The Application of GeoRSC Based on Domestic Satellite in Field Remote Sensing Anomaly Verification

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Abstract. The Geo REC is the digital remote sensing survey system which based on domestic satellites, and by means of it, the thesis carried out a remote sensing anomaly verification field application test in Nachitai area of Qinghai. Field test checks the system installation, the stability of the system operation, the efficiency of reading and show the remote image or vector data, the security of the data management system and the accuracy of BeiDou navigation; through the test data, the author indicated that the hardware and software system could satisfy the remote sensing anomaly verification work in field, which could also could make it convenient for remote sense survey and improve the work efficiency. At the same time, in the course of the experiment, we also found some shortcomings of the system, and give some suggestions for improvement combined with the practical work for the system.

1. Introduction
In recent years, with the gradual development of prospecting breakthrough strategic action, China Geological Survey has carried out exploratory researches trials on new techniques and methods of geological survey. Not only remote sense technology is widely popularized to improve the efficiency and quality of geological survey, but also the complete flow informatization is strengthened. It has developed regional geological survey digital acquisition system, realizing the main process informatization regional geological survey field data acquisition, indoor settlement and result output.

In order to satisfy the needs that geological survey can continuously advance to the tough and complicated areas in the west and the needs of developing field geological work in arid areas and areas without the electronic signals, China Geological Survey has organized the project “Construction and Application of Field Geological and Mineral Survey Service and Management System”, which has also carried out the applied research and promotion experiment of domestic satellite technology with the financial support of NDRC’s “Demonstration Projects of Applying High Technology to Production”. It has researched and developed GeoRSC with vast essential data, remote sensing data processing, distribution and service, geological information identification and extraction technology, space information bearing and display platform based on moveable equipment. The main purpose is satisfying the requirements of modernization, elaboration and hommization for field geological investigation and establishing Chinese field geological survey business operation and integrated management system based on domestic satellites, thus maintaining the safety of operating personnel...
on remote sensing geology in their field work and improving the overall efficiency.

2. **Introduction to the Field Terminal of GeoRSC**

The field terminal of GeoRSC belongs to the moveable residence version of remote sensing satellite data service system. According to “Remote Sensing Satellite Data Service System Construction Plan” (Table 1), it mainly realize remote sensing geological survey functions including remote sensing anomaly verification, control spot film collection and spectral curve collection, which also realize operation management combined with Beidou Satellite. There are specifically remote-sensing image and vector data demonstration, GPS navigation and location, input and output of remote sensing data and vector data, adding and editing the property of observation points, control spot film collection, Beidou communication, spectral curve collection and result data output (Fig 1).

| Version                        | Function Module                          | Technical Index                                                                 |
|--------------------------------|------------------------------------------|---------------------------------------------------------------------------------|
| Central Version of Remote      | Routine data processing                   | Realizing remote sensing data process under regular state, including             |
| Sensing Data Service           |                                          | cutting, joining, fusion and thematic information extraction                    |
|                                | Remote sensing data resource catalog     | Under regular state, the center nodes of remote sensing data service can only    |
|                                |                                          | provide remote sensing data resource catalog under private geological survey    |
|                                |                                          | network, existing data can be referred to but it doesn’t provide data download  |
|                                | Immediate emergent data processing       | Realizing immediate remote data processing in emergency, including immediate     |
|                                |                                          | geometric correction, cutting, joining and fusion of field control spot film     |
|                                |                                          | as well as interpretation of emergent special information.                     |
|                                | Emergent data service                    | Realizing emergent data transmission from remote sensing data service centre     |
|                                |                                          | node to regional center nod and professional applied center node inside the     |
|                                |                                          | private geological survey network, covering an area of 10 km × 10 km, offering  |
|                                |                                          | high-mark data, the product data is 2 G and time 30 min.                       |
|                                | Control spot film management             | Connecting to the backstage field control spot film database, realizing         |
|                                |                                          | control spot film management                                                   |
|                                | Remote sensing anomaly verification result| Connecting the backstage result database, realizing the remote sensing anomaly     |
|                                | management                              | verification result management                                                  |
|                                | Spectral curve management                | Connecting the backstage spectral curve database, realizing spectral curve       |
| Regional Central Version of    | Routine data query                       | Refer to the released remote sensing data resources through the remote          |
| Professional Application       |                                          | sensing data resource catalog under normal state                               |
| Central Version                | Emergent data acquisition                | Obtaining the emergent remote sensing data sent by the node of remote          |
|                                |                                          | sensing data service center through point-to-point method under emergent state  |
|                                | Control spot film management             | Managing the control spot film data gathered in moveable stations or field     |
|                                |                                          | terminals, entering the local field control spot film database                 |
|                                | Remote sensing anomaly verification result| Managing the remote sensing anomaly verification result data gathered in         |
|                                | management                              | moveable stations or field terminals, entering the local result database        |
|                                | Spectral curve management                | Managing the spectral curve data gathered in moveable stations or field         |
|                                |                                          | terminals, entering the local spectral database                               |
| Moveable Residence             | Control spot film management             | Managing the control spot film data gathered in field terminals, entering the  |
|                                |                                          | local field control spot film database                                         |
3. Experiment on Anomaly Verification of GeoRSC Terminal

3.1. Natural conditions of experimental site

The thesis selects Nachitai area of Qinghai to carry out the field test of GeoRSC. Within the experimental site, the natural, economic and geographical conditions are quite severe. The average height above sea level is 4500m and the highest is 5600mm; the mountains are high and precipitous, whose relative height difference is 500 to 1600 m. Apart from the highway lines, most places are dead zone of communication. Within the area, it is very cold and it has longer winters and shorter summers; it belongs to arid or semiarid areas. Its summer is arid and the highest temperature can reach 25 ℃; while its winter is long, with strong wind and sands, less snow and extremely low temperature, whose lowest temperature can reach -30 ℃. Thus, the field working time is very short, which can only last from middle May to late September. Within the area, vegetations don’t grow, most of which are herbages, generally growing along mountains or rivers valleys, particularly centering in Dong Da Tan and Xueshuihe drainage basin. The basement is bare and its soil is mainly high and cold desert soil. Most places here are no man’s land, whose economic development is very unbalanced.

3.2. Experimental objective and content

According to the needs of field work environment, the experiment carried out a test aimed at the stability, accuracy and data security of the software platform of GeoRSC Terminal; it mainly focuses on the stability of the new software system, fluency of reading and showing remote sensing data and vector data, accuracy of Beidou Satellite positioning as well as security of data usage. Based on this, we select two types of remote sensing data respectively with medium-low resolution ratio and high resolution ratio, Shape-type and MapGIS-type vector data, 20 layers and three abnormal vector data with different spectral resolution to have a test. Meanwhile, 30 outliers are selected to test according to the process of anomaly verification. Besides, two different types of locations, maintain environment and plain and hill environment are selected to test the accuracy of Beidou positioning.
3.3. Experiment workflow

System installation is done indoors to make preparations for field experiment and test. Firstly, because of the updating of software, it is necessary to install the latest GeoRSC for tablet PC and PDA and complete online registration. At the same time, connect and install the drive programs of access equipment like GPS. Secondly, based on ETM remote sensing data, Aster remote sensing data and TASI/CASI hyperspectral data, extract abnormal information of different spectral resolution in the test area used for verifying the system’s applicability to different data. Use the aerial photo data at the height of 50 m and 0.5 m (data with medium-low resolution) and at the height of 300 m (data with high resolution) from China-Pakistan satellite CBERS-2 to make the operation base map of the experimental site, which is used for testing the system’s load capacity. Besides, respectively load them into the system according to the usage procedures.

According to the designed verification spots, field verification is carried out one by one. The system will record the geological and alternation phenomenon, which will be recorded in the database (Fig 2).

In order to verify and analyze the positioning ability and stability of Beidou-1 bluetooth portable terminal, it carries out positional accuracy measurement of static single-point long-term sequence of Beidou, and two schemes are designed. The first is to choose positional accuracy measurement of static single-point long-term sequence, which is used for simulating mountainous environment. This experiment chooses field stations for experiment. Beidou terminal is put in southward one-way windows with good intervisibility, having a long-term sequence monitoring of the terminal’s locating data so as to confirm the positional accuracy and stability. With 7 hours’ continuous positioning (with an interval of 1 minute), about 400 locating data is obtained. The second is the positional accuracy measurement of single-point long-term sequence under multiway sighting conditions, which is used for simulating plain and hilly environment, conducted in the base station of Golmud Seismostation, where the view is open and there are no high buildings around, which can be viewed as intervisibility. The base station has a triangulation point (XZ01), and according to the data provided by State Bureau of Surveying and Mapping, its Xi’an 80 geographical coordinates is 36°25’ 57.854” in latitude and 94° 52’28.11539” in longitude, and elevation: 2749.660 m. On the site, ongoing continuous base station PT measurement is adopted, whose continuous measurement duration is up to 8 hours, which totally measures 438 locating points.

3.4 Field measurement result of GeoRSC terminal

**System installation and debugging test:** the system installation process is successful, there is no report error or circumstance where the connection fails influenced by internet connection in networking activation; Beidou Navigation Satellite System and the communication system needs to connect with the tablet PC through Bluetooth. Influenced by Bluetooth connection, there are occasional conditions where the equipment can’t be found; GPS Module needs to connect with the tablet PC through USB data line, and the device attachment is normal. **Data loading test:** By loading the measurement of 2 image layer and 20 vector layers, the system and normally load single vector and remote sensing data (documents whose data size is less than 150M), and the batch of loaded documents may likely to fail; it doesn’t support the loading and display of remote-sensing images of single document more than 150 M, and it can only be loaded normally after cutting the single image; when the loaded amount is more than 300M, the image dragging and zooming will have delayed display (the total data in this test is about 770M); the software system of the current version doesn’t support the customized line styles, styles and colors of vector layers, and the vector files are of relatively lower recognition. **Data security test:** The system of the new version has good stability and there is no forced termination in the operation process, which ensures the security of field work data. Aimed at the stability of the system data storage, we design 30 verification spots in the database, whose data storage is complete and the query and derivation are normal. Aimed at the system’s performance of mass data management, in terms if the 30 verification spots, we collect them in the database respectively in five days in different orders. There is no confusion in the data storage and the
query and derivation are normal. **Beidou positioning accuracy test:** Through the test, in areas with good sighting conditions, after deducting system errors (southing offset), the positioning circular error probable (CEP) of Beidou 1 Bluetooth portable terminal is about 3.83 m, and the mean square error (standard deviation) is about 5.09 m. the better the seeing condition is, the smaller the circular probable error and mean square error is. According the stipulations of mapping 1:50000 topographic map error, Beidou 1 Bluetooth portable terminal can satisfy the working needs of simple measurement, positioning and navigation of 1:50000 or smaller measuring scales.

4. **Major Advantages and Improvement Suggestions**

4.1 **Major advantages**

This system can better realize the function of field positioning accuracy and real-time information passing; besides, tablet PC is applied in the field verification of remote sensing geological survey, which brings remote sensing survey from a traditional way to a digital age, realizing traditional pin-points in actual material maps and recording of paper books, thus effectively improving the work efficiency. It makes it convenient for field display and referring to image and remote sensing anomaly of different measuring scales; it also realizes database management of real-time logging field verification materials in the field.

4.2 **Improvement suggestions**

In this field test process, the author finds some defects of the system, including: in the process of connecting GPS positioning module to Beidou Bluetooth communication module, it is restricted by the system stability, hoping to integrate these two modules with the system hardware and improve the usability and portability of the whole system; it is in need of adding the function of adjusting layer display order, which is thus convenient for the leading-in and display of newly added survey data. Besides, it is necessary to increase the display of customized line types, symbols and colors of vector data so as to enrich the drawing expression.

5. **Conclusion**

As to traditional remote sensing geological survey, the GeoRSC is a revolutionary leap, helping the survey staff change from original manual recording to all-digital information age, thus realizing intelligence and process of remote sensing geological survey; this system also applies Beidou communication satellite to have an online management of the working staff, thus realizing real-time and accurate monitoring of field staff, maintaining the security of working staff in the tough areas, realizing real-time information communication, solving problems in the field work on the site and greatly improving the efficiency of geological survey. It marks that the geological industry has entered a universe integrated information age. Though the system still needs continuous improvement in some hardware and software, this system will be accepted and adopted by field geological survey staff, which will have a wide application prospect. The wide popularization of the system will greatly increase the application level of Chinese proprietary technology, strengthening the working security of field working staff, making remote sense survey more convenient and better applying remote sensing technology to Chinese geological mineral course.

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