

## *Retraction*

# **Retracted: Improved Newton Iterative Algorithm for Fractal Art Graphic Design**

### **Complexity**

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1].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

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

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

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

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

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

### **References**

- [1] H. Chen and X. Zheng, "Improved Newton Iterative Algorithm for Fractal Art Graphic Design," *Complexity*, vol. 2020, Article ID 6623049, 11 pages, 2020.

## Research Article

# Improved Newton Iterative Algorithm for Fractal Art Graphic Design

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Fractal art graphics are the product of the fusion of mathematics and art, relying on the computing power of a computer to iteratively calculate mathematical formulas and present the results in a graphical rendering. The selection of the initial value of the first iteration has a greater impact on the final calculation result. If the initial value of the iteration is not selected properly, the iteration will not converge or will converge to the wrong result, which will affect the accuracy of the fractal art graphic design. Aiming at this problem, this paper proposes an improved optimization method for selecting the initial value of the Gauss-Newton iteration method. Through the area division method of the system composed of the sensor array, the effective initial value of iterative calculation is selected in the corresponding area for subsequent iterative calculation. Using the special skeleton structure of Newton's iterative graphics, such as infinitely finely inlaid chain-like, scattered-point-like composition, combined with the use of graphic secondary design methods, we conduct fractal art graphics design research with special texture effects. On this basis, the Newton iterative graphics are processed by dithering and MATLAB-based mathematical morphology to obtain graphics and then processed with the help of weaving CAD to directly form fractal art graphics with special texture effects. Design experiments with the help of electronic Jacquard machines proved that it is feasible to transform special texture effects based on Newton's iterative graphic design into Jacquard fractal art graphics.

## 1. Introduction

Fractal geometry is often used to describe irregular things in nature. The well-known Euclidean geometry describes objects composed of points, straight lines, common polygons and curves in two dimensions, and boxes and surfaces in three dimensions [1, 2]. Most common man-made objects can be described by Euclidean geometry, such as books, desks, lighthouses, houses, and other buildings. However, many natural objects in nature cannot be described by conventional geometric figures, such as clouds and coastlines [3]. The emergence of fractal geometry provides a new perspective for describing natural objects. In fact, it is difficult to judge the difference between two clouds and two coastlines only from the structure and shape, because these natural objects have self-similarity. Fractal geometry uses the idea of fractal dimensions to describe the difference in this

characteristic and maps objects with different dimensions [4].

In foreign countries, the research on fractal art is mainly based on scientists, and artists' attention to this field is not very common [5]. The research of fractal art has always had its own system and development history, which is particularly prominent in design education [6]. Reason education has been mentioned in art education for a long time, and geometry is even regarded as one of the foundations of art design teaching [7]. Joseph Albers, Max Bill, and others have cited many geometric principles in graphic design to guide operation and design [8, 9]. A large part of their courses are graphic creation based on mathematical prototypes. In China, the research on fractal art mainly focuses on artists, and scientists pay little attention [10]. This is a manifestation of the different understandings of fractal art research at home and abroad. Relevant scholars explained how Julia set,

Mandelbrot set, and Newton fractal set adjust the number and shape of petals in clothing design and extracted texture information of different flower types, focusing on analyzing the relationship between Julia set flower types and various parameters [11]. Researchers proposed that works of art should represent nature and work like nature [12]. Science is also trying to explain the laws that determine nature. Technology provides appropriate tools for both parties to achieve common goals [13]. Fractal art is at the core of the triangular relationship between art, science, and technology. Fractal geometry and chaos theory bring new perspectives to art. The study of fractal features provides broad possibilities for art development [14]. Relevant scholars have used artificial neural networks to realize the fusion of natural scene image content and classic painting style and transfer the classic painting style to the content image [15]. Through parameter adjustment, the generated image meets people's aesthetic standards. As an important branch of deep learning, style transfer has been favored by many scholars [16]. In terms of practical application, because theory and practice have not been well integrated and due to lack of understanding of fractals, there are very few researches on the rules of graph generation and the application of the rules [17]. Only the clothing and textile industry is involved and requires fractal technology. Higher industries such as movies and 3D games have no real substantive applications for the time being. In addition, due to the disconnection between science education and art education in China, the domestic understanding of fractal graphics is still at the initial stage. Scientists are not paying enough attention to this kind of artistic performance, so it has not attracted more attention. The research on fractal art lacks knowledge not only in theory but also in material support. Therefore, the road to popularization of fractal theory is still very difficult [18–20]. How to further promote fractal theory to make people realize its material value and economic benefits, or to use fractal art image as a new art form, requires our further efforts.

Newton's iterative graph is generated from nonlinear dynamics theory by changing its mathematical model and related parameters. In the calculation process, the Gauss-Newton iteration method is used to optimize the selection of the initial value of the Gauss-Newton iteration method. The optimization method makes full use of the characteristics of the actual problem of target positioning and combines the advantages of the Gauss-Newton method to perform local fast search. The situation where the Gauss-Newton method does not converge or only converges to the local optimal solution is avoided, and a more ideal positioning result is obtained. Four Newton iterative transformation forms are proposed to produce different shapes of graphics, which can affect the texture effect of the fractal art graphics surface. Mathematical morphology processing of Newton's iterative graphics with the help of MATLAB makes the pixel points of the graphics directly correspond to the tissue points, making them directly into fractal art graphics and presenting a variety of special texture effects, and we design experiments with the help of electronic Jacquard machines. In order to

design special texture effects of fractal art graphics, a new way for reference is explored.

The rest of this article is organized as follows. Section 2 analyzes the related theories of fractal art graphics. Section 3 constructs an improved Newton iteration algorithm. Experiments and discussions were conducted in Section 4. Section 5 summarizes the full text.

## 2. Theories Related to Fractal Art Graphics

*2.1. Characteristic Analysis of Fractal.* A fractal is a collection of some "complex" points in some simple spaces. This collection has some special properties. First, it is a compact subset of the space where it is located and has the typical geometric characteristics listed below:

- (i) The fractal set has proportion details at any small scale, or it has a fine structure.
- (ii) The fractal set cannot be described by traditional geometric language. It is neither the trajectory of points that satisfy certain conditions nor the solution set of some simple equations.
- (iii) The fractal set has a certain self-similar form, which may be approximate self-similar or statistical self-similar.
- (iv) The "fractal dimension" (defined in some way) of a fractal set is generally greater than its topological dimension.
- (v) In most interesting situations, the fractal set is defined by a very simple method and may be generated by iterations of transformations.

For a variety of different fractals, some may have all the above properties at the same time, some may only have most of them, and some have exceptions to certain properties, but this does not affect us calling this set a fractal. It should be pointed out that most of the fractals involved in nature and various applied sciences are approximate. When the scale is reduced to the size of the molecule, the fractality disappears, and strict fractal exists only in theoretical research.

Fractals are generally divided into two categories, deterministic fractals and random fractals. If multiple iterations of the algorithm still produce the same fractal, this fractal is called a deterministic fractal. Deterministic fractals are repeatable. Even though some randomness may be introduced in the generation process, the final graph is deterministic. Random fractal refers to the fact that although the rules for generating fractals are determined, they are affected by random factors. Although the fractals generated by each generation process can have the same complexity, the shape will be different. Although random fractals also have a set of rules, the introduction of randomness during the generation process will make the final graph unpredictable. That is, the graphics generated by the two operations at different times can have the same fractal dimension, but the shape may be different, and random fractals are not repeatable. The frame diagram of the fractal graphic design program is shown in Figure 1.

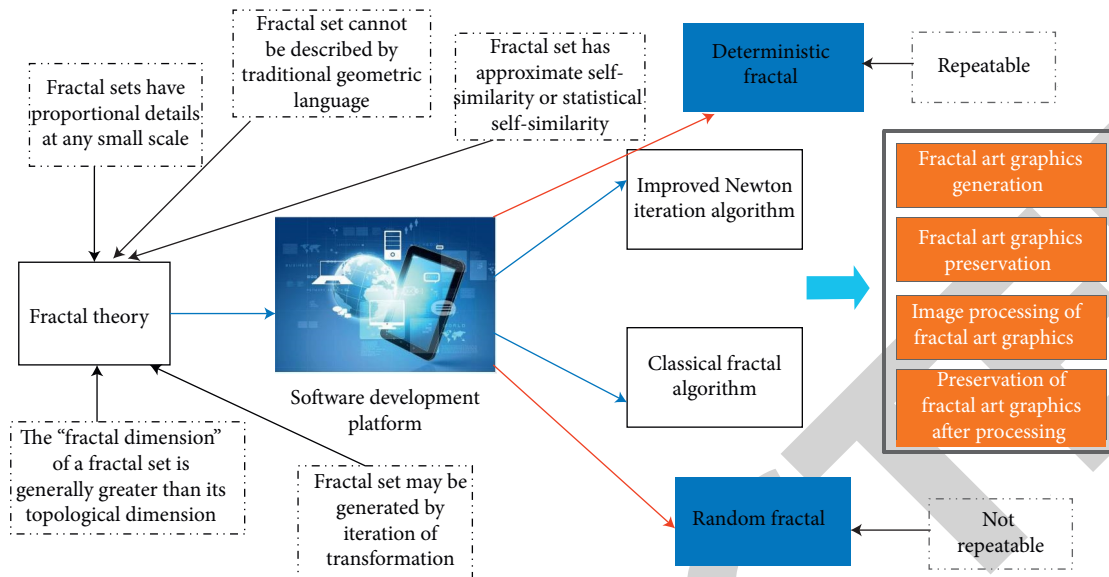


FIGURE 1: Framework diagram of fractal graphic design program.

**2.2. The Difference between Fractal Geometry and Euclidean Geometry.** To explain the difference between fractal geometry and Euclidean geometry, first we introduce the characteristics of Euclidean geometry. Euclidean geometry is a study of regular geometric figures. The so-called regular geometric figures are familiar points, straight lines, and line segments; squares, rectangles, trapezoids, rhombuses, various triangles and regular polygons on planes, and planes; and cubes, cuboids, and regular tetrahedrons in space. The other type is geometric figures composed of curves or surfaces, circles and ellipses on a plane, spheres, ellipsoids, cylinders, cones, and truncated cones in space. The dimensions (Euclidean dimension) of these points, lines, screen graphics, and space graphics are 0, 1, 2, and 3, respectively. The geometric measurement of regular geometric figures refers to the measurement of length, area, and volume.

The graphics studied by fractal geometry are more complex or more realistic than those studied by Euclidean geometry. Its important feature is that it has no characteristic length, and the lines or surfaces that make up its shape are not smooth and nondifferentiable. For example, clouds are not spherical, mountains are not conical, coastlines are not arcs, tree bark is not smooth, and even lightning does not traverse the sky in a straight line. These irregular geometric shapes are difficult to describe with straight lines, smooth curves, and smooth curved surfaces in Euclidean geometry. Therefore, the research object of fractal geometry is a kind of irregular geometric shapes with no characteristic length. Although this kind of object cannot be processed by classical Euclidean geometry, it has “good” properties. To facilitate research, important idealized assumptions are often made; that is, it is assumed to be self-similar. Self-similarity means that if a part of the figure to be considered is enlarged, its shape is the same as the whole. Although these assumptions are too simplistic, only then can we study them while still being suitable for the purpose of the

application. Of course, no real structure will remain the same after an infinite number of repeated amplifications. In principle, self-similarity is only approximately reflected in the application.

There is no strict definition of the characteristic length. Generally, the length that can represent the geometric characteristics of an object is called the characteristic length of the object, such as the radius of a sphere, the side length of a cube, and the height of a person; these are the characteristic lengths of various objects, and they well reflect the geometric characteristics of these objects. For the shapes of objects with characteristic lengths, even if they are slightly simplified, as long as their characteristic lengths remain unchanged, their geometric properties will not change much. In other words, for this type of object, you can use geometrically well-known simple shapes such as rectangles, cylinders, and spheres to combine them, and they can closely resemble their structures. For objects that do not have a characteristic length, the characteristic is that they cannot or are difficult to measure with conventional geometric scales.

**2.3. Fractal and Chaos.** Fractals often show irregular representations, but this does not mean that they are absolutely irregular. Fractals have the characteristics of “self-similar”; that is, they take any part of the fractal figure and enlarge it appropriately, and you can still get a similar image to the original whole figure.

The object described by chaos has an infinite self-similar structure and also has an irregular representation but actually has an infinite self-similar nested structure. In this way, the research on “fractal” and “chaos” has moved towards convergence. We can see the fact that there is a chapter on “fractal” in the book titled “Chaos,” but in the book titled “Fractal,” there is another chapter on “Chaos.” “Fractal” and “Chaos,” the two theories developed from different angles, converge on “self-similarity.”

Nonlinear scientific research turns people's understanding of "normal" things and "normal" phenomena to the exploration of "abnormal" things and "abnormal" phenomena. "Multimedia" technology is a new "unconventional" method used to encounter a large number of "unconventional" phenomena in the process of information storage, compression, conversion, and control. Chaos breaks the various "singular attractors" phenomenon that the deterministic equation determines the motion of the system by the initial conditions.

Chaos comes from a nonlinear dynamic system, and the dynamic system describes an arbitrary process that develops and changes over time. Such systems arise from all aspects of life. The research purpose of the dynamic system is to predict the final development result of the "process." However, even the simplest dynamic system with only one variable will have an essentially random characteristic that is difficult to predict. The sequence produced by successive iterations of a point or a number in a dynamic system is called an orbit. If a small change in the initial conditions causes the corresponding orbit to change only slightly within a certain number of iterations, the dynamic system is stable. At this time, the orbit arbitrarily close to the given initial value may be far from the original orbit. Therefore, it is extremely important to understand the set of unstable points in a given dynamic system. The set of all points whose orbits are unstable is the chaotic set of this dynamic system, and small changes in the parameters of the dynamic system can cause rapid changes in the structure of the chaotic set. This kind of research is extremely complicated, but, with the introduction of a computer, you can visually see the structure of this chaotic set and see whether it is a simple set or a complex set and how it changes as the dynamic system itself changes. It is from here that fractal enters the chaotic dynamic system research.

Chaos mainly discusses the unstable divergence process of a nonlinear dynamic system, but the system always converges to a certain attractor in the phase space, which is very similar to the generation process of fractals. Chaos mainly discusses the behavioral characteristics of the research process, while fractal pays more attention to the study of the structure of the attractor itself. At the same time, chaos and fractal rely heavily on the advancement of computers, which poses a challenge to the traditional concept of pure mathematics. It also greatly stimulated the interest and understanding of scientists and the public and played a role in promotion. The consistency of fractal and chaos is not accidental. In the computer image of chaos set, it is often the set of points with unstable orbit that forms the fractal. So these fractals are given by an exact rule. They are a chaotic set of dynamical systems and various strange attractors. Therefore, the beauty of fractal images is the beauty of chaotic collections, and the study of fractal images is part of the study of chaotic dynamics.

*2.4. Method of Generating Fractal Graphics.* The *L* system is a set of methods to describe plants and trees proposed from the perspective of plant morphology. At the beginning, it only focused on the topological structure of plants, that is,

the neighboring relationship between plant components. After years of research, geometric explanations were added to the description process. The high simplicity and multilevel structure of this system provide an effective theory and method for describing the morphological and structural characteristics of the growth and reproduction process of plants and trees. Not only can the *L* system describe plants but also its composition method can be used to draw all kinds of regular fractal curves and other shapes. Figure 2 shows the calculation framework of the fractal dimension value generated by fractal graphics.

Iteration Function System (IFS) is an important branch of fractal geometry, and it is also one of the most vital and promising fields in fractal images. IFS is a fractal configuration system. Aiming at this system, a set of theories was proposed, a series of algorithm rules were developed, and they were used in many aspects. The theory of IFS includes compression mapping, metric space, existence of invariant compact sets, and measurement theory. The iterative function system has great advantages in the modeling of a large class of objects, especially the advantages of computer simulation of natural scenery. Because of this, IFS has a wide range of applications in graphics. Among them, the research of visualization technology has been extended from 2D fractal to 3D fractal objects; the self-similar fractal image researched by IFS expands its application range, and the IFS transformation need not be limited to affine transformation. For the geometric transformation of the original graphics, the linear transformation in IFS is extended to the nonlinear transformation; for the discussion of the computer generation of natural scenery, the modeling method is also extended from two-dimensional to three-dimensional.

The fractal set of complex dynamical system mainly includes Mandelbrot set and Julia set. Mandelbrot set is the most famous fractal set in fractals. Julia sets are an iteration of polynomials and rational functions. Both the Mandelbrot set and the Julia set are sequences of points obtained by repeated iterations in the complex plane.

The Mandelbrot set is a general outline of the Julia set, and the Julia set is the boundary of the Mandelbrot set. The beautiful images presented in front of people by Mandelbrot and Julia impressed the artists. The benefits have broad application prospects. People's research on Julia set and its extension includes generation algorithm, related demonstration, three-dimensional fractal graph generation, and its further extension; the research on the mapping of Julia set also has further development, including high-order Julia set generation. The study of methods extends the quadratic complex mapping to higher-order complex mapping; the second-order Julia set algorithm-escape time algorithm, random inverse function algorithm, and rotating escape time algorithm are extended to higher-order and generalized Julia sets and the fractal image of Julia set. Through computer experiment method, the research of Julia set has been extended to transcendental function; this research field of artistic design based on fractal and Julia set image has set up another pass for people.

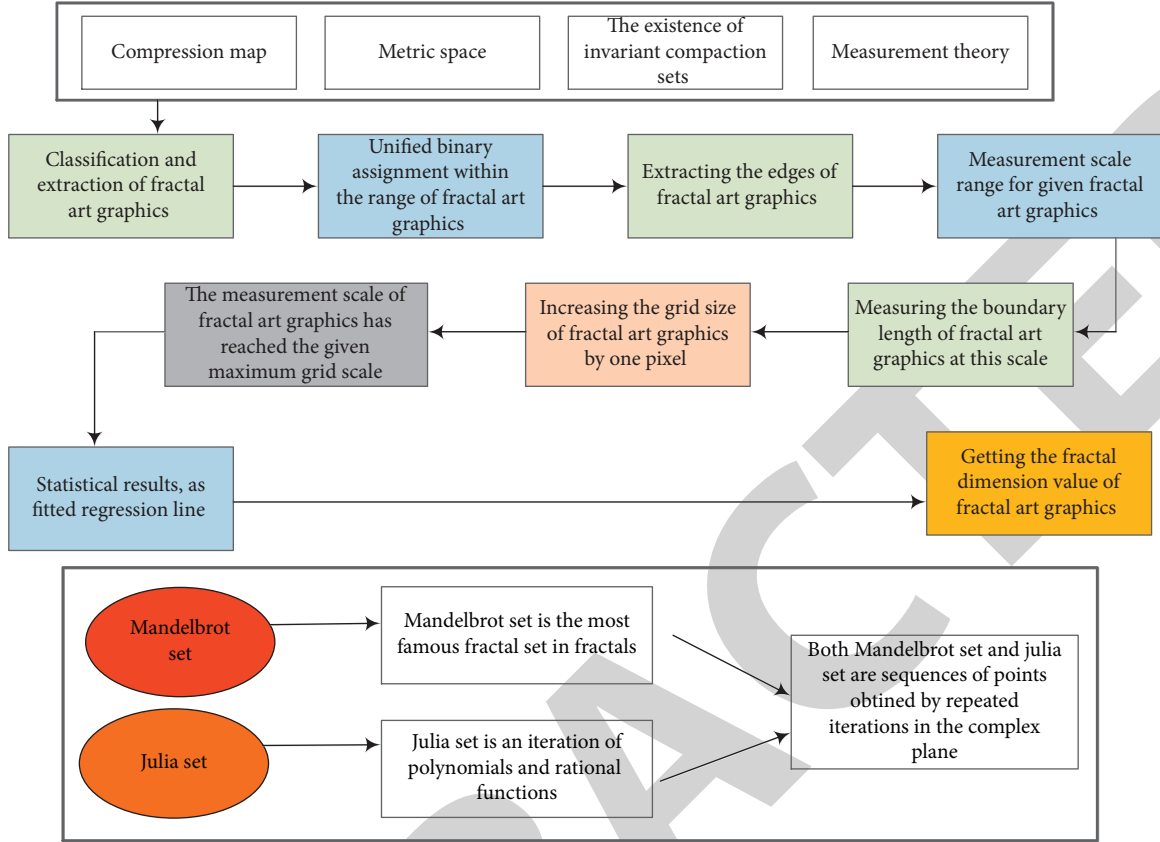


FIGURE 2: The calculation framework of fractal dimension values generated by fractal graphics.

### 3. Improved Newton Iteration Algorithm

**3.1. Gauss-Newton Iteration Method.** Gauss-Newton iteration method is used to solve nonlinear regression problems. After setting the initial value, through multiple iterations, the regression coefficients are modified to obtain the optimal solution of the equations. The basic idea of the Gauss-Newton iterative method is to use Taylor series expansion to approximately replace the nonlinear regression model, and then, after several iterations, the regression coefficients are constantly revised to make the regression coefficients constantly approach the best regression coefficients of the nonlinear regression model. The goal is to minimize the residual sum of squares of the original model. The Gauss-Newton algorithm is an algorithm for solving nonlinear least squares problems. It can be seen as Newton's method to find a minimum function variant. It is used to minimize the sum of the square values of the function. In nonlinear regression, the parameters in the model are sought after, making the model consistent with existing observations, such as nonlinear least squares problems.

Given  $m$  functions  $R = (R_1, \dots, R_m)$  of  $n$  variables  $\alpha = (\alpha_1, \dots, \alpha_n)$ , where  $m \geq n$ , the Gauss-Newton iterative algorithm finds the least square sum:

$$s(\alpha) = \sum_{i=1}^m r_i^2(\alpha). \quad (1)$$

We iterate from the set initial value

$$\alpha^{(s+1)} = r\alpha^{(s)} J_r^T (J_r J_r^T)^{-1} + \alpha^{(s)}. \quad (2)$$

Among them, the Jacobian matrix is

$$J_r = \frac{\partial r_i(\alpha^{(s)})}{\partial \alpha_j}. \quad (3)$$

We set the system of equations to

$$f_i(x, y) = [(x - x_i)^2 + (y - y_i)^2]^{1/2} - [(x - x_{i+1})^2 + (y - y_{i+1})^2]^{1/2} + vt_{i,i+1}. \quad (4)$$

Its Jacobian matrix is

$$G(x, y) = \begin{pmatrix} \frac{\partial f_1}{\partial x} & \frac{\partial f_1}{\partial y} \\ \frac{\partial f_2}{\partial x} & \frac{\partial f_2}{\partial y} \\ \frac{\partial f_3}{\partial x} & \frac{\partial f_3}{\partial y} \end{pmatrix} = \begin{pmatrix} C_{11} & C_{12} \\ C_{21} & C_{22} \\ C_{31} & C_{32} \end{pmatrix}. \quad (5)$$

When the Jacobian matrix is a nonsingular matrix (the determinant is not zero), the target coordinate iteration formula is

$$\begin{pmatrix} x^{(k+1)} \\ y^{(k+1)} \end{pmatrix} = \begin{pmatrix} f_1(x^{(k)}, y^{(k)}) \\ f_2(x^{(k)}, y^{(k)}) \\ f_3(x^{(k)}, y^{(k)}) \end{pmatrix} \cdot \begin{pmatrix} \frac{\partial f_1}{\partial x} & \frac{\partial f_1}{\partial y} \\ \frac{\partial f_2}{\partial x} & \frac{\partial f_2}{\partial y} \\ \frac{\partial f_3}{\partial x} & \frac{\partial f_3}{\partial y} \end{pmatrix} + \begin{pmatrix} x^{(k)} \\ y^{(k)} \end{pmatrix}. \quad (6)$$

**3.2. Selection of Initial Value.** The Gauss-Newton iteration method is greatly affected by the initial value. The three-node set in the target positioning system used in this article can form a triangular array, and the function value of the Jacobian matrix in the corresponding direction is calculated by calculating the points on the outer extension line of each side of the triangle. The function value no longer changes.

At points on the straight line, the value of the Jacobian matrix is 0. At this time, the Jacobian matrix function takes the extreme value. The Jacobian matrix function takes the minimum value on the left side of the point and the maximum value on the right side, but the value of the Jacobian matrix function remains unchanged. Therefore, when the Gauss-Newton iteration method is used to solve the problem and when the initial value and the real calculation result are in the same range (referring to the same side of the extreme value point), the optimal solution can be obtained after several iterations. When the initial value and the true value are not in the same range, more accurate calculation results cannot be obtained, and only iterative convergence can lead to a local optimal solution.

Based on the idea of genetic algorithm, the selection of the initial value of Gauss-Newton iteration method is optimized. Genetic algorithm is a nondeterministic quasi-natural algorithm. Genetic algorithm is a random algorithm that uses natural selection and genetic mechanism in nature. The main idea of the algorithm is to simulate heredity, mutation, and crossover in natural selection. We select ideal individuals and recombine them through genetic operators to generate a new set of candidate solution groups, until the optimal solution or better solution that meets the setting is obtained. Genetic algorithm provides a new method for the selection of the initial value of the Gauss-Newton iteration method. In the calculation of the Gauss-Newton iteration method, a group of candidate points are selected to participate in the iteration, and the reasonable selection parameters are selected according to the fitness function to select the candidate points that minimize the error of the calculation result as the initial value of the Gauss-Newton iteration method. The point with the highest fitness is selected as the initial value. The probability of selection is

$$P = \frac{fit(i)}{\sum_{j=1}^n fit(j)}. \quad (7)$$

The two-by-two connection of three nodes in this fractal design system can divide the points in the entire positioning area into seven ranges. Therefore, when selecting the initial value, one point in each of the seven regions can be randomly selected as a candidate point for the initial value. We use these seven points as the initial values in the Gauss-Newton iteration method to perform iterations and limit the number of iterations to 10. Within the specified number of times, the point where the fitness function takes the smallest value is taken as the final true initial value. This initial value is calculated iteratively, and a better initial value is selected for the iterative process. Each iteration corrects the calculated solution to obtain the optimal solution.

The final result obtained will be returned as the calculation result of target positioning. This ensures that the optimal result can be obtained conveniently in the locatable area. Figure 3 illustrates the calculation steps in detail.

## 4. Experiment and Discussion

**4.1. Optimization Results of Newton Iterative Algorithm.** The value of the Jacobian matrix obtained in the process of calculating the representative points of different regions is different, so the correction amount that determines the iteration is different. As a result, convergence and non-convergence occurred in the iterative calculation. The final result of iterative calculation of the initial values of different artistic graphic candidates is shown in Figure 4.

It can be seen from Figure 4 that the error of the calculation results of the initial values of different art graphics is less than 7%. This verifies that selecting the initial iterative value by region is effective in improving the traditional Gauss-Newton iteration method. Compared with the method of randomly selecting the initial value, selecting the initial value by region can improve the calculation accuracy of the Gauss-Newton iteration method. Most of the results obtained by the iterative process of randomly selecting initial values have large errors. The positioning result is largely limited by the distance between the randomly generated initial value position and the actual sound source. The smaller the distance between the randomly generated initial value of the iteration and the actual far sound point, the smaller the error of the calculation result and the more ideal calculation result. When the randomly selected initial value is far away from the actual sound source point, the calculation result has a large error. The positioning method of randomly generating initial values is limited to the range of generating random numbers, and, at the same time, due to its randomness, it is not suitable for practical systems.

**4.2. The Influence of Iterative Function and Parameter Changes on the Generation of Newton Iterative Graph.** The factors affecting the generation of Newton iterative graphics mainly include the type of the iterative function and the value of the parameters  $p$  and  $q$  and the selected Newton iterative graphics part in the design of fractal art graphics.

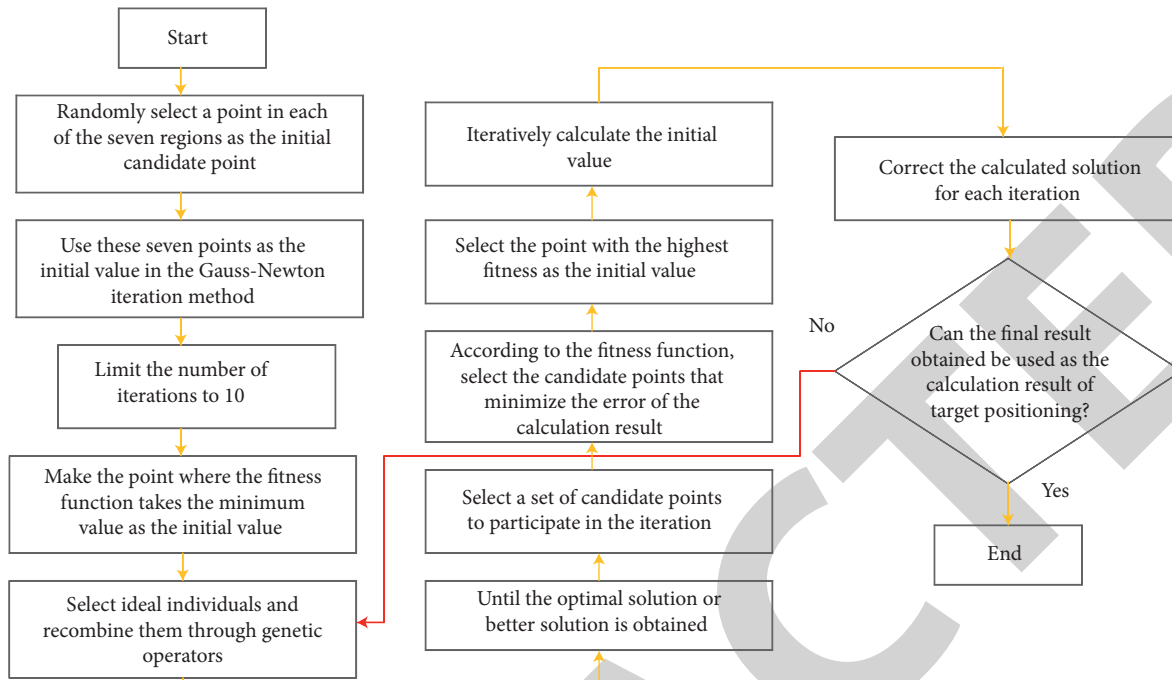


FIGURE 3: Flowchart of initial value selection.

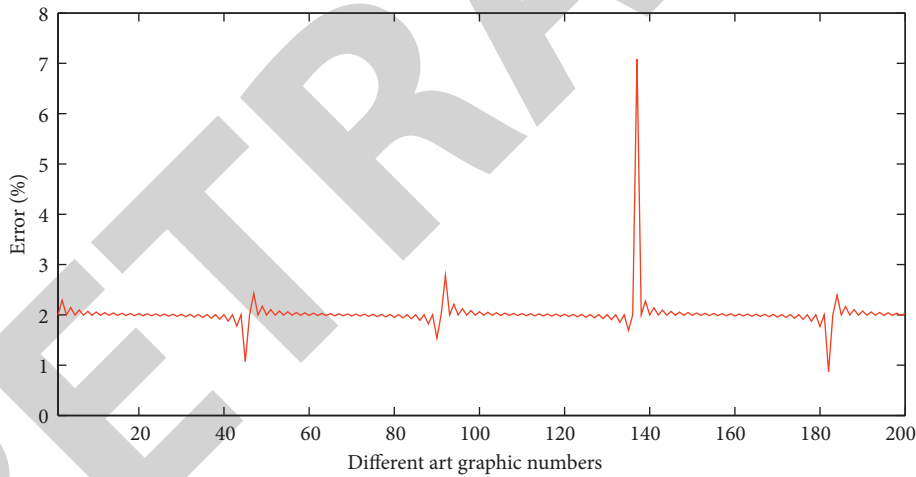


FIGURE 4: Calculation results of the initial values of different artistic graphics.

Through experiments and analysis and summary, some regular trends of Newton iterative graph changes can be grasped, and Newton iterative graphs with special texture effects can be generated.

According to the definition of Newton's iteration and its computer visualization principle, it can be known that the type of iteration function has a decisive effect on the formation of Newton's iterative graph fractal art. The iterative function can choose trigonometric function, power function, exponential function, hyperbolic function, absolute value function, and so forth. Selecting different iterative functions can get  $N$  set graphics with different shapes. Among them, trigonometric functions are divided into sine, cosine, tangent, cotangent, and other trigonometric

functions and can also include the power exponent change of the trigonometric function. This article mainly chooses trigonometric functions, power functions, exponential functions, and hyperbolic functions as the iterative functions of Newtonian iterative graphs. The Newton iteration graphs generated by different iteration functions are shown in Figure 5.

In the same type of iterative function, changing the iterative mapping function means changing the numerator and denominator of the real and imaginary parts of the iterative formula, and the reconstructed Newton iterative graph will also have a kaleidoscopic structure. This article has proposed a variety of methods to reflect the texture of Newton's iterative graphs in the design. Among them, the



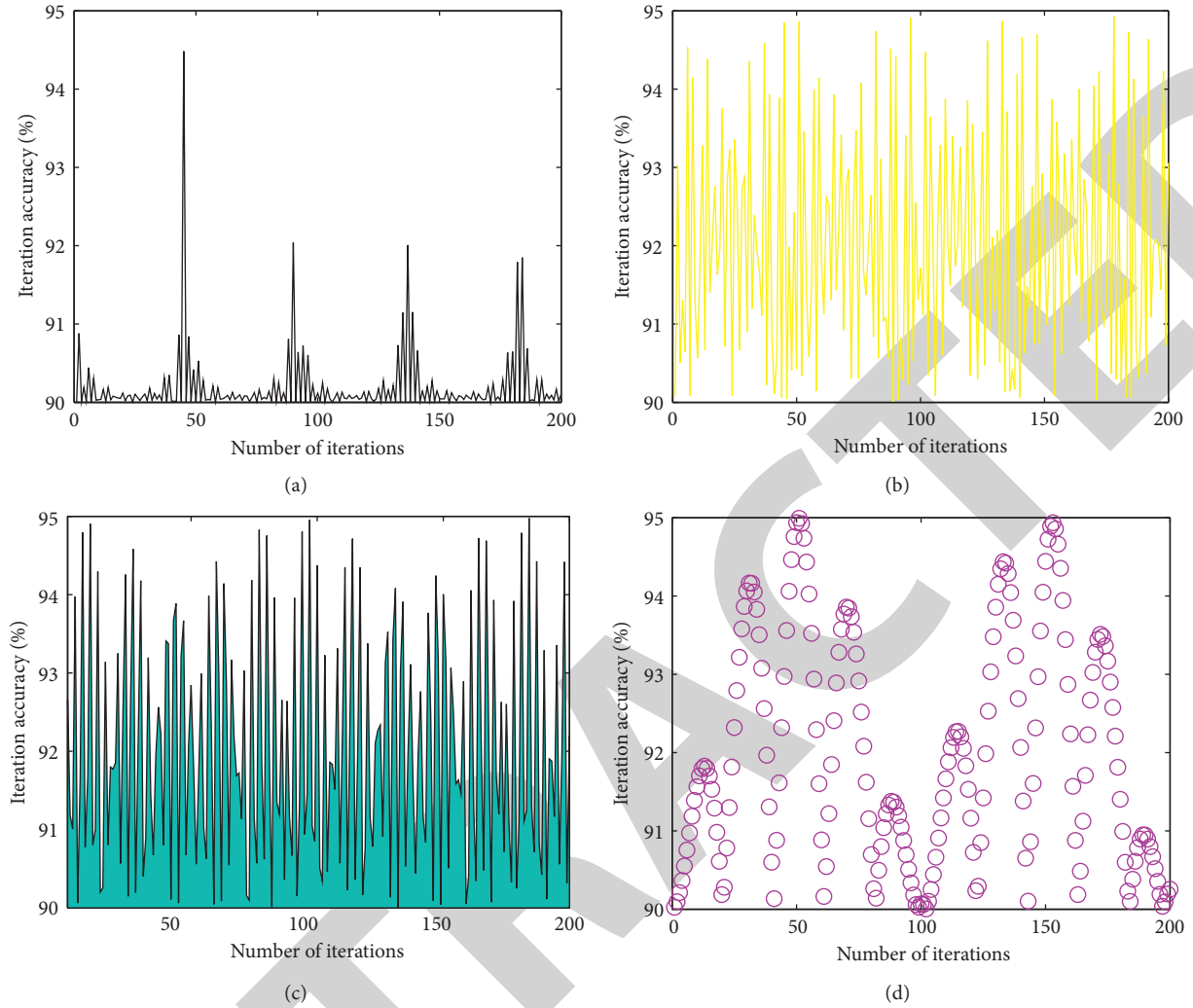


FIGURE 5: The accuracy of Newton iteration generated by different iteration functions. (a) Power function Newton iteration accuracy rate. (b) Trigonometric function Newton iteration accuracy rate. (c) Exponential function Newton iteration accuracy rate. (d) Hyperbolic function Newton iteration accuracy rate.

power function Newton's iterative graph and the trigonometric function Newton's iterative graph change greatly because of the change of the iterative function.

It is found through experiments that the power exponential Newton iteration graph and the trigonometric function Newton iteration graph are more sensitive to the changes of parameters, while the exponential function Newton iteration graph and the hyperbolic function Newton iteration graph have little adjustment to the graph structure caused by the change of the parameters.

**4.3. The Influence of Mathematical Morphology Image Processing Methods on Newton Iterative Graphs.** Through Matlab software, we have performed a variety of mathematical morphological processing on Newton's iterative graphs, including two operations, expansion and erosion. Figure 6 in this article is a sample of Newton's iterative graphics processed by mathematical morphology as fractal art graphics.

By comparison, it can be found that when the two structural elements of diamond and square are selected, the image effect after the corrosion operation is clearer, and the style of Newton's iterative graphics is more obvious. However, there are many block structures after image processing of structural elements, which will cause uneven tension in the warp and weft directions during design, which is not conducive to design.

**4.3.1. Selection of Structural Elements.** Choosing appropriate structural elements plays an important role in better expressing the special texture effects of Newton iterative graphics. Structural elements include spherical, linear, diamond, square, and disc. Through multiple experiments and comparisons, this article mainly uses two structural elements, diamond-shaped and square-shaped, in the experiment.

As shown in Figure 7, it is found through experiments that, with the increase of structural elements, Newton's

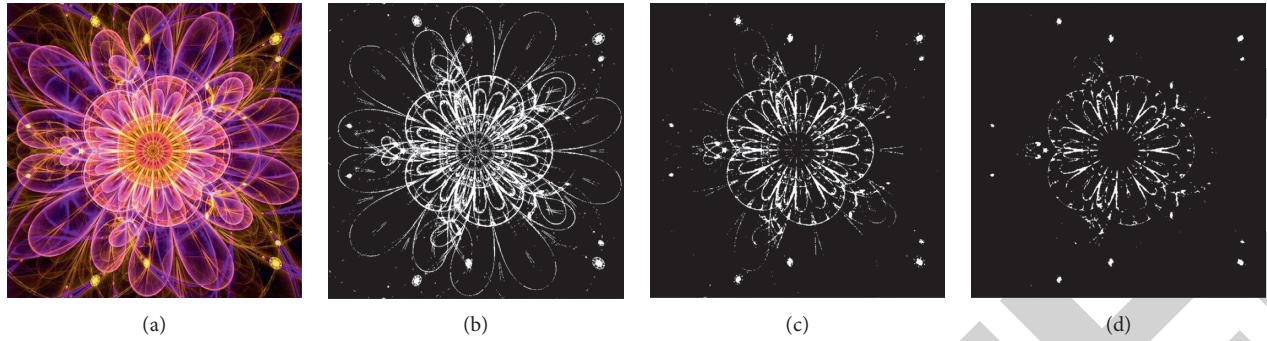


FIGURE 6: Comparison of Newton iteration graphs after corrosion calculation of different structural elements. (a) Original image. (b) Binary image after dither processing. (c) Corrosion of diamond structural element. (d) Corrosion of square structural element.

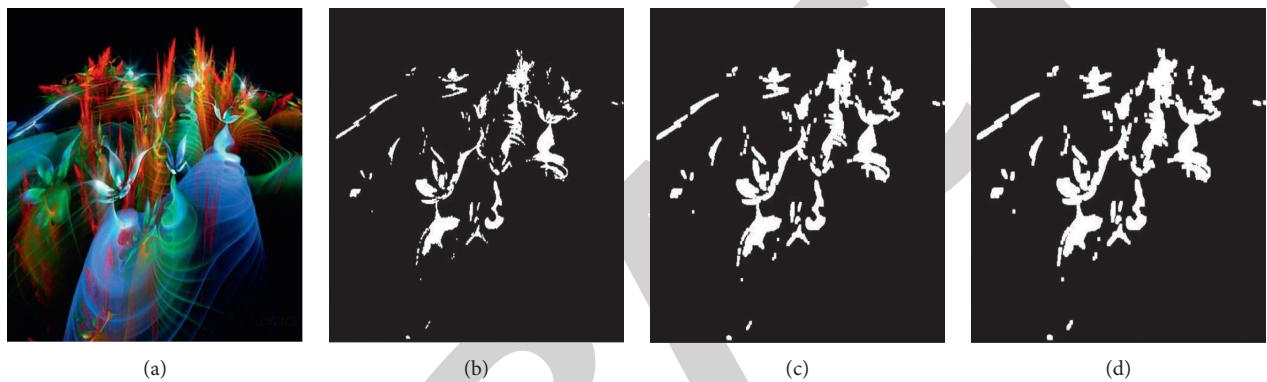


FIGURE 7: The Newton iteration graph after the expansion operation of the diamond structure element in different units. (a) Original image. (b) 1-unit diamond structural element expansion. (c) 2-unit diamond structural element expansion. (d) 3-unit diamond structural element expansion.

iterative graphics gradually turn from delicate to rough style, and their inherent texture effect gradually disappears.

**4.3.2. Application of Expansion Calculation.** The expansion operation is more suitable for nonscattered Newton iterative graphs. For scatter Newton iterative graphs, after the expansion operation processing, the scattered points will be combined with the scattered points of the attachment to become a block, and as the structural elements increase, the scattered points disappear quickly, and the unique texture effect also disappears.

**4.3.3. Application of Corrosion Calculation.** By comparison, it can be found that the erosion operation is more suitable for Newton iterative graphs of scatter points. When selecting the two structural elements of diamond and square, the image effect after the corrosion operation will be clearer than before, and the style of Newton's iterative graphics will be more obvious. With the increase of structural elements, the more blocky structures appear after image processing.

**4.4. The Influence of Fractal Art Graphic Organization and Fractal Art Graphic Density on Experimental Results.**

Traditional fractal art graphics are divided into flower parts and ground parts. Different colors are used to express in the weaving design, and the organization is corresponding; that is, one color corresponds to one organization. Newton iteration graphics are all composed of scattered points and thin lines, which determine that the flower parts are composed of scattered points and thin lines, and the rest are all ground parts, which need to be properly organized. In the experimental design of this paper, the same fractal art graphics are matched with 2–4 organizations, so that the warp and weft yarns of the fractal art graphics are more complex, the surface of the fractal art graphics reflects more details, and the texture is more complex and delicate.

The fractal art graphics used in this topic are inherently complex and delicate, which require delicate materials, better gloss, and the highest possible density of yarns. The density of cotton fractal art patterns can reach up to 70–85 pieces/cm, and the density of silk fractal art patterns can reach up to 190 pieces/cm. Therefore, it can be seen that real silk has a great advantage in reflecting the delicate structure of fractal art graphics. For this reason, we choose real silk as raw material, and we can also try to use cotton yarn, chenille, polyester, and other raw materials to obtain different style effects. The fractal accuracy rate of art graphics of the improved Newton iterative algorithm is shown in Figure 8.

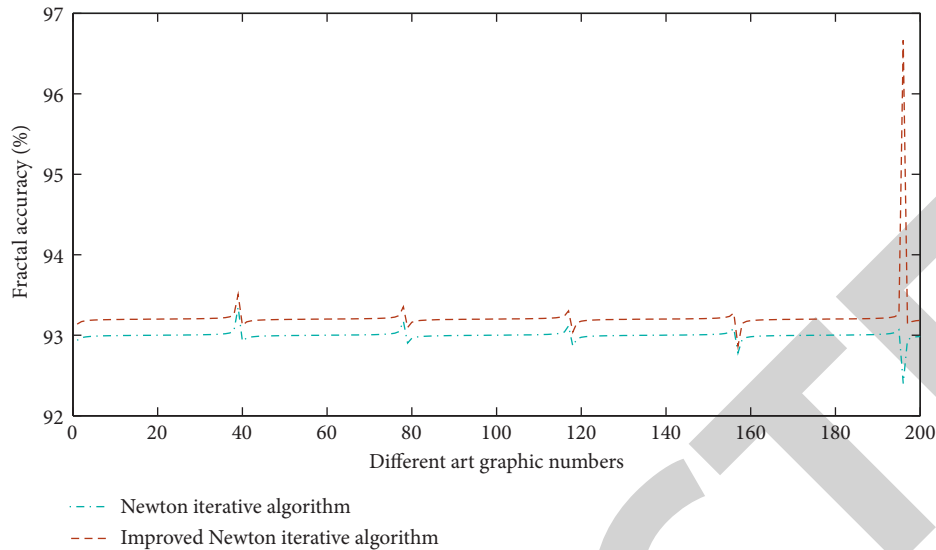


FIGURE 8: The fractal accuracy of artistic graphics of the Newton iterative algorithm before and after the improvement.

## 5. Conclusion

This paper analyzes the basic principles of the Gauss-Newton iteration method and we found that the Gauss-Newton iteration method is greatly affected by the initial value of the iteration. If the initial value is not properly selected, the iteration may not converge to the wrong result. Conversely, selecting appropriate initial values can efficiently calculate accurate results and reduce positioning errors. A representative point is selected from the seven regions as the candidate initial value and substituted into the equation for iterative calculation. We use the value with the smallest error as the final calculation result. The method of selecting the initial value in the Gauss-Newton iteration method is optimized. We construct a new fractal art graphic design and form model based on Newton's iterative theory. Specifically, it includes changing various factors that affect the generation of Newton iterative graphs, continuously transforming the factors that affect the generation of Newton iterative graphs and summarizing the regularity of their changes. In order to find a special type of Newton iterative graphics, we design fractal art graphics and then select the appropriate organization to reflect the unique mechanism of Newton's iterative graphics. We use MATLAB to perform morphological transformation on the designed fractal art graphics to obtain the transformed fractal art graphics. We use this kind of fractal art graphics to design fractal art graphics with special texture effects with the help of weaving CAD and Jacquard design technology. Through factors such as the selection of fractal art graphic organization and the change of the size of the fractal art graphic cycle, we design fractal art graphic textures with different effects.

## 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 conflicts of interest or personal relationships that could have appeared to influence the work reported in this paper.

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