Research on the application of traditional culture in landscape design

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Abstract

In order to make the landscape design concept break through the traditional barriers and achieve diversification and nationalized development, this paper proposes a landscape design model that integrates traditional culture to effectively integrate traditional culture and landscape design. First use active adaptation technology to test the algorithm convergence ability, and then sample the basic situation of landscape design, reconstruct the collected information, construct the characteristic information flow, and use the linear regression analysis model and the Internet of Things technology to construct the distribution The structure model is used to analyze its characteristics. Then, by introducing the nonlinear dynamic inertia weight coefficient, according to the traditional particle swarm algorithm, the optimized particle swarm algorithm is proposed, and its robustness is tested, the error is analyzed, and the error values are all less than 0.1. Finally, the model in this paper is experimentally tested in a quantitative way. The results show that the traditional culture and landscape design fusion model proposed in this paper has a reasonable error value and has practical application significance.

Keywords: Traditional culture; Landscape design; Particle swarm algorithm; Linear regression analysis; Weight coefficient

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1 Introduction

More attention has been paid to landscape design. With the continuous development of big data and
the network today, Chinese traditional culture not only has rich spiritual connotations and unique
historical charm, but also is broad, profound and all-encompassing, and its connotation and form are
worth advancing with the times [1-3]. Traditional culture not only has strong vitality, but also has
profound life perception and great artistic value, and has strong informatization ability [4]. Therefore,
traditional culture plays a role in enriching design materials for modern landscape design, and also
changes the way of thinking of designers [5].

People have carried out many researches in landscape design, and put forward some related
optimization algorithms. James Kennedy [6] proposed the particle swarm optimization algorithm in
1995, which originated from the predation behavior of birds. The particle algorithm is also very
effective to solve more complex optimization problems. There are also scholars based on the tourism
culture of traditional villages, in the construction of tourism culture, combined with the local tourism
and cultural environment, to develop a tourism economy that conforms to the characteristics of the
local tourism industry, promote the development of tourism cultural resources in traditional villages,
and build beautiful villages. The traditional village tourism and cultural resources integration model,
the fusion cluster scheduling based on big data information is proposed for the purpose of economic
income level, but like the genetic algorithm, it is prone to problems such as premature convergence
and late oscillation [7]. The famous scholar Ruspini [8] first proposed the concept of fuzzy partition
in 1996, and introduced fuzzy set theory into cluster analysis. P.C. Fourie et al. [9] proposed a particle
swarm algorithm to optimize size and shape. [10] introduced a flyback mechanism to control the
constraint boundary of the particle swarm, and applied it to the structural optimization design. G.
Venter et al. [11] proposed to apply the particle swarm algorithm to the multidisciplinary optimization
design process of aircraft wing structure, and proved the advantages of the improved algorithm. R.E.
Perez et al. [12] proved the advantages of particle swarm optimization in structural optimization
problems by comparing three typical optimization cases with other optimization algorithms. Ali R
Yildiz [13] developed a new particle swarm algorithm process and applied it to the optimization
process of product development and design.

However, the rapid development of modernization has also brought a series of problems. From a
cultural point of view, Chinese traditional culture is gradually being westernized [14], losing its
original color and connotation. With the advent of the Internet era, while life has become more
convenient and efficient, traditional culture has also been forgotten in people's necessities of life [15].
But traditional culture still plays a huge role in today's life practice, guiding people's life [16-17]. In
response to the above-mentioned problems, relevant people at home and abroad have made certain
efforts. However, at present, relevant models and algorithms of landscape design use very normal
design concepts and there are also few studies that combine landscape design with traditional culture.
Therefore, in order to promote the effective integration of traditional culture and landscape design,
this paper focuses on the standard particle [18]. To make the particle convergence better, an optimized
particle swarm algorithm is proposed [19]. It is expected to make a certain contribution to the
development of traditional culture, and at the same time, to optimize and improve the existing
landscape design concepts, and to realize the diversified and nationalized development of landscape
design.
2 Landscape design information adoption and characteristic analysis

2.1 Sampling of landscape design information

Statistical analysis method is used to collect landscape design information, reconstruct the relevant information collected, construct the characteristic information flow of landscape design, use the linear regression analysis model and The Internet of Things technology to construct a distributed structure model of landscape design, and use the $x_{n-j}$ to represent landscape the fuzzy distribution autocorrelation of the design attribute set the $\eta_{n-j}$ represents the finite distribution set of the landscape design attribute feature vectors, then the landscape design information flow reorganization model is expressed as:

$$x_n = a_0 + \sum_{i=1}^{MAR} a_i x_{n-i} + \sum_{i=0}^{MMA} b_i \eta_{n-j}$$  \hspace{1cm} (1)

Among them, $a_0$ is the sampling amplitude of the statistical data, and $b_i$ is the most suitable rule attribute for landscape design. Characteristic analysis of the relevant information of landscape design with the method of subsection sample statistical analysis. The scalar time series of the landscape design is $x(t), t = 0,1,\ldots,n-1$. Combined with the fuzzy information characteristic analysis method, the limited set of the distribution of the landscape design is obtained as follows:

$$x(t), t = 0,1,\ldots,n-1$$  \hspace{1cm} (2)

Combined with the fusion clustering model, the correlation characteristics of landscape design are obtained as follows:

$$C(l) = \sum_{i=1}^{k} \sum_{j=1}^{n_j} \left\| x_{j} - A_j(L) \right\|^2$$  \hspace{1cm} (3)

In the era of big data, the landscape design information management system has gathered a large number of multi-dimensional information resources. Analyzing Statistical Measurement Errors of Cultural Resources in landscape design at the fuzzy clustering center.

When the relative distance satisfies $\|C(l) - C(l-1)\| < \zeta$, the clustering iterative formula of the landscape design is:

$$A_j(L+1) = \frac{1}{n} \sum_{i=1}^{n} x_{j} (j = 1,2,\ldots,k)$$  \hspace{1cm} (4)

Let $t \left(S_k, a_k\right)$ and $\left(S_i, a_i\right)$ be the fuzzy proximity vector between the integration nodes of landscape design, then the corresponding binary semantic feature map of resource distribution is described as:

$$\theta : S \rightarrow S \times [-0.5, 0.5]$$  \hspace{1cm} (5)

$$\theta(S_i) = (S_i, 0)$$  \hspace{1cm} (6)
Let the real number $\beta [0, T]$ be the similarity, and the descriptive statistical feature distribution evaluation set of landscape design scheduling is $\{v_1, \ldots, v_M\}$, which represents the landscape design information set. Using the association fusion method to schedule the landscape design resources, the obtained statistical feature quantity is expressed as:

$$C_\phi (u) = \phi (\phi^{-1} (u_1), \ldots, \phi^{-1} (u_n)) u \in I^n$$

(7)

Among them, $u_i$ is an arbitrary evaluation index weight. The landscape design configuration is carried out under the condition of informatization. And the statistical panel data of landscape design integrated traditional culture is defined as $v m, m \in [1, n]$. Construct a collection of landscape design configurations (whose element is $g, \omega, m, \omega \subseteq \{G, T, W, L\}, m \in [1, n]$) to enable sampling of landscape designs.

2.2 Statistical analysis of landscape design

The cloud computing model is used to analyze the integration structure of landscape design, extract the characteristic quantities of the cross frequent items of landscape design, analyze the correlation between the main variables of landscape design integration, realize regression analysis and effectiveness evaluation of landscape design integration, and construct landscape design. The integrated explanatory variable model and control variable model are designed, and the mathematical model is established as follows:

$$\max Z = \sum_{i=1}^{m} \sum_{j=1}^{m} x_{ij} c_{ij}$$

(8)

$$st = \sum_{i=1}^{m} x_{ij}$$

(9)

$$x_{ij} = 1$$

(10)

$$st = 1, or, 1$$

(11)

Among them, $x_{ij} = 1$ represents the regression coefficient of landscape design integration, which is set to green early warning; $x_{ij} = 0$ represents the conditional probability that the landscape design is reasonably utilized under the condition of information technology, which is set to orange early warning; $x_{ij} = -1$ represents that the landscape design has not been obtained under the multiple regression model Use it rationally and set it as a red alert. Using correlation analysis and Pearson regression analysis methods, according to the results of descriptive statistical analysis, landscape design integration is divided into three levels, using multiple linear regression analysis method to build a detection statistical analysis model for the integration of traditional culture and landscape design. The expression is:

$$TTD = a_1 x_1 + a_2 x_2 + \cdots + a_k x_k + \delta$$

(12)
In the above formula, $TTD$ represents the relevant factors of landscape design integration, which are $a_1, a_2, \cdots, a_k$ respectively. Under the landscape design distribution structure model, with $\beta$ as the boundary condition, the expansion extension $M^\beta$ of landscape design integration is obtained:

$$M^\beta = \{ x | x \in M, |f(x) \cap Y| / |Y| \geq \beta, 0 \leq \alpha \leq \beta \leq 1 \}$$  \hspace{1cm} (13)

$U(t) = \sum_{M \in E} p[M]$ is used to represent the trust attribute state set of the landscape design integration subject, $Ax \subseteq P \times T$ is used to construct the landscape design fuzzy assignment scheduling set, and the rough set coupling characteristic mathematical model of landscape design scheduling information is obtained. Based on fuzzy clustering and rough set algorithm, the integration of landscape design is realized quantitative regression model building.

3 Particle swarm algorithm

3.1 Traditional particle swarm algorithm

Particle swarm optimization was originally established based on the foraging habits of birds. This algorithm essentially simulates a bird as a particle, and the solution set of multiple optimization problems represents a flock of birds. In the solution set, each particle has an Active adaptation value after passing through the optimization function determined at the beginning, and the particle's movement speed represents its movement direction and distance. The movement trend of particles can be judged by comparing the most suitable position (pbest).

In the algorithm, if the particle swarm is initialized, the initialized particle can correspond to its own optimal solution after iterative operation. In the iterative process, there are two choices for the optimal solution of the particle's position: one is that the particle finds the optimal solution (pbest) through the walking path; the other is that the optimal solution is found by the walking path of the entire population that is global extremum $P_g$

$$v_{i,j}(t+1) = wv_{i,j}(t) + c_1r_1[p_{i,j} - x_{i,j}(t)] + c_2r_2[p_{g,j} - x_{i,j}(t)] \hspace{1cm} (14)$$

$$x_{i,j}(t+1) = x_{i,j}(t) + v_{i,j}(t+1)(j = 1, 2, \cdots, d) \hspace{1cm} (15)$$

The steps are expressed as follows.

Step 1: Assign the initial position and velocity.

Step 2: Evaluate the fitness of these particles, store the positions and fitness values of these particles in the pbest of each particle, and store the most suitable particle positions and optimal fitness values in all pbests in the global extremum.

Step 3: Update velocity and position with

$$v_{i,j}(t+1) = wv_{i,j}(t) + c_1r_1[p_{i,j} - x_{i,j}(t)] + c_2r_2[p_{g,j} - x_{i,j}(t)] \hspace{1cm} (16)$$

$$x_{i,j}(t+1) = x_{i,j}(t)v_{i,j}(t+1) \hspace{1cm} (17)$$
Step 4: Compare the fitness value of these particles. If the position is better, determine the best position.

Step 5: Compare all current pbests and gbests to determine the globally optimal gbest.

Step 6: If the output result satisfies the end condition, the iterative operation ends, and the calculation result is output. If the output result does not satisfy the end condition, go back to step 3 to continue the iterative operation.

3.2 The optimized particle swarm algorithm

When \( w = w_{\text{max}}; \quad f \leq f_{\text{avg}} \), the dynamic weight coefficient is:

\[
W = w_{\text{min}} - \left( w_{\text{max}} - w_{\text{min}} \right) \times \left( f - f_{\text{min}} \right) / \left( f_{\text{avg}} - f_{\text{min}} \right)
\]

It can be seen that there is a certain active adaptability between the inertia weight coefficient and the particle objective function value. The improved active adaptive particle, the basic flow of the algorithm is shown in Figure 1

![Flow chart of the optimized algorithm](image-url)

Figure 1. Flow chart of the optimized algorithm
The target value of each particle and the weight coefficient are usually positively correlated, and the inertia weight coefficient becomes larger as the optimization degree of the particle becomes better; otherwise, the inertia weight coefficient becomes smaller [20]. When the function value of the particle is worse than the target value, the corresponding inertia weight coefficient will also become larger [21], and the stability is poor. An optimized algorithm is proposed, and the safety and smoothness are introduced on the basis of the path length, and a fitness function for dynamically adjusting the path length is established [22]. The optimized algorithm has strong security and real-time performance, and has strong global search ability.

3.3 Optimized particle swarm optimization and robustness test

In the improved particle swarm algorithm, we use the landscape design feature as \( z(t) \), and combine the support vector machine model to integrate the optimal solution vector optimization. The optimization model of vector machine learning is:

\[
\min_{\omega, \xi, \xi^*} \frac{1}{2} \| \omega \|^2 + c \sum_{i=1}^{l} (\xi_i + \xi_i^*)
\]

(19)

In the above formula, \( \xi_i \) and \( \xi_i^* \) represent descriptive statistical characteristic variables. The larger the value of \( c \), the better the fitting degree of landscape design integration. The fuzzy function of resource integration is obtained as follows:

\[
f(x) = \sum_{i=1}^{l} (a_i + a_i^*) \kappa (x - x_i) + b
\]

(20)

Calculate the fuzzy correlation degree features of landscape design, and use mean clustering method to fuse the extracted correlation features of landscape design. The optimized model can be expressed as:

\[
\min F = R^2 + A \sum_{i} \xi_i
\]

(21)

\[
\text{s.t.: } \| \phi(x_i) - o \|^2 \leq R^2 + \xi_i \text{ and } \xi_i \geq 0
\]

(22)

\[
\max \sum_{i} a_i K(x,x_i) - \sum_{i} \sum_{a_i} a_i K(x,x_i)
\]

(23)

\[
\text{s.t.: } \sum_{i} a_i = \text{land} 0 \leq a_i \leq A, i = 1, 2 \ldots
\]

(24)

Since \( \sum_{i} a_i = \text{land} 0 \leq a_i \leq A, i = 1, 2 \ldots \), analyzes the performance of landscape design, the integrated output optimization model of landscape design is obtained as:

\[
\max 1 - \sum_{i} \sum_{j} a_i a_j K(x_i, x_j)
\]

(25)

\[
\text{s.t.: } \sum_{i} a_i = \text{land} 0 \leq a_i \leq A, i = 1, 2 \ldots
\]

(26)
In $K(x_i, x_j) = e^{-\frac{\|x_i - x_j\|^2}{2\sigma^2}}$, the smaller the value of $\sigma$, the better the convergence. It can be seen that the designed landscape design integration model is robust and convergent.

### 3.4 Error analysis

The effect of the spatial pattern of the algorithm in this paper is evaluated in a quantitative way, and the average reconstruction error is used to evaluate the reconstruction result of this system. The calculation method of the average reconstruction error is as follows:

$$E_{av} = \frac{1}{N} \sum_{j=0}^{N-1} \lim_{i \to j} \left\{ \frac{|A_i x_j + B_i y_j + C_i z_j + D_i|}{\sqrt{A_i^2 + B_i^2 + C_i^2}} \right\}$$

(27)

In the formula: $N$ and $n$ are the total of reconstruction points and the total of reconstruction objects, respectively; $A_i x_j + B_i y_j + C_i z_j + D_i$ is the reconstruction object surface expression; $(x_j, y_j, z_j)$ is the coordinate value of the reconstruction point, and the above formula $j = 0, 1, 2, \ldots, N$ uses the spatial pattern of the urban garden landscape staggered belt from different perspectives, Find the minimum distance between the reconstructed point and the $n$ faces of the ideal cube model, and average to obtain the error value. Based on the average reconstruction error, the effect of reconstructing the 3D model system in this paper is analyzed, and 4 different types of landscape space interlaced zones are selected as the 3D reconstruction objects. Each interlaced zone takes 8 reconstruction perspectives. Based on the above formula, the system integrates traditional Chinese culture into landscape design. The average reconstruction error of, the results are shown in Figure 2:

![Figure 2](image_url)

**Figure 2.** The average error of integrating traditional culture into landscape design

In Figure 2, due to different types of garden landscape structures, the system in this paper has different errors in the spatial pattern of the reconstructed landscape staggered zone, but the overall error is less than 0.1, which is in line with the accurate reconstruction standard. Therefore, the algorithm proposed in this paper is a kind of A reliable algorithm for the fusion of traditional culture and landscape design.
4 Active adaptation techniques to ensure algorithm convergence performance

After analysis, the algorithm proposed in this paper has certain defects. After analysis, it can be seen that the main reason for the interference of its performance is that when individuals face the living environment, in order to improve their own adaptability, their genetic behavior will change without restraint. According to the above reasons, the Active adaptation genetic algorithm came out. In the genetic system of the Active adaptation algorithm, if the Active adaptation ability of the group is relatively concentrated, the values of the crossover probability \( P_c \) and the mutation probability \( P_m \) will increase; on the contrary, if the fitness of the group is in a relatively scattered state, the values of \( P_c \) and \( P_m \) will increase. will decrease, and the two parameter probabilities automatically adjust their values according to the following two equations:

\[
\begin{align*}
P_c &= \begin{cases} 
  k_1 \left( f_{\text{max}} - f' \right) / \left( f_{\text{max}} - f_{\text{ave}} \right), & f' \geq f_{\text{ave}} , \\
  k_2 , & f' < f_{\text{ave}} ,
\end{cases} \\
\end{align*}
\]

(28)

\[
\begin{align*}
P_m &= \begin{cases} 
  k_3 \left( f_{\text{max}} - f \right) / \left( f_{\text{max}} - f_{\text{ave}} \right), & f \geq f_{\text{ave}} , \\
  k_4 , & f < f_{\text{ave}} ,
\end{cases} \\
\end{align*}
\]

(29)

In the above formula, \( f_{\text{max}} \) represents the highest fitness, \( f_{\text{ave}} \) represents the mean value of fitness, \( f' \) represents the fitness of individuals with relatively high fitness among multiple crossover individuals, \( f \) represents the fitness of individuals that generate variation, and \( 0 < k_1, k_2, k_3, k_4 \leq 1 \).

5 Experimental results and analysis

Since the diversity of the population decreases, the algorithm is easy to ignore the global. Taking the function Schwefel as an example. It can be seen that the particle population distributions of the two algorithms are relatively uniform when initialized at the beginning of the iteration. However, when it comes to the later stage of the iteration, the improved particle swarm algorithm still maintains a high diversity, the particles are evenly distributed, and has strong evolution ability, while the diversity of the basic algorithm is obviously inferior to that of the improved particle swarm algorithm, and showed an aggregated state [23].

5.1 Comparison algorithms

This paper uses the optimized algorithm and the traditional algorithm to conduct a comparative experiment [24] to test the performance of the optimized algorithm. Initially set the population size to 40 and the number of iterations to 1000, run 30 times independently at \( D=10, 30, \) and \( 50 \), respectively.

5.2 Experimental results and analysis of algorithm performance testing

Figures 3-5 are the test functions when \( D=10, 30, \) and \( 50 \), respectively, and the optimal solutions of the two algorithms. The Wilcoxon test method with a significance level of 0.05 was used to judge the performance of the algorithm. Among them, “+”, “-”, and “~” indicate that the results of the optimized particle swarm algorithm are better than, inferior to and equal to the test results of the traditional algorithm, respectively.
It can be seen from Figures 3 to 5 that the optimized particle swarm optimization continues to have the best performance in both low and high dimensions in the three cases, and can be used in unimodal, multimodal and combined functions. Find a better solution. From the Wilcoxon results in Table 1, the optimized particle swarm optimization has more obvious advantages than the traditional particle swarm optimization when $\alpha=0.05$. It is worth noting that the optimized algorithm has obvious advantages when solving high-dimensional data. Although the optimized particle swarm algorithm has its own shortcomings, in general, the optimized particle swarm algorithm has greatly improved the optimization results.

5.3 Algorithm running time comparison

To further illustrate the adaptability of the optimized algorithm, set the experimental environment of the traditional algorithm and the optimized algorithm to be the same, and let both sides run independently for 20 times, the number of particles is 40, and the record algorithm reaches the specified value. Running time when converging accuracy. If the required accuracy cannot be achieved after 200,000 iterations, it is represented by “—”.

Under the same experimental environment, the optimized particle swarm optimization runs better than the traditional particle swarm optimization and its improved algorithm when it reaches the specified accuracy requirements. In this regard, the effectiveness of the optimized particle swarm optimization algorithm is verified again [25].

**Figure 3.** The results of the traditional algorithm and the optimized optimization test function when $D=10$
Figure 4. The results of the optimal solution of the traditional algorithm and the optimized optimization test function when D=30

Figure 5. The results of the optimal solution of the traditional algorithm and the optimized optimization test function when D=50

Table 1. Results obtained by Wilcoxon's test

<table>
<thead>
<tr>
<th>D</th>
<th>The optimized particle swarm algorithm and the basic particle comparison value</th>
<th>+</th>
<th>≈</th>
<th>-</th>
<th>α=0.05</th>
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<tr>
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<tr>
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<td>0.005062</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>Yes</td>
</tr>
</tbody>
</table>
6 Conclusion

The optimized particle swarm model proposed in this paper effectively integrates traditional culture and landscape design, and fully considers the convergence of the algorithm. Although it has certain barriers in stability, compared with the traditional algorithm. The results and the running time of the algorithm have been greatly improved, which has certain reference significance for the practical application of the algorithm.

1) The error analysis results of the improved particle swarm application model in landscape design of traditional culture proposed in this paper are all less than 0.1, so it can not only carry forward traditional culture, realize the diversification and nationalization of landscape design, but also has a certain practical effect. application meaning.

2) From the results of Wilcoxon, when $\alpha=0.05$, the optimized algorithm has obtained obvious advantages compared with the comparison algorithm in the test function. Therefore, the traditional cultural landscape design optimization model using the optimized particle swarm algorithm is feasible and effective.

3) The running time of the optimized particle swarm algorithm when it reaches the specified accuracy requirements is better than the running time of the standard algorithm and its improved algorithm. The effectiveness of the particle swarm algorithm can greatly improve the aesthetic value and practical value of the landscape.

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References


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