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GIS-based key technique of surveying and mapping data processing

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Abstract

Geographic Information System(GIS) is an important part of the IT system, and every advancement of its technique is closely related to the rise of the latest IT technique. With the growth and application of cloud computing, large data, artificial intelligence and other technologies, today's GIS basic software has formed five technical systems. As an emerging technique, surveying and mapping data processing has the characteristics of precision, accuracy, flexibility, efficiency and speed. Based on this, this paper uses GIS to summarize the surveying and mapping data processing, and focuses on the key technologies and specific applications of GIS-based surveying and mapping data processing, in order to improve the level of surveying and mapping applications, and then for the growth of China's surveying and mapping industry. Some current scientific data processing, to achieve the purpose of collecting relevant data, to provide necessary data support and technical support for subsequent projects.

Keywords

GIS technique; surveying and mapping data processing; surveying and mapping technique.

1. Introduction

Intelligent mapping is an emerging technique. Under the fusion of artificial intelligence and mapping technique, the types and scales of measurement data have undergone great changes, and the previous data processing has turned to intelligent data. Deep machine learning, neural network, intelligent target recognition and other new technologies[1]. In actual surveying and mapping, both positioning service and surveying and mapping technique require accurate measurement data, and these data often have problems such as confusion and uncertainty[2]. In the case of a small amount of data, although the traditional data processing method has strong computing power, it is still unable to meet the new data demand in the era of large data. Due to the influence of various factors, in the process of intelligent drawing, there are some uncertain factors that cannot be ignored, difficult to estimate or predict[3]. From the perspective of data processing, it can be summed up in the following aspects: First, in a large amount of large data with uncertainty, how to ensure the effectiveness of parameter estimation and adaptive learning algorithms, and how to ensure the effectiveness of the large amount of data contained in the The second is the construction of adaptive learning and identification algorithms and control algorithms; the third is how to predict the data-based feedback control mechanism to the greatest extent; the fourth is how to adjust the objects with "game" behavior in complex systems. Therefore, this paper puts forward the key technique of surveying and mapping data processing based on GIS, and uses GIS technique to process surveying and mapping data, which lays the foundation for future technique.

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2. The technical introduction of GIS in surveying and mapping data processing

2.1. Basic overview of surveying and mapping techniques

Surveying and mapping technique is mainly to digitally process the data information obtained by surveying and mapping, so as to construct corresponding image information. It is much more vivid, which can improve the readability of data, and can also provide more three-dimensional space coordinates, which is convenient for engineers to carry out corresponding engineering modeling; secondly, it can also automatically process the data on the map and generate corresponding pictures. It ensures the work efficiency of the whole project, which facilitates the growth of surveying and mapping; finally, the use of surveying and mapping technique can meet different data processing requirements and has strong flexibility. Process form the final image, and perform various operations on it.

2.2. Development of International Cultural Industry

From the perspective of surveying data processing theory, the surveying and mapping data processing can be summarized into the following three characteristics:

1) Large-scale, distributed, and ubiquitous

The surveying and mapping data includes a collection of professional data such as multi-resolution, multi-purpose satellite remote sensing, positioning information, photogrammetry, geophysics, topographic mapping, etc. It can also be joint observation large data of air, sky, land, and ocean, and a high-precision real-time surveying and mapping system. Realize rapid intelligent mapping from static to dynamic, ground-based to space-based, regional to global, indoor to outdoor, passive to active[5]. These data come from different disciplines, and have the characteristics of cross-scale, cross-platform, and cross-parameter, large scale and diverse types, providing a large amount of data support for the study of surface changes. However, because the data comes from a complex engineering environment, there are strong coupling relationships between data, systems, levels, and environments, making it difficult to effectively guarantee the quality of data and analysis results. The raw data consisting of probe data, flight data and instrument status data has strong variability, and it is difficult to decouple them precisely[6]. The characteristics of massive data, such as diverse modalities and indistinguishability between authenticity and falsehood, are the difficulties in constructing complex systems. How to explain the impact of random and nonlinear relationships between different platforms, different scales, and different parameters on the evolution of large data is a key issue in current surveying and mapping data processing, theoretical problems to be solved.

2) Multi-source, heterogeneous, periodic

With the expansion of surveying and mapping targets, the demand for multi-scale, personalized, intelligent, and all-weather surveying and mapping services continues to increase, and the perception of complex target data will also face problems such as massive data sources and heterogeneity. Observations between different disciplines, different technologies, different observation tools, different resolutions, and different targets will lead to the diversity of observational data. Due to the differences in data types, statistical properties and data structures, the data alternately change in time and space, showing a certain cycle, repetition or superposition characteristics[7]. Therefore, surveying and mapping data often have the characteristics of multi-source, heterogeneous, and periodic emergence. Traditional data processing methods have been unable to effectively analyze and predict the changing laws and actual values of large data. Big data requires new algorithmic theories that do not depend on all data, and in order to enhance uncertainty and locally incremental machine learning performance, the IID assumption of small-scale data must be broken.

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3) High speed, fast update, short timeliness

Due to the rapid growth of various observation methods in space, land and ocean, the speed of data acquisition and update has been accelerated, and the amount and time of information have been shortened[8]. New technologies such as drones, mobile survey vehicles, and backpack-type laser stereo scanning can collect relevant geographic information in real time. In addition, satellite-to-ground data has fast speed, fast update, and short timeliness, which not only has a large number of large data characteristics, but also has real-time update data flow characteristics[9]. Rapid processing of large data and timely decision-making are necessary conditions for realizing high-speed large data, such as real-time road condition information, shared taxi running routes, etc. The data center will be upgraded every 10 seconds to 1 minute. To improve the processing speed of surveying and mapping data, it is necessary to base on rapid surveying and mapping data. To predict the location, time and intensity of earthquakes, it is necessary to obtain data quickly, and to analyze and process the data quickly[10]. The real-time nature of spatio-temporal data requires the use of various methods to efficiently mine it, so how to quickly process a large amount of spatio-temporal data has become a hot spot in the current data processing field.

2.3. Introduction to GIS

GIS was sprung up in the early 1960s as both a technique and a discipline[11]. As a decision support system, GIS has various characteristics of information systems. In GIS, the real world is expressed as a series of geographic elements and geographic phenomena, and these geographic features are composed of at least two components of spatial location reference information and non-location information. And GIS is supported by five major technologies.

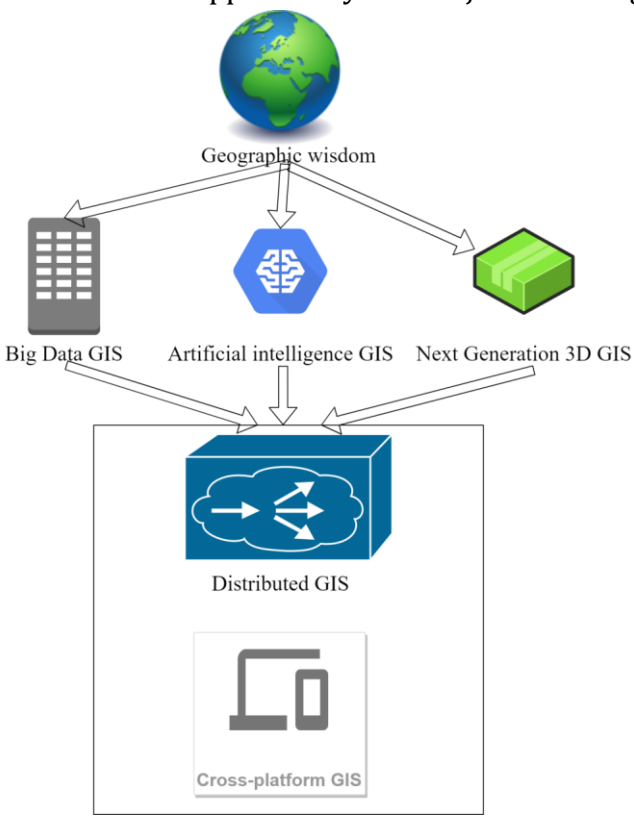

Figure 1 Five supporting technologies of GIS

(1) Definition

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The concept of GIS includes two aspects. GIS is a new interdisciplinary, it describes, stores, analyzes and outputs various theories and methods of spatial information; while GIS is a technical system based on GIS, using GIS technology, using GIS technology to provide various spatial, Dynamic geographic information for geographic research and decision-making.

GIS has three characteristics:

First, it can collect, manage, analyze, and output various geographic information, with spatial and dynamic characteristics;

Second, use computer systems to manage spatial geographic data, use computer programs to simulate traditional or specific geographic analysis methods, process spatial data, generate useful data, and complete tasks that cannot be done by human beings;

Third, the support of the GIS system is a main feature of the GIS system, which can quickly, accurately and comprehensively analyze the spatial position and dynamic process of the complex system.

(2) Composition

Table 1 GIS system composition table

System	Composition
GIS system	Computer system (hardware: including the central processing unit for executing programs, storage devices for saving data and programs; software: consisting of core software and application software)
	Geographic database system
	Application personnel and organization

The system includes a database entity and a GIS. Geographic data can be divided into two categories: geometric data and attribute data. The data representation methods include grid and vector. Geometric data represents the location, size, shape, orientation and topological relationship of geographic entities. GIS is mainly used for data maintenance, manipulation, query and query. Geographic database is the key technology in the process of project implementation, and it is also the key technology in the process of project implementation.

A well-planned project should include the project manager, system design and implementation, technical staff information management, system customization applications, and final users.

(3) Function and application

Based on this, the application of spatial analysis, model analysis, network, database, data integration, secondary development and other technologies has demonstrated a wealth of system application functions(resource management, regional planning, land monitoring, auxiliary decision-making, etc.).

GIS applications include: surveying and mapping, urban and rural planning, ecological and environmental protection analysis, navigation, land use and natural resource management, public facility management, property registration, market analysis and business layout, mineral resources survey and development, mineral resources evaluation, military strategy analysis. With the rapid development of computer, space technology and modern information technology, space information technology plays an increasingly prominent role in the world. Among them, the unconstrained nonlinear model is optimized namely:

$$\min_{x \in R^N} f(x) \tag{1}$$

Where is $f(x)=f(x_1,x_2,\cdots x_n)$ the n element nonlinear real-valued function $x=(x_1,x_2,\ldots,x_n)^T$ defined in R^N.

Iterative algorithm for nonlinear model optimization, that is, the step factor is determined by a certain search method α_k, so that:

$$f(x_k+\alpha_k d_k)<f(x_k) \tag{2}$$

That is to make the objective function $f(x)$ move in a specified direction until equation (1) is satisfied. Different displacements (different choices of search direction d_k and step factor α_k) result in different iterative algorithms. In order to ensure the convergence of the algorithm, the search direction is required to be the descending direction.

GIS technology has great advantages in the processing of surveying and mapping data, mainly reflected in the following points:

1) It promotes the integration of attribute data, making it more intuitive and convenient. Because geographic location exists objectively, and geographic features are relatively complex, including natural and social properties, it can be said to be very rich. Therefore, geographic information systems must have a coordinate, and use GIS technology to integrate various data, forming a complete framework, allowing the attribute data to be presented intuitively.

2) Strengthen the utilization of information resources. Using GIS technology, not only can spatial data be obtained, but also spatial data can be analyzed, processed, and output to the corresponding location. In practice, information processing can be carried out according to the actual needs of the enterprise, so as to effectively promote the information management of the enterprise and improve the utilization of the enterprise's resources.

3) Provide decision support. The application of GIS technology in real estate surveying and mapping can provide support for decision-making. Through the analysis of the space, relevant assistance is provided for users.

4) Draw a map. Based on computer, it can realize high-accuracy drawing and improve work efficiency.

3. Analysis of key technologies of surveying and mapping data processing under GIS

Surface mapping data perception is to obtain valuable data from large-scale, distributed and ubiquitous data processing. How to perceive data more effectively from a fine-grained individual level and use swarm intelligence to improve the perception ability of data processing is a problem that data processing theory needs to solve.

1) Perception and acquisition technique of high-quality data processing due to the expansion of the scope of surveying and mapping objects, data perception will face complex data characteristics such as multi-source, heterogeneous, and cross-platform, cross-scale, and cross-parameters, which makes data collection prone to missing, Therefore, the signal-to-noise ratio of the data is reduced, and the intelligent learning method that uses data processing to accurately restore the intrinsic properties of the system becomes difficult. Artificial intelligence algorithms have strong advantages in data processing and understanding. How to improve them to effectively handle data processing with complex data characteristics and shorten the time for information extraction is a new problem that needs to be studied in data processing methods. The existing small-scale data or static data processing theories obviously cannot adapt to the above-mentioned changes in data processing methods. It is necessary to study new algorithms for accurate perception and efficient acquisition of multi-source heterogeneous data

processing, and analyze the relationship between algorithm accuracy, stability and data scale. relationship, and research an efficient acquisition model that takes into account both accuracy and performance.

2) In multiple time series, data processing information fusion and information fusion based on quality monitoring data of multiple platforms can effectively solve the problems of single mode insufficiency and lack. Multi-dimensional, multi-source, and cross-platform multi-scale data includes not only quantifiable digital data, but also non-numeric data such as images, videos, and description texts, which makes data fusion very difficult. Data processing is carried out from complex environments and linked to the geological environment. The relationship between data and data, different scales, and different system environments is intricate, and issues such as the update and exchange of new and old data will have a great impact on data processing and processing. Due to the complexity, uncertainty, and data of different resolutions, different physical meanings and different statistical properties, data fusion is difficult. At the same time, due to the problems of noise, uncertainty, incomplete data, incomplete data, and asynchronous data in time series mapping data, the quality of data processing is particularly important. In terms of data processing and data mining, with the continuous advancement of artificial intelligence algorithm research, the unique advantages of deep neural networks in data processing and analysis are becoming more and more obvious. Decoupling and reconstruction of multi-source heterogeneous data from the perspective of dynamics, using the laws of mathematical statistics to reduce the similarity between each time period and the number of samples for data processing on the time scale, and intelligently learn to extract key information from massive data, which can form a general method for surveying and mapping data processing.

3) GIS technique has been widely used in ground object recognition and remote sensing object recognition. Intelligent vision is a cutting-edge technique that integrates computer and artificial intelligence technique, and combines it with the idea of mapping data processing. At present, in terms of modeling and classification, in addition to introducing real number domain features for modeling and classification, some people have also proposed compound domain deep neural networks to improve the classification accuracy of SAR images. However, the current surveying and mapping data processing algorithms have many shortcomings, such as a large demand for training data, and its use efficiency is very low when the data is insufficient or the data quality is not high. Therefore, it is necessary to seek a new intelligent method in terms of unsupervised learning and weakly supervised learning, so that it can better serve intelligent maps.

4. Conclusion

Combined with the future growth trend, this paper divides GIS technique into five systems. Large data GIS technique is the underlying support, deep mining the value of spatial large data. Artificial intelligence GIS technique empowers geographic intelligence and brings intelligent industrial transformation to GIS. The new generation of 3D GIS technique provides full spatial expression, true 3D analysis and calculation, and a vivid visual experience combined with game engines. Distributed GIS technique will bring more efficient, more flexible and more stable capabilities to GIS technique. Cross-platform GIS technique ensures the security, scalability and innovation of GIS basic software technique. These five technique systems deeply integrate cutting-edge technique with the GIS industry, making GIS technique keep pace with the times and effectively meet the diverse needs of users for spatial information. And for the surveying and mapping large data processing, use GIS technique to carry out key analysis, and be sure of the importance and practicability of this technique.

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References

[1] Liang F, Hatcher WG, Liao W. Machine Learning for Security and the Internet of Things: The Good, the Bad, and the Ugly[J]. IEEE Access, 2019, 1(99):1-1.

[2] Ham Y, Golparvar-Fard M. Mapping actual thermal properties to building elements in gbXML-based BIM for reliable building energy performance modeling[J]. Automation in Construction, 2015, 49(37):214-224.

[3] Francesco, Lambiase, Antoniomaria. A parametric study on residual stresses and loads in drawing process with idle rolls[J]. Materials & Design, 2011, 14(9):124-126.

[4] Shi ZL, Gong Y, Cao M. Discussion on the Application of Surveying and Mapping Technology in the Internet of Things Times[J]. Modern Surveying and Mapping, 2010, 65(4):503-515.

[5] Ji Q, Zhao F. InGAP-sv: a novel scheme to identify and visualize structural variation from paired end mapping data[J]. Nucleic acids research, 2011, 39(22):567-575.

[6] Schooler JW, Smallwood J, Christoff K. Meta- awareness, perceptual decoupling and the wandering mind[J]. Trends in Cognitive Sciences, 2011, 15(7):319-326.

[7] Lopez J, A Vega-Gálvez, Torres M J. Effect of dehydration temperature on physico- Chemical properties and antioxidant capacity of goldenberry (Physalis peruviana L)[J]. Chilean Journal of Agricultural Research, 2013, 73(3):293-300.

[8] Kondoh T, Sudo Y, Hato K. Reduction of VM Lead Time in Massive Sc ale Out[J]. ieice technical report information networks, 2013, 19(11):113-113.

[9] Wang L, Yan C, Wei LI. Research on Spatial-temporal Characteristics of Tourist Flow Based on Sina Microblog LBS Data: An Case Study of Lanzhou[J]. Tourism Tribune, 2017, 8(4):578-582.

[10] Peng JQ, Wen XH, Zhang Y. On Rapid Processing Technology of Vehicle-mounted Mobile Mapping Data in Emergency Surveying and Mapping[J]. Value Engineering, 2014, 3(1):178-179.

[11] Chuvieco E, Aguado I, Yebra M. Development of a framework for fire risk assessment using remote sensing and geographic information system technologies[J]. Ecological Modelling, 2010, 221(1):46-58.