HOUSE BORDER LINE EXTRACTION BY USING EDGE AND COLOR

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ABSTRACT: We have developed some algorithms for house detection from high resolution satellite image. High resolution satellite image has two kinds of images. One is panchromatic image. The other is multi spectral image. Multi spectral image has color information. But, ground resolution of multi spectral image is less than that of panchromatic image. Color images showed some jitters in boundary area of house. These jitters came from low resolution of multi spectral image. In this study, we proposed an algorithm to eliminate jaggy boundary of house by using edge and color information contained in pan sharpening image.

1. INTRODUCTION

Some methods[1],[2],[3],[4],[5] for detecting objects from high resolution satellite images have been proposed. High resolution satellite image has two modes, multi spectrum mode and panchromatic mode. Multi spectrum mode has optical spectral information. Panchromatic mode has advantage of high ground resolution compare with that of multi spectrum mode. Color image showed some jitters in boundary area of house. These jitters came from low resolution of multi spectral image. In this study, we proposed an algorithm to eliminate jaggy boundary of house by using edge and color information contained in pan sharpening image. Multi spectral image should be interpolated to fit with panchromatic image. Boundary lines were extracted from some objects. Houses were detected by using edge and color information of the objects. Boundary lines of the objects are very important for house detection.

2. HOUSE DETECTION ALGORITHM

In this section, the sequential methods of house detection used in this study are described.

2.1 Satellite image used in this study

The object image is shown in Figure 1. This image was obtained on 2 May 2002. This area is included in Saitama that is located at the north west of Tokyo in Japan. Multi spectral image in Quickbird image has 4 band images that are composed of 3 visible band images and one infrared band image. The ground resolution is 2.44m. Panchromatic image in Quickbird image has 0.61m ground resolution. Quantization level of original image is 11 bits. In this study, we quantized from 11 bits to 8 bits.

Figure 1. Panchromatic image of target area.

2.2 Preprocessing

Ground resolution of multi spectral image is less than that of panchromatic image. We improve ground resolution of multi spectral image by interpolation. Ground resolution of panchromatic image is 4 times higher than that of multi spectral image. One pixel of multi spectral image corresponds to 16 (=4x4) pixels of panchromatic image. Difference of ground resolution is too large. Therefore, we increased the

ground resolution of multi spectral image to 4 times. Size of multi spectral image enlarged to 4 times for both horizontal and vertical direction. Multi spectral image of target image is shown in Figure 2.

Figure 2. Enlarged image of multi spectral image.

2.3 Making of Mask

Masks were created to eliminate water, vegetation and soil area.

2.3.1 Water mask creation.

Density level of water area in panchromatic image is very low. Water area can be found out by using density level. We created the binary image which shows water area white. Some small white areas are not water area. Such areas were eliminated by threshold. Water mask is shown in Figure 3. Small white areas were eliminated in this mask image.

Figure 3. Water area mask.

2.3.2 Vegetation mask creation.

Vegetation area can be detected very easy by using NDVI. NDVI can be calculated by following equation.

NDVI=(CH4-CH3)/(CH4+CH3) (1)

Vegetation mask was created as binary image by using thresholding of NDVI image. Vegetation mask is shown in Figure 4. White shows high vegetation area.

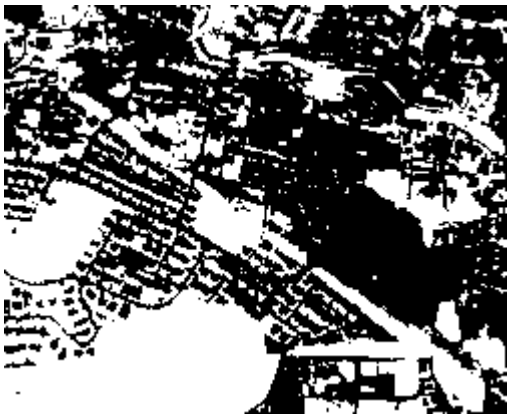

Figure 4. Vegetation area mask.

2.3.3 Soil mask creation

Extraction of soil area is very difficult only using density level of each pixel. Density level of soil is medium value in both of panchromatic image and multi spectral image. Characteristic of soil density level is that standard deviation is very low. Filtering method was introduced for the extraction of soil area. Difference of maximum filter and minimum filter was calculated. Maximum filter means that maximum value of 3x3 filter was selected as the value of central pixel of output image. Minimum filter was the same filtering. Soil, water and roof of house have small value of such filtering result. Mean value of maximum filtering image and minimum filtering image can be useful for distinguishing the roof of house and water area from soil area. Water area and some roofs have small value. Soil area and some roofs have medium value. Some roofs have high value. We could extract soil area and some roofs by combining the difference value and mean value of maximum filter and minimum filter. The area of soil is wider than that of roof. We can distinguish two areas easy. Extracted soil area are shown in Figure 5. White shows soil area.

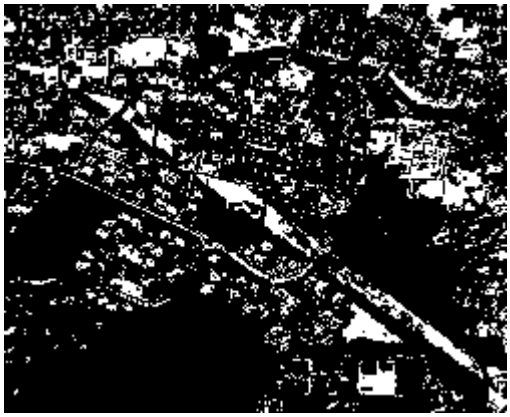

Figure 5. Soil area mask.

2.4 Pan sharpening image

Pan sharpening image can be created by combining of panchromatic image and multi spectral image. Pan sharpening image created by panchromatic image and true color image is shown in Figure 6.

Figure 6. Pan sharpening image of true color

Pan sharpening image created by panchromatic image and infrared color image is shown in Figure 7.

Figure 7. Pan sharpening image of infrared color

2.5 Classification

Pan sharpening image can be divided into three band images. Band 1 and band 2 images were selected from true color pan sharpening image. Band 3 and band 4 images are selected from infrared color pan sharpening image. These four band images were used for unsupervised classification method which used k-means algorithm. Classified result is shown in Figure 8.

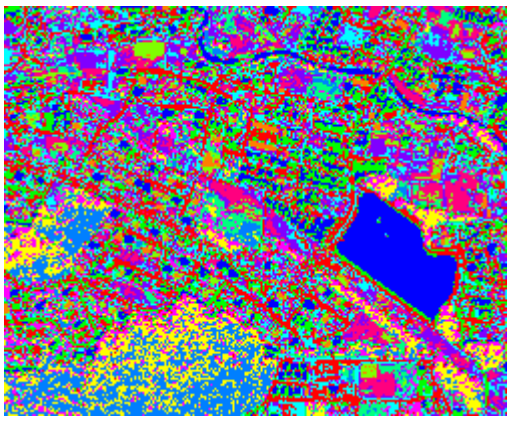

Figure 8. Classified result.

We cannot find out each house clear in Figure 8. Roof color has many varieties. It is very difficult to find out each house roof by using above method. We propose a method by using the difference of maximum filter and minimum filter. Pseudo color of the difference image is shown in Figure 9.

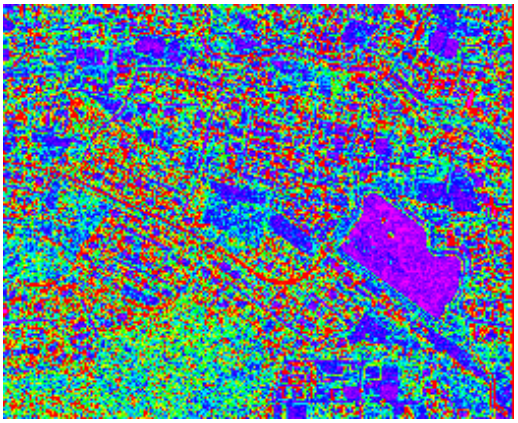

Figure 9. Pseudo color image of the difference image

Figure 9 shows the house border line as red line. This result also shows that house detection is not so easy.

2.6 Masked image

Figure 10 shows the masked classified image. Masked pseudo color image is shown in Figure 11.

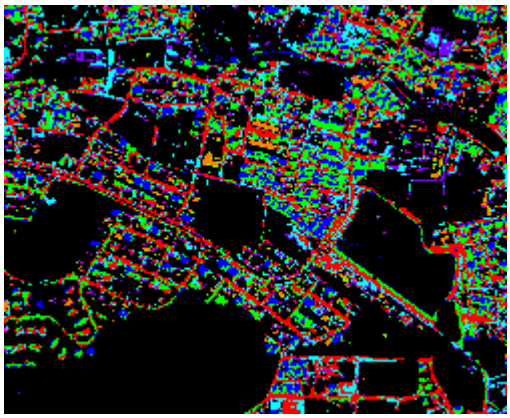

Figure 10. Masked classified image.

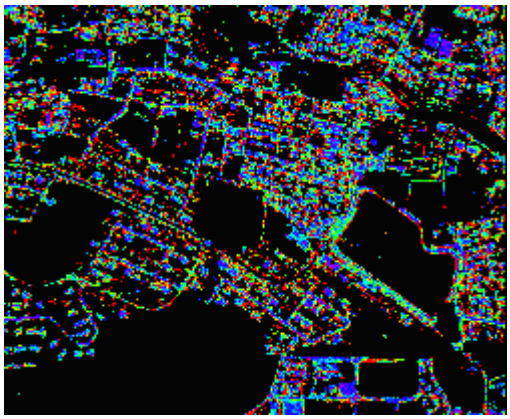

Figure 11. Masked pseudo color image.

3. CONCLUSION

New method was proposed for detection of house. In this study, we introduced the filtering technique for interpolation of multi spectral image in order to detect house by using difference of maximum filter and minimum filter. The result shows that there exist some problems for the house detection.

References

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