ESTABLISHMENT OF VALIDATION FIELD FOR SATELLITE REMOTE SENSING IN SHIKOKU, JAPAN

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ABSTRACT:

Though remotely sensed satellite imageries are increasingly accessible to Geoinformatics societies, the disparity between spatial grid in satellite data and geographic information are needed to coordinate for the societies. The coordination will be effectively eased to apply to the societies. On the other hand, the development of web technology is enhancing the information technology more advantages.
Three databases are established for validation field. The establishment of the validation field for satellite remote sensing will be very useful for the societies to coordinate geosciences researches. The databases are GCP database, mountain tracking database and vegetation spectral database. Above 500 GCPs are collected together with photographs. The GCPs cover the area of about 20,000 km^2 and are widely spreading throughout the Shikoku, Japan. The mountain tracking data are collected by hiking the peaks of Shikoku Island's mountains. Useful data are collected along mountain tracking such as collection of waypoints with photographs and surrounding land-cover information and tracking the route. All mountain tracking routes are archive after the field excursions. For vegetation spectral database, sample trees leaves photographs and their spectral data are collected using spectrometer under the laboratory condition. Weekly data are achieves from these data. Amount these three databases, GCP database and mountain tracking database are completed to open web-publication while vegetation spectral database is on the implementation stage.
The databases are published through the internet to all societies with free of charges. The important beneficial contribution of the works to the societies are GCP database can improves satellite image registration and geometric correction, mountain tracking database can helps validating the satellite image classification and vegetation spectral database can apply in validation of spectral classification methods. Thus, these works filled the gaps of three corners of Geoinformatics which are extremely requires by the societies in raster and vector integration. Moreover, the procedures on field work management, field work scheduling and group trip planning were indirectly benefits to the students and researchers of host institution.

1. INTRODUCTION

"Asia Onward Space Age" the theme was announced in ACRS 30th. Most of countries in the region have their own satellites. Regarding Japan is one of advance technologies leading countries in the region; they launch many earth observation satellites to the space and orbiting the earth and providing a lot of remotely sense images. Though satellite images are widely used in the science and engineering applications, validated datasets are requiring for remotely acquired images for their consistency in accurate applications.

Referring the requirement of remote sensing applications; at least GCPs database should be developed for a validation field. Moreover, whilst other databases such as spectral reflectance of vegetations and route tracking in mountainous area are available the validation field will be more applicable.

ALOS satellite images were processed over four testfields: Piemont, Italy, Bern/Thun, Switzerland and Saitama and Okazaki, Japan (Kocaman, S. and A. Gruen, 2007). Although the testfields are considered for one scene of PRISM imagery with extent of 35 km x 40 km on the ground, a wider area should be considered to verify the consistency of image mosaic. Whilst the wide coverage is considered mosaic multi-image registration and images mosaic could be possible to validate.
Author's laboratory selected the whole area of Shikoku Island of Japan as a wide validation field covering 18,803 km^2.

2. VALIDATION FIELD

2.1 Location

Shikoku is selected as validation field in Japan. The Shikoku is the 4th island of Japan located western territory (figure 1). Remote and mountainous conditions make the area extremely in the need of validation. The establishment facilitates the area with high accurate in infrastructure.

Figure 1. The location of validation field

The Shikoku has four administrative prefectures: Ehime, Kagawa, Kochi and Tokushima. Regarding AVNIR-2 image, the extent of the image is 70 km x 80 km with four spectral bands. Altogether 16 AVNIR-2 images could be verifying in selected validation field (figure 2).

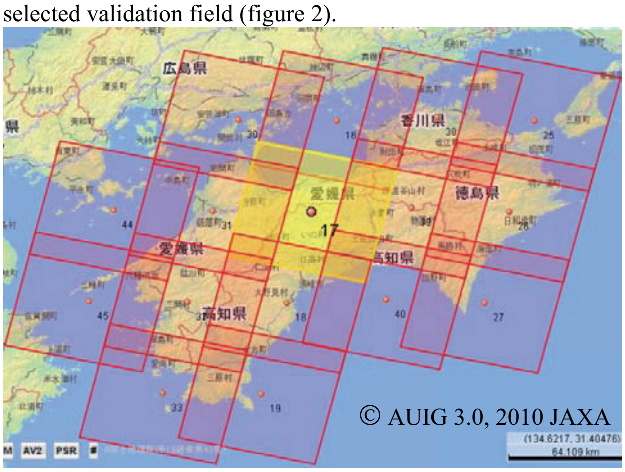

Figure 2. The grid of AVNIR-2 images over validation field

Selection is done by the excellent accessibility from the University where the databases are initiated. Moreover, the validation field area is very remote area of Japan and it is demanding the precise geolocation by hilly geography.

In case of image registration, whilst 20 GCPs are considered for an image, about 320 GCPs are required to cover the whole area of the validation field. Thus, many GCPs are required to collect. Recently, over 500 GCPs are published through the internet.

2.2 Accessibility

Being that the databases are developed in the Takagi laboratory of Kochi University of Technology, the university is located with advantage to access the whole Shikoku Island within one day drive.

2.3 Model

Developed databases will be provided to public through the internet. The publishing model is presented in the figure 3. Recently three databases are involved.

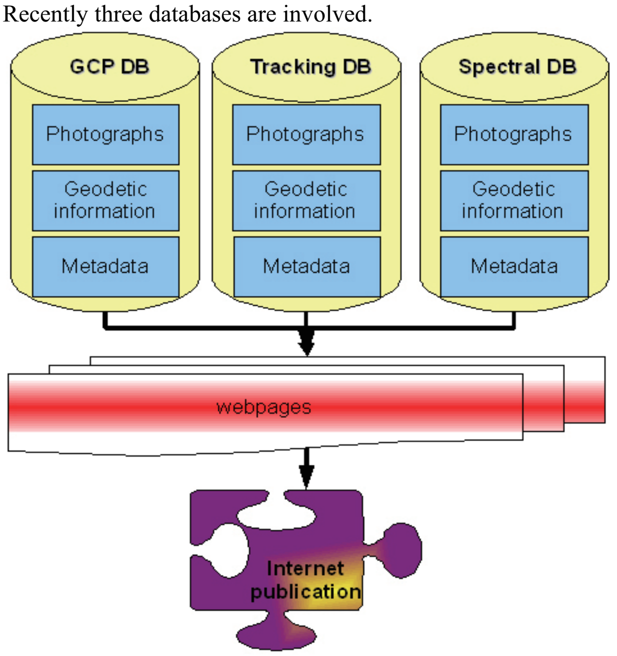

Figure 3. The development model

3. GCP DATABASE

GCPs are required by precise satellite images registration, even though RPC camera replacement model is used in geometric correction (Grodecki 2001, Hu and Tao 2001, Tao and Hu 2001, Jacobsen, K., 2003, Grodecki et al. 2004, Hashimoto, T., 2006, Clive S. Fraser and Mehdi Ravanbakhsh, 2009). To fulfill this requirement, a very useful and very precise GCP database was developed in the Takagi laboratory and public to researchers through the internet (Kojima et al. 2009). The GCPs are collected used VRS-GPS (RTK or static measurement) advance geodetic surveying device.

3.1 Field Survey

Several field surveys are conducted around the whole island of Shikoku using the VRS-GPS. In the procedure of GPS field survey, three steps are important to be noticed. They are planning, implementation and recording.

A successful field survey is started by well plan. First of all, location waypoints are selected visually on the available raw images. Whilst the points are surely visible, the route map is draw for a day drive on the available free web-map (e.g. google earth, goo map).

The route map should bring along with the field survey to locate the pre-defined waypoints. The second step of the field survey is driving the pre-defined points through planed route and doing GPS survey on selected waypoint. At least two persons are required to finish field survey smoothly.

3.2 Database Development

Field data are digitally collected by the VRS-GPS device and a digital camera. Both of them are downloaded to the workstation computer machine in laboratory and named the data file and transferred to the related folder of the web-server. Publication information is organized to a web page by the xml program to publish to the internet.

3.3 Publication

Webpage is mains media in the publication (figure 4). A webpage composes of photographs, image subsets, geodetic data and location information. Geodetic information has 2 centimeters accuracy and it is very useful for geometric correction of very high resolution satellite images. Validation of the GCP for ALOS-PRISM using 3D projective transformation model produced 1.3 pixels (Kojima et al., in press).

Figure 4. Publish GCP database

4. MOUNTAIN TRACKING DATABASE

Mountain tracking and field data collection is implement meanly in the summer season by Takagi laboratory members. Most of the highest mountains in the Shikoku are observed since 2009 summer. Waypoints are selected from false color composite image of AVNIR-2. Selection of waypoints from different color of FCC image is one of important facts in the tracking database (figure 5).

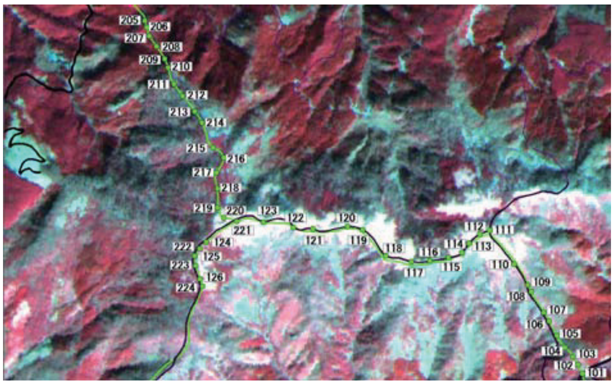

Figure 5. A route on AVNIR-2 image with selected waypoints

4.1 Field Survey

A check list is developed (table 1) in field survey of mountain tracking database. Responsibility of each member is appointed in pre-organizing meeting.
Drawing route map, selecting waypoints and choosing the way to approach the starting points are pre-event tasks for the trip.

Table 1: check list for before and after trip

Check list

No.	Tools to bring	before	after
1	handy GPS	O	O
2	GPS lodger	O	O
3	clinometers	O	O
4	route map	O	O
5	digital camera	O	O
6	tripod for camera	O	O
7	2 elevated poles	O	O
8	transceivers	O	O
9	medical box	O	O
10	note PC	O	O
11	battery	O	O
12	tree guide books	O	O
13	topographic map and compass	O	O
14	note books	O	O

Two important things before departure for the trip are need to adjust the camera time with GPS and need to open the GPS lodger before leaving. The adjustment of time between devices is very useful to synchronize the photographs on to the tracking route.

4.2 Database Development

The same procedure which used in GCP database development is done in tracking database development. The main development media is xml program for the webpage generation. All collected data are finally transferred to the web-server with specific file name.

Figure 6. Mountain tracking database

Tracking database (figure 6) is dedicated to land-cover applications. Vegetations of four directions plus above the ground are observed by shooting photographs from all waypoints.

4.3 Publication

Mountain tracking database publication includes photographs of vegetation cover of each waypoint (figure 7). However, the geodetic information of waypoints are poor in precision, the database dedicate to different type of vegetation covers to support satellite image interpretation and validation.

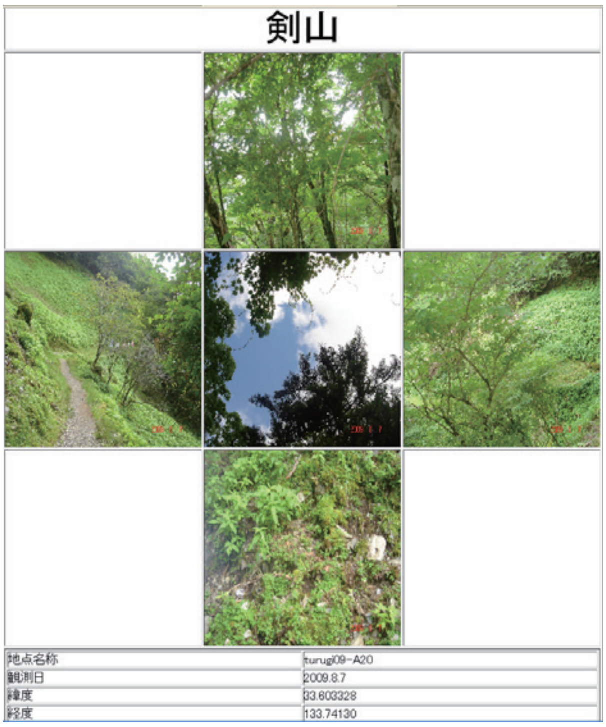

Figure 7. Published tracking database

The photographs present seasonal vegetation of waypoint locations in the web publication. Waypoints are defined based on the different colors on FCC image of AVNIR-2. On the other hand, most of tracked routes are intersected over transacted vegetations which appear by the elevation differences and temperature differences.

5. SPECTRAL DATABASE

4.1 Field Survey

Eight types of trees are selected for creating spectral database including evergreen tree, evergreen conifer tree, and deciduous tree (table 2).

Table 2: sample trees for spectral collection

No	Name (Japan)	Name (Scientific)	Name (English)	Forest Type
1	ヒノキ	*Chamaecyparis obtuse*	Japanese cypress	Evergreen conifer
2	イチイカシ	*Quercus gilva*	oak	Evergreen
	アラカシ	*Quercus glauca*	blue Japanese oak	Evergreen
3	ケヤキ	*Zelkova serrata*	zelkova	Deciduous
4	クヌギ	*Quercus acutissima*	sawtooth oak	Deciduous
5	クス	*Lauraceae Cinnamomum*	camphor	Evergreen
6	ササ	*Bambusioideae*	bamboo grasses	Deciduous
7	シイ	*Castanopsis*	sieboldii	Evergreen
8	スギ	Cryptomeria japonica	cedar	Evergreen conifer

Sample trees are chose near to the developer laboratory and the leaves are collected by assigned laboratory member weekly.

4.2 Database Development

Different ages of leaves are collected from a tree and photographs are taken as show in figure 8. On the other hand, the spectral of each leaf are collected by spectrometer (Ocean photonics® USB4000).

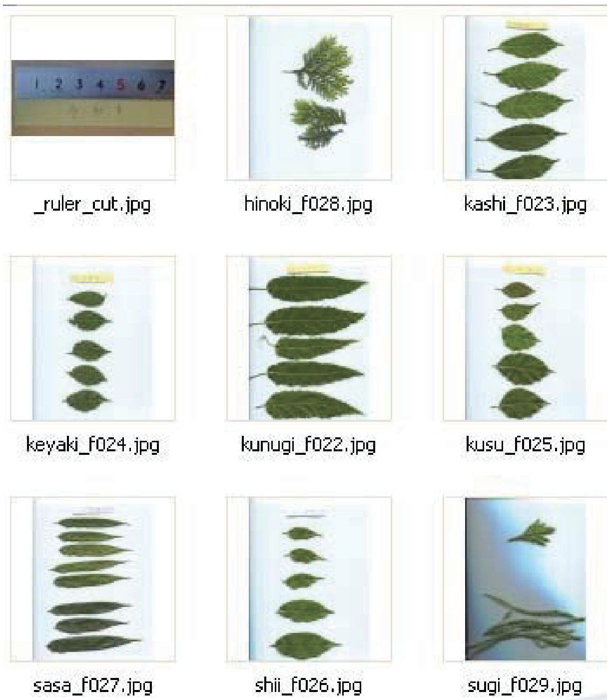

Figure 8. Sample leaves

The spectrometer is able to observe spectral range of the leaf from 200 nm to 1100 nm. A collected spectral subset for sample leaf is presented for each tree (figure 9). Although a set of spectral is presented in the paper, the spectral of front and back of the leaves are scanned and added to the database.

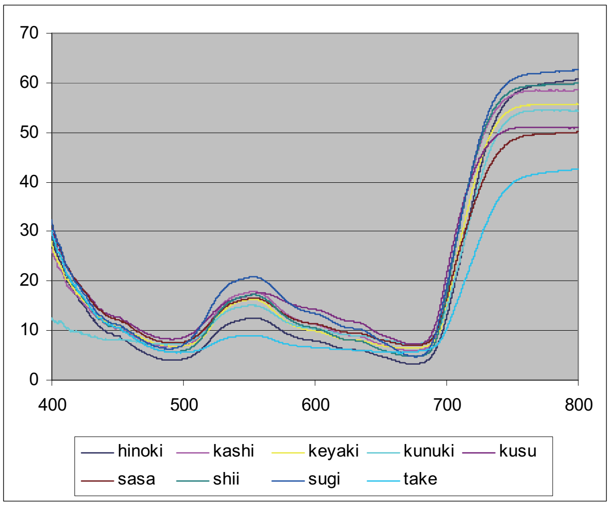

Figure 9. Spectral data of sample leaves

This spectral database dedicated to support satellite image applications such as tree types classifications, forest cover-mapping and forest classification.

4.3 Publication

The publication will be on the website. Recently this database is under the development. Spectral data and leaf photographs will be linked to their tree location on the internet webpage (figure 10).

Figure 10. Publish sample trees of spectral collection

All above database are overlaid on the basic topographic data which are public from Geospatial Information Authority of Japan (GSI). WebGIS technology assists these databases integration.

6. CONCLUSION

GCP are evaluated with ALOS PRISM image and the evaluation result shows almost enough accuracy of GCP for PRISM data. On the other hand, accuracy of the GCP will depend on identification of GCP on the satellite image. Data from the GCP database are already applying by satellite remote

sensing researchers for their research purposes especially on geometric correction their satellite images.
Some important facts are found in these works. They are:

- well preparation before field surveys,
- good team works,
- good management, and
- safely work done.

Data storage will be one of considering option for the future database expansion.

Finally, author would like to conclude that all these data are available through the internet without fees and the web address is http://www.infra.kochi-tech.ac.jp/takalab/ (figure 11).
All data are dedicated to research and user communities.

Moreover, Professor Masataka Takagi would be very happy to response your further inquires about further collaboration and technology transfer.

Figure 11. Home page of Takagi laboratory

Even though webpage design can be changed without notice, accessibilities to the databases will being exist though the web-links.

7. FUTURE WORKS

Vector-line GCP will develop for the place where point GCP collection is difficult.

Even though GCPs are verified using PRISM image, the consistency of GCP will be confirmed by other sensor images.

More mountain tracking routes and their data will be observed and added to the recently database.

Other species of trees will be observed and will be added to the database library.

Moreover, observation of spectral of other features such as soil, asphalt, concrete and water can be future tasks.

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