

# Research on comprehensive Perception of park Landscape based on intelligent optimization algorithm

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**Abstract:** Taking the comprehensive park landscape as the object, this paper studies the public perception tendency of the landscape, the aesthetic differences between different groups and the landscape preference within the group. It aims to continuously develop the theory and application of intelligent optimization algorithms. In the study of park landscape perception tendency, the overall element perception tendency is that uneven terrain is greater than flat terrain, entity perception is greater than spatial perception, and plants and natural form are the two perception focuses of plant elements.

## 1. Introduction

With the rapid development of science and technology, it is no exaggeration to say that any human-computer interaction mode that ignores human emotional state or cannot respond effectively cannot arouse the confidence of users, but is regarded as cold, unreliable, and uncommunicative. More and more evidence shows that the understanding and expression of emotion contribute to the resonance in interpersonal communication, which makes the human-computer interaction methods that pay attention to users' emotional information more acceptable. In the process of realizing effective human-computer interaction, one of the most important prerequisites is to establish a robust and reliable emotion recognition system with a high recognition rate and suitable for practical application. This process judges the emotional state through the observation of emotional expression and the reasoning of emotion generation situation "[1]. Recognition includes publicly expressed emotions, such as facial expression, voice intonation, and obvious gesture or body language, as well as emotions expressed through personal contact, i.e. physiological signals.

The characteristic of Optimization algorithms make it very effective and practical emotion recognition system. Optimization algorithms, which based on simulating biological intelligent behavior in nature, is that the intelligent behavior of human brain is realized by a large number of neurons through organic organization and coordination, while some biological behaviors such as foraging and establishing nests are also realized through group cooperation, which is organized and coordinated with human neurons. It has a high degree of similarity. Human neurons are simple, and their activities are completed through the cooperation and coordination between various neurons. It is a perfect model for individuals and groups to complete tasks, while organisms complete a task through the effective organization of individuals and groups.

Generally speaking, the behavior of individuals is relatively simple and can be described by a single functional function. Cooperation is an interaction between individuals, which is manifested in the communication ability between individuals. This communication ability is the key to our distributed solution. Therefore, intelligent algorithm has the following characteristics: simple individual description and convenient implementation; Individuals are widely distributed, such as foraging ants looking for food everywhere; It has no expected goal and is robust; Individuals cooperate through communication, and the optimization range is large.

This paper studies the evolution process of particle swarm optimization algorithm. It can be seen that the convergence speed of particle swarm optimization algorithm is very fast in the initial stage.

After many iterations, the particles lose their diversity, tend to be consistent, and the convergence speed slows down, resulting in premature depression [2]. Simulated annealing algorithm has the ability of probability jump in the search process, which can effectively avoid the search process falling into local minima. SA algorithm can not only accept good solutions, but also accept difference solutions with a certain probability [3]. At the same time, this probability is controlled by temperature parameters, and its size decreases with the decrease of temperature. Therefore, in order to overcome the premature phenomenon, PSO can be combined with SA. First, use the fast search ability of PSO to get a better group, and then use the jumping ability of SA to optimize some better individuals.

The steps of SA based PSO algorithm are as follows.

Step1: randomly initialize the position and velocity of each particle in the population;

Step 2: evaluate the fitness of each particle, store the current position and fitness value of each particle in each particle, and store the position and fitness value of the individual with the best fitness value in all pbests in the;

Step 3: determine the initial temperature;

Step4: determine the adaptation value of each at the current temperature:

$$tf(p_i) = \frac{e^{-\left(p_g\right) - \left(p_g\right) / T}}{\sum_{i=1}^N e^{-\left(p_g\right) - \left(p_g\right) / T}}$$

Step 5: use roulette strategy to determine the global optimal alternative value, and then update the speed and position of each particle according to the formula;

Step6: calculate the new target value of each particle, update the value of each particle and the value of the group;

STEP7: conduct temperature reduction operation;

Step8: if the stop conditions are met (usually the preset operation accuracy or iteration times), the search stops and the results are output. Otherwise, turn to step 4;

Step9: the initial temperature and annealing method have a certain impact on the algorithm. Generally, the following initial temperature annealing method is adopted.

$$T_{K+1} = \lambda T_K, T_0 = (P_G) / IN5$$

## 2. Perceptual propensity experiment

### 2.1 Research object

Jining people's Park and Qingdao Chengyang Century Park belong to citywide parks and regional parks among comprehensive parks respectively(as shown in Figure 1 and 2). The selection of these two research parks is mainly based on the following two considerations:

(1) Park is the most common natural element landscape provider in the urban environment, which has the closest relationship with users. Compared with natural landscapes such as forests, native rivers, and lakes, the park has the highest aesthetic efficiency, so it has high research value.

(2) The comprehensive park in the park has the most complete types of natural and artificial elements and the most uniform distribution, so the data provided is more effective.



Figure 1 Jining people's Park



Figure 2 Qingdao Chengyang Century Park

### 2.1.1 Jining people's Park

Jining City, Shandong Province is located in the East Asian monsoon climate zone, belonging to the warm temperate monsoon climate with four distinct seasons. In summer, it is mainly South, affected by tropical marine air mass or denatured tropical marine air mass, with high temperatures and rainy; In winter, it is mainly northerly, and the weather is sunny and cold due to the influence of polar continental air mass[4]; Spring and autumn are two periods of great cycle adjustment. It is easy to dry and windy in spring and recover quickly; Autumn is cool, but it rains sometimes. It is rich in light energy resources, which is a remarkable feature of Jining climate. The annual average temperature in Jining is 13.3 °C - 14.1 °C, and the average frost free period is 199 days. The average annual precipitation is about 597 mm.

Jining people's Park, built-in 1962, is a comprehensive park with the ancient city wall as the mountain and the moat as the water. In 2004, the people's Park was demolished and designated as an open park. In 2006, Jining Municipal People's government decided to transform the park. The overall planning area of the reconstructed people's Park is about 129000 square meters. It starts from the northern edge of the Cultural Square in the south, Dongmen street in the north, Tianmen street in the West and Communist Youth League road in the East. Its function is positioned as an open park, focusing on plant landscape and integrating culture, leisure, and fitness[5].

### 2.1.2 Qingdao Chengyang Century Park

Qingdao is located in the north temperate monsoon zone. It belongs to a temperate monsoon climate and slightly marine climate. Due to the direct regulation of the marine environment and the influence of the southeast monsoon, ocean current and seawater mass, the urban area also has obvious marine climate characteristics. The air is moist, the temperature is moderate, and the four seasons are distinct[6]. The temperature rises slowly in spring, a few months later than inland: summer is humid, hot and rainy, but not hot. The average temperature in July is 23 degrees, and the extremely high temperature is 37.4 degrees; In autumn, the weather is fresh and the precipitation is less: in winter, the wind is strong, the temperature is low, and the duration is long, but there is no severe cold. The average temperature in January is - 3 degrees and the extremely low temperature is - 16 degrees.

Chengyang Century Park is located at the south end of the green central axis of Chengyang District, Qingdao. It is adjacent to the viaduct of national highway 308 in the west, Great Wall Road in the East and Xingyang road in the north. This is the green south gate of Chengyang in the future. The park is triangular, 1000 meters long from east to west and 800 meters wide from north to south. It covers an area of about 430000 square meters, including 272500 square meters of green space, 92200 square meters of water area, 24800 square meters of roads, 5000 square meters of buildings and 34200 square meters of squares. More than 260 kinds of plants and more than 400000 trees and shrubs are planted in Century Park: according to the natural landscape layout, the relationship between various landscape elements such as terrain, water, roads, plants and sketches is organized and arranged to form various garden spaces and form the natural landscape layout of "three mountains, water lakes,

three islands and one beach"; Relying on different landforms, different ornamental characteristics and ecological types of flora, 16 plant ecological landscape gardens have been formed[7].

## 2.2 Subjects

The subjects selected in this experiment are mainly Jining citizens, Qingdao citizens and college students, a total of 59 people. Among them, there were 25 person times in Jining people's Park and 34 person times in Qingdao Chengyang Century Park. It took four months from spring and summer to autumn in 2009. Most of the cameras used by Jining subjects were Fuji F100 digital cameras provided by the researchers. After telling the subjects how to use the camera, the subjects were invited to take pictures in the park. Most of the cameras used by Qingdao subjects were self-contained. After the experiment, 6228 photos were obtained (see table 1), including 6164 valid photos.

Table 1 Photo statistics

Experimental materials	Shooting season	Person times of shooting	Original photos (piece)	Valid photos (piece)
Jining people's Park	Spring and summer	15	1884	1863
	Autumn and winter	10	687	667
Qingdao Chengyang Century Park	Spring and summer	19	2573	2552
	Autumn and winter	15	1084	1082
total		59	6228	6164

## 3. Evaluation results and analysis

### 3.1 Photo statistics

The researchers led a 7-member statistical team composed of graduate students majoring in landscape design to observe the photos, determine the overall element categories and carry out classified statistics (see table 2); Analyze the photographed objects, and classify and count the photographed objects at different perception levels according to each independent element category. The subject can be the multi-element or multi-category.

Enclosed spaces in space types are rare in urban parks and are difficult to reflect through photos. Therefore, the hierarchical elements not listed in table 2 are counted according to the horizontal hierarchical characteristics of the photo.

Table 2 Statistics of overall factors

Overall elements	category	describe	Photos (piece)	Specific gravity (%)
terrain	flat terrain	Flat grass, square, water surface	2297	37.3
	Convex terrain	Hills, mountains and micro terrain	1158	18.8
	Concave terrain	Lowlands, caves, depressions, water surfaces	1644	26.7
	Undulating terrain	Natural fluctuation or scattered space	1065	17.3
	space	cover	A space covered by the top and open all around	885
space	open	The space is open all around, outward and without privacy	1289	20.9
	semi-open	One or more parts of the space are enclosed by plants	2562	41.6
	other	No special sense of space, such as close-up	1428	23.2
color	coordinate	Soft and natural	3176	51.5
	contrast	Stand out	2988	48.5
arrangement	First floor	Only one of foreground, medium or perspective	2173	35.3
	Two layers	There are two types of foreground, medium or long-range	2305	37.4
	multi-storey	The front, middle and future levels are rich	1686	27.4

In order to verify the rationality of the data of the statistical group, 6 people were randomly selected

from the subjects to form an examination group, and the subjects were interviewed. Statistical results; Frequency f and F2 are the recording frequency of the shooting objects in the statistical group and the inspection group respectively, that is, the number of times each element category appears as the shooting subject: PN and p21 are the proportion of the number of subcategories of the shooting subject in the statistical group and the inspection group to the total number of elements; PR2 and P2 are the occurrence frequency of each element in 6164 and 654 photos of the subjects in the statistical group and the inspection group, respectively.

SPSS software was used to analyze six statistical data: f-fr and pr-p21. The correlation analysis of prp22 is carried out respectively, as shown in table3.

Table 3 Correlation coefficient

Correlation statistics	N	Spearman's rho	Sig(2-tailed)
F1-F2	33	0.883	0.000
P11-P21	33	0.782	0.000
P12-P22	10	0.918	0.000

It can be seen from the table 3 that the data of the statistical group is highly correlated with the data of the test group. The Spearman correlation coefficients of the three types of statistics are greater than 0.75, and the correlation coefficients of pl2 and PRN are greater than 0.9, which is significant at the level of 0.01. Therefore, the data of the statistical group can reflect the real choice[8].

### 3.2 Landscape perception tendency

#### 3.2.1 Overall element perception

As can be seen from table 3-1, terrain, as the most basic landscape element, is also one of the most intuitive description features of photos. Among all kinds of terrain, flat terrain accounts for the largest proportion, accounting for 37.3%, followed by concave terrain, accounting for 26.7%, convex terrain and undulating terrain account for 18.8% and 17.3% respectively, and the latter three are non-flat terrain, accounting for about 62.7%. Therefore, we can draw the following conclusions: compared with flat terrain, undulating terrain has the advantage of being perceived: if the undulating terrain is further divided into convex terrain, concave terrain and undulating terrain, then among the four terrain types, flat terrain is perceived the most times, followed by concave terrain.

In terms of space type, the proportion of semi-open space is the largest, 41.6%, which is related to the composition characteristics of photos. Followed by open space, accounting for 20.9%. The coverage space is 14.4%. In addition, the proportion of photos without spatial sense is also very high, 23.2%. Most of these photos are close-up or close-up. In the subjects of semi-open space and non-space photos, the weight of entity elements is higher, while in the subjects of open space and coverage space photos, the weight of an open body is higher. The proportion of the former reached 76.8%, which shows that the public is more inclined to entity perception.

Color refers to the overall environment and combined elements. Statistics show that the number of photos with high color coordination and contrast is very close.

The photo layer is mainly one or two layers, accounting for 72.6% of the total, and the photos with rich layers account for only 27.4%. It cannot improve the subject's artistic recognition. Therefore, photo statistics are very reliable.

#### 3.2.2 Perception of independent elements

It can be seen from the statistics of the statistical group in table 3-2 that according to the frequency of shooting objects, they are arranged from large to small, such as plants > small crystals > rocks > site > people > buildings ≈ water body > sidewalks > animals > vehicles and weather scenes.

The subjects' perception of plant landscape in the park landscape elements was the highest, up to 25.5%. Among them, the proportion of the plant population is 76.5%, and the proportion of plant individuals is 23.5%. The proportions of Natural layout, mixed layout and regular layout in the plant population were 37.0%, 24.3% and 15.2% respectively. The proportion of natural plants and plastic plants in a single plant was 19.2% and 4.3% respectively. From the above data, it can be seen that the

most important perception element and goal of the subjects for the park landscape are the plants in the park. They are more inclined to perceive the landscape created by the flora than a single plant. Whether it is a plant group or a single plant, the proportion of natural form is far greater than that of regular form or plastic form with obvious artificial sense.

The perception of the sketch is second only to plants, in which sculpture and landscape walls dominated by viewing account for more than 64.1%, followed by service facilities, accounting for 23.7%, higher than 12.2% of entertainment and fitness sketches. Strong appreciation is the most important factor affecting sketch perception.

For the perception of mountain rock elements, the proportion of most rocks is 57.2%, while the proportion of rockeries is 42.8%. The proportion of functional revetment, retaining wall and curbstone in landscape stone is 35.9%, which is higher than 21.3% of ornamental stone and scattered stone alone. This is the opposite of the sketch, which may be related to the fact that there is not much difference in the appearance of decorative and functional landscape stones.

In terms of site perception, straight Garden Road and plank road account for 61.6% of the site area, followed by ground platform and square, accounting for 3.3% of the site area, while the proportion of point entrance is only 5.1%. These data show that linear roads have advantages in perception compared with other sites.

The subjects' perception of people in the landscape unexpectedly exceeded their perception of buildings and water bodies, which indicates that the activities of park users have a significant impact on the park landscape. It is often difficult to obtain such data through questionnaires or interviews. The data show that other users participating in non-tourism activities are the most concerned, accounting for 60.7%. These activities include singing, games, interviews, photos, etc.

Among the architectural elements, the perception of Chinese traditional architecture is the highest, up to 84.5%. The proportion of traditional exotic architecture and modern architecture is far lower than this data. Understandably, the subjects are not sensitive to it, but it also reflects that in the urban parks represented by these two parks, Chinese traditional architecture accounts for a large proportion of ornamental gardens.

Perception of water was the biggest difference between the statistical group and the test group. The frequency of water in the statistical group was 8.9%, which was lower than 15.4% in the test group. Through the interview with the subjects in the inspection group, we learned that there is water in the picture, but water is not the main content of the composition. The inspection group believes that water is also more the subject of shooting than the statistics group. This sends a signal that water can be keenly perceived by subjects, even if it is only used as a background.

The use frequency of pavement is 5.6%, and the proportion gap between natural materials and artificial materials is not obvious. Although sidewalks can be seen everywhere in the park and are an important part of the garden landscape, in most cases, sidewalks exist as landscape matching. The designer's first consideration is to coordinate with the environment and avoid occupying the host. This can also be seen from the fact that the number of photos coordinated with the environment in the perceived artificial material pavement is 3.4 times that in sharp contrast.

The frequency of animals, vehicles and weather scenes combined was only 3.4%. On the one hand, the number of tourists in the park is very small, but on the other hand, it also shows that the above elements are not the focus and main appreciation object of theme tourists when visiting the park.

#### **4. Conclusion**

Intelligent optimization algorithms have been developed for more than 20 years. The theoretical research and discussion are still in-depth, and the application field is expanding, showing wide application and strong vitality. From the perspective of development, intelligent computing not only imitates the function, but also makes the subject have the same characteristics as the real subject.

In the research of park landscape cognition, park landscape perception is divided into two independent element levels. The perception of overall elements is that heterogeneous terrain is greater than flat terrain, and physical perception is greater than spatial perception. Compared with a single plant, subjects tend to perceive the landscape composed of plants. Whether flora or single plant, the

proportion of natural form is much larger than that of regular form or plastic form with obvious artificial feeling. Strong appreciation is the most important factor in sketch perception: mountains and stones are different. Compared with functional landscape stones, decorative landscape stones have no visual advantages. In the field, linear field has perceptual advantages over plane field. The activities of other users in the park, especially non sightseeing activities, may have a positive impact on the aesthetic attitude of tourists. Among the architectural elements, traditional Chinese architecture has the highest perception, and the theme is very sensitive to water, even if it is only used as a background.

## References

- [1] Luo Junjie, Lei Zexin, Hu Yike, Wang Miao, Cao Lei. Analysis of tourists' emotional tendency in urban parks based on deep learning -- Taking Tianjin Water Park as an example [J]. Chinese garden, 2021,37 (09): 65-70.
- [2] Ou Dinghua, Xia Jianguo. Research on Optimization of landscape pattern in suburban areas of large cities based on Particle Swarm Optimization -- Taking Longquanyi District of Chengdu as an example [J]. geographical research, 2017,36 (03): 553-572.
- [3] Du Juan. Research on image edge information capture based on an ant colony algorithm with sensing function [J]. life science instruments, 2018,16 (06): 37-40.
- [4] Yang Jianmin, Wei Wen. Study on the comprehensive evaluation of the autumn landscape of Kunming Heilongtan Park Based on the beauty evaluation method [J]. gardens, 2021,38 (09): 93-99.
- [5] Liu Di, Meng Xiangzhuang. Research on forest park landscape perception experience [J]. Green technology, 2018 (21): 23-25.
- [6] Yu Sujian, Yuan Shuqi. Research on comprehensive perception of park landscape based on SD method -- Taking Fuzhou as an example [J]. tourism science, 2012,26 (05): 85-94.doi:10.16323/j.cnki.lykx.2012.05.001.
- [7] Wang Ruobing, Qian Zhanglin. Research on utilization rate and transformation strategy of Yangzhou urban parks based on Poe [J]. popular literature and art, 2022 (03): 56-58.
- [8] Lin Huiying, Zhang Yue. Prospect of waterfront park landscape design research based on restorative perception [J]. Smart building and smart city, 2020 (7): 76-77.