ISSN 1330-3651 (Print), ISSN 1848-6339 (Online) https://doi.org/10.17559/TV-20241112002124
Original scientific paper

Research on Landscape Design of Chinese Literati Garden Based on Footprint Agglomeration Analysis from the Perspective of Ecological Aesthetics

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Abstract: Looking at the traditional Chinese culture, ecological aesthetics has a distinct expression in garden literature. Literati garden has dual attributes of culture and art, and is the ideal carrier for elegant collection activities. The garden scenery is rich in literature, and the scenery is prominent in literature and scenery, which makes the participants happy and enjoy endless taste. Mu Wen proposed a big data analysis method of location association and aggregation based on the cluster analysis of the footprints of literati groups. Based on the moving footprint data of literati, he demonstrated the research on landscape design of Chinese literati gardens. From the data of 110,000 footprints in the field of humanities, he used the location association technology of GIS to form footprint maps and construct the migration network map of literati. The spatial PageRank algorithm is used to calculate the cultural attraction, which intuitively presents the gardens where scholars gathered in different periods. The feature visual reconstruction and spatial distributed detection of landscape spatial environment design images were carried out by combining the template matching method of block areas. In order to visually recreate landscape spatial environment design images, the similarity information fusion model was used to perform landscape art information fusion perception and template matching of block areas. Using the footprint aggregation analysis method, garden art landscapes can have their information fusion perception and visual reconstruction quality evaluated. According to the simulation results, this method successfully recreates the artistic elements of the landscape spatial environment vision while also having a high output signal-to-noise ratio, high image recognition accuracy, and a good overall effect on the landscape spatial environment design.

Keywords: ecological aesthetics; footprint clustering analysis; interactive ecological aesthetics perspective footprint aggregation analysis algorithm; similarity information fusion; scholar garden landscape

1 INTRODUCTION

Ecological aesthetics, as defined by Chinese scholars, reflects on the theoretical dilemma in the current aesthetic field with the holistic and intersubjective thinking mode of ecology, so as to establish the theoretical form of ontological aesthetics that ADAPTS to the needs of social development. Ecological aesthetics takes the harmonious coexistence of man and nature as the aesthetic object. Different from unilaterally judging from the object itself, ecological aesthetics integrates the elements of nature and pays attention to the subjective aesthetic needs of man while paying attention to the objective existence. The artistic conception beauty of literati gardens is caused by people traveling in the landscape, feeling the feelings revealed by the entities such as rocks, flowing water, trees and flowers, and resonating with the gardeners in spirit. Many of them are the revelation of thought, emotion and subjective consciousness. While landscaping the landscape environment, landscape design provides activity space for people, where people can communicate and relax and release tension. It is an objective space composed of elements of landscape design; of course, landscape design also has its theme beauty [1].

What they have in common is that they provide a beautiful environment for people. The difference is that literati garden is a closed garden for a few people, a kind of "unique paradise", which can be two different worlds from the outside of the garden, while modern landscape design serves the majority of people, provides public activity space, is open, and integrates with the whole garden environment, and plays a role in inheriting the history and context of the garden [2]. But whether there are many people or few people, the ultimate goal is to serve people. The artistic conception beauty of literati gardens is to mobilize the passion of visitors through various gardening techniques of gardeners, and achieve resonance, and experience the infinite beauty of nature [3]. From another point of view, landscapers symbolize natural beauty through the beauty of the landscape in the garden, using a special language - the various emotions reflected in the elements of the garden, and the beauty reflected in the elements of the garden is summed up from calligraphy and painting and nature. The viewer can experience the harmonious beauty between man and nature, which shows that the viewer has the ideological consciousness and character to accept this emotional transmission, and can resonate with the gardener's thinking mood. There is no barrier between the transmitter and the receiver, and their understanding of the natural beauty of the garden is on the same level. Of course, the elements of the garden play the role of the main intermediary.

Taking modern garden landscape design as the starting point, this paper analyzes the relevant theories and landscape elements of literati garden elegant collection activities and residential landscape design, extracts activity elements from literati garden elegant collection activities as six nodes (ceremony, tea, painting, piano, learning, incense), and seeks the connection and continuation of the space of literati garden elegant collection activities and modern residential landscape space. This paper's goal is to provide a concise overview of the theory and practice of landscape architecture as it pertains to contemporary residential areas, and it then proposes an approach to landscape space environment design that is based on an algorithm for footprint aggregation analysis as the ideal way. A model for fusion reconstruction using fuzzy pixel regional features and a system for spatially distributed feature recognition in landscape spatial environment design images are developed. In order to bring the landscape art design to life, the visual reconstruction process of landscape spatial environment design images is carried out using the similarity information fusion model, which carries out the fusion perception of landscape art information and the template matching of block areas. The last step is to run the simulation and analyze the results, reach a conclusion about the veracity. Additionally, they serve as a basis for future landscape design projects and are utilized in the planning of particular residential districts. The first chapter is introduction, the second chapter is related work, and the third chapter is data and analysis methods of footprint aggregation from the perspective of ecological aesthetics. The fourth chapter is optimization design of landscape space environment based on footprint aggregation analysis algorithm; the fifth chapter is simulation verification, and the sixth chapter is conclusion.

2 RELATED WORK

Ecological aesthetics makes landscape design both ecological and aesthetic benefits, so that nature and humanity are unified. Ecological aesthetics is a new thinking on the aesthetic relationship between man and nature, man and society, man and culture, and a new aesthetic of landscape art from the perspective of ecological civilization. Under the current development trend of globalization and internationalization, ecological aesthetics is the development direction for the future and will become a new aesthetic of landscape design, bringing landscape design into a new realm of transcending nationalities and displaying the characteristics of The Times, and forming a new concept of landscape design that takes nature as its teacher, co-existence with nature and integration with nature [4, 5]. Ecological aesthetics is a new direction of modern landscape design that shows human concern and recognizes that nature is more in line with modern people's aesthetic and psychological needs than artificial decoration [6]. Nowadays, people's vision is becoming more and more open, and a new aesthetic concept is gradually exerting its influence. This new aesthetic idea is ecological aesthetic idea. Designers should use more ecological measures, choose ecological materials, do not cause secondary damage to the environment, and provide high-quality living environment for villagers [7,8].

Using visual image processing methods, we can study and extract features of garden landscape spatial environment, create a visual reconstruction model of design images for garden landscape spatial environment, and enhance our ability to identify and reconstruct artistic features of garden landscape spatial environment. This is all made possible with the development of computer vision information processing technology [9, 10]. To enhance the capacity to recognize visual characteristics, it is possible to implement garden landscape spatial environment design and visual picture reconstruction [11, 12]. To achieve landscape spatial environment design and optimization recognition, the essential feature quantity of the landscape spatial environment design picture is built, and pixel tracking and fusion technology is utilized. Many people are interested in learning more about related methods of landscape spatial environment design.

The author expounds that "literati garden not only expresses the communication between garden and poetry and painting in gardening techniques and techniques, but also integrates literati officials' independent personality, values and aesthetic concepts as the soul of garden art." [13, 14] and a systematic summary and summary of its development process, and a general description of the development of literati gardens. In Chinese literati Painting and Literati Freehand Garden, the influence and function of literati painting on the aesthetic appreciation of literati garden are analyzed from the development track, style characteristics and artistic conception creation of literati garden, and it is believed that the two are consistent in aesthetic aspirations [15, 16]. In the Art of Literati Gardens of Ming and Qing Dynasties, it is pointed out that the aesthetic level of literati gardens also affects the aesthetic view of literati gardens. By comparing literati gardens with royal gardens, it is analyzed that compared with other types of gardens, the most important feature of literati gardens is "literati sense" [17, 18]. In "Literati Gardens", the author focuses on the freehand features of literati gardens, and summarizes the influence of literati's personality ideal, daily life and ideal pursuit on literati gardens [19]. The value of literary garden artistic conception beauty in modern landscape design is mainly reflected in the following aspects. First of all, it is reflected in the inheritance and innovation of traditional culture. After more than a thousand years of development and evolution, the literati garden integrates the aesthetic thoughts and cultural attains of Chinese literati, enscribes the noble character of literati in the character of all things in nature [20, 21]. Such as ethics, blessing, etiquette, architecture, etc., can be found everywhere in the various elements of the garden, the ancient literati can find such a way to express culture [22, 23], and continue to shine bright light after thousands of years, indicating that this is a way acceptable to everyone and can continue to pass on. On the one hand, modern landscape design is to provide people with leisure and entertainment space, and more importantly, to convey the information of beauty to the public and create a beautiful public space environment. The way of conveying the artistic conception of literati gardens can be fully applied to landscape design [24, 25], so that landscape components can become a carrier of traditional Chinese culture inheritors. Literati gardens are maturing in evolution, while modern landscape design must innovate in inheritance to pass on culture [26]. Rocks and ponds, plant architecture, color and light are also elements of landscape. Therefore, traditional culture can continue in these carriers, and new organizational forms can be used to apply these elements in landscape design [27], so as to continue to express the profound heritage of traditional Chinese culture, create a landscape type that mimics the natural landscape pattern, and refine the internal concept and space construction method contained in Yaji activity space by referring to relevant case design, and apply it to modern residential landscape [28, 29]. As an important carrier of the values and concepts of ecological civilization in China, landscape architecture in China has a new interpretation of the landscape space of modern residential areas based on the perspective of literati landscape architecture activities, and has continued to inherit and develop the internal ideas of the literati landscape architecture activities and the construction mode of the space in which it is located. Both have profound significance in culture and positive influence in reality.

3 DATA AND ANALYSIS METHODS OF FOOTPRINT AGGREGATION FROM THE PERSPECTIVE OF ECOLOGICAL AESTHETICS

PageRank (PR) was originally a method to sort web pages and measure the importance of websites, and this algorithm has been applied in the quantitative calculation and ranking of network nodes, such as measuring the connectivity of blocks [30]. GIS spatial analysis can effectively support spatial network analysis and pay more attention to the attribute information represented by each edge of the network. For example, economic activities among gardens and interpersonal relationships among people in different gardens [31]. The spatial network model of population flow and the web link model targeted by PR algorithm have some similarities and differences in details. The traffic from one garden to another in geographic space can be likened to the hyperlink mode between web pages, and the PR algorithm can be used to analyze the population flow and agglomeration characteristics between different gardens, and the movement of literati between different gardens can be regarded as a "vote" on the garden. This paper introduces the literati moving flow and garden distance into the PR (PageRank) algorithm: Literati flow. In the garden network model, the literati flow of the two gardens has A magnitude, that is, how many literati have carried out spatial migration from garden A to garden B. Garden distance. In the garden network space, distance directly constitutes the most important cost and resistance to flow, which is also in line with the characteristics of ancient transportation. The variable definitions are shown in Tab. 1.

Table 1 Variable definitions

Variable	Meaning
z	template image
x	search image
$f(j)$	flow of literati
$D(j-i)$	distance between gardens
p	context boundary
j	hidden layer's node
k	output layer's node

The table of the abbreviations meaning is shown in Tab. 2.

Table 2 Abbreviations meaning

Abbreviations	Meaning
PR	PageRank
SRDCF	Learning Spatially Regularized Correlation Filters for Visual Tracking
DCF	Discounted Cash Flow) framework

In order to facilitate the calculation and analysis, the distance of two gardens is directly added into the algorithm as a weight factor. The PR algorithm formula after spatializing the flow of literati and the distance between gardens is as follows:

$$PR(i)=\frac{1-\sigma}{n}+\sigma\sum_{j=1}^{n}PR(j)\times f(j)\times D(j-i)^{*} \quad (1)$$

By analyzing the function and judging the obtained information based on three-dimensional picture simulation judgment, we can better understand the correctness of collecting spatial feature data. This procedure is both essential and accurate in guaranteeing the distribution of the simulated garden's spatial features. The analysis is shown in Fig. 1.

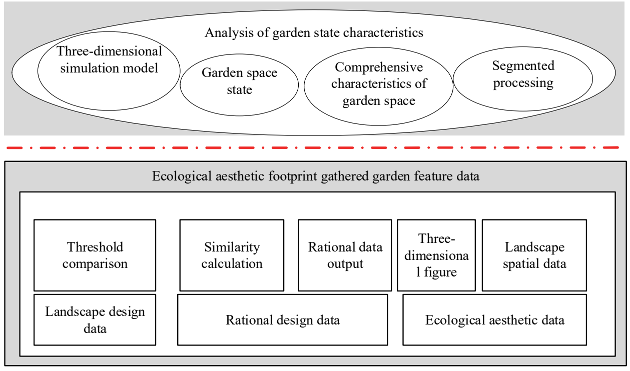


Figure 1 Analysis of the state characteristics of scholar gardens with footprint aggregation from the perspective of ecological aesthetics

3.1 Garden Landscape Based on the Clustering of Literati Footprints

According to the changes of dynasties, the mobile footprints of 328 representative literati during the Tang and Song dynasties were divided into four sets of data: 618-770, 771-907, 960-1127, 1128-1279 (908959 is the Five Dynasties period, with less data and no analysis). The Tang Dynasty was divided into the early and late Tang Dynasties based on the An-Shi Rebellion, and the Song Dynasty was divided into the Southern Song Dynasty and the Northern Song Dynasty. Fig. 2 shows the tracks of literati in each period.

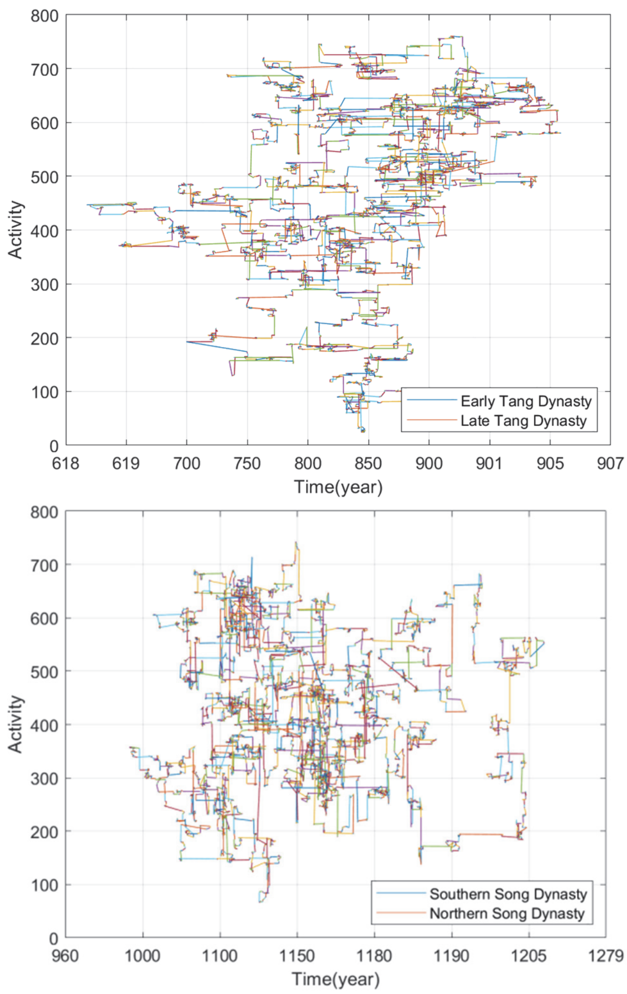


Figure 2 Movements of 328 literati in Tang and Song dynasties

Although the superposition map of literati tracks can intuitively show the activity of literati in different regions in different periods of Tang and Song dynasties, this method can only show the footprints of literati in Tang and Song dynasties and the traversed gardens statically. Although the superposition of literati tracks can show the possible relationship between gardens, it does not have the ability of quantitative comparative analysis, and does not consider the relationship between gardens. In this paper, the spatial PR algorithm is used to calculate the PR values of gardens in different periods, which not only assigns weights to gardens according to "literati flow", but also introduces the influence of geographical locations of different gardens in cyberspace, that is, not only the number of departure gardens, but also the influencing factors of departure gardens, including the attractiveness of departure gardens, distance between gardens and the number of people circulating between gardens. The combination of the two can obtain a more scientific evaluation of the cultural attractiveness of gardens, and can better evaluate the change of the cultural attractiveness of different gardens with the change of dynasties. Tab. 3 shows the ranking and quantification value of garden attractiveness based on the accumulation of literati footprints.

Table 3 Ranking and PR value of the top 20 urban gardens of literary attractiveness in the four periods of Tang and Song dynasties

City	Early Tang Dynasty	Late Tang Dynasty	Northern Song	Southern Song
	PR	PR	PR	PR
Xi 'an	0.0959	0.1036	0.1172	0.0779
Luoyang	0.0422	0.0363	0.0130	0.0145
Chengdu	0.0068	0.0087	0.0071	0.0072
Shaoxing	0.0066	0.0076	0.0063	o.oo6g
Wuhan	0.0065	0.0075	0.0062	0.0066
Shangqiu	0.0064	0.0071	0.0059	0.0066
Zhenjiang	0.0061	0.0070	0.0055	0.0064
Suzhou	0.0061	0.0068	0.0054	0.0060
Yueyang	0.0061	0.0067	0.0053	0.0060

The spatiotemporal regular correlation filter tracking algorithm is used to identify small targets in literati garden scenes, which is a more powerful appearance model than SRDCF (Learning Spatially Regularized Correlation Filters for Visual Tracking) tracking algorithm. It integrates space and time regularization into the DCF (Discounted Cash Flow) framework. By converting the original optimal model into multiple sub-models, the algorithm improves the model solving speed and thus the target tracking speed.

$$\begin{cases} f = \gamma \| \sum_{d=1}^{D} x_i * f_d \| + u \| f - f_i \|^2 \\ q = \sum_{d=1}^{D} \| w * q_d \end{cases} \quad (2)$$

For any object tracking problem, similarity learning can be used to solve it. The learning function compares the template image z with the search image x, and the score is relatively high for two images with the same target, and low for two images with different targets.

$$f(z,x) = \varsigma(z) * \varsigma(x) \quad (3)$$

During the training process, the error between the actual frame and the predicted frame is calculated using the logistic loss function. Loss function:

$$h(y,s) = ln(1 + \exp(-ys)) \quad (4)$$

If the size of the original bounding box is (c,d) and the context boundary is p, the scale factor p is selected so that the area of the scaled rectangle is equal to the constant A.

$$\begin{aligned} & s(c+2p) \times s(d+2p) = 127^2 \\ & p = \frac{c+d}{4} \end{aligned} \quad (5)$$

3.2 South Migration of Chinese Literati Garden Landscape is Demonstrated Based on Literati Footprints

The analysis of literati agglomeration calculated according to the literati track in different periods can reflect the distribution and change of landscape distribution in Tang and Song dynasties. From the perspective of data visualization, the overall pattern of the concentration centers of literati in Tang and Song dynasties is as follows: the concentration centers of literati in Tang Dynasty were in the north, and the Northern Song Dynasty began to change to the south. In order to explore the details of the specific southbound movement, this paper divides China into the south and the north with the Qinling Mountains and Huaihe River as the boundary, and then classifies all literati footprints according to the 20-year resolution. The PR value of cultural attraction of each city in each period was calculated, the sum of PR values of the northern and southern cities was counted, and the difference of PR values of the northern cities minus PR values of the southern cities was used to draw a quantitative north-south attraction change curve, as shown in Fig. 3.

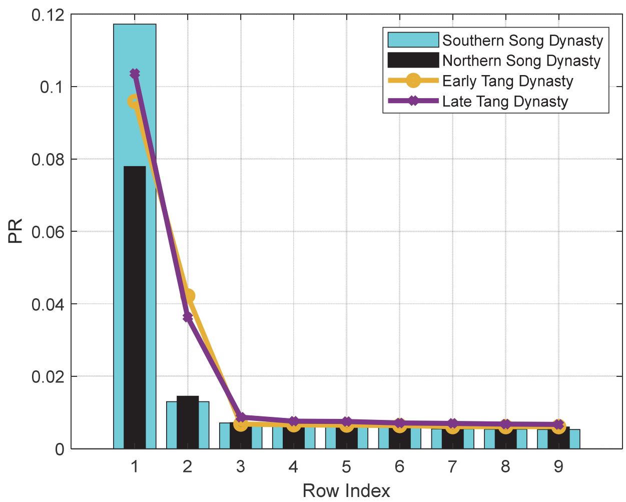


Figure 3 Change curve of cultural attraction between the South and the North in Tang and Song dynasties

The use of remote sensing devices to create a two-dimensional model of the cityscape allowed for better coordination of the landscape's general plan and more efficient landscape design. Preprocessing the initial urban remote sensing image and then segmenting and reassembling the processed image is necessary for accurate spatial positioning of the remote sensing data due to issues such as periodic noise, excessive redundancy, mountain shadow, etc. When dealing with images with higher levels of noise, it is common practice to smooth the image before obtaining the noise derivative and processing the differential operator.

To improve the realism and realism of textures in 3D landscape production, it is crucial to choose the best texture paths. The ant colony method with positive feedback principle is utilized to develop the model for the problem of texture path selection during 3D landscape generation, which is seen as the optimal path planning problem under many convergence circumstances. From the root of the problem, we can see that the texture path serves as the empty question range; we have a full graph representing the ideal problem scale, which we can use to assign adjacency moments; and in every path along this graph, we can simulate the ant's wood body acting as the agent. The following traits are also hardcoded into the ant colony algorithm for every individual ant: The distinctive pheromone on the passing path was retained by each ant and was tied to the path selected by the ant each time the whole graph's path was traveled.

To make sure that heuristic information is not buried by feature pheromones, the ant should update the pheromone after each cycle. Then, during the $t + n$ phase, you can change the quantity of information in path (i, j) using this formula:

$$\tau_{ij}(t+n) = (1-p)\times\tau_{ij}(t) + \Delta\tau_{ij}(t) \tag{6}$$

Nodes in the network typically employ real integers as their weights, and the encoding mode is binary bit string. The approach uses real-number encoding, which shortens the string.

Uneven distribution of solution questions is a common result of population initialization due to the randomness of the beginning population. Properly selecting the character length and population specifications, having a large number of patterns and diversity, improving the morphological order of the initial population individuals, transforming the initial solution of the optimization problem into individuals in advance, and using artificial methods to generate the remaining individuals of the initial population in the problem solution space are all necessary. To speed up the search, we can determine the range of each extreme point in the first generations of the population.

In order to accomplish landscape information fusion processing, a Back Propagation (BP) neural network was trained using this basis. Fig. 4 shows the three-layer architecture used by the BP neural network.

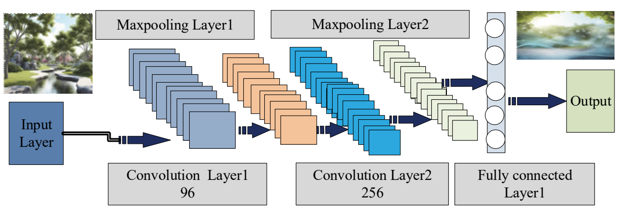


Figure 4 Neural network architecture diagram of literati garden landscape

Here is the fundamental procedure for calculating:

The JTH node input to the hidden layer is used for forward calculation of the network's output:

$$net_j = \sum_j w_{ij} o_i + \theta_j \tag{7}$$

The hidden node J's connection weight to the input layer i is denoted by w, and O_i is the node input to the input layer L.

This is the description of the output analytical statement of the hidden layer's node j:

$$a_j = \frac{1}{1+e^{net_j}} \tag{8}$$

For the output layer's node k, the input is:

$$y_k = \sum_i V_{kj} a_j \tag{9}$$

4 OPTIMIZATION DESIGN OF LANDSCAPE SPACE ENVIRONMENT BASED ON FOOTPRINT AGGREGATION ANALYSIS ALGORITHM

4.1 Landscape Space Environment Design Image Acquisition

We build a pixel space fusion model of the landscape spatial environment design images, use the feature matching method to detect features in the images, and then do sparse feature reconstruction of the images so that we can realize the design and visual reconstruction of the landscape based on the footprint aggregation analysis algorithm. As illustrated in Fig. 5, the feature points of the landscape spatial environment design photos were matched using the Atanassov extension approach, and a template matching model was built for the visual reconstruction of these images.

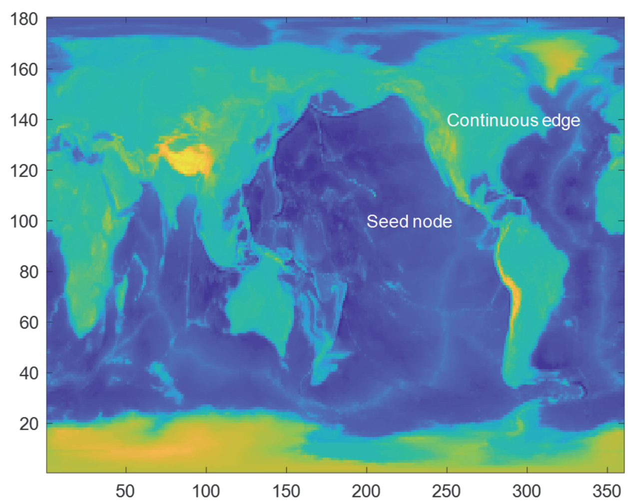


Figure 5 Template matching model of landscape spatial environment design

To build the feature vision reconstruction model of the landscape spatial environment design image, we assume that the gray pixel set is (i, j) and use it as the pixel center. Then, we use the sharping template block combination method to construct the model. Spatial environment design images captured in the k sub-band have their grayscale values split up into a space for feature distribution in the grayscale pixels. A picture of a landscape's spatial context can have its matching gradient feature component created in this way:

$$p_{rk} = \frac{\sum_{j=1}^{c} I_{wk}(r,k)}{c} \tag{10}$$

In this context, c denotes the column number of the LGB vector quantization matrix pertaining to the garden landscape spatial environment design image, while r represents the motion fuzzy characteristic quantity. By integrating the fusion reconstruction technique of fuzzy pixel regional characteristics, a distributed pixel set representing the spatial environmental art features of garden landscapes is derived. This facilitates the information reconstruction and three-dimensional perception of garden landscape spatial environment design images, thereby enhancing environmental design capabilities.

The visual feature reconstruction model for garden landscape spatial environment design images, together with the visual feature distribution, is as follows:

$$G(x) = \sum_{j=1}^{p} G_j(x) \tag{11}$$

For the purpose of reconstructing the image vision of landscape design, the adaptive fusion approach was utilized, and the edge vision reconstruction model of landscape space environment design was built. Following is the method that was used to obtain the fuzzy proximity function of the landscape space environment image:

$$fitness(x) = f(x) + \sum_{j=1}^{p} G_j(x) \tag{12}$$

Develop the perception and fusion model for the integration of garden art landscape information, and derive the fitness function for this information fusion as follows:

$$fitness(x) = \begin{cases} f(x) \\ 1 + rG(x) \end{cases} \tag{13}$$

Taking into consideration the design of the landscape space environment, the gray pixel level well utilizes the gray invariant moment feature decomposition approach in order to construct the resolution model of the landscape space environment vision. The reconstruction model of the landscape space environment vision y is obtained in the following manner:

$$w(x, y) = e^{k \ln(x)} \times \frac{K}{\sqrt{y}} \tag{14}$$

Following the evaluation of the precision of the data that was gathered, the simulation of the spatial feature distribution of the garden that is based on the fuzzy clustering algorithm is broken down into three stages:

To begin, the data will be standardized.

By taking this step, interference that is brought on by index characteristics and orders of magnitude can be effectively eliminated. Following the completion of the standardised processing, the characteristic index values of all of the sample information are transformed into values that fall within the range of [0, 1]. Additionally, the standard deviation and average value of the JTH feature of n samples are computed. It is as follows that the expressions are:

$$s_j = \sqrt{\frac{1}{n} \sum_{j=1}^{n} (x_{ij} - \bar{x})^2} \tag{15}$$

Combined with the extreme value standardization formula, the standardized data is compressed into the closed interval [0, 1]:

$$x_{ij} = \frac{x'_{ij} - x'_{j\min}}{x'_{j\max} - x'_{j\min}} \tag{16}$$

In the second step, you will create a fuzzy similarity matrix and then produce a new matrix based on the enhanced similarity degree coefficient.

When it comes to calculating the similarity degree coefficient, there are a few different approaches. In this particular piece of research, the similarity matrix and the distance matrix are brought together, and the resulting equation is as follows:

$$r_{ij} = \frac{c_{ij} + d_{ij}}{2} \tag{17}$$

To proceed to the third step, compute the fuzzy equivalence matrix.

In order to create fuzzy similarity matrix RX, which possesses the property of footprint aggregation analysis from an ecological aesthetic point of view, the transfer closure of fuzzy similarity matrix R is carried out.

Step 4: Determine the threshold that is most appropriate.

The cluster pedigree diagram that was generated and chosen in connection with the practice can be used to establish the threshold value with some degree of accuracy.

4.2 Literati Landscape Design Optimization

The method of gradient descent was utilized in order to reconstruct the spatial environment vision of landscape architecture into regional blocks. This was done in order to ensure that the sparse feature values of the spatial environment design images of landscape architecture were satisfied. The results of the sparse prior representation were used to determine the ideal visual reconstruction threshold at the m frame (x, y) of the spatial environment design image Fm. This threshold was obtained. Template matching of landscape spatial environment design photos is carried out using the approximate sparse representation approach. The matching coefficient is calculated as follows, and it is written as follows:

$$g_i^* = \begin{cases} Rs_j, z \le i \le x - y \\ g_u \end{cases} \tag{18}$$

R is a standard constant that is used in the formula. It is combined with the block area template matching method in order to carry out landscape spatial environment design and distributed detection. Additionally, the contour point matching model is utilized in order to extract the edge features of landscape spatial environment design. The following is the greatest gray value that can be achieved by the image analysis component of the landscape spatial environment designed:

$$n_{pg} = \frac{u_{pb}}{u^{\gamma}} \tag{19}$$

In order to carry out the visual reorganization of garden landscape spatial environment design, methods such as sparse representation and super-resolution reconstruction were utilized. Additionally, a footprint aggregation analysis algorithm was utilized in order to achieve the fusion perception of garden art landscape information. In order to obtain the information reconstruction model of the garden landscape spatial environment design, the following instructions were followed:

$$g(x, y) = f(x, y) + \varepsilon(x, y) \tag{20}$$

A feature expression model for the landscape was built, an information fusion model for the vision of the landscape was built using the local feature adaptive feature matching method, and the segmented area template matching method was used for the feature vision reconstruction of the landscape spatial environment design images. Data fusion in garden art landscapes is best shown through the following lenses: ecological aesthetics, footprint aggregation analysis, and evolutionary optimization.

$$g = k \otimes f + n \tag{21}$$

This is where the operator ⊗ for convolution is represented. We build a visual feature decomposition model of the landscape spatial environment by applying vector set fusion processing on the gathered photographs of the design. Here is how to get the highest quality feature value for landscape spatial environment vision:

$$s_{ppm}(t) = \sum_{j=0}^{p} p(t - iT_p - c_j T_c - a_i \varepsilon) \tag{22}$$

Fig. 6 shows the block model of the garden landscape spatial environment design that is derived by footprint aggregation analysis.

Adding gray correlation constraints to determine the final matching points, the image pixel decomposition model is expressed as:

$$x(t) = \sum_{m=1}^{M} \sum_{k=1}^{K} w_{nk} s(t - T_{mk}) \tag{23}$$

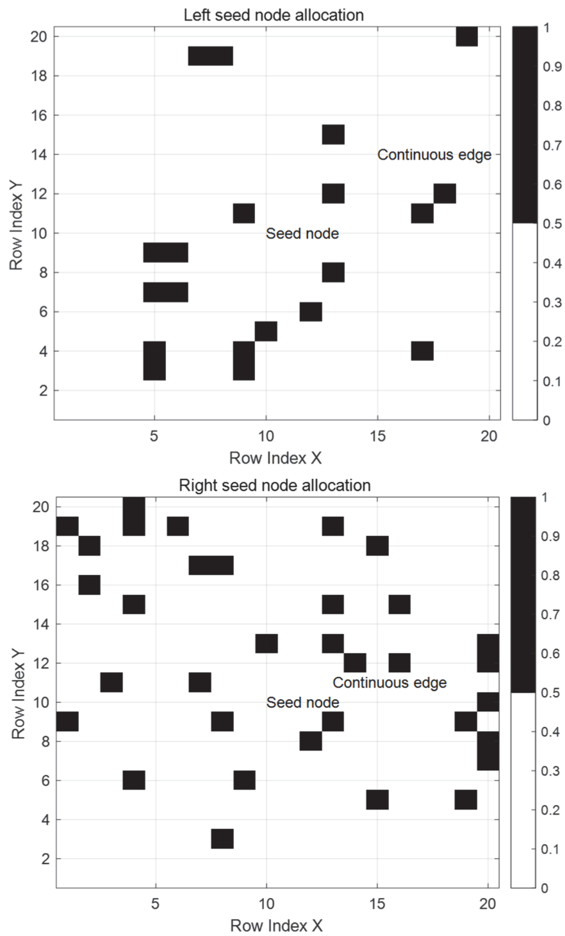


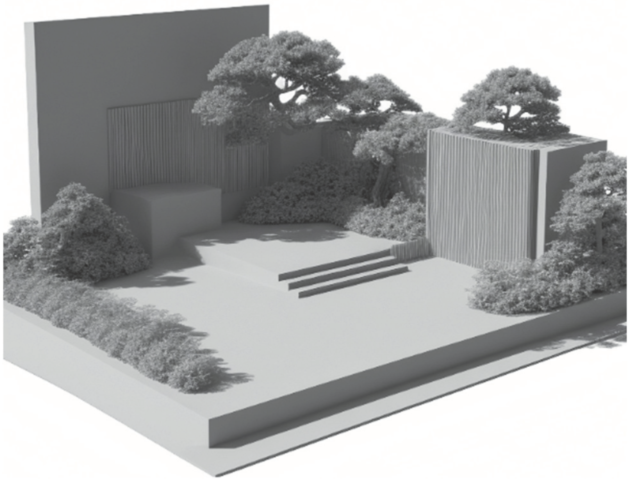
Figure 6 Landscape space environment design

5 SIMULATION VERIFICATION

Analyses of simulation experiments were conducted to confirm the effectiveness of the suggested strategy in the execution of landscape spatial environment design. The 40 seed points, 0.36 feature matching coefficient, and 200 × 200 pixel block size were all taken as given in the landscape design. In Fig. 7, we can see the landscape design gray scale.

Utilizing the image shown in Fig. 7 as a point of departure, we applied the similarity information fusion model in order to combine our views of the garden art landscape with the images of the spatial environment design, thereby visually recreating them. We were able to improve the design as a result of this. The results of the best possible performance were displayed in Fig. 8.

(a) Design sample 1



(b) Design sample 2

Figure 7 Gray scale of landscape design

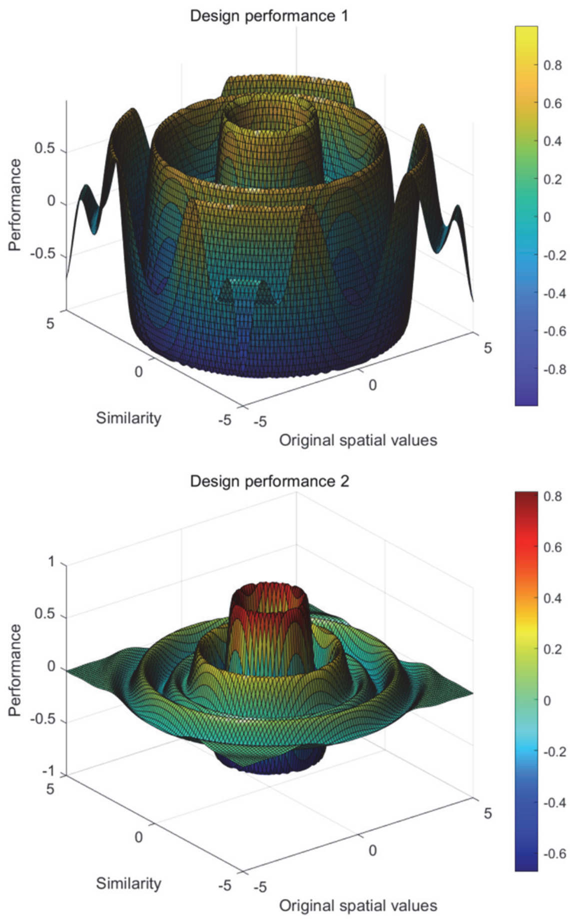


Figure 8 Optimization of landscape design

According to the analysis presented in Fig. 8, the technique that has been recommended has the potential to effectively achieve the optimization design of garden landscape space environments. This is because it has a high picture recognition accuracy and an increased design effect. For example, the output signal-to-noise ratio of the recommended technique is 14.6% greater than that of the conventional way when compared to the usual method.

For the purpose of putting the simulation approach to the test, it is necessary to model the distribution of spatial features and then compare the results to the actual arrangement of the garden. There is a comparison graphic demonstrating the degree of fit for a number of different tactics that can be seen in Fig. 9.

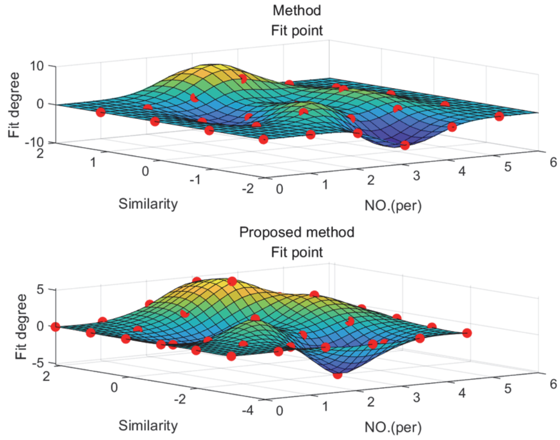


Figure 9 Comparison of fit degree of different simulation methods

In the absence of a mechanism for selecting sensor cluster heads, the probability of damaged nodes becoming cluster heads increases at a rate that is exponentially proportional to the number of damaged nodes. The findings of employing the likelihood of the damaged node becoming a cluster head as a validation index to assess the stability of the models presented in this paper, reference [4], and reference [5] are displayed in Fig. 10.

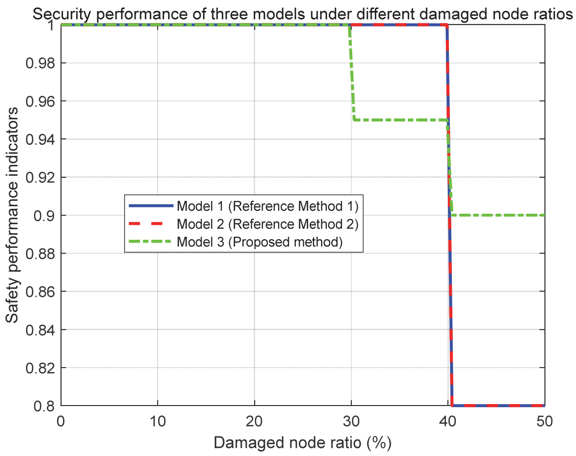


Figure 10 Probability of a damaged node becoming a cluster head

According to the findings of the research presented in Fig. 10, all three models demonstrate a high level of security when the percentage of compromised nodes is less than thirty percent. When the ratio is greater than forty percent, the suggested model performs better than the two literatures that were considered. The model that is presented in this work continues to provide a high level of security yet the number of nodes that have been damaged continues to increase. By taking into account the issue of model convergence and accurately displaying the data that is necessary for landscape design when the model is being constructed, this research was able to increase the stability of the information fusion model.

Using real number coding, which is a component of data processing and storage, this work proposes a way for minimizing the cost of node information storage and communication. This goal is accomplished through the utilization of the aforementioned technology. For the purpose of representing a wide variety of data kinds, the utilization of unified coding results in a better information fusion node. In this experiment, the 110 nodes that comprise the remote sensing sensor network in the landscape region are dispersed at random within a radius of 110 meters by 110 meters using a random distribution method. The energy consumption of three different information fusion models is compared in Fig. 11, which may be found here.

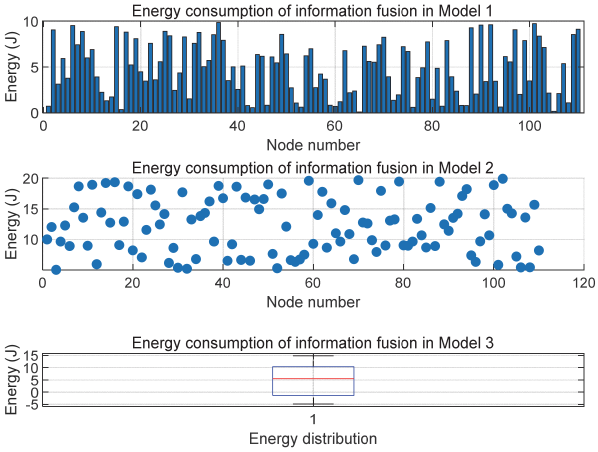


Figure 11 Comparison of energy consumption of the three methods

Model 3 is the strategy used in this paper, as shown in Fig. 11. Model 1 and model 2 have higher energy consumption throughout the information fusion process, in contrast to this model. The reason behind this is that model 2 makes use of data fusion, which increases the quantity of data transfer and consumes more energy, while model 1 always uses two cluster heads per cluster. This paper presents a model that improves the modular information fusion efficiency of the landscape design process, decreases energy consumption, and improves the accuracy of information fusion and calculation storage. It achieves all of this by utilizing a footprint aggregation analysis algorithm that takes an ecological aesthetics viewpoint.

6 CONCLUSION

Based on the thinking of data science, this paper uses big data of literati footprint to analyze the indicators of cultural gathering places and their changes from the perspective of quantity, geographical location changes and time series. Taking 20 years as an interval, this paper scientifically calculates the comparison and evolution of literati gardens in the north and south during the Tang and Song Dynasties, and verifies the changes of literati gardens in the north and south cities over time. It provides strong support and proof for the theory of cultural geography. From the perspective of ecological aesthetics, an optimal design method of landscape spatial environment is proposed by means of footprint aggregation analysis. Landscape spatial environment design images underwent multi-level feature decomposition and gray pixel feature separation. A visual feature reconstruction model was established for these images. Fuzzy feature quantities were extracted from the landscape spatial environment design images. The model included visual feature spatial distributed detection and fuzzy pixel regional feature fusion reconstruction. To achieve the goal of information fusion perception and visual reconstruction quality assessment of garden art landscape, an algorithm for footprint aggregation analysis was employed, with an eye towards ecological aesthetics. This paper analyzes how to build a one-stop smart garden big data service platform to serve the government, enterprises and individuals to efficiently solve the garden. The application of advanced technology in planning and management is not enough, the high efficiency and precision of data collection is not yet in place, and the intelligent degree of the system is constantly deepened, and the functions are more concise and comprehensive.

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