Research on Urban Distribution Network Planning and Optimization Measures Based on Real 3D Scenes

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Abstract. With the continuous advancement of smart grid construction, the structure of the power grid is becoming increasingly large and complex, and it is increasingly difficult to adapt to the requirements of grid development using traditional 3D drawings for grid design and operation and maintenance. The emerging 3D real-world modeling technology can visually and comprehensively display terrain, landforms, equipment appearance dimensions, wiring methods and other information. To promote the application of real-world 3D scene technology, electric power companies have repeatedly carried out 3D design of power grid projects and construction of data centers Optimized distribution network planning. Realize the linkage of real-world 3D scene plan maps, building information models, etc. through geographic connections, provide real feedback on site conditions, reduce the number of site surveys, save manpower and resources, and effectively implement urban power distribution network planning.

Keywords: Real 3D scene, Urban distribution network, Distribution network planning, Optimization.

1. Introduction
With the rapid development of China's economic construction, power engineering construction and technological transformation have continued to deepen, real and detailed real-world 3D scene grid data has become an important information foundation for the intelligent development of power companies. As an important part of the power system, the distribution network concentrates a large number of important power facilities. The digitization and intelligence of the distribution network as the basis for its daily monitoring and maintenance is of great significance to the development of power safety, and it is also a hot topic in domestic and foreign research in recent years [1].

1.1. Real-time 3D scene technology development
With the rapid development of the power industry, the development of smart grids has entered a new era. The construction of the distribution network, the mixed connection of the distribution network, the interconnection of regional grids, the popularity of ring network power supply, and the acceleration of the automation application of the distribution network have all increased the complexity of the power grid, and also proposed the lean construction of the power grid. Higher requirements. Traditional
drawings have been difficult to meet the requirements of power grid design and operation and maintenance. The use of emerging 3D real-time shooting technology and real-life 3D scene modeling technology can realistically and intuitively reproduce the relevant information of the power grid and equipment, allowing workers to more quickly and accurately learn more about the grid. Therefore, strengthening the visual management level of the power grid is an inevitable choice to adapt to the results of smart grid planning and construction. Actively promote the application and promotion of real-world 3D scene technology in business departments, practical application of real-world 3D scene technology, and produce staged results [2].

1.2. Application of real-world modeling technology in the power industry

Efficient application of grid intelligence, informationization, and visualization in grid planning, grid construction, and grid operation and maintenance. Integrate ground panorama technology, aerial aerial panorama technology, and real-world modeling technology with traditional grid management to accelerate grid system planning and construction. And operation and maintenance, leading to visual management and technological change that adapt to the rapid development of the power grid. Based on the application of the new technology of "3D real-world modeling", aiming to achieve more accurate power grid data, better service, and more efficient operation and inspection, we will actively adapt to the development law of the power grid and create a refined power grid [3].

Fig. 1 Analysis diagram of urban distribution network in real three-dimensional scene

2. Design of 3D scene technology panorama photos

2.1. Research on panoramic image shooting

Panoramic photos of general distribution networks refer to 360-degree panoramic photos in the horizontal direction. What we mean by 720-degree panorama refers to images that exceed the normal human viewing angle, that is, 360-degree horizontal and 360-degree full-angle viewing. A panorama is actually just a flat picture generated by mapping the surrounding scene with a certain geometric relationship. Only through the correction process of the panorama player can it become a three-
dimensional panorama. Traditionally, panoramic photos need to be taken multiple times and taken at the same height. Subsequent synthesis of panoramic photos has complicated operations and high photography techniques. The panoramic camera breaks this professional limitation. With a single camera and a single shot, you can easily obtain panoramic photos. The operation is simple and does not require professional shooting methods, creating conditions for the practical application of panoramic technology [4].

2.2. Stitching Synthesis of Panoramic Image of Distribution Network
Change the shortcomings of low efficiency and high error rate of the original manual data entry, import the real-world photos taken by the panoramic camera into the panoramic generator, quickly integrate the panoramic point photos through intelligent calculation, and connect the panoramic points by coordinate information to complete the panoramic line corridor. Photos of all attractions, photo shooting, image stitching, generating browsing scenes, adding key power equipment hotspots and highlighting modes to quickly complete the scene scene construction. At the same time as the panoramic photo is generated, the data entry is also completed. Improve the efficiency and accuracy of data entry. In order to perform more accurate 3D scene expression of power grid equipment.

3. Distribution network data collection and processing

3.1. Distribution Network Data Collection
The UAV tilt photography can be used to collect images from different perspectives, and through computer graphics calculations, combined with POS information for air three processing, TIN network construction and texture mapping, finally can generate outdoor three-dimensional models. Because there are many related literatures and applied researches, this article will not introduce them. The indoor real-world 3D scene of the distribution network uses the SLAM mobile scanning system. The equipment includes 3 stereo laser scanners with a 30m range, 6 panoramic cameras unified by the photography center, and high-precision IMU sensors. During the scanning process, spatial point cloud, image and attitude POS data can be acquired simultaneously. In the process of mobile scanning, point cloud data is continuously and uninterruptedly collected, and panoramic images are acquired at the same distance or time interval according to the actual situation [5].

![Fig. 2 Schematic diagram of urban distribution network planning structure](image_url)

3.2. Distribution network data processing
The processing flow of the SLAM scan data includes: preliminary matching of point cloud data according to IMU data, and feature point matching algorithm between adjacent point cloud data sets to
minimize the error value to obtain a local optimal solution. The closed-loop detection is adjusted to the number of frames of the laser point cloud to each frame through closed-loop detection to reduce the IMU cumulative error and further optimize the global trajectory. Through the attitude parameters between the sensors, the point cloud and panorama are registered according to the spatiotemporal information, and finally a three-dimensional scene model of the real scene is established [6].

3.3. Real-time 3D scene data collection
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3.4. Real-time 3D scene data processing
The processing flow of SLAM scan data includes: preliminary matching of point cloud data according to IMU data, and the feature point matching algorithm between adjacent point cloud data sets to minimize the error value to obtain a local optimal solution [13]. The closed-loop detection is adjusted to the number of frames of the laser point cloud to each frame through closed-loop detection to reduce the IMU cumulative error and further optimize the global trajectory. Through the attitude parameters between the sensors, the point cloud and panorama are registered according to the spatiotemporal information, and finally a three-dimensional scene model of the real scene is established.

3.4.1. Fusion of image and point cloud. In the constructed 3D space of point clouds, the temporal and spatial consistency is used to achieve the matching of panorama and point clouds. Firstly, point cloud and panoramic image data at the same time are retrieved according to the data recorded by the time recorder. Spatially, space is unified through coordinate transformation. The data directly collected by the equipment are based on the respective sensors as the coordinate origin. For example, point cloud data is a laser scanner polar coordinate system established with the scanner as the coordinate system origin and the scanning beam as the polar axis.

3.4.2. Fusion image processing technology for real 3D scenes. Each panoramic camera is a separate camera coordinate system constructed with its photographic light center as the imaging plane center and the vertical imaging plane as the z-axis. There are several coordinate systems involved here: laser scanner polar coordinate system, laser scanner rectangular coordinate system, panoramic camera coordinate system, (all panoramas) camera coordinate system, and platform coordinate system. Each
laser scanner has its own polar coordinate system, and three scanners build a custom rectangular coordinate system. Multiple panoramic cameras together form a panoramic camera coordinate system. The platform coordinate system is a virtual rectangular coordinate system of each internal sensor. The matching of the final data requires a coordinate system transformation through the following steps:

4. Urban Distribution Network Planning Countermeasures and Implementation

The urban distribution network lacks capital investment and scientific technical guidance. The urban distribution network planning cannot keep up with the pace of urban construction and economic development, and it cannot maintain coordination with the main network construction. Therefore, it is necessary to strengthen the planning of the distribution network. When planning the distribution network in the future, it is necessary to formulate a reasonable and specific planning plan to prevent the waste of resources. In the following, some methods are proposed for urban distribution network planning.

4.1. Analysis of distribution network planning

Do a good job of planning the distribution network structure to make it forward-looking, reliable, and operable. Electricity demand forecasting is generally carried out according to district and year-by-year models. The distribution network of 10kV and below is divided according to towns, industrial parks or areas with important point loads. The forecast period of power and electricity is generally carried out by year, and special analysis should consider the typical daily load curve in summer and winter and the maximum hours of use in the year. The forecast of electricity and power demand should consider the local economic development and the total social product value, and analyze the economic conditions and electricity consumption of various industries.

4.2. Three-dimensional scenes simplify the structure of the city's distribution network

It is best not to have more than two structural forms. The complex and diverse structure is easy to cause misoperation of operation and scheduling, and the reliability is reduced. With regard to the distribution of power distribution sites, scientific analysis and decision-making are made on the division of power supply range, the selection of paths, the switching stations, and the location of distribution transformers. The selection of the path and the distribution transformer is reasonable or not, it plays a decisive role in the power supply radius, and must be paid enough attention to. The preliminary work of the planning and construction of the urban distribution network layout must be closely integrated with the urban
development planning. Not only must the economic development planning and urban land planning be used for load forecasting and load distribution, divide the power supply area, determine the wire cross section, the size of the switching station, and The distribution transformer capacity must also be coordinated with the urban construction plan to further determine the location of line corridors, switch stations and distribution transformers. With the development of urban modernization, overhead lines, pole switches, pole transformers, etc. will be replaced by underground cables, switch stations and box transformers. Therefore, the power supply department must actively cooperate with relevant departments of urban planning and construction, and establish efficient and timely Communication mechanism and interconnection. When planning and constructing a new residential area, the power supply and distribution of the area should be considered at the same time. The urban planning and power supply departments should plan the distribution points, and the power supply departments should strictly check when they are installed to prevent overload.

4.3. Advantage Analysis
Advantages include: fast data acquisition and automated processing, which solves the complex internal structure and difficult digitalization of distribution network. The established real-life three-dimensional scene model realizes the real unification of texture and space, and is the main digital data base of the power industry. The WebGL cloud server platform has greatly changed the data space-time use limit, improved the data utilization rate, and enhanced The flexibility of work; the customization of personalized functions, and the cloud-based platform can provide more scenario customization services according to actual needs. The basic functions developed so far can provide an intelligent technical support for distribution network training and teaching, engineering design acceptance approval, equipment management, etc., effectively integrate internal information, improve work experience, improve work efficiency, and better serve distribution Grid planning design and application.

5. Conclusion
With the continuous advancement of the modern city process, we should accelerate the construction of urban power grids, comprehensively analyze the problems and deficiencies in the distribution network planning, optimize the distribution network planning, take effective methods and measures, and actively solve various problems in accordance with the actual conditions of different cities. Problems, do a good job of upgrading the power distribution network, make the power distribution network planning and urban power grid construction, urban planning development effectively coordinate, and promote the continuous development of urban power grid construction. With the application of three-dimensional scene technology, the power distribution network planning will become more Come the better.

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