Hindawi
Security and Communication Networks
Volume 2023, Article ID 9804284, 1 page
https://doi.org/10.1155/2023/9804284

Retraction

Retracted: A Study of the Morphological Design of Architecture from a Geometric Logic Perspective

Security and Communication Networks

Received 17 October 2023; Accepted 17 October 2023; Published 18 October 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1].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) Peer-review manipulation

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] L. Zhao and Y. Yang, "A Study of the Morphological Design of Architecture from a Geometric Logic Perspective," *Security and Communication Networks*, vol. 2022, Article ID 8140350, 11 pages, 2022.

Hindawi
Security and Communication Networks
Volume 2022, Article ID 8140350, 11 pages
https://doi.org/10.1155/2022/8140350

Research Article

A Study of the Morphological Design of Architecture from a Geometric Logic Perspective

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Received 17 June 2022; Revised 20 July 2022; Accepted 1 August 2022; Published 29 August 2022

Academic Editor: Tao Cui

In order to further solve the problem of the application and auxiliary function of geometric prototypes in the process of complex architectural structural form design, a method of architectural form design research based on the perspective of geometric logic is proposed. Taking buildings as an example, combined with the requirements of architectural form design, the optimal design of architectural structure form is studied with the help of genetic algorithm, focusing on the verification of building plane and space optimization design under displacement constraints. The results show that after 3257 iterations, the adaptive degree does not change, the corresponding maximum uniqueness is 0.1196 mm, and the weight of the truss structure is 0.3585 t, indicating that the structural design based on geometric logic and genetic algorithm can effectively satisfy the optimal form design of the building form under the constraints. The design method of geometric logic incorporates the whole process of building use, building site, building system, and production and construction into the control scope of the design. In the design process, according to the real environment, through the translation and logic construction of computer language simulation, the architectural concept scheme is generated, and finally the building product is promoted. Complete with high precision.

1. Introduction

In recent years, with the continuous development of the construction industry and the progress of science and technology, the construction industry has undergone profound changes based on the improvement of digital technology, artificial intelligence technology, and construction technology [1]. Advanced parametric design tools and powerful computing advantages of computer technology provide a certain technical support for the innovative development of the construction industry and the innovative design of architectural forms. With the support of these technologies, modern architecture even began to surpass the traditional architectural form, and the connotation and extension of modern architectural form design have been extended to a certain extent. With the aid of parametric design tools and geometric logic principles, more and more complex buildings began to appear, and the innovation of architectural form design was incisively and vividly reflected. The architectural industry has put forward higher requirements for the design, the rationality of the architectural form, and the possibility of use and correlation. The architectural design is no longer subject to the constraints and constraints of traditional geometric principles, and the modern architectural form under the perspective of geometric logic more and more meet people's demand for high-quality buildings [2].

2. Literature Review

Architectural geometry emerges as architecture enters the digital era. It is theoretically influenced by advanced geometry theories such as differential geometry, topology geometry, fractal geometry, and cellular automata. It mainly focuses on the design and analysis of complex public building forms and the application research of construction process. The research content includes free-form surface creation of architectural form, discrete generative design of surface, digital prototype manufacturing, and so on, which mainly plays a role in the optimization control of architectural form and surface. With the development of society, the emergence of complex buildings, the continuous progress of parametric building technology, and the emergence of digital virtual technology have narrowed the distance between people and the future space [3]. However, no matter how extensive such expansion is, it cannot change the materiality of architecture as an object existing in space. This materiality carries the hard and intelligent work of temperature technology from generation to generation. To continue to adhere to it is to adhere to the belief that architecture is the cultural foundation [4].

The research on the application of geometric logic in architectural design thinking and architectural form control in China mainly focuses on the study of architectural form design or construction methods based on geometry or advanced geometry. The main research directions are the application of topology in contemporary architectural form and space creation; research on architectural geometric logic control based on engineering practice; research on the generation and construction of complex architectural forms based on advanced geometry; and complex architectural form control based on geometric logic. This part of the research is mainly based on the use of geometric control system method, the control and optimization method of architectural form is discussed, and the research is based on engineering practice and project practice, and has high research value [5]. In the research of parametric design digital construction based on geometric logic thinking, on the one hand, it is aimed at parametric technology or digital construction technology, and the geometric logic construction method of architectural form, such as the geometric logic construction method of architectural form based on parametric technology and research on geometric construction strategy of contemporary digital architecture [6]. On the other hand, the research on the application of parametric method to the generation of architectural design scheme also includes the research on the operation process of digital technology based on a certain relationship [7]. After entering the twenty-first century, the geometric form of architecture develops from linear geometric form to more free-stretching nonlinear geometric form. The transformative appearance of parametric nonlinear design method makes the geometric form of this period a comprehensive product based on the analysis of the real environment and real performance requirements of the building. The geometric logic design method brings the whole process of building site construction system and production and construction into the control scope of the design. In the design process, based on the real environment, the architectural concept scheme is generated through the translation and logical construction of computer language simulation. In the deepening and construction links, precise geometric modules are used to control the control drawings and samples of each datum, and finally promote the high-precision completion of architectural products. It is such digital transformation that once again promotes the relationship between architecture and geometry, thus triggering the transformation of geometric logic thinking in architectural design [8].

3. Architectural Structural Form Design Based on Genetic Algorithm

As a typical algorithm in modern optimization algorithms, genetic algorithm, compared with mathematical programming method and optimal criterion method, has the advantages of high efficiency, strong robustness, and strong global optimization ability, and can more effectively search for structural optimization by simulating the natural evolution process. However, the traditional genetic algorithm is prone to premature convergence in the iterative process, oscillation around the optimal solution when it is approaching the optimal solution, and large randomness. The factors that need to be considered in the design of building structures are becoming more and more important. The more complex traditional genetic design methods are often difficult to handle. Therefore, in order to avoid the traditional genetic algorithm falling into the local optimal solution prematurely, this paper improves the traditional genetic algorithm from the two aspects of fitness value function calibration and population diversification, broadens the optimization space of the genetic algorithm, and uses the improved genetic algorithm. The algorithm solves the optimization problem with discrete variables of structural section size and stress constraints, which provides a new idea for scientific structural design optimization.

3.1. Principle of Genetic Algorithm in Shape Design

3.1.1. Operating Principle. The operation of genetic algorithm is divided into three elements of coding fitness function and genetic operation, which work alternately in coding space and decoding space. The genetic operation of chromosomes is completed in the coding space, while the discrimination and selection of solutions are carried out in the solution space, as shown in Figure 1. The whole genetic algorithm is to use coding and decoding to connect the coding space and solution space, work in a continuous cycle, and finally search out the optimal results in the solution space [9, 10].

Feasibility refers to whether the solution obtained after chromosome decoding is contained in the range of the solution. If the solution is within the range, it indicates that the solution is feasible. If it is not within the range, the results obtained are not feasible. Legitimacy refers to whether the obtained chromosomes can represent the solution of the problem, as shown in Figure 2.

3.1.2. Fitness Function. The general fitness function has the following three transformations:

The first is to directly use the objective function as the fitness function:

The biggest problem with objective functions:

$$\mathrm{Fit}(f(x)) = f(). \tag{1}$$

Minimum objective function problem:

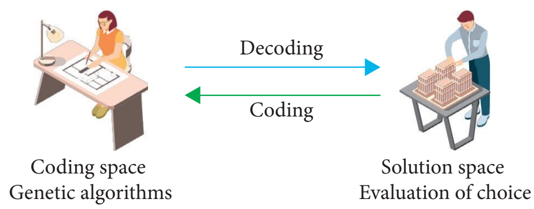

Figure 1: How genetic algorithms work.

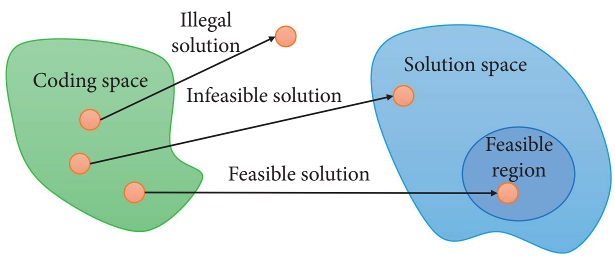

Figure 2: The feasibility and validity of the solution.

$$\mathrm{Fit}(f(x)) = -f(). \tag{2}$$

The advantage of this method is that it is more intuitive and simple, and easy to understand, but the disadvantage is that it cannot meet the non-negative conditions of some selection methods, and when solving some function problems, the value difference is too large, which hinders the average performance.

Second is boundary construction method.

To minimize the objective function:

$$\mathrm{Fit}(f(x)) = \begin{cases} c_{\max} - f(x), & f(x) < c_{\max}, \\ 0, & \text{others}, \end{cases} \tag{3}$$

$c_{\max}$ is an estimated large number of $f(x)$.

If we find the maximum problem of the objective function,

$$\mathrm{Fit}(f(x)) = \begin{cases} f(x) - c_{\mathrm{mim}}, & f(x) > c_{\min}, \\ 0, & \text{others}, \end{cases} \tag{4}$$

$c_{\min}$ is an estimated decimal of $f(x)$.

To minimize the objective function:

$$\mathrm{Fit}(f(x)) = \frac{1}{1 + c + f(x)}, \quad c \geq 0,\ c + f(x) \geq 0. \tag{5}$$

If you want to maximize the objective function,

$$\mathrm{Fit}(f(x)) = \frac{1}{1 + c - f(x)}, \quad c \geq 0,\ c - f(x) \geq 0. \tag{6}$$

This method is an improvement of the second method, and c estimates the bounds of the objective function.

3.1.3. Genetic Operator Operation. Among all crossover operators, the most common is single-point crossover, which means that there is only one crossover point. Genes at the intersection of two paired chromosomes are exchanged and recombined to form new chromosomes in three steps:

(1) Pairwise selection of the population operated by crossover operator is generally random, but also can be selected sequentially.

(2) After the pairing was completed, a random crossover point was formed for each pair of chromosomes, and the crossover point was located between loci [11, 12].

(3) The genes behind the intersection of two paired chromosomes are swapped and recombined according to the location of the intersection, so that two new chromosomes are created such that one pair of paired chromosomes in a population is

$$\begin{aligned} &C_1\text{: } 10011001|11, \\ &C_2\text{: } 01001111|00. \end{aligned} \tag{7}$$

Including | for cross-position will be crossed off the gene behind two chromosomes' intersection after restructuring and get two new chromosomes:

$$\begin{aligned} &C_1'\text{: } 10011001|11, \\ &C_2'\text{: } 01001111|11. \end{aligned} \tag{8}$$

The advantage of using single-point crossover is that if individual traits or fitness is provided by continuous loci, single-point crossover can greatly reduce the probability of breaking such continuity, which is beneficial to the convergence and efficiency of genetic algorithm. In the operation of genetic algorithm, the main parameters mainly include chromosome encoding length L, population size M, crossover probability p_c, mutation probability p_m, termination algebra T, and so on. Termination algebra is only one of the termination conditions of genetic algorithm. It can also determine whether to terminate genetic algorithm according to the convergence after each iteration [13, 14].

3.2. Procedure of Algorithm.

(1) The total population of chromosomes was randomly generated, and fitness calculation was carried out. According to the selection probability, chromosomes with better fitness were selected from the total population as the parent of the first iteration, and chromosomes with poor fitness were selected as the backup pool, as shown in Figure 3.

(2) Parent generation pairs are paired to perform crossover operator operation to generate offspring chromosomes, and the fitness of offspring is calculated. Parent generation 1 is selected according to the fitness to perform mutation operator operation, as shown in Figure 4.

(3) Parent 1 operates the mutation operator according to the coefficient of variation to generate offspring 1 and calculate the fitness. By comparing with parent 1 and backup pool 1, chromosomes with better fitness are selected as the mother of the next iteration, as shown in Figure 5.

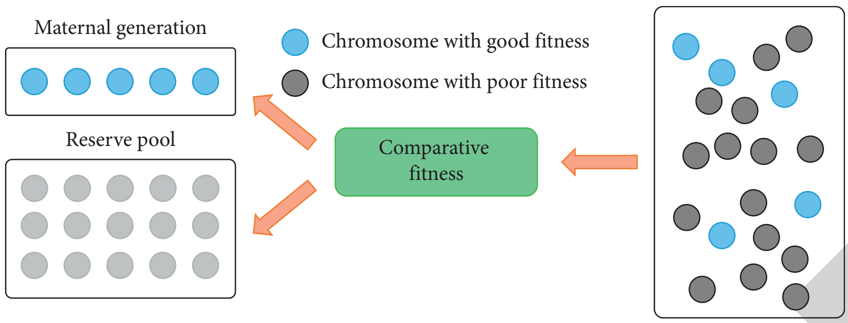

Figure 3: Selection operator operation.

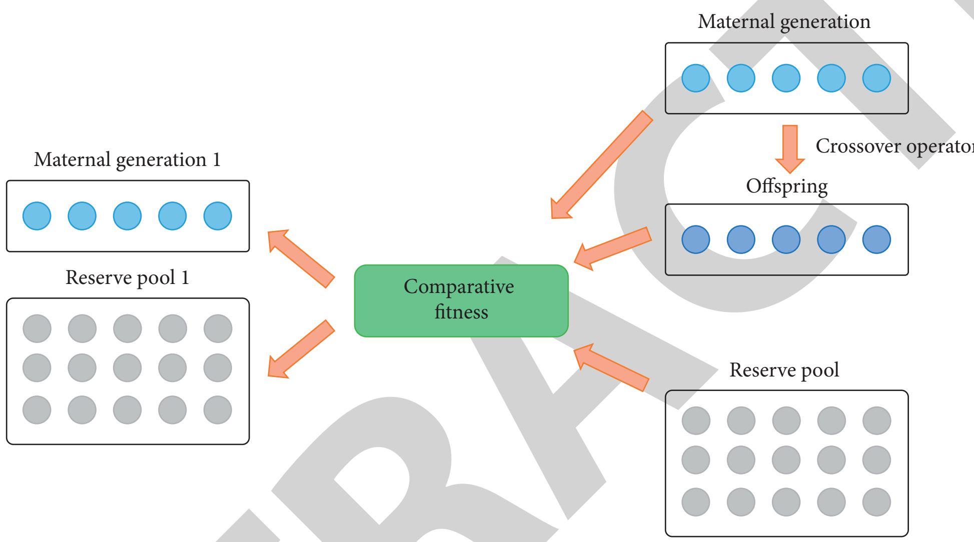

Figure 4: Crossover operator.

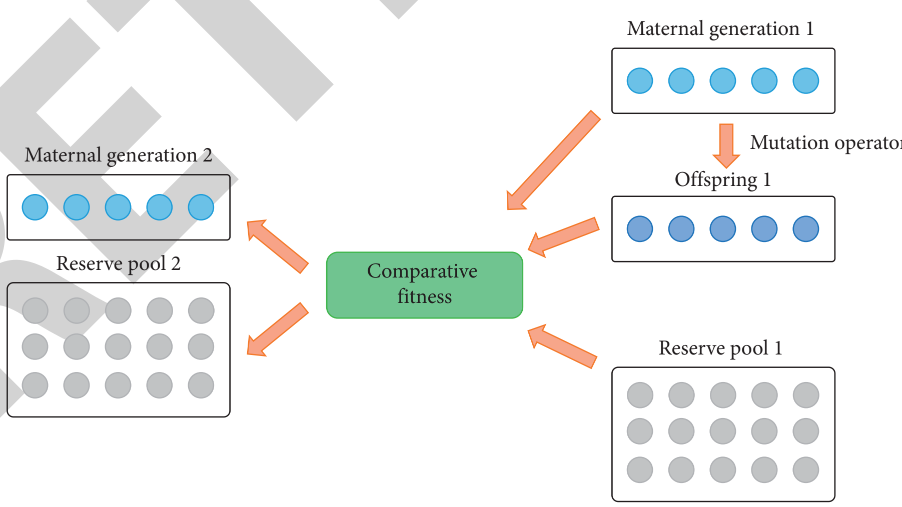

Figure 5: Mutation operator operation.

The operation of genetic algorithm is mainly accomplished by selection operator, crossover operator, mutation operator, and fitness calculation. After the completion of each genetic operation, the fitness was calculated and sorted by comparison, and the individuals with better fitness were retained for the next genetic operation [15, 16]. Figure 6 shows the flow of genetic algorithm.

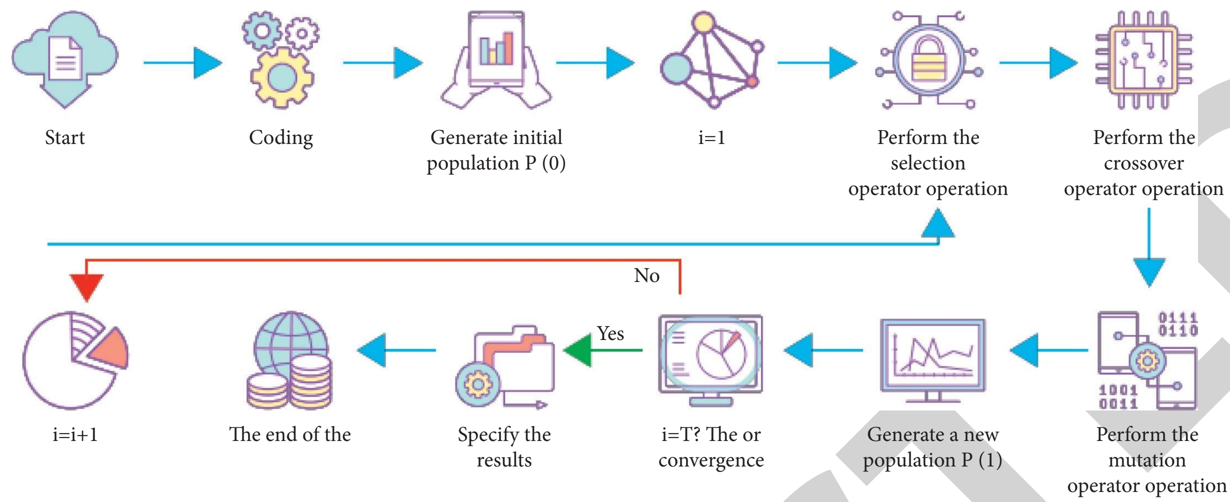

Figure 6: Genetic algorithm flowchart.

3.3. Function Evaluation. The real solution x is converted to a binary number, and the binary 0–1 string formed is used as the chromosome 0–1 string for genetic algorithm. The length of the binary 0–1 string depends on the accuracy of the function solution. For example, in the range [0, 1], the precision is 0.001, then the binary 0–1 string length is 10 assuming that one of the solutions is 0.305, and then it is represented by binary:

$$C\text{: } (0100110111). \tag{9}$$

To convert the binary 0–1 string obtained after the operation of the genetic algorithm into the corresponding real number, the decimal value of the binary 0–1 string needs to be calculated first. For example, the binary 0–1 string D in $[C, D]$ is as follows:

$$D\text{: } (a_1a_2a_3a_4a_5a_6a_7a_8a_9a_{10}). \tag{10}$$

Convert it to a base 10 number:

$$x = \left(\sum_{i=0}^{9} a_i \cdot 2^i\right)_{10} = (a_1a_2a_3a_4a_5a_6a_7a_8a_9a_{10})_2. \tag{11}$$

Then, x corresponds to the real numbers of $[c, d]$:

$$x_1 + c + x \cdot \frac{d-c}{2^{10}-1}. \tag{12}$$

For example, a code string C: (0011110110) with 0.001 precision in [0.1] represents a real number of 0.246.

Based on the accuracy, we can determine that the length of chromosome coding string is 10 and randomly generate 50 binary coding strings to form the initial population, minus Table 1 [17, 18]. After fitness comparison, 10 chromosomes were selected proportionally for genetic algorithm operation iteration process, as shown in Figure 7.

It can be seen from Figure 7 that the fitness increases with the number of iterations and does not increase after reaching a certain point. In this case, the optimal solution is

Table 1: Iterative process.

Iterations	Binary coding	X	Fitness
Step 1	0 1 0 0 1 1 0 0 1 0	0.307	−0.786491
Step 3	1 0 0 1 1 1 1 1 1 0	0.506	−0.750033
Step 9	0 0 0 1 1 1 1 1 1 0	0.504	−0.750012
Step 10	1 1 1 0 1 1 1 1 1 0	0.502	−0.750008
Step 11	0 1 1 0 1 1 1 1 1 0	0.501	−0.750003
Step 16	0 1 1 1 1 1 0 1 0 0	0.500	−0.750001

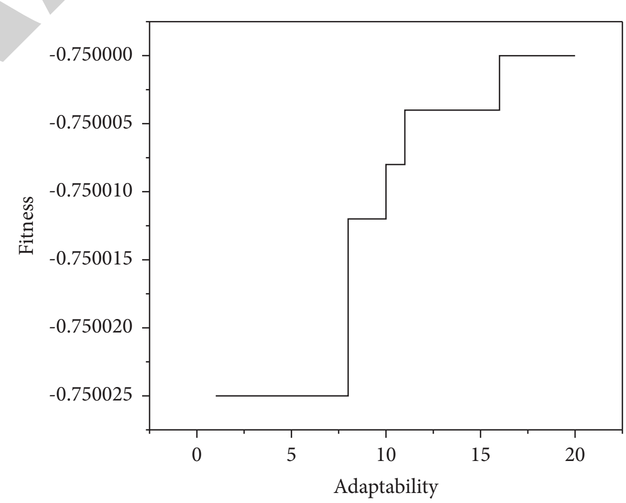

Figure 7: Fitness iteration polyline.

(0 1 1 1 1 1 0 1 000), which is converted into a real number of 0.500, and the maximum value of the function is −0.750000.

When the genetic algorithm iterates to the 118th generation, the result obtained is the optimal solution. Figure 8 shows the broken line of the relationship between fitness and iteration times. It can be seen that fitness decreases with the increase of iteration and does not decrease after reaching a certain value[19, 20]. See Figure 8.

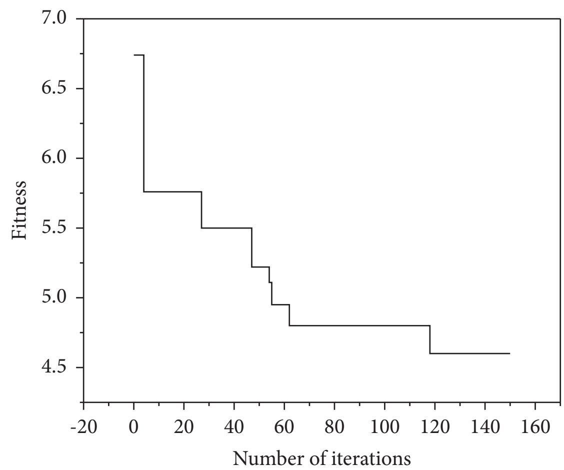

Figure 8: Fitness iteration polyline.

3.4. Algorithm Example. Taking truss structure optimization as an example, the three variables that have great influence on the mechanical properties of the truss structure, namely, the topological form of the truss and the truss shape and the cross-sectional area of the members, are operated by genetic algorithm. The problem can be expressed by the following mathematical model:

$$\begin{cases} \min, \quad \text{fitness}(x) = \dfrac{1.0}{D_{\max} * W}, \\ \qquad s \in \Omega, \\ s.t, \\ \qquad A \in A_0, \end{cases} \tag{13}$$

x is the topological relation of the structure, the cross-sectional area, and the coordinates of the nodes and other variables, $D_{\max}$ is the maximum displacement of the structure, W is the weight of the structure, s is the shape of the structure, Ω is the spatial condition, indicating that the node position should be within the spatial range of the constraint, A is the cross-sectional area, and A_0 is the cross-sectional area condition indicating that the selected cross-sectional area type should restrict the cross-sectional area range.

The shape design under constraint conditions is to meet certain constraints such as displacement and internal force and carry out topology and shape design of the structure [21, 22]. The research focuses on the optimization of truss structure shape under displacement constraints, as shown in Figure 9, where the precision instrument is placed on the structure. The structure produces vertical displacement due to the weight of the precision instrument itself. In order to ensure the accuracy of the measurement of the precision instrument, the vertical displacement of the upper surface of the structure is required to be equal.

The three nodes in the middle of the lower chord in the figure are taken as variables. It is required that all nodes of the upper chord have the same vertical displacement under the gravity of the precision instrument. The following mathematical model can be used to represent this kind of problem:

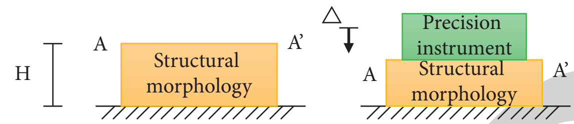

Figure 9: Deformation diagram.

$$\begin{cases} \min \quad \text{fitness}(x) = \dfrac{\sum_{i=1}^{n} \left(\Delta y_i - \overline{u}\right)^2}{n}, \\ s.t \quad s \in \Omega. \end{cases} \tag{14}$$

As shown in Figure 10(a) and 10(b), the topological form of the truss has been given, wherein the ordinate of node 6 is changeable, and point 1 is used as the origin of the coordinate, so the range of ordinate variation of point 6 is [0, 1], with a precision of 0.001. Point 1 and point 5 are hinge supports, and a vertical load of 1 KN is applied at points 2, 3, and 4, respectively. The cross-sectional area of the rods is 2.5 cm^2, requiring that the vertical displacement of the joints of the upper chord of the truss is basically the same. As the vertical displacement of the nodes of the upper chord of the truss is required to be equal, the fitness is selected as the displacement variance, the initial population is 50 chromosomes, the selection probability is 20%, and the mutation probability is 0.01. After genetic algorithm iteration, the results are as follows:

As can be seen from the figure above and Table 2, when the genetic algorithm iterates to the 11th time, the ordinate of point 6 is the optimal solution that meets the constraint conditions, which is 0.486.

As the vertical displacements of the nodes of the upper chord of the truss are required to be equal, the fitness is selected as the variance of the vertical displacements of the three nodes. The initial population is 100 chromosomes, the selection probability is 20%, and the mutation probability is 0.01. After genetic algorithm iteration, the results are shown in Figure 11(a) and 11(b).

It can be seen from the figure that as the number of iterations increases, the truss form obtained changes constantly. When the iteration reaches the 1026 generation, the optimal result is obtained, as shown in Tables 3 and 4.

It can be seen from the above table that when the genetic algorithm iterates to the 1026 generation, the displacement variance between points 3, 4, and 5 is the smallest, and it can be considered that the vertical displacement of the three nodes is equal. As the number of iterations increases, the fitness also increases, and it stops changing when it reaches a certain value. In the figure, when the iteration reaches the 3257 generation, the fitness does not change. The maximum displacement of the final truss form obtained by iteration is 0.1196 mm, and the weight of the truss is 0.3585 t.

4. Architectural Form Design under Geometric Logic

4.1. Factors Influencing the Formation of Complex Architectural Structure Form. There are some complex form buildings, the structure is separated from the external form,

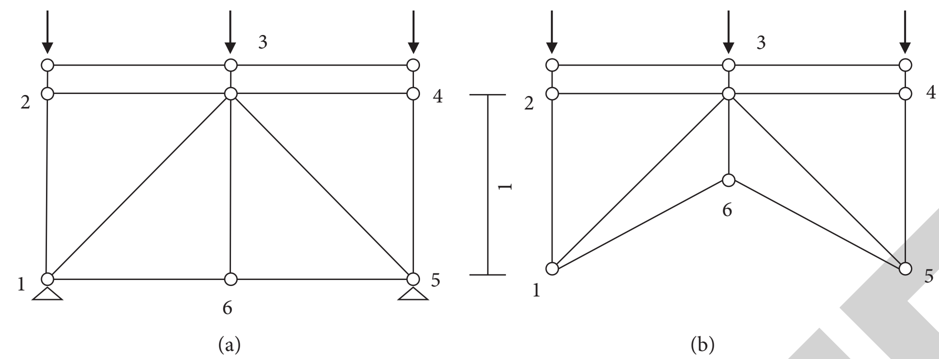

Figure 10: Truss optimization under constraint conditions. (a) Initial conditions. (b) Final shape.

Table 2: Iterative process.

Step	Fitness	Y_3
Step 1	2.513E-07	0.497
Step 5	2.049E-07	0.495
Step 11	3.891E-07	0.486

but it is not that the structure does not conform to the logic of building form generation, but because the building is a very large and complicated system, sometimes in order to achieve different purposes, the structure and form system can also be divided into two corners, and the structure can also be divided into different function systems. Some buildings are complex in shape, but the internal function layout is still in accordance with the traditional floor setting room division. In this case, the structural system of the building can be divided into several parts according to the actual demand, and the structural part most closely related to the shape is obtained by the shape generation logic. The more orderly part of the interior can adopt the simple structure of the traditional beam, plate, and column system. The targeted scheme avoids unnecessary economic losses caused by the complexity of simple problems. For example, in the super high-rise China Respect Project, the central square core tube is a simple part of the whole structural system, while the periphery (the four corners of the square plane) is a complex part of the structure, such as the giant column system and the waist truss system, which change with the change of the building form [23, 24].

4.1.1. Structural Mechanical Factor. The safety, applicability, and durability of structures are directly related to their mechanical properties, so mechanical factors become the primary consideration for the realization of structures. Generally speaking, complex building structural systems have unique mechanical characteristics to meet the realization of complex forms. It can distribute its load and stress effectively to the whole structure system. From the principle of structural mechanics, the structural system can evenly transfer the load, which indicates that it has high efficiency. Therefore, the complex structural system itself has quite high mechanical rationality, which is more in line with the construction logic than the traditional beam, plate, and column system.

Optimization can be divided into two aspects, due to structural optimization, take the form as the optimization variable, adopt the appropriate optimization algorithm, and get the optimal form, this method is also known as the numerical method of creating form, because it involves a lot of expertise in structural engineering.

On the other hand, the finite element software ANSYS and structural design software PKPM are used to analyze and optimize the structural component system after the building surface shape is determined under the influence of structural indicators. The main aspects of the study are static analysis, modal analysis, and buckling analysis, and the secondary components of the structure are tested and analyzed to obtain the optimal solution of its mechanical properties.

4.1.2. Structural and Functional Factor. Under certain circumstances, the establishment of the structural system can provide an interrelated dynamic system for the crowd movement trend function configuration space characteristics; for example, the linear setting of the structure can determine the single path of the crowd flow line. The scale and transparency of the space established by the structure can provide specific modes of behavior or spatial use. This correlation is not only limited to complex structure, but also reflected in the traditional structure, but complex structure can be deduced form the more thoroughly clear. Especially after using the parameterized technology, integration of the behavior of the feature space, and the intelligent programming language through algorithm, such as demand, structure of system becomes more diversified, more relevant, and functional use.

The influence of function on the integration of structure is also reflected in the direct integration of the two. In the process of diversified development of architecture, the boundary between the structural skin and the room has become increasingly blurred. Sometimes, the structure is a functional space, and the space is also reflected by the structure. For example, Toyo ITO Sendai Media Center's design concept is a completely free system of behavior, and no room division, through the beamless floor and seaweed light columns to reflect the structure. These hollow structural columns are cleverly designed as stairwells, elevators,

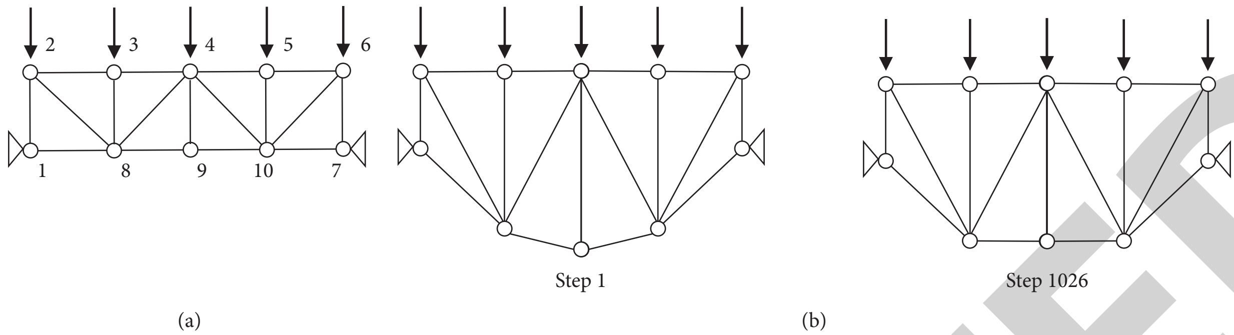

Figure 11: Truss optimization under constraint conditions. (a) Initial conditions. (b) Final shape.

Table 3: Change the coordinates of the nodes.

Iterations	Fitness	8-point ordinate	Nine-point ordinate	Ten-point ordinate
1	1.28E-11	0.59561	0.44943	0.57552
3	6.37E-12	1.24593	0.3582	1.24592
15	4.63E-13	1.0046	0.98342	1.0045
74	4.43E-13	0.85409	0.87443	0.85383
133	3.90E-15	0.40721	0.53047	0.40782
218	5.46E-17	1.21322	1.11779	1.21314
344	2.69E-19	0.82483	0.85166	0.82448
548	2.51E-19	0.91055	0.91117	0.91051
1026	2.12E-21	0.91256	0.91254	0.91224

Table 4: Constrain the displacement of the node.

Iterations	Fitness	4-point displacement	4-point displacement	5-point displacement
1	1.28E-11	−2.1775277E-04	−2.1879394E-04	−2.1367026E-04
3	6.37E-12	−1.9874904E-04	−1.9948945E-04	−1.9870909E-04
15	4.63E-13	−1.2137348E-04	−1.2191081E-04	−1.2137351E-04
74	4.43E-13	−1.1954922E-04	−1.2008521E-04	−1.1959555E-04
133	3.90E-15	−1.2437863E-04	−1.2442926E-04	−1.2439288E-04
218	5.46E-17	−1.2965421E-04	−1.2964772E-04	−1.2965318E-04
344	2.69E-19	−1.1929033E-04	−1.1929005E-04	−1.1929033E-04
548	2.51E-19	−1.1973768E-04	−1.19737798E-04	−1.1973766E-04
1026	2.12E-21	−1.1975644E-04	−1.1975644E-04	−1.1965744E-04

equipment, pipes, and small rest spaces due to their appropriate space accommodation, thus achieving a high degree of integration of structure and function.

4.2. Geometric Logic in Architectural Structural Form Design

4.2.1. Selective Construction Starting Point. From the perspective of thinking method, parametric geometric logic construction is guided by nonlinear thinking method, which advocates flexibility and uncertainty of design process and opposes solidification and stylization of thinking activities. Therefore, parametric geometric logic construction advocates constructors to enter the work of geometric logic construction in different ways. In the process of design, through updating and reconstruction, they can deepen their knowledge and understanding of the design environment and gradually reach a balance state with the design constraints. However, there are many complexities in architectural design. In the initial stage, parameterized geometric logic construction should make design objectives and thoroughly analyze the relationship between various parameters and the environment. Thus, instead of the traditional top-down approach, the construction starts with one or several distinct geometric logics.

4.2.2. Select Parameters. In the process of constructing parameterized logic, it is very necessary to optimize the selection of variables. Only by selecting the correct parameters, can the parameterized geometric model be controlled in the best way. Generally speaking, the parameters should be selected to meet the requirements of architectural form control precision as the basic conditions, and the number of parameters should be set in accordance with the principle of less to more on this basis and tries to set the parameters in the initial stage of geometric logic construction and reduce the parameter adjustment in the construction process. In the design, the architect first performs a logical analysis of the target geometry and draws a logical framework on the computer, then writes a script and debugs it. Debugging is an important part of programming and is the most common solution architects use when logical relationships are unclear. Debugging can not only verify the correctness of the program function, but also provide inspiration and enlightenment to the constructor in the process of solving mistakes. It is a dynamic feedback process. In addition, the geometric form of architectural form usually has some relatively stable topological structure and internal laws. Architects can also rely on mature algorithms or functions to carry out parametric construction work, such as using existing functions in MATLAB and Mathematica to directly generate hyperboloid minimal surface. In a word, the process of finding logical relations and establishing models in parametric geometric logic construction can be illustrated in Figure 12.

4.2.3. Output. Theoretically, the process of parametric geometric logic construction is finished after the parametric model is obtained, but in practical work, the parametric model is not the real result required by architects, and it needs to be further output as a solid model for subsequent work such as rendering, animation, and 3D printing. For projects that need to be built and implemented, parameterized software not only needs to provide the building model to the manufacturer, but also needs to provide the management database of all production components synchronously, including naming rules, positioning parameters, and material attributes. The output of the result is the last step of the construction of parametric geometric logic and also the key link of transforming the construction of parametric geometric logic from thinking consciousness to material form. At present, the file output formats of various parametric software and digital manufacturing software are not unified. Architects often need to convert file formats among various software. Generally speaking, file formats with small storage space have good compatibility, but the model accuracy is not enough, and it is easy to lose information. File formats with high accuracy are perfect for the storage of various information of parameter models, but occupy a large space and process slowly. Therefore, architects need to consider the output of results in the initial stage of geometric logic construction. Currently, the commonly used output formats are 3 ds file, igs file, obj file, and so on.

4.2.4. The Combination of Parametric Design and Construction Techniques. The construction method of parametric geometric logic can be summarized as the following six steps:

a) Find the internal law
b) Formation law
c) Using parametric tools to transform the law into computer program
d) Debugging program
e) Result feedback
f) Program optimization
g) ……
(d)–(g): Repeat cycle steps (d) - (g)
h) The ideal parameter model is obtained

Figure 12: The process of finding logical relationships and building models.

(5) The combination of parametric design and local construction techniques.

Parametric geometric logic construction method has strong adaptability and can provide parametric solutions in different regions and different ideologies. It is an effective innovation approach for northern Xinjiang. But under the strong and accurate control of parametric geometry construction, to achieve a short time of fine construction requires the cooperation of high-precision CNC equipment, which is not consistent with the construction truth in Xinjiang [25]. Therefore, it is necessary to combine parametric geometric construction with low-tech technical construction in the later stage. At the beginning of the design, the convenience of artificial construction and the use of low-tech strategy should be considered, and local technologies and materials should be used according to local conditions. Improve the readability of drawings, and interpret the construction of each detail to workers by using construction manuals with a large number of 3D detail model disassembly at the construction site. At the same time, we pay attention to the decomposition and simplification of difficult problems, and give each project participant the most simple and clear task, so as to achieve comprehensive overall and efficient control.

5. Conclusion

In the context of nonlinear and complex architecture, geometry has become an indispensable tool in the design and construction of buildings. On the one hand, the architecture makes use of advanced geometry principles to generate rich algorithms and mathematical models in the generative logic. On the other hand, geometry, as a practical tool, deals with the referential meaning of geometric symbols, the complex relationship between geometric figures and the exact size. It should be pointed out that in the whole process of realizing the structural system of the base control surface and the skin system, the architectural form control is in a process of constant optimization considering many variables and complex factors. Therefore, the construction of geometric control system is a precise control of the architectural system. More accurately, it is a process of finding the optimal solution that is most suitable for the material and spiritual context of the building in the process of constantly running in with diversified systems such as culture, aesthetics, environment, ecological structure, and material structure. From the perspective of architectural shape design requirements, this study focuses on the key points of architectural structure shape design with the help of genetic algorithm and geometric logic. The results show that, after 3257 iterations, the fitness does not change, the corresponding maximum is only 0.1196mm, and the weight of truss structure is 0.3585t. It shows the structure design based on geometric logic and genetic algorithm. It can effectively meet the constraints of the architectural shape optimization design. The application of geometric logic should be the stage of controlling the design from the whole system and the whole construction system, which makes the realization process of complex form architecture become an interlocking and efficient docking process. Because of the materiality of architecture, it is not a beautiful idea but a functional space that needs to be put into practice. Therefore, in the whole design and construction process, it is restricted by the actual space construction technology, material characteristics, structural means, and many other aspects. This paper first uses advanced geometric principles to generate rich algorithms and mathematical models, and then improves the traditional genetic algorithm in terms of fitness value function calibration and population diversification. Convergence, low precision, large randomness, and other problems are applied to the optimization design of building structures, the application of geometric logic can better meet the actual needs of building structure optimization engineering, the practicability has been greatly improved, and it has scientific reference value.

Data Availability

The labeled data set used to support the findings of this study is available from the corresponding author upon request.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

Acknowledgments

This work was supported by the Hebei University of Water Resources and Electric Engineering.

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