Prospects for Utilizing KITSAT-3 Imaging

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우리별 3호 위성영상 처리 및 분석

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Abstract

The KITSAT-3, launched on May 26th of 1999, is equiped with a high-resolution earth-watch sensor that has spectral bands similar to that of the SPOT. In this paper, the primary discussion is on investigation of possible application of images acquired from this sensor. The secondary discussion is on the comparison of the images with those of Landsat TM and SPOT.

요 약

1999년 5월 26일에 발사된 우리별 3호는 고해상도 지구관측 센서가 탑재되어 있으며, SPOT과 거의 유사한 분광대를 갖고 있다. 따라서 본 보고에서는 우리별 3호에서 획득한 위성영상의 활용가능성을 확인하는 것을 주목적으로 하며, 현재 상용으로 제공되고 있는 대표적인 위성영상인 Landsat TM과 SPOT영상과 비교하는 것을 부목적으로 한다.

Characteristics of the sensor on the KITSAT-3

It has 3 spectral bands similar to those of the SPOT's HRV; they are Green(520~620nm), Red(620~690nm), and Near-infrared(730~900nm) with a spatial resolution of about 15m. The camera has linear CCD element of 3456 and it adopts pushbroom scanning method to acquire images.

Test Images

Test images are for the area of the west coast of Korean peninsula where Yong-jong island is in the center. There are clouds at the north-west of the images and also are some smolder and fogs. Therefore, the images are not clear. The area also experiences fast changes due to large scale constructions for an international airport. The images were acquired on July 4th of 1999 and they are stored in the BSQ(Band Sequential) format.

Data Processing

a. merging two images of 3456 by 2048 into one image of 3456 by 4096. (figure1)
b. line noises are reduced or removed by taking averages of each upper line and lower line. Speckles are removed by using a median filter.
c. the image is geometrically corrected using 1/25,000 digital maps. the 1st order binomial and the Bi-linear interpolation are used.
d. In the original image, it is hard to distinguish forests from farmland. They are adjusted using natural colors so that they now can be distinguished one from the other. (figure2)
e. classification and various image processing: Supervised Classification, Unsupervised Classification, PCA, NDVI, edge map, 3D display, merging with IRS-1C. (figure3)

figure 2

figure 1

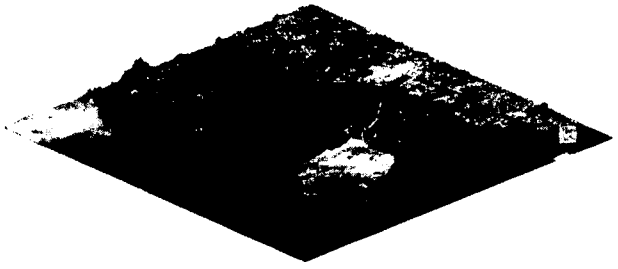

figure 3

Unsupervised Classification

The ISODATA classification method is used. The initial conditions areas follows : class = 50, iteration = 100, maximum standard deviation = 2, minimum distance between class = 1, desired percent unchanged = 98

Figure X is the result of labeling with 7 classes after this method with 50 spectral classes is applied. (figure4)

figure 4

Supervised Classification

figure 5

A training area is directly extracted from the image on a computer monitor. Th same training classification is applied for images of Landsat TM for the same area. This classification is done both using all bands and only using bands 2, 3, and 4. Note that KITSAT image has those 3 bands only. Maximum Likelyhood Method is used for this classification. Landsa TM images are resampled to have 15 m resolution. (figure5)

dark green : forests, yellow : farmland, red: urban area, pink: bare ground, blue: deep sea, light blue: shallow sea or tidal flat, white: salt farm or cloud, and so on.

The precise comparison has to be systematically done. However, a quick exam with eyes only shows that there are minimal differences in classifying urban areas and bare grounds. However, the KITSAT image gives difficulties in recognizing vegetation.

The reason giving those difficulties may come from the weather and season of the image aquisition, but more likely from an imperfect calibration. The imperfect calibration could fail to utilize the bands that distinguish vegetation. Necessary are further studies on a texture analysis and improvement in a classification accuracy aided by supplementary data. (figure6,7)

figure6. ML Classification
(Landsat TM all band)

figure7. ML Classification
(Landsat TM 2, 3, 4)

NDVI

The KITSAT-3 has spectral bands similar to those of SPOT. Therefore, we apply the same method as used for SPOT to do NDVI using bands 2 and 3. (figure8)

NDVIkitsat
Kitsat3-Kitsat2/Kitsat3+Kitsat2

PCA(Principal Component Analysis)

Spectral bands of satellite images have correlation to radiometric characteristics, topographic inclination and direction, radiometric duplication and so on. Satellite images have unuseful information by these correlations. PCA make each new component image using statistic characteristics of original image.

The following pictures is first, second and third component images of unstandard PCA using covariance matrix. We can know that noise and transfomation factor by lens distortion of satellite image is extracted in the third component image.

we can confirm that stripe noise and discoloration of KITSAT-3 image is to be decresed, as the result of reverse conversion of two principal component except third compoinent with great noise. (figure9,10,11)

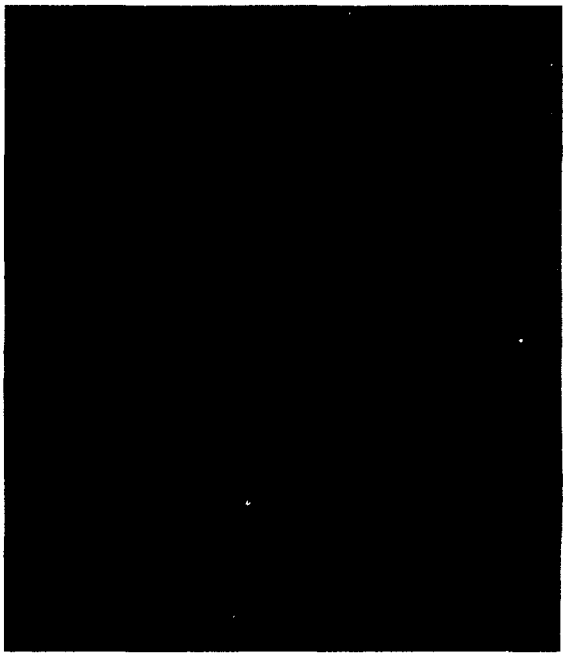

figure8

figure9. first Component

(figure12)

figure10. second Component

figure11. third Component

edge map

The sensor of KITSAT-3 has a better resolution than that of Landsat TM . Hence, it has an advantage when used to extract linear features of urban facilities. The following edge map is made by applying a certain cut-off value on extracted edge lines with the Sobel filter.

figure12

Conclusion

The KITSAT-3 satellite image has spectral bands similar to that of the SPOT and Landsat TM.. In this paper, we confirmed possible application of images acquired from this sensor.

The precise comparison has to be systematically done. However, a quick exam with eyes only shows that there are minimal differences in classifying urban areas and bare grounds. However, the KITSAT image gives difficulties in recognizing vegetation.

Necessary are further studies on a texture analysis and improvement in a classification accuracy aided by supplementary data.

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