EDUCATION AND TRAINING OF PHOTOGATAMMETRY AND REMOTE SENSING IN CHINA

LI Deren, LIN Zongjian

Department of Photogrammetry & Remote Sensing
Wuhan Technical University of Surveying & Mapping
Wuhan, China

Comm. Ⅵ, ISPRS X Ⅶ Congress, Washington D. C.

Abstract

The progress of education and training for photogrammetry and remote sensing in China is brifely summarized. A general evaluation of the status of photogrammetry and remote sensing education and training in China is given, which incldudes types and degrees of education and training, scale and distibution, facilities and teaching manpower as well as courses and training programme. The tendance of the integration of photogrammetry and remote sensing with GIS has being significant influence on education and training of our discipline in China.

1. Introduction

China has 9. 60 Million $(Km)^2$ area and 1. 16 Billion population. She has to keep the fifth of the whole world population alive with only the fifteenth land area of the earth. Therefore the investigation and rational use of natural resourses and eviroment is very important. For this purpose photogrammetry and remote sensing are very powerful and effecfive means for such investigation.

The Chinese Governmeut pays much attention to photogrammetry and remote sensing activities. In order to meet the need for training and trained manpower in research and application the educational undertaking in photogrammetry and remote sensing in China has developed rapidly during the past 30 years.

The high education of photogrammetry in China has long history. In 1932 the Department of Surveying was set up in the Faculty of Engineering of Tongji University, with photogrammetry as one of its main courses. Since 1949 the high and middle education of aerial photogrammetry were oriented to cartographic map making for more than ten years. Modern remote sensing application in China was initiated in 1972 when satellite image data were provided from Landsat 1. Since 1980 the GIS technique has been gradually used in different disciplines of Geo - scienees after the execution of many remote sensing application projects.

When photogrammetry and remote sensing technology is going ahead rapidly in our country, education and training in Photogrammetry and remote sensing are gaining their own momentum too. In this paper a general evaluation of the status and development trend of education and training in photogrammetry and remote sensing is given [Lin, 1988; Cheng, et al, 1990]

2. Types and Degrees of Education and Training in Photogrammetry and Remote Sensing.

As is the case in many other countries, photogrammetry and remote sensing education in China originate mainly from two sources. One is the discipline of photogrammetry and remote sensing, which estallishes the basic theories and experiences from the processing and application of airphoto or spaceborne imagery, develops the technology along a natural way from analog through analytical to digital and from manual through interactive to automatic, and expands the application field from purely topographic mapping to land information system,

resource investigation, environment evaluation, agricultural planning, forest surveys, rural and urban planning and management. Another source is the disciplines of geography, geology, mine survey, forestry, traffic engineering, civil engineering and hydroelectric engineering etc. Each speciality of them has s strong base in their own discipline. But they accept photogrammetry and remote sensing knowledge to enhance their technology and make definite applications in a special field. According to the percentage of teaching hours to be taken for photogrammetry and remote sensing courses and to the future profession of the students, photogrammetry and remote sensing education in China can be divided into two types, i. e. a dicipline dedicated to photogrammetry and remote sensing and disciplines with remote sensing courses. The offered degrees are listed in Tab. 1

Tab. 1 Types and Degrees of photogrammetry and remote sensing education

Discipline		Degrees Offered				
		Certificate	Diploma	Bachelor's	M. Sc.	Ph. D
Dedicated to photogrammetry and remote sensing	remote sensing	×	×	×	×	
	photogrammetry and remote sensing	×	×	×	×	×
	information engineering	×	×	×	×	
Disciplines with photogrammetry and remote sensing courses	geography, geology, agriculture, forestry, soil science, traffic engineering, hydroelectric engineering, urban planning	×	×	×	×	×

3. Teaching Programme

The contents of courses are very different for different education types, degree levels and universities. Some typical catalogue listings are as follows.

3. 1 Training and education in remote sensing for personnel from general disciplines. (Tab. 2)

A=General disciplines with remote sensing courses
B = Short - term courses with certificates (3 to 5 months)
C=Postgraduate courses with M. Sc. degrees (2. 5 years)
×=Required √=Elective

Tab. 2 Courses in remote sensing for personnel from general disciplines

Course name	Number of hours			Level		
	Lectures	Practical	Tutorial	A	B	C
Physical fundamentals of remote sensing	80	20		√	×	×
Computer processing of imagery	120	40		√	×	×
Optical processing of imagery	40	40		√	×	×
Visual image interpretation	60	20		√	×	×
Remote sensing applications(in geology, forestry, soils, vegetation, environment, oceanography)	each 20—40			√	√	√
Courses in research direction	150	600	50			√
M. Sc. thesis			1 year			×

Universities: Peking University (National Remote Sensing Education Centre of China)
Zhongshan University (Guangzhou)
Zhejiang University (Hangzhou)
Beijing Agricultrual University (Beijing)
Pedagogical University (beijing, Wuhan, Shanhai)
Geology University(Wuhan, Changchun)
Forestry University(Nanijing, Beijing)
Mining industry University(Xuzhou)

3. 2 Training and Education in Photogrammerty and Remote Sensing for Personnel from general disciplines(Tab. 3)

A=Short - term courses with certificates(4 months)
B=Postgraduate diploma courses(1 year)
C=Postaraduate courses with M. Sc. degrees(2. 5 years)
×=Required √ = Elective

Tab. 3 courses in Photohrammetry and remote sensing for personnel from general disciplines

Course name	Number of hours			Level		
	Lectures	Practical	Tutorial	A	B	C
Physical fundamentals of remote sensing	44	10		×		
Aerospace data acquisition	24	6			×	×
Photographic processing	16	8		√	√	√
Topographic surveys	20	80		√	√	√
Adjustment	38	12		×	×	×
Visual image interpretation	20	60		×	×	×
Photogrammetry	40	60		×	×	×
Analytical plotting	10	10		×	×	×
Computer aided cartography	10	4		×	×	×
Digital image processing (A)	20	4	10	×		
Digital image processing (B)	60	20			×	×
Rimote sensing application technology(A)	20	4	10	×		
Remote sensing application technology(B)	60	30	30		×	×
Geo - infoumation systems	40	10	20		×	×
Close range photogrammetry	16	8			√	√
Advanced mathematics	80		30		√	×
Pattern recognition	40	8	20		√	×
Digital Photogrammetry	32	12	20		√	×
Computer software engineering	24	16	20		√	×
Computer interface	12	20	20		×	×
Systems engineering	20				√	×
M. Sc. thesis			1 year			×

Universities:

Nanjing University (Nanjing),Tongji University (shanghai),
Wuhan Technical University of Surveying and Mapping (WTUSM) (Wuhan)
South - West Jiaotong University(chendu)

33 **Dedicated education in remote sensing and geographic information engineering** (Tab. 4)

A=Short - term courses with certificates(5 months)
B=Postgraduate diploma courses(1 year)
C=Postgraduate courses with M. Sc. degree (2. 5 years)

Tab. 4 courses in remote sensing and geographic information engineering

Course name	Number of hours			Level		
	Lectures	Practical	Tutorial	A	B	C
Physical fundamentals of remote sensing	44	10		×	×	×
Aerospace data acquisition	24	6		√	×	×
Adjustment	38	12		√	×	×
Visual image interpretation	20	60		×	×	×
Photogrammetry	40	40		×	×	×
Computer aided cartography	10	4		×	×	×
Digital image processing	60	20		×	×	×
Remote sensing application technoloyg	60	30	30		×	×
Resource investigation and evaluation	40	60			×	×
Environmental monitoring and planning	26	34			×	×
Regional and town planning	32	48			×	×
Economics for resources and environment	34	6		×	×	×
Remote sensing information systems	40	20	10	×	×	×
Urban information systems	20	20	10		×	×
Pattern recognition	40	8	20		√	×
Systems engineering	20				√	×
Computer software engincering	12	20	20		√	×
Computer interface	24	16	20		√	×
M. Sc. thesis			1 year			×

University; WTUSM

3. 4 **Dedicated education in photogrammetry and remote sensing(4 year, bachelor's degree)** (Tab. 5)

Tab. 5 courses in Photogrammetry and remote sensing (4 years)

Subjects	Hours					
	Introductory		Intermediate		Advanced	
	Lecture	Lab	Lecture	Lab	Lecture	Lab
Group A; math, science an engineering						
1. Mathematics	200	100			45	16
2. Physics.	120	50				
3. Earth science	50	32				
4. Computer science	42	36	30	20	20	10
5. Engineering	122	51				

Tab. 5 (continued)

Group B: surveying and mapping						
6. Geodetic positioning			75	26	40	10
7. Gravity field determination			35	4		
8. Adjustmant			100	40		
9. Plane surveying	50	50	40	120	40	120
10. Engineering and mining surveys						
11. Hydrographic surveying						
12. Legal surveying					40	40
* 13. Photogrammetry and remote sensing	80	90	40	15	220	250
14. Digital mapping						
15. Land information systems					40	60
16. Cartography			70	35		
Group C: non - technical						
17. Land and business law						
18. Planning						
19. Econmics and management					30	30
20. Humanities					30	20

Universities: WTUSM(Whan) Tongji University(Shanghai) South - West Jiaotong University (Chendu)
Zhengzhou Institute of Surveying and Mapping (Zhengzhon)

* This course includes fundamental photogrammetry, analytical photogrammetry, digital photogrammetry, Principle and Application of remote sensing.

3. 5 Dedicated educationin Photogrammetry and remote sensing (2. 5 years. M. Sc. degress) (Tab. 6)

Tab. 6 courses in photogrammetry and remote sensing(2. 5 years, M. Sc. degress)

Course name	Hours	ID
Principles of Photogrammetry (with remote sensing)	80	×
Matrix algebra	60	×
computation methods	60	×
Parameter Estimation and Advanced Adjustment	60	×
Computer Graphics	40	√
Englich	120	×
German	60	√
Relialility Theory	40	√
Digital Image Processing (high level)	60	√
Computer Vision	60	√
Date Bases	40	√
Artificial Intelligence expert systems	50	√
Modern Photogrammetry and Remote sensing	40	√

University: WTUSM; South - West Jiaotong University;
Zhengzhon Institute of Surveying and Mapping
×=Required, √=Elective.
Each postgradrate student has to elect least 3 Courses from these elective courses.

3. 6 Education in Urban - Rural surveying, planning and management(Tab. 7)

A=Short - term course (1 to 3 months)

B=Short - tem course(3 to 6 months)

C=Postgraduate course (18 months)

D=M. Sc. degree (30 months)

Tab. 7 Courses in urban - rural surveying, planning and management

Course name	Number of hours		Level			
	Lectures	Practical	A	B	C	D
English(writing,reading,speaking,translation)	240				×	×
Dialectics of nature	80				×	×
Operations research	80				×	×
Fuzzy set theory	60				×	×
Principles of systems engineering	60				×	×
Basic photogrammetry	30	20	×	×	×	×
Aerial photography and remote sensing techniques	36	14	×	×	×	×
Cadastral surveys	36	14			×	×
Urban/rural airphoto interpretation	40	60	×	×	×	×
Urban organzation and planning	30	10			×	×
Urban/rural planning and management (including physical aspects)	40	10			×	×
Personal compuetr AT database princeples	50	70	×	×	×	×
Computer aided cartography	30	40		×	×	×
Urban/rural ecology and enviromnental planning	28	12		×	×	×
Urban/rural planning information systems (USEMAP and MASMAP)	40	60			×	×
Urban/rural economic information systems	30	10			×	×
Municipal information systems	30	10			×	✓
Earth resources information systems	30	10			×	×

	A	B	C	D
Case study(Hangzhou)		two weeks	three months	one year
M. Sc.				

University: WTUSM (Cooperation with ITC)

4. Facilities, Teachers and Students

In regard to training purpose and type of education, the facilities are very different beween the universities. However, the actual status, in many cases, can meet the needs of essential practical teaching, Some simple pieces of equipment, such as stereoscopes, transferscopes and light tables, can be supplied to nearly every student. In photogrammetry and remote sensing departments, every student can arrange to have several hours for practical operation of photogrammetric plotters of high precision including analytical plotters. In recent years, Chinese institutions have purchased a certain amount of digital image processing equipment, among which there are about 60 sets such as DIPLX (Canada) of I^2S(United States). Now, more than 10 universities are equipped with digital image processing systems, both on workstation and PC computers.

Nearly all the universities offering remote sensing courses have good teaching environments, such as classrooms and television demonstration tools. and possess strong teams for teaching basic courses, e. g. mathematics, physics, chemistry, geography and comprter science. Through several years of teaching and research in remote sensing, the teaching staffs have already gathered experience. About 30 percent of the remote sensing lecturers in the key universities have been abroad to acquire advanced knowledge of training. Many distinguished experts from abroad have been invited to give lectures in Chinese universities and research institutes.

At present, more than one hundred universities and colleges have opended courses about remote sensing technology. Among them the Wuhan Technical University of Surveying and Mapping, Zhengzhou Institute of Surveying and Mapping and South - West Jiaotong University have estallished departmant of Photogrammetry and Remste sensing with about 1000 students, 50 Post - graduate students and 20 doctor

candidates. A section of remote sensing geology has been set in Department of geology of Zhejiang University. The rest universities have opened 1 — 3 course concerned remote sensing. There are various kinds of universities in remote sensing, such as universities directly under the leadership of State Education Commission, universties administrated by Ministry of Mieral Resource, Ministry of Agriculture, Ministry of Forestry, Ministry of Railway, Ministry of Hydrology, Bureau of Survey and Mapping, Bureau of Meteorology, and some military universities. There are many disciplines to connect with remote sensing technolgy, geography, gelolgy, agriculture, forest, aerophotography and mapping, oceanography and hydrology, mathematics, computer science, physics and electronics, Among them, department of geography opened the most amount courses concerning remote sensing, 39% of their total courses, Depurtment of geology stands second 15%, Department of aerophotography occupies 12%, Department of agriculture has 10%, Department of computer science has 6%, courses connected with remote sensing.

Peking University had opened a course "an introduction to remote sensing" for selections of whole university students. According to statistics, the number of students to take remote sensing courses are as follows:
geography, 60;
geology, 100;
computer science, 70;
geophysics, 20.
The total number is about 450 per year. Based on this figure, we estimate 5,000 students to attend remote sensing lectures in our country every year.

5. Future Trends and Conclusions

As stated above, education and training system with several degrees/levels and for dfferent disciplines has been estallished in China for photogrammetry and remote sensing.

The recent development of photogrammetry and remote sensing shows that [Ackerman, 1992]

(1) Computer technology has launchde vast improvements of performance;
(2) The natural result has been a great methodical and thematic expansion which is giving our discipline a new status, new self - confidence and vastly extended application.

As consequence photogrammetry and remote sensing are operating and interfacing with more general fields like computer vision, spatial information system, digital image processing, computer science, aerospace science. With these drastic changes our discipline has being now from photogrammetry that be longs to classical geometry science to iconic informatics that belongs to modern infromation science [Li, 1992] In order to meet the demands of these changes the future education and training in photogrammetry and remote sensing must be reformed, renewed and extended from time to time. The quality of future education concepts will have to be measured with criteria like [Gruen. 1990]:

* Comprehensive thinking in the context of systems as opposed to the control of spotted skills;
- Creative, independent thinking as opposed to receptive learning; intellectual education instead of pure conveyance of facts;
- Capalility for interdisciplinary and team work complementary to individualised study ability;
- Flexibility of curriculum with respect to fast adaptation to quickly changing technologies and professional conditions as opposed to static, frictional, everlasting concepts;
- Project oriented coursework and exemplary studies as opposed to striving for competeness in the conveyance of detailed procedural knowledge;
- Modularity of curriculum with respect to the consideration of permanent continuing education as opposed to the concept of a one - in a - lifetime grogram;

For the engineer in photogrammetry and remote sensing it will be of utmost importance in the future to acquire a bette understanding of mang areas in basic subjects like mathatics and physics (also English for Chinese engineer) and in supporting subjects like electrical engineering, computer science and information theory. This will provide for a solid

basis for technical flexibility and the a blity to acquire new technical knowladge without excessive expenditure.

Although China has made a great progress in education and training of photogrammetry and remote sensing there are still very hard works that we have to be done in the future in order to meet the demands of "Four Modernization" of China.

[References]

Ackermann, F. (1992): Strukturwandel in der Photogrammetrie, ZPF, 1/92

Cheng J. et al. (1990): The Remote Sensing Education in China, Proceedings of the 11th Asian Conference on Remote Sensing Nov. 1990, Guangzhou, China.

Gruen, A (1990): A Modern Approach to Photogrammetric Curricula, Invited Paper to ISPRS Comm. VI Symposium, 13 — 16 september, 1990, Rhodes Island, Greece.

Li, D (1992): From Photogrammetry to Iconic Informatics, ZPF, 1/92

Lin, Z. (1988): The Status of Remote Sensing Education and Training in China, Education and Training In Remote Sensing for the ESCAP Region - Report of the Working Group Meeting, 11—14, Oct. 1988 Wuhan, China