AGRICULTURAL SATELLITE IMAGE CLASSIFICATION USING AUTOMATIC COLOR EXTRACTING TECHNIQUE

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Abstract

Automatic features extraction remains an open research area in the satellite images classification. While many algorithms had proposed for features extraction, none of them solved the problem completely. This paper presented a new technique for increasing the accuracy of the classification depending on color extraction from selected band combination image and an acceptable classification results obtained by comparing with traditional classification technique (parallelepiped technique).

تصنيف الصور الفضائية الزراعية بإستعمال تقانة استقطاع اللون آلياً

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الخلاصة

يبقى استخراج المعالم آلياً، مجال بحث مفتوح في تصنيف الصور الفضائية. على الرغم من الخوارزميات العديدة المقترحة لإستخراج المعالم، فمشاكل التصنيف لم تحل بشكل كامل. هذه الدراسة قدمت تقانة جديدة للحصول على دقة تصنيف اعلى بالاعتماد على استقطاع اللون من صورة حزمة مركبة مختارة، تم الحصول على نتائج مقبولة بالمقارنة مع تقانة تقليدية في التصنيف (تقانة الانابيب المتوازية).

Introduction

The automatic extraction of topographic features from satellite images has been still one of the major topics in remote sensing studying, for example in monitoring the vegetation, studying the desertification phenomena, quantities of water, change detection, and many other fields. This paper focused on extracting the three main features in two selected agricultural regions, which were vegetation, water, and soil. The technique applied can considered as a supervised technique, since the underlying requirement of supervised classification techniques is that the analyst has available sufficient known pixels for each class of interest that representative signatures can developed for those classes. These prototype pixels are often referred to as training data, and collections of them, identified in an image and used to generate class signatures, are called training fields [1].

In this paper, the given conditions, for example, in vegetation extracting can be applied to any other image and can be considered as a priori labeling of pixels.

Unfortunately, it does not provide an accurate area information about the studied classes at the same time of the ETM+ scene captured, thus the paper presents a comparison with parallelepiped technique as a classical supervised classification technique.

Parallelepiped technique is sensitivity to category variance by considering the range of values in each category training set. This range may defined by the highest and lowest digital number values in each band and appears as a rectangular area in two-channel scatter diagram [2].

Studied Regions

The applied satellite imageries had captured by the Landsat7 ETM+ system in 13th of September 2002. Bands 3, 4, and 5 used, so the data sets had three bands. The study regions taken from Samara's scene, such that the first region covered about 136 km^2, with upper left corner 357165 E and 3756015 N, and lower right corner 368535 E and 3744045 N, and the second region covered about 359 km^2, with upper left corner 368655 E and 3917565 N, and lower right corner 392625 E and 3902595 N. Location of these regions in Samara's scene had shown in figure (1)

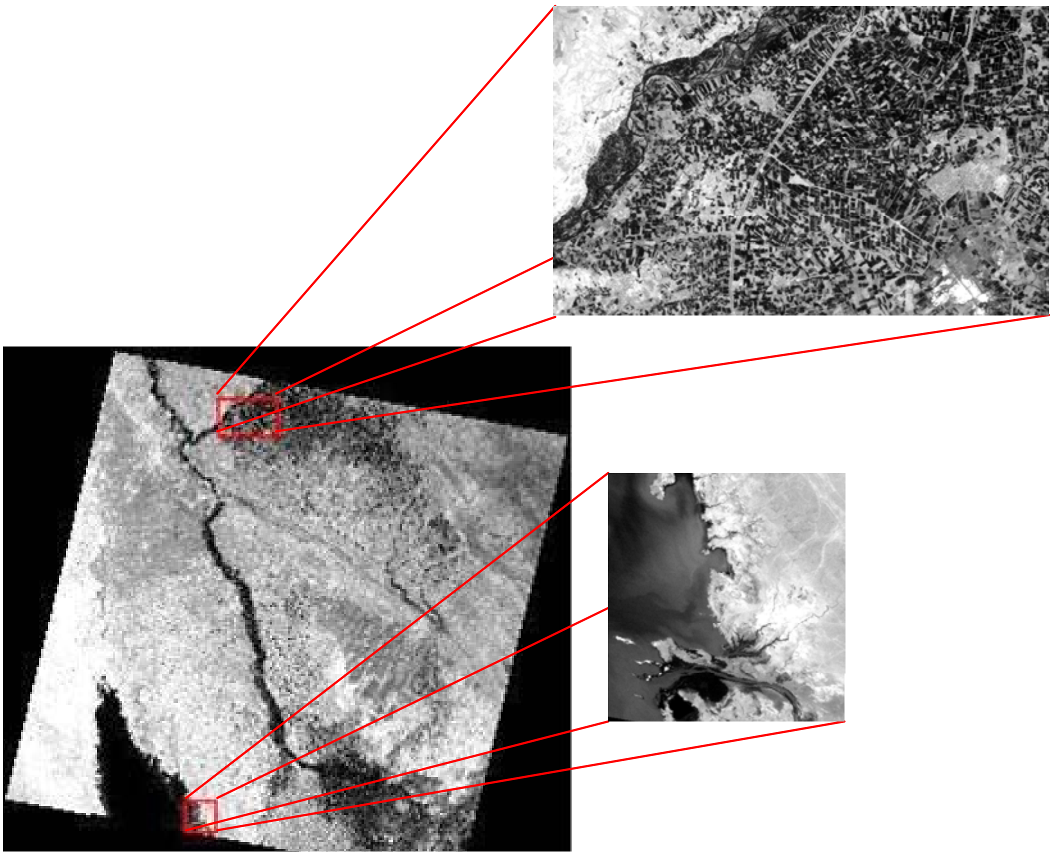


Figure 1: Location of the studied regions in Samara's scene, the lower is region I and the upper is region II.

Methodology

Band combination is one of the power tools that classifier can used to evaluate his classification technique. In this work, the best ETM+ false color band combination for visually interpreting agricultural features was R: band 5, G: band 4 and B: band 3 [3], as shown in figure (2)

Region I (R: band 5, G: band 4 and B: band 3).

Region II (R: band 5, G: band 4 and B: band 3).

Figure 2: Regions I and II in 5,4,3 band combination

The combination used firstly, such that extracting of the most contrasted colors was the aim, in actual that represents extracting features from RGB image, and thus represents classified the image. In other words, features extracted by visual interpretation of RGB image.

The problem here was how can these colors to extract? Indeed, in the RGB-color spaces, the problem is big, and so to overcome these drawbacks, the study transformed the image data from RGB to HSV-color spaces, by using the transformation equations [4]:

$$V = R + G + B \quad \ldots\ldots\ldots\ldots (1)$$

$$H = \frac{G - B}{V - 3B} \quad \ldots\ldots\ldots\ldots (2)$$

$$S = \frac{V - 3B}{V} \quad \ldots\ldots\ldots\ldots (3)$$

where: R, G, B are the Red, Green, Blue, and H, S, V are the Hue, Saturation, and Value respectively.

The boundary conditions for extracting the green color or for vegetation extracting ($V\_extracted$) can be shown in figure (3), such that all the green color delineated in a rectangular, then put these boundaries in a mathematics form, similarly for extracting the blue color. Thus ($V\_extracted$) are:

$$(0.195 \le H \le 0.46) \ \textit{and} \ (0.2 \le S \le 1) \ \textit{and} \ (0.2 \le V \le 1) \ldots\ldots\ldots (4)$$

In addition, the boundary conditions for extracting the blue color or for water extracting ($W\_extracted$) are:

$$(0.557 \le H \le 0.71) \ \textit{and} \ (S \ge 0.3) \ \textit{or} \ (V \le 0.18) \ldots\ldots\ldots (5)$$

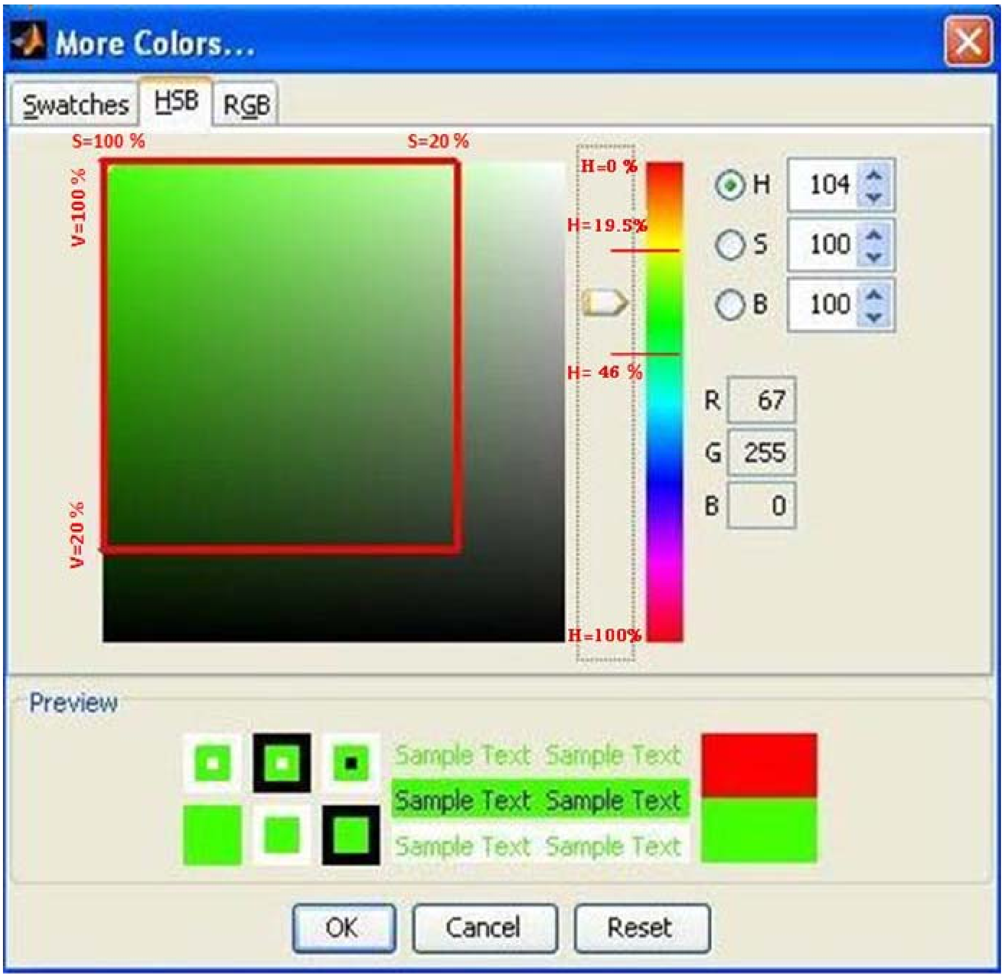


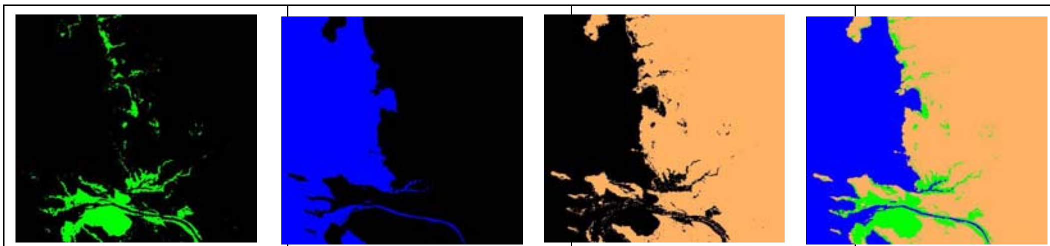
Figure 3: Extract of green color.

For soil extracting ($S\_extracted$), the work supposed that the remaining main feature was soil, and thus, its color boundary conditions are:

$$I(5,4,3) \neq (V\_extracted \quad or \quad W\_extracted) \;...... \;............ \;(6)$$

Where $I(5,4,3)$ represents the RGB image with R=band 5, G=band 4, and B=band 3.

According to the previous color boundary conditions, the images classified and the results shown in figure (4) for both studied regions



Vegetation	Water	Soil	Classified Region I

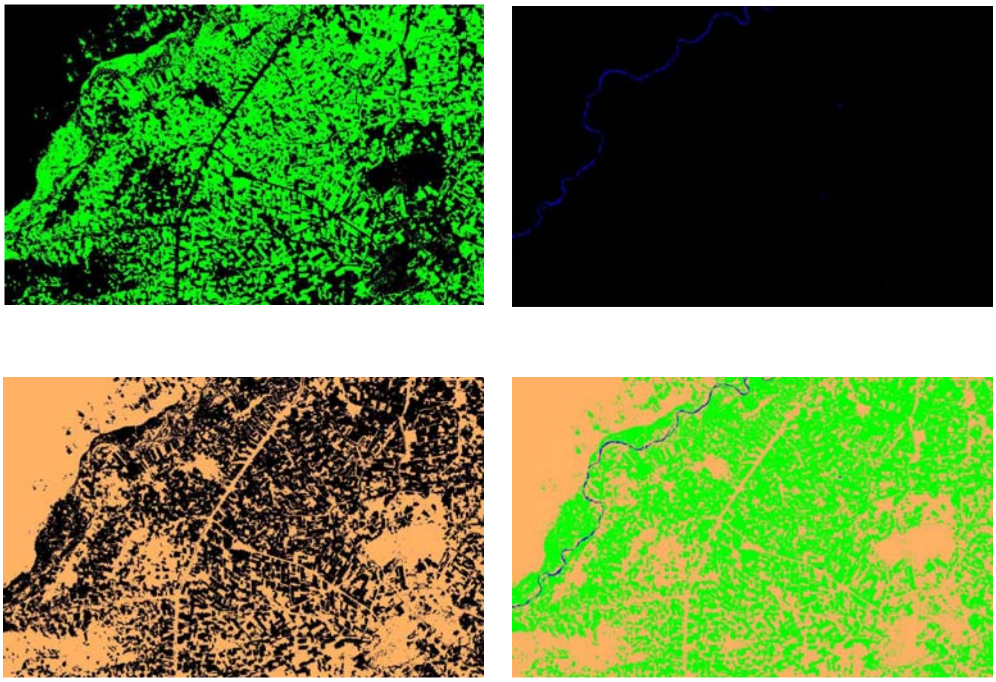


Figure 4: The classified images using the paper technique.

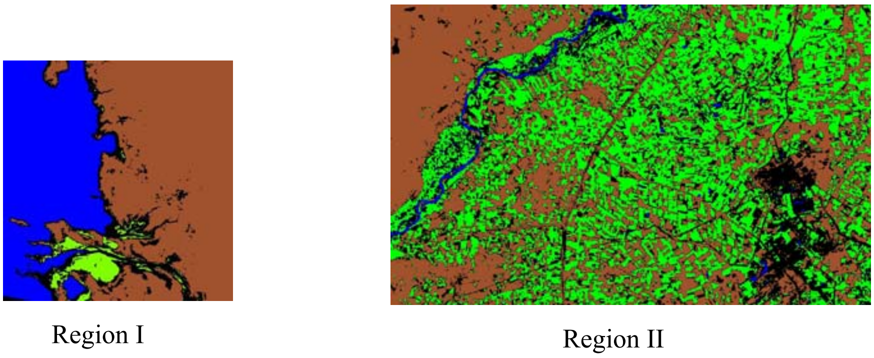


Figure 5: Parallelepiped classification results, unclassified pixels had black color.

The comparison had been done with parallelepiped method as a traditional technique, and the classified images according to this

3. technique were shown in figures 4 and 5, and the percent area for each class illustrated in tables 1 and 2

Table 1: % areas for each class using the research technique.

% class / regions	vegetation	soil	water	unknown
Region I	7.11	57.76	35.13	0
Region II	46.91	0.30	52.79	0

Table 2: % areas for each class using the parallelepiped.

% class / regions	vegetation	soil	water	unknown
Region I	3.31	51.92	33.55	11.22
Region II	37.47	36.82	0.94	24.77

Conclusions and Suggestions

The mixing in the classes is clearly in the parallelepiped results, while in this work, the green color in the band combination had been extracted as vegetation, the blue and black or dark color had been extracted as water, and the remaining had been assumed as soil. Thus, the new classification technique gives better results than the parallelepiped technique and with full classification, (there is no any unknown pixel class).

This technique can be used (with more precision in bounding color for the required feature) to classify the image using more than one band combination to do sub-classes, for example classify the soil to dry and moisture, and the water to deep and shallow and so forth. However, there are several limitations for this technique, as shadow problems that can be source of interpretation error leading to misclassification; therefore, this technique prefers to enhance the image data with a suitable enhancement method as a first step to overcome these problems.

References

1. John, A. R. and Xiuping, J. **2006.** *Remote Sensing Digital Image Analysis.* Springer-Verlag Berlin Heidelberg, 4th Ed, p. 295.
2. Thomas, M. L. Ralph, W. K. and Jonathan, W. C. **2008.** *Remote Sensing and Image Interpretation.* John Wiley and Sons, Inc., 6th Ed, p. 552.
4. Terrill, W. R. **1994**. A FAQ on Vegetation in Remote Sensing. Div. of Geological and Planetary Sciences California Institute of Technology.*http://www. Yale . edu / ceo / Documentation /rsvegfaq.html*
5. Floyd, F. S. JR. **1987**. *Remote Sensing Principles and Interpretation.* W. H.Freeman and company New York, 2nd Ed, p. 252.