THE DEVELOPMENT OF PHOTOGRAMMETRY 
AND REMOTE SENSING 
FROM 1996 TO 2000 (NATIONAL REPORT OF CHINA)

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ABSTRACT This report summarizes the achievements in photogrammetry, RS and GIS in
China from 1996 to 2000.

1 Data acquisition and management

From 1996 to 2000, the State Bureau of Surveying and Mapping (SBSM) of China focused on two
main aspects: establishing China’s national spatial data infrastructure (CNSDI) and providing basic
information production for hazard prevention and reduction. The production format has been changed
from analog to digital. These digital products include the digital elevation model (DEM), the
digital orthophoto map (DOM), the digital raster graphic (DRG), and the digital line graphic
(DLG). Digital products are the main data sources of the national fundamental geographic information
system (NFGIS), which occupies a key position in CNSDI.

— NFGISs based on vector data of 1:4 000 000, 1:1 000 000 (77 frames) and 1:250 000 (about
900 frames) scales have been finished by SBSM, and NFGISs of 1:50 000 and 1:10 000 scales are
being constructed by each province in China.
— Established the data sets of 1-km resolution monthly NDVI in China from 1996 to date (Liao
Mingsheng et al., 1999).

— Seven digital production bases have been established by SBSM.
— 1:50 000 DRG (about 20 000 frames) have been accomplished.
— The task of producing DEMs with 1:50 000 covering the whole China is in progress. The DEMs
of eastern China from 108° E (near 10 000 frames) have been completed, and those for other areas will
be completed by the end of 2000.
— Completed 1:10 000 database of DEM (about 14 000 frames) and DOM (about 13 000 frames)
covered the flood-frequented areas of the seven main river basins.
— Completed the renewal of 1:50 000 DRG and the production of DOM (more than 500 frames) by
using SPOT images in Beijing and Qinghai Province.
— Accomplished the task of 1:50 000 DEM (189 frames) and 1:10 000 DOM (980 frames) in the
area of Three Gorges.

2 Instruments and systems

2.1 Photogrammetry

Supersoft Inc., based in China, was founded by WTUSM in 1996 and merged with International
Data Group (USA) in 1997 and Intel Corporation (USA) in 1999. Its flagship products, VirtuoZo
NT softcopy photogrammetric system, IMAGIS visualization GIS, ImageSuite image processing sys-
2. Deren LIU, Liangming FILL, Xiaoqin TERN, Cybercity urban modeling & visualization system, and Cyberland remote sensor image fusion system, can provide solutions to meet the needs of the entire softcopy photogrammetric and GIS workflow. Through its branches in USA, Japan, Hong Kong, Beijing and Xi'an, a full network of sales and service has been set up worldwide. The products have earned a convincing market share and have over 200 facilities throughout 20 countries.

A series of software and hardware for digital mapping have also been developed by China Siwei Surveying and Mapping Technology Beijing Company, including JX-4A DPS, JSH6080 Laser Raster Plotter, SX-23 Image Scanner, MapED Map Edit Workstation and Digital Aero-triangulation Software etc. These products are also exported to other countries, such as Japan and Pakistan.

A few similar and simple DPSs have also been developed by other institutions in China (Wu Yundong et al., 1998; Hu Wensong et al., 1998).

2.2 Remote sensing

FY-2, the first geostationary meteorological satellite of China, was launched on January 10, 1997, and in this field, bi-satellite systems will be adopted. FY-1C, the third polar orbiting satellite of China, was launched on May 10, 1999, and handed over for application after testing in August, 1999. CBERS-1 (China-Brazil Earth Resource Satellite) was launched in China in October, 1999. The plan for HY-1, the first sea satellite of China, was made in 1997 and HY-1 will be launched with FY-1D in April, 2001. Respecting small satellites, some have already been launched, such as SJ-4, SJ-5, some others in plan, including HY-1, 863-2, CSA Small Satellite and Tsinghua-10, etc. Proposals have been made for still others, e.g., COSMO/SKYMED, ZHI-1, solid small satellite and small satellite constellation for surveying and mapping.

A variety of sensors are made by ourselves or in cooperation with foreign partners, such as CCD Camera (similar to SPOT-HRV), IRMSS (Infrared Multi-Spectrum Scanner) and WFI (Wide Field Imager) in CBERS-1; Multi-Channel Scanning Radiator (MCSR) in FY-2; 10 band Visible-Infrared Scanning Radiometer (VISR) in FY-1C (Gong Huixin, 1999), etc. Some new types of sensors are also under research, e.g., Sea Radar Altimeter, Median Resolution Imaging Spectrometer, Median View Radiometer and Microwave Radiometer, etc.

At present, the advanced airborne earth-observation system is under research. It is composed of five sensors, i.e., Operative Modular Airborne Imaging Spectrometer (OMIS), Wide-view CCD Pushbroom Hyperspectral Imagery (WPHI), High Resolution CCD Digital Airborne Camera, Airborne 3D Imager and Airborne Laser-Ranging-Multispectral-Imaging Mapping System (ALIMS) (Li Shukai et al., 1998; Wang Jianyu et al., 1999). At the same time, the unmanned remote sensing airplanes are also in research. Many achievements have been made in the research for military use. UAVRS-I system for civil use, supported by the government’s high technology development plan (863 Plan), is in development as well (Li Ziwei et al., 1999).

2.3 GIS

China has been developing its own GIS industry. In recent years, the GIS industry in the country has been growing significantly. Some domestic GIS products have started to show their competitiveness on the domestic market.

In order to boost the software research in the country and the production of the best GISs, we have made substantial efforts for producing independent copyright GIS platforms. Financial supports have been sought and obtained from various sources. After many tests and evaluations for China-made GISs, our own GISs are found superior to GIS products from abroad, especially in respect of input, edit and high precision publishing of maps, database management for very large capacity maps, image processing etc. They are flexible in adaptation, second development and use according to specific conditions in different countries. For example, GeoStar, a GIS software platform for integration of vector data, attribute data, image data, and DEM, is produced by WTUSM. Presently, it is composed of a series of geographic information softwares with the OO technology, including GeoGrid, GeoTIN, GeoImager, GeoImageDB, GeoSurf, and GeoScan.
3 Theories and methods

When science and technology is experiencing a rapid development today, the spatial information science is no exception. What will it be like and where should it go? These are questions frequently asked by professionals in this area. The relationship between \textquote{\textit{Geomatics}} and \textquote{\textit{surveying and mapping}} has already been a topic of discussion and analysis. It was proposed that \textquote{\textit{Spatial Information}} or \textquote{\textit{Spatial Information Engineering}} should represent the characteristics of future development of surveying and mapping (Wang Zhizhuo, 1998).

In order to develop the high-tech in information in China, the concepts of and relationships between NII, NSDI and Digital China are also under research (Li Deren, 1999), and the drawing of digital Geospatial Data Framework was also designed and implemented in China (Li Deren \textit{et al.}, 1998). For this purpose, many new theories, methods and technologies have been studied.

3.1 Photogrammetry

Photogrammetric theory based on projective geometry in stereo vision was tested and verified (Shan Jie, 1998). A multiple-stage calibration method for geometric calibration of CCD array camera was developed, which eliminates the related effects between the unknowns, resulting in good data accordance and a high precision (Li Deren \textit{et al.}, 1997). EFP (equivalent frame photograph) was applied in a simulation study on bundle adjustment from space using three CCD linear scanner imagery (Wang Renxiang, 1998). The relationship between traditional Chinese architectural and garden design from the viewpoint of chaology and fractal geometry was studied (Li Deren \textit{et al.}, 1998). Annotation is important for map production. Some algorithms and methods have been designed and implemented to add annotation to maps automatically (Cheng Kongzhe \textit{et al.}, 1997; Fan Hong \textit{et al.}, 1998; Fan Hong \textit{et al.}, 1999; Du Ruiying \textit{et al.}, 1999).

Kinematic GPS positioning has been introduced into aerial triangulation. Some investigations and achievements have been completed on GPS-supported automatic aerial triangulation, such as, the laying of control strip, the configuration of ground control points, the accuracy of GPS-supported aerial triangulation without ground control points and the theoretical accuracy for GPS-supported bundle adjustment by calculating the accuracy matrix $Q_{xx}$, the conclusions are the same as the ones of related research in other place of the world (Yuan Xiuxiao \textit{et al.}, 1997; Yuan Xiuxiao, 1998). OTF (On the Fly) method was applied to handle the GPS signal cycle slip on airborne GPS data processing for photogrammetry (Chen Xiaoming \textit{et al.}, 1997). The interior accuracy better than 1 dm for the differential GPS positioning can be obtained.

Many research projects were involved in data processing and information extraction, such as, the probability relaxation algorithm for the automatic connection of cut road lines (Pan Li \textit{et al.}, 1997); semi-automatic road extraction from aerial images (Liu Shaochuang \textit{et al.}, 1996); CNS-based extraction of buildings’ shadow structures (Mei Xueliang \textit{et al.}, 1996); the recognition and extraction of hatched polygons on maps (Hao Xiangyang, 1999); the multiple description and recognition approach for 3D industrial objects (Li Deren \textit{et al.}, 1997); natural environment image segmentation based on the fractal characters (Yang Bo, 1999); the knowledge acquisition based on Markov random field for aerial image understanding (Zheng Hong \textit{et al.}, 1997); a new texture recognition method based on MRF parameters and linear programming (Zheng Zhaobao, 1996); recognition of point-shaped map symbols with a new neural network model (Huang Wenqian, 1996); deformable-template based building detection from aerial imagery (Liu Shaochuang \textit{et al.}, 1997); an algorithm for automatic location and orientation in pattern designed environment (Lin Zongjian \textit{et al.}, 1998).

Some pieces of research work were concerned with 3D landscape visualization and reconstruction, e.g., research of 3D visualization method of urban buildings concerning terrain (Zhu Yinghao \textit{et al.}, 1998), fractal-based expression of landform (Yang Yurong, 1996), reconstruction of 3D landscape from images with large scale for urban region (Zhang Jianqing \textit{et al.}, 1998), a landscape map
generation method based on image matching (Zhang Zuxun et al., 1999). Some new methods were proposed in quick generation of TIN and its dynamic updating (Zhu Qing et al., 1998) and in the fractal interpolation of DEM (Wang Qiao et al., 1996). Multi-image matching without similarity measurement was also proposed (Shao Juliang, 1998).

3.2 Remote sensing

In order to use various remote sensing data, a few research projects were involved in remote sensing data calibration and location, for instance, radiation correction methods based on local maximum entropy (Tian Jinwen et al., 1999), study on the spectra mixing model of soil and canopy in the Poyang Lake area (Zhang Liangpei et al., 1997), area of location processing research of NOAA AVHRR 1A.5 data (Liu Liangming et al., 1998), error analysis and processing of multi-beam soundings (Zhu Qing et al., 1998), and calibration of Aviris remote sensing data from the Poyang Lake area (Zhang Liangpei et al., 1997), etc.

Image processing and analysis are very important steps in remote sensing data processing. In image compression, some methods, based on wavelet transform domain by using BP neural network (Wu Bin et al., 1999), on wavelet transform (Xia Tao et al., 1997; Yan Yusong et al., 1999), on the multi-mode adaptive quantization (Zhou Xiaokuan et al., 1997), or on multi-pattern prediction (Guo Quji et al., 1999), were studied. In image coding, some algorithms, such as the segmentation-based image coding algorithm using the features of human vision system (Huang Jiwu et al., 1999), the quick fractal block coding algorithm based on multi-scale matching (Pi Minghong et al., 1999), the fractal coding based on vector quantization (Shen Jianjun et al., 1999), the neural network based on vector quantizer and Lorry compressed coding on remote sensing image (Shen Weiming et al., 1996), etc. were developed. In image classification, some investigations were conducted, e.g. classifying image texture using texture model (Huang Guilan et al., 1998), texture classification with Markov random field (Huang Guilan et al., 1999), classification using wavelet neural network (Wang Yao-nan, 1999), a fully fuzzy supervised classification (Zhang Jingxiong, 1998), texture classification based on genetic algorithms (Zheng Zhaobao et al., 1998), construction of a neural network for image classification (Zhang Jianbao et al., 1999), etc. As it is considered as an important issue to establish the theory of multi-source image fusion in remote sensing, some data fusion methods have been proposed, including fusion based on wavelet models (Li Deren et al., 1996), fusion based on feature (Li Jun et al., 1997), fusion based on local histogram matching filtering techniques (Li Jun et al., 1999), etc.

As regards radar, based on synthetic aperture radar (SAR) imaging, has exhibited many significant advantages, it has therefore drawn considerable attention in China. Research work in this field includes: speckle filtering of single-look SAR image (Xu Xin et al., 1999), an automatic matching strategy for INSAR data (Liao Mingsheng et al., 1999), the coherence coefficient map and residue guided least square phase unwrapping algorithm (Zhang Li et al., 1999), a study on the extraction of 3D information from SAR image (Liao Mingsheng et al., 1999), the study of noise reduction for SAR image (Fang Shenghui et al., 1998), geometric rectification of SAR image (Fan Yonghong, 1997), a study on D-INSAR by using ERS-1/2 data for monitoring land subsidence, where the accuracy of height deformation can reach ±1.1 cm of RMS (Zhou Y et al., 1999), etc.

Other research work includes: image segmentation based on the fractal characters (Yang Bo et al., 1999) and wavelet transform (Li Jun et al., 1997), object-oriented knowledge representation for expert system of remote sensing image understanding (Ni Ling et al., 1997), a framework of spatial data mining and knowledge discovery (Di Kaichang et al., 1997), mining association rules with linguistic cloud models (Li Deyi et al., 1998), knowledge representation and discovery in spatial databases based on cloud theory (Di Kaichang et al., 1998), intelligent query in spatial databases based on cloud model (Di Kaichang et al., 1998), and a study on activation of global memory associated with collection of tuples of subimages.
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(Guan Zequn et al., 1998), color histogram based on image retrieval (Bo Xiaochen et al., 1999), skeletonization and reconstruction via mathematical morphology (Zhou Nan et al., 1997), image thresholding based on maximum between-class posterior cross entropy (Xue Jinghao et al., 1999), the automatic selection of image threshold on the basis of genetic algorithms (Zheng Hong et al., 1999), a method based on principle vector set for texture analysis (Cheng Yimin et al., 1999), texture analysis and fractal assessment (Shu Ning, 1998), multi-band wavelet transform in image analysis (Yang Xiaomei et al., 1999), robust edge detection based on soft morphology (Shu Changxian et al., 1999), a wavelet based on iteration regularized image restoration algorithm (Cai Hantian et al., 1999), a genetic algorithm for 3D shape recovery (Tian Yingli et al., 1999), wavelet-based hierarchical image restoration (Zhu Shulong et al., 1997), wavelet models for image restoration (Li Deren et al., 1996), different-image-based multiple motion targets detection and tracking (Wang Shuang et al., 1999), distinguishing and solving of pseudo match in image mosaicing (Ding Ying et al., 1999), and a fast sequential least squares algorithm for image joining (Deng Dexiang et al., 1997), etc.

3.3 GIS

At present, GIS is being transformed from static modeling in two dimensions to dynamic modeling in multi-dimension. GISs are very important vehicles running on Information Superhighway and serve many different users with the provision and manipulation of geo-spatial data. The two characters of GIS are technology-driven and application-oriented. With the rapid development of computer technology, communication technology, space positioning technology, remote sensing and visualization technology, GIS hardware and software environment and the methods of spatial data acquisition, storage, access, analysis, representation and visualization will be improved constantly and rapidly (Li Deren, 1997). Against this background, many research projects are concerned with these topics, which include the optimal model of spatial data with attribute data in computer, automatic acquisition and updating of spatial data, spatial data quality and uncertainty, spatial query and analysis of GIS data, visualization, symbolization and multiscale representation of spatial data, etc.

A great deal of research work is involved in the establishment of the spatial data models, such as, a GIS semantic data model for the purpose of data sharing (Chen Changsong et al., 1999), field-based models for positional and attribute uncertainty (Zhang Jingxiong et al., 1999), uncertainty model of circular curve features in GIS (Tong Xiaohua et al., 1999), an object-oriented spatio-temporal data model in GIS (Gong Jianya, 1997), the research on the conceptual frame of the integration of 3D spatial data model (Li Qingquan et al., 1998), error models for geometric features in three-dimensional GIS (Shi Wenzhong et al., 1998), powerset-based query model and its query capacity (Li Lin, 1998), an integrated data model in three dimensional GIS (Gong Jianya et al., 1997), a fuzzy field approach to mapping e-error band model (Zhang Jingxiong et al., 1997), the nine-intersection model for describing spatial relation (Li Chengming et al., 1997), and an object-oriented spatio-temporal data model (Shu Hong et al., 1997), etc.

Spatial relation is one of the key theoretical issues in GIS (Chen Jun et al., 1999). It is very important how the data is described, represented, managed and analyzed. Many studies have been conducted in this direction with ample achievements, e.g., a hybrid data structure in 3D GIS (Li Deren et al., 1997), definition of spatio-temporal topological relationships and description of temporal topological relationships (Shu Hong et al., 1997), a matrix for describing topological relationships between 3D spatial features (Chen Jun et al., 1998), an algorithm for three dimension convex hull creation of a set of spatial points (Li Qingquan et al., 1998), generating visibility-shortest-path Voronoi diagram with limited linear obstacles (Li Wulong et al., 1998), three-dimensional run-encoding
(3DRE) for Octree (Li Qingquan et al., 1997), formal framework of 3D spatial features and topological property based on manifold topology (Guo Wei et al., 1997), mathematical morphology applied in GIS spatial analysis (Ma Fei et al., 1996), spatial adjacency query based on Voronoi diagram (Li Chengming et al., 1998), raster-based method for Voronoi diagram (Li Chengming et al., 1998), organizing for large seamless geographical databases (Li Aiqin et al., 1998), design and realization of spatial metadata system (Shen Tiyan et al., 1999), buffer curve and buffer generation algorithm in aid of edge-constrained triangle network (Wu Huayi et al., 1999), techniques for graphic generation in virtual reality (Liu Xuehui et al., 1997), and 3D dynamic interactive visualization model (Zhu Qing, 1998), etc.

In order to solve the problems in multi-user, browser/server-based Internet and cross-platform and distributed GIS, some studies have extended good progress (Gong Jianya et al., 1998; Zhu Xinyan et al., 1999, Han Haiyang et al., 1999).

4 Close-range photogrammetry

Surveying engineering supervision based on Windows is an integration of modern close-range photogrammetry and other technologies. Surveying supervision aims at providing all-round quality control of single limber components and total building assembling by collecting and constructing 3D maps and image database of ancient buildings. These methods and technologies have been applied in the building supervision of Hong Kong Chi Lin Nunnery successfully where great achievement has been made. During supervising the building of the Chi Lin Nunnery, which is one of ten famous scenic sites in Hong Kong, a set of projects and technologies for surveying supervision were used, including traditional methods and close-range photogrammetric ones. These methods can provide all-round quality control and 3D space database (Jiang Wangshou et al., 1999). Close-range photogrammetry is also applied in architecture, archaeology, cultural relic duplication, machine-making industry and some other fields, for example, the application and simulation for ship-wave (Wang Hongmei et al., 1999), a digital close-range photogrammetric system used for grain-lacking objects (Feng Wenhao et al., 1996), and application of the structure light engineering surveying based on a laser theodolite with three freedoms of rotation (Feng Wenhao et al., 1998), etc.

5 Photogrammetry, remote sensing and GIS applications

Along with the development of DPS, GPS, GIS and RS, GPS-supported automatic aerial triangulation, which can economize the use of the field control points and shorten the cycle of map production, has already been widespread in applications in China since 1990. DDKIN and WuCAPS, which are developed by WTUSM, have been applied in the China-Australia cooperation project for Hainan island and map measurement for the boundary between China and Vietnam. Some applications are also made in Beijing, northeast China and Tianjin (Li Deren et al., 1998). The integration of RS, GPS and GIS is the mandatory path of the progress of photogrammetry. WTUSM has developed an entire set of software and work flow from aerial photography to GIS spatial database. This integrated software has been used for a model project of the provincial fundamental GIS system in Guangzhou and is being broadly extended to production within the surveying and mapping community in China (Li Deren et al., 1999).

On the basis of our GIS platform production, many application systems have developed, which have been used in urban planning, communication network, water supply network, gas pipeline network, power distribution network, cadastre management, land investigation, GPS navigation and supervision, military command, public security alarm, environment protection and popular geographical information manufacturing, etc.

China is a country with serious and frequent occurrences of multi-disasters. Remote sensing and GIS are effective technological means for disaster monitoring and assessment, thanks to its timeliness, flexibility, reliability, accuracy and integrality.
While the monitoring of flood and waterlogging condition is the main task for us, we have established a four-level monitoring system which integrates with GIS, GPS, DPS and RS, i.e., by spacecraft (any kinds of remote sensing satellites, such as NOAA, FY, Landsat, SPOT, Radarsat, ERS, etc.), aircraft (key project investigation in urgent cases), helicopter, and ground observation stations. A great deal of achievement has been made in this type of work, especially during the huge flood of Yangtze River in 1998. Many applications are also undertaken in monitoring other natural disasters, e.g., sand storm (Zheng Xinjiang et al., 1999), drought (Liu Liangming et al., 1999), volcanic activities (Bo Ligun et al., 1999), desertification monitoring and estimation (Long Jing, 1999), the thermal IR anomaly in earthquake precursor (Cui Chengyu et al., 1999) and land degradation (Yang Shengtian et al., 1999), etc.

Some applications are involved with resource and environment, e.g., forest and non-forest mapping (Li Zengyuan et al., 1999), landuse change and urban growth monitoring (Li Yingcheng et al., 1999), the tropical forests (Li Xueqian, 1999), the sea level variations in China Sea and its vicinities (Wang Haiying et al., 1999), sea surface temperature (Cheng Weiying et al., 1999), offshore suspended sediment detection (Deng Ming et al., 1999), landslide-structures (Shi Huosheng), snow-depth (Bo Yanchen, 1999), the maximum shelter temperature of Qinghai-Tibetan Plateau (Liu Ruiyun et al., 1999), energy distribution of land surface (Tian Guoliang et al., 1999), and global model estimation of potential nitrogen fluxes and storage in soil (Lin Binle et al., 1999), etc. The applications based on spatial information technology are even more extensive and profound.

6 Education and publication

6.1 Education

With the nationwide reform and adjustment of specialties and curriculum systems, the education in China is experiencing fundamental changes. Because of the integration and development of photogrammetry, RS, GIS, and GPS, they have become compulsory courses in programs concerned. There are many courses related to photogrammetry and RS, GIS, and GPS, such as basis of remote sensing and image interpretation theory, remote sensing geology, atmosphere remote sensing and remote surveying, meteorological satellite and satellite image analysis, the theories, methods and applications of remote sensing. A new series of textbooks have been compiled. Taking the photogrammetry and remote sensing subject as an example, we have updated the contents by adding more of digital photogrammetry, space photogrammetry, remote sensing technology, digital image processing, image information system and other related new and advanced technologies. The new features of the courses include:

1) Closely integrate with other specialties. For example, the integration with surveying has resulted in the course of photogrammetry and remote sensing. The same is also true with other specialties including geography, geology, water conservation, agriculture and forest industry.

2) Due to the development of remote sensing itself, in some other specialties, the theory of remote sensing need to be strengthened, and the depth and width of its application furthered. Therefore, the remote sensing theory and its application courses are still the major courses of many specialties, such as, photogrammetry surveying, information engineering, urban planning, cartography, land management and specialties mentioned above.

3) Some courses related to remote sensing have formed a series of new courses, such as digital image processing, pattern recognition, microwave remote sensing, remote sensing thematic cartography, GIS and expert system.

4) Integrates with other high technologies. The most important of all is the theory and method of GIS, GPS and RS integration. The courses of this technology have came into being. Another integration is found in the expert system and network technology.

5) The corresponding teaching materials are published openly. The Training Department for RS and GIS includes Beijing Training Center and Wuhan Training Center. The Beijing Training Center used to be in Remote Sensing Graduate School of Beijing
University. With the adjustment of specialties, it now operates under the School of Urban Planning and Construction and the Department of Geology and Geography. The Wuhan Training Center is in WTUSM, which has a number of renowned professors and researchers working to train professionals in the filed of RS, DPS and GIS, at post-doctoral, doctoral and masters levels. Each year it recruits students from the Asia and Pacific Region and Africa (Mongolia, DPR Korea, Vietnam, Laos, Myanmar, Nepal, Sri Lanka, Pakistan, Bhutan, Tanzania, Sudan, Iran, Libya and so on). While it carries out various scientific activities at the same time, it is also selected as the base for training the key members and leaders in relevant institutions. The Training Center for NSDI was established in WTUSM by SBSM a few years ago. Many teachers and scientists engaged in RS and GIS have been trained there.

The demand in China for advanced level professionals undertaking research and applications in spatial information science is markedly increasing. For example, according to the latest statistics, there are only 100,000 professionals working in remote sensing field, while specialists estimate that 700,000 will be a number closer to the needs. The increasing demand for high level professionals in the country has resulted in the recent expansion of recruitment size in universities and colleges by 3 to 4 times, as is also evidenced in other educational means, such as TV university and adult education institutes (Bian Fuling et al., 1999).

In recent years, new ways of teaching, such as CAI, are greatly improved in the country. For some contents of remote sensing courses, it is very difficult to do well orally, but charts, slides and films can be very helpful. For its vividness and operability, computer aid tool appeals to the students. For this reason, many universities have built multifunction classrooms equipped with computers, large panel projection systems, close-circuit television systems and recorders, etc. Their use has certainly improved teaching. Many CAI coursewares of high quality have been developed and applied in teaching in China. We have produced many video tapes, e.g., the Theory of Remote Sensing, Image Processing of Remote Sensing and the Theory of GIS. The union of university computer networks — Chinese Education and Research Network (CERNET) and Internet provide teachers and students with a more comfortable environment for retrieving data, communication and international interactive distance education (Liu Yanfang et al., 1998; Shi Youyu et al., 1998; Jiang Xin et al., 1998).

6.2 Books and journals

Journals: Remote Sensing Information, WTUSM Bulletin of Science and Technology, Journal of WTUSM, Geo-spatial Information Science, Journal of Image and Graphics, Journal of Remote Sensing, Bulletin of Surveying and Mapping, ACTA GEO-DAETICA et CARTOGRAPHICA SINICA (Journal of Surveying and Mapping).

Books: The Theory and Methods of Remote Sensing (Sun Jiabing et al., 1998), Spatial Information Science, Technology and Its Applications (Li Deren et al., 1998), Photogrammetry (Jin Weixian, 1999), Digital Photogrammetry (Zhang Zuxun, 1999), Urban Information Systems (Lan Yunchao, 1999), The Application Technologies of Remote Sensing (Qiu Zhaoyue, 1999), Urban Remote Sensing (Zhan Qingming, 1999), Present Theories and Technologies of GIS (Gong Jianya, 1999), Digital Elevation Model (Li Zhilin, 2000), The Integration and Accomplishment of Spatial Information System (Li Deren, 2000), Spatial Analysis (Guo Renzhong, 2000).

7 Conferences

1. Advanced Workshop on GIS Software Engineering and Its Related Technologies, January 1997, Wuhan, China
2. The International Workshop on Dynamic & Multi-Dimension GIS, August 25 ~ 26, 1997, Hong Kong, China
3. The 10th National Conference on Remote Sensing, September 1997, Qingdao, China
4. Chinese Remote Sensing Argument Meeting for Young Professionals for 1998, May 1998, Dalian, China
5. Geoinformatics '98 Conference, June 17 ~ 19, 1998, Beijing, China
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