Research on Valid Data Automatic Collection Technology in Dynamic Land Information System

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Abstract: With the rapid development of Global Position System, remote sensing technology and geographic information system, dynamic land information system combines these three to generate new valid data automatic collection technology. When measuring and counting land information data, valid data automatic collection technology shows completely its advantages, providing convenience for land data collection. Based on analysis of composition and technical route of this technology, land information data collection of a certain diggings is taken as an example to analyze the advantages of the technology, and the valid data automatic collection technology in dynamic land information system is thereby discussed.

Keywords: Dynamic land information system; Valid data automatic collection technology; GPS; GIS; RS

1. Introduction

Land is a kind of scarce resources and plays an irreplaceable role in social economic development. In recent years, with the rapid development of social economy, urban population and area extend constantly, more and more experts focus their attention on how to rapidly and effectively collect land information data. In order to realize rapid collection of land information data, experts developed a new data collection technology in dynamic land information system, this technology is based on cooperation of GPS (Global Position System), RS (remote sensing), GIS (geographic information system) and database, thus, valid data can be collected rapidly and accurately. In order to discuss the validity of valid data automatic collection technology in dynamic land information system, the composition of this technology is firstly analyzed in this paper, then the technique route is described in detail, and the example of diggings data collection is described to analyze the advantages of the technology, the research of this paper is thus finished.

2.Analysis on Design of Valid Data Automatic Collection Technology in Dynamic Land Information System

2.1. Composition design of valid data automatic collection

Valid data automatic collection technology in dynamic land information system is composed of four parts which are respectively GIS, GPS, RS and database. Valid data automatic collection technology collects data by using GIS, GPS and RS of computer, then incorporates the data collected into a database to finish valid data automatic collection [1].

RS is adopted to measure the land status because it is able to quickly find the features of land area from macroscopical, comprehensive and dynamic perspectives. Information obtained have following features: wide detecting range, new real time documents, rich information and video easy to process. GPS is used to finish following measurement work of land data: measurement of field data is finished by using differential positioning; field investigation table is filled according to actual measuring conditions in measuring field; transformation of coordinates is used to finish the transformation of GPS collection coordinates system to land database coordinates system; interior measuring data reduction is finished according to related technique regulations; land data exchange document is formed based on measuring graph and measuring record chart. GIS is used to finish the processing of valid data and to store the data collected into database, detailed procedures of land data are shown as Figure 1.

2.2. Executive procedures of valid data automatic collection technology

In full digitalization environment, combination of valid data automatic collection technology and computer technology further accelerates the land data collection, accordingly, filtrating accuracy is improved, and technological procedures and methods are optimized. Likewise, the resolution of several key technologies

such as obtain of updating data origin procedures of graphs with different plotting scale, rapid extraction of changing information, sporadic land and re-measurement of omissive pattern spot [2].

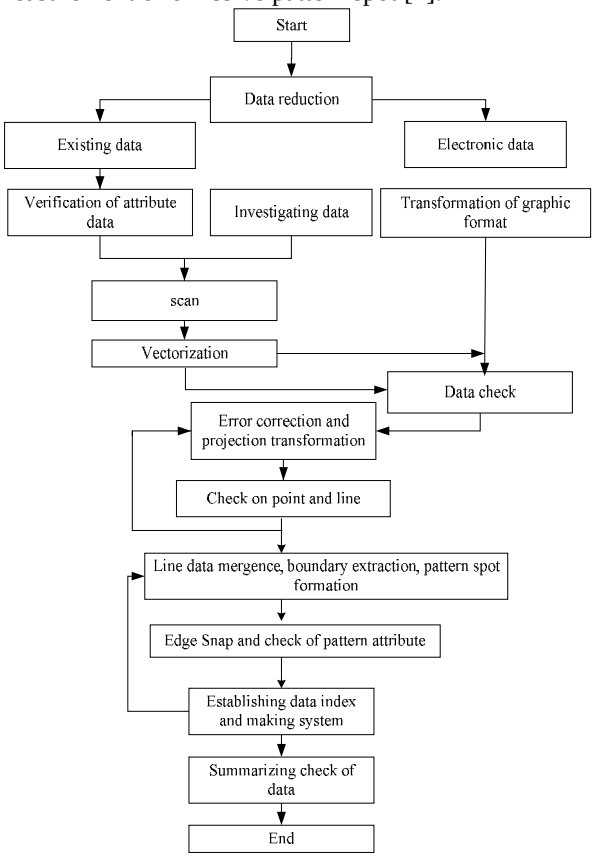

Figure 1. Data processing procedures

The detailed technique route of valid data automatic collection technology is: with guidance and accurate positioning of GPS, real time coordinate information of land can be obtained by field investigation in most convenient way with fastest speed and highest accuracy, and type, area and ownership of land pattern spot are confirmed, measurement of land width and sporadic land (including omissive little pattern spot) are verified; RS system gets land data through different remote sensor, then processes and analyzes the data, and finally gets the video data related to the research, or based on RS system and existing land data as well as land current state map, land information can be found by using computer automation, or land information data can be extracted by man-machine mutual interpretation [3]. Based on ground investigation, supported by multi-source information of GIS, digitized updating of basic map is realized by interior processing. If there existed land vector database, it can be used directly to choose valid data with vectorization method, and be used to update the attribute data and database; if only paper map but not database existed, in digitized environment, rasterization method is used to choose valid data, as the choosing results are in digital form, direct drafting is possible and paper map can be output. According to condition of retrievable RS data, land data are analyzed. In case of successful RS data access (RS data in base period), valid land data can be obtained from both of RS data in base period and updated RS data; in case of difficult access of RS data in base period, only updated RS data are used. Data obtained are analyzed by using RS data and computer man-machine mutual extraction technology, with its capacity to process mass data, most valid data can be selected. Data collected are stored in database which will conduct second filtration to data through the filtration function of computer to ensure the collection of valid data. To establish the database, it requires that firstly, the GIS platform which supports the database can identify and utilize the 1:10000 or 1:2000 topographic data in CAD format or the data format; secondly, the GIS platform which supports the database can identify and utilize the 1:2000 or 1:500 cadastral data in CAD format or the data format; thirdly, the GIS platform which supports the database can identify and utilize the 1:10000 current and historical land data in CAD format or the data format; fourthly, the GIS platform which supports the database can identify and utilize the 1:10000 overall planning data of land and related explications in CAD format or the data format; fifthly, the GIS platform which supports the database can identify and utilize the 1:10000 land data of regional digital elevation model or 1:50000 land data of state digital elevation model in CAD format or the data format; sixthly, the GIS platform which supports the database can identify and utilize the complete attribute data; finally, the database should be able to conduct second filtration and conserve valid geographic data. Technical procedures of valid data automatic collection technology are shown in Figure 2 [4].

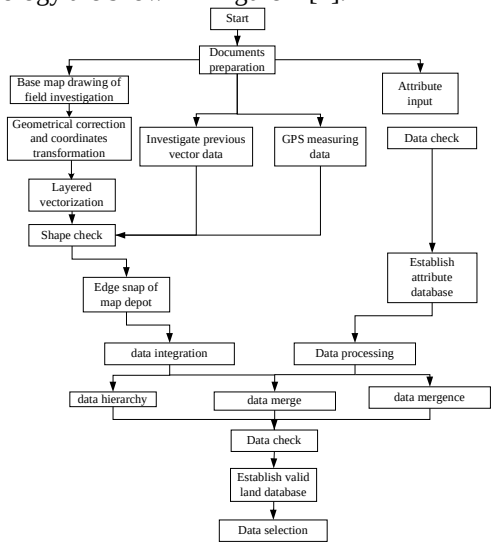

Figure 2. Technical procedures of data automatic collection technology in dynamic land information system

3. Case Analysis

To ensure the effect management of geographic information data of diggings, data automatic collection technology in dynamic land information system is used to collect the geographic information.

First of all, C-order GPS control network is laid within the diggings. In view of the requirements for dynamic accuracy and operating radius, 14 GPS control points are laid which have an average length of side of 10 km, the points are as uniform as possible and existing traverse point and benchmark over fourth-order are selected. In measurement of diggings data, three step- 1 instruments are adopted to measure for a period of 30 minutes. GPPS base line resolving and ADJ adjustment software are used in interior resolving. After the base line resolving passed, using GPPS software to search the duplicate measure baseline or searching the simultaneous observation loop and non-simultaneous observation loop by manual. The simultaneous observation loop has a good accuracy, the closure errors of non-simultaneous observation loop are shown in Table. 1. WGS84 free net adjustment is firstly selected, then 54 constrained adjustment. Statistics of horizontal coordinate accuracy are demonstrated in Table. 2.

Table 1. Closure errors of non-simultaneous observation loop

	Closed ring	Observing time	Closure errors	Horizontal relative accuracy	Elevation relative accuracy
1	2031-2025	02:25		1：93	1:91
	2022-2052	02:43	0.001		
	1958-2022	02:43	0.002		
	2031-1958	01:57	0.003		
2	2023-1958	06:02		1:22	1:21
	1958-2022	02:43	0.003		
	2031-2022	07:20	0.013		
	2023-2031	07:20	0.014		
3	2023-2031	07:20		1:24	1:13
	2031-2026	10:10	0.010		
	662-2026	10:10	0.006		
	2023-662	10:10	0.022		
4	2075-2026	02:18		1:10	1:15
	662-2026	02:18	0.020		
	662-863	02:15	0.024		
	863-2075	02:08	0.020		
5	662-863	05:11		1:38	1:16
	863-2095	05:55	0.004		
	2095-2085	05:55	0.006		
	2085-662	05:15	0.016		

Table 2. Statistics of horizontal coordinate accuracy

	Maximum	Minimum	Average
MX(cm)	2.1	0.1	1.3
MY(cm)	2.1	0.1	1.2
MP(cm)	2.8	0.1	1.8

Secondly, Ashtech STEP-1 single frequency GPS receiver with 12 channels is used. This receiver has quick speed, when it works in dynamic way, sampling interval can be set as 5s. The observing time of each point is within 3 minutes. Mainframe of moving station is set as dynamic, mainframes of moving station and base station can interchange if they are the same. Partition measurement is necessary as measuring area is large. Measurement is conducted in taking existing point of each section as base station.

Then data are obtained by using dynamic measurement model of RS system. And field data collection is performed by using STEP- 1 single frequency receiver equipped with HP- looocx handbook, the procedures are as follows: (1) taking one RS receiver as base station, RS antenna connecting with engine base and corner bracket, signal transmission line is used to connect the antenna with RS mainframe, centring levelling is conducted on the existing point which is open and closer to to the area; then connecting the handbook and mainframe, turning on the HP-looocx electronic handbook to input the name and sampling rate of existing point, static measurement is conducted. Only at least four satellites' signal is received while checking the receiving situation of satellites can measurement be conducted. (2) initialization requires to turn on two receivers which are taken as moving station and to put them near to base station with a distance shorter than 5m. Using the electronic handbook to set the measurement model of moving station RS receiver as dynamic, and to set the point number of initialization, as well as the observing time as 10 min or longer. Signal will be given by handbook after initialization. (3) dynamic measurement. After initialization, the two RS receivers of moving station can move from the measuring point. The epoch of each moving point is set as 2 min. RS antenna is kept horizontal and satellites received are not less than four at any moment and any position, thus, there is a station in each observing point, observation is conducted by using handbook to input number of observing point for 2 min. After the observation of the point, reminder will be given by handbook to move to next observing point. (4) initialization after observation. When all unknown points are observed, two RS receivers of moving station return to initialized point to conduct initialization after observation. Then the measurement is finished and data are stored in receivers after turning off.

Finally, dynamic method is adopted to measure the three-dimensional coordinate in land information data collection of diggings, which cannot ensure the validity of data. Therefor, further check of data by using GIS is performed to supply the investigation (procedures of supplemental investigation are demonstrated in Figure 3),

and to choose valid land data of diggings. (1) self-inspection of control point. There are several base stations in the whole measuring area. To perform self-inspection, the moving station of other base stations is used to inspect the nearby control point, and the inspected results are shown in Table. 3. (2) mutual inspection of dynamic characteristics. When working in dynamic way, the method used to perform mutual inspection of characteristics is to set moving station of base station, previous characteristics are firstly inspected, then mutual deviation is registered, registration of mutual deviation is demonstrated as Table. 4.

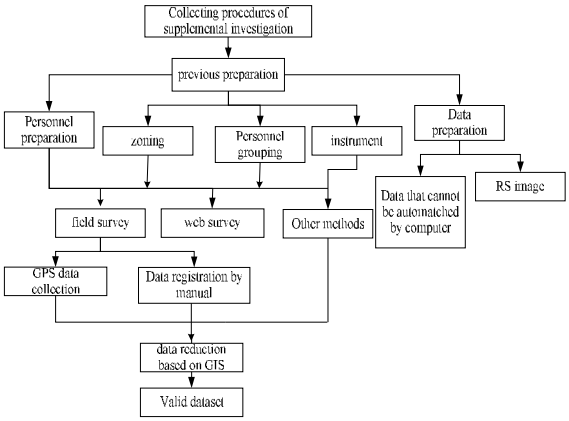

Figure 3. Procedures of data supplemental investigation

Table 3. Inspected results of control point

Base station	Parameters		Error of inspected point	
	1952	20252	M=20mm	M=10mm
1958	20760	20116	M=5mm	M=10mm
	20755	20331	M=7mm	M=7mm
	20116	20938	M=6mm	M=12mm
	20938	20751	M=10mm	M=20mm
1960	665	1968	M=3mm	M=9mm
	20116	20755	M=11mm	M=16mm
	20751	1922	M=13mm	M=10mm

Table 4. Data registration of mutual deviation of dynamic characteristics

	Point number	ΔX	ΔY	ΔH	MP
1	GD001	0.003	0.013	0.048	0.017
2	GD002	0.003	0.009	0.019	0.010
3	GD003	0.002	0.001	-0.028	0.001
4	GD004	0.002	0.008	0.611	0.007
5	GD005	-0.003	-0.020	-0.196	0.006
6	GD006	0.001	0.007	-0.042	0.020
7	GD007	0.004	0.007	0.022	0.007
8	GD008	-0.005	0.006	-0.071	0.002
9	GD009	0.004	0.009	0.026	0.010
10	GD010	-0.007	0.007	0.006	0.011

4. Technique Evaluation

In data collection of diggings, the high-tech advantages of valid data automatic collection technology in dynamic land information system are fully demonstrated, which include: (1) faster speed and shorter time are realized by GPS. In addition, the measurement by this technique doesn't require intervisibility between observing points, which makes the measurement of transition point unnecessary and thus reduces the workload. (2) when measuring the land data, automatic data collection technology is not limited by time, namely, it can work for 24 hours without being influenced by climates such as rain and wind. (3) when measuring the land data, automatic data collection technology is easier to operate, and the receiver has a smaller volume, lighter weight, which greatly moderates the suppression and labour intensity of field workers. (4) data collected by valid data automatic collection technology are more than that by general measurement, accordingly, the validity of data is further improved.

5. Conclusions

Based on the composition and technique routine analysis of valid data automatic collection technology in dynamic land information system, the research on valid data automatic collection technology in dynamic land information system is performed in this paper by exemplifying the case of land data collection of diggings and analyzing its advantages, with the wish that research in this paper can benefit the land data collection.

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