kappa_{\text{code}} f(x, y) \tag{16}$$

In Formula 16 κ_{code} is the image data coding coefficient, which is determined by RLE algorithm. According to the above process, the data encoding result of double-sided braided pattern image is obtained.

3 Experimental Analysis of Coding Performance Test

In order to test the coding performance of the RLE algorithm based image data coding method for Tujia brocade double-sided woven patterns, the performance test experiment is designed by means of comparative testing. This experiment tests the coding quality and coding efficiency of Tujia brocade double-sided woven pattern image data. The contrast methods set in the experiment are reference [2] image coding method and reference [3] image coding method. To ensure the uniqueness of experimental variables, the optimization design method is the same as the coding object of the contrast method. And run in the same experimental environment.

3.1 Build Image Data Coding Performance Test Environment

This experiment selects MATLAB software as the development tool of the experiment. MATLAB software has powerful numerical calculation and data analysis capabilities. At the same time, MATLAB software can also be integrated with image processing technology and programming technology to solve scientific and practical engineering problems. MATLAB software also provides solutions to other professional problems, such as text and voice processing, symbol calculation, visual modeling, engineering and circuit simulation. MATLAB software mainly consists of two main parts: core function part and toolbox. The disciplinary toolbox mainly consists of professional tools such as signal processing toolbox and control toolbox. The functional toolbox is used to complete the functions of simulation, modeling and extended symbolic operations. The

7.0 version of MATLAB software is used in the performance test experiment. Compared with the older version, MATLAB 7.0 has made a greater degree of upgrading in the programming development environment, data processing, numerical operation and I/O interface. It mainly includes redefining the desktop environment, enhancing the functions of array editor and workspace browser, and adding the M-Lint code analysis function. In MATLAB7.0, users can define desktop windows and shortcut keys according to their own requirements, so that they can access and manage the document interface more conveniently. The directory browser adds coverage analysis tools, code efficiency analysis and M-Lint code analysis tools. M-Lint code analysis tool can help programmers complete the analysis of program efficiency, redundancy and other parameters, so as to effectively improve the efficiency of program execution. Install MATLAB7.0 software in the main test computer, and debug relevant functions.

3.2 Preparation of Double-Sided Woven Pattern Image Samples

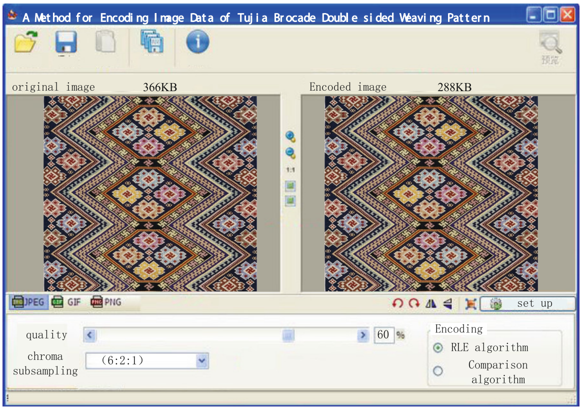
This time, several double-sided woven patterns of Tujia brocade were taken as the research object, and Nikon D50 digital SLR camera was used to collect image samples of double-sided woven patterns of Tujia brocade. The sensitive element of the camera is CCD, the sensor size is about 24 * 16 mm, the total number of pixels is 610 pixels, and the resolution can reach more than 2000 dpi. Place the double-sided woven pattern of Tujia brocade at a place with sufficient light, set the camera focus and other image acquisition parameters, and obtain the preparation results of the double-sided woven pattern image samples. Figure 6 shows the preparation of some samples of Tujia brocade double-sided woven pattern images.

Fig. 6. Image sample of Tujia brocade double-sided woven pattern

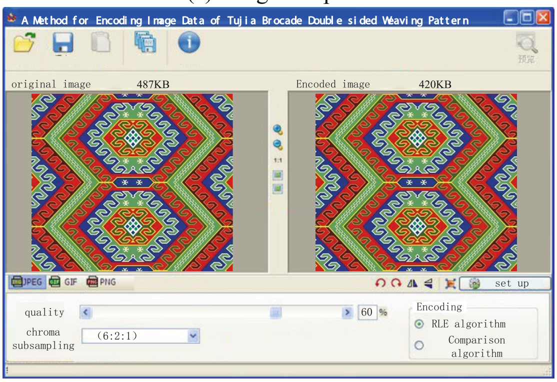
Before the experiment, the image sample size was unified by image clipping, geometric transformation, etc. In order to ensure the credibility of the experimental results, the number of Tujia brocade double-sided woven pattern image samples prepared for this experiment is 150.

3.3 Describe the Experimental Process of Coding Performance Test

The RLE algorithm based image data coding method of Tujia brocade double-sided woven pattern is converted into computer code that can be run directly by using programming tools to realize the development of optimization design coding method. Input the prepared double-sided braided pattern image samples into the image data encoding program one by one to obtain the corresponding encoding results. Figure 7 shows the coding results of some Tujia brocade double-sided woven pattern image samples.



(a) Image sample 1



(b) Image sample 2

Fig. 7. Image coding results of Tujia brocade double-sided woven patterns

In the same way, the coding processing results of all image data samples in the experiment can be obtained. According to the above method, the development of two contrast encoding methods is realized, and the image samples are input into them to obtain the image data encoding results of the contrast method.

3.4 Setting Image Data Coding Performance Test Indicators

According to the purpose of the experiment, the test is carried out from two aspects: coding effect and operation efficiency. The test indicators set in the coding effect part are the peak signal to noise ratio and compression ratio, where the numerical results of the peak signal to noise ratio indicator are:

$$\varepsilon = 10\lg\left(\frac{G_{\max} \cdot MN}{\sum_{x=1}^{M}\sum_{y=1}^{N}\left[f(x, y) - f_{\text{code}}(x, y)\right]^2}\right) \tag{17}$$

Where parameters $G_{\max}$ is the maximum grayscale value of the image, M and N the length and width of the image respectively, and the peak signal to noise ratio are commonly used as the measurement method of signal reconstruction quality in image compression and other fields. The test result of compression ratio index is:

$$\sigma = \frac{\gamma(f(x, y))}{\gamma(f_{\text{code}}(x, y))} \tag{18}$$

Variables in Eq. 18 $\gamma(f(x, y))$ and $\gamma(f_{\text{code}}(x, y))$ is the data amount of the original image and the compressed image respectively. The higher the peak signal to noise ratio and compression ratio, the better the coding quality of the corresponding method. In addition, the test index of image data coding method operation efficiency is coding efficiency, and the test result is:

$$\eta = \frac{H(f(x, y))}{\overline{L}} \times 100\% \tag{19}$$

Among $H(f(x, y))$ is the information source entropy of the image, $\overline{L}$ is the average code length of image compression data, variable $\overline{L}$ the calculation formula of is as follows:

$$\overline{L} = \frac{\gamma(f_{\text{code}}(x, y))}{MN} \tag{20}$$

The coding efficiency reflects the closeness between the average code length after data compression and the source entropy η When it is equal to 1, it indicates that this compression algorithm is the best coding algorithm that reaches the theoretical limit and completely eliminates redundant information in image data. If the data of the same image is encoded with different encoding methods, the higher the efficiency of the algorithm, the better the algorithm selected.

3.5 Experimental Results and Analysis of Coding Performance Test

Count the maximum gray value data in the coding results of Tujia brocade double-sided woven pattern image, and obtain the test results of peak signal to noise ratio index through the calculation of Formula 17, as shown in Fig. 8.

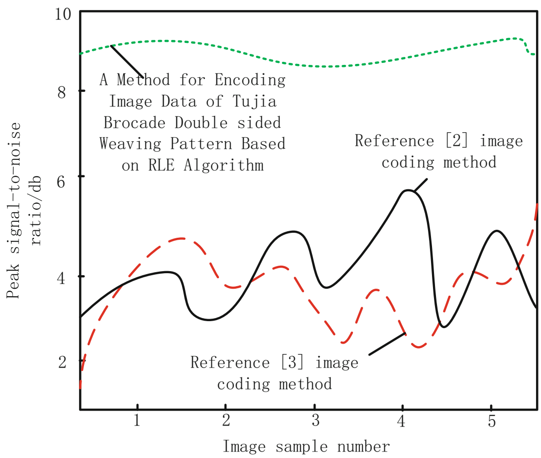


Fig. 8. Peak Signal to Noise Ratio Test Results of Image Data Coding

It can be seen intuitively from Fig. 8 that compared with the two comparison methods, the peak signal to noise ratio of the optimized design method is significantly improved by about 5.7 db. This is because this paper realizes the preprocessing of the pattern image through filtering, image enhancement, and illumination compensation, and removes most of the noise. The test results of compression ratio index are shown in Table 1.

Table 1. Test Data of Image Compression Ratio Index

Image sample number	Amount of original image data/KB	Image data amount/KB obtained by reference [2] image coding method	Image data amount/KB obtained by reference [3] image coding method	Tujia brocade double-sided woven pattern image data encoding method based on RLE algorithm
1	366	351	347	288
2	487	482	475	420
3	505	500	496	415
4	389	384	379	304
5	510	501	498	412
6	495	487	480	424
7	396	389	382	304
8	518	512	508	399

By substituting the data in Table 1 into Formula 18, the average image compression ratio of the two comparison methods is 1.02 and 1.03 respectively, while the average compression ratio of the optimized RLE algorithm based Tujia brocade double-sided woven pattern image data coding method is 1.24. This is because this paper innovatively applies RLE algorithm to eliminate redundant information, complete the image data transformation, and realize the high compression code of double-sided pattern of Tujia brocade. In addition, through the calculation of Formula 19, we can get the test results of the operation efficiency of the image data encoding method, as shown in Fig. 9.

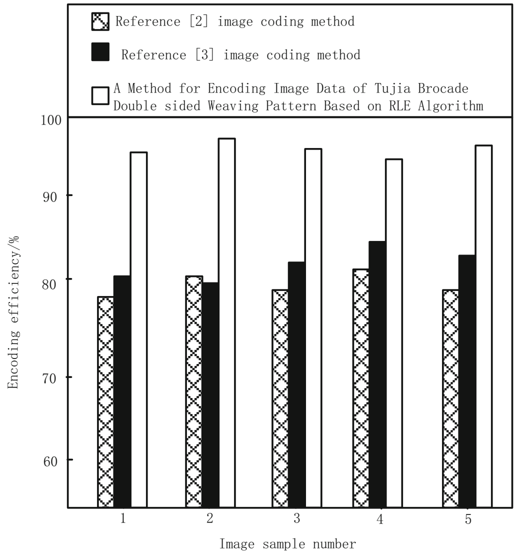


Fig. 9. Test Results of Operation Efficiency of Image Data Coding Method

The average coding efficiency of the two comparison methods is 78.4% and 80.2% respectively, and the average coding efficiency of the optimal design method is 95.5%. In conclusion, the optimization design method has obvious advantages in coding effect and operation efficiency. This is because this paper innovatively applies RLE algorithm to eliminate redundant information and improves the image data coding efficiency of double-sided pattern of Tujia brocade.

4 Conclusion

Tujia brocade double-sided woven pattern is the product of Chinese history, and has high application value. This paper innovatively uses the RLE algorithm to encode the Tujia brocade double-sided pattern image data, which effectively solves the problems of large space occupation and high distortion rate. From the experimental results, it can be seen that the optimization design method has high application value. In addition to the double-sided woven patterns of Tujia brocade, the optimization design method can also be applied to other complex image compression and coding work, providing auxiliary tools for image processing. However, due to the limited conditions, the basic coding data of this method is limited, and the coding patterns are not rich enough. The future research will improve the pattern range and improve the coding effect.

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