TV BROADCASTING FREQUENCY PROGRAMMING BASED ON GIS

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ABSTRACT:

In recently years, GIS has a high-speed development and has made a great progress in its own field. This paper applies theory and method of geographic information system to TV Broadcasting frequency programming, and it uses GIS spatial database to help TV Broadcasting departments manage TV station data. GIS, combining with the theory of radio waves transmission, simulates transmission and coverage of radio waves in the real world. Spatial analysis helps to TV station position programming, and spatial visualization can visually reflect programming result. All of them can provide scientific assistant decision-making for TV Broadcasting frequency programming.

1. INTRODUCTION

Nearly twenty years, with the development of computer information science, GIS has a high-speed development, and has made a great progress in its own field, such as: spatial data management, network GIS, 3D GIS and so on. GIS can seamlessly connect spatial data and attribute data, and realize spatial visualization; meanwhile, it possesses so many functions as the spatial measurement, spatial query and statistics, the space location, spatial analysis and so on. Because of its powerful ability in processing and analyzing spatial data, GIS has been applied to urban infrastructure construction, government departments, city planning and many other industry and departments. In recent years, GIS has also gradually been applied to TV Broadcasting frequency programming.

In TV Broadcasting frequency programming, Series of construction work, such as base station programming, base station position selection, field strength prediction, coverage analysis, interference analysis, frequency distribute and so on, is all related to the spatial data query, expression and analysis. Because traditional artificial programming manner lacks of precision and flexibility, especially in the complicated variable areas, while carrying on interference analysis and coverage calculation, it demands exact base station location information, so it is difficult to get accurate prediction. And it is eager to a new kind of technology to assist TV Broadcasting frequency programming.

2. GIS KEY TECHNOLOGIES IN TV BROADCASTING FREQUENCY PROGRAMMING

It is GIS characteristic theory and method that can bring frequency programming great convenience. Spatial database can effectively access and manage TV Broadcasting thematic data; spatial visualization can truly and intuitively project spatial data on electronic map, so that it is facilitate to carry on statistical analysis; spatial analysis can effectively analyze surrounding terrain of the base stations and provide technical support for base station location selection; It is GIS application model, spatial measurement and calculation and spatial statistical analysis that can provide technical support for accurate prediction of base station coverage. So, it is a developmental trend that using geographic information system to strengthen TV Broadcasting coverage network management and construction.

2.1 TV Broadcasting Thematic Data Integration and Loading

TV Broadcasting thematic spatial data includes two parts of property: the spatial property and thematic property. Spatial property refers to spatial geographic coordinates (LONG., LAT.), elevation and so on. Thematic property includes the province which base station belongs to, transmission program, antenna height, channel, band, feed line loss and so on. Spatial property can judge space consistency of base station to avoid redundant data. Both spatial property and thematic property can realize three kinds of query of competitive database, such as: thematic information query, spatial information query and joint query.

After spatial encoding thematic data, comprehensive database will be created by integrating and loading these thematic data and basic geographic information data. The basic geographic information database describes the limited geographic feature, spatial relationship and geographic function, and it is specific generalization and abstraction of geographical environment. In order to fully moderately reflect the spatial geographic information and meet the multi-scale data harmonious require, while designing spatial database, it is common to adopt this kind manner of multi-scale coexistence to establish spatial database. Based on existing basic geographic information data source, unattached TV Broadcasting thematic data source can be created. And then both basic geographic information data

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and TV Broadcasting thematic data will be integrated and linked together by spatial property of thematic data and comprehensive database will be created. It can effectively manage many complex base stations data, guarantee base station data uniqueness, and prevent errors and redundant data.

2.2 Frequency Coverage Prediction Mode Based On the Spatial Analysis

Frequency coverage prediction model is the important application of GIS simulation model in the field of TV Broadcasting. By analyzing the correlated attributes of subordinate base stations and surrounding natural condition and combination of theory of radio wave transmission can predict field strength value of frequency coverage, and get actual coverage of this frequency in the natural environment. In the process of model simulating real coverage, strong function of GIS spatial analysis can be embodied everywhere.

(1) Effective height of the transmitting antenna and degree of terrain irregularity
The most important factor which influences frequency is effective height of the transmitting antenna. It consists of three parts: height of the transmitting antenna, the local elevation and surrounding average altitude. The terrain altitude of transmitter geographic location can be obtained by overlapping 2-dimension coordinate layer of transmitter and high-precise DEM layer. Similarly, we can get all altitudes of transmitter surrounding areas, and thereby get average altitude, finally effective height of the transmitting antenna can be got. In addition, DEM layer combination of calculation formula of degree of terrain irregularity can obtain degree of terrain irregularity of transmitter. In virtue of GIS powerful auxiliary function, the various parameters can be easily got.

(2) Normalized field strength
In virtue of GIS spatial measurement and calculation, the distance between a certain space point and the transmitter can be gained; at the same time, geographic coordinates of a certain spatial point can be gained according to the distance between the transmitter and a certain space point. While calculating field strength, you can select a certain space point, and then get the distance between a certain space point and the transmitter according to spatial measurement and calculation. According to the distance and the effective height of the transmitting antenna and the transmitter power and propagation curves, you can determine a certain spatial point normalized service field strength value.

(3)Field strength modify
The biggest factor that influences field strength is terrain element. Therefore after obtaining normalized service field strength, field strength should be modified. According to degree of terrain irregularity and the distance between a certain space point and transmitter, and then querying modified table of degree of terrain irregularity, you can modified degree of terrain irregularity of Normalized field strength.

Some more difficult calculation about modified items can be realized by space basic geographic information database. Take land-ocean alternating modification for example, fundamental geographic information database contains all the information of the water area distribution, overlapping line and polygon, the length ratio of waterway and land route can be obtained in direction of the transmitter path, field strength over mixed land and sea paths can be obtain by selecting different weighted curve. So after modifying, GIS can more accurately simulate reality. Similarly, In virtue of the ground layer in the basic geographic information database, GIS can simulate the more real ground objects, such as forest, grassland. Using the corresponding modification methods can get more accurate field strength value. The closer to the reality is, the more precise the field strength predicate.

Comparing field strength which is got by above method with critical field strength, critical spatial point of receiving signal can be obtained by repeating computation. GIS can build spatial topology of critical point, and form coverage polygon of transmitter, and the polygon can be memorized as attribute of transmitter, so that you can query it. Service zones can be shown on electronic map by spatial visualization, and it can intuitively show coverage circs.(See figure 1)

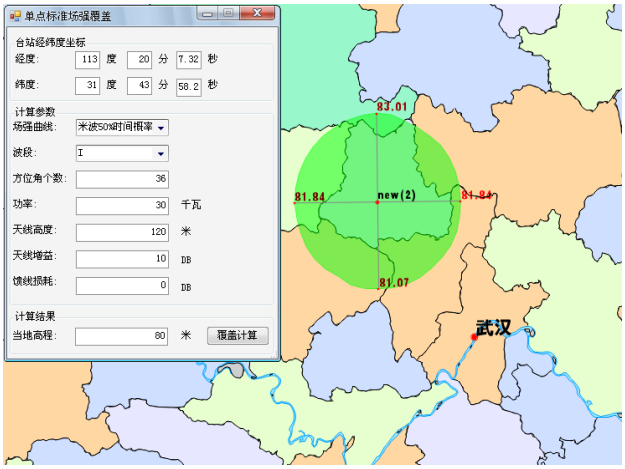

Figure 1. Field strength prediction

2.3 Frequency Interference Analysis Model Based on the Spatial Analysis

The interference between the frequencies mainly considers the spatial distribution of base stations and relationship of the correlative base stations. Interference analysis model is used to solve geographic distribution of interference zones and service zones of base stations. Interference coverage analysis calculation consists of the following several parts, it can calculate the distance between both two transmitters by spatial measurement and calculation; it can judge corresponding interference type, such as the same frequency, adjacent frequency and mirror frequency; it can gain the harm field of interference station by interference field strength calculation; it can calculate available field strength by power synthesis; making usable field strength as critical field, calculating critical spatial point of available signal, it can form real a service zone while being interference. According to spatial calculation, it can obtain the distance between two transmitters, azimuth and service superposition and so on.

Service zones and interference zones of base stations can be visually shown on electronic map by GIS spatial visualization, and it is helpful for analyzing compatible relationship. By using the GIS map function can output the corresponding thematic map, and it can provide field strength prediction information, so decision-maker can conveniently devise decision-making. As shown in figure 2, the outer circle represents the ideal coverage when a transmitter is not be interfered, the inside small circle

represents the actual coverage when a transmitter is be interfered. Surrounding stations denote.

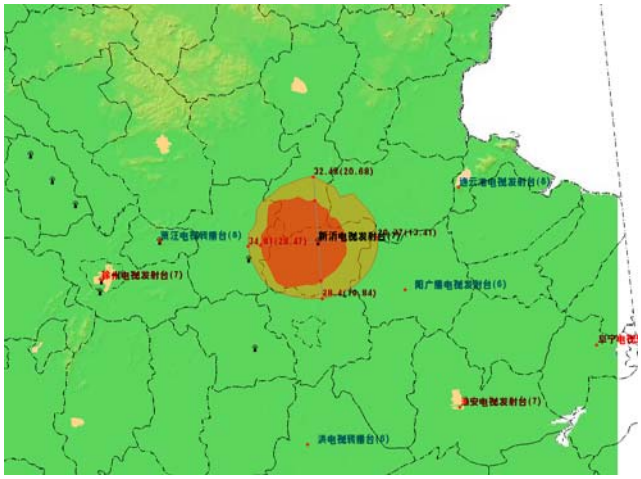

Figure 2 . Compatible relationship figure of transmitters

3. APPLICATION PROSPECT

With the advent of knowledge economy era, it is the rapid development and the wide application of information and science technology that drive the whole society demand to spatial information, without fail, space information will become an important part of a country or the global information current, and gradually become one of the most basic information services. At the same time, that TV Broadcasting frequency programming as a new research field of GIS will promote the progress of theory and technology of GIS, and widen GIS subject field.

With a large number of GIS data being shared and opened, GIS will play a greater role in the field of TV Broadcasting. And it will provide more accurate programming and decision-making support for the space location and the spatial distribution of base stations. Spatio-temporal GIS is the main tidal current of GIS development, using spatio-temporal GIS, all the base stations information can be maintains through 4D spatial data, and TV Broadcasting coverage evolvement can be dynamic demonstrate, which can instruct the next programming.

It is the further development of WebGIS combination of TV Broadcasting frequency programming that will bring the revolutionary change. All of the spatial data can be unified managed through the Web, which makes information realize sharing and unity in the high-speed network environment, and resolve unified chaotic situation of TV Broadcasting base station data, and provide the consistency for data query, edit and modification, also, and provide convenience for the base station data statistics and analysis.

In virtue of GIS and GPS, TV Broadcasting signal strength can be automatically recorded to the map by the special car. So it can realize the complete automatic take-over and measurement, and improve the level of TV Broadcasting monitoring.

Undoubtedly, it is wide application of GIS and the growth and increasing diversification of GIS technology that will be the salient features of the GIS development in the future years, it is using GIS to realize TV Broadcasting programming management that will become a trend in the TV Broadcasting development.

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