Research on the Development of Geographic Information Acquisition Technology and Its Application in Power Grid

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Abstract. The development of three-dimensional information technology has effectively promoted the entire life cycle management process of buildings. Power engineering is complicated to operate and has a large number of equipment. It takes a lot of time and manpower to rely on the traditional power grid system. Based on the 3D geographic information platform, this paper analyzes the development of grid data acquisition technology, focuses on the technical principles of aerial photogrammetry and GIS spatial data, and provides basic support services for improving data processing efficiency and operation quality.

Key words: Geographic information technology; data collection; three-dimensional display.

1. Introduction

In recent years, two-dimensional computer-aided technology has been widely used in the power industry. With the rapid development of computers and changes in the application life cycle of engineering applications, grid engineering began to explore and apply three-dimensional digital technology to assist applications, three-dimensional digital technology as a The new display method, due to the intuitive, convenient, easy to use and transfer advantages of the digital information model, is being researched and applied by the design, construction, operation and maintenance units.

For power operating units, regular inspections and maintenance of power lines and facilities under their jurisdiction are a very difficult task, not only costly, but also long-term, especially for transmission lines that pass through mountains and mountains. Its engineering is more difficult. By adopting aerial photography, laser scanning and other technical means, not only can the detailed spatial data and attribute data of the grid equipment in a large area be quickly obtained, but also the three-dimensional modeling can be used to realize the visual management and analysis of the power grid engineering. The basis for supporting grid engineering safety, self-healing, green, strong and reliable operation is panoramic real-time data acquisition, transmission and storage of power grids, as well as rapid analysis of massive multi-source data. Therefore, with the continuous deepening and advancement of power grid construction, the amount of data generated by grid operation and equipment inspection/monitoring has

grown exponentially, which has gradually formed the big data of today's information science community, which requires corresponding storage and rapid processing technology as support.

2. Research status

With the development of power systems, facing the increasingly dense power grid, complex power equipment, changing load information, and people's growing concern about power quality, environmental protection, power market system reform, etc., traditional grid management The method has been difficult to meet the requirements of grid construction and safe economic operation. Adopting new technologies and means to make management work into a track of quantification, scientific and automation has become an important task at present.

The three-dimensional geographic information system is the main direction of discussion in recent years. It combines the realistic simulation of 3D scenes with traditional GIS applications to present real and intuitive grid engineering scenarios, and has powerful data processing, analysis and integration capabilities. Previously, Zhejiang Super High Voltage Company operated this technology on several transmission lines such as Jiaxing-Wangdian 500kV in Zhejiang Province to establish a three-dimensional geographic information system, directly guiding the operation, maintenance and management of transmission lines, and achieved good results. North China, Tianjin, Jiangsu and other places have successively launched application research work in the production, operation and dispatching of grid geographic information systems. The three-dimensional digital display has the advantages of being intuitive, three-dimensional, real, and rich in information than the previous two-dimensional system, and has obvious advantages in improving engineering construction quality, shortening time, and saving cost.

3. Aerial Photogrammetry Technology

The set modeling methods of 3D SMAX include polygon modeling, NURBS modeling and Subdivision Surface modeling. Generally, building a model can be obtained by several methods, but there are advantages and disadvantages and simplicity.

(1) Polygon modeling

Multi-form modeling technology is one of the earliest modeling techniques. Its simple idea is to use a facet to simulate a surface to create three-dimensional objects of various shapes. The facets can be triangles, rectangles or other polygons. But actually more are triangles and rectangles. Polygon modeling allows you to create realistic objects by directly creating basic geometry, using modifiers to adjust object shapes as required, or by using lofts, surface patches, and composite objects. The main advantage of polygon modeling is that it is simple, convenient and fast, but it is difficult to generate smooth surfaces. Therefore, polygon modeling technology is suitable for constructing objects with regular shapes, such as most artificial objects, and only according to the requirements of the system, only Models with different resolutions can be obtained by adjusting the parameters of the established model to suit the needs of the system scene display.

(2) NURBS modeling

NURBS is an abbreviation for Non-Uniform Rational B-Splines, which is purely a mathematical concept in computer graphics. NURBS modeling technology is one of the most important modeling methods for 3D animation in recent years. It is especially suitable for creating smooth and complex models, and it has unparalleled other technologies in terms of application breadth and model detail fidelity. Advantage. However, since NURBS modeling must use surface patches as the basic modeling unit, it also has the following limitations: NURBS surfaces have only a limited number of topologies, making it difficult to make objects with complex topologies (such as objects with holes). The basic structure of NURBS patches is grid-like. If the model is complex, it will lead to a sharp increase in control points and difficult to control. It is often necessary to cut the surface when constructing complex models, but a large number of crops are easy to cause computer errors; NURBS technology is difficult to construct "Branched" object.

(3) Subdivision surface technology

Subdivision surface technology is a 3D modeling method introduced in 1998. It solves the difficulty of NURBS technology in building curved surfaces. It uses arbitrary polyhedrons as control meshes and then automatically generates smooth surfaces according to the control mesh. Subdivision surface technology meshes can be arbitrarily shaped, making it easy to construct a variety of topologies and always maintain the smoothness of the entire surface. Another important feature of subdivision surface technology is "segmentation", which adds detail to the local part of the object without having to increase the complexity of the entire object while maintaining the smoothness of the object with increased detail.

With the above 3DSMAX several modeling methods, it is possible to select the appropriate modeling method according to the requirements of the system before the corresponding model is produced by the geographic information system, and to complete the system model production more quickly and economically.

In the production of electric three-dimensional geographic information system, one principle should be followed: under the premise of ensuring visual effects, try to use a relatively simple model, and if the objects constructed by parametric methods are constructed with parametric methods as much as possible, at the same time, In the process of model creation, the model is segmented and modeled separately to facilitate operation and inspection in the system.

4. GIS spatial data technology

The data in GIS can be divided into two categories: one is mainly related to spatial position and spatial relationship, called spatial data (SpatialData); the other is non-spatial attribute information in geographic elements, called attribute data. Spatial data is data used to represent information about the location, shape, size, and distribution characteristics of a spatial entity.

Spatial data is suitable for describing all aspects of a region in a two-, three-, or even multi-dimensional distribution. It not only represents the spatial position and shape information of the entity itself, but also information representing the attributes of the entity and the spatial relationships (such as topological relationships).

The spatial data model is about the concept of spatial entities in the real world and their interconnections. It provides a basic method for describing spatial data organization and designing spatial database schemas. Therefore, the understanding and research of spatial data model plays an important role in designing spatial databases and promoting the development of GIS.

The formation of GIS data model is a process of abstraction from the real world to the computer. It consists of three layers of conceptual data model, logical data model and physical data model, as shown in the figure.

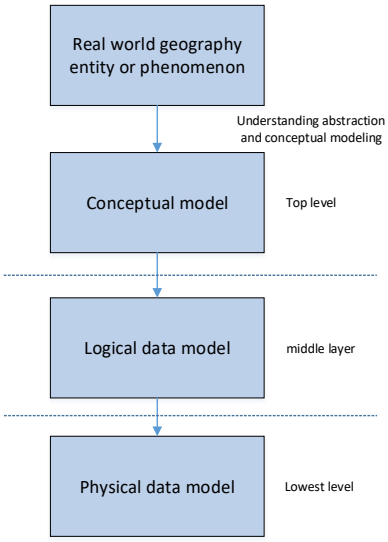

Figure 1. Three levels of the spatial data model

At present, GIS development mainly adopts the object-oriented whole data model. The model expresses geospatial space based on independent, complete and geographically significant entities, and uses a single spatial geographic entity as the basic unit of data organization and storage. Entity information is divided into two categories: the first category is information reflecting the geospatial location of the object, called spatial information or spatial data; the second category is information that reflects other characteristics of the transaction, which is not related to the geographical location, and is called attribute information or attribute data. The two depend on the type and serial number, and can be stored in the graphics file and the relational database, or in the relational database. The implementation of the entity-oriented data model adopts a completely object-oriented software development method, which has the advantages of entity management, convenient modification, spatial analysis, etc., which is convenient for users to understand and accept, and system maintenance and expansion are convenient.

In this model, geospatial is expressed as a set of objects with interrelationships. Each object not only has its own geometric information, attribute information and time information, but also has a topological relationship and a semantic relationship with other objects. All of this information is equally important in the overall data model, and the object itself is the one that connects. According to the shape characteristics of the object, and in order to facilitate computer implementation and management, we can divide the objects in geospatial into five basic objects: points, lines, polygons, annotations and complex objects.

5. Conclusion

The grid three-dimensional geographic information system uses massive data management and computer virtual reality technology to maximize the integration of data related to the grid business, and demonstrates the environment in which the entire power network is located through scientific representation. Research and build a unified digital power grid, build an open grid geographic information service platform for enterprise-level applications, improve the lean management level of the power grid, and provide strong support for various business applications. Serving the spatial information resources sharing of the smart grid, providing auxiliary decision-making for the economic and efficient operation of the smart grid, providing basic support for the self-healing and reliable of the smart grid, and providing grid infrastructure sharing services for the government and related departments.

References

[1] Chen Haibo, Zheng Jian, Fei Ruiqi, et al. Typical Application of Virtual Reality Technology in Power System [J]. Power Grid and Clean Energy, 2016, 32(2): 20-25.
[2] Lei Guangjie. Application of 3D Geographic Information System in Transmission Line Design [J]. Henan Electric Power, 2012 (2): 49-52+ 38.
[3] Wang Wei. Research on GIS-based optimization algorithm for transmission line path [D]. Baoding: North China Electric Power University, 2015.
[4] Cai Ying, Wang Hongliang.Application of 3S Technology in Transmission Line Design [J]. Journal of Northeast Electric Power University, 2011 (Z1): 37-40.
[5] Lei Guangjie. Application of 3D Geographic Information System in Transmission Line Design [J]. Henan Electric Power, 2012 (2): 49-52+ 38.