Active Statistical Map Cartography Method Based on Knowledge Learning

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Abstract. In this paper, based on knowledge learning active statistical cartographic model, in inducing summary based on the statistical cartographic user demand, put forward from the user mapping needs to mapping scheme to solve the model, and discusses the realization method of active statistic cartography. Through the construction and experiment of the application system, the feasibility of the active statistical map mapping model is demonstrated, which can meet the needs of personalized, real-time and professional level efficient mapping of the general statistical map.

Introduction

Statistical mapping is an important type of thematic cartography, its theory and method is an important part of the science and technology of geographic information system, and is accompanied by the development of geographic information science has experienced many different stages of development. From the rely on drawing software (such as AutoCAD, Illustrator, CorelDraw, etc.) manual drawing, software automation or semi-automatic mapping, the development of the current statistical mapping service model. Has been widely used in various industries in the national economy.

At the same time, the mapping users to improve the requirements of the map, the map of the designers and users are gradually blurred, so the personalized needs of the increasingly enhanced mapping. But traditional modes of software and services are based on the "pull" model, drawing users for drawing various processes and parameters need to master to get satisfactory results of mapping, this technique for mapping the user's requirements higher, for ordinary drawing users to want to obtain ideal statistical map, in addition to the familiar with graphics software itself, but also rely on the cartographic expert guidance. The research of active statistical map method is used to unify the application of drawing software and the knowledge of expert drawing. This paper studies the model and method of active statistical mapping service. The core of the active statistcartography is to understand the user's drawing needs, according to the mapping knowledge and understanding of the user's make personalized drawing program and on the user's selection process for learning, improve the mapping knowledge.

Active Statistical Mapping Model

According to the original "pull" mode of statistical mapping process, the active statistical mapping can also be called "push" mode statistical mapping. "Pull" mapping mode rely mainly on mapping software and graphics drawing experience, for ordinary statistical mapping the user to achieve the desired level of professional drawing effect, have software itself and the drafting experience limited. In view of this situation, this paper puts forward the individuation and real-time of graph based on knowledge learning active statistical cartographic method, active statistical cartographic can reduce the mapping complexity, according to the knowledge for the user to offer possible mapping effect and can facilitate the construction. From the point of view of software technology development, active statistical map drawing is based on automatic drawing, and it is based on the theory of automatic drawing. Comparison of the characteristics of active statistical map and non-active statistical map drawing is shown in Table 1.
Table 1. Comparison of the Characteristics of Active Statistical Map and Non-active Statistical Map.

<table>
<thead>
<tr>
<th></th>
<th>Active Statistical Map</th>
<th>Non-active Statistical Map</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complexity</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Individualization</td>
<td>Convenient</td>
<td>Inconvenient</td>
</tr>
<tr>
<td>Real time</td>
<td>Convenient</td>
<td>Inconvenient</td>
</tr>
<tr>
<td>Automation</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Intelligence</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Active push</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

**Knowledge Management And Learning of Active Statistical Map Drawing**

**Statistical Map Knowledge Categories**

Knowledge management and learning is the base of active statistical map drawing, which mainly includes the knowledge of the drawing itself and the information knowledge of the users. The drawing itself knowledge according to the data characteristics, so decided to drawing symbol type, data classification method, drawing color scheme and graphics user information including user interest information and data, as well as the user's color preferences, etc. In the process of drawing, the drawing knowledge is often used to determine the various parameters and expression methods of the drawing. Among them, the management of knowledge also includes the construction of a priori mapping knowledge and the updating of the drawing knowledge.

**Knowledge Learning Strategies**

Knowledge learning include more users to choose the initiative to learn the user's preferences, and for the user's knowledge of correcting the update, also includes updates to the original prior drawing knowledge, for example, according to the different data distribution features are suitable cartographic model types may vary. Therefore the knowledge learning strategy also includes two aspects, namely the user knowledge renewal strategy and the drawing knowledge renewal strategy. For users, service software for an understanding of the user in addition to the basic information of the user description, only by the user in the application of software services make choice of learning, so for the user's learning should conform to the conventional probability theory, namely, the user selects a characteristic frequency increasing, the weight of the information is bigger also. The software is recommended to the user information to the user according to the weight from small to priority scheme. This kind of learning is repeatable, and it is independent of each other, that is, the different attributes will not affect each other. The user's learning strategy is illustrated in Figure 1.

For the knowledge of the drawing itself, because of different parameters together constitute the expression of the mapping results, so the mapping between the various attributes of the property or have the influence of. So we can use the method of adding weight to improve the naive Bayes model, and establish the learning mechanism of the basic statistical knowledge rules. The adaptability between the statistical data and the mapping model may be adjusted by the application of the simple Bias classification model with the change of the condition of the mapping. Naive Bayes theorem assumes that a property value of a given class independent of other attributes of value, and this assumption in the actual situation often is not established, and therefore need to design naive Bayes classifier based on the weight, the compensation due to the attribute independence assumption conditions brought about the loss of classification accuracy.

**Knowledge Management And Application**

With the learning strategy, the knowledge rule base of statistical map is constructed by using the idea of object-oriented. By drawing a priori statistical cartographic knowledge and rules to build the original knowledge base, using the relational database technology to construct statistical map knowledge rule learning system, through the statistical cartographic knowledge (select cartographic model, classification method, the color scheme, etc.) of learning, self-learning and improve statistical map knowledge base system. By ECA (event condition action) to construct the basic event database, and basic event with the combination of complex event, the event may originate from the graphics engine, drawing environment or external mapping message. The application process of drawing
knowledge is illustrated by the example of drawing engine. Among them, the main role of map drawing engine is key information of user needs and current the main statistical data source formats analysis, and classification of information source, this design information classification of different data sources of the parsing process, the final design of unified system can accept the specification data structure, data source formats into a uniform data format.

**Solution Model of Statistical Mapping Scheme**

**Solution Model to Solve the Problem**

According to the user demand keywords and statistical knowledge map based on, through the establishment of the statistical cartographic scheme for solving the model, the conversion of user mapping information to the needs of statistical map mapping services, in the process to match the appropriate statistical cartographic visualization symbols and data classification method and symbolic color scheme selection, in order to construct the complete drawing program. The main content includes: (1) from the statistical cartographic needs to statistical map drafting parameters transformation, decomposition and combination method (2) according to the statistical cartographic knowledge selection method of drawing symbols, classification, symbol color scheme (3) statistical cartographic classification service solution assembly method. In this process, it is important to design the solution to the model design. A design method for solving the model is given below.

**Design of Solving Model**

Solving the model is to complete the solution process from the user requirements to the mapping scheme. A complete solution including color scheme, drawing symbol scheme, data classification scheme, etc.. The basic needs of users can be standardized through the system, finishing as a relatively standardized mapping language. Statistical mapping language is composed of the mapping key words, the formation of basic drawing language database, the language database includes basic mapping parameters, such as color, regional scope, drawing type, etc..

Set user requirements for X, program collection or available information set for \{Y1, Y2, Y3... Yn\}, according to X, the process of finding the appropriate Y is the process of demand. We can further describe the Y collection as:

\[ Y1=Z1+Z2+...+Zn \]  (in which, Zi for color scheme, grading scheme and other basic sub program)

Thus only finding out each Zi can get a complete mapping scheme. The solving process of the important sub programs in the drawing process is given below.

**Solution of Classification Scheme**

Suppose that the classification set is \{DT1, DT2, and DT3, according to the classification of data features,... DTn\}, the original data analysis model is M, through the model calculation, it is concluded that the original data belong to each data classification of the probability of a collection of \{P1, P2, P3,... Pn\}, and calculate the maximum probability of class DT-Max (P1) =DTi, so the original data for the data type of DTi. According to the data classification and classification scheme, the corresponding classification scheme is obtained.

There are many kinds of classification methods, and there are two kinds of standard mathematical classification and free custom classification. But these two types in the practical application has some limitations, the standard mathematical classification for users is difficult to make appropriate choice, the more appropriate to use what kind of mathematics at different levels, different characteristics of the data may need different mathematical classification method; and freedom to customize the class
although can design very reasonable classification limit, but in the running process of the active service need manual intervention, and the influence of the active service process and efficiency. Therefore, the design of better classification scheme for solving the model. According to the idea of software programming and drawing experience, taking into account the characteristics of the active drawing can design follows the statistical data classification model: grading scheme = classification knowledge + classification standard and personalized classification algorithm, so that the classification scheme is dynamic, personalized, conform to the usual classification standard.

Solution of Color Scheme
The color scheme of the design is one of the important content of cartography, in the active map drawing, unified color scheme database for all kinds of color scheme to build a, respectively with color scheme code said for \{C1, C2, C3, ..., Cn\}, according to the classification number or the number of different classification can be divided into a single type, two types of contrast, multiple types of contrast; according to the color information can be divided into warm colors, cool colors, dual tone and multi tone.

These has kept a good color scheme as a color expert can be used directly in the active statistic cartography process and in active statistic cartography process may according to different situations and master knowledge directly or indirectly using a variety of color schemes. This includes knowledge of color main object or target using the social significance of the color of the special knowledge, color or artificially extended meaning. In addition, for the concept of spatial data, such as inspection of water depth, the mountain height can reference space cartography of GIS common color scheme and the establishment of basic color scheme database.

Solution of Visual Symbol Scheme
One of the important contents of the thematic visualization symbol expression is the statistical cartographic and continuous development of cartographic visualization of symbols formed various special symbols, zonal statistics symbol map visualization including single scale charts, line graphs, trend charts and graphics, choropleth map including texture, color and contour method. When solving the visual symbol scheme, considering the different characteristics of the data and the use of data and other factors, considering all kinds of subjective factors, and finally give a visual symbol.

There are other such as layout scheme, the size of the solution, etc..

From active service point of view, the active statistical cartographic resources layer must include statistical data, base map data, drawing knowledge and drawing function. Mapping users can provide their own statistical data can also use the statistical data in the system, which depends on the user's choice and whether the system exists in the user needs of the data resources. On the one hand, the system as far as possible to the user all the information needed, on the other hand, the system needs to have the ability to integrate data provided by the user, in order to meet the needs of users in the future, the same case.

Summary
This paper presents a method for the realization of active statistical map drawing based on knowledge learning. Active statistical cartographic services can reduce the mapping complexity, facilitate the realization of real-time, personalized mapping services, provide a good foundation for the wide application of thematic cartography, relieve the bottleneck of application threshold is high, and the comprehensive active geographic information services for the future provide the basis.

References


