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Design of Iterative Reconstruction Method of Landscape Environment Based on Deep Belief Network

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Abstract. The 3D reconstruction system can reproduce the spatial pattern of urban landscape ecotone and provide an effective design method for urban ecological environment planning and urban spatial layout. Using the technology of combining computer aided design (CAD) with geographic information system (GIS), digitizing the components of landscape architecture can not only realize the virtual reproduction of landscape architecture, but also store and manage the artistic details such as the structure and function of landscape architecture. This article constructs a 3D reconstruction system of landscape environment based on CAD technology driven by artificial intelligence (AI), expounds the structure of deep belief network and the stage of automatically extracting landscape image features, and how to eliminate the data redundancy of original CAD data sources while ensuring the authenticity of the scene, so as to reproduce the accurate, realistic and visual spatial pattern of urban landscape ecotone. The simulation results show that compared with the control scheme, the accuracy of this method is improved by 25.72%, and the feature information of terrain image can be well restored and the background information can be suppressed. CAD 3D structure construction drawing can not only accurately show the shape change law of the structure, but also observe the shapes of various parts of the structure in various directions, and intuitively see the mutual relationship and interference of the components, which is more conducive to accurately guiding the construction.

Keywords: Landscape Environment; 3D Reconstruction; Artificial Intelligence; Deep Belief Network; CAD
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1 INTRODUCTION

In the stage of urban growth, it is need to continuously plan the layout of urban landscape and optimize the distribution of landscape ecotone in order to adjust the urban ecological environment and save urban planning space. From the architectural point of view, landscape architecture is one of the branches, and the materials used in the stage of landscape construction are basically the same as those used in construction projects. The task automation in landscape design simulation environments often involves an edge recognition planning architecture for motion structures. View planning is the core of optimizing view planning algorithms. It defines a set of views on the motion model and determines the optimal viewing angle and range in each view for use in subsequent reconstruction processes. Arce et al. [1] conducted iterative development on the basis of view planning to gradually improve the reconstruction of the structure. This usually requires the use of computer graphics technology and numerical optimization algorithms to minimize the error between the reconstruction results and the actual structure, and ensure that the reconstruction results meet the expected requirements. Finally, the results of iterative development are used to generate Iterative reconstruction. This usually requires the use of computer graphics technology and rendering technology to present realistic reconstruction results. This process may require multiple iterations and optimizations to gradually improve the reconstruction of the structure. In addition, it is also necessary to consider the efficiency and scalability of the algorithm in order to handle large-scale structures in practical applications. Traditionally, building construction drawings mainly include general description, general plan, building construction drawings, structural construction drawings and equipment construction drawings, among which building construction drawings and structural construction drawings are important drawings to guide building construction. Drawing geometry and engineering 2D and 3D drawings in architecture and vocational education are a very important field that involves graphic expression and communication in architectural design and construction processes. Cartographic geometry is a discipline that studies how to accurately express three-dimensional objects on a plane. In architecture and vocational education, drawing geometry is widely used for the expression and drawing of architectural drawings. Drawing geometry includes basic concepts such as projection, proportion, size, etc. Through these concepts, architects' design ideas can be transformed into flat drawings. Byun and Sohn [2] conducted a CAD graphic software analysis. It provides rich drawing tool functions for 3D drawing analysis of three-dimensional models. As one of the core technologies of digital city, the 3D visualization technology of digital city is a technology that applies computer 3D visualization technology to the construction of digital city, and develops people's description of urban landscape status and planning and design from 2D map and 3D physical model to computer 3D spatial expression. Three stream deep neural network is a deep learning technique used for image segmentation and object detection. The task of extracting building roof wireframes from aerial images can benefit from the application of three stream deep neural networks. Esmaeily et al. [3] used a three stream deep neural network to train aerial images and proposed an image framework based on building position extraction. The training process usually involves iterative optimization of neural network parameters to minimize the Loss function. After the training is completed, the trained three stream deep neural network can be used to predict new aerial images. The predicted results usually require post-processing, such as removing noise, filling voids, etc. It designed some unique decoders for the selection and combination of building training sets, and studied the prediction results of building network structure, which significantly reduced the error detection rate. In order to improve the convenience of construction guidance and help the owner to understand all aspects of construction, CAD 3D way can be used to show the structure diagram. In the stage of guiding the construction work, the internal structure of garden buildings is displayed to the builders and owners by combining 2D plan with 3D structure diagram, so that the builders and owners can observe the internal structure of garden buildings intuitively, efficiently and comprehensively. Han et al. [4] used a deep learning-based image encoding program to assist in the completion calculation design of high-rise landscape buildings. Starting from the fully automatic collection of real data, decoder segmentation of feature images was carried out through the development of 3D real data such as drones and cameras. The elevation clustering and clustering algorithm proposed by the research institute for building landscape contour segmentation have achieved good results. Compared with the real data intensive point cloud of Contour line, its developed scene automatic conversion creates accurate algorithm precision.

Due the rapid growth of computer technology, the 3D reconstruction technology of urban landscape ecotone can highly restore the layout of urban gardens, reduce the large-scale spatial pattern in graphics software, and provide a fast and effective expression for reverse engineering design. The iterative method of remote sensing big data and cultural characteristics detection and past landscape process analysis is an effective technology, which can be used to extract and analyze the cultural characteristics of landscape and the change process of past landscape. Howey et al. [5] can study the process of landscape changes in the past by comparing and analyzing remote sensing data from different time periods. This includes modeling and simulating the evolution of the landscape to understand the changing trends and historical evolution of the landscape. On the basis of cultural feature detection and past landscape process analysis, iterative methods can be used to continuously optimize and improve the analysis results. This includes repeated analysis and processing of remote sensing data, as well as combining with field surveys and expert knowledge to obtain more accurate and comprehensive results. On the basis of iterative methods, it is necessary to analyze and manage the collected remote sensing data, including data preprocessing, feature extraction, pattern recognition, and visualization. This can help researchers better understand the cultural characteristics and historical evolution of landscapes. The construction of landscape architecture needs the construction and construction drawings with high professional level. For decision makers and owners, its internal structure cannot be understood, and the architectural structure in the bidding and construction process cannot be displayed, communicated and evaluated. In order to improve the efficiency of design and construction, and realize 3D design and 2D or 3D drawing, a large quantity of designers can be liberated from the heavy work of drawing 2D construction drawings. At the same time, CAD dynamic observation is used to simulate on-site construction, and the construction objects in local or global landscape environment can be observed from any angle. 3D reconstruction system can reproduce the spatial pattern of urban landscape ecotone and provide an effective design method for urban ecological environment planning and urban spatial layout. The purpose of this article is to build a 3D reconstruction system of landscape environment based on CAD technology driven by AI. The goal is to reproduce the accurate, realistic and visual spatial pattern of urban landscape ecotone, and provide an effective way to reproduce the urban landscape ecotone and optimize the rational layout of urban landscape.

How to improve the accuracy of feature recognition of landscape images is an important topic in the research of 3D modeling of landscape environment CAD. The traditional landscape image classification is to extract features manually, which is subjective and inefficient. However, the depth belief network can automatically extract the features of images, which overcomes the shortcomings of manual extraction and lays a solid foundation for CAD modeling of landscape environment. DBN is composed of several Restricted Boltzmann Machine (RBM), which are trained layer by layer from bottom to top when training the network. RBM network consists of two levels of network structure, namely, visual layer and hidden layer. In specific applications, the visible layer is also called "data input layer" and the hidden layer is also called "feature extraction layer", and the nodes of these two layers are linked by weight coefficients. In this network, the weight model of each level is independently learned. DBN can extract more abstract features and represent data by greedy training RBM layer by layer. Although DBN has achieved good results in data representation, most of the hidden neuron variables in DBN are noise variables, which leads to redundant representation of many data, thus affecting the classification effect of DBN. In this article, the application of deep belief network and CAD technology in 3D reconstruction of landscape environment is studied, and the following innovations are made:

⊖ Based on the classification of the main modeling objects of urban landscape, this article establishes a 3D spatial data structure and realizes a 3D reconstruction method of landscape environment based on deep belief network and CAD.

⊜ Combining the idea of characteristic view, the landscape space is divided evenly based on latitude and longitude, and then the subspace is merged by using fuzzy moment invariant features combined with clustering algorithm to extract characteristic view.

⊛ In order to solve the problems of complex network structure and low prediction accuracy caused by the fact that there are many characteristic variables in the input data of DBN, a DBN model based on information correlation strategy is designed.

This article first introduces the significance and demand of landscape CAD modeling, and then puts forward the application of AI method to the 3D reconstruction of landscape environment, and combines DBN to build a dynamic fusion model of landscape image characteristics; Then the modeling performance of this method is tested. Finally, the contribution of this article and the future research direction are summarized.

2 RELATED WORK

Crack detection under the control of engineering landscape images has always been an important topic in the detection of civil facilities. Kalfarisi et al. [6] conducted an image ensemble evaluation analysis based on deep learning. It uses deep learning and 3D realistic mesh models for quantitative evaluation and integrated visualization of crack detection and segmentation. And developed different boundary framework 3D network model training architectures. By visualizing and quantitatively evaluating the infrastructure of the regional neural network, the impact of different image cracks on the effectiveness and stability of different models was determined. For integrated visualization, a graphical user interface (GUI) can be used to display the output results of the model. For example, the detected cracks can be annotated on a 3D mesh model and displayed to the user. We can also use color mapping technology to display the size and shape of cracks. Lee et al. [7] conducted a prospective analysis of high-depth image multi perspective stereo applications. It reconstructs perception through the matching cost of integrated planar scanning stereo software. An attempt to verify the accuracy was constructed by evaluating the matching structural dataset of the 3D model of software visibility for matching costs. Collect sufficient data for subsequent processing. These data can come from laser scanners, depth cameras, or other 3D scanning devices. Use initial 3D models, such as 3D data obtained from laser scanners or depth cameras, or other existing 3D models for reconstruction. Matching the initial reconstruction results with the surface of each object can use common surface matching algorithms, such as curvature based matching algorithms or feature point based matching algorithms. The sustainable resource development of public landscapes is currently one of the research hotspots in landscape performance.

Li et al. [8] collected relevant data on the entrance landscape of the station through on-site surveys or questionnaires, including measurement and quantitative data of various factors. Based on the research objectives and collected data, a hypothetical causal Relational model can be established. For example, landscape aesthetics will affect traffic efficiency and safety, and traffic efficiency and safety will also affect the ornamental value of the landscape. It has constructed a positive impact on the sustainable development of spatial community vitality in terms of public landscape efficiency. It improves the variable parameter system of the model landscape of subway station entrance landscape. Through a comprehensive investigation of structural equations, it was found that there is a significant complex correlation between subway variables that affect green landscape and traffic capacity. Any change in variables may lead to attenuation or enhancement of related variables. Currently, enhanced learning based on CAD interactive visualization has become increasingly important. Virtual displays have great visual analysis value in mathematical visualization. Lu et al. [9] enhanced the platform space through CAD interactive visualization. Users can directly manipulate CAD models in 3D space, thereby gaining a deeper understanding and mastery of the details and features of the model. For example, users can view various parts of a model, as well as their relative positions and relationships, through operations such as rotation, scaling, and dragging. CAD interactive visualization can also enhance users' spatial perception. By operating in three-dimensional space, users can better understand the size, shape, and spatial layout of the model. This is very helpful for the design and manufacturing process, as users can more accurately grasp the size and proportion of the product, thereby better carrying out design and manufacturing. Interactive visualization based on CAD has many advantages in enhancing platform space. It can help users better grasp the size and proportion of products for better design and manufacturing. At the same time, it can also enhance team collaboration and communication, thereby completing design tasks faster. Máder et al. [10] studied and analyzed the engineering activity shortcut methods for building 3D design. It considers the direct impact of measurement tools and methods on the accuracy of data in CAD software. By using precise measurement tools and methods, CAD software can more accurately capture and record geometric data in space. At the same time, measurement tools and methods also affect the data input method of CAD software. For example, if digital sensors or scanning devices are used, the actual measurement data can be directly input into CAD software, which can better restore the real scene. If machine vision or laser scanning technology is used, a large amount of data can be quickly input into CAD software, which can better facilitate subsequent data processing and analysis. The current factory model building landscape model construction assembly does not have a highly automated environmental model construction problem as a whole. Therefore, to address this issue, Petschnigg et al. [11] elaborated on a 2D planning assembly solution based on environmental models. By digitally decomposing the production environment, it establishes an information model accuracy impact framework for object recognition using Bayesian neural networks for point cloud segmentation. It evaluated the accuracy of production models for large-scale digital environments using real datasets. The evaluation results indicate that the Bayesian based segmentation network significantly improves the baseline performance of the model scene, which improves the simulation accuracy of the static environment of the scene's information. Sepasgozar [12] conducted the construction of building landscape information scale monitoring based on CAD digital twin technology. It uses a 3D spatial model to construct an autonomous platform for analyzing the detectable control of urban data. Through CAD digital twin, Intelligent design of building environment can be realized in the design phase. By using parameterized design, machine learning, and artificial intelligence technologies, intelligent building solutions can be quickly generated. Through CAD digital twins, real-time monitoring of the building environment can be achieved. In the digital twin model, various sensors and monitoring data can be integrated to achieve real-time feedback and adjustment of the building environment. Digital twins can help urban planners with long-term planning. By simulating the impact of different planning schemes in the future, the sustainability and effectiveness of these schemes can be evaluated. Digital twins can help cities respond more quickly to emergencies. For example, in the event of a traffic accident or natural disaster, digital twins can provide real-time traffic information and the best response strategies. Through digital twin technology, the connectivity of smart cities can be improved and the impact of infrastructure construction planning can be measured. This helps to improve the transportation efficiency, convenience, and sustainability of cities, providing better support for their future development.

Shirowzhan et al. [13] conducted decision-making connectivity for smart cities and selective development of large-scale projects. By applying advanced unmanned applications in different geospatial intelligent landscapes, compatibility has been increased. Color and structure based on EEG features is an emerging technology in landscape recognition, which uses EEG signals to identify color and structure information in the landscape. In landscape recognition, color is an important feature that can provide important information about the landscape. For example, in different seasons, the color of vegetation in the same location may change, which can affect the overall appearance and aesthetics of the landscape. Therefore, identifying colors is crucial for landscape recognition. The structure of landscape color has important signal rating value for human perception. Different structures of images and filtering structures have overall assistance for color landscape images. Wang et al. [14] conducted EEG feature landscape classification recognition using support vector machines. Extracting people's understanding of the color and structural information of landscapes by analyzing the electrical signals of the human brain. This technology also has some challenges and limitations. For example, it requires a large amount of training data and algorithm development to achieve accurate landscape recognition. The digital system of ancient architectural decoration art needs to fully consider the diversity and variability of decoration art. Therefore, when designing and implementing the system, it is necessary to cover as many types and styles of decorative arts as possible, taking into account their changes and evolution. At the same time, it is also necessary to maintain and update the system well to ensure its continuous accuracy and effectiveness. Xin and Daping [15] conducted data processing on the inheritance and design of decorative art in ancient architecture. In order to prevent the traditional artistic and architectural effects from losing vitality, a static construction mode for ancient architectural decoration was constructed based on neural network image feature analysis. At the same time, on the basis of building scanning Data and information visualization, it carries out the process of building a framework of artistic dynamic data for scene simulation. The reality virtual augmentation technology based on CAD has played a significant role in the application of geographic information systems. The current resource architecture creation models have certain limitations in constructing 3D models for mobile maps. The data collection cost is high, and Yang [16] has developed a semi-automatically generated 3D urban architecture city model to improve people's spatial perception of urban spatial areas. The least squares estimation of pseudo quaternion polarization image reconstruction in linear compact polarization SAR can be achieved through the following steps. Construct a least squares optimization problem where the objective function is the sum of squared errors between the actual measured and predicted values, and the independent variable is the pixel values in the pseudo quaternion polarization image to be reconstructed. Use optimization algorithms to solve the least squares problem and obtain the reconstruction results of pseudo quaternion polarization images.

Yin et al. [17] conducted parameter reconstruction analysis of nonlinear equations for three-dimensional structural reconstruction. Unlike traditional imaging methods, its proposed multipolar information reconstruction shows superiority in complex window areas such as farmland. It should be noted that the least squares estimation for the reconstruction of linear compact polarimetric SAR pseudo quaternion polarimetric images needs to be realized based on actual data and specific algorithms, and different algorithms and data may need to be adjusted and optimized differently. The color effect of landscape design refers to the creation of different spatial atmospheres and psychological feelings through the color matching and combination of elements such as plants, buildings, and sketches, in order to achieve aesthetic and pleasant effects. By combining different colors, different spatial atmospheres and psychological feelings are created. Achieve balance in space through symmetrical or asymmetrical means. The application of color in landscape design can directly have a significant impact on the model design of landscape architecture. Zhang and Deng [18] conducted a study on the emotional structure of artistic aesthetic colors. It analyzed the impact of spatial perception factors of landscape colors on psychological structure. By analyzing the emotional structure of urban residents' garden colors, the spatial emotional relationship content of color context was guided. The development of Building information modeling and geographic information system of intelligent city needs to be constructed in different data integration. Zhu and Wu [19] used the integration of Building Information Modeling (BIM) and Geographic Information Systems (GIS) to construct language markers for the differential transformation of urban geographic information. It develops a building model information based on Computer graphics. Through computer graphics technology, BIM/GIS data integration can be presented visually. This can be achieved by using computer graphics software or visualization engines. In the visualization process, it is necessary to consider factors such as data visualization methods, colors, symbols, annotations, etc. in order to better display urban data and information.

3 3D RECONSTRUCTION METHOD OF LANDSCAPE ENVIRONMENT

3.1 Deep Belief Network (DBN) Principle

The core idea of AI is to let the computer simulate the thinking mode of human brain, carry out training and learning, and then realize the functions of classification, recognition and prediction. Deep learning (DL) is a new method emerging in the field of machine learning, that is, using a large quantity of sample data to learn and train the network from bottom to top, extracting hierarchical features, and storing the features through the weights between neurons. Once the samples to be identified are input, the network can identify them immediately according to the weights. Based on the successful application of DL algorithm in the fields of image classification, speech recognition, document classification and video detection, it can be found that when using neural network to solve practical problems, the quantity of nodes in the input layer and the quantity of nodes in the output layer are given, while the quantity of hidden layers and the quantity of nodes in each layer need to be determined by users. Image recognition technology is a process in which computer uses computer vision, pattern recognition and machine learning to identify image content and extract semantic information. Therefore, it is very important to correctly identify the image content, further improve the recognition accuracy of natural images, and propose efficient image recognition methods and related technologies. A large quantity of experiments show that DL can automatically extract low-level and high-level features without relying on manual selection, and better represent the essential features of images.

DBN is composed of several Restricted Boltzmann Machine (RBM), which are trained layer by layer from bottom to top when training the network. RBM network consists of two levels of network structure, namely, visual layer and hidden layer. The advantage of DBN model training method is also unique in that it sets the initial value of the network in a range that is most likely to achieve global optimization through unsupervised pre-training process, and finally obtains the optimal solution of the network through supervised fine-tuning process, thus accelerating the convergence speed. In specific applications, the visible layer is also called "data input layer" and the hidden layer is also called "feature extraction layer", and the nodes of these two layers are linked by weight coefficients. In this network, the weight model of each level is independently learned. RBM can be regarded as an undirected graph model with one layer visible, one layer hidden, completely connected and disconnected between layers. This method uses multi-layer nonlinear transformation to deeply abstract and characterize the data in complex cloud computing environment. The feature recognition structure of DBN image is shown in Figure 1.

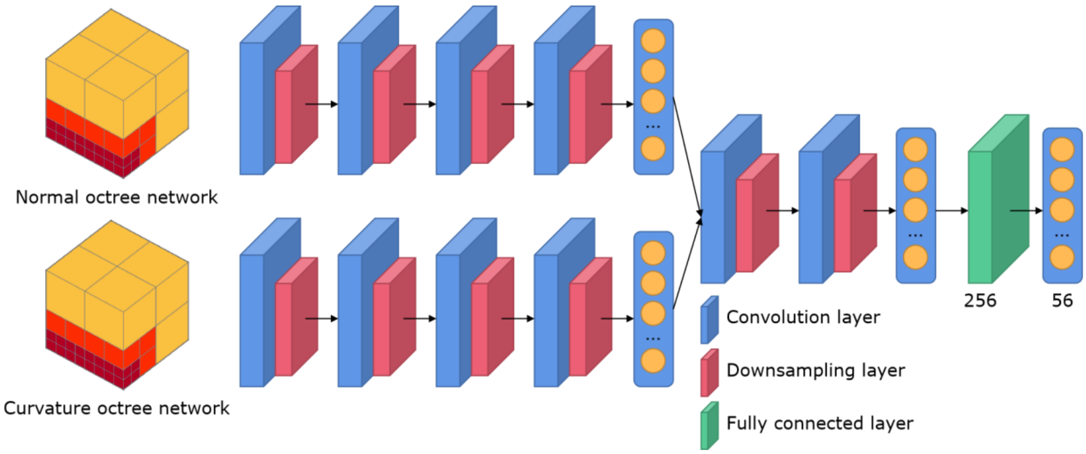

Figure 1: DBN image feature recognition structure.

The stage of image recognition using DBN is divided into two stages: training stage and testing stage. Before training, first set the initial parameters of DBN, such as the quantity of neurons in each hidden layer, the quantity of iterations, the learning rate, whether to add dropout, sparsity and so on. In this article, a two-stage feature variable selection method is proposed. Firstly, the feature variables are sorted by low-cost filtering method, and then the irrelevant feature variables are further deleted by high-cost encapsulation method, so as to reduce the quantity of neurons in the input layer, reduce the network complexity and improve the model accuracy.

The parameter learning of DBN can be divided into two stages. The first stage is unsupervised initialization learning, which provides a good starting point for subsequent supervised learning. The second stage is supervised learning, in which the parameters are fine-tuned by supervisory signals to ensure that the parameters of the whole DBN converge to a better solution. The DBN model can reflect the posterior distribution of training data through training. The probability distribution function of the data reflects all the information of the data. Using the probability distribution function of the data to train the DBN model can make the trained DBN model more robust. In multivariate probability distribution function, it is relatively difficult to calculate the normalized constant. At the same time, the characteristics such as correlation between data can be analyzed without knowing the normalized constant, so the training method based on probability distribution kernel can simplify the learning stage of DBN. Assuming that each node takes values between sets $\{0,1\}$, that is:

$$\forall i, j, v_j \in \{0,1\}, h_j \in \{0,1\} \tag{1}$$

The state of the ith visible layer node is v_i; the j th hidden layer node state is h_j; the calculation method of the (v,h) RBM energy function for the network state is as follows:

$$E(v,h|\theta) = -\sum_{i=1}^{n} a_i v_i - \sum_{j=1}^{m} b_j h_j - \sum_{i=1}^{n}\sum_{j=1}^{m} v_i W_{ij} h_j \tag{2}$$

Among them, $E(W_{ij}, a_i, b_j)$ is the RBM parameter; W_{ij} is the connection weight between the visible node i and the hidden node j; a_i is the bias of the visible node i; b_j is the bias of the hidden node j. When the parameters are determined, the energy function can obtain the joint probability distribution of (v,h):

$$P(v,h|\theta) = \frac{e^{-E(v,h)}}{Z(\theta)}, Z(\theta) = \sum_{v,h} e^{-E(v,h|\theta)} \tag{3}$$

Among them, A $Z(\theta)$ is the normalization factor. The activation probability of the j th hidden unit is:

$$P(h_j = 1|v,\theta) = \sigma(b_j + \sum_i v_i W_{ij}) \tag{4}$$

Among them, $\sigma(x) = \dfrac{1}{1+\exp(-x)}$ is the activation function of Sigmoid.

Comparing the traditional image recognition technology with the image recognition technology using DL, it can be found that the data features extracted by DL method can better describe the rich internal information between data, and the features between data can be automatically learned through training without manual extraction.

3.2 Dynamic Fusion of Landscape Image Features

Visualization of 3D landscape model is a method and technology that uses computer graphics and image processing technology to transform 3D landscape model into graphics or images displayed on the computer screen. Visualization technology enables people to manipulate and interact with 3D graphics in computers. The development of computer graphics enables 3D representation technology to be realized, enabling computers to reproduce objects in real environments and express this complex information with 3D shapes. This technology is visualization technology. The urban three-dimensional landscape model is a real model constructed based on the actual three-dimensional geographic coordinates of buildings, and is a three-dimensional computer model that combines urban terrain and feature descriptions. In this 3D landscape model, the spatial position relationship between buildings corresponds exactly to the site, and the spatial 3D coordinates of any point can be measured. In 3D scenes, it is not only necessary to truly reflect the terrain and features, but more importantly, how to seamlessly integrate the terrain and features.

The 3D model establishment method based on multi-image photogrammetry combines ground photogrammetry with aerial photogrammetry to obtain 3D city model data. Then, use AutoCAD to establish a 3D model of the building, and then map real photo textures to generate a 3D model with high realism photo textures. A method for obtaining 3D data based on existing GIS databases and planning and construction files, combined with digital photogrammetry technology. Obtain data from 2D GIS databases and building documents, and use AutoCAD or OpenGL to model buildings in 3D. In the actual 3D modeling process, due to the fact that ground objects and terrain models are mostly modeled separately in different ways, their data structures and organization methods are completely different. The perspective projection imaging of three-dimensional objects with different poses is the perspective projection of three-dimensional objects on different imaging planes. The dynamic fusion method of landscape image features based on DBN is shown in Figure 2.

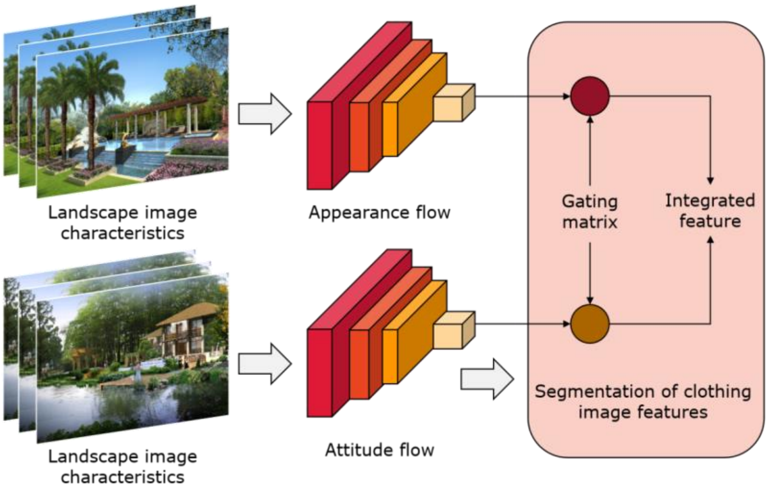

Figure 2: Dynamic fusion of landscape image features.

However, its training model was a single-scale model, so its ability to identify targets with small sizes declined sharply, and the recognition of sequence images was not considered. The establishment of 3D landscape model, especially the realistic 3D model embedded with image texture, makes the description of urban landscape status analysis and planning and design get rid of the conventional expression based on 2D map and 3D physical model and replace it with computer-aided 3D expression. Its basic idea is to display non-intuitive data in the form of video, so that people can obtain information in the 3D graphics world by previously unimaginable means, thus improving work efficiency. Visual simulation technology is the synthesis of the latest achievements such as numerical simulation technology, computer graphics and information display technology. According to the purpose of simulation, the expected effect is achieved by real-time realistic animation display technology of 3D models and scenes.

Take any triangular patch T_0 and record its three vertices as I_t, C_t and Q_t, then the unit normal vector of triangular patch T_0 can be expressed as:

$$R_t(p_{1t}, Q_t) = p_{1t} \bullet \min(I_t + Q_t, D_t) - (p_{0t} \bullet Q_t + C_t \bullet AI_t) + R_{t-1} \tag{5}$$

The vertex normal vector I_{t+1} of C_t can be calculated by weighting the area of the normal vector of triangle patches in the first-order neighborhood of vertex I_t, and the vertex normal vector of vertex I_t can be calculated as follows:

$$I_{t+1} = I_t + Q_t - \min(I_t + Q_t, D_t) = \max(I_t + Q_t - D_t, 0) \tag{6}$$

After the normal vector of vertex I_t is obtained, the curvature AI_t of the vertex can be calculated:

$$AI_t = \frac{(I_t + Q_t)}{2} \bullet \frac{(I_t + Q_t)}{D_t} \tag{7}$$

Where $I_t + Q_t$ is the included angle between the vertex normal vector and k related triangular patches.

One method to solve the problem of 3D object recognition is to use multiple 2D views to describe the 3D object and transform the problem of 3D object recognition into a problem of object recognition in 2D images. The 2D multi view method represents 3D objects, dividing the observation space into a limited number of regions and selecting appropriate representative views, namely feature views, for each region. The relationship between point features and terrain is a relative positional relationship. Point features typically refer to independent trees, streetlights, etc. The position of these features on the ground can be represented by a point. Linear features mainly refer to railings, fences, etc. For these features, first simplify the lines and remove redundant nodes, and then obtain elevation attributes from the terrain through interpolation.

Large scale terrain and texture data are usually very large. If all the data is loaded into the computer memory for display at once, it will not only cause a serious shortage of computer memory, but also unnecessary. Because any user is only interested in the details of a small area at a certain moment, they only need to transfer the data blocks of the area of interest to memory. Using normalized fourth order moment features combined with neural network technology to recognize 3D objects from 2D images, only single scale recognition of the object was considered, without considering recognition of multiple frame sequence images. A confidence based multi network fusion method was used to improve recognition rate, but it only considers single scale recognition of the target and does not consider recognition of multiple frame sequence images. It is very important to determine the size of the data block when segmenting images. If the data block is too large, it will reduce the number of times data is passed in, but the amount of data passed in is large, which will take too long for the data to be passed in and cannot show its advantages. The degree of crowding in landscape space can better describe the visual openness in three-dimensional space, which can be expressed as:

$$SC_b = \frac{\sum_{i=1}^{n} V_{bi}}{\max\{H_b\} \times A} \tag{8}$$

In the formula, SC_b represents the crowding degree of the landscape building space, V_{bi} represents the i th building volume, and $\max\{H_b\}$ represents the maximum height value of the landscape building. The component complexity of a 3D landscape image can reflect the color of the landscape and the diversity of its constituent elements, which can be expressed as:

$$F = CR \times TY \tag{9}$$

In the formula, CR represents the quantity of types of the main colors of the landscape, and TY represents the quantity of types of the landscape.

Multi-view model represents 3D objects through multiple images, which are taken from any viewpoint in space or from a specific viewpoint. For most objects, it is need to obtain a large quantity of images representing the orientation of the object in all directions in order to realize the effective object recognition task.

4 MODEL TEST ANALYSIS

After using 3D spatial data structure and texture mapping to model the urban landscape, it is need to put these solid object models in the corresponding scenes according to their spatial positions, and finally display the whole scene on the computer screen in the form of 3D graphics. The 3D rendering of the scene is controlled by man-machine interaction, so that users can browse in the 3D scene, and the rendering quality is improved by using the accelerated rendering algorithm. Because 2D surface features do not have elevation attribute information, when they are superimposed with DEM, the surface features will float under the terrain, so it is need to adopt relevant data processing methods to obtain elevation attributes from the terrain. In practical processing, the polygon feature can be converted into a point feature, which is the center point of the polygon feature, and then the elevation information of the point feature can be obtained from the terrain by interpolation, and then the elevation information can be assigned to the polygon feature, thus realizing the transformation of a 2D polygon feature into a 3D polygon feature.

Through comparative simulation test, the results of DBN model and conventional model are compared to test the performance of the model proposed in this project. The identification efficiency of the operator is evaluated according to the number and accuracy of the detected boundary pixels, as shown in Table 1.

	Original image	*Robert*	*Sobel*	*Prewitt*	*LOG*
Edge points	750	664	646	601	595
Detection ratio	-	83.9%	82.5%	79.7%	83.3%
Misjudgment point	-	None	Basically none	None	None

Table 1: Comparison of recognition effects without noise.

Most of the landscape images processed in practice are images polluted by noise. When areal features and terrain are superimposed, some features are immersed in the terrain, and some features have cracks when their boundaries and terrain are superimposed. When modeling based on these surface data, the ground object model will be partly on the terrain and partly under the terrain, so it is need to locally transform the original terrain covered by surface objects. Table 2 shows the comparison results of recognition effects when Gaussian noise is added.

	Original image	*Robert*	*Sobel*	*Prewitt*	*LOG*
Edge points	750	595	583	525	557
Detection ratio	-	78.4%	81.5%	79.2%	81.3%
Misjudgment point	-	Basically none	Have	Have	Basically none

Table 2: Comparison of recognition effects when Gaussian noise is added.

When the experiment is trained on the data set, the initial learning rate is 0.001, the learning rate changes in multistep, the step value is set to 26,000 and 54,000, the gamma is set to 0.1, and the maximum quantity of iterations is set to 500. Figure 3 shows the effect of high-resolution landscape image data in a uniform data set. Figure 4 shows the effect of a set of high-resolution landscape image data in a real data set.

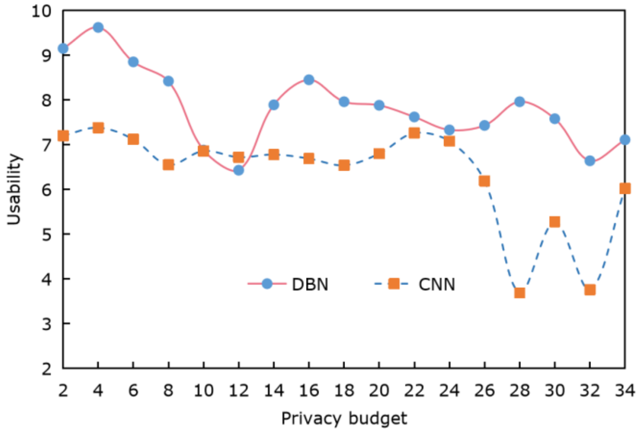

Figure 3: Effect of landscape image data in uniform data set.

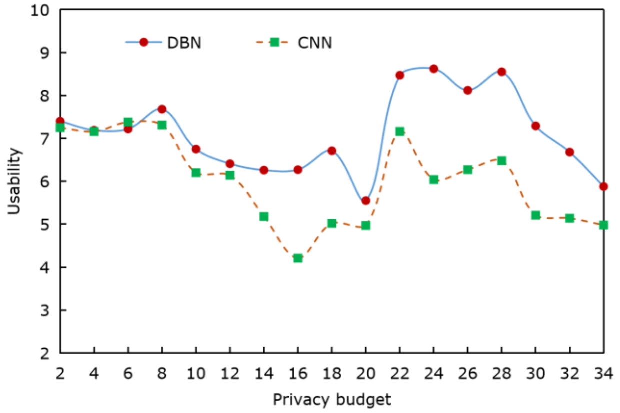

Figure 4: Effect of landscape image data in real data set.

On this basis, a new method based on compressed sensing is proposed. By simplifying the node algorithm and using compressed sensing technology to process the transmitted data, the data transmission volume of the system is greatly reduced. During the processing, firstly, the 2D surface features are expanded in the buffer zone, with the purpose of involving more terrain points outside a certain range of the ground surface in the local reconstruction of the terrain triangulation. Then, the expanded 2D surface features are converted into line features to obtain the boundary line of the surface features, and the boundary line is interpolated to obtain the elevation attribute information from the terrain, making it into a 3D line feature.

In the stage of 3D reconstruction, it is very important to extract the feature points of two 2D images, which determines whether the 3D model is accurate. Therefore, the modeling accuracy of 3D reconstruction system can be improved from the perspective of accurately extracting the feature points of 2D images. The results of feature recognition fitting test using traditional CNN model are shown in Figure 5. The results of feature recognition fitting test using DBN model are shown in Figure 6.

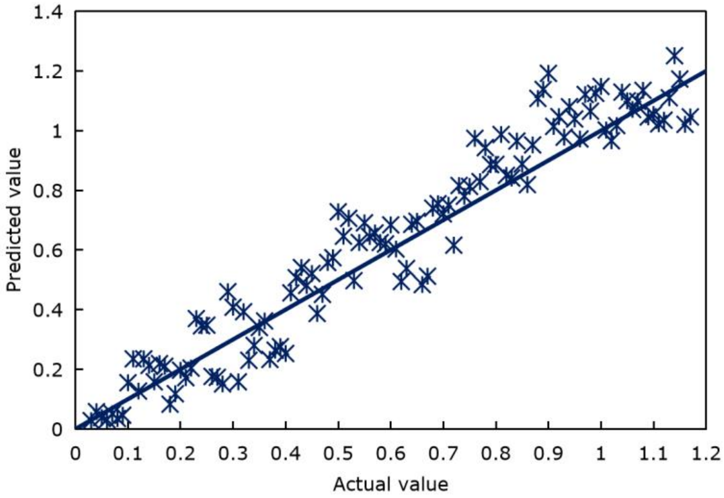

Figure 5: Test results of CNN model.

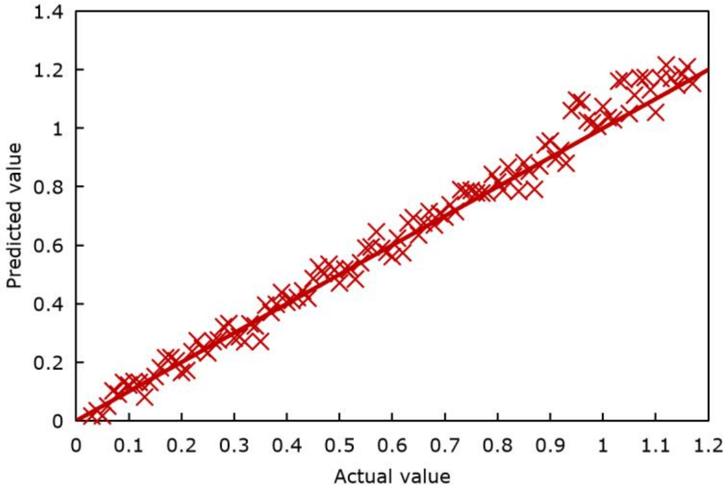

Figure 6: Test results of DBN model.

In the graph, points represent the ratio between prediction and reality. The closer the distance is to the y=x line, the closer the recognized features are to the real image features. Comprehensive experiments show that the DBN model has higher accuracy and efficiency than CNN.

Usually, each of the characteristic variables contains certain information, but its importance and emphasis are different, and the information provided by some variables overlaps to some extent, that is, information redundancy. If all of them are input into the network input layer, a large quantity of unimportant or redundant information will inevitably be input into the network, which will not only make the input layer have too many neurons, increase the network training burden and structural complexity, but also lead to the decrease of prediction accuracy. Figure 7 shows the modeling accuracy test of different algorithms.

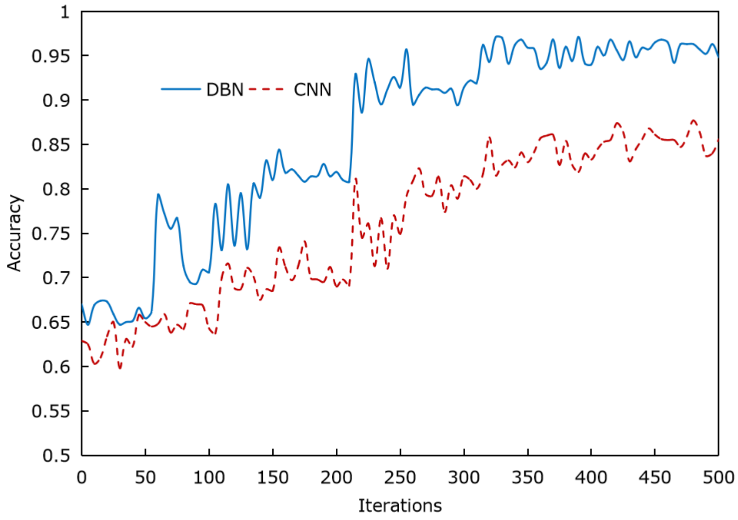

Figure 7: Accuracy test results of different algorithms.

In this article, a 3D reconstruction algorithm of landscape image CAD based on DBN is studied, which can well overcome the problems of unclear and stereoscopic landscape image on the premise of ensuring the clarity of landscape image. Compared with the control scheme, the accuracy of this method is improved by 25.72%, which can well restore the feature information of terrain images and suppress the background information. In the actual 3D model construction process, the project cost should be combined to decompose. For the same type of buildings, rules can be associated with their own attribute information, just write a general rule and call it repeatedly. For a large-scale scene, when the building features in the area are relatively common, you can write a script of a common building to build a 3D model.

5 CONCLUSIONS

In order to improve the efficiency of design and construction, realize 3D design and 2D or 3D drawing, a large quantity of designers can be liberated from the heavy 2D construction drawing work, and CAD dynamic observation can be used to simulate on-site construction. The 3D reconstruction system can reproduce the spatial pattern of urban landscape ecotone and provide an effective design method for urban ecological environment planning and urban spatial layout. In this article, a DBN model based on information-related strategy is designed to solve the problems that there are many characteristic variables in the input data of DBN, and the complex relationships among variables affect each other, resulting in complex network structure and low prediction accuracy. The purpose is to build a 3D reconstruction system of landscape environment based on CAD technology driven by AI. The results show that, compared with the control scheme, the accuracy of this method is improved by 25.72%, and the feature information of terrain image can be well restored and the background information can be suppressed. 3D visualization of landscape shows the 3D visualization effect of terrain features from the perspective of space, giving people an intuitive and immersive feeling, which is conducive to solving people's needs in comprehensive information processing, evaluation analysis and decision-making, and is conducive to interactive observation and analysis of terrain features, thus improving the understanding of geographical environment. Although the proposed method improves the modeling accuracy to a certain extent compared with the traditional method, the model loading speed is slow, and it occupies a large amount of memory. In the future, it is need to study related model optimization algorithms to reduce the data volume of the model construction surface and improve the scene browsing speed.

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