

## Research Article

# Fast Decomposition Algorithm Based on Two-Dimensional Wavelet Transform for Image Processing of Graphic Design

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Graphic design is an important part of the design field today. In this era of information explosion, designs that can deliver information faster and more accurately are bound to gain popularity among the public. In this paper, we propose a fast decomposition algorithm image processing method based on a new transform of the wavelet transform, which mainly addresses the problems of large computation of feature points and long-time consumption of traditional image processing algorithms. Firstly, the second-order decomposition of the image is performed by wavelet function to obtain the low-frequency components of the image, and the wavelet gradient vector is used to extract feature points from the overlapping regions of the low-frequency image so that the transformation parameters of feature points can be obtained quickly under the low-frequency image to guide the feature point extraction under the high-frequency image; on this basis, an improved algorithm of image processing based on the fast decomposition algorithm of two-dimensional wavelet transform with planar design is proposed. Using the properties of one-way matching and directional consistency of feature point constraints, the mismatched point pairs are effectively eliminated to improve the feature point matching accuracy and real-time performance. Finally, the effectiveness and feasibility of the proposed method are verified by two sets of experiments.

## 1. Introduction

Image processing methods refer to the use of various image alignment algorithms and image fusion algorithms to stitch multiple images with overlapping regions into a single wide-field, seamless, high-resolution image or dynamic panoramic image. Currently, image processing methods are widely used in graphic design, drone surveillance, and search, virtual reality, space exploration, satellite remote sensing, and medical and military fields. And graphic design is an important part of modern design, and graphic design innovation is the eternal topic of its development research. Because graphic design has unique advantages in aesthetics and information transmission that are incomparable to other forms, modern graphic design is widely used in the field of commercial advertising [1]. This horizontal crossover has created a complementarity in the development of graphic design and commercial advertising,

and whenever there is a breakthrough in the development of one side, it always results in a huge innovation on both sides.

In the process of research on image processing, wavelet transform is a feature and hot spot of research in the field of image processing in recent years, as an effective multiresolution image processing tool with good time-frequency localization characteristics, which has a profound impact on the research of image filtering, image compression, and data fusion. In the process of image acquisition as we know, due to the preparation used is not very perfect, as well as the influence of inconsistent external light intensity, there will be a situation where the image quality of the general film is reduced. Wavelet transform algorithm analysis is in the time domain, and frequency domain at the same time has a good localization nature in addition and has multiresolution analysis characteristics, so it can effectively distinguish the signal from the noise to form the necessary tools for image analysis and thus more able to carry

out better image processing. Image processing technology for graphic design based on the fast decomposition algorithm of 2D wavelet transform is one of the most rapidly developing technologies in recent years. The extensive development of related technologies represented by image processing technology has led to a radical change in the way the public receives information. The various media platforms relying on new media technology have expanded the way of graphic design presentation. Under the new media platform, graphic design works are required to contain more information and enhance the functionality of the works; at the same time, the rich changes make the audience have more emotions and appreciation pleasure and enhance the aesthetics of the works. This series of changes has not only changed the quality of graphic design presentation and the quantity of information but also made it inevitable for graphic design, which used to be static, to develop dynamically [2].

And information is the invisible but most precious resource in today's era. In the process of applying art and design to practice, the design work carrying the function of information transmission is the final manifestation of the combination of information, art, design, and technology. The emergence of fast decomposition algorithms based on two-dimensional wavelet transform can make the image processing better, as well as let designers design better works [3]. In the process of information "explosion," the development of new media brings infinite possibilities for the full integration of art, design, and technology and has an impact on the way of life of the public. The advancement of new media is constantly changing the way the public accesses design and receives information, thus creating a demand for a change in design, while the advent of the new media era has also given the graphic design a new medium of communication.

## 2. Related Work

Many scholars have also conducted a lot of research on this technique and achieved fruitful results. The literature proposes the scale-invariant feature transformation algorithm, which can effectively extract image feature points, but the algorithm generates feature descriptors with high dimensionality, thus affecting the real-time performance of image matching [4]. The literature proposes an accelerated robust feature algorithm, which determines the candidate points by using a matrix with a nonextreme suppression strategy, which both compensates for the shortcomings of the previous algorithms and effectively ensures stability under image scale and affine transformation.

On this basis, the literature proposes a fast region center-of-mass image alignment algorithm for the problem of complicated operations with the traditional normalized correlation image alignment method, which searches for the best matching point instead of the usual upper-left corner point position of the image, and the algorithm also improves the real-time image matching. To further improve the image alignment speed, the literature proposes a novel optimized fast decomposition algorithm image fast alignment method based on 2D wavelet transform by using image downsampling preprocessing method to effectively reduce the number of feature points

and using image overlap region extreme value feature extraction method to improve the feature point matching rate. The literature uses an improved detection algorithm to extract scale-invariant corner points, uses the operator idea to precisely locate the corner points, and uses a fast decomposition algorithm based on the two-dimensional wavelet transform to describe the operator pair corner points to achieve fast and stable image matching. The literature, on the other hand, proposes an algorithm that utilizes the transformation relationship within a multiplexed image sequence to complete temporal alignment by extracting time-dependent common features in multiplexed images and using an improved singular value decomposition method to determine the similarity of the common features. The literature proposes a fast decomposition algorithm based on improved wavelet transform based on 2D wavelet transform feature image alignment algorithm [5], which preprocesses the baseline and subsequent images by multiresolution wavelet decomposition, and then uses a fast decomposition algorithm based on a 2D wavelet transform algorithm to extract feature points of low-frequency components of images containing a large amount of information and further uses a fast decomposition algorithm and a fast decomposition algorithm to examine and search feature point pairs. The literature proposes a fast decomposition algorithm based on wavelet transform for image matching, by using fast decomposition algorithm and scale limitation processing for coarse matching and fine matching of image feature points, respectively, and using sample statistics method to eliminate the false matching, which effectively improves the problem of high false matching rate of traditional fast decomposition algorithm.

Based on the extensive previous work, the concept of multiresolution analysis is being proposed. With high resolution, the closer the distance is relative, the more accurately the features of the scene can be reflected by the information obtained. The literature, in conducting the theoretical analysis of multiresolution wavelet transform and its application in image processing, is inspired by the tower algorithm and proposes a fast algorithm for tower multiresolution analysis and reconstruction of signals, which is called the Marat algorithm. The literature proposes the lifting framework to construct wavelet filters, and as a result, an integer-based transform is investigated which establishes a one-to-one correspondence between the integer sequence and the integer wavelet coefficients and enables the corresponding inverse transform, which is known as the lifting wavelet transform [6].

## 3. Image Preprocessing and Feature Point Extraction and Matching

The flow of the new SURF image stitching method based on wavelet transform mainly consists of three parts: (1) image preprocessing based on wavelet function, wavelet decomposition of the image to be aligned to obtain low-frequency images; (2) feature point extraction by fast decomposition algorithm based on 2D wavelet transform, feature point extraction by wavelet gradient vector for the overlapping region of low-frequency images, so as to achieve (2) fast decomposition algorithm based on 2D wavelet transform for feature point

extraction [7], which extracts feature points from the overlapping regions of low-frequency images by means of wavelet gradient vectors, so as to quickly obtain the transform parameters of feature points in low-frequency images to guide feature point extraction in high-frequency images; (3) fast decomposition algorithm based on 2D wavelet transform for feature point matching, which effectively eliminates mismatched point pairs by using the properties of one-way matching and directional consistency of feature point constraints, so as to improve feature point matching accuracy and real time. The application of image processing technology in graphic design is the most widely used among some graphic designers. It can better design and create for these designers and provide better image processing technology.

**3.1. Image Preprocessing Based on 2D Wavelet Transform.** The high-frequency components in the image contain noise influence, using wavelet transform for multilayer decomposition can effectively remove the high-frequency components, and the more layers of wavelet decomposition go the better the image processing effect [8]. Therefore, this paper will choose to decompose the image to be aligned based on the two-dimensional wavelet transform for preprocessing the decomposed image. Considering that the matching feature points in the decomposed low-frequency image will be reduced, if the image is decomposed by wavelet multilayer decomposition and then matched may lead to too few matching feature points to meet the normal matching demand, or even multilayer decomposition in multiple matching will instead increase the matching time, this paper will use two-dimensional wavelet decomposition method for image preprocessing and then extract matching feature points from the low-frequency components.

The function based on the two-dimensional wavelet transform is one of the simplest and earliest used orthogonal wavelet basis functions possessing tight support, which is formulated as follows.

$$\mu_X = \lim_{n \rightarrow \infty} \frac{1}{n} \sum_{i=1}^n X_i Y_i \left( \frac{F - \mu}{\sigma} \right). \quad (1)$$

This formula plays an important role in this article. It can play a good role in the fast decomposition algorithm based on two-dimensional wavelet changes and provides a sufficient theoretical basis for the algorithm in this article. This formula can draw better details in image drawing and can be more conducive to graphic design, so this formula is the more important formula in this article. The two-dimensional wavelet decomposition of the image  $f(x, y)$  to be aligned is performed by the function of the two-dimensional wavelet transform, and firstly, the  $x$ -direction of the image function  $f(x, y)$  to be aligned is analyzed by  $H(x)$  and  $F(x)$ , respectively, to decompose  $f(x, y)$  into two parts of low and high frequencies, and a similar analysis is done along the  $y$ -direction on this basis. The image  $f(x, y)$  to be aligned is processed by  $H(x)$  and  $F(y)$  to obtain the image LL after the first layer wavelet decomposition, and the remaining three images obtained are LH, HL, and HH, and then, do the same processing as above for LL

shown in Figure 1 to obtain the image LL1 after the 2nd layer wavelet decomposition of the image  $f(x, y)$  to be aligned [9].

**3.2. Fast Decomposition Algorithm Based on 2D Wavelet Transform for Feature Point Extraction.** The feature points of the image are distributed on different scale ranges, to solve the problem of detecting the scale invariance of the feature points, and the fast decomposition algorithm based on two-dimensional wavelet transform uses Gaussian function to construct linear scale space, but the linear scale space has problems such as blurring the image contour when detecting the feature points, the wavelet function has the advantages of selection flexibility [10] and tight support relative to the Gaussian function, and it is possible in the wavelet to transform process to better retain image features with different scales, so from the perspective of the multiscale performance of the wavelet transform, the scale and rotation invariant image feature points are extracted using the wavelet gradient vector. The obtained image LL1 of the 2nd layer wavelet decomposition of the image  $f(x, y)$  to be aligned is noted as image  $g(x, y)$ , and its image alignment process is shown in Figure 2.

The algorithm is to use the image  $g(x, y)$  through the 2D wavelet transform on the image overlap region for feature point extraction, that is, through the principle of wavelet mode maxima to extract the feature points of the image. According to the definition of two-dimensional wavelet function can be known as  $t(x, y)$  for 2D smooth function, consider the image contains the influence of high-frequency factors [11], directly seek the inflection point of the smooth function  $t(x, y)$  is more complex, so seek its first-order derivative of the mode of the maximum value. The formulas are, respectively,

$$G(x) = \lim_{n \rightarrow \infty} \frac{1}{n} \sum_{i=1}^n X_i \left( \frac{1}{n} y_x \right). \quad (2)$$

Then, at scale  $2^j$ , when the functions  $H(x, y)$  and  $F(x, y)$  satisfy the conditions of the two-dimensional wavelet transform, the wavelet mother functions are obtained as

$$F(x) = \lim_{n \rightarrow \infty} \frac{1}{n} \sum_{i=1}^n X_i \Omega_{vv}. \quad (3)$$

Then, in convolution of equations, the image function  $g(x, y)$  at scale  $2^j$  yields a two-dimensional wavelet transform of an image  $g(x, y)$  as

$$W(x) = \frac{dy}{dx} \lim_{n \rightarrow \infty} \frac{1}{n} \sum_{i=1}^n (X_i - \bar{X})^2. \quad (4)$$

Then, the feature point extraction steps are as follows: the mode and angle of the binary wavelet transform of the image  $g(x, y)$  at scale  $2^j$  are

$$F(x, y) = \lim_{n \rightarrow \infty} \frac{1}{n} \sum_{i=1}^n (X_i - \bar{X})^2 \left( \frac{x - \mu}{\sigma} \right). \quad (5)$$

According to the wavelet gradient vector for local

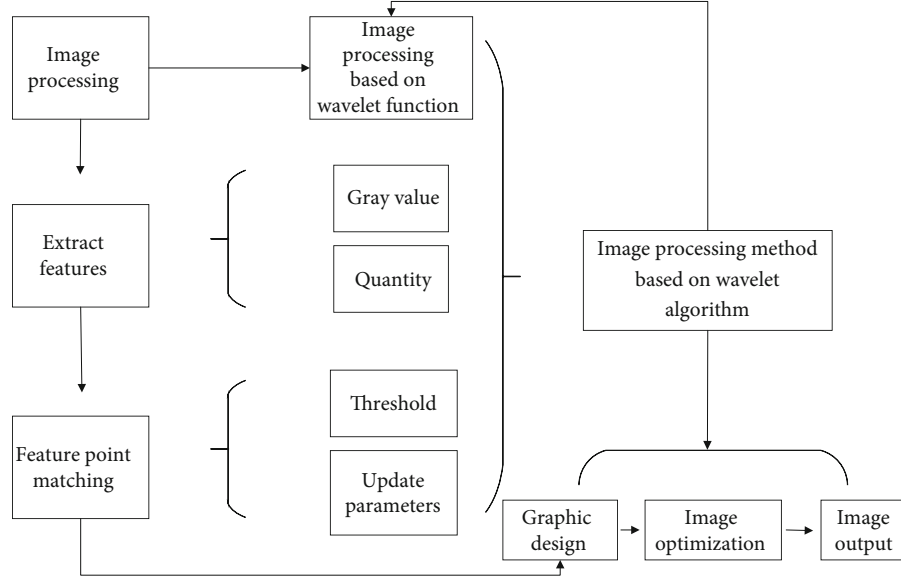


FIGURE 1: Improved algorithm flow.

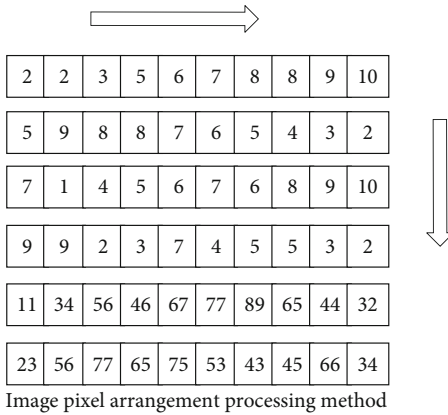


FIGURE 2: Image pixel arrangement processing method.

nonextreme value suppression, it is to compare the gradient value with the surrounding 8 points, only the current point has the largest gradient value, then the point is a pending feature point; otherwise, the point is eliminated from the feature detection algorithm, if the gray value of the pending feature point is greater than the set threshold  $\lambda$  is called a candidate feature point; otherwise, the point with a gray value less than the threshold  $\lambda$  is eliminated. If the number of candidate feature points exceeds the set threshold  $\mu$ , the larger the gray value of the candidate feature point is selected as the image feature point, and if the number of candidate feature points is lower than the set threshold  $\mu$ , the candidate feature is the image feature point [12]. If the number of candidate feature points is lower than the set threshold  $\mu$ , the candidate features are image feature points. Figure 3 shows the main process of image feature extraction.

**3.3. Fast Decomposition Algorithm Based on 2D Wavelet Transform for Feature Point Matching.** In the process of feature point matching, to improve the accuracy of image

feature point matching, this paper adopts the improved feature point matching algorithm based on the fast decomposition algorithm of the two-dimensional wavelet transform and determines the corresponding matching relationship between the feature points of the image to be matched by the combination of one-way and directional constraint alignment method. Firstly, the one-way matching is performed on the image with matching [13], "feature points." The matching accuracy of matching is 95%, and then, the difference of the direction of the feature vector between each matched point pair is calculated, and the feature point matching is considered successful when the difference is within a certain threshold; otherwise, the other mismatched point pairs are rejected to improve the accuracy of the image feature point matching. The specific implementation process is as follows:

- (1) Calculate the difference between the principal directions of the feature vectors for each matching point pair, which is given by

$$H = \frac{\partial^2 \Omega}{\partial u \partial v} \cdot \frac{\delta y}{\delta x}. \quad (6)$$

- (2) The difference of all matched point pairs is counted to generate a histogram, with  $10^\circ$  as 1 column and 36 columns in total. The formula is

$$D(x) = x \cdot \frac{1}{n} \sum_{i=1}^n X_i \left( \frac{\delta y \Delta y}{\delta x \Delta x} \right). \quad (7)$$

- (3) Find the angle corresponding to the peak in the histogram as the standard deviation of the successful

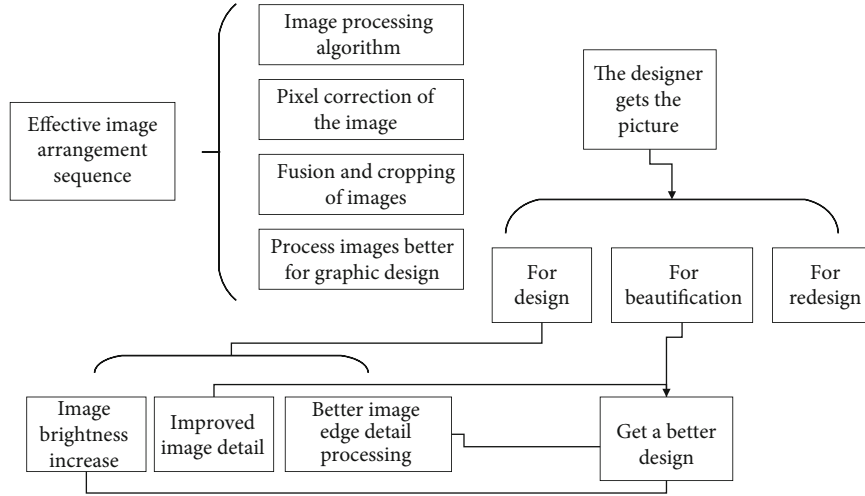


FIGURE 3: Steps for extracting image specific diagnosis.

matching pairs, keeping the matching pairs within  $10^\circ$  of the peak and eliminating the other matching pairs

Influenced by different factors, there are many types of design image noise, and environmental noise and reverberation noise are the main factors that interfere with the correct interpretation of design image information. From the design image noise analysis, it is known that the ambient noise is an additive noise, and the reverberation noise is a scattered noise distributed in the background region, which is a multiplicative noise that approximately obeys the Rayleigh distribution. Therefore, the filtering method of the design image should be able to filter out both multiplicative and additive noise. The traditional BM3D filtering method is more suitable for handling additive noise with Gaussian distribution. If the traditional BM3D filtering method is directly applied to the design image, it can filter the ambient noise well, but it cannot play an optimal role in filtering the reverberation noise. The formula is

$$G(x) = \frac{dy}{dx} \cdot \frac{1}{n} \cdot \frac{x - \mu}{\sigma} \quad (8)$$

To better filter the reverberant noise, the image needs to be transformed in some way to change the distribution characteristics of the reverberant noise, but this in turn will affect the distribution characteristics of the ambient noise. The edges and noise of a design image are mostly concentrated in the high-frequency part of the image, and reasonable processing of high-frequency information can achieve the filtering effect without losing the overall contour information of the image and improve the quality of subsequent image segmentation. The image is decomposed by a layer of wavelets to generate a low-frequency component (low-frequency subband) and three high-frequency components (high-frequency subband) with horizontal, vertical, and diagonal directions, respectively [14].

#### 4. Application of Image Processing Techniques in Graphic Design

The development of computer technology has led to the wide application of image processing technology. The image processing technology is an effective combination of computer technology and painting, which provides a digital creation method for graphic design, and can obtain a creation with a high degree of similarity to the graphic designer's hand-drawn work in a relatively short period, and image processing technology provides image modification, refinement, and storage functions for graphic design, which can effectively improve the brightness [15], color balance, and other effects of graphic design works. There are many methods to apply image processing technology in graphic design, but the pencil drawing generation method described in the literature to improve the natural image graphic design overly pursues the similarity with the pencil drawing of graphic design, and there are more breakpoints in the lines, which lead to a large gap between the described object and the original image and cannot effectively describe the key features of the image; the image stylized drawing algorithm based on foreground target extraction does not use convolutional lines to simulate the real graphic design. The line is simulated in the way of a pencil drawing of real graphic design, and the obtained pencil line drawing effect is relatively smooth and complete but lacks the real sense of hand-drawing. The fast decomposition algorithm based on two-dimensional wavelet transform can solve the above problems well. The principle formula is as follows:

$$T(x, y) = x \lim_{n \rightarrow \infty} \frac{1}{n} \sum_{i=1}^n (X_i - \bar{X})^2 \left( \frac{\Delta y}{\Delta x} \cdot \Omega_{uv} \right) \quad (9)$$

4.1. *Generating Sketches for Graphic Design.* In graphic design, the principle of using image processing technology to generate pencil drawings of color graphic design is as follows: the conversion function provided by OpenCV software in image



processing technology is used to convert RGB images to YUV images, and the generation of pencil drawings of color graphic design is essentially a transformation of the chromaticity and luminance information contained in the YUV color space and reintegration. The chromaticity information is described by  $U$  and  $V$ , and the luminance information is described by  $Y$ . The luminance information value is used to obtain the new pencil drawing luminance information  $Y'$  of the graphic design, and the completed pencil drawing of the color graphic design is obtained by combining  $Y'$  and  $UV$ . The line is a key component in pencil drawing, which is used to outline and shape the drawing object and emphasize the details of the object. In the real pencil drawing of graphic design, there are line crossings, inflection points, and breakpoints for artificial reasons, which makes the pencil drawing of graphic design more natural and vivid and adopts the way of convoluted lines to simulate the real pencil lines. The principle of getting pencil lines close to the real pencil hand-drawn effect is as follows: when convolving the image gradient map, use a reasonable length of linear convolution kernel to get the ideal pencil hand-drawn lines. The process is as follows.

- (1) The gradient map of the image is obtained using Equation (11)

$$B = \frac{\Delta y}{\Delta x} \cdot \frac{\partial^2 \Omega}{\partial u \partial v} \cdot \frac{\delta y}{\delta x}. \quad (10)$$

- (2) To obtain the orientation of different pixels, the detailed approach is convolution gradient map reduces the noise of the linear direction;  $g_i$  is selected as each linear direction, and convolution  $B$  obtains the corresponding convolution map; when there is a maximum value of the convolution map corresponding to the direction of  $g_i$  on the convolution map of all directions, then  $g_i$  exists in the pixel  $p$ , and  $g_i$  is proved to be the direction of pixel  $p$ . The direction of the pixel is necessarily obtained before the convolution operation is performed on each convolutional map, and the convolution operation ensures that the pixel spreads in the correct direction. The principle formula is as follows:

$$G(x) = \lim_{n \rightarrow \infty} \frac{1}{n} \sum_{i=1}^n X_i \left( \frac{x - \mu}{\sigma} \right). \quad (11)$$

- (3) The design image containing the target can usually be divided into the target bright area, the target dark area, and the design reverberation area. The target bright area is a brighter area generated on the design image when the design is completed by returning a stronger echo; the target dark area is the area that does not generate an echo signal due to the obscura-

tion of the object that makes the design a bit difficult; the area around the target bright area and the target dark area is the submarine reverberation area. The target light and dark areas contain more target information and are the areas where the researcher should focus his analysis. The design image is dominated by low-frequency components, and the clarity usually does not reach the standard of the optical image, and the design image speckle noise is prominent, and the edges are blurred; these characteristics make the optical image segmentation method applied to the design image fails; based on this, the original image obtained from various types of imaging design needs to be filtered and other preprocessing, suppressing the noise while focusing on protecting the target edges [16], laying a foundation for the subsequent image segmentation and interpretation cornerstone

*4.2. Image Processing Techniques for Generating Graphic Designs.* Based on the generation of pencil sketches for graphic design, the pencil drawings for graphic design are beautified using the pencil drawing filter generation technique for graphic design. Based on the study of realistic pencil drawing textures, the following conditions are set in the process of creating pencil drawings for graphic design by using image processing techniques: (1) arbitrary arrangement of ink particles according to the difference of paper roughness; (2) spreading of ink marks in the direction of strokes; (3) arrangement of ink marks at an angle perpendicular to the strokes in alternating light and dark manner, and the mathematical model of the filter is constructed based on the above conditions, Figure 4 shows the mathematical structure in graphic design.

There are two main parts to the process of processing in graphic design species as follows.

- (1) Base estimate, the input image is divided into small blocks of the same size in a certain step, and an image block is selected as the reference block  $R$  in the search region  $Q$ . The similarity degree between the subblocks in the search region and the reference block is measured, and the blocks that meet the similarity index are marked as the similar blocks of the reference block and are arranged and combined into a three-dimensional group according to the similarity degree from large to small, and the three-dimensional group is subjected to a three-dimensional linear transformation (the three-dimensional transformation is a separable combination of the two-dimensional transformation of each block and the one-dimensional transformation of each column of the three-dimensional array) to obtain a sparse representation of the signal. The three-dimensional linear transformation is a separable combination of the two-dimensional transformation of each block and the one-dimensional transformation of each column of the three-dimensional array to obtain a sparse representation of the signal [17], and after the transform domain shrinkage coefficient achieves the initial denoising effect, the estimated value of each group of blocks is returned by the inverse three-dimensional linear transformation,

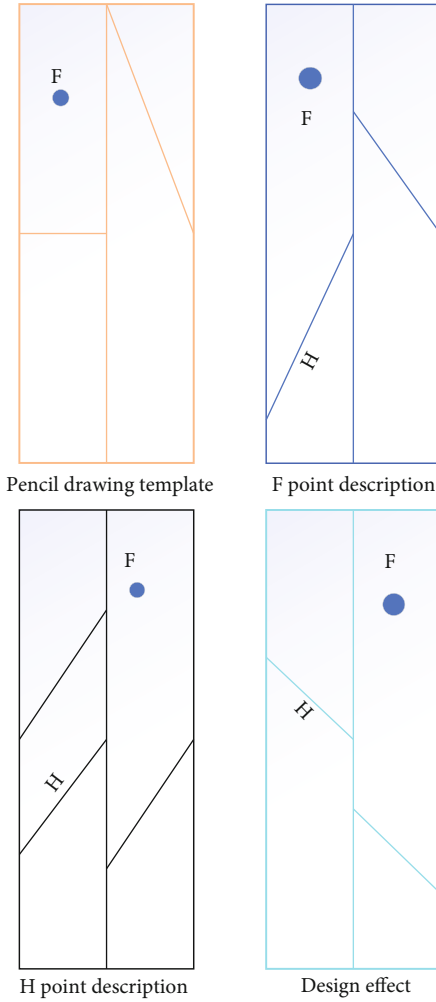


FIGURE 4: Design model in plane.

and the estimated value is returned to the original position of each image block, and finally, considering that the subblock information has overlap, the base estimated image is obtained by weighted average

- (2) Final estimates, the base estimated image is similarly chunked, a reference block  $R$  is defined on the base estimated image in the same way, and a 3D group is determined so that two 3D groups are determined for the noisy image and the base estimated image; a 3D linear transformation is applied on both groups to further filter the noise with the help of empirical wiener filtering; then, the inverse 3D linear transformation obtains the estimates of all grouped blocks and returns them to the initial block position; finally, the final estimate of the true image is calculated by aggregating all the local estimates by weighted average

**4.3. Research on Dynamic Graphic Design Based on Fast Decomposition Algorithm.** The research of dynamic graphic design based on a fast decomposition algorithm is to research a new more designer-oriented algorithm, which can increase

the interactive experience of designers in the process of design. The most powerful support behind the maturity of new media technology is the promotion of digitalization, which is most intuitively reflected in the implementation of graphic design. The digital nature of the new media platform has made the computer the most widely used tool for design production. In the study of dynamic graphic design, it is necessary to consider various types of graphic and multimedia production software and make full use of advanced production technology to realize it and use it as an important way of innovative design production. In the process of traditional graphic design creation, hand-made is the main way of realization, especially before the popularization of printing technology; hand-drawing is almost the only means of creating and reproducing graphic works. Although the hand-drawn method is to a certain extent a better way to show artist's talent and creativity, any negligence may lead to the loss of a nearly completed work due to manual involvement. The principle formula is as follows:

$$F(x) = \frac{\Delta y}{\Delta x} \cdot \frac{\partial^2 \Omega}{\partial v^2} \cdot \frac{\partial^2 \Omega}{\partial u \partial v}. \tag{12}$$

There were considerable difficulties in popularizing the initial graphic design concepts and works. Changes in the implementation of graphic design introduced powerful software into graphic design. In response to the need for dynamic graphic design, graphic design software began to have features built in to implement dynamic effects in the process of constant updating. In response to the increasing demand for dynamic graphic design, not only has graphic software gradually incorporated features to achieve dynamism in its constant updates but multimedia software has also been gradually applied to dynamic graphic design. Motion graphic design, which is aimed at bringing graphic design to life, follows the principles of graphic design and is created through the use of multimedia software previously used in animation or film technology (or other visual media that changes over time). Motion graphic design is an integration of traditional graphic design with timeline, audio, and space [18].

Therefore, multiple software will be involved to implement different modules, the study of dynamic graphic design based on fast decomposition algorithms enables designers to have an interactive experience in the design process, and interaction is one of the frequent ideas in the field of design today. In modern design philosophy, design is different from pure art and is an aesthetic application that serves the final audience. Therefore, focusing on the focus and expectation of the receiver on the design and even the participation of the receiver as one of the design works becomes one of the current design development trends [19]. As an important branch in the field of design, graphic design is one of the important ways and means to realize the dynamism of graphic design by integrating the concept of interaction into it and creating graphic design works with interactive functions. Due to the constraints of technology and means of implementation, most of the traditional graphic design works realized by printing are in a relatively static state, both for the viewers and the works themselves. Although some excellent works will trigger the imagination and thinking of the viewer, it is still difficult to

produce substantial interaction; except for special attention groups (such as peers, designers, and information followers), few people will delve into the content of the picture. Especially in today's information explosion, most of the works are swept through by the public, and the arrival rate of information transmission is very low.

## 5. Experimental Results and Analysis

To derive the superiority of image processing methods based on a fast decomposition algorithm of 2D wavelet transforms for graphic design, experimental comparison among various algorithms of image processing is required to analyze which algorithm is more efficient in image processing. In the preprocessing of the image, the image enhancement, image correction, and image alignment, the result of these steps can generate a complete impact, but the image has some problems [20]; the most serious problem is the alignment process generated by the stitching problem; the brightness difference between the image needs to be aligned, so that the bright and dark transition on both sides of the stitching abrupt; image alignment errors will also make the objects located on both sides of the stitching. These problems are all directions that need to be improved. Figure 5 shows the whole image processing process.

The essence of many applications (such as image processing, filtering, and image compression) is the transform, and the essence of the transform lies in the basis. There are many forms of basis in space, the different basis for different transformations, the choice of basis determines the computational process of the transform, the characteristics of the basis determine the function of the transform, and thus, the application area of the transform, so the choice of basis is very important for the transform. For example, the Fourier transform formula is shown in (12). Its basis is a series of triangular waves, which are carefully selected, and the orthogonality property of the trigonometric basis implies that the inner product of two arbitrary bases is 0. This calculates the transformation coefficients  $a$ ,  $b$  extremely simple, with the following equations.

$$F(x) = A0 + \sum_{n=1}^{\infty} \left[ \frac{\partial^2 \Omega}{\partial n^2} \cdot \frac{\delta y}{\delta x} \right]. \quad (13)$$

*5.1. Experiments on Image Processing Based on Fast Decomposition Algorithm of 2D Wavelet Transform.* Images are often blurred at the edges and contours of the image after certain manipulation processes, for which you can use fast decomposition processing to bring clarity to the image. Fast decomposition processing is used to highlight the detailed information of interest and does not necessarily approximate the original image in terms of the actual viewing effect. Fast decomposition processing algorithms are divided into two main categories, namely, differencing and high-pass filtering. Among them, the differential method belongs to the null domain processing algorithm, suitable for implementation on hardware, commonly used are gradient algorithm and Laplace algorithm and fast decomposition algorithm based on two-dimensional wavelet transform. Their algorithms are formulated as [21].

$$F(x) = \lim_{n \rightarrow \infty} \frac{1}{n} \sum_{i=1}^n (X_i - U)^2. \quad (14)$$

In this section, we will analyze the implementation principles separately, compare and evaluate them based on the simulated image processing results, and finally, select the algorithm with superior performance to be implemented in hardware. The individual modules are instantiated into the same top-level module according to the previous introduction, and the corresponding system framework diagram is shown in Figure 6.

Following the above block diagram in the top-level module, the connection of the designed individual modules is completed for the instantiation. The median filtering algorithm module is first tested at the actual board level, and we first verify the feasibility of the algorithm by simulation processing in a MATLAB environment. Based on the implementation principles of the various sharpening algorithms mentioned above, M programs are written for Robert's gradient algorithm and the Laplace algorithm with two different templates, respectively. The principle formula is as follows:

$$F(x) = B0 + \sum_{n=1}^{\infty} \left[ \frac{\partial^2 B}{\partial n^2} \cdot \frac{\delta y}{\delta x} \cdot \frac{\partial^2 \Omega}{\partial B^2} \right]. \quad (15)$$

Since the core operations of all three algorithms are composed of a direct assignment instruction, their MATLAB algorithm programs can be implemented using only two row-counting for loops and the corresponding assignment statements. To compare the processing effect of the three algorithms, we first use the previously mentioned algorithm, the smoothing of an original image, and then use the three sharpening algorithms to do the sharpening process, respectively, and compare the processing result image to judge their good or bad effect. By performing a functional simulation of each algorithm in MATLAB software, we obtain the image shown in Figure 7. The image shown in the picture is to test the efficiency of Robert's gradient algorithm [22].

The results of the efficiency graph of Laplace's algorithm is shown in Figure 8.

Figure 9 showed the efficiency of the fast decomposition algorithm based on the 2D wavelet transform.

From the above efficiency graph, we can see that the fast decomposition algorithm based on two-dimensional wavelet transform is the most efficient one of the algorithm species, with this algorithm applied to graphic design image processing species greatly improving the efficiency of graphic designers. The efficiency of its several different algorithms is shown in Table 1. what are the specific data of the efficiency of the different algorithms for image processing.

To prove the effectiveness of the improved algorithm in this paper, five image processing algorithms are chosen as experimental objects here; from subjective analysis, median filtering and Kuan filtering can smooth the background region well, but at the cost of edge loss, the blurring phenomenon of image edge details occurs; wavelet soft thresholding method, traditional image processing method, and this paper method can remove part of the noise while avoiding distortion,



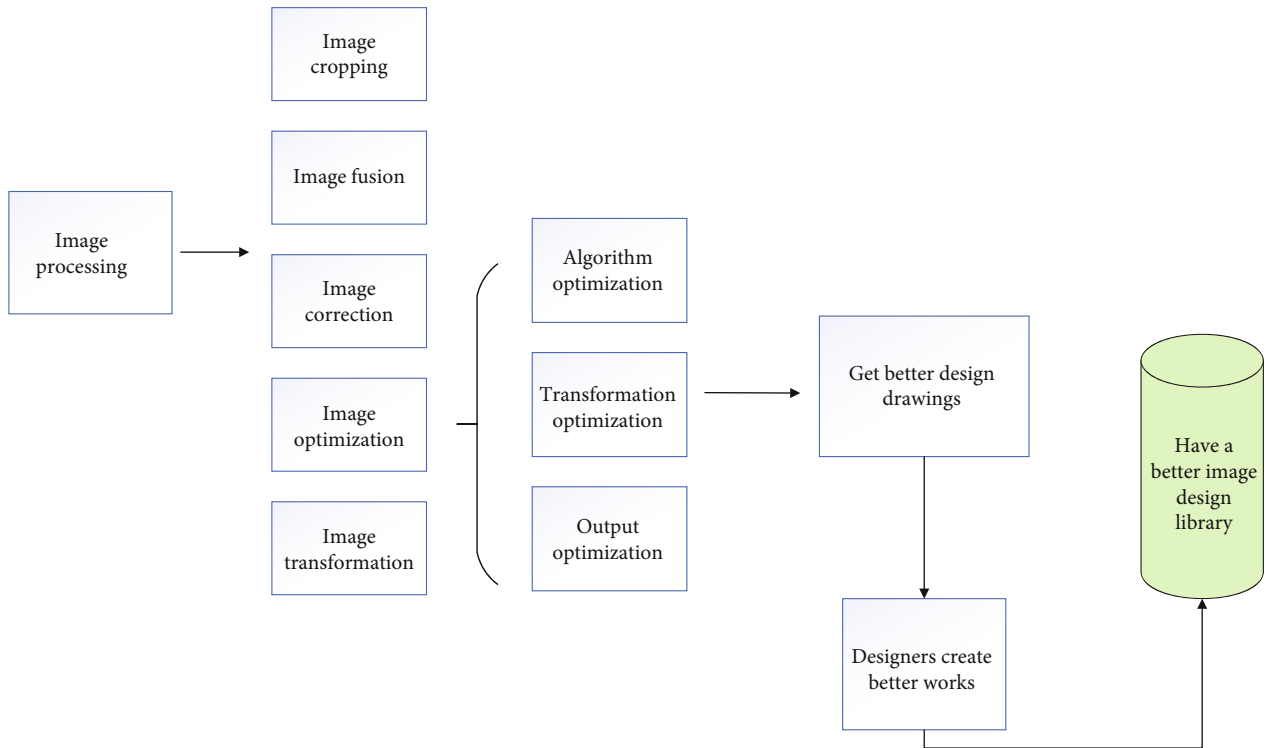


FIGURE 5: Image processing flow chart.

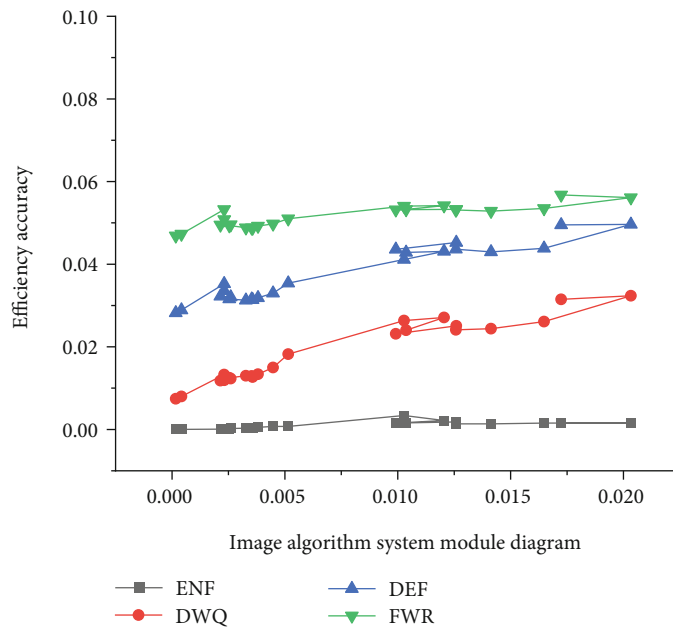


FIGURE 6: Image algorithm system module diagram.

although greatly degree to ensure that edge information is not lost; because it does not start from the distribution characteristics of the noise, the smoothing of its background is not ideal. The specific image processing process is shown in Figure 10.

The visual evaluation of the method in this paper is optimal because it starts from the type of sonar image noise distribution and takes into account both reverberant noise and environmental noise, and before the method of image

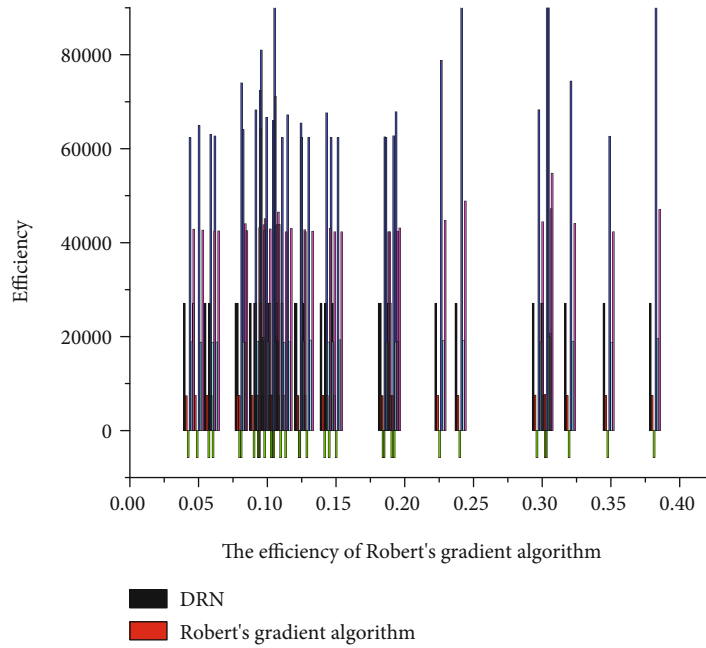


FIGURE 7: Efficiency of Robert's gradient algorithm.

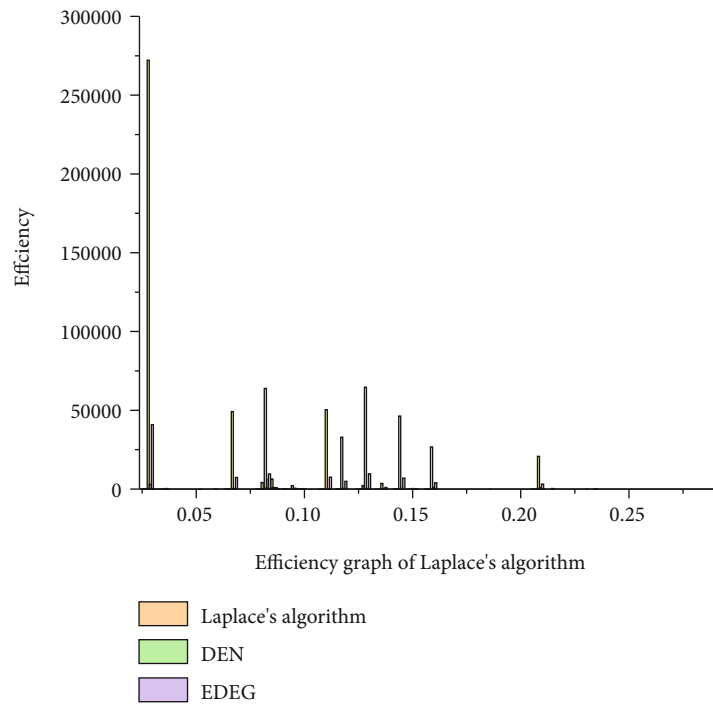


FIGURE 8: Efficiency graph of Laplace's algorithm.

execution processing, part of the environmental noise is filtered out with the help of wavelet transform, and according to the distribution characteristics of the reverberant noise, the transformed into Gaussian additive noise-sensitive to response, so while inheriting the advantage of wavelet algo-

rithm edge keeping, its image processing method based on 2D wavelet transform fast decomposition algorithm of planar design is the most advantageous. Table 2 then is the specific presentation of the efficiency of its image processing algorithms.

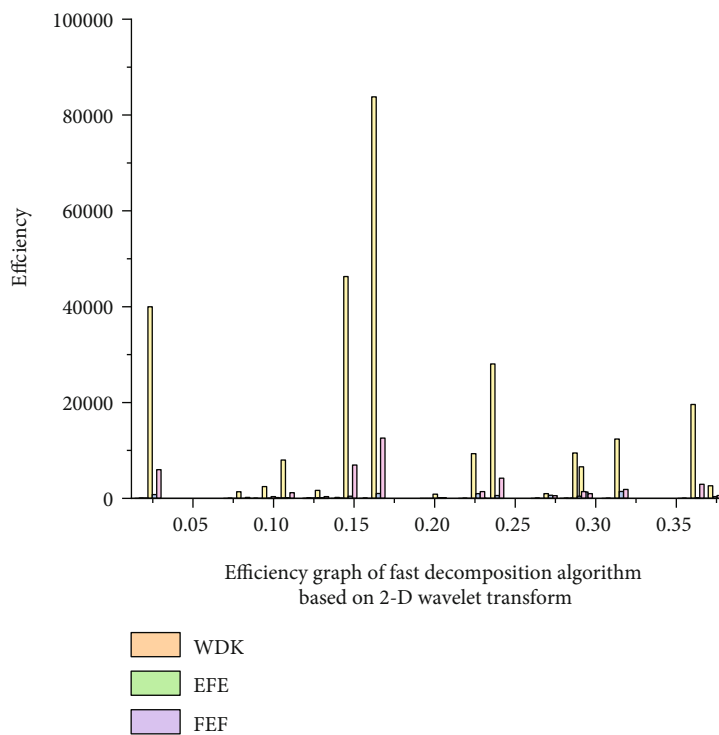


FIGURE 9: Efficiency graph of fast decomposition algorithm based on 2D wavelet transform.

TABLE 1: Accuracy of different image processing algorithms.

Image	Contrast	Detail	Texture visibility	The final effect is presented
Image processing based on new algorithms	0.81	0.98	0.99	0.95
Image processing based on traditional algorithms	0.67	0.76	0.77	0.67

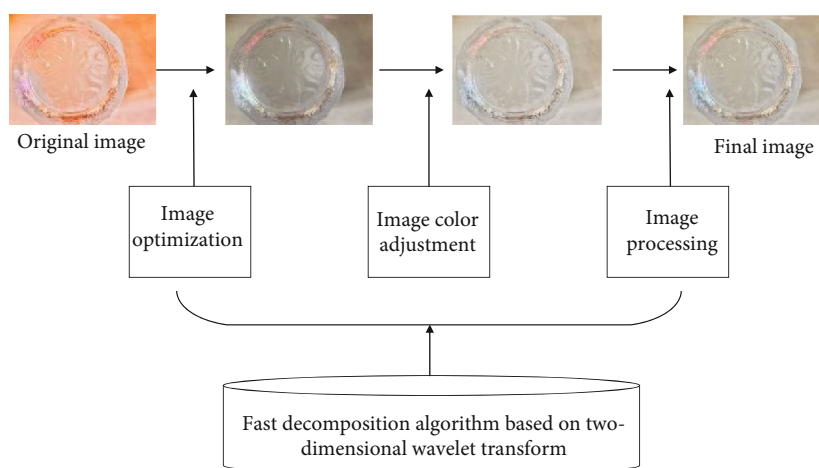


FIGURE 10: The image processing flow of fast decomposition algorithm based on two-dimensional wavelet transform.

TABLE 2: Efficiency of individual image processing algorithms.

Image processing algorithm	Processing efficiency	Time spent sampling
STIF	90	10S
Wavelet transform	95	1S
DHW	89	23S
DEIRN	82	24S

## 6. Conclusion

In this paper, based on the traditional image processing algorithm, an image processing method based on the fast decomposition of wavelet transform for planar design is proposed. The low-frequency components of the second-order decomposition are obtained by image preprocessing of wavelet functions, and the wavelet gradient vector is used to extract feature points from the overlapping regions of low-frequency images, and the extracted feature points are qualified by gray value and number threshold to reduce the number of feature point pairs and the extraction feature point time, and on this basis, the improved wavelet algorithm is used for feature point matching to effectively eliminate the matched point pairs to improve the feature point matching accuracy and real-time performance. The experiments use parallax image and parallax-free image as the image to be matched, respectively, with the traditional image processing algorithm for image stitching comparison; the experimental results indicate that the proposed method in this paper has a good effect and fast image processing, while the feature point matching rate is high, which is a good promotion for the graphic design industry. This algorithm still has a lot of room for improvement. Through continuous improvement of two-dimensional wavelet changes, the speed and efficiency of image processing can be better improved. The future development direction should be the same. Better image processing technology derives better designer works.

## 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 they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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