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EXTRACTING FEATURE OF WATER FROM REMOTELY SENSED IMAGE

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Abstract

In the present work, different remote sensing techniques have been used to analyze remote sensing data spectrally using ENVI software. The majority of algorithms used in the Spectral Processing can be organized as target detection and classification. In this paper method of target detection has been studied constrained energy minimization on the Therthar Lakeand surrounding area has been done.

Also the results that obtained from applying constrained energy minimization were more accurate than other method comparing with the real situation.

Keywords: Spectral Analysis, Target Detection, Constrained Energy Minimization, Minimum Noise Fraction.

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1. Introduction

The term remote sensing was first used by Evelyn Pruitt, ascientist working for the U.S. Navy's Office of Naval Research, coined this term when she recognized that the term aerial photography no longeraccurately described the many forms of imagery collected using radiation outside the visible region of the spectrum[1].

Remote sensing can be defined as any process where information is gathered about an object, area or phenomenon without being in contact with it. Human eyes are an excellent example of a remote sensing device, they are able to gather information about their surroundings by measure the amount and nature of the reflectance of visible light energy from some external source (such as the sun or an artificial light) as it reflects objects in their field of view. Contrast this with a thermometer, which must be in contact with the phenomenon it measures, and thus is not a remote sensing device[2].

Spectral imaging for remote sensing of terrestrial features and objects arose as an alternative to high-spatial-resolution, large-aperture satellite imaging systems. Early applications of spectral imaging were oriented toward ground-cover classification, mineral exploration, and agricultural assessment, employing a small number of carefully chosen spectral bands spread across the visible and infrared regions of the electromagnetic spectrum [3].

Target detection:

Target detection refers to the use of high spectral resolutionremotely sensed images to map the locations of a target or feature (often a plant species of interest) with a particular spectral or spatial signature. The aim of target detection is to search the pixels of a data cube for rare spectral signatures. In the present work, detection of water pixels for aTherthar Lake and surrounding area has been done using method of target constrained energy minimization. The Minimum Noise Fraction (MNF) transform is an important technique as far as target detection is concerned. It works on the principle that it segregates noise from information content and also reduces the variance in the data. MNF transform consists of two cascaded principal components [4]. The difference between Minimum noise fraction (MNF) transform and Principal Component Analysis (PCA) is that MNF takes into account the sensor noise and also it orders the image in terms of signal to noise ratio (SNR). On the other hand, PCA consider the data variance not the sensor noise [4].

The MNF consists two steps. In the first step transforms the data with unit variance and ensures no band to band correlation (it decorrelates the data). In the second step it applies principal component to the noise whitened data. The images are called eigen images. The more largeeigenvaules signifies more useful information. Eigen values close to one indicates noise affected data. Now the first requirement in the process is to estimate sensor noise. The major information is contained in first some of the MNF components and information content decreases as number of components increases. Hence, Minimum Noise Fraction (MNF) is a linear transform which reduces the dimension, removes noise and reprojects the input data in which whole of the noise is removed which is better than PCA[5].The step of CEM algorithm is: by designing a finite response filter, minimizing the total outputenergy of the linear combining process subject to a linear equality constraint applied to desired target (d). This problem can be converted to an unconstrained minimization using the method of Lagrangemultipliers, using the filter to all pixel vectors to get the target detection. By using filter coefficient equation (1), a CEM detector can detect desired target (d) by using cem(r)= (wcem)T r , at the sametime, minimum output energy caused by interfere background and unknown signal, Filtercoefficient is given by[5]

$$\text{Wcem}=\frac{R^{-1}d}{d^{T}R^{-1}d} \qquad (1)$$

Where: R is sample autocorrelation matrix, d is desired target.

Classification

Image classification defined as assigning a label or class to each pixel of the data. The majority ofimage classification is based on the detection of the spectral signatures (i.e., spectral response patternsof land cover classes). There are two general approaches to image classification, the first require priorknowledge of the ground cover in the study site known as supervised classification and the second canbe used without having prior knowledge of the ground cover in the study site known as unsupervisedclassification. In our work, minimum distance supervised classification method has been applied[6].The minimum distance technique uses the mean vectors of each endmember or region of interest andcalculates the Euclidean distance from each unknown pixel to the mean vector for each class given byequation [7]

$$Ed = \sum_{i=0}^{n} \sqrt{(X_i^p - X_i^m)^2} \quad (2)$$

Where n is number of bands, X_i^P is test pixel spectrum, X_i^m is mean spectrum

The study area:-

Therthar Lake is located in the west of Iraq, between the provinces of Anbar and Salahddin between longitudes (43˚-44˚) and latitude (33˚-35˚) Figure (1) and (2)

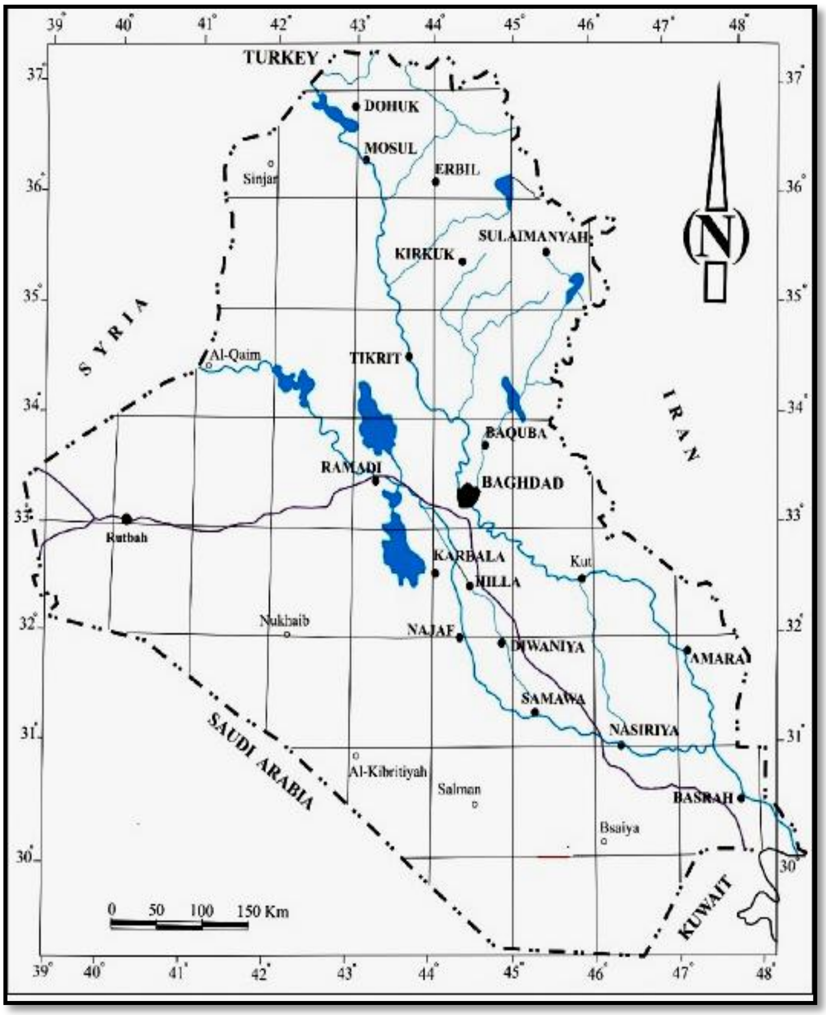

Figure (1) Iraq map.

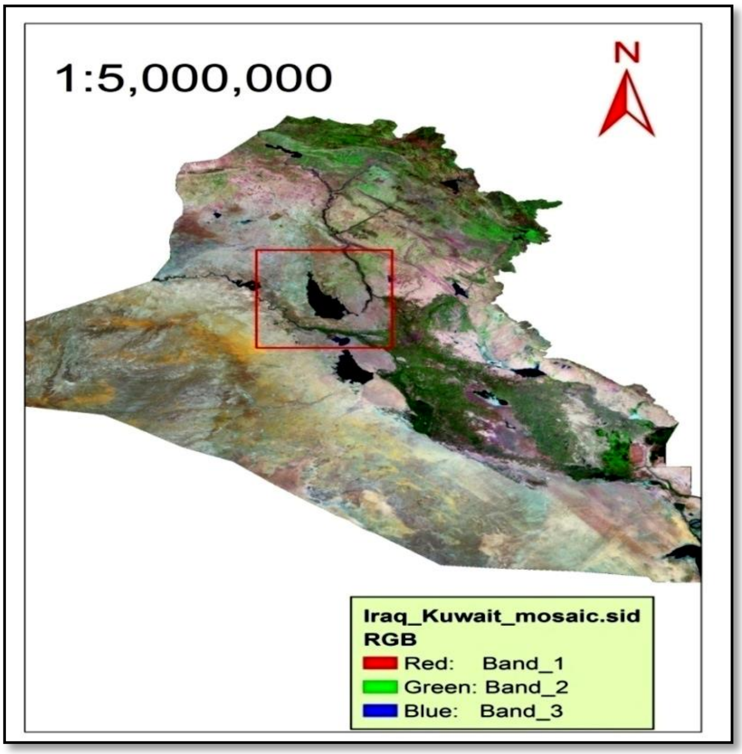

Figure (2) Iraq satellite image.

Experimental Result:
Applying Atmospheric correction using dark pixel subtraction method. The result is illustrated inFigure (3)

Figure (3) Atmospheric correction.

Applying methodCEM to target detection. The result is illustrated in Figure(4)

Figure(4) target detection.

Then applying method of classification The result of classification is shown in the Figure (5)

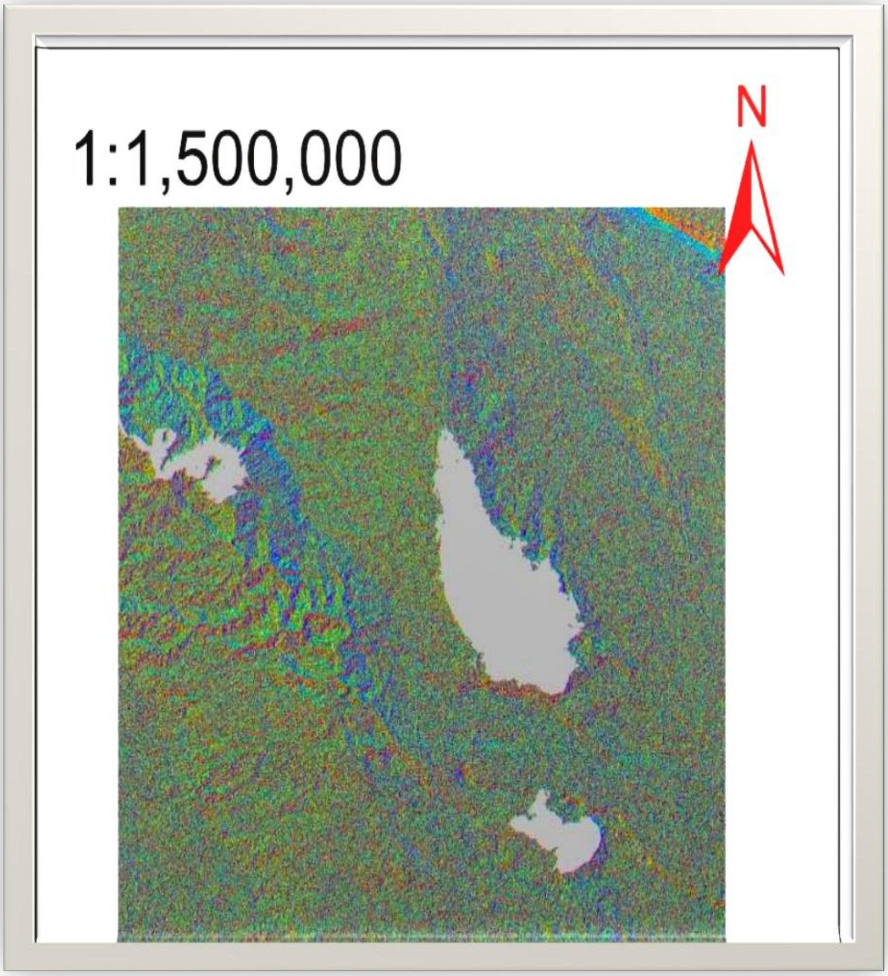

Figure (5) image classification.

Conclusions:

According to the results that have been obtained from this study, we can conclude, the accuracy of the results depends on the experience of the analyzer (ability to deal with thesoftware ENVI) andcharacteristic of the image using in the analysis (spatial and spectral) When mapping the water body of the study area, theaccuracy of the results are depended on the preprocessing on the images like applying atmospheric correctionThe results of the target detection technique that have been obtained for the study area, extract water body from satellite image by applying constrained energy minimization were high accurate when comparing with real situation.

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