Research on Automatic Color Enhancement Method of Interior Wall Drawing Pattern Based on Sparse Representation Assisted by Matlab Software

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Abstract. There are many ways to express art. Everyone has different views on the understanding of any kind of art form. As a new form of art combining personalized expression and typical design, the art of wall painting plays a positive role in the progress of interior design in recent years. Its wide use can be seen in the degree of people's love for this way of expression. Moreover, with the continuous prosperity of computer Matlab simulation technology, the research of color automatic enhancement scheme based on sparse representation pattern has become a new situation of art evaluation and appreciation of interior wall painting\textsuperscript{[1]}.  

Keywords: MATLAB, Sparse Representation, Wall Painting, Pattern Enhancement

1. Introduction
In recent years, with the popularization of the concept of visual culture and personalized design, people more and more like to pursue the artistic independence of individual space. People also hope to be able to enhance their own personal space of cultural taste and unique artistic atmosphere. From the level of artistic expression, interior wall painting as a way to beautify the room can be personalized, it not only meets the spiritual needs of people. It can also meet people's psychological aesthetic needs. This kind of artistic expression also caters to the spread of personalized decoration concept\textsuperscript{[2]}. It also paves the way for the computer aided pattern enhancement technology.

When it comes to the simulation skills of MATLAB, people prefer to use academic language to evaluate the computer simulation system. However, it is this kind of academic simulation that can help us enhance the color of real and beautiful patterns. We know that patterns are one of the main ways for human beings to obtain information about the system. It's used in about 70 percent of the population. The better the image quality, the better the information it can convey to people is more quality and accurate. Interior wall painting is a kind of technology to convey information of patterns. The combination of computer matlab technology and wall painting technology can show the meaning of wall painting patterns more deeply and touching.

2. Sparse representation of color image based on interior wall painting

2.1. The relationship between color images and human senses
Everyone's visual perception of different color images and the category of technical appreciation are very different. In theory, in the process of image processing, color description will rely more on people's subjective understanding and evaluation of color. At the same time, people's perception of color and the difference of space distance are also closely related. Color images can stimulate the excitement of human senses. This is one of the reasons why people like interior wall painting.

2.2. Pattern enhancement of color image
The processing of pattern enhancement usually includes two algorithms. They are divided into two parts: spatial domain and frequency domain. In the spatial image enhancement processing means, histogram equalization algorithm can enhance the global contrast of the image. Histogram can be obtained by MATLAB algorithm. The image enhancement in frequency domain can express the information of color drawing completely through the clarity of local area (see Figure 1).

2.3. Sparse representation of color image
The so-called sparse representation of image refers to that people can clearly understand the specific information of image expression through some simple pattern description[3]. Generally speaking, people usually use sparse representation of patterns to report and preprocess information. In the process of color enhancement of wall painting, sparse representation can also play an important role.

3. The establishment of sparse representation algorithm of wall drawing pattern based on computer

3.1. Basic steps
We can use a color analysis model based on people's perception of color for model space conversion. In the computer system only, the computer can classify and compare the colors in the color image according to different color types. After the original color image is converted to the lab color model space, we can convert the image space into different units. We can even get the conceptual formula of component calculation.

\[
f(t) = t^{1/3} (t > 0.008856) \quad (1)
\]
\[
f(t) = 7.787t + 16/116(t \leq 0.008856) \quad (2)
\]

3.2. The change of DCT of image
After the original wall drawing image is transformed by DCT, we can get the DCT coefficients directly related to the content of the image. Generally speaking, the number of DCT coefficients is relatively small. However, through the demonstration of these coefficients, we can quickly reconstruct
and simulate the computer image. When simulating, we can use MATLAB software for auxiliary operation.

### 3.3. Sparse representation of patterns

The distribution of DCT functions described above can determine the content of the sparse algorithm representation. The synthesis of the algorithm of this process is as follows:

\[
\begin{align*}
\text{RGBToXYZ}(X, Y, Z, R, G, B, w, h) \\
\text{XYZToLab}(L, a, b, X, Y, Z, X_0, Y_0, Z_0) \\
L_{\text{coe}} &= \text{dct2D}(L, N) \\
a_{\text{coe}} &= \text{dct2D}(a, N) \\
b_{\text{coe}} &= \text{dct2D}(b, N)
\end{align*}
\]  

When the image space changes from RGB color to lab space color, we can see that the space component of lab can represent the real brightness information of the original image.

### 3.4. Representation of DCT coefficients

Through the calculation of the above formula, we can see the distribution of DCT coefficients and the expression of coefficients through the computer image\(^4\). We can also see that there are few non-zero coefficients above smooth areas and slow non-zero functions above areas with more textures on different components. However, in areas of the same color, there is little change in the amplitude of the region. In the texture region, the chromaticity component will lose a lot of texture details compared with the luminance component, and there will be almost no non-zero coefficients above. Finally, we can find that the sparsity of DCT coefficients in chroma component is the best compared with the component with clear brightness (see Table 1).

### Table 1. The establishment of sparse representation algorithm of wall drawing pattern.

| Algorithm steps                          | Mathematical expression                  |
|-----------------------------------------|-----------------------------------------|
| Preparation in advance                  | Component calculation of image           |
| DCT transform                           | Image reconstruction                    |
| Sparse representation of image          | Representation of brightness information in lab space |
| Coefficient representation of DCT       | Coefficient representation of components based on chromaticity |

### 4. The steps of automatic color enhancement of interior wall drawing pattern based on sparse representation assisted by MATLAB software

#### 4.1. Transformation of DCT transformation in two dimensional space based on MATLAB

For the matrix module of DCT coefficient image, we can use MATLAB software to set the calculation formula of binary transformation as follows:

\[
F(u, v) = \frac{2}{N} \sum_{x=0}^{N-1} \sum_{y=0}^{N-1} f(x, y) \times \cos\left(\frac{\pi}{2N} (2x + 1)u\right) \times \cos\left(\frac{\pi}{2N} (2y + 1)v\right)
\]  

In the original image after mathematical transformation, most of the signal components in the pattern will be distributed in the high frequency region. Therefore, through the inverse transformation of these coefficients and the reconstruction of the system, we can make a new image similar to the original image. The advantage of this method is that it can copy the low frequency area of the wall painting pattern. In this way, we can enhance the color clarity of the wall painting patterns.
4.2. Noise suppression in the process of pattern enhancement

Because of the noise and texture information often exist in the high frequency regions of the coefficient image, the coefficient value of these regions will be reduced. At the same time of texture enhancement, the noise will be infinitely amplified. This is a bad phenomenon. If the pattern is processed in this way, the corresponding edge effect will appear. Therefore, in order to avoid the appearance of edge effect, we need to restrain the influence of noise. We can use threshold as the main definition of noise recognition. Its definition is as follows:

\[ T = \Delta \times \sqrt{2\log N} \]  

The inverse transformation formula of DCT is

\[ \tilde{f}(u, v) = \sum_{x=0}^{N-1} \sum_{y=0}^{N-1} f(x, y) \times \cos \left( \frac{\pi \times (2x + 1) u}{2N} \right) \times \cos \left( \frac{\pi \times (2y + 1) v}{2N} \right) \]  

4.3. The use of MATLAB software function and the corresponding code writing

We know that the functions of computer simulation software are various. Matlab software is a mathematical modeling software that many people like to use. It is used on the condition that the mathematical expression needs to be found artificially. People input the expression into the software, matlab will automatically analyze the mathematical aspects of the problem. For this wall painting color enhancement method, we can use the following pseudo code.

\[ \text{Im} \ gDCT = \text{dct2}(\text{Im} \ g, N) \]
\[ T = \text{CalThreshold} \]
\[ \text{Im} \ g\_out = \text{idct2}(\text{Im} \ g\_Buffer, N) \]  

5. Importance of research on color enhancement method of interior wall painting based on sparse representation assisted by MATLAB software

5.1. It can help us understand the computer MATLAB software

At present, many people will not use computer simulation software to deal with problems. For MATLAB software, it can analyze all kinds of calculation problems related to mathematical formulas through mathematical methods. However, it is difficult to use MATLAB software. According to the wall painting color enhancement experiment, we can take advantage of this opportunity to learn more about the use of MATLAB software[5].

5.2. It can enhance people's appreciation of wall painting art

The art of interior wall painting has always been a difficult topic for people to understand. Many people regard wall painting as a high-end art variety. This leads to many people do not dare or do not want to accept it and appreciate it. Through the subject of this paper, we can enhance people's appreciation of wall painting art.

6. Conclusion

Through the extensive use of wall painting, we can see its market value and artistic value. It gives our society the progressive role of art is undeniable[6]. The method of automatic color enhancement can enhance the clarity and appreciation of wall painting. Therefore, I think it is necessary to study the color automatic enhancement method of interior wall drawing pattern based on sparse representation assisted by MATLAB software.

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