

GIS-based Noise Spatial Analysis

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The core of spatial analysis is to understand the spatial dependence and spatial association of some data related to geographic location, and to establish the statistical relation among the data according to the spatial location. Base on the knowledge of spatial analysis and fifty on-site measured noise value, this paper analyzes the noise date distribution the central area of Guangzhou city a by GIS spatial analysis software Geoda. It shows that the spatial analysis could offer some reference for analyzing spatial structure and pattern of environmental noise and for policy – making related to noise issues.

Key words: noise; GIS; spatial analysis; Geoda

1. INTRODUCTION

Lots of knowledge can be found in GIS (Geography Information System) data, as has reached common understanding in this field. Through selecting and spatial analyzing interested data, some characters and rules contained in it can be Preliminary findings^[1]. This paper uses the method of GIS spatial data analysis to analyze the distribution of environment noise in city by GIS software “Geoda”, and then obtains the noise Hot-spot so as to learn the noise distribution pattern of environment noise.

2. DATA AND METHODOLOGY

2.1 Spatial Analysis Method

Due to its unique advantages in geographic information collecting and managing, GIS is selected as design and management tool by a large number of cities’ environment and planning departments nowadays. The environment departments accumulated a great deal environment noise data, and this provided elements for the use of GIS-based spatial analysis method.

The spatial data of GIS has special quality and value, and it is significant to link geographic position with data in GIS system. Spatial analysis is one of the most important functions of GIS. It includes a series of technologies of analyzing spatial data, and its purpose is to test model and obtain knowledge. Spatial analysis method includes four inter-related concepts. They are: (1) Spatial data operation, including spatial query and search, spatial measure and calculation, spatial interpolation, overriding analysis, buffer analysis, network analysis and

numeric elevation analysis. It mainly bases on the geometric characters of the geography objects, and through visible drawing to describe objects futures. (2) Spatial data explore analysis, mainly meaning describing and exploring analysis technologies and methods. Through showing data with graphics or map, it researches potential model and abnormality in data, etc. (3) Spatial data statistic analysis, describing data’s quality through statistic method. (4) Spatial modeling, constructing model to forecast spatial process and result. This is the further development of spatial analysis^[2].

The current environment GIS usually comprises methods of spatial query, spatial measure and calculation. And it can also offer statistic diagram, but it only involves spatial data operation and almost no analysis to spatial data.

The spatial analysis put forward in this paper mainly means spatial data analysis and spatial statistic analysis. Spatial statistic analysis is used to classify and synthetically value spatial data. Its core is to cognize the spatial dependence, spatial inter-link or spatial autocorrelation among data that related to geographic positions, and building statistic relationship among data through spatial positions.

From the view point of geography, this paper alternately analyzes environment noise problem, visualizing exploring and analysis of process steps, and with the support of computer alternately research data feature. The spatial statistic analysis of the environment noise can be used to find noise Hot-spot, can also describe noise distribution.

2.2 Software

This paper uses visual and exploring spatial data analysis software Geoda095i, which is developed by “GeoDa”

geographic science research center, Arizona State University, USA. The center is devoted to the development, implementation and application of state-of-the-art methods of geospatial analysis to policy issues in the social and environmental sciences. This software is suitable for exploring spatial data analysis in different spatial scale, and it is the newest production of the software tools for designing and realizing exploring spatial data analysis [3].

Geoda095i uses the “shp” documents as the standard format to store spatial information, and is suitable for exploring spatial data analysis and relativity analysis.

3. NOISE DATA SPATIAL ANALYSIS

3.1 Data sources

The first step of spatial analysis is to determine analysis objective and requirements. The objective of this analysis is to learn the influence of road traffic noise to the around environment, in other words, is to determine the Hot-spot in the area, noise distribution layout and the relation of noise and around environment.

Preparing the data of spatial analysis is an important step. The basic geographic data used including the spatial data and feature data of architectures and roads. The other data such as schools, office and business institutions can also be added into it so as to the result of analysis more clear. Good GIS data can help to save analysis time, reduce analysis error, improve analysis efficiency and reach satisfactory analysis result.

The noise data used in this research come from field measure. During August 2008 and January 2009, according to “Acoustics, Environment Noise Measure Method ” (GB/T3222-94), the author of this paper several times measured 50 points in the range of 1.4 square kilometers in Guangzhou city central area, and obtained the average continuous equivalent A acoustics class. The area map for investigation is as Fig.1.

Making measure result as data label, and in putting it into software ArcGIS, the value of tested spots and their distribution can be seen directly in this GIS software, as Fig.2.

The shp file generated from ArcGIS will be inputted into software Geoda to alternatively explore and analyze the data of measure points.

3.2 Visualize spatial analysis

Fig.3 demonstrates the analysis to noise Hot-spot. Using refresh technology combine the view of geographic space and feature space is an alternative dynamic window analyzing and refreshing process.



Fig.1 Area map for investigation



Fig.2 Noise measure points in the area

Through analyzing “box-whisker plot”, the chart can be seen at the right side of the window. This chart offers the statistics of these tested spots. It can be seen that the most up points have the highest noise level. When clicking the point in “box-whisker plot”, the color of this point will change, and the corresponding point in right figure will be “flashed” and highlighted shown. At the same time, the data item in lower table will also be highlighted shown. After alternatively analyzing, it is known that in this area the position at Dongfeng Lu has the largest noise level. It reaches 85.6 dB(A) at its highest value. And in Guangwei Lu, a noise “Hot-spot”, it also has a high noise value reaching 82.9 dB(A). One of these two roads is a busy main traffic street, another sets more than one

bus terminal. The highlighted line in the middle of the figure shows the average value of the noise in this area. The average value in this example is 68.7dB(A). The lowest noise value point in this area is in position of Guangzhong Lu primary school, 43.8 dB(A).

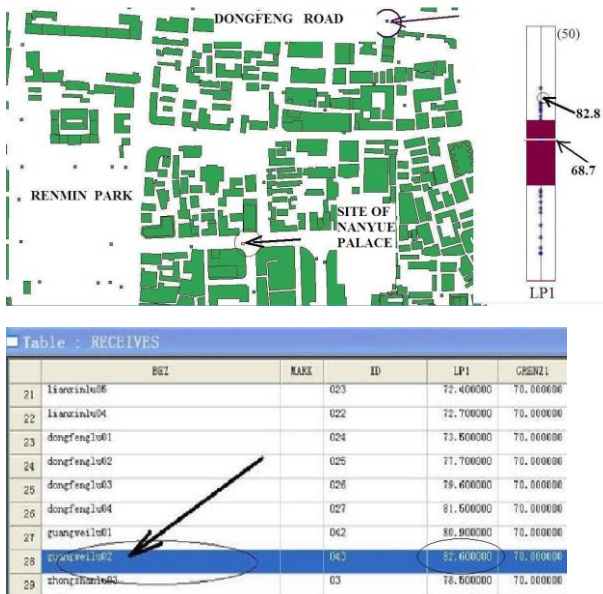


Fig.3 Box-whisker plot and noise Hot-spot

Fig.4 is an analyzing to noise distribution pattern and the result is a four color map, with one layer one color. From the figure it is known that the area with the lightest and brightest color has the lowest noise level, the deeper the color, the higher the noise level in the area. Contrasting Fig.1 and Fig.4, it can be found that the zone 4 which with the highest noise level locates along the main traffic road Dongfeng Lu and sub-traffic road Jixiang Lu. Renmin Park situates in three different zones. The zone 4 close to Jixiang Lu is the noisiest area. The zone 3 is the entrance close to Zhongshan Lu is also noisy. The zone 2 is the area close to the municipal government builds is the quietest area, comparatively. The area with the lowest noise level with in the research area illustrated in Fig.4 is the site of Nanyue Palace ruins and a resident area, known after comparing Fig.1 and Fig.2. Due to densely covered old buildings in resident area with the narrow road entrance and squiggly path, this area is quiet.

The spatial analysis method of GIS can also be used for the data analysis of strategic noise map. The construction of city and traffic planning can be analyzed through using the predicted or measured data.

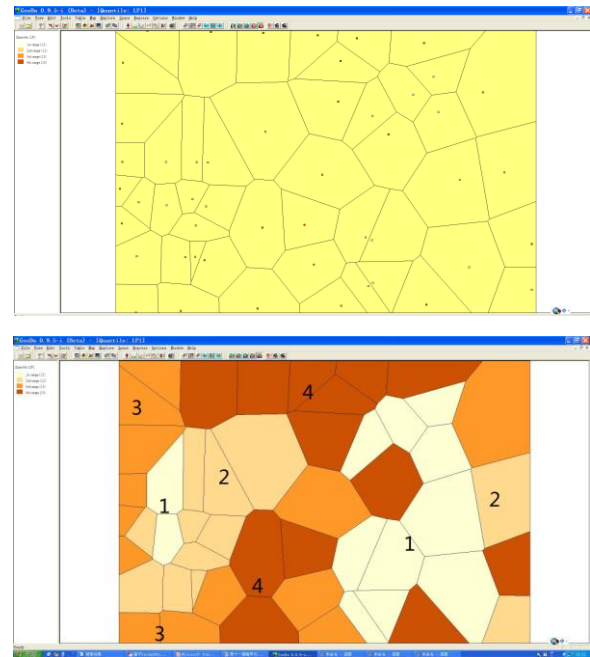


Fig.4 the “four-color” choropleth map of noise distribution

3. CONCLUSIONS

Environment noise is one of the problems during the development of the city. It need be managed scientifically. The data spatial statistic analysis provided by GIS can help people understand environment more deeply, and more effectively manage environment and solve its problem. Using spatial statistic and analysis software of GIS, this paper has analyzed noise level data of 50 tested points. This method visually contrasts environment noise data and geographical position, is a good approach in environment noise analysis and research.

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