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Research on Landscape Space Design Optimization of Green Buildings based on Virtual Generation Algorithm

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Abstract: Traditional architectural landscape design often has problems such as poor visual effect, low satisfaction of residents, and unreasonable design in green environmental protection. Therefore, this paper proposes a green landscape space environment optimization design scheme based on virtual generation algorithm. Firstly, according to the virtual generation algorithm, the virtual generation of the building landscape size is optimized, and the optimization targets include the cost of the building and public facilities such as green belt. Secondly, a new algorithm for generating panoramic landscape images in virtual reality based on feature extraction is proposed. The determinant of Hessian matrix of each pixel in the landscape image is calculated to obtain SURF feature point values. The similarity between landscape images is measured by the Euclidean distance between feature points to achieve feature matching. Through orthographic projection, all landscape images to be synthesized are projected onto the cylindrical surface, and the overlapping parts of adjacent landscape images are fused. After obtaining the projected landscape images, the three-dimensional landscape images generated by orthographic projection are seamlessly spliced through feature matching, and the three-dimensional landscape images generated by orthographic projection are split from a certain position and projected on a plane to obtain a visual consistency of the panoramic landscape image. Finally, the experimental results show that there is almost no gap between the overlapping regions of the panoramic landscape images generated by the proposed algorithm. The brightness difference is not large, the "ghost" phenomenon can be eliminated, and the memory and time consumption are less.

Keywords: feature matching; green building; landscape space; panoramic landscape; virtual generation algorithm; virtual reality

1 INTRODUCTION

Green building refers to the building that saves resources (energy saving, land saving, water saving, material saving), protects the environment and reduces pollution to the maximum extent during the whole life cycle of the building, provides people with healthy, applicable and efficient use of space and harmonious coexistence with nature. Aiming at the evaluation and grade division of green civil buildings in China, the green building evaluation standards [1] are formulated, and the definition, connotation, technical specifications and evaluation standards of green buildings are clearly proposed for the first time. Subsequently, the green building evaluation standards were introduced, and the new green standard made a lot of improvements in construction management indicators. Outdoor landscape space is a comprehensive carrier of human interaction, cultural characteristics and ecological construction, which has corresponding index requirements in green building evaluation standards. At present, the construction of outdoor landscape space of green buildings is mainly to meet the evaluation indicators, ignoring the connotation and function of outdoor landscape space. Therefore, on the basis of meeting the evaluation standards of green buildings, the activation and construction of outdoor landscape space of green buildings and the mining and utilization of multiple values are effective ways to improve the quality of green buildings and enhance the quality of life in residential areas.

At present, the green building evaluation standard system has been fully promoted, and the national green building construction and star rating standards have also been very perfect. However, for the uneven construction of outdoor landscape space, the lack of relevant construction experience, and the lack of pre-job training, the construction technology is difficult to be guaranteed, which reduces the survival rate of planting to a certain extent. Therefore, it is of great significance to study the VR(Virtual Reality) technology of landscape architecture. Literature [2] draws a virtual model template through the software in the building information model, then renders the lighting and materials, exports the animation in avi format, and combines VR technology to realize dynamic engineering space. This method can well solve the construction safety problems caused by environmental factors such as pipelines. Literature [3, 4] focuses on the introduction of three-dimensional terrain technology of fractal terrain. The rhombiform modeling method in midpoint displacement is used to build a terrain model, and the terrain simulation is achieved by combining VR technology, which has achieved certain expected results. Literature [5] converts the model library in the building information model into the VR model library, and designs the subsystem of the collaboration between the building information model and VR, which mainly includes the preliminary preparation work, collaborative procurement, construction and other parts, so that designers and consumers can personally feel the existence of the building entity. Domestic and foreign scholars have carried out a lot of research work on the generation of panoramic landscape images: Document Matrix [6] realizes the generation of panoramic landscape images through Alpha hybrid algorithm, which has the advantages of fast running speed and less space, but it cannot solve the "ghost" problem caused by landscape image registration errors. Literature [7] proposes a region-based panoramic landscape image generation algorithm, which describes the corresponding relationship between landscape images through the gray correlation function, and realizes the generation of panoramic landscape images according to the corresponding relationship. The implementation process of this algorithm is simple, but it will cause mismatching when the region content is not significant. Literature [7] proposes a fractal based panoramic landscape image generation algorithm, which matches landscape images according to fractal ideas, so as to realize the generation of panoramic landscape images. The algorithm makes full use of the statistical characteristics of the landscape image gray level, and the panoramic landscape image generated has good smoothness, and can be accurately matched in the noise environment, and has high stability. However, its calculation process is complicated, and it is not suitable for practical application.

Aiming at the disadvantages of the above algorithms, a new panoramic landscape image generation algorithm based on feature extraction in virtual reality is proposed. This paper deeply studies the method of generating the correction number of virtual reference station, including the research and analysis of the common calculation model, the comparison and analysis of the common interpolation model and the research and analysis of the correction number generated by the common interpolation algorithm. The experimental results show that there is no gap between the overlapping regions of the panoramic landscape images generated by the proposed algorithm, the brightness difference is not large, the "ghost" phenomenon can be eliminated, and the memory and time consumption are less. The first part is introduction, the second part is related work introduction, the third part is landscape space evaluation of green buildings based on virtual generation algorithm, the fourth part is modeling method of green building landscape virtual algorithm, the fifth part is simulation verification, and the sixth part is conclusion.

2 RELATED WORK

"Building Performance Optimization" [8] is an intelligent, fully automated process designed to select an optimized solution from a set of viable alternatives when solving multiple problems. Building performance optimization algorithm realizes comprehensive performance improvement through the coupling of performance simulation and optimization algorithm. At present, a large number of relevant researches has been carried out at home and abroad. For example, Nguyen et al. [9] showed in their research that random population algorithm is the mainstream algorithm for building performance optimization, including genetic algorithm (GAs), cultural algorithm, differential evolution algorithm, particle swarm algorithm, ant colony or bee colony algorithm, intelligent water drop algorithm and hybrid algorithm. Genetic algorithms are commonly used in optimization algorithms that are able to handle a large number of design variables when exploring a complex solution. An objective function is often a mathematical function that characterizes environmental impact, energy consumption, or cost. With the maturity of algorithms and tools, in recent years, foreign scholars have gradually introduced the study of "multivariate virtual generation" using optimization algorithms into the process of green building scheme design. In general, the objective function of virtual generation optimization is the minimization of energy consumption, economic expenditure, indoor discomfort or environmental impact. Limited to the complexity of the calculation and the convergence of the final solution set, two [10] or three [11] objectives are usually used as optimization objects. In this regard, a dual-objective genetic algorithm is applied to find the optimal design balance between energy cost and occupant thermal comfort [12], and three objectives are applied to minimize heating, cooling, and lighting requirements in building energy efficient design. Domestic scholar Han Junsong [13] combined genetic optimization model, building environment information model and neural network model to establish GANN-BIM digital energy-saving design platform, which can effectively improve energy consumption and photothermal performance of office buildings in cold areas, and calculate the non-dominated solution required by balanced multi-performance objectives.

The blocked area in the virtual view will be exposed under other viewpoints, and the exposed information is exactly what the void is missing. For example, literature [14] uses landscape images under adjacent viewpoints of virtual viewpoints to obtain exposed information, and uses the exposed information to generate empty areas of virtual views. The displacement map of virtual view is generated by forward mapping [15]. The missing parts of the displacement map of virtual view are completed by displacement maps of multiple reference landscape images, and then the virtual view is generated by the reverse mapping process. The virtual view is generated by reference visual landscape image and auxiliary visual landscape image [16], and then the virtual view is generated by asymmetric fusion algorithm. Although this method can make up for the deficiency of reference viewpoint information, it needs to transmit multiple reference landscape images when synthesizing virtual view, which results in high transmission bandwidth and cannot carry out real-time virtual viewpoint rendering. Simultaneous transmission of multi-channel video is easy to be affected by illumination, which causes color inconsistency in some areas of the synthesized virtual view.

Under the guidance of the theoretical model of green building evaluation system, various evaluation indicators are discussed and optimized from the perspective of performance, an evaluation system for office building design stage is established, and corresponding evaluation software is developed. Finally, the evaluation system is tested and evaluated [17]. According to the domestic KGBCC (Korean Green Building Certification Criteria) green building evaluation system [18], a method to evaluate the performance of green buildings by using user experience is proposed. The key of this evaluation method is the needs and satisfaction of users. The results of green building evaluation are reflected by the relationship among user characteristics, user experience and green building elements, and the results are reflected on two-dimensional graphs [19]. The proposed method overcomes the limitations of traditional statistical analysis and visualization, and has great enlightening significance. Factors affecting the evaluation of green buildings were studied [20], and an evaluation method based on the whole life cycle of buildings was proposed by focusing on the cost of carbon dioxide emission. They hope that through this method, enterprises can ensure the performance of green buildings in the construction process, but also reduce carbon emissions and achieve profits. The risks of green building projects have been studied [21]. They believe that previous studies have separated risks from each other, while in fact most risks are interrelated. Therefore, they developed a Social network Analysis method (SNA) based on the stakeholder risk analysis method to evaluate and analyze the interaction of risks in complex green building projects. However, the green building evaluation system mainly targets above-ground buildings and their affiliated parts. Due to the particularity and complexity of underground space, these evaluation and design indicators often cannot be directly used in the green design and evaluation of underground space. For example, compared with above-ground buildings, underground space itself meets the land-saving index. For example, in the energy conservation of the above-ground building, factors such as window wall area ratio and building orientation should be considered in addition to the material of the envelope structure, while the underground space is deeply buried underground and the window opening is limited, so the control factor consideration is different from that of the above-ground building, more factors such as the material of the envelope structure are considered, and the impact of the building orientation on the underground building is basically negligible. In terms of green building design and optimization, domestic and foreign scholars have conducted a large number of studies. Starting from two dimensions of economy and environment, virtual generation genetic algorithm has been adopted to try to find the optimal solution from green building design [22]. Combining the fault model and the analysis method of influencing factors, a constraint analysis model [23] was established to identify the constraints of the energy-saving renovation of existing buildings and better guide the design of green buildings. A virtual generation model [24] was established from the three dimensions of goal, profession and time to evaluate the green building design scheme. Based on the basic model, this model proposed a prediction model of green building project cost and schedule based on data mining technology [25], which is suitable for the early design stage of the project. A virtual generation optimization model combining Life Cycle Assessment and Genetic Algorithm (C Genetic Algorithm) [26] is proposed, which can assist designers to optimize the shape design of green buildings. A model for calculating the sustainable goal value of architectural design schemes is proposed [27]. This model combines two methods, Life Cycle Assessment and C target value design, to analyze in detail the contents, evaluation results and evaluation indicators of green building certification projects [28]. The differences and similarities in green technology selection of construction units are summarized. A method for selecting green building design schemes is proposed. First, the evaluation index system of green building design schemes is constructed, then the index weight is determined by the method of expert scoring [29], and finally, the comprehensive evaluation model of green building design schemes is established by the grey clustering method. Three-dimensional greening means that the greening of the roof and wall parts of the building can be coordinated with the landscape. The traditional optimal design of building space often has problems such as poor direct view effect and low satisfaction of residents, which is due to the unreasonable distribution of building space.

3 LANDSCAPE SPACE EVALUATION OF GREEN BUILDINGS BASED ON VIRTUAL GENERATION ALGORITHM

3.1 Spatial Evaluation of Architectural and Scape based on Virtual Generation Algorithm

Aiming at the large void region in the virtual viewpoint video, the algorithm in this paper takes the foreground region moving in the void and regenerates it into the background region, so as to ensure the continuity of the moving picture between video frames. This algorithm generates the foreground moving area of the blank space and proposes the idea of optical flow to guide pixel propagation, that is, the optical flow sequence of the motion foreground extracts the blank space in the video, connects the optical flow between the foreground pixels and the video frame in this process, establishes and connects the foreground pixels to other frames to fill the foreground area of the optical flow video with the blank sequence. The generation of the foreground motion region not only ensures the continuity of the motion between video frames, but also makes full use of the redundant information between video frames, that is, the information exposed by the video in other frames is used to fill the empty area of the current frame. For the background region in the void and the foreground missing region that is not connected to any pixel in other frames, the Edge-PU net network in this paper is used to generate the background region. The technical frame diagram is shown in Fig. 1.

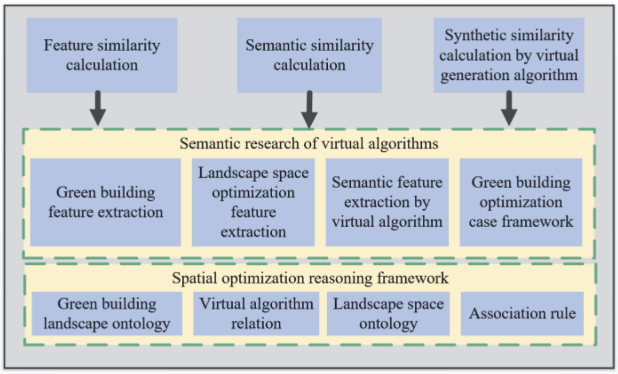


Figure 1 Architecture diagram of green building landscape space optimization based on virtual generation algorithm

Based on public facilities such as entrances and parking Spaces of architectural landscape, the space and size of architectural landscape are optimized according to residents' satisfaction with landscape space, as shown in Eq. (2). The judgment matrix of the index layer is obtained by using the analytic hierarchy process, and the weight value is calculated. The weight judgment matrix of the index layer can be expressed as:

$$W = (0.381, 0.16, 0.035, 0.018, 0.207, 0.121) \tag{1}$$

Comprehensive analysis of the weights of public facilities in the architectural landscape space, such as green belts, seats and parking Spaces, shows that the final weights are 0.419, 0.120 and 0.235, respectively.

Based on the analysis of green belt, seat, parking space and other factors related to the optimization of architectural landscape space, the objective function of construction cost and residents' satisfaction is constructed. The construction cost objective function includes the price of various construction facilities and can be expressed as:

$$\min(\cos t) = \sum_{1 \le i \le n} a_i \cdot \triangle x_i \tag{2}$$

where: cost represents the input cost of architectural landscape facilities, a represents the price of architectural landscape facilities, and *X* represents the number of architectural landscape facilities.

Residents' satisfaction function. When the proportion of the architectural landscape is set high. In a fixed space, the larger the scale of architectural landscape facilities, the more architectural landscape facilities, the higher the satisfaction of residents, and the number of architectural landscape facilities will correspondingly reduce the activity demand, which could not be met, resulting in a decline in satisfaction. However, when the size of architectural landscape facilities is small, the number of residents' daily life will increase correspondingly, and the layout will be more dense, affecting the beauty of the entire building and environmental planning, and residents' satisfaction will also decline. After comprehensive consideration, the residents' satisfaction function can be expressed as:

$$\max S = \sum_{1 \le i \le n} W_i \times (x_i + \triangle x_i) \tag{3}$$

where: *S* represents satisfaction and *W* represents weight value.

In this algorithm, the DFC (Design For Cost) network uses convolutional God network to generate the missing optical flow sequence. It is necessary to train the DFC network and use the trained network model to generate the missing optical flow sequence. The flow chart is shown in Fig. 2. Abbreviations in this paper are shown in Tab. 1.

Table 1 Abbreviations

Abbreviations	Fullname
DFC	Design For Cost
KGBCC	Korean Green Building Certification Criteria
VR	Virtual Reality
SURF	SpeedUpRobustFeatures
ID	Identitydocument

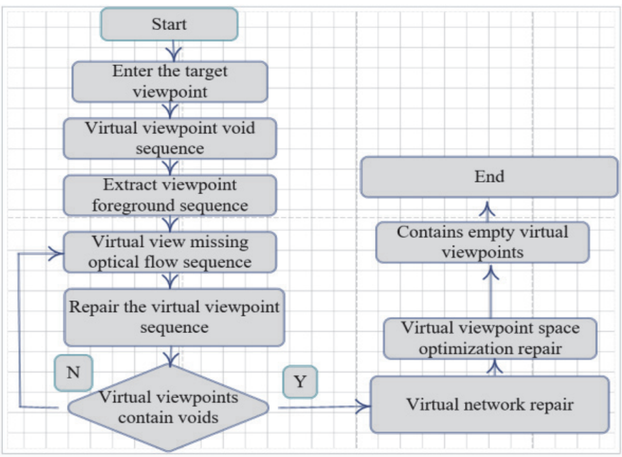


Figure 2 Flow chart of green building landscape space optimization based on virtual generation algorithm

3.2 Research on Virtual Generation Algorithm based on Feature Extraction

Because SURF features are highly unique and robust, this section extracts and matches SURF (Speed Up Robust Features) features of landscape images in virtual reality. SURF convolves landscape images by integrating landscape images, and uses the measure of Hes-sign matrix to establish detectors [30]. Assuming that the points in landscape image $I(X)$ in virtual reality are described by $X = I(i, j)$, the integral landscape image can be described as:

$$I_{\sum}(X) = \sum_{i \le x} \sum_{j \le y} I(i, j) \tag{4}$$

In the process of obtaining the integral landscape image, it is only necessary to traverse the source landscape image once, and the computational complexity is very low [31]. The determinant of the Hessian matrix of each pixel in the landscape image is calculated to obtain the value of the feature point. Hessian matrix calculation efficiency and accuracy are high, the scale of Hessian matrix *H* calculation formula is as follows:

$$H(x, \delta) = \begin{pmatrix} L_{xx}(x, \delta), L_{xy}(x, \delta) \\ L_{yx}(x, \delta), L_{yy}(x, \delta) \end{pmatrix} \tag{5}$$

where *L* is used to describe the second derivative of the Gaussian function at *X* and the convolution of the landscape image.

$$\det(H) = D_{xx} D_{yy} - \left(\frac{9}{10} D_{xy}\right)^2 \tag{6}$$

The similarity between landscape images is measured by the Euclidean distance between feature points. The Euclidean distance calculation formula is as follows:

$$OP = sqrt[(x_1 - x_2)^2 + (y_1 - y_2)^2] \tag{7}$$

Orthographic projection is the process of projecting a series of single-angle landscape images around a fixed spatial cylinder to the side of the cylinder. The landscape images generated through this process are called spatial cylindrical stereoscopic landscape images [31], and the orthographic projection process is shown in Fig. 3. The first picture is the projection of a space cylinder onto a cylindrical surface, and the second one is a panoramic image, that is, a three-dimensional landscape image of the space cylindrical surface. Back projection is to cut the three-dimensional landscape image generated in the orthographic projection process from a certain position and project it onto a certain plane, as shown in Fig. 4.

Then the space coordinates (x, y, z) can be found:

$$\begin{cases} x = r \cdot \cos \dfrac{2\pi \times s}{S \times width} \\ y = r \cdot \sin \dfrac{2\pi \times s}{S \times width} \\ z = (S \times height - t) \cdot h \big/ S \times height \end{cases} \tag{8}$$

Then the coordinates of a pixel in the panorama can be:

$$\begin{cases} s = \dfrac{S \times Width}{2\pi} \arctan \dfrac{y}{x} \\ t = \dfrac{S \times height(h - z)}{h} \end{cases} \tag{9}$$

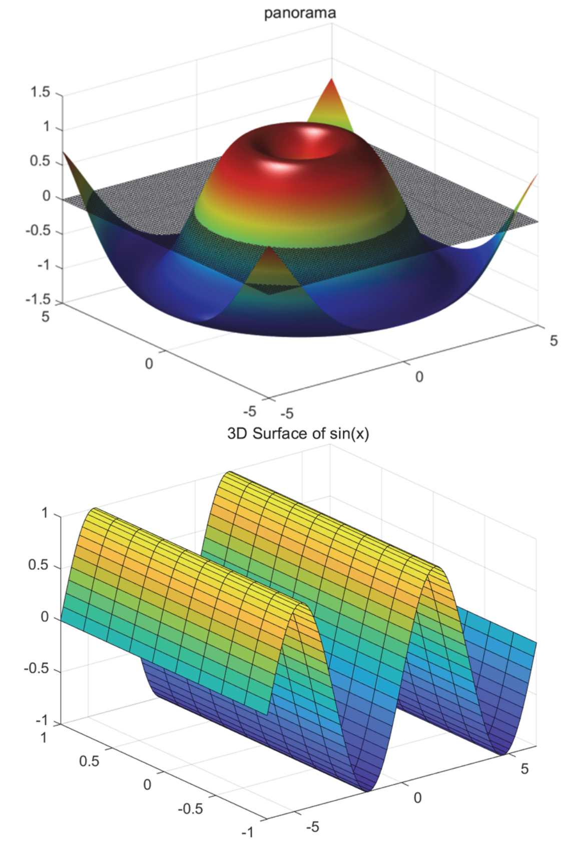


Figure 3 Orthographic projection

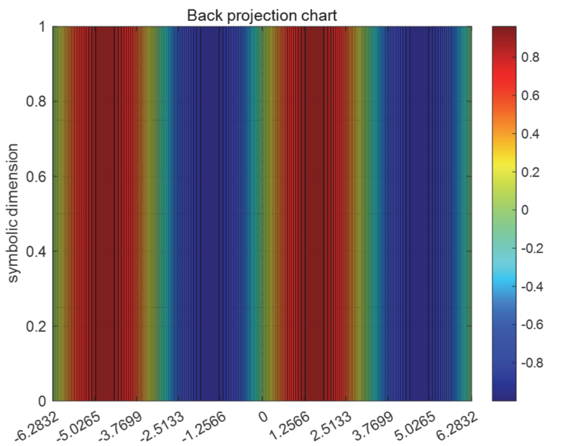


Figure 4 Process from cylindrical three-dimensional landscape image to 360 degree panoramic landscape image

3.3 Optimization of Architectural Landscape by Virtual Generation Algorithm

The sharing function is used to modify the individual fitness value in the population, so as to ensure the diversity of the population. The sharing function is formed by the combination of coding type difference and fitness difference. Suppose there are two individuals x, and the distance between them is d_1 and the fitness distance is d_2, then the sharing function S can be expressed as follows:

$$S(x_i) = \begin{cases} 1 - d_1(x_i)/a_1 \\ 1 - d_2(x_i)/a_2 \end{cases} \tag{10}$$

where, a_1 and a_2 are the radius of the virtual generation algorithm. By integrating the sharing function into the fitness function of the individual, the fitness function of the individual after modification is obtained:

$$f(x_i) = \frac{f(x_1)}{\sum_j S(x_i, x_j)} \tag{11}$$

where, $f(x_1)$ represents the modified individual fitness function, $f(x)$ represents the original individual fitness function, and N represents the total number of individuals.

The method proposed in this paper is used to optimize the architectural landscape, and satisfaction is used to represent people's recognition. Tab. 2 shows people's different degrees of attention to the evaluation factors of squares and pedestrian streets, and Tab. 3 shows people's satisfaction after the optimization of architectural landscape space. This article assumes that satisfaction is divided into 5 different levels, and the corresponding score value is 1 - 0. It can be seen from Tab. 3 that after optimization of the algorithm in this paper, the results of all evaluation factors are generally consistent. For most of the evaluation factors of architectural landscape, people give an evaluation above "satisfactory", which indicates that people are more satisfied with the spatial layout of the optimized architectural landscape in Huaqiang North, and it also indicates that the algorithm in this paper can achieve good spatial optimization of architectural landscape.

Table 2 Different degrees of attention to the evaluation factors of square and pedestrian street

Evaluation factor	Plaza	Pedestrian street
Space security	0.064	0.073
Space privacy	0.073	0.074
Greening rate	0.172	0.162
Color diversity	0.084	0.089
Accessibility of public facilities	0.252	0.245
A sense of openness of vision	0.082	0.083
Casual atmosphere	0.174	0.195
Personalization of space layout	0.097	0.094

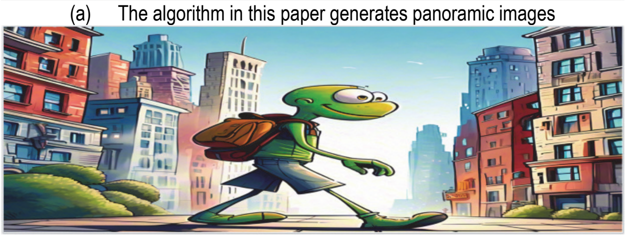
Table 3 Satisfaction after architectural and scape space optimization

Evaluation factor	Plaza	Pedestrian street
Space security	0.42	0.25
Space privacy	0.73	0.34
Greening rate	0.81	0.62
Color diversity	0.54	0.29
Accessibility of publicfacilities	0.85	0.45
A sense of openness of vision	0.25	0.23
Casual atmosphere	0.72	0.35
Personalization of space layout	0.56	0.34

Compared with the optimization satisfaction values of square and pedestrian street in Tab. 3, it can be seen that the average satisfaction values of the two landscape Spaces are 0.62 and 0.39, respectively. This shows that the square has the highest satisfaction. The reason is that the square is the main area for people's leisure, and its facilities and green areas are well planned. In the pedestrian street, the decoration style of various shops has its own characteristics, which looks dazzling, easy to cause aesthetic fatigue, and the vegetation greening rate along the street is low, so the satisfaction is low.

In addition, there are moving objects in the adjacent source landscape images, and the phenomenon of "ghost" appears. The algorithm in this paper, fractal algorithm and particle filter algorithm are respectively used to generate and process the panoramic landscape images of the source landscape images with the phenomenon of "ghost", and the results are described in Fig. 5. The analysis of Fig. 5 shows that the proposed algorithm can effectively eliminate "ghost" in the source landscape image, while "ghost" still exists in the fractal algorithm and particle filter algorithm, which verifies the effectiveness of the proposed algorithm.

(a) The algorithm in this paper generates panoramic images



(b) The fractal algorithm generates the panorama

(c) The particle filter algorithm generates panoramas

Figure 5 Comparison of results generated by the three algorithms

Virtual generation algorithm needs to simulate human senses such as audiovisual and tactile, so that users can feel the real world. Various perceptual techniques, such as visual rendering, audio processing, haptic feedback, etc., are required. Among them, visual rendering is to simulate the process of light irradiation and reflection to increase the three-dimensional sense and sense of reality of the three-dimensional model. Audio processing is to simulate the transmission and processing of sound, so that users can hear realistic sound effects. Haptic feedback is a process that simulates tactile stimuli to make users feel the interaction and contact with the virtual environment. These technologies can enhance the user's sense of immersion and realism, and improve the experience effect of virtual reality system.

4 MODELING METHOD OF GREEN BUILDING LANDSCAPE VIRTUAL ALGORITHM

4.1 Procedural Modelling based on Constraints

The main task of landscape modelling is to collect modelling data, which mainly includes two-dimensional graphics, surface graphics and model surface texture. With the diverse development of landscape models, the difficulty of obtaining data has increased due to different architectural styles and other reasons in recent years. In order to reduce the problem of low data utilization in the process of building modelling, a data attribute analysis model is proposed, as shown in Fig. 6.

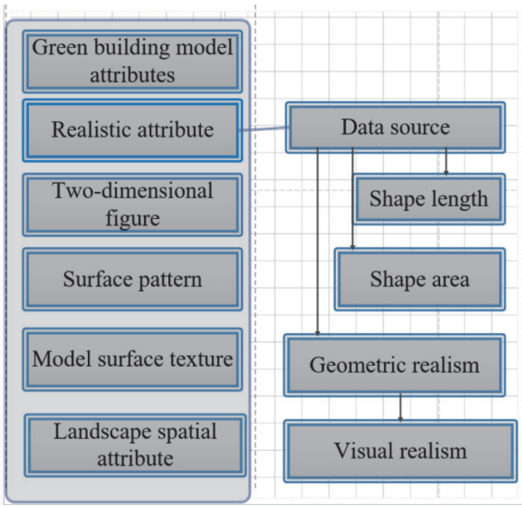


Figure 6 Data attribute analysis model

The model comprehensively considers the data sources needed in the process of landscape modelling, because different data have different effects on modelling. For example, attributes mainly explain the ID (Identity document) label or collection method of metadata, play an auxiliary role in the establishment of the model, and can truly reflect whether the data is standardized. Based on the characteristics of input data, the realistic factors of the modelling are analyzed, and the realistic factors of the model are improved from both geometric and visual aspects.

The above rules are used in different algorithms of landscape architecture modelling. For example, by generating height rules, the building height is squeezed to form the building model, which can increase the sense of geometric reality. The visual sense can be enhanced by mapping the architectural texture through geometric segmentation and texture selection rules.

Since there is no height attribute in the input data, there is a lack of three-dimensional information of the model during modelling. Therefore, a custom height generation rule is adopted to generate the height value of the building by programmatic method, and two attributes of building type and building level are added to the building through the calibration platform. The building type attribute can ensure the particularity of the building. Building level attributes not only ensure that there is no large height difference between buildings, but also ensure the rationality of texture mapping. The height of the building model is generated according to the building attributes, and the height range of the building can be expressed by the formula:

$$\begin{aligned} H_{\max} &= \min(A_{type}, A_{leve}) \\ H_{\min} &= \max(A_{type}, A_{leve}) \end{aligned} \tag{12}$$

H_{max} and H_{min} represent the maximum height and minimum height of the building respectively. A_{type} indicates the building type attribute. A_{Level} represents the building hierarchy attribute. In addition to building type and building level attributes, building height is also affected by other constraints such as environment. Based on this, a method to calculate building height in a random way is proposed. The formula can be expressed as follows:

$$\{H = \delta \times B(A_{type}, A_{leve}) + \gamma \times C(A_{widt}, A_{leng}) + D(h) + \lambda \times E \quad (13)$$

where, B represents the influence function of building type and building level on buildings; C represents the influence function of the community on the building; D represents the influence function of the surrounding environment on the building; E represents the influence function of other factors; h represents the average height of the surrounding buildings; X represents the random number generated by the random function; R_{max} represents the maximum value generated by a random function. The height of all buildings can be generated through the height generation strategy, and due to randomness, it can enhance the realism of the model while conforming to the actual situation.

For the four different directions of the opposite block, the front, back, left and right sides, different texture patterns are selected for mapping to ensure that different types of buildings can obtain corresponding texture patterns. Combined with the height of buildings and texture naming rules, the scope of the texture library of buildings is determined. The formula can be expressed as:

$$G_{num} = \frac{Y \cdot (N-1)}{R_{max}} + 1 \quad (14)$$

where, Y represents the random value selected in the random number; max represents the maximum value generated by the random function; N indicates the selectable material. Through building generation rules and texture selection rules, landscape architecture models can not only be constructed, but also have a strong sense of reality, which provides the basis for complex digital landscape modelling.

4.2 Landscape Layout Estimation

In order to generate realistic 3D model of landscape architecture as much as possible, it is necessary to restore scene layout and other information. The object in the building is identified by object detection algorithm, and the object layout structure is estimated by object detection results. Firstly, the object in the three-dimensional space is projected into the two-dimensional space, and the optimal layout solution is sought by adjusting the layout. For a single object in the scene, the objective function is:

$$\min_{H} k = 1 - L(h, O(H, l, P)) \quad (15)$$

In order to make the layout of objects in the building more accurate, the design optimization method. Through the information obtained from the two-dimensional space, the landscape space surrounding box can generate more accurate data.

Object detection can obtain the category and number of objects, and the type initialization of objects can be expressed as:

$$W_i = \{V_{zi}^1, V_{zi}^2, \ldots, V_{zi}^n\} \quad (16)$$

In order not to lose generality, this section takes the whole test set as the research object, and takes the edge retention index, mean value and standard deviation as the measurement indicators to evaluate the performance of the algorithm in this paper. The edge retention index can reflect the integrity of edge information of panoramic landscape image. The higher the edge retention index is, the more complete the edge of panoramic landscape image will be. Standard deviation can reflect the distribution of pixel values in panoramic landscape images, and the larger the standard deviation is, the more uneven the distribution is. The mean value can reflect the average value of the pixel value of the generated panoramic landscape image, and the higher the mean value, the smaller the brightness difference. The formula for calculating the edge retention index is:

$$EPI = \frac{\sum |p_s - p_{sn}|}{\sum |p_o - p_{on}|} \quad (17)$$

The standard deviation is calculated as follows:

$$SD = \sqrt{\frac{1}{MN} \sum_i \sum_j (I(i,j) - I)^2} \quad (18)$$

As can be seen from the analysis of Tab. 4, the edge retention index of the proposed algorithm is 0.95, which is significantly higher than 0.88 of the fractal algorithm and 0.81 of the particle filter algorithm, indicating that the edge integrity of the panoramic landscape image generated by the proposed algorithm is higher than that of the other two algorithms. In addition, the standard deviation of the proposed algorithm is significantly lower than that of the fractal algorithm and particle filter algorithm, and the mean value is higher than that of the fractal algorithm and particle filter algorithm, indicating that the pixel distribution of the panoramic landscape image generated by the proposed algorithm is more uniform.

Table 4 Comparison results of the three quantitative evaluation indexes

Index	Textual algorithm	Fractal algorithm	Particle filter algorithm
Edge Retention Index	0.95	0.88	0.81
Average value /mm	122	103	109
Standard deviation /mm	1.15	2.37	3.22

In order to further verify the effectiveness of the proposed algorithm, the memory consumption and time required for generating panoramic landscape images by the proposed algorithm, particle filter algorithm and fractal algorithm were compared and analyzed when the number of source landscape images was different. The results obtained are described in Tab. 5.

As can be seen from the analysis of Tab. 5, with the gradual increase in the number of source images, the memory and time required by the three algorithms show an increasing trend. However, when the number of source images is the same, the memory and time required by the proposed algorithm are significantly lower than those of the fractal algorithm and the particle filter algorithm, indicating high performance of the proposed algorithm.

Table 5 Comparison of memory and consumption time of the three algorithms

Number of source landscape images	Textual algorithm		Fractal algorithm		Particle filter algorithm	
	Internal memory	time	Internal memory	time	Internal memory	time
5	17.3	5.9	19.8	7.4	18.6	6.7
9	22.5	7.2	26.7	9.3	24.8	8.7
12	26.3	9.3	30.8	12.2	31.2	13.4
22	29.4	12.5	35.6	15.3	33.7	16.1

5 SIMULATION VERIFICATION

Due to the complexity of the realization process of the whole three-dimensional ecological landscape, this paper takes the greening landscape of the whole interface of the building as an example to describe its realization method. The root of the greening of the building interface is the design concept of "land space", where the building interface is mainly the roof, facade and the ground around the building. In the actual design process, the roof is usually covered with soil with a thickness of 30 - 40 cm and good permeability and drainage. With the development of modern science and technology, new materials such as artificial foam, decomposed sawdust frogstone soil or artificial light soil have gradually emerged. At the same time, we also need to consider the drainage and waterproof problems of the roof, so we need to lay a layer of anti-penetration on the roof sealing layer that is not resistant to root damage, and then plant plants in the matrix layer above. The green structure of the roof is shown in Fig. 7.

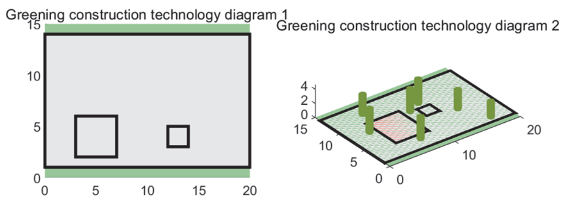


Figure 7 Construction technology of roof greening

The climbing plants can be divided into self-climbing species, climbing species, winding species, climbing species and hanging species. Among them, the self-climbing class (such as ivy, rock, ivy, wild grape, hydrangea, etc.) has less damage to the wall, and can be used for a larger area of greening. And some linear spreading plants (such as vetch, grapes, etc.) need to be fixed on the wall metal supports, and even some climbing rose branches need to use a certain frame for traction. In addition, it must be mentioned that the choice of plants for the west-facing wall, because the west-facing wall is subject to strong solar radiation for a long time, can not only be to plant ornamental plants, but also to plant some fruit trees that do not bear fruit in the local climate, and the branches can be fixed on the wall frame. Fig. 8.


Figure 8 Balcony greening construction

In order to make a correct and objective evaluation, 30 images from cam3 view point in Ba1let video sequence and Breakdancers are selected as the reference view respectively, and 17IBR technology is used to generate virtual view image under cam4 view point. PSNR and SSIM values of each image are calculated after voidness is generated. The PSNR and SSIM values generated by different methods are shown in Fig. 9 and Fig. 10. It can be seen from the figure that the PSNR and SSIM values of the image generated by the proposed method are significantly higher than those of the sample block-based method and PUnet method, indicating that the generated image has less distortion and is closer to the real image.

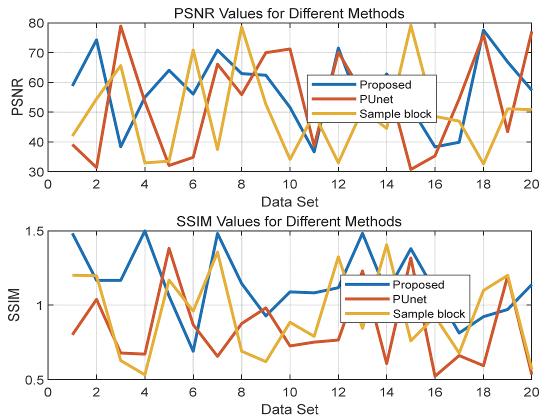


Figure 9 PSNR comparison of virtual view images after generation

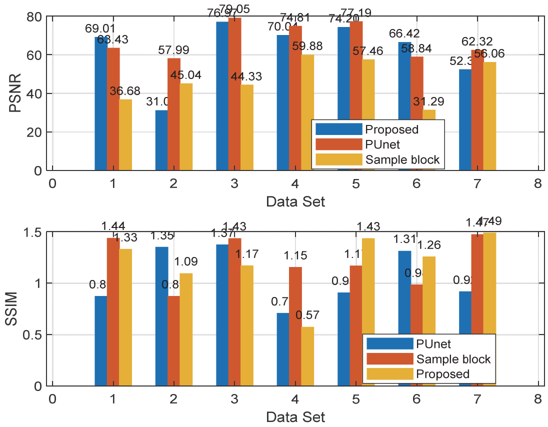


Figure 10 SSIM comparison of the generated virtual view image

In addition, the correlation algorithm of virtual generation correction number is applied to the software system of observation generation of virtual reference station developed by ourselves. In addition, experimental tests are carried out in the virtual reference station network, where: in the network, the RTK positioning error distribution of the test point is shown in Fig. 11.

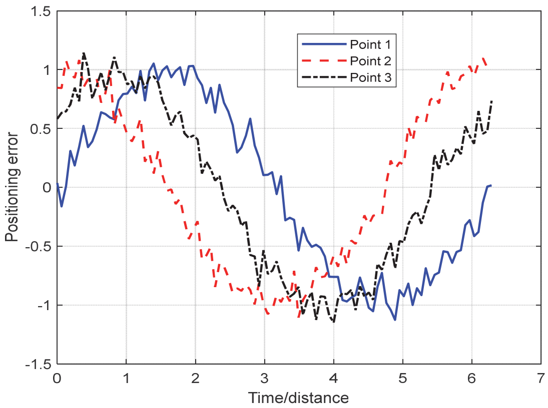


Figure 11 Positioning error distribution results of the experimental network internal test pilot

Outside the network, the positioning error distribution of test points is shown in Fig. 12.

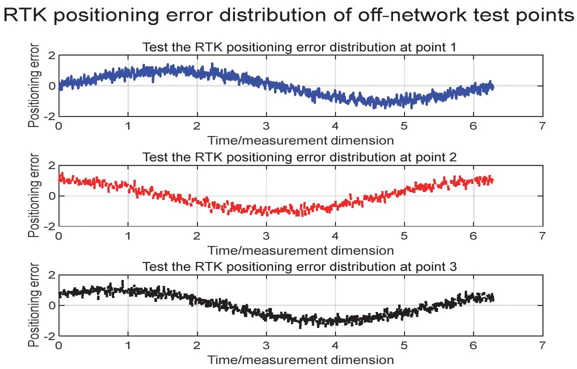


Figure 12 Results of positioning error distribution of test points outside the experimental network

With the continuous improvement of national quality, more and more ecological environmental protection work concept has been effectively applied into relevant management and control work. At the same time in the development process of construction industry in our country, the green building concept has been widely paid attention to; at the same time in our country in the process of landscape architecture planning and design work, the planning and use of more green buildings are getting higher and higher. At the same time our country green engineering construction standard and requirements are fully met. In the planning and design work of landscape architecture, it is necessary to comprehensively strengthen the diversification of plant landscape inside the landscape. Due to the relatively late start time of ecological environmental protection work in China at this stage, we can continue to learn some more advanced engineering construction experience from abroad, and at the same time, we should add some scientific and reasonable design concepts to minimize energy consumption. In landscape planning and design, it is necessary to continuously add some ecological development concepts, pay full attention to the effect of comprehensive management of vegetation community, and highlight its unity and order, so as to form a relatively stable vegetation community, ensure the diversification of vegetation mix in landscape architecture, and effectively combine the characteristics of various vegetation, design a more pleasing landscape content. In addition, it is also necessary to effectively control the structure of the garden vegetation system, and rationally distribute various substances and energy in it. In the planning and design of green garden landscape and green building, it is necessary to fully ensure that its good ornamental value is realized on the basis of ecological benefits. The practice of green landscape is a full test and supplement to the design of green buildings. In the next step, the development of three-dimensional ecological landscape should continue to follow the development trend of human history, give full play to its functional value, and further refine its aesthetic and social value.

6 CONCLUSION

This paper proposes a green building landscape environment optimization design scheme, which uses virtual generation algorithm to optimize the architectural landscape in order to obtain better direct view effect and reduce the construction cost. In addition, this paper also optimizes the internal structure of the architectural landscape, so that it can maintain a reasonable greening ratio. The results show that the scheme proposed in this paper can improve user satisfaction compared with the traditional scheme, and has higher practical application value. The process of green design scheme generation is the process of analyzing, researching, innovating and expanding the generalized green strategy. At the same time, according to the different design variables and objectives realized by the algorithm, the design results will also change accordingly, just as the Pareto optimal solution set given in the virtual power generation optimization is not the only optimal solution. The guiding role of subjective thinking and choice is very important, which is also the source of continuous innovation of Jianyi aesthetics.

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