Application of Power Load Forecasting in Urban Distribution Network Planning Based on 3D Real Scene Platform

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Abstract. The 3D real-view platform technology builds a power load forecasting platform in urban distribution network planning. The completion of this system can provide integrated support for power load forecasting in power distribution line planning, and further provide a three-dimensional foundation platform for power load forecasting analysis and calculation software in power distribution planning. Urban distribution network planning is an important task for power supply companies. The quality of its construction directly affects the development of urban economy and the improvement of people's quality of life. This paper combines the years of work experience to introduce the importance of power distribution network planning, which optimizes the structure of the power distribution network, which can ensure the safe operation of the power grid, reduce power loss, improve power supply reliability, and accurately predict power loads. To meet the needs of urban power load development.

Keywords: 3D reality platform, Distribution network; Planning; Load forecasting.

1. Introduction

1.1. The development of 3D Modeling Technology
With the rapid development of the power industry, the development of smart grids has entered a new era. Urban power distribution network planning and construction, AC-DC hybrid connection, regional power grid interconnection, popularization of ring network power supply, and accelerated application of distribution network automation have all increased the complexity of the power grid, and also proposed 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 reality platform technology and 3D reality platform 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 management level of the three-dimensional reality platform of the power grid is an inevitable choice for adapting to the smart grid planning and medium power load forecasting [1].
1.2. Application of real-world modeling technology in the power industry
At present, electric power companies are using "3D real-world modeling" as a technical means to promote the efficient application of power grid intelligence, information technology, and 3D real-life platforms in power grid planning, power grid construction, and power grid operation and maintenance. With the integration of ground panorama technology, aerial aerial panorama technology, and real-world modeling technology with traditional grid management, we will accelerate the planning, construction, operation and maintenance of the grid system, and lead the management and technological change of the three-dimensional real-world platform that adapts to the rapid development of the grid. The new technology of "3D real-world modeling" will "increase bricks and mortar" for company management innovation. 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 [2].

2. The importance of urban distribution network planning
The construction period of the grid structure of the power grid is relatively long, and there is generally no major change in the short term after completion. During the development of the city's power distribution network, due to the uncertainty of load development, the grid structure of the city's power distribution network planning needs to be adjusted and changed according to the load development situation. Therefore, the adjustment or update cycle of the urban distribution network planning is more complicated and frequent than the distribution network planning. Urban power distribution network is one of the important infrastructures of a city and has a very close relationship with the development of the city. Urban power distribution network planning is an important part of urban development planning. The urban power distribution network must be closely coordinated with urban construction, implemented at the same time, and must have advanced awareness and coordination with urban landscape [3].

Fig. 1 Analysis of Power Load Forecasting Structure in Distribution Network Planning

2.1. Main contents of urban distribution network planning
The main contents of urban distribution network planning are summarized as follows: Analysis of regional population, economic status, industrial structure and distribution. Statistics on the size of the power grid and the status of the power distribution network [4]. Analysis of the problems in the low and
medium voltage distribution network, including several aspects: whether the power capacity of the
distribution network is sufficient and the radius of the power supply is reasonable; the condition of the
equipment, the number of old switchgear and high-loss transformers to be transformed; the 10kV feeder
Status, including: specific heavy-load and excessively long lines, should be transformed by transferring
loads or replacing large-section lines; whether the grid structure of the power grid is reasonable,
including how many unconnected lines, and whether there are accidents with connected lines Ability to
transfer [5].

2.2. Load forecast in planning period
The load forecast in the planning period has a great impact on the correctness of the urban power grid
planning. In actual load forecasting, in order to be close to the actual development of the city, it should
be based on the official urban development plan formulated by the government through a large amount
of information collection and investigation. Fully understand the local electricity demand. The load
forecast during the planning period includes the maximum total load forecast and the geographical
distribution of the load. The requirements of the power grid planning for the accuracy of the load forecast
are in the range. The forecast of the total amount of electricity and the maximum load is mainly used to
measure the rationality of the total power supply planning of the distribution network, and the
preliminary calculation of the scale of new transmission and transformation facilities during the planning
period is also the basis for the forecast of the geographical distribution of loads. There are mainly
methods for predicting the total amount of electricity: power elasticity method, time series method,
parameter regression method [6].

Fig. 2 Analysis of urban distribution network planning

(1) Electricity elasticity coefficient method.
The power elasticity coefficient method is a macro index describing the relationship between power
development and national economic development, and is usually defined as: \( K = \frac{V_w}{V_G} \). Among them:
\( V_w \) is the average annual growth rate of electricity, and \( V_G \) is the average annual growth rate of the
economy.

The power elasticity coefficient method first calculates \( K \) based on historical data, and then uses this
\( K \) value to predict the amount of electricity in the planning period. The power elasticity coefficient
method is suitable for areas with relatively stable load growth. It has a poor prediction effect on areas
that are in rapid development, areas with large changes in industrial structure, areas with a single
economic structure, and are greatly affected by industrial policies.

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(2) Time series method.
Time series method is a load forecasting method with the least required data. It is common to use a curve-fitting formula to obtain the historical load change law \( W(t) \) over time, and then predict the planned annual power consumption. This method only requires historical power data. When the power changes suddenly during the forecast period, the prediction error is large. At the same time, attention should be paid to the selection of the fitting function and the deletion of bad measurement points.

(3) Parametric regression method.
The parametric regression method and the time series method are both curve fitting methods, but the independent variable is not time, but economic parameters such as economic indicators. Multiple parameters can be selected if necessary, but single parameters are more conducive to function selection. This forecasting method can take into account changes in economic growth factors, but there is greater uncertainty in parameter selection and regression model selection, and the application effect is greatly affected by human factors.

2.3. Forecast of geographical distribution of load
The load geographical distribution forecast is used to measure the rationality of the power distribution of the distribution network, and to determine the load growth in the planning period of each power supply area in the city. The 10kV network has a low voltage level, a small power supply range, and a corresponding load division. The geographical distribution of loads is a difficult point in load prediction. The main prediction methods of load geographic distribution prediction are useful simulation method and load density method.

2.4. Determination of planning technical principles
Including the grid structure of the power grid, the selection of lines, the selection of transformers and switchgear, the technical requirements of secondary equipment (relay protection equipment and integrated automation systems), etc. Because the 10kV distribution network directly bears the responsibility of supplying power to users, it needs to cover the entire power supply area. There are many lines and equipment. A large number of switches do not have remote signaling and protection functions. Therefore, the network structure and operation mode should be simplified as much as possible. The ring network connection and open-loop operation should not be too complicated. Try to achieve independent operation of the small rings. In addition, due to the widespread use of load switches, short-term power outages are allowed for local users during faults, but power should be restored as quickly as possible through load transfer.

3. Power Load Forecasting Methods in Distribution Network Planning
At present, the commonly used power load forecasting methods include the following:

3.1. Neural network prediction method
The neural network forecasting method is a power load forecasting method based on the neural network. Through the learning function of the neural network, the computer can learn the mapping relationship contained in the historical power load data and use it as a basis for future Effective power load forecasting and analysis. The neural network prediction method can play an extremely important role in short-term power load forecasting, but for long-term power load forecasting, this method has corresponding defects and will affect the accuracy of the forecast results.

3.2. Output value unit consumption method
Output value unit consumption refers to the cost consumed by the unit output value. For the power industry, it is the electrical energy consumed by the annual GDP. It can be divided into two types: comprehensive output value unit consumption and sub-industry output value unit consumption. Among them, comprehensive output value unit consumption Consumption refers to the ratio of the total amount of electricity used in the statistical area to the GDP of the region, while the unit consumption of the
output value by industry is based on the relevant indicators of the annual consumption value of the industry output value by forecast and the national consumption of the industry in the region. The GDP target is to forecast the power demand of various industries in the forecast year, and combined with the forecast value of the daily electricity consumption of residents, the actual forecast value of the power load can be obtained.

3.3. Load density method
The load density method refers to multiplying the area of the area where power load forecasting is required with its load density, and then the corresponding power load forecast value is obtained, which is expressed by the formula, where \( L \) is the power load and \( a \) is the forecast. The area of a region, and \( d \) represents the load density of the region. For this method, the most critical point is the choice of load density. In this process, the relevant power load forecasters should fully consider the nature of the land used in the forecast area and its future development, while referring to the power load level and actual conditions in mature regions in the country, and then can effectively determine the load density.

![Fig. 3 Analysis of Urban Distribution Network Planning Based on 3D Real Scene Platform](image)

3.4. Fuzzy prediction method
The fuzzy forecasting method is a forecasting method based on a mathematical model. It uses the professional knowledge of power load forecasters and combines fuzzy logic to form data and language related to power load to form a fuzzy rule for power load forecasting. However, because this method does not have a corresponding learning function, the prediction results obtained often lack accuracy and need to be combined with neural network prediction methods to achieve complementarity between the two and improve the accuracy of power load prediction results.

4. Three-dimensional virtual modeling of distribution network
Distribution facilities have obvious geographical characteristics, especially in some areas where the distribution network is the main form. In the upgrade planning of the distribution network to the city network, the direction, span, tower, and substation of the line are urgently needed. Information related to geographical elements, such as location and topography of routes, is managed scientifically and effectively. Compared with the traditional two-dimensional GIS, the three-dimensional GIS currently used in power systems has great advantages. It can virtual reality scenes and truly reflect the terrain and topography around power equipment such as lines and towers. It is used for line inspection and equipment maintenance. Personnel provide a true functional environment information. This paper discusses the modeling method of 3D real-world platform of distribution network, and implements component modeling of distribution network through GoogleSketchUp.

GoogleSketchUp is a software specially used by Google for 3D modeling. It has strong real-world simulation capabilities. It is oriented to the design process, easy to use, and completely avoids the complexity of other design software; it provides texture and material design tools to enhance the reality of the model; it can use GoogleEarth's terrain and influence data for free. Due to the above advantages,
SketchUp is widely used in urban 3D modeling, campus environment modeling, dam unit stereo modeling, etc., and has achieved good results. To build a real three-dimensional scene, accurate geometric modeling is required. For power distribution systems, terrain modeling, building and power distribution equipment modeling are the keys to achieving virtual visibility of the power distribution system.

![Image](image_url)

**Fig. 4** Urban Distribution Network Based on 3D Real Scene Platform

4.1. Terrain Modeling

In order to construct the actual ground surface of the studied area and create a realistic 3D real-life platform scene, the terrain needs to be modeled. The current methods are: 1) Introducing existing contour lines and creating smooth terrain through the extended toolbar in SandUp-Sandbox; 2) Adding digital elevation model (DEM) production of the ground surface. The methods of obtaining DEM are: scanning the digital contours using existing topographic maps to obtain elevation data generation; directly scanning through digital measurement systems or airborne scanner systems; aerial photography and aerospace remote sensing.

4.2. Intelligent Platform Management 3D Real Scene Platform

The distribution transformer terminal is used to realize the integration and comprehensive online management of multiple intelligent devices in the station area. Through the RS485 bus, the data access and control of the station residual current action protector, three-phase station meter, reactive power compensation controller, dual-mode carrier meter reading concentrator, and station carrier meter are supported, and the station operation status is supported. Real-time monitoring functions, including station load, power factor, voltage, current, and reactive power switching status. All smart devices in the station area share the GPRS channel of the station's distribution transformer terminal. Through the only GPRS channel, data exchange with the master station system is realized. The entire station area only needs to be equipped with a mobile phone card to achieve the monitoring of all equipment in the station area. Management.

4.3. Fault Reporting and Repairing 3D Real Scene Platform

The distribution network three-dimensional reality platform management platform establishes a dedicated mobile field module to promote the dynamic management of fault reporting and repair. After accepting 95598 or customer repair work orders, the power supply station directly enters the management platform, issues repair work orders to designated dedicated repair mobile phones, and automatically sets time node information. After the on-site repair and processing personnel arrived at the scene, they used a dedicated mobile phone to record in real time the time of arrival at the scene, the cause of the fault, and the end of the processing in a GPS positioning and interactive manner.

The personnel on duty at the power supply station tracked the real-time location and movement trajectory of field personnel in real time through the platform's three-dimensional real-time map, and
visually displayed the entire repair process, ensuring that the entire repair process was controllable, controllable and in control.

5. Conclusion
Applying intelligent distribution network technology to the planning of urban distribution networks is an important means to achieve sustainable development. It is also an important task for China to maintain continuous and rapid progress in power technology. It is also a need for China to build a socialist cause. It is of great significance to improve the quality of China's power work. Nowadays, users have higher and higher requirements for the reliability of power supply. Many countries in the world are actively promoting the development of new energy technologies. It can be seen that countries around the world have very urgent adjustment needs for energy adjustment. Issues to consider. This article mainly combines the characteristics of China's urban distribution network, and elaborates the main strategies of combining technologies by region, hoping to provide some references for the distribution network planning.

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