

# Research and Construction of Cable 3D Intelligent Management and Control Platform Based on Parametric Modeling Technology

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**Abstract.** Traditional three-dimensional modeling is not only tedious, but also can't edit existing three-dimensional model, parametric modeling technology can flexibility modify graphics under design or drawing state through dimension driving. Model changes automatically following relevant design parameters and environmental modification, this progress improves modeling efficiency greatly [1]. Basing on analyzing the power cable traditional management model, this paper integrate cable 3D graphics information, geographic information and cable asset information, upgrade traditional power cable management to digital, visual, information modern management, improve operation and management level of power cable, improve reliability of power supply [2].

## 1. Introduction

With the advancement of the construction of smart cities, the application of urban underground cables has become more and more popular, and the information management of existing underground cable data has become more and more urgent. Due to the longtime of underground cable laying and improper data management, resource data is lost, and due to the unsatisfactory data update, detailed and correct data cannot be provided, resulting in chaotic management of underground cable data, and it is impossible to correctly grasp the current status and operation of the cable. In the event of an accident, it is impossible to determine the location in a timely and accurate manner, which brings great difficulties to the repair of the fault [1].

Although the traditional two-dimensional GIS can directly express the plane spatial position and path direction of the power pipeline, it cannot directly express the spatial layer distribution, cross relationship and position information of any angle between the pipelines. The use of three-dimensional technology is to solve the problem. Effective means, through the use of three-dimensional visualization technology can effectively improve the level of power pipeline basic data management, business approval management and other aspects [2]. In view of this, after the twentieth century, especially in the past ten years, with the development of computer level and the improvement of social demand, the research on the three-dimensional visual display and analysis of underground pipelines has been widely carried out in China [3]. Through the research and implementation of the cable three-



dimensional intelligent management and control platform, this paper completes the support for the urban underground cable business needs, and meets the power enterprise's efficient, intelligent and refined management requirements for underground cables.

## **2. Research status**

At present, two types of power cable management modes are widely used in power systems at home and abroad: cable numbers are marked at the cable wellhead and cable trend maps are drawn; cables and GPS positioning data are collected using GIS technology and marked on the GIS system. The practical application results show that the traditional power cable management mode has problems such as inadequate monitoring and large maintenance workload [4]. Specifically embodied in:

(1) The length of the cable cut during cable construction is usually longer than the length actually required to be laid. The excess portion of the cable is treated in the form of a coiled cable well or wrapped back and forth in the cable trench and is not indicated in the cable pattern. When the fault is located, this part of the excess cable will seriously affect the positioning accuracy and greatly extend the cable repair time.

(2) The lack of historical data of the old cable or the loss of the nameplate of the new cable will cause the multiple cables in the same cable trench to be indistinguishable, thereby reducing the accuracy of the faulty cable positioning.

(3) Only relying on the accurate positioning of the two ends of the cable can not effectively describe the spatial position (especially the depth) and the shape of the cable, which leads to accidental interruption of other units (such as water companies, natural gas companies, municipal units, etc.) during construction. Power cable or damage cable insulation.

With the development of GIS technology, GIS technology combining computer graphics and database has been used more and more in power systems. However, at present, the GIS system based on two-dimensional coordinates is mainly used, which can only process the information on the plane X-axis and Y-axis, and its spatial performance and analysis ability have great limitations [5]. Two-dimensional drawing can not show the actual space of the cable, resulting in unreasonable cable space position and inaccurate cable length during the construction process, which brings inconvenience to the construction and also causes waste of cost. In order to visualize the spatial relationship between each cable and improve the quality and effectiveness of the cable arrangement, it is necessary to expand the research on the spatial arrangement of the cable channel from a three-dimensional perspective. The research on cable three-dimensional graphic visualization management system based on ground penetrating radar technology will help to strengthen the spatial positioning capability of cables and promote the transformation of cable management mode.

## **3. 3D modeling**

Describe and express the various attributes of things by establishing correct and simplified models is a universal and important method for modern science to explore the development and operation of things themselves. The modeling and simulation of the real world is a process of digitally reproducing the shape, material, motion and other attributes in the digital space according to the research objectives and key points.

Using the common underground cable collection technology, through the four steps of data standard, data acquisition, data identification, and data processing, it provides data support for the underground cable refinement management system, and completes the operation standards and various standards in the data collection operation. Specification.

### *3.1. Cable related data*

Prepare cable data (organized according to cable loop data structure). The cable loop is composed of a series of adjacent cable channel nodes; the channel node is used as the abstract logical node in the cable loop, and the cable joint model is not available. The multiplexing part consists of a cable channel

model (reusable part). The channel node manages the rack model data, cable data, and cable head data inside the channel.

### 3.2. Data preprocessing

All cable loop data is collected in the preprocessing module for preprocessing, and the topology relationship of the cable channel nodes is obtained, as well as the placement position, orientation and hanging point configuration information of the bracket (including phase sequence, belonging loop, etc.) Information) and other information.

### 3.3. Attitude calculation and model generation

A: In the loop calculation module, calculate the position and attitude of the joint model managed by the channel node, the position and attitude of the channel model, the world transformation matrix of the bracket, and the position of the hanging point, and calculate the cable line according to the phase sequence according to the position of the hanging point on the bracket. Center line data;

B: Model the node joint model and the attitude model of the channel model and the channel section parameters, and generate a local model (including the .mesh/.material file). The platform channel parameter setting interface is shown in Fig. 1.

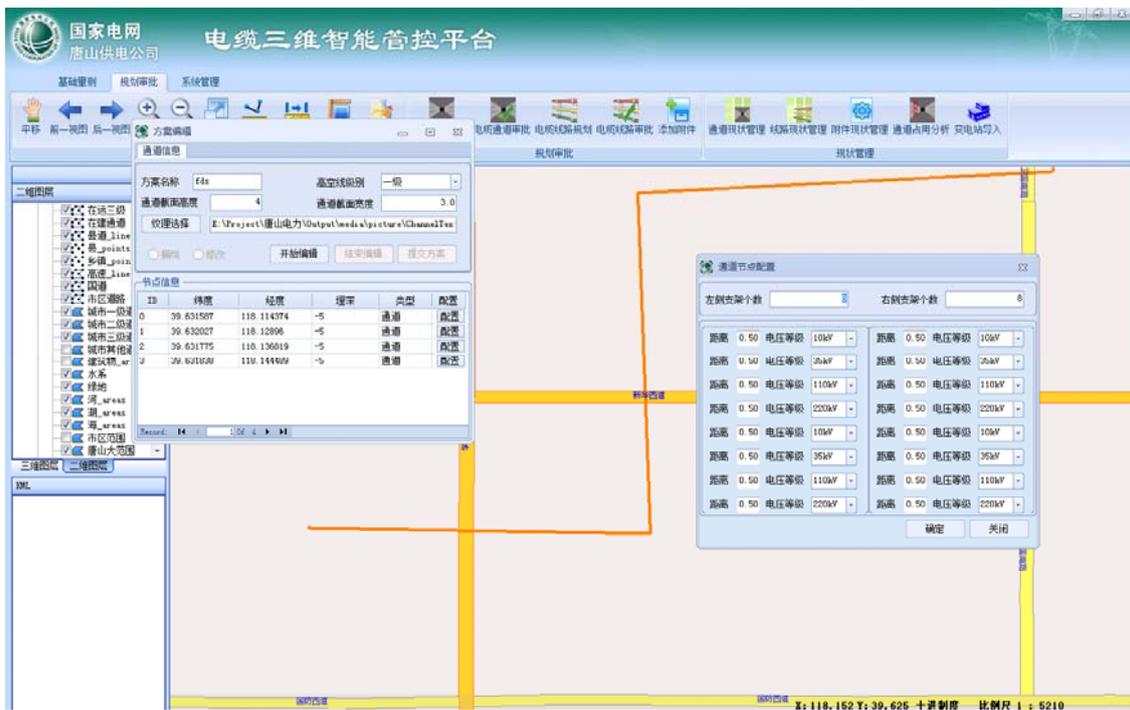
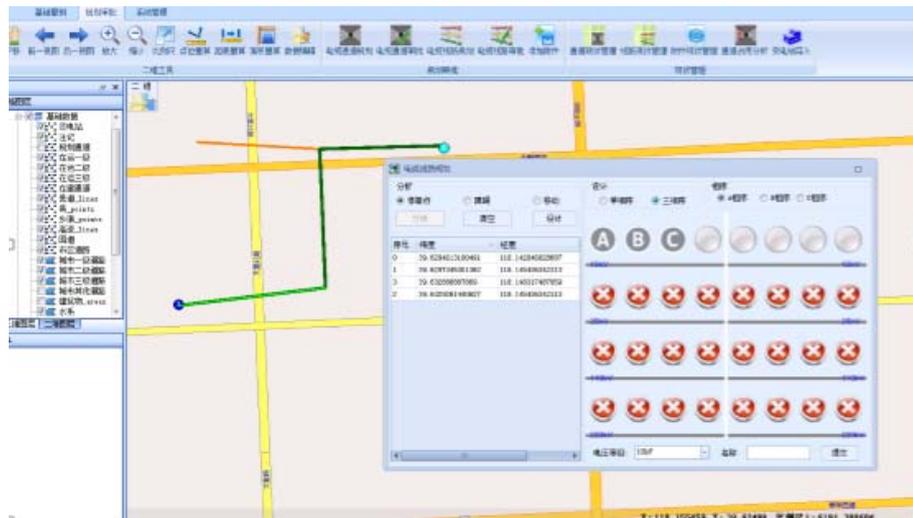
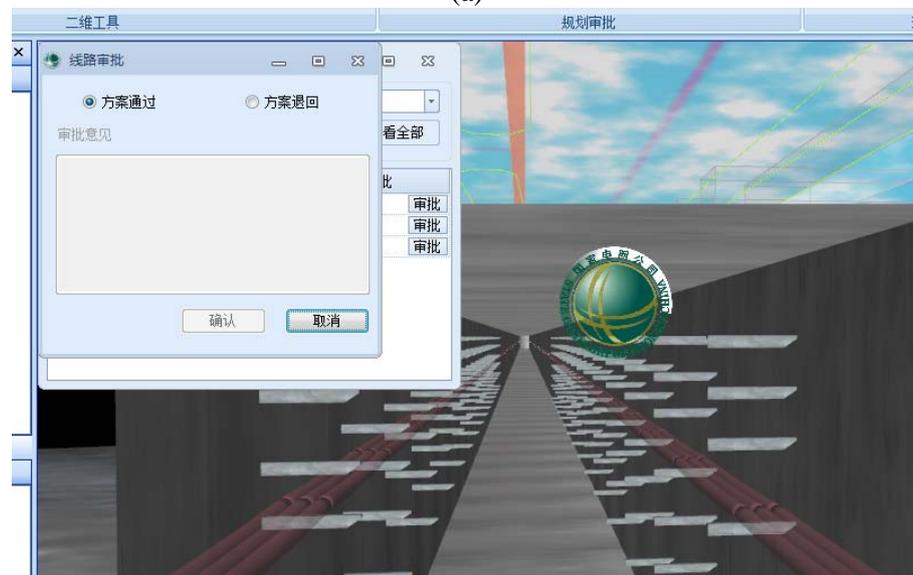


Figure 1. Channel parameter settings.

C: Models the center-line data of the cable and the interface dimensions and material parameters of the cable, and generates a local model (including the .mesh/. material file). The cable setup page and the resulting effect diagram are shown in Fig. 2.



(a)



(b)

**Figure 2.** (a) Cable parameter settings, (b) Cable model rendering.

3.4. Data storage

Data storage (including data sets and logical data) by cable loop

A: model data, position and posture information, etc. are entered into the data set, and the model data is spatially indexed according to the trochee algorithm;

B: Logical object data organized by loop is entered into the logical table.

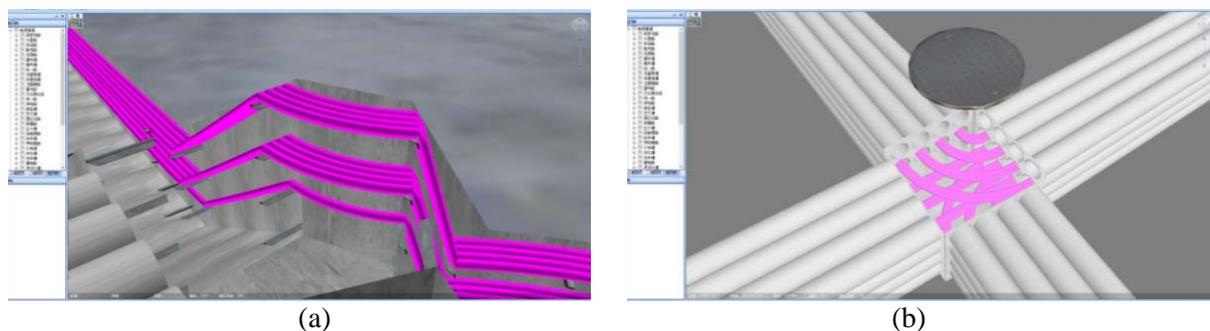
3.5. Data-set and logical data loading rendering

The Data-set in the database is loaded in the form of the underlying model layer (instance layer/non-instance layer) and rendered into the scene. The rendering rendering of the platform is shown in Figures 3(a) and (b).

After the power engine database is integrated, all Data-set data is divided into three categories: node instance Data-set, node non-instance Data-set; attachment instance Data-set, attachment non-instance Data-set (temporarily unused); wire (cable) instance Data set (not used temporarily), wire (cable) non-instance data set.

The EV-Globe 5.0 underlying platform directly supports the loading and rendering of instance and non-instance model data-sets, and dynamically loads and unloads model data according to spatial index information and load distance control mechanism, thus ensuring the efficiency and effect of model data rendering. It also reduces the burden of large model data on system memory.

The automatic modeling technology of cable and channel 3D model establishes a parameter-driven mechanism for modeling by constructing a parametric model of cable and channel objects. The parametric model is based on the actual size of the cable and channel three-dimensional model, including rich information, intuitive, can express the flexible dynamic characteristics of the cable and the connectivity characteristics of the channel model, and the workload is small, the process is simple and convenient. This new modeling technology can meet the needs of mass production, model modification and variant design of cable and channel 3D models, and is the key technology for cable and channel automation modeling.



**Figure 3.** (a) Cable channel rendering, (b) cable tube rendering.

The efficient management and rendering of the massive cable 3D model is mainly through layered management of cables and auxiliary equipment, and the model trochee spatial division is set up, and the resource asynchronous scheduling mechanism is adopted to achieve the purpose of efficient query and smooth rendering of the model. There are many techniques for model loading. The trochee is one of the data structures for 3D spatial data partitioning. It is also the mainstream technology for large-scale 3D game scene management and virtual reality geographic scene data management and rendering. It satisfies the constraints, divides the specified range space into a cube, divides it into eight small cubes, and recursively divides the small cubes. The advantages of this scene management rendering technology are reflected in the following aspects: First, speed up the visibility query process of the local scene in the viewport and the current form, so as to quickly eliminate scenes that are not in the viewport. Second: Accelerate the ray query process of the scene rendering entity, avoiding the intersection of the ray with each entity and the triangle face.

As the mainstream scene management technology, although the general scene can guarantee the query efficiency, the effect is not obvious for the special spatial distribution feature data. For example: discrete distribution of massive model data, data intensive in local space, and so on. Therefore, it is necessary to further improve it by using techniques such as LOD.

#### **4. Platform construction**

Using 3D virtual reality technology, the acquired 2D underground cable channel basic information is deeply processed and produced, and the data is presented in 3D space. The way of 3D technology simulating the real channel makes it a useful tool. Due to its accuracy, authenticity and infinite operability, it can greatly improve the understanding, recognition, location, judgment and utilization of channel information. It can provide basic spatial query, attribute query, spatial statistical service, channel-based. Spatial analysis service for data. The 3D real scene makes the visualization more intuitive, enabling viewing of different angles underground, which is easier for the user to identify. Mobile job management can be built in conjunction with the production management system, or as

part of the production management system, the mature IoT technology can be introduced into the intelligent distribution network integrated operating system solution, in device identification, GPS navigation and positioning, data Provide technical means for collection, safety production control, equipment status collection, etc., which can effectively improve the acquisition of production business data.

Combined with the EV-Globe platform, the integration of various functions can finally achieve fast loading of cables and channel models, and support functions such as line planning and editing.

## 5. Conclusion

The construction goal of the cable three-dimensional intelligent management platform is to provide a full range of information services for underground cable collection and information management. Through the support of the system, it can support the underground cable information of each business system, and finally realize the connection and closed-loop business objectives between the advanced application and the basic information system. The establishment of the underground cable refinement management system has realized management innovation, changed the traditional working methods and ways of thinking, cultivated innovative thinking, promoted the transformation of management concepts, improved the overall management level of underground cables, and improved the service awareness of employees. And the quality of service reflects the social responsibility of the company and establishes a good corporate image. Strengthening the management and research of underground cables and their pipelines has important practical significance and far-reaching historical significance, and will surely play a huge role in promoting the overall construction and sustainable development of enterprises.

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Chenguang Wang (1976- ), senior engineer, mainly engaged in power planning and electrical system automation research.

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