

ANALYSIS OF ARSC'S SURVEYING AND MAPPING MODE —INTEGRATING AEROPHOTOGRAMMETRY, DIGITAL MAPPING AND GIS DATABASE ESTABLISHMENT

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ABSTRACT:

With the work experiences of surveying and mapping production, technology designing and technology supervision, the author systematically summarizes the concrete working flow of ARSC's modern surveying and mapping production mode, bringing forth ARSC's high-tech preponderance as well as its independent innovation new achievements.

1. GENERAL SITUATION

ARSC has been founded for 43 years. Through the 43 years, a group of senior experts witness ARSC's development, cultivating a technical team of young people, leading ARSC's surveying and mapping technology moving upward to computer automatic mapping from traditional manual mapping. With the applications of digital technologies, ARSC's surveying and mapping technology has gone up an era-acrossing leap, which reduces much burdensome field work. Based on 20 years surveying and mapping work experiences, the author discusses how ARSC, this gigantic surveying and mapping team, utilizes surveying and mapping high-tech and combines its independent innovation to realize ARSC's modern surveying and mapping mode integrating aerophotogrammetry, digital mapping and GIS database establishment. With some recent years domestic and overseas surveying and mapping projects cases ARSC performed, the author illustrates the significant results brought by ARSC modern surveying and mapping mode and introduces ARSC's independent development software, various map products (4D products), database achievements.

In the view of impelling the technology development in the fields of photogrammetry, digital mapping, database establishment, and making technical exchanges as well as common study and improvement on the opening of the 21th International Society for Photogrammetry and Remote Sensing conference, the purpose of this thesis is making technical discussion and technical exchanges with domestic and overseas friends and experts of same trade, to enhance ARSC's surveying and mapping level.

2. ARSC MODERN SURVEYING AND MAPPING PRODUCTION MODE AND TECHNICAL WORKING FLOW

2.1 Title ARSC Surveying and Mapping Production Scale

Through 43 years, with the efforts of several generations of ARSC people, a great number of leading surveying and mapping technicians emerge up. So far the technical level, the scale of surveying and mapping capability and surveying and

mapping facilities of ARSC are rare both in China and overseas surveying and mapping organizations, which receives many professional interviewers' praises. There are 8 (eight) Chinese national surveying and mapping experts, 5 (five) senior engineers of professorial rank, 126 (one hundred and twenty six) senior engineers, 168 (one hundred and sixty eight) engineers, and 210 (two hundred and ten) assistant engineers. The percentage of all technical talented persons (689 (six hundred and eight nine) persons) occupies 85% of the total staffs. ARSC owns the world leading and China leading surveying and mapping facilities: aerophotogrammetry equipment four sets (picture 1), GPS receiver numerous sets, Leica 530 GPS duplex signal receiver four sets, Leica 300 four sets, GPS duplex signal receiver four sets, 200S monochromatic signal receiver four sets, CR333 four sets, Leica NA 3003 digital level two sets, Zeiss Ni 002 precision level two sets, Zeiss Ni007 precision level two sets, top intelligent surveying station numerous sets, Leica TC 1102 two sets, Leica TC702 two sets, Leica TC500 total station four sets, Leica T2 theodolite numerous sets, Leica Di 3000 laser rangefinder numerous sets. ARSC's advanced software and hardware equipments: Intergraph SSK full digital photogrammetry work station thirty sets, China Si Wei JX-4C full digital photogrammetry work station four sets, Intergraph Imagestation work station one set. ARSC also holds Intergraph ISAT, Intergraph photoscan, Intergraph ISPM, Intergraph ISDM, Intergraph ISMT, Intergraph ISDC, Intergraph ISFC, Intergraph ISSD, Intergraph Orthpro, Intergraph I/RASC, Bentley Microstation J/V8, Adobe PhotoShop, Autodesk Autocad 2004, ARSC surveying and mapping engineering branch MHMS.



DMC



UCX



RC—30 RMK TOP 15
(Picture 1)



Leica 530 GPS Diplex Signal Receiver (Picture 2)

2.2 ARSC Modern Surveying and Mapping Production Mode Technical Working Flow

ARSC modern surveying and mapping production mode technical working flow.

2.2.1 Aerophotography

2.2.1.1 Fixing on shooting time, aircraft, airport and aerophotography equipments upon the terrain and climate of project region.

2.2.1.2 Data Processing

With digital aerophotography equipment (DMC digital camera) and PPS, a kind of data post-processing software on the aircraft, we perform the original data radiant processing (to make up for the default caused by temperature, aperture and other radiation factors), geometry rectification (to correct lens distortion incline) respectively. And the mosaic work will be done at last to generate a few different data outputting formats—full color format, color (RGB mode) format and color infrared format (Picture 3).

2.2.1.3 Designing Shooting Parameters (Picture 4)

2.2.1.3.1 Photo Overlapping Percentage

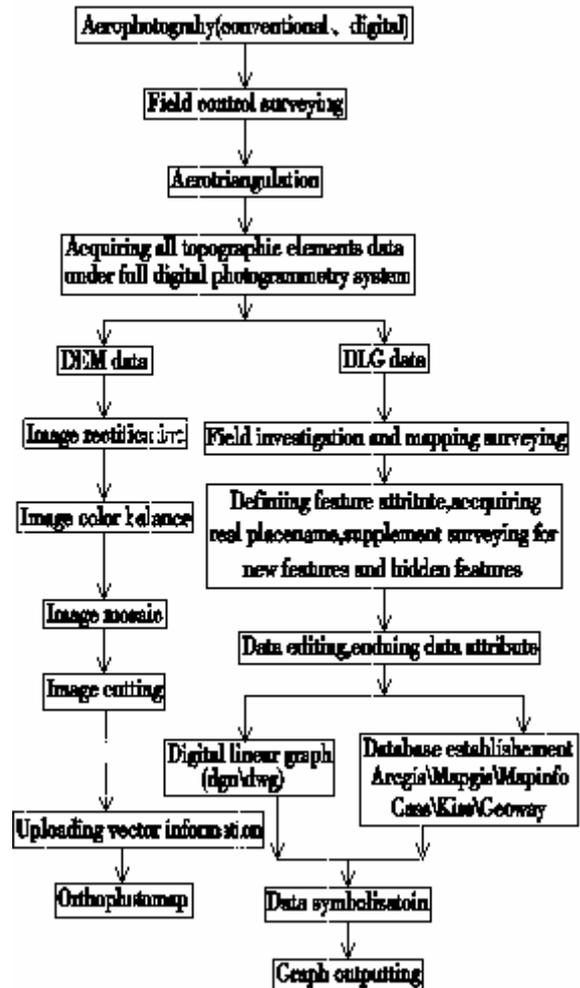
2.2.1.3.2 Flight Coverage

2.2.1.3.3 Project Region Dipartition

2.2.1.3.4 Arrangement of Flight Lines Direction

2.2.1.3.5 Flight Height Definition

2.2.1.3.6 Photo Volume Evaluation



full color real color color infrared
(Picture 3)

2.2.2 Field Control Surveying

2.2.2.1 Basic Control Surveying

2.2.2.1.1 Establishing Surveying Coordinates System (plane, elevation)

2.2.2.1.2 D grade GPS Control Net Arrangement and Setting,

Point-Selecting, Stone-burying, Observation, Calculation.

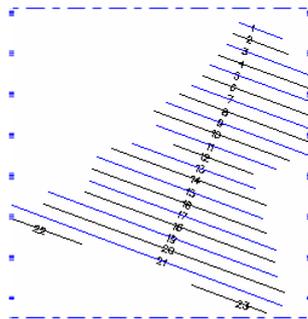
2.2.2.1.3 Four Class Level Observation

2.2.2.2 Photo Control Surveying

Photo control surveying mainly includes: photo control points arrangement, numbering, punch points selecting, grooming, surveying.

2.2.3 Aerotriangulation

All our indoor aerotriangulation is full digital aerotriangulation. The full digital aerotriangulation provides reliable high quality orientation points for field elevation points surveying, plane points checking, aerotriangulation and data collection.



(Picture4)

2.2.4 Acquiring All Topographic Elements Data under Full Digital Photogrammetry System

With Microstation software platform support, data collection process is based on SSK,DMS,JX-4C full digital photogrammetry workstations. Planimetric features acquiring will be done based on models and according to the corresponding elements classification rules, and then data files will be generated in DGN\DWG format.

2.2.5 Field Investigation and Surveying, Supplement Surveying

Referring to collected data, we open paper map. According to the corresponding project field technical specification and denotation methods, in field spot, we define the attribute of the features, acquire place names, and make supplement surveying for hidden features as well as new features.

2.2.6 DLG Data Editing

In DLG data editing, on the basis of full digital collected graphic data and according to the project plot specification, the indoor operators do map grooming with the comparison to the field investigation and surveying. The operators do some processing work like topographic features grooming, symbolization, building eaves correction, adding notes to layers and structure attributes, road grades classification, vegetation symbols filling, linear symbols designing, hues classification, various name noting, attribute connection. Through this processing, the beautiful map is achieved, which is ready for database inputting.

2.2.7 DEM Data Extraction

After full digital topographic map collection, in view of the

need of DOM rectification, we shall generate a set of DEM data. Therefore, through elements filtering and extraction, the real land elements (breaklines, terrain characteristic) will be extracted. Then, with certain calculation and interpolation, DEM or DTM of various types and software formats will be generated (Picture 5).

2.2.8 DOM Data Production

2.2.8.1 In Orthopro modules, according to DEM file we make orthophoto rectification for the photos with defined exterior elements.

2.2.8.2 With I/RASC, we check the rectified images.

2.2.8.3 We do color balance processing with professional color balance software, to make the whole project area symmetrical and consistent in color.

2.2.8.4 After color balance processing, we do image mosaic with I/RASC.

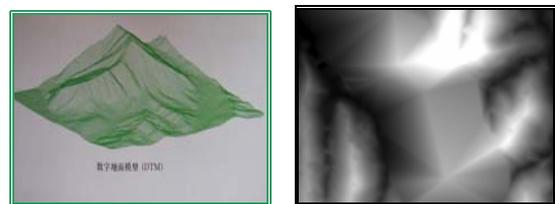
2.2.8.5 In photoshop, we check and correct the images.

2.2.8.6 Uploading Vector Data

In digital orthophotomap delivery, besides image data, photo frame, coordinates system, production unit, place name, elevation information shall be delivered.

2.2.9 GIS Database Establishment

With information modernization improvement, clients become very demanding. They do not only require graphic data for urban or rural planning, engineering designing, but also require GIS database for easy inquiry, analyzing, counting. For land resources investigation projects, the clients' demands on database, which require beautiful plot effect and perfect database, are particular high. From DGN via FME to ARCGIS, MAPINFO, from DGN via DXF to MAPGIS, from DGN via main procedure, ARSC's database production mode automatically introduces CASS, KISS different conversion schemes. These schemes are widely applied in various surveying projects, such as Field Information Management System, National Land Resources Information Management System, and City Planning Information Management System.

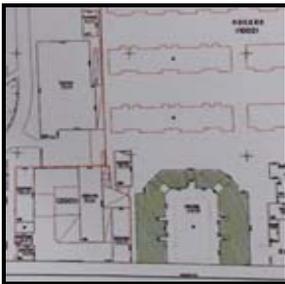


(Picture 5)

3. THE CONCRETE APPLICATION CASES AND ACHIEVEMENT

In view of the thesis length, the following cases are only from a few recent years project achievements.

3.1 Digital Linear Graph



Cadastral Map



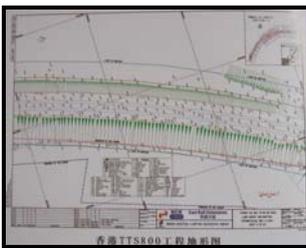
House Property



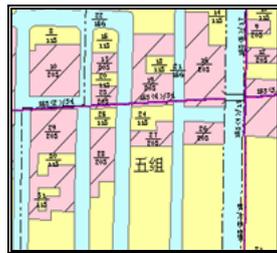
City Planning Map



Yellow River Current Map



Hong Kong TTS800 Engineering Topographic Map



Land Utilization Linear Map

3.2 Digital Orthophotomap



Luo Yang Digital Orthophotomap



Asynchronous Orthophotomap of Beijing Olympic Square

3.3 3D Modeling Cases



3D Modeling of Soap Mining Industry Square

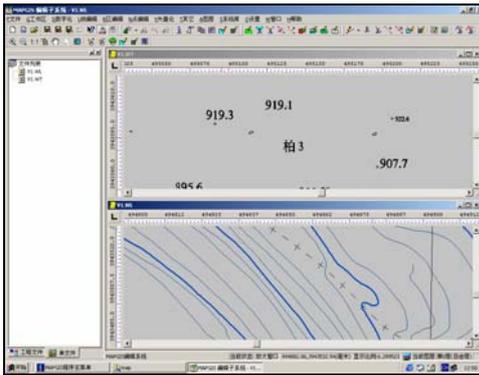


A Community 3D Modeling of Beijing

3.4 Database Achievement



Dongtai City Urban Rural Integrative Cadastral Management Application System



1:2000 Topographic Database of Sihekuo District, Jincheng City ARSC Independent Development Digital Mapping System(MHMS)

3.5 Drawings in papers prepared in digital form must be in the appropriate location in the document.

Sureying Control Points				
Triangle Points	Triangle Points on Ridgeau	Small Triangle Points	Small Triangle Points on Ridgeau	Lead Points
Non Stone-burying map basic points	Level Points	GPS Points	Astronomical Points	Lead Points on Ridgeau
Resident field and wall bars				
Normal Buildings	Buildings under Construction	Auxiliary Lines of Steply	Constructed Building	Porch
Damaged buildings	Exterior Dotted Line of Shed	Shed Angle Line	Dotted Line of buildings Built on Stepls	
Real Line of Buildings Built on Stepls	Brace of buildings Built on Stepls	Abutts	Brace of colomade	Balcony
Bath Cover				
Bath Cover	Steps	Outdoor Steps	basement	Building Clearstory
				Fence
Dotted Lines of Construction under Ground	Dotted Lines of Construction under Ground			Bounding Wall
				Bridge

3.6 Products Awarded with Prizes

- ※ Datong 1:1000 Aerophotogrammetry Project: National Excellent Reconnaissance Gold Prize
- ※ Brazil PDSFN Project, ARSC Produces 1:10000 Orthophotomap 2286 Tiles, Covering an Area of 66945 Square Kilometers, with Contract Value of Eight Million US Dollars
- ※ Nanjing City Cadastral Management Information System: Jiangsu Province Excellent Engineering Prize
- ※ Hong Kong West Railway TS-800 Aerophotogrammetry Digitization Project: Special Prize of the Tenth Excellent Geology Report Awarded by China National Administration of Coal Geology
- ※ 1:2000 Digital Orthophotomap Producing and Database Building Project of Baotou City: Surveying and Mapping

Technology Progress Second Prize

※ Kailuan Mining Area Aerophotogrammetry Digitization Topographic Map Project: Science and Technology Progress First Prize Awarded by China National Administration of Coal Geology

※ Longkou Mining Area 1:2000 Scale Aerophotogrammetry Digitization Mapping Project: Science and Technology Progress Second Prize Awarded by China National Administration of Coal Geology

4. CONCLUSION

ARSC's modern surveying and mapping mode, which has been tested by market projects implementation and received high praises home and abroad, is improving to maturity. In recent years ARSC keeps business cooperations with USA, UK, Canada, France, Hong Kong, Japan, etc. In domestic market, the projects that we undertake are through out China. ARSC's people leave their tracks all over the country. From the world fastigium Tibet plateau to coastal cities, from westernmost Xinjiang to the easternmost Jiangsu and Zhejiang Provinces, ARSC people leave their footprints. Practice proves that, ARSC's modern surveying and mapping production mode, standing up test, is a set of high technological, high efficient and reasonable production system, which keeps up with times and receive all circles owners' approvals. ARSC will achieve greater accomplishment in future, as long as ARSC keeps innovations in the light of this scientific development thought.

The characteristics of ARSC's modern surveying and mapping production mode are: (1) With a set of integrative strength of data acquire, data processing, data analysis, ARSC possesses strong competence from technical team members to various software and hardwires facilities, technical working flow and production capabilities. ARSC's great production scale and strong capability can be rarely found in China or Overseas countries. (2) ARSC's data acquiring platform, data editing platform, data conversion pattern as well as database establish platform adopt the most advanced Chinese or foreign software. Relying on its own independent developed serial data acquiring, data processing, data checking software package, ARSC intensifies the functions of various software.

REFERENCE

Various Surveying and Mapping Projects Technology Designing Schemes (Inner Materials)

