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Monitoring of Graveyards in Mountainous Areas with Simulated KOMPSAT-2 imagery

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Abstract: The application of simulated KOMPSAT-2 imagery to monitor graveyards is to be developed. Positions calculated from image were compared with those obtained from Geographic Positioning System. With 24 checkpoints, the position of graveyards showed within 5-meter range. Unsupervised classification, supervised classification, and objected-orientation classification algorithms were used to extract the graveyard. Unsupervised classification with masking processes based on National topographic data gives the best result. The graveyards were categorized with four types in field studies while the two types of graveyards were shown in descriptive statistics. Cluster Analysis and discriminant analysis showed the consistency with two types of tombs. It was hard to get a specific spectral signature of graveyards, as they are covered with grasses at different levels and shaded from the surrounding trees. The slopes and aspects of location of graveyards did not make any difference in the spectral signatures. This study gives the basic spectral characteristics for further development of objected-oriented classification algorithms and plausibility of KOMPSAT-2 images for management of mountainous areas in the aspect of position accuracy and classification accuracy.

Keywords: graveyard, KOMPSAT-2 simulated images, GPS, rule-based classification.

1. Introduction

The burial culture has prevailed in our country because of the effect of Confucianism. By the way, tombs have had a negative effect on the vista of national land and caused an ineffective use of national land recently. For this reason, the systematic management of the tombs is necessary.

1) Study Purposes

The first purpose is to identify tombs' geographical coordinates from ortho-image and to analysis algorithms for extracting tombs on the satellite image. The second purpose is to check out the potential classification methods. The last one is to clarify the spectral signature of graveyards with statistical analysis.

2) Methods 1

We've used one IKONOS-2 image for those purposes, because it's very similar to KOMPSAT-2 image's characteristics that will be launched in 2005.

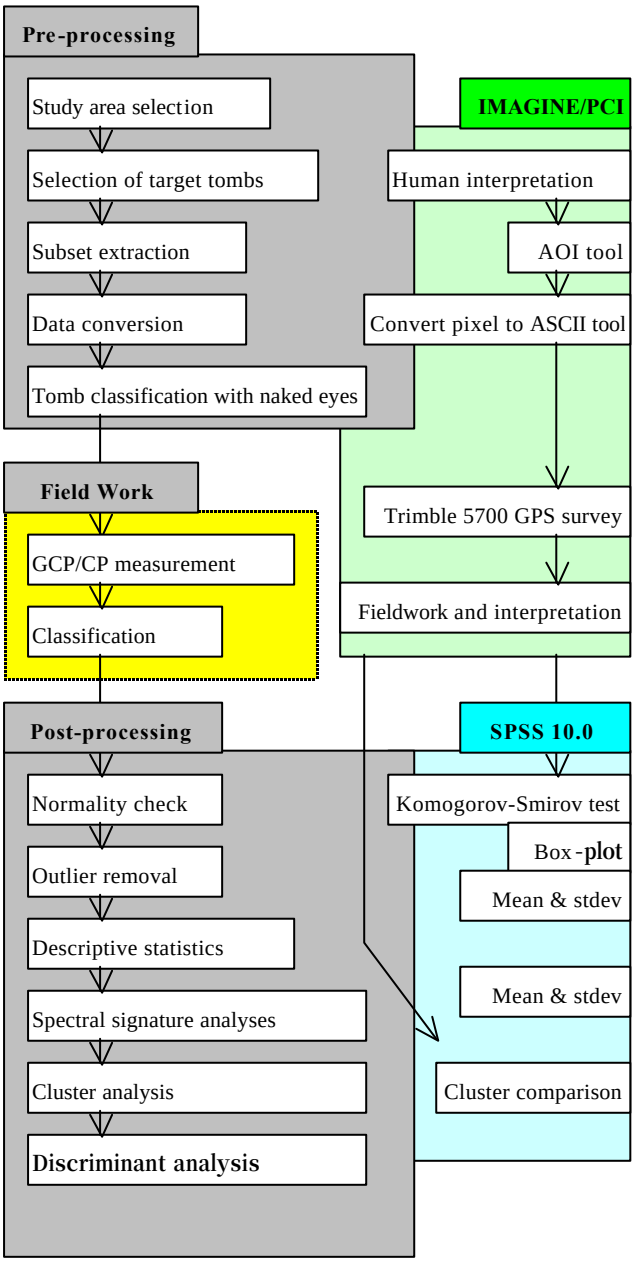


FIG. 1. Study methods and flow

2. Result 1: Geographical Position Accuracy

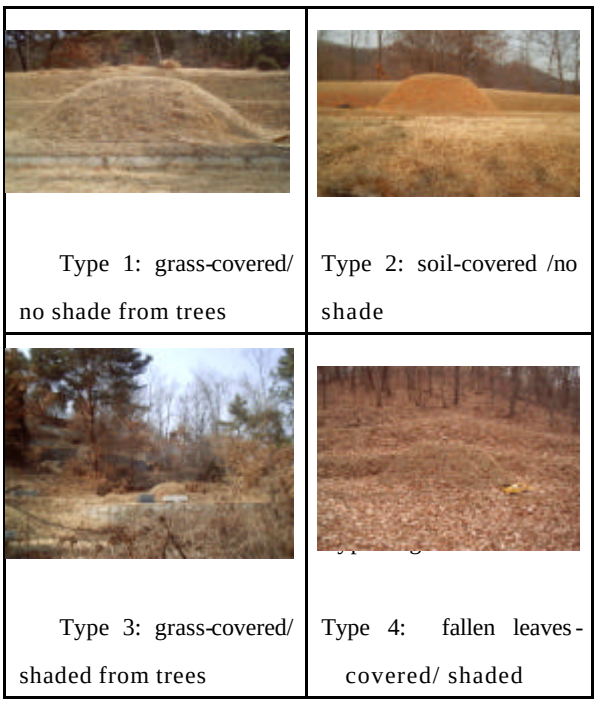
First, the geographical coordinates extracted from ortho-image were compared with those of GPS survey. The digital maps were used to produce Digital Elevation Model and ortho-rectify raw satellite image. And ground control points were extracted from digital maps. We ascertained that the residual error was about from 2m to 3m. As taking a mound over grave into consideration, the residual error will be about from 4m to 5m.

3. Result 2: Classification from the fieldwork

The classification of tombs and the statistical radiometric characteristics of graves were identified from this project. We think those procedures will be necessary to extract tombs with semi-automatic method from satellite imagery. The graves could be classified to four groups from the field survey. As compared with grouping data after clustering and a discriminant analysis, the two results coincided with each other.

4. Result 3: Image classification

Object-oriented classification algorithm for feature extraction was researched in this project theoretically. And we did a pilot project that was performed with mixed methods.



Type 1: grass-covered/ no shade from trees

Type 2: soil-covered /no shade

Type 3: grass-covered/ shaded from trees

Type 4: fallen leaves-covered/ shaded

FIG. 2. Graveyard types: the ground truth

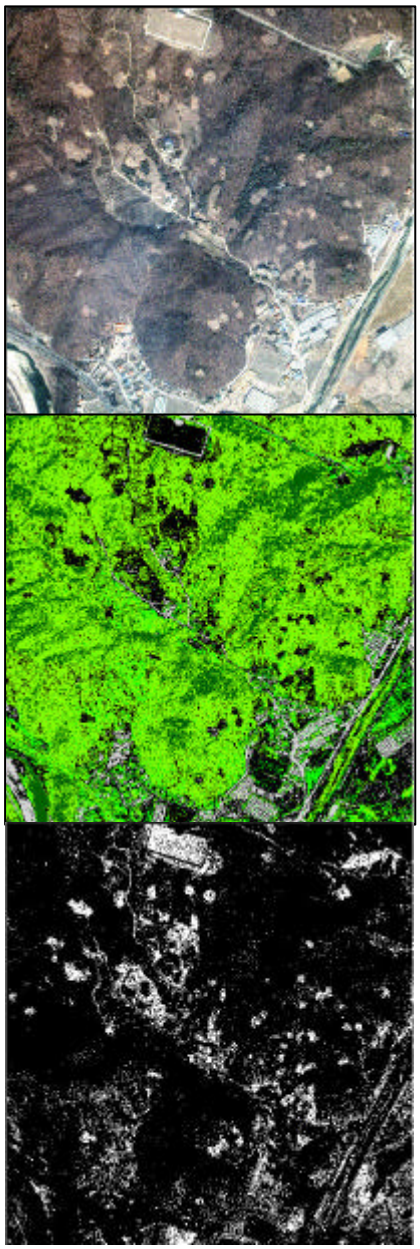


FIG. 3. Upper: raw data image, Middle: unsupervised classification, Lower: 4th masked image

That is, the conventional methods such as unsupervised and supervised classifications were mixed up with the new method for feature extraction, object-oriented classification method. This methodology showed about 60% classification accuracy for extracting tombs from satellite imagery.

The extraction of tombs' geographical coordinates and graves themselves from satellite image was performed in this project. We think the systematic management of tombs may be possible using the satellite imagery that has fine resolution.

5. Conclusions

The position accuracy was below 2~3meter, per se, enough to monitor illegal graveyards. Rule-based classification was the best method among many trials. Round shape and crescent shade was typical shape for visual interpretation. As the graveyard is natural feature, more than two clusters were classified. Winter scene does not cause any problem to identify the location of graveyards. Further study should focus on the object-oriented one and texture analysis. The systematic management of tombs may be possible using the satellite imagery that has fine resolution such as IKONOS and KOMPSAT-2.

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