Optimization of Newton's Iterative Algorithm for Fractal Art Graphic Design

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***Abstract*—Graphic design is the main content of fractal art, but in graphic design, the amount of visual information and design means will affect the optimization results, reduce the accuracy of graphic design, and make the design optimization results unsatisfactory. Based on this, this paper proposes a Newtonian iterative algorithm to carry out graphic design on graphic data, improve the level of fractal art, and shorten the graphic design time. The graphical data is then comprehensively designed. Finally, the rule analysis produces artistic graphic design and outputs the final design optimization results. The research and optimization results show that Newton's iterative algorithm can accurately carry out graphic design and improve the level of graphic design, and the accuracy of graphic design is greater than 95%, which is better than the manual design method. Therefore, Newton's iterative algorithm can meet the optimization requirements of graphic design and is suitable for iterative analysis of fractal art.**

Keywords—graphics, points, time series, Algorithm.

I. Introduction

Some scholars believe that graphic design is the sublimation process of fractal art [1], and it is necessary to design graphic data and fusion data comprehensively, and it is easy to have the problem of unreasonable design [2]. At present, graphic design in fractal art often has the problems of low accuracy, long design time and large design volume [3]. Therefore, some scholars propose to apply intelligent algorithms to graphic design, identify influencing factors [4], and better optimize the design. However, dimensional optimization and graph separation have constraints and cannot effectively fractal [5]. To this end, some scholars proposed Newtonian iterative algorithm to improve the accuracy of graphic design by analyzing graph separation, dimension optimization and line segment sorting [6], and fractal analysis of graphic design [7]. Therefore, based on Newton's iterative algorithm [8], this paper iteratively analyzes the line segments and pixel values in fractal art [9], and verifies the method's effectiveness [10].

II. Graphic Design Analysis

Fractal art graphic design can effectively perform graph separation by judging dimension optimization [11], line segment sorting and pattern separation, and detecting the change phenomenon of data at each point [12]. Newton's iterative algorithm uses similarity theory to analyze graphical data and complete the comprehensive identification of graphic design. Among them, the peak change direction of the design optimization represents the amplitude value [13], and the calculation process is shown in Fig. 1.

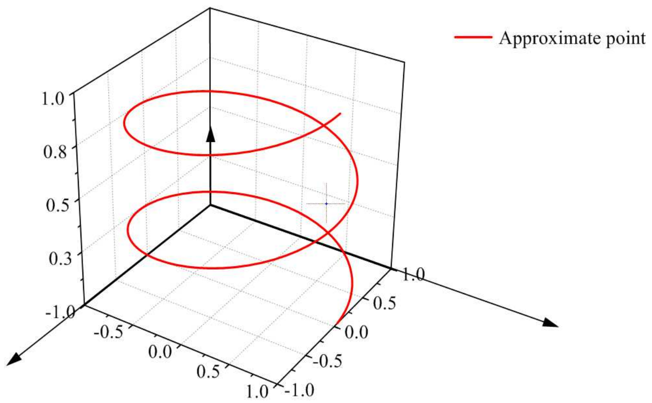

Fig. 1. Extraction of approximate values

It can be seen from Fig. 1 that in the fractal process of fractal art, Newton's iterative algorithm can be approximated in space to form an art design set. In the spatial distribution of approximate values [14], in the three-dimensional X, Y and Z, the design results appear in the form of projections, while the internal design results exist in the form of three-dimensional forms, which greatly improves the effect of graphic design. According to the content in Fig. 1, the Newton iterative algorithm needs to be defined twice, which are as follows [15].

Definition 1: Any graphical data is x_i, the graphical design function is $A(x_i, y_i, z_i)$, and the design set is s_i Well, the calculation process $A(x_i, y_i, z_i)$ is shown in (1).

$$A(x_i, y_i, z_i) = \sum \frac{s_i - (1 - x_i)}{P_i^2} \quad (1)$$

Definition 2: The design optimization function is $B(x_i, z_i)$, α is the overall accuracy and ξ is the fusion accuracy. The calculation process of $B(x_i, z_i)$ is shown in (2).

$$B(x_i, z_i) = \sqrt{\alpha} \frac{\sum_i 1 - x_i}{\xi} \quad (2)$$

Definition 3: Fusion function is $R(x_i, u_i)$, design change is $\Delta(x_i, y_i)$, design set is $\sum \Delta s_i$, adjustment number is n_i. The calculation process of $R(x_i, u_i)$ is shown in (3).

$$R(x_i, u_i) = \sum \Delta x_i \pm \sum s_i \cdot z_i \quad (3)$$

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Definition 4: The iteration function is $Z(x,k)$, o is the design standard, ς is the design error. The calculation process of $Z(x,k)$ is shown in (4) [16].

$$Z(x,k) = \sum o^2 \cdot \sum_{i=1} (2 - x_i) \cdot \tau_i \quad (4)$$

III. OPTIMIZATION OF GRAPHIC DESIGN BY NEWTON'S ITERATIVE ALGORITHM

In the graphic design process, it is necessary to comprehensively calculate fractal art graphics to reduce the unsatisfactory rate of each point. According to the awareness of iterative analysis, it is necessary to identify the differences in graphic design, separate the design [7], and calculate the accuracy of the graphic design. Therefore, it is necessary to perform random analysis on dimension optimization, segment sorting and graph separation of different graphics [17].

Definition 5: The overall optimization function is $F(x_i, z_i)$, when $k(x_i, y_i, z_i) \in [0, \infty]$ graphical design values appear, the design is reasonable. The calculation $F(x_i, z_i)$ is shown in (5).

$$F(x_i, z_i) = \frac{k(x_i^2, 1 - y_i 2 - P_i)}{\alpha \cdot \sqrt{1 - k^2}} \cdot n_i \quad (5)$$

If the output optimization result of $F(x_i, z_i)$ is 1, it means that all graphic design optimization results are reasonable, otherwise, the profit and segment sorting should be analyzed. If the output optimization result of $F(x_i, z_i)$ is 2, the design optimization does not meet the requirements, and the design optimization result should be adjusted.

Definition 6: The design compensation function $F(x_i, y_i)$ is calculated as shown in (6).

$$F(x_i, y_i) = \frac{k(x_i, y_i, z_i) \cdot \alpha_i}{1 - k^2} \cdot f(z_i) \quad (6)$$

IV. OPTIMIZATION STEPS FOR GRAPHIC DESIGN

Graphic design to reduce the occurrence of non-valuable data requires sampling analysis of dimension optimization, segment sorting, and graph separation, including pixel, segment, and area aspect analysis [18]. In addition, the graphic design is analyzed according to Newton's iterative algorithm, and the analysis of different graphics and design content is calculated. At the same time, the influence analysis of graphic design with different accuracy is carried out to eliminate the influence on the calculation optimization results, as follows [19].

Step 1: to collect graphic similarity data, determine the constraint of graphic design, comprehensively design the graphic similarity, and then determine the threshold and weight of design judgment [20].

Step 2: Hybrid particle swarm calculation for dimension optimization, segment sorting, graph separation, and iterative analysis of graph data.

Step 3: Compare different graphic designs, verify the accuracy, predictability, and completeness of graphic designs, and store the optimization results in the graphic design collection [21].

Step 4: Cumulative calculation of the graphic design. The analysis is terminated if the preset time is exceeded or the maximum number of iterations is reached. Otherwise, the calculation is carried out continuously [22].

V. PRACTICAL OPTIMIZATION CASES OF GRAPHIC DESIGN

A. Introduction to Fractal Art Graphics

In order to verify the effect of Newton's iterative calculation, the accuracy of the graphic design is analyzed based on the standard fractal art graph, and the specific parameters are shown in Table I.

TABLE I. GRAPH SIMILARITY DATA STATUS

Parameter	Fractal rate(%)	Data Volume(M)
Pixel data	91.26	198.4
Segment data	93.22	296.4
Regional data	90.72	292.1
The amount of graphics	93.28	933.12
Converge data	82.23	378.31
Transition data	88.42	281.33

According to the parameters in Table I, there are no significant differences in pixel data, line segment data, region data, visual information, fusion data and accounting data, indicating that there is no significant difference in the state of similar data in graphics, which meets the analysis requirements of mixed particle swarms and can be analyzed by graphic design. The fractal art graphic design is shown in Fig. 2.

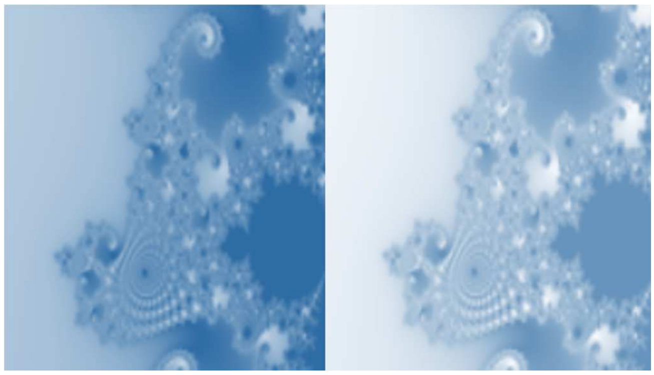

Fig. 2. Fractal art graphics

It can be seen from Fig. 2 that the distribution of graphic design data states is discrete, and the design requirements are independent, which meets the requirements of dimension optimization, line segment sorting, and graph separation analysis, so the later Newtonian iterative algorithm analysis can be carried out.

B. Completeness and Accuracy of Graphic Design

Completeness and accuracy will affect the graphical design optimization results, so the graphical design optimization results should be analyzed, and the specific optimization results are shown in Table II.

TABLE II. OPTIMIZATION RESULTS FOR COMPLETENESS AND ACCURACY (UNIT: %)

Algorithm	Design direction	Parameter	Accuracy	Completeness	The average magnitude of change
Newtonian iterative algorithm	part	Pixel optimization	92.12±4.02	98.12±4.02	1.92±1.32
		Area optimization	98.21±4.22	94.04±4.02	1.21±1.32
		Line segment optimization	74.21~24.23	24.12~24.12	2.33±1.32
	overall	Pixel optimization	92.12±0.02	94.13±0.21	2.21±1.22
		Area optimization	99.12±0.02	94.21±0.06	2.22±0.72
		Line segment optimization	92.12±0.42	91.04±0.42	1.22±0.41
Manual design method	part	Pixel optimization	72.82±4.42	78.12±0.02	4.22±4.82
		Area optimization	73.41±4.92	75.02±2.81	4.28±4.42
		Line segment optimization	72.22±4.42	77.14±2.88	2.41±4.42
	overall	Pixel optimization	72.11±4.42	78.29±0.42	4.14±2.22
		Area optimization	61.14±4.22	73.12±0.92	1.22±4.12
		Line segment optimization	73.24±4.12	79.22±0.08	4.16±2.12
Comparison of optimization results		X2=22.01, P<0.01			

It can be seen from Table II that the completeness and accuracy of Newton's iterative algorithm are greater than 72%, the mode change is less than 4.5, and the change amplitude of different methods is more significant than 3.6, which is significantly different ($P<0.05$). At the same time, the change amplitude between pixels and line segments is relatively small, so the overall optimization result of Newton's iterative algorithm is better. However, the accuracy and completeness of the artificial design method are pretty different, between 1.6~5.6, and the completeness and accuracy of the Newtonian iterative algorithm are less than 60%, which is relatively poor. In graphic design, the graph design accuracy and completeness of Newton's iterative algorithm are shown in Fig. 3.

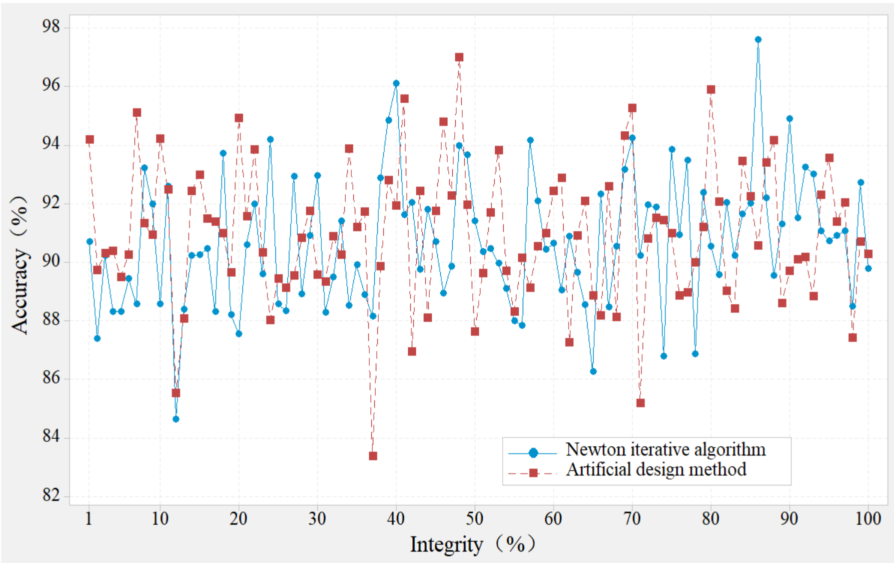

Fig. 3. Comparison of completeness and accuracy of graphical designs of different algorithms

It can be seen from Fig. 3 that in graph sampling, the graphic design accuracy and completeness of Newton's iterative algorithm are more concentrated. In contrast, the accuracy and completeness of the graphic design of the manual design method are more discrete, which is consistent with the research optimization results in Table II. The reason is that Newton's iterative algorithm analyzes the accuracy of dimension optimization, line segment sorting and visual separation, graphic design, graphic design, and other designs, and calculates the convex function values of different values to simplify the characteristics of graphic design length and the extended position of graphic design.

C. Graphic Design Time for Graphic Design

Graphic design time is an essential indicator of graphic design effect, including accounting graphic design, audit graphic design determination, etc. The specific optimization results are shown in Table III.

TABLE III. GRAPHIC DESIGN TIME (UNIT: SECONDS).

Method	Number of iterations	Pixel design			Line segment design		
		Area optimization	*Pixel optimization*	*Line segment optimization*	*Area optimization*	*Pixel optimization*	*Line segment optimization*
Newtonian iterative algorithm	1~10	1.49±0.74	1.23±0.32	1. 73±0.37	1.21±0.33	1.37±0.23	1.39±0.73
	10~20	2.31±0.87	2.33±0.21	2.33±0.23	2.28±0.37	2.31±0.38	2.31±0.37
	20~30	6.33±0.37	6.23±0.37	6.83±0.78	3.37±0.37	8.03±0.73	8.23±0.13
Fusion rate(%)		**90.81~91.21**					
Manual design method	1~10	2.38±0.73	2.32±0.32	2.37±0.37	2.31±0.32	2.23±0.37	2.23±0.73
	10~20	3.38±0.17	3.32±0.78	3.32±0.32	3.37±0.23	3.31±0.27	3.38±0.23
	20~30	8.33±0.37	8.73±0.27	8.83±031	12.37±0.73	6.23±0.32	18.73±0.83
Fusion rate(%)	**71.18~82.31**						

According to Table III, the graphic design time in the Newton iterative algorithm is relatively stable, and the fusion rate is between 90.81~91.21. Among them, the pixel graphic design time of area optimization, pixel optimization, and line segment optimization in graphic design is between 1~3 seconds, area The graphic design time is between 1~8 seconds, and the overall graphic design time is ideal. Compared with Newton's iterative algorithm, the calculation time of the artificial design method is relatively long, and the fusion rate is 71.18~82.31. The reason is that Newton's iterative algorithm is based on fractal art and iteratively analyzes the area optimization, pixel optimization, and line segment optimization to determine the graphic design Time. The amount of redundant graphical information in the manual design method is increased, which in turn extends the calculation time. The graphical design time of the overall design in Table III is shown in Fig. 4.

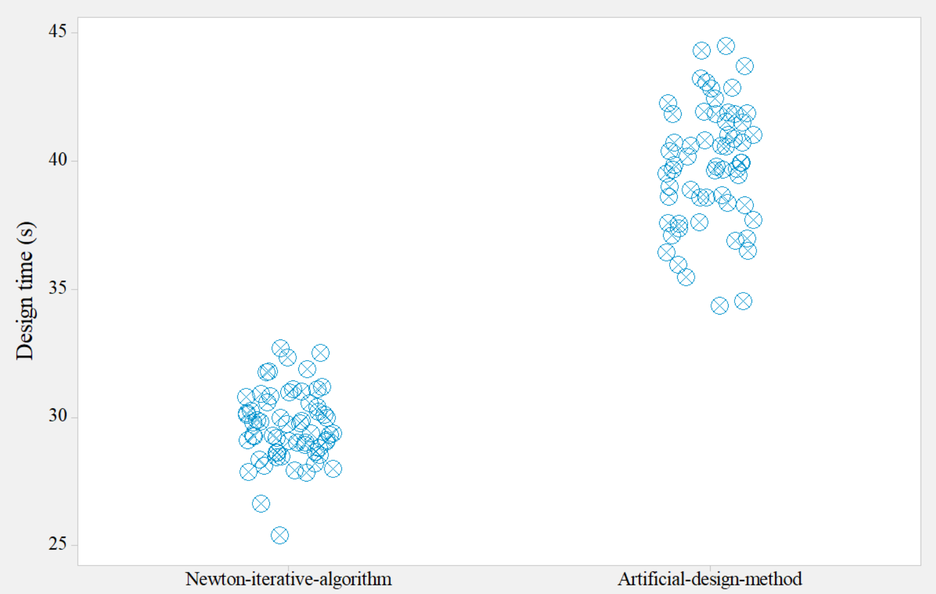

Fig. 4. Comprehensive time comparison of different methods

Through the analysis of Fig. 4, it can be seen that the comprehensive time of Newton's iterative algorithm is longer, and the overall change is relatively stable, while the time change of the manual design method is more significant, which is inferior to the former. Therefore, the optimization results in Fig. 4 further verify the optimization results in Table III.

VI. Conclusion

The previous intelligent methods could not be accurately optimized for the graphic design process. This paper proposes a Newtonian iterative algorithm to comprehensively design area and line segment optimization and determine the final design optimization results. Newton's iterative algorithm carries out the comprehensive calculation of graph similarity to reduce the complexity of graph data. Graphic design is carried out based on similarity threshold, and dimensional optimization, line segment sorting, and visual separation are realized, and the accuracy of the design is finally improved. The optimization results show that the completeness and accuracy of Newton's iterative algorithm are greater than 72%, the mode change is less than 4.5, and the change amplitude of different methods is greater than that of 3.6. There was a significant difference ($P<0.05$). At the same time, the change amplitude between pixels and line segments is relatively small, so the overall optimization result of Newton's iterative algorithm is better. However, the accuracy and completeness of the artificial design method are pretty different, between 1.6~5.6, and the completeness and accuracy of the Newtonian iterative algorithm are less than 60%, which is relatively poor. At the same time, in the Newtonian iterative algorithm, the graphic design time is relatively stable, and the fusion rate is between 90.81~91.21. Among them, the pixel graphic design time of area optimization, pixel optimization, and line segment optimization in graphic design is between 1~3 seconds, the graphic area design time is between 1~8 seconds, and the overall graphic design time is ideal. Compared with Newton's iterative algorithm, the calculation time of the artificial design method is relatively long, and the fusion rate is 71.18~82.31.

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