DIRECTION OF DIGITAL IMAGE ANALYSIS TRAINING THROUGH THE 28 YEARS EXPERIENCE

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ABSTRACT:

Remote Sensing Technology Center of Japan (RESTEC) has been organizing various kinds of remote sensing training programs since RESTEC was established in 1975. Among them, remote sensing training course intended for engineers of developing countries has been organized, under the trust of JICA (Japan International Cooperation Agency) since 1978. This course mainly consists of 4 parts. First is classroom lecture about basic principles and various kinds of applications of remote sensing. Second one is practical hands-on training of digital image analysis using MS-Windows PC and analysis software developed on our own and free of charge. Third one is focused on local area hands-on training. Participants visit Japanese local universities and execute a practical training, ground truth and sea truth. Last one is presentation of action plans based on the application of remote sensing. The curriculum design is required to be changed due to the popularization of Information Technology (IT) and Internet. Before spreading of the Internet, engineers in developing counties almost had no chance to take a lecture and training except for attending such kind of training. Though it was able to learn on one's own PC by using textbook, it was impossible to discuss interactively with lecturers. Therefore, the lecture took important position in the training course. However, it is able to have interactive lectures through Internet called as "e-learning". JICA have started remote lecture system in 2005. However, digital analysis and ground truth training is still difficult to be executed through cyber space. Inevitably, our training courses' proportion of lecture and hands-on training were forced to increase the hands-on training course. This paper describes the historical changes and a new aspect of our training course including the application usage of Japanese new earth observation satellite ALOS.

1. INTRODUCTION

Remote Sensing Technology Center of Japan (RESTEC) has been holding various kinds of training courses of remote sensing technology. We have 2 kinds of courses in domestic training course, which are fundamental remote sensing course and Synthetic Aperture Radar (SAR) course. We hold 10 times above courses per annum. International course are held 2 or 3 times per annum. Main course is executed under the trust of JICA. It holds over 2 and half months and be held in Japan. Other course is held irregularly, which takes a caravan style to go around Asia region. Both courses we instantaneously adopted PC-based training in 1987 and analysis software are developed on our own. Hardware and software are taken into account to adopt the newest trend. Also curriculums are changing due to popularization of the new infrastructures, which is Internet and IT. Based on such circumstances, we describe our now and future framework of training courses taking into accounts Japanese newest satellite "ALOS".

2. TRAINING ENVIRONMENT

2.1 Hardware Environment

Computer environment is dramatically improved in this recent 10 years. At the incunabula of digital image analysis training, computer was mainframe system and 3 or 4 trainees used at one computer's terminal. Next generation, computer system was changed to UNIX system. Also it is difficult to prepare the X window consol for each trainee due to the problem of cost. The third generation is windows PC. Nowadays, the potential power of windows PC is enough to execute not only image display but also executing heavy image processing like SAR image reconstruction from raw SAR data. Therefore, PC environment prepared for our training course is sustainable for such kind of image processing. Due to the low price of windows PC's hardware, we can prepare PC for each trainee and they can comparatively be easy to create the same PC environment as our training after they back to their countries. It is big improvement because the trainee can use the learned knowledge and techniques directly at their office without preparing anything. The following items show the spec of PC

we used in this training course;

- OS : Windows XP Professional (English)
- Style : Laptop PC
- CPU : Pentium4 2.0GHz
- RAM: 512MB SDRAM
- DISPLAY:12 inch 1024x768pixels, Full Color display
- LAN : IEEE802.b/g Wireless LAN

2.2 Software Environment

The commercial software for remote sensing data analysis is too expensive for not only people in developing countries but also people in developed countries and this price prevent us from using commercial software for all trainees. Though it has very easy to use and have good GUI human interface, the essentials of analysis theory cannot appear clearly and sometimes it seems to be a "BLACKBOX". Therefore, we mainly use the software of which developed our own for training. The name of software is "Remote-10/Win". Basic components of this software was made in the middle of 80's for MS-DOS PC/AT compatible machine and has been developing to adjust current remote sensing techniques and Windows OS environment. This software has following functions;

- Display image in full color
- Import CEOS image
- Geometric Correction
- Land Cover Classification
  (Supervised and Unsupervised)
- Band Operation (Ex.: Calculation of NDVI)
- Resolution Merge (Use HIS conversion)

We also develop the SAR data analysis training software on our own. This software focuses on the Japanese SAR satellite JERS-1 and ALOS. This software has following functions;

- Image reconstruction from RAW SAR data.
- SAR Interferometry Processing
- Differential Interferometry Processing
- Orthorectification of SAR image using DEM

Fig.1 shows the software interface of InSAR processing.

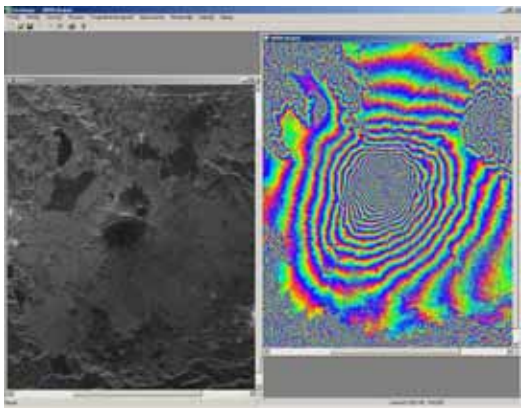

Fig.1 InSAR processing software

2.3 Other Environment

It is necessary to prepare the surrounding environment of training as well as hardware and software. Especially Internet environment is imperative nowadays. Because trainee use Internet not only for research but also as dictionary, making report and sometimes writing e-mail to their families or stuffs in their office. We prepared wireless LAN system to each trainee's PC and it can use freely. However, it needs careful operation to open Internet freely to the trainee due to the damage of computer virus.

Fig.2 Classroom lecture

3. CURRICULUM OVERVIEW

Training course curriculum mainly consists of 4 parts: classroom lecture, ground truth / sea truth, hands-on training, designing action plan. The period of our remote sensing training course is more than two and half months and the number of trainee is about 10 people / Year in average. This section describes the characteristics of each curriculum contents. Typical curriculum schedule is shown in following items;

Day 1-5 <Classroom Lecture>

- Introduction of remote sensing
- High resolution optical sensor remote sensing
- Thermal InfraRed remote sensing
- Hyperspectral sensor
- SAR remote sensing
- Atmosphere and Ocean remote sensing
- Satellite Data structure and Format
- Land environment monitoring
- GIS and remote sensing

Day 6 <Ground truth training>

- Ground truth training

Day7-24 <hands-on training at RESTEC>

- Interpretation of Satellite image
- Geometric Correction and HSI data fusion
- Land Cover classification and Field Evaluation

- SAR Interferometry
- SAR and Optical sensor data fusion
- Disaster monitoring using remote sensing data
- Searching satellite image through internet

Day25-26 <Application oriented training to governmental institutes>

- Geographical Survey Institute
- Public Works Research Institute
- National institute for Rural Engineering

Day27-33 <Hands-on training at Japanese local area>

- Sea Truth training (At Kanazawa)
- GIS and disaster management (At Hiroshima)

Day34-39 <preparation of action plan report>

- Discussion with lecturer and making a report

Day40 <action plan presentation>

3.1 Classroom lecture

There were 10 kinds of classroom lectures in 2006. Before the popularization of Internet, the numbers of the classroom lecture were maximum 20. However, each trainee can learn basic principles of remote sensing using e-learning system through cyber space. JICANET, which have started in 2005 is the remote education system through Internet and trainee can join the lecture through the Internet. They have no reason to come to Japan only to learn the classroom lecture. Therefore, we reconstructed curriculums to reduce the number of classroom lecture and only essential lectures are remained.

The target participant of this training course is for the first time to use satellite image data. Therefore, the lecture starts from fundamentals and introductions of remote sensing at first. Then, basic lecture about theory of optical and microwave remote sensing and next is lecture about land, atmosphere and ocean remote sensing applications. Then, lecture about GIS and satellite data format are held at last. These contents are readjusted in every 5 years. The first time of this training course, this course had many hardware introduction and analog photo interpretation lectures. However, such contents were reduced to adjust current remote sensing technologies.

Fig.3 Ground truth training

3.2 Hands-on training

Hands-on training is the most important part of this program. Because it is almost impossible to communicate the technical know-how and to discuss with trainee about analysis results through Internet. The new training made recently is “Disaster monitoring using remote sensing data”. In recently, the huge natural disasters are occurred so many times in this several years on all over the world and they are something related with global earth environmental change. The remote sensing techniques have a potential to prevent and reduce the damages from such kind of disasters. Therefore, we adjusted such trend to make use of our remote sensing data analysis experience as Sumatra tsunami event in 2004 (Tanaka et al., 2005).

Fig.4 Hands-on training

3.3 Make Action Plan report

It is very essential to confirm how trainee acquired the knowledge and techniques from the training. To examine this, we imposed a report about hands-on training and ground truth training on each trainee until 3 years ago. However, this confirmation style could only check the improvement of trainee’s proficiency. Also, we are sometimes required estimation about the cost-effectiveness of training course. Therefore, we changed the confirmation style to impose action plan report on each trainee and finally we hold an action plan presentation meeting. We can check not only their improvement of proficiency but also how the learned techniques are useful for their job. However, it is very difficult to make a complete action plan report. Therefore, we prepared one week for making action plan at RESTEC’s training room. At least one lecturer always remain in this room and if the trainee has a question or problems which is difficult to solve on their own, lectures can discuss and advise every time. Trainees can use the same PC as used in their training for making action plan report. This PC can use also wireless LAN system to connect Internet and trainee can use Internet freely for research and making action plan. We lead them to make an action plan that other staffs in their office can understand what they want to do to use remote sensing techniques when they go back to their country and write as

concrete as possible. For example, budget and times for achieving their plan, the number of person to need, infrastructure to promote the plan, and the problem to be expected.

Through the discussion between trainee and lecturers at the action plan presentation, more constructive and concrete future plans for the application of remote sensing technologies can be effective for each trainee, we hope.

4. METHOD FOR EFFECTIVE USE OF ALOS DATA IN OUR TRAINING

On January 24, 2006, Japanese new satellite named " ALOS" was launched successfully. ALOS is the abbreviation of "Advanced Land Observation Satellite" and Japanese name is "Daichi" meant the "Mother Earth". ALOS have 3 kinds of sensors that are PRISM (Panchromatic Remote-sensing Instrument for Stereo Mapping), AVNIR-2 (Advanced Visible and Near Infrared Radiometer-2), and PALSAR (Phased Array type L-band Synthetic Aperture Radar). One of the main purpose of ALOS is to make a world map of 1:25000 scale. PRISM has 3 different observation sensors at the same time, which is forward view, nadir view and backward view. Its spatial resolution is 2.5m. It is hoped that quite precise Digital Surface Model (DSM) can be created by PRISM sensor. AVNIR-2 is a multispectral sensor, which equipped RGB and Near InfraRed (NIR) observation spectral bands with 10m spatial resolution. PALSAR is the only sensor spaceborne SAR sensor that equipped L-band. To enhance these features of ALOS data in our training, we are planning following training training subjects;

- Resolution merge (Pansharpen) of AVNIR-2 and PRISM
- DSM extraction and Stereographic view training using PRISM data
- SAR Interferometry processing of PALSAR data
- Orthorectification of PALSAR image using DSM created by PRISM stereo pair

Now ALOS satellite is under the Calibration and Validation phase and goes to normal operation phase on October 2006. Therefore we have been preparing above training curriculums for the training program of fiscal year 2007.

5. CONCLUSION

We have been holding satellite data utilization training for foreign engineers during 28 years. To keep the quality and quantity of training, we struggled to improve not only software and hardware but also training environments and effective curriculum arrangement. The software and hardware are needed to be improved along with the advance of technical trends. Curriculums also need readjustment to technical trend and circumstances of training environments. Also, we impose each trainee to make action plan to see clearly the use of what they learned in this training course. Summarizing what they learned in the action plan report style is very effective for both trainees and lecturers because trainees can remind how to use what they learned and lecturers can understand what they want to do to the remote sensing techniques and what is lacked in our training course, and to prove the high cost-effectiveness of this training course.

The world-wide promotion of Japanese satellite data, especially ALOS is also our important task. There are so many developing countries, which have insufficient 1:25000 scale maps. We continue to dedicate the world-wide capacity building of remote sensing techniques through the use of ALOS data for our training curriculums in a positive way.

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