RESEARCH ON STATISTICS DATA SPATIO-TEMPORAL REASONING MODEL OF GEOGRAPHICAL THEMATIC ELEMENT BASED ON DATA MINING

Dongmei Yu[a,b]   Rentao Huang [b] GuanYan [c]

([a] Qing Dao University, 16 Qingda Road, Qing Dao, China, 266071.
[b] Wu han University, 129 Luoyu Road, Wu han, China, 430079.
[c] Science Press, Bei Jing, China, 100717.)
Email: dongmeiyu@hotmail.com

ABSTRACT:

This article introduced the function and the method of statistical data excavation, through the analysis sex statistical data characteristic, the data mining technology was carried on for sex statistical data analysis. Proposed the classification, clustering and connection analysis method of sex statistical data, people carries on statistical data mining through different algorithm, seeks to conceal, valuable decision rule and pattern in the data, and established the spatio-temporal reasoning model. The findings may for raise the sex research level and the management level of decision serve. As the year by year increasing quantity of sex statistical data and difficulty in analysis decision-making ,as well as to the intellectualization and automated request enhancement of sex decision analysis, people will widely accept using statistical data mining technology and Spatio-temporal reasoning model to solve the more and more social problem.

1. INTRODUCTION

The national governments' statistics bureau at all levels invests massive time, manpower, physical resource every year to build kinds of statistical yearbook for country, province, city and area, county and so on. Statistical data has the general data characteristics. In addition, space statistical data also has time series characteristic and dynamic change characteristic, region spatial distribution characteristic and multi-dimensional structure characteristic, as well as attribute characteristic. In vast statistical data sea, people always hope for withdraws the effective information, but the final conclusion accuracy is nothing. Processing the primitive statistical data through the data mining technology, people can obtain the valuable information accurately and highly effective from the data sea.

Data mining carries on analysis to huge data set, studies the unknown relations and summarizes the data in the way which may understand by data user. Common algorithm and theory of data mining are rough sets, artificial neural network, decision tree, genetic algorithms, Agent algorithm and so on. The commonly used model of data mining includes: The classified model, the connection model, the order model, gather model and so on. We has conducted the comparison research to many kinds of the current data mining methods, and pointed out its application limitation, pointed out the multi-methods fusion, the organic combination and supplementary will become the development tendency of statistical data excavation.

Spatio-temporal reasoning comes by the tense inference and the spatial inference. Summarizes the Spatio-temporal logic aspect research, studies how establishes better spatio-temporal reasoning model, and propose the feasible solution. In recent years spatio-temporal reasoning becomes relevance field The earth super-crust system is a complicated huge system, only that the composition elements are numerous, but also very that

research hot spots such as artificial intelligence, geographic information system and spatio-temporal data base.

2. SPATIO-TEMPORAL STATISTICAL DATA AND DATA MINING

The geographical data already develops from the data base to great capacity data, from data writer to data service, from the data extension to data connotation, and data query to information service, the platform coming true is calculation technology , the method coming true is the data mining and knowledge discovering. Because there is geographical feature law among the data, it requires the calculation technology, Stan Openshaw [UK] thinks that the space data mining already become an important branch in quantify geography and he names this new discipline as Geographical Computation (Geo-Computation).

The Spatial Data Mining shorter form in which SDM, or be called Knowledge Discovery from Spatial Databases, refers to abstract something from spatial data base which user are interested in such as the spatial pattern and characteristic, common relation of spatial and no-spatial data and other common data characteristic of implication in data base. It handles spatial data, which has complexity characteristics such as non- Structured, many dimensions, higher-dimension number, self correlativity, fuzziness and uncertainty. The use of the spatial data mining technology services for the intelligence spatial decision-making hold out system and handles as well as intelligence image treatments, it is a forceful mean of driving intellectualized spatial information.

2.1 Geographical Spatio-Temporal Data

the element interrelation is complicated. Geo-analysis reveal the super-rust dynamics mechanism and space-time characteristics

of the earth's surface information stream reflect area different and announce to regional development process wielding modern sciences method such as system theory, information theory and cybernetics and synthesize spatial technology and calculated technology. Spatio-temporal information and description to the geographical entity characteristic, the time change, the spatial distribution, and the geographical system; is synthesis regional different and development characteristic. Space, attribute and time are three elements of spatio-temporal information.Area difference refers to contrast between inside structure and external of area. Regional development refers to history course and evolution of society, economy, the humanities landscape [1]. Spatio-temporal data is true record of the geographical entity, geographical system characteristic, time change and spatial distribution in this huge complicated system. Spatio-temporal data base is composed of the commonly spatio-temporal data which has the continuity and the inserting and no spatio-temporal data which has the straggling characteristic's is non-sequence and non-inserting. The geographical feature spatio-temporal data has the following essential features, which are base of the data mining and knowledge draw.

2.1.1 Geometry characteristic: Contains geographical space target's quantity , size , form, and counting space target's maximum value , minimum value , mean value , method difference , mode and so on, carries out probability analysis after getting sufficient samples, seeking out geographical features, for example investigation and count analyses of the plant type and distributed.

2.1.2 Spatial distributions laws: Contains geographical space target's zone distributes law, the natural phenomenon difference on latitude direction, longitude direction and perpendicularity direction scatters solar radiation, the air temperature and precipitation geographical distributes, and difference in form and distributing such as animal , plant , soil, and the distribution difference of population settlement.

2.1.3 Spatial connections rule: Refers to using the spatial connection rule of the geographical goal neighboring, connect , coexist, contains, for example analyzing the natural logical relations such as company the inhabitant with the road, the road and river connecting crossing bridge in region geographical space characteristic analysis.

2.1.4 Spatial classifications rule: The spatial classification rule is also called the spatial gathers rule. It is a rule researching on gathers of geographical goal which has close the nature and characteristics, it can be the charting synthesis principle such as the terrain classification and the charting generalization.

2.1.5 Types constitute law: The different characteristic of aggregation or attribution between two kinds or multi-class geographical space targets may be the characteristic distinguishing the different object target.

2.1.6 Spatial evolution regulation: To multi-temporal data of geographical space target in the same range, it can discover the spatial changes regulation. Spatial development refers to seeking the change law of geographical space target from the changes regulation of space target according to time, for example deducing the climate changes characteristic in the geology period according to the general configuration of the earth's surface deposition gyration.

2.2 Spatio-Temporal change and Spatio-Temporal relation

Spatio-temporal changes geographical phenomenon the change show the change in mass characteristic and the quantity characteristic for spatio-temporal phenomenon, namely change of spatio-temporal phenomenon has the qualitative change and quantitative change. Quantitative change is inside change of spatio-temporal phenomenon, show change of spatio-temporal

phenomenon in quantity number, and the state shows different editions. The qualitative change is the change between spatio-temporal phenomena, show diversity of spatio-temporal phenomenon on the character. The qualitative change is the change between the state and event, dealing with the event and the state sequence change between two spatio-temporal phenomena, since spatio-temporal phenomenon is composed of states. The element composing spatio-temporal phenomenon changes contain state, event and the relation between state and the event.

Space, time and semanteme relation exist in spatio-temporal phenomenon, spatial relation among these relation shows for spatial topology relations, spatial direction relation and spatial magnanimity relation. Similar to spatial relation, time relation shows for time topology relation, time direction relation and time magnanimity relation. The spatio-temporal object can be described by state and the event and spatio-temporal relation shows for object level relation and state- event level spatio-temporal relation. Spatio-temporal relation mainly studies space-time topology relation at present.

2.3 Geographical Spatio-Temporal Statistical data

The geographical data includes the spatial characteristic data, the special subject characteristic data and time characteristic data. That spatio-temporal statistical data is spatial data which takes statistical characteristic as special subject characteristic, and occupies more proportion in spatial data, such as: census data, industry, agriculture and traffic statistical data in the field of society and economy. The geographical spatio-temporal statistical data unit is more standard, the statistical unit is administrative, and the statistical data between every administration rank has certain inner relationship. Geographical spatio-temporal statistical data has contrast and internal unity between the statistical units. According to the height accuracy analysis and applying demanding demand the statistical unit be as small as possible. The unity inside element unit ignores internal difference of element, the obvious data decrease in obtaining, analysis and processing making geographical spatio-temporal statistical data, and achieving high-effect, fleetness analysis and in allowable range of space dimension and accuracy.

With the development of statistical project informatization, all various levels statistics systematic data base are built step by step. General mini-type data base adopt data bases software such as Foxpro, Access, while big-type data base adopt Oracle system. Some industries and large enterprises have built themselves statistical data base too. Web-based statistical data base system has still built at present. The statistical information collected from different data sources, provides condition for the statistical data mining by the fact that it composes a large-scale statistical data storehouse, by the data checking up, the varying, integration, putting in and periodical data renewing.

That geographical time series statistical data base is time series statistics data base. It is data base of geographical element varying array value with time, including the data base reflecting month, season, and annual change, data bases are to appear with statistical yearbooks, reflecting status in many aspects such as country and region economic growth, population, education, trade. They are especially cost since they form a long range pass history accumulation.

2.4 Spatio-Temporal Data Minning

Data mining (DM), also named Knowledge discovery in database (KDD), refers to extracting the information previously,

unknown, available, having the valuable applying information in the data base and applying it to the process of important management decision [2]. Spatial Data Mining, also named geographical knowledge discovery is a branch of data mining field, mainly studying extracting interested knowledge, space relation or other meaningful pattern from implication in space data etc. It synthesizes relevant field technologies such as statistics, machine study, space database, expert system, pattern identify, Visualization, the tradition data mining technology expand into space data base. The space data mining is sequence of the data mining combining with space data base. The geographical space data mining and information extracting process is espressed in Fig.1. The space data mining is much more complicated than general data mining because of the space data complexity characteristic. The space data mining requires further perfect in many aspects such as data mining accuracy, the algorithm in efficiency, mining method and task diversity and the data mining uncertainty.

The data mining in common use the geographical algorithms including Probability Theory, Evidence Theory, Space Statistical, Regulation Induction, Clustering Analysis, Space Analysis, Fuzzy Sets, Cloud Theory, Cough Sets, Neural Network, Genetic Algorithm, Visualization, Decision Tree, Online Space Data Mining at present. With development of the data gaining technology and the data gaining means's diversity, large amount of the data relevant with space location is collected, and people urgently need to gain information or knowledge from these data by forceful data analysis implement, this leads to the space data mining appearing as one brand-new research field. Space Clustering Analyses now can discover target implication in the in great capacity data for clustering regulation, and union with other data mining methods, to excavate deeper knowledge of ideas and improve efficiency and mass of the data mining. It is an important research direction of space data mining. The commonly use methods of space data at present include: The Array Analyses, Classification Analyses, The Forecast, Clustering Analyses, The Connected Regulation Analyses, Time Series Analyses, Rough Sets and Cloud Theory etc.
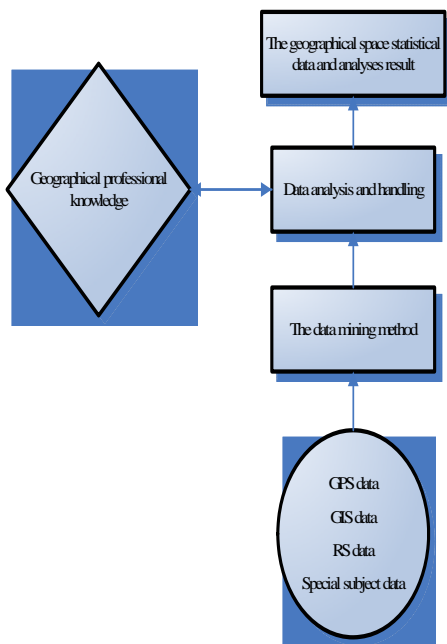
The spatio-temporal data mining is drawing development changes information of spatio-temporal object, the space data mining considering time factor and multi- moment time series, which has moment continuity and correlativity. It applies important method such as classification analysis, clustering analysis and the connected regulation analysis, time series analysis. By using the spatio-temporal data mining, it is able to discover the evolution characteristic or change trend of research object, and various phenomena concerns. On this basis, it makes the forecast and decision-making by quantitative analysis and space analysis.

3. SPATIO-TEMPORAL SATISFACTICAL DATA MODEL

The spatio-temporal database is the massive accumulation of different historical and different scale spatio-temporal data and the non- spatio-temporal data, and is most important information origin of "the digital Earth" strategic. Presently, in the world every year the quantity of the spatio-temporal data gathered is big, but the application data only occupies the gain data about 10%. How fast does excavate the useful characteristic and discovery knowledge from these large-scale spatio-temporal databases has already become a bottleneck question for the present spatio-temporal data processing and analysis. Geographical knowledge discovering need support of the spatio-temporal data base, which is the organization core of spatio-temporal geographic information system and based on spatio-temporal data base is spatio-temporal data model. Geographical knowledge discovering and feature extracting process is expressed in Fig.2. The state and the event are basic concepts of spatio-temporal data model. The event is any thing happen during the time from the beginning to end making relation. And it is remarked in form of time point. Spatio-temporal GIS research particularly emphasis on state model and the event model research at present.
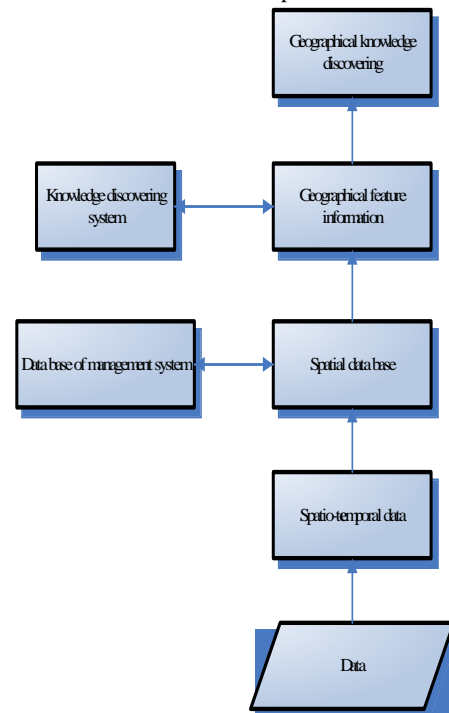

Fig.1 The geographical space data mining and information extracting process

Fig.2 Geographical knowledge discovering and feature extracting process

3.1 Spatio-Temporal Data Model

The spatio-temporal data model describes the state, event and the relation between state and the event of spatio-temporal phenomenon changing by time, including relation between states, between events and relation between state and event. The spatio-temporal data model includes the state model and the event model. At present, research on spatio-temporal data model emphasis on expressing state and the event separately, and shows as the state based model and the event-based model, cannot combine the merits of both models. Taking state, event and the relation between state and the event as centre content, Yin Zhangcai has brought forward state- event-based spatio-temporal data model, which describes state, event and various spatio-temporal topology relation. It is easy to do spatio-temporal analysis by using spatio-temporal the data model, mainly showing state inquiry, event inquiry and relation inquiry. The state- event spatio-temporal model can carry out directly inquires between the state and the event, as well as inquires between various spatio-temporal topology relationships.

3.2 Spatio-Temporal statistical data base

In spatio-temporal statistical data base, the spatio-temporal data is an important kind of the data information. These data, such as various real time monitoring data, sex population employment data , population migration data as well as sex population administration data, has one common characteristic of time attribute. Building spatio-temporal statistics data base is different from other data bases since it needs to consider the problem on statistical data and model scale.

3.2.1 spatio-temporal Scale problem of the statistical data: Scale, which is produced because of terrestrial organizations and complexity on the earth's surface and process, is inherent Nature characteristic or law. Scale is the key of understanding the complexity of various processes and phenomena in geoscience. It is dependent on the observing scale to know the earth system. From statistics, scale is the spatio-temporal measures gap and range measuring the earth's surface area, and is more understood as the dimension of observing, instead of the dimension of the phenomena observed. Different statistical unit scales mainly reflect characteristics information of target and process in different of surface.

The phenomena which are nomogeneous on one spatial scale may be heterogeneous on another spatial scale, with scale changing of the landscape pattern arrangement also possibly affects the observing result. The time scale of some area statistical element shows in short time (several hours to several day), longtime (several months to several years, even more longtime) generally. To analysis element component for every statistical unit change and parameterization law, first of all it need to ascertain the spatial scale of area studied (the whole world , the country , province , cities and counties) and the time scale of process pattern development (day, ten-day period, month, season, year, century, or 1000 year). Then we can carry out reasonableness on processes in studying system such as the sex population distribution and developing, and discuss the sex population change in different spatio-temporal systems.

3.2.2 spatio-temporal Scale problem of models: Building a spatio-temporal model it requires to quantitative describe spatio-temporal vicinity degree between two geographical units. Xiaowen Li given academician definition the spatio-temporal vicinity degree between two nomogeneous areas (hold point) in quantitative remote sense, and given "stream" and direct proportion to general rate of flow between two areas, and inverse proportion to the average time of whole course from one end to another.

To static analysis about two geographical units, spatio-temporal vicinity degree is direct proportion to distance in common border, and inverse proportion to Duclidean space distance between two units centre. In fact, though spatio-temporal vicinity degree can quantitative contrast distance between geographical units, but change amount of vicinity relationship in geographical space are more complicate, pending for studying further.

3.3 Geographical Spatio-Temporal Statistical Data Model

The spatio-temporal data model is a kind of geographical data model which can effectively organize and manage of the temporal geographical data, and more entirely describe attribute, space and time [12]. The spatio-temporal data model is the basis of the spatio-temporal data base which is the organization core of the temporal GIS. To development spatio-temporal data processing and analysis model it is urgent need at present proposed in spatio-temporal data unceasingly accumulation process, the goal is, to strengthens processing ability of the magnanimous data, enhances geographical research and analysis depth, and to develop decision-making analysis technical method through quantitatively and fast withdrawing useful information and the pattern relevant to the practical application goal[4,5].

In order to obtain to entirely information on space, time, and the attribute of the geographical phenomenon, to realize spatio-temporal data unification save, management, and according to withdraws information for different demands, completes the many kinds of analyses including the time order, space and spatio-temporal and so on. It has become current an important research direction of the geographic information system field to develop the spatio-temporal modeling technology with the spatio-temporal data integration ability. That basic goal of the spatio-temporal data modeling is expressing spatio-temporal straggling change and continuous change. The time concept model may be divided the based-event model and based-process model. Combining with Field-based and object-based space concept model spatio-temporal concept model may be divided four kinds: Field event spatio-temporal concept model, Field process spatio-temporal concept model, Object event spatio-temporal concept model, Object process spatio-temporal concept model.

Building sex statistics spatio-temporal data organizing frame model is expressed in Fig. 3, we comes out the brand-new summary and designing this frame model from many aspects such as definition of sex s counting basic data incorporates, spatio-temporal data storehouse connotation, spatio-temporal data organization arrangement of ideas and algorithmic application arrangement. Suggesting and building frame model is a basis of the sex statistic further analysis and studying. Based on to this new frame model, and focusing on temporal data organization of spatio-temporal data stored specifically for sex counting, we have adopted that the grid-based the time sequence snapshot amendment model, and brought forward the row data compressing code scheme specifically for saving snapshot amended in the model.

In data format exchange algorithm, we have adopted grid-based space concern eight directions of vector constant value line interpolative algorithm and floury grid point. That sex counts

multi-dimensions spatio-temporal data storehouse is the core part of entire frame model. The formalized description and definition sex multi-dimensions counting data base is the concept basis of the spatio-temporal data storehouse structures. In further identification process of fact, dimension, arrangement of dimension, relationship of dimension arrangement, it is important especially to organize and retrieval of spatio-temporal dimension.
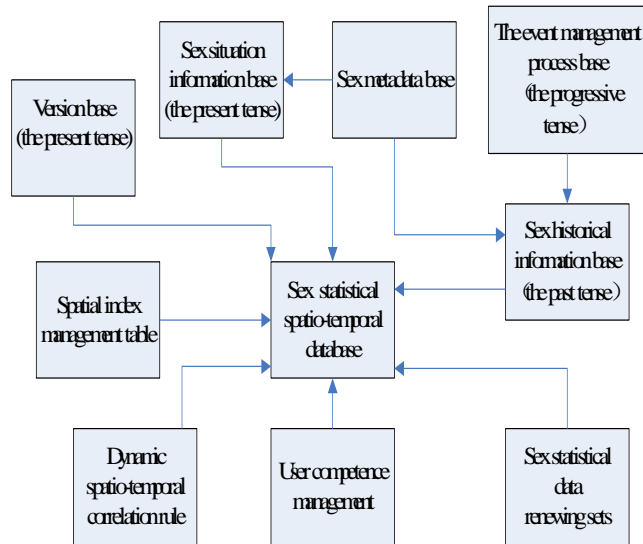

Fig.3 Sex statistics spatio-temporal data organizing frame model

3.4 Spatio-Temporal GIS

Geographic information system is one kind of the computer systems collecting, storing, managing, analysis and demonstrating with space data on the earth's surface, with application field gradually expands, there is brought forward higher request on data treatment, which needs to be able to preserve and effectively manage history change data, to rebuild conveniently historic state, track changes, and forecast future in the future, the GIS like this is called Spatio-Temporal geographic information system. Spatio-Temporal geographic information system has carried out unified expression on time, space and attribute of geographical information.

The tradition GIS handling data that has no time conceptual, only to be a "snapshot" of the real world in some moment, which shows the static fact. The real world described by GIS is continuous change with time. With the application field of GIS is expanding, time dimension must be put in GIS as a factors equate to space in quantity. Taking the time affection into account of the application of GIS, Temporal GIS or four-dimensional GIS will be produced. Temporal GIS is mainly applied to the following condition: firstly the object varies very quickly with time, getting one or even several data every second. Secondly is the backtracking and evolving of the history, requires backtracking the past time according to data obtained or forecasting future in a moment. Thirdly is estimating in some moment or for a short period, to gain a changed value in the mean value moments during the time from t1 to t2.

The currently main Spatio-Temporal GIS model include space-time cube model, array snapshot model, map-based amend

model, spatio-temporal experiencing model. The Spatio-Temporal GIS research is mainly carried out on four aspects: the spatio-temporal data base model, spatio-temporal analyses and reasoning, spatio-temporal data base management system, spatio-temporal data Visualization. Among these researches on spatio-temporal data base model is comparatively thorough, while the research on temporal Visualization problem is less. In the past research described temporal characteristic of geographical data with methods such as trajectory, while the research now is to develop to the direction of characterizing geographical data in time dimension with animated cartoon technology.

4. SPATIO-TEMPORAL REASONING MODEL OF GEOGRAPHICAL THEMATIC ELEMENT

The development of computer science, such as speed processing, the capacities selling data and storing enlarge, and development of data base theory makes it possible to handle a great amount of data with complicated space relationship. Thereby visualization research of Temporal GIS , spatio-temporal data model , chart in real dynamics pattern display etc. the data model studying more priority space and spatio-temporal data model design, Visualization show in real dynamics pattern dealing with two-dimensional, three-dimensional , four-dimensional, using chart to display the result of geographical analysis and handling such as data mining, geographical discovery and reasoning.

4.1 Spatio-Temporal Reasoning

The spatio-temporal reasoning refers to reasoning carried out on object occupying space and changing. It develops from the temporal and the space reasoning. Current spatio-temporal model can be divided into the universally theorized model and professional use model appointing to particular application. Theorized model can be major divided into two kinds of based-algebraic method and based-logical method. There are other researches, for instance restraining net, semantic net etc. but having not formed system. In the qualitative space reasoning, topology relationship is a space relation of the most fundamental, important and studied. The spatio-temporal reasoning which ought to put in equality is a method of formalized handling concept respectively from and space and temporal field in order to unified space and temporal and combining. At present the spatio-temporal reasoning research still main develops the way of unifying spatial area relation changing with time, and many jobs are limited inquire about the spatio-temporal data base.

The international research in spatio-temporal logic has gained many works, such as spatial topological logic, spatial metric logic, the integration of metric and topological logic, Allen's temporal interval logic, propositional temporal logic, and spatio-temporal logic respectively based on linear time, branching time, interval time. But there is lack of deep analyses of s patio-temporal relation and spatio-temporal interaction based on ontology about spatio-temporal logic research. People already obtained some spatio-temporal logics only supporting topology spatial relation, very few people give the spatio-temporal logic supporting spatial relation such as topology, distance and direction. Spatio-temporal relational algebra research has only given the name and description of spatio-temporal relation, but not given the truth system and formalize induction, as well as the space logic and time logic of relation compound form and deep analyses on their combined characters

of the reasoning tactics; being lack of the research on the basis of time and space thinking as indivisible units.

The tradition GIS has the function of accomplishing the collection, management, store, handling of the data and certain spatial analytical ability but whose ability of spatial analysis reasoning and decision-making is weaker. Bringing the relevant reasoning technologies in artificial intelligence into GIS, GIS will be able to have certain space reasoning analytical ability, which will make up for the deficiency of GIS in the aspect of decision-making supports, play the best GIS efficacy, making GIS to resolve more complicated problem.

4.2 Geographical Spatio-Temporal Reasoning Model

The spatio-temporal reasoning is the gaining, indicating, storing, analysis and reasoning of geo-knowledge in spatio-temporal information. That core is geonomy analysis and reasoning, and guided by geonomy and combined with concrete geo-knowledge and geographical information, though some technology means such as geonomy analysis and artificial intelligence, it can gain more accurately the analysis results reflecting actual geonomy law. Geonomy knowledge includes general common, expert experience, surface feature physical, chemistry and living things characteristic property, the spatial distribution and spatial interrelation, spatial Vein structure characteristic, appraise distributing characteristic and developing law and so on. Developing geographical intelligent reasoning system, refer to synthesis geonomy analysis in interaction of spatio-temporal information and geonomy knowledge based to geonomy analysis model and adopting the geonomy intelligence technology such as statistical analysis, neural computation, knowledge treatment system, geonomy optimization, [7].

The structure of spatio-temporal reasoning system has arrangement which needs to emphasize several questions resolving: Geonomy knowledge expressing and reasoning; Building multi-scale spatio-temporal data fuse model; Spatio-temporal data characteristic expression modeled; Introduce field up-to-date method in artificial intelligence. Designing the effective, speedy spatio-temporal data's express, analyses of the characteristic, data mining and knowledge discovering algorithm, form a series of function of spatio-temporal data intellectualized treatment and analyses function. On the other hand on knowledge base system basis, it improves the geonomy analytical depth by simulating the process of geonomy expert understanding and analysis geographical research object[5]. Geographical spatio-temporal intelligence reasoning frame is drawn in Fig.4.

With the progresses and popularization of computer information processing technology, the spatio-temporal data and data base intelligence reasoning already have some accumulation. Some technologies, such as the digital picture handles, pattern recognition and the statistical algorithm provide realizing conditions for the data mining and information extracts. The purpose that the data statistical and analysis derive basis geo-spatial data is achieved by synthetically applying method such as statistical method, induce, clustering, space analysis method, and sound nature data analysis as well as image analysis and pattern recognition, neural networks.

Spatio-temporal reasoning is spatio-temporal logic combined metric space and the time and spatio-temporal qualitative method of combined with location relationship. Based on bearing relation model taking point and area as basic unit, it

puts forwards a kind of determined the nature expression and reasoning algorithm combined with the topology and the bearing, it is able to handle a lot of kind space information, and it gives kind of thin method on "the same area". And it suggests a group of regulations that infers out topology relation from inside host bearing relation, and the spatio-temporal logic model combined with metric spatial logic and temporal logic, and a kind of spatio-temporal expression reasoning method synthesizing direction, distance and the time.
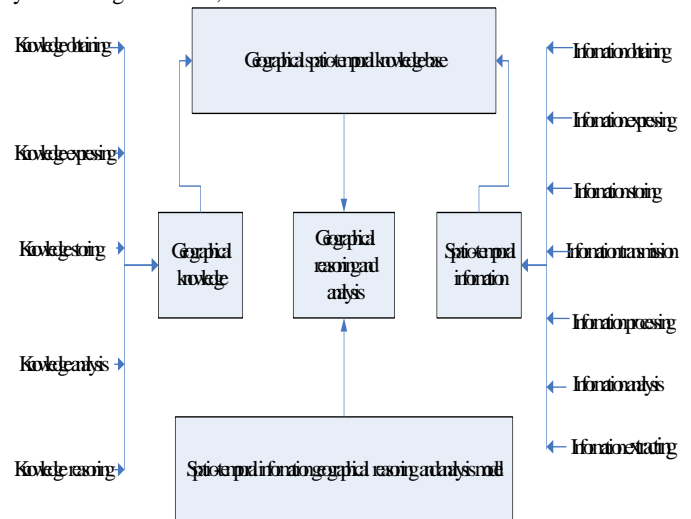

Fig.4 Geographical spatio-temporal information reasoning frame

4.3 Spatio-Temporal Satisfactics Data Mining of Geographical thematic element

According to geographical spatial target feature, the data mining of geographical spatio-temporal statistical data describes geographical space target, by adopting GIS intelligence analytical, remote sense information translating, adopt the characteristic gauge, the predicate logic, object-based method, Visualization method. It promote information exchanging and sharing to explore potential knowledge and available value in basis geographical feature information though data mining, and it is important drawing and quantization description method and expression form which study natural and humanity geographical entity information. The application of spatio-temporal data mining involves in every aspect of national economy and national military now, such as geographic information system, remote sense, traffic, urban planning, environment. Therefore the space data mining is a field with promising prospect, and is also a hot studying spot at present. And in basis of artificial intelligence technology clustering, classification algorithm, time series analysis provide new prop for spatio-temporal data mining. To draw space evolution regulation in spatio-temporal data base, we also may make use of routine data base technology such as: Space data base overlying analysis method etc. First of all we draw out data having changed, then synthesize statistical method and sum up method to get spatio-temporal evolution regulation.

The sex statistics is a kind of statistical method analysis and studying the social economic growth changes, and also is a scale to judge men and women on position, right, effect and developing status in social economic growth. Building and perfecting sex statistical index system is a clear demand United Nations brings forward to governments of all countries in the

world. Begin from 1990's, United Nations has brought into sex developing index and the sex bestow on right exponent in human developing report. By analysis sex statistics and the data collecting and analysis, it can make governments and society of all countries in the world know men and women survival situation and social position gap. This provides a basis for making policy.

According to the demand of international community for sex statistics, combined with reality of our country, we work out sex statistical index, and list it in National Bureau of Statistics and relevant government department statistical data form and collect sex statistical data at the regular intervals, and announce the result statistical at the regular intervals. Some important sex statistical index is difficult to enter each annals collecting range, such as time assignment, family violence, woman poor, sex income. So it is necessary to build rolling sampling investigation system for important breach data. One or two special subjects ought to be arranged to sampling investigation every year, and every special subject should repeat investigating once every across five to six years to inquire into the blank space of collecting data for routine form. "Program for the Chinese Women's Development (2001---- 2010 years)", our country government worked out, also clearly and definitely suggests that the sex statistical index should be brought into country statistical system and the department concerned in the statistical investigation and routine statistical l works, building and perfecting sex data base may provide a basis for the country to work out the plan and the science decision-making.

The sex spatio-temporal statistical data is expressed three aspects of: Time, location, census quantity. Therefore sex spatio-temporal statistical model is a representative four-dimensional dynamics mathematic model, including four aspects elements: Time (t), the earth coordinate (longitude L, latitude B) or space right angle coordinate (X, Y), and population quantity (Z). Building-up spatio-temporal statistical model, needs to summarize sex population quantity in some area, and to form some area quantity value in some period, the annual sex census model, and to compose spatio-temporal sex population model in a period of time, according to the method of structuring. Using three-dimensional visualization technology of GIS carries out population condition analysis by two methods: one is annual sex population quantity model method, each one frame of whose is sex population quantity every year, the other is sex population quantity model method accumulating various levels administrative area in many years.

5. DISCUSSION

Geographical statistical data intelligence reasoning method based on data mining, is a intelligence handling method which takes geographical element space , space relation, time developing and other attribute characteristic into account, and explores the geographical statistical data with geonomy knowledge and spatio-temporal statistical the data model , spatio-temporal reasoning machine and geonomy expert system,. Therefore we find it is very important to discover geonomy knowledge and build the spatio-temporal reasoning model. However, perfect spatio-temporal statistics data base will play an important role in discovering geonomy knowledge and spatio-temporal reasoning.

REFERENCES

1. Shupeng Chen. Geographical Analysis Of Remote Sensing in Spatio-Temporal Dimension [J]. Journal of Remote Sensing, 1997, 1 (3) : 161～ 171.

2 Peter C, Pablo H. D iscovering DataM ining: From Concept to Implementation. New Jersey: Prentice Hall PTR. 1998

3. Zhangcai Yin,Lin Li. Research on Spatial-Temporal Data Model in GIS [J]. Science of Surveying and Mapping Vol.30 No.3,J un

4. Guanhua Xu. Application and Prospect of Remote Sensing and Resouce Envirenment Information System [J]. Envirenmental Remote Sensing, 1994, 9 (4) : 241～ 246.

5. Deren Li. Establishing Spatial Observing Earth Data Handling System Based on Automation and Intelligence [J]. Envirenmental Remote Sensing, 1994, 9 (1) : 1～ 10.

6. Luo Jiancheng, Theoretical and Techn ical Issues on Intelligent Processing and Analyzing Models for Temporal and Spatial Data [J] Journal of Image and Graphics Vo l. 6 (A) ,No. 9 Sep. 2001

7. Yi Liang. Artificial Intelligence, Spatial Analysis and Spatial Decision-Making [J]. ActaGeographicaSinica, 1997, 52: 104～ 113.

8. Jianya Gong. Object-Oriented Spatia- Temporal Data Modele In Gis [J] . Cartographica Sinica,1997 ,26 (4) :2892298.

9. Zhangcai Yin,Lin Li. Spatio-temporal Data Model Based on Graph Theory [J] . Cartographica Sinica,2003 ,5.

10. Guangfa Lin, Xuezhi Fen. Spatial- Temporal Data Modeling Method [A] GIS Proceedings [C], 2004

11. Qunyong Wu,Qinmin Wang. Statistical Data Visualization Based on WebGIS [A] Cartographica and GIS [C], 2004 .

12. Cao Zhiyue , Liu Yue. An Object-oriented Spatio-temporal Data Model [J] Cartographica Sinica Vol. 31 , No. 1 Feb. 2002

13 Wenzhong Shi. Object-Oriented Approach for Spatia-Temporal and Attribute Data Modeling [A] . Proceedings Volume 2 ,GIS/ L IS '95 ,Nashville ,TN :9032912.

14 Langran G. States ,Events and Evidence :The Principle Entities of a Temporal GIS [A] . Proceedings of GIS/L IS '92[C] ,San Jose :4172425.

15 Langran G. Time in Geographic Information System [A] . Taylor & Francis Ltd ,London ,1992.

16 Zhang Zu-Xun , Huangming Zhi. Temporal GIS Data Structure Discussion[J] . Bulletin of Surveying and Mapping , 1996 , (1) : 19-22.