

## THE STUDY AND MANAGEMENT OF THE URBAN PIPELINE NET MAPPING AND ANALYING ON MAPINFO

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### ABSTRACT:

The urban underground pipeline is the one of the most important parts of infrastructure. It is the key for urban planning, managing and constructing. However, with the urban enlarge, the pipeline net become more and more large and complicated. So it needs scientific management. GIS is the new technology, and it can be applied to the pipeline management. With the help of GIS's functions of spatial analyzing, the pipeline net can be designed, managed and constructed easily. This paper mainly discuss the methods of pipeline mapping, which include the methods of data collection, the data file structure design and the approach to integrated indoor mapping with the field data collection. And how to dig out the knowledge by the longitudinal and lateral section analyzing on MapInfo, which include some algorithms research and section data file structure design and the methods of section maps mapping and outputting to user. In this paper, the method of pipeline mapping is studied in detail with using the data of field collecting. And the some data file structures are designed. Meanwhile, the methods of pipeline section mapping and analyzing are studied. Then the simulation run is done by using the field collecting data in Zhenjiang city Jiangsu provence China. The results of simulation are satisfied very much.

### 1. INTRODUCTION

The urban underground pipeline is the one of the most important parts of infrastructure. It is the key for urban planing ,managing and constructing . However, with the urban enlargen , the pipeline net become more and more large and complicated. So it needs scientific management.

GIS is the new technology ,and it can be applied to the pipeline management . With the help of GIS's functions of spatial analyzing , the pipeline net can be designed ,managed and constructed easily.

This paper mainly discuss the methods of pipeline mapping ,which include the methods of data collection ,the data file structure design and the approach to integrated indoor mapping with the field data collection. And how to dig out the knowledge by the longitudinal and lateral section analyzing on MapInfo, which include some algorithms research and section data file structure design and the methods of section maps mapping and outputting to user. At the same time, these are simulated on MapInfo by using the field data of a block in zhenjiang city jiangsu provence China.

### 2. THE PIPELINE NET MAPPING

#### 2.1 The Methods of Data Collection

The information system based on data, so how to obtain the pipeline net data , map ,and output to users are the fundamental parts for pipeline net management. There are three methods of collecting the pipeline data collecting the field data, digitizing the pipeline maps, and exchanging the other's system pipeline

data. In this paper, the way of the collecting field data is discussed in detail.

The field data collecting of pipeline includes exploring and surveying. The exploring is to investigate the pipeline attribute and to probe the underground information by using instruments, which is used to get the pipeline situation, depth , orientation and pipeline attributes (such as the pipeline type , scale, the years by buried , unit and so on .) and mark the project center of this point . The surveying is to measure the marks' coordinate X, Y and the elevation. The surveying methods are the same as the general one. But the ways of surveying are divided into two: one is the way with node, which can record the marks' X, Y ,elevation and the relationship between each other; the other is the way without node, which only records the X,Y and elevation and draw the sketch which express the marks' relationship. The purpose of recording the marks' relationship is to map. After these, the investigation data file and the measurement data file are built.

#### 2.2 The Data File Structure

##### 2.2.1 The Measurement Data File Structure

Based on above maintained, the measurement data files can be built by the field surveying. They include two types: the data file with node and the data fields without node. Their data files structures are as the following:

Number	The field operation node		X	Y	The elevation
Number	X	Y	The elevation		

In the table, the field operation node is mainly used to record the relationship of the marks each other. The field operation node isn't discussed In this paper.

**2.2.2 The Investigation Data File Structure**

After the field investigating , the investigation data file are built. The structure is as follows:

Number	Pipeline Point(marks) type node	Deep
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In the table, the pipeline point type node record the points' type ,which can be used in pipeline mapping , so the points can be symbolized. The methods of point noding aren't discussed in this.

**2.2.3 The Pipeline Mapping Data File Structure**

In the view of the pipeline mapping ,the pipeline entry can be divided into point and line , and the line can be expressed by points. So the mapping information can be divided into the two parts too: the pipeline point data file which records the points' X,Y, elevation, the point type node and depth ; the pipeline index data file which records the linking relationship each other and can be built by the field operation node using program or by the sketch to edit, and which includes the pipeline line node and all the points of the line.

The pipeline point data file can be built by combining the measurement data file and the investigation data file. And the pipeline index data file is the base of building the topological data file and MapInfo standard exchange data file (MIF and MID).

**2.3 The Implementation of Integrated Indoor Mapping with the Field Collecting Data**

After dealing with pipeline point data file and the pipeline index data file by programming, the pipeline topological data files and the MIF and MID files can be built on scale of one work unit .According to data management requirement ,the whole work unit is divided into 9 layers, and every layer is divided into

point file and line file ,so there are 18 MIF and MID files in the whole work unit.

The line MIF and MID files contain the lines' type, color, pattern information, attribute and so on. Meanwhile, the point MIF and MID files contain the points' type, color ,the symbol information, the attribute ,and so forth. We know the MIF and MID files are MapInfo's standard exchange data files, so the pipeline's MIF and MID files can be imported into MapInfo and built tables, last the pipeline net map can be drawing.

For the background map :topographic, firstly, it will be digitized and matched with pipeline net map .Then it can be used as the background map and help to analyze and design and output.

The flow chart of mapping is as the following (Figure 1).

In the flow chart , the pipeline index data file , the topographic data file and the MIF and MID files are built by using VC++ programming , however, combining data and drawing pipeline map are implemented by using MapBasic which is the programming language of MapInfo.

The symbols of pipeline points can be built by the symbol making function of MapInfo, and added into the symbol database, When mapping the pipeline net, we can use these symbols to symbolize the points.

In the light of the above \_maintained design, data flow and the method of implementation, the comprehensive pipeline net map can be built as the following(Figure 2).

**3. THE LOGITUDINAL AND LATERAL SECTION ANALYZING**

With the pipeline net mapped, we can do the spatial analyzing and dig out the knowledge. The spatial analyzing includes longitudinal and lateral section analyzing , topological analyzing and network analyzing , and so on. . However, the section analyzing is the most important for pipeline design and construction, and it is the base of all kinds of infrastructures' construction. The following is the method of longitudinal and lateral section analyzing, which can be done based on the pipeline map above.

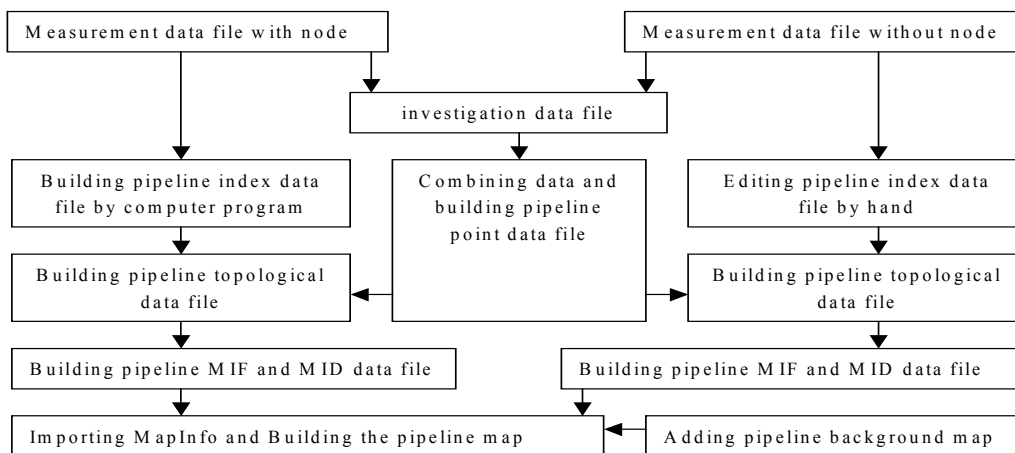


Figure 1. The data flow of pipeline mapping

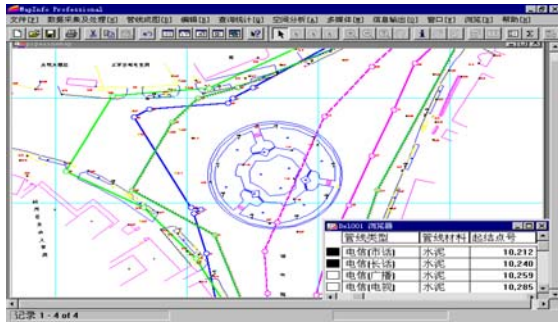


Figure 2. The comprehensive pipeline net map

### 3.1 The Data File Structure Design of Longitudinal and Lateral Section

According to the requirements of engineering and mapping the section, we design the section structure as the following:

- type interobj (the structure of the intersect between the section and pipelines)
- X as float
- Y as float
- Type as string (the type of pipeline which intersects with the section)
- Plinedia as float (the diameter of pipeline)
- Z as float (the mark's elevation)
- Deep as float (the deep of the buried pipeline)
- Distance as float (the distance of two pipelines)
- End type

In the structure, the purpose of "type" design is that the section can be drawn the same color as the pipeline net map. For example, if the pipeline's color is red in the pipeline net map, when we draw this pipeline section, we can only use the red color to display this section. So it is more clearly to express the section information.

### 3.2 Building the Section Map

Based on the section structure design, the pipeline longitudinal and lateral map can be built. The proceeding is as the following.

Firstly, opening the layer which need to be done the section map, and then marking the situation of the section in which there is the engineering requirement or user's interesting, according to MapInfo, the layer "FZXC" is designed to save the section line. After marking the section line, taking advantage of Mapbasic to program and implementing the intersect locating algorithm and linear interpolated algorithm, the section data files can be built based on the designed structure. Using this files, Building the MIF and MID files and then importing MapInfo, at last, the longitudinal section can be mapped.

However, the lateral section map is the one following the pipeline. The method of mapping is the same as the longitudinal one generally. Firstly, in the "FZXC" layer marking the lateral section (selecting the two points in the same pipeline), and then finding all the points which locate between the two points and building the section data files according to above maintained section data structure. But some times the lateral section is often the longitudinal one too, so we must look the lateral section as longitudinal one and do the works of longitudinal section mapping. It is the same to draw the lateral section, which is to exchange the section data files to MIF and MID files and import to MapInfo. In the end, the lateral section maps can be drawn.

### 3.3 The Implementation of the Different Scale Output on Longitudinal and Lateral Section Map

In the section map, the lateral coordinate's (elevation) variety is little, if we select the same scale, the results of section map isn't very good, so we must select the different scale. The proceeding of implementation is as the following:

Firstly, the pipeline information system gives a dialogue, which ask for importing the longitudinal and lateral scale. According the importing scales, the system displays the section map based on longitudinal scale, and the lateral coordinate in the drawing equals to the lateral coordinate multiplying longitudinal scale and divided by the lateral scale. However, the value marked in the section map is the same as the primitive. So the different scale section maps are built.

### 3.4 The Section Map Output Uniting the Spatial and Attribute Information

For using the section information, the section spatial information (map) and attribute are designed in the same window to be displayed. So in this window, we can not only know the spatial information, but know the attribute precisely. It can be done by using MapInfo's layout window function.

After three proceeding, the longitudinal section map is as Figure 3 and the lateral section map as Figure 4.

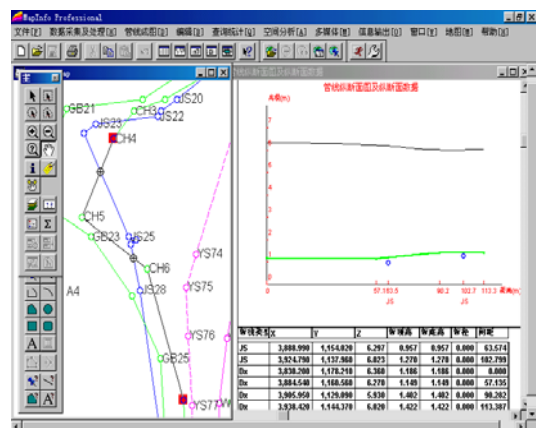


Figure 3. The longitudinal section map

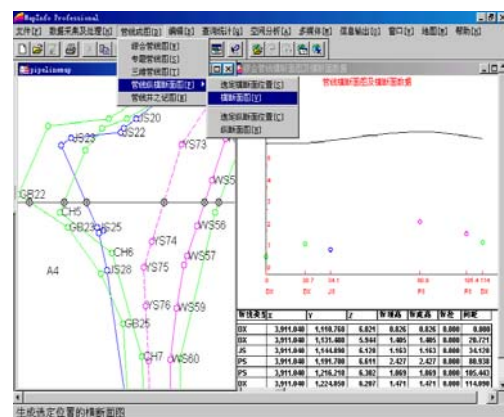


Figure 4. The lateral section map

#### 4. CONCLUSION

Now, the GIS is been used in every field, so the research about pipeline on GIS is hot. In this paper , the method of pipeline mapping and longitudinal and lateral section analyzing are studied in detail. And the simulation run is done by the field data in Zhengjiang City Jiangsu province China .The results are satisfied very much. These demonstrate that the design and data file structure and the algorithms are right and valid. However some problems always need to be solved, mainly including the following:

1. Improving the mapping function to adapt the large data ,for example the whole city, the whole region and so forth.
2. For section map analyzing, the special problems ought to be considered and handled , for example the pipeline project is a point or a circle.
3. The section analyzing results ought to be applied in design plan, and construction of pipeline and urban planing. This needs cooperating with the others municipal departments.

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