

Using the tasseled cap (TCT) and principle component analysis (PCA) transform on satellite image from area of Al diwaniya city

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Abstract

In this paper treated the tasseled cap transformation (TCT) and the principle component analysis (PCA) applied to satellite image of land sat 7 enhanced thematic mapper plus (ETM+).The image taken on march 25,2001 that included the area between Al diwaniya center and southern of its . These techniques are similar,the analysis of the transformation images obtained shows that the results of pca and tct was proved to be a reliable and convenient methods of landsat ETM+ data .the information on vegetation and soil easier to display and understand but pca is best than tct in the resolution of information . The tasseled cap transformation gives an information on the types of the vegetations and soil and the wetness was highlight as shown as the river color .

Key word: the tasseled cap transformation, the principle component analysis, land sat 7 enhanced thematic mapper plus,

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QC 801 – 809

1. Introduction

The analysis of principal components may be a means of inspiration and guidance for specific tasseled cap transformations. This generates new variables such as the weighted sums of the digital numbers of different bands. In general, most of the information contained in the data recorded is concentrated in the first components, and components higher than three are usually considered as lacking information [1].The analysis of principal components consists in transforming data

into a new system of coordinates with mutually orthogonal axes, result that can also be attained by applying the tasseled cap transformation. The latter is based on the method of principal component analysis combined with empirical observations.the “tasseled cap” transformation is a work procedure facilitating the in-depth interpretation and study of satellite data, aiming at reducing the amount of data layers (dimensionality). The procedure uses mathematical equations to transform a number of multispectral bands (n) into a new n -dimensional space[2].

The tasseled cap transformation based on landsat 7 at satellite reflectance was developed. This transformation is appropriate for regional applications where atmospheric correction is not feasible [3]. The brightness, greenness and wetness of the derived transformation explained over 97% of the spectral variance of the individual scenes used in this study [4].

Crist and Cicone adapted the tasseled cap transformation to the six channels of Thematic Mapper data [5]. The weights are different and the third component is taken to represent soil wetness rather than yellowness as in Kauth and Thomas' original formulation. [6] The tasseled cap transform (TCT) is a practical vegetative index and spectral enhancement and has been adapted to other multispectral sensors. The TM, ETM and ASTER. There have been modifications to the tasseled cap derivation presented in literature that created confusion regarding the transform and the proper orientation of the defined feature space. [7] PCA is a useful statistical technique that has found application in fields such as face recognition and image compression, and is a common technique for finding patterns in data of high dimension. [8]

This application contains a set of statistics methods [8].

Standard deviation (SD) :The average distance from the mean of the data set to a point .as formula

$$s = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{(n - 1)}}$$

Where s is the usual symbol for standard deviation of a sample

2-Variance: is another measure of the spread of data in a data set. In fact it is almost identical to the standard deviation. The formula is this:[8]

$$S^2 = \frac{\sum_{i=1}^n (x_i - \bar{x})^2}{(n - 1)}$$

3- Covariance: is always measured between 2 dimensions. The formula for covariance is very similar to the formula for variance. The formula for variance could also be written as:[8]

$$\text{Var}(x) = \frac{\sum_{i=1}^n (x_i - \bar{x})(x_i - \bar{x})}{(n - 1)}$$

here is the formula for covariance:[8]

$$\text{cov}(x,y) = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{(n - 1)}$$

Kauth and Thomas (1976) refer to the transform space as the fixed feature space, which has its coordinate axes aligned in the Tasseled Cap directions (e.g. Brightness, Greenness, Wetness). To accomplish this alignment, the linear transform is defined as:[7] $u = W_{TC}X + r$

where x is the DN value of the QB 11-bit data, W_{TC} is the orthogonal transform matrix, and the vector r is an offset vector that was used to both maintain positive coordinate values of TCT vector u and to compare TCTs from one sensor to another (Kauth and Crist, 1986). The literature

$$s = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{(n - 1)}}$$

presents two general categories of TCT coefficient derivation whereby the vectors within W_{TC} are discovered. [7]

2. Data and Methods

PCA and TCT has been applied to a subset image from landsat 7 (ETM+).The image taken on march 25_2001 that included the area between Al diwaniya center and

The next diagram represents steps of this work:

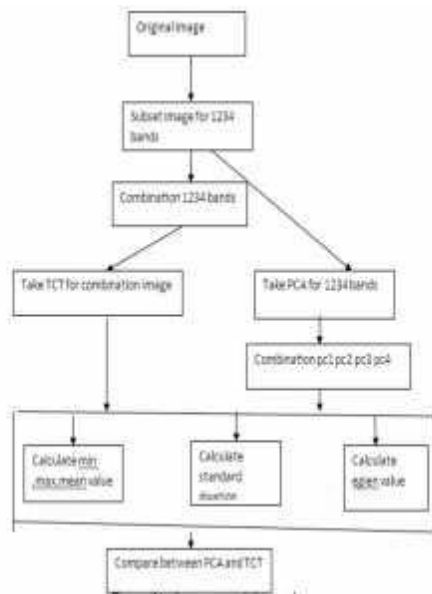


Figure (1): shows steps of this work

3. Results

The principle component analysis was applied to the landsat7 ETM+ image for 4 band .The second image is combination pc1 pc2 pc3 pc4 as figure 3 that shows the vegetation is

The tasseled cap transformation was applied to the landsat7 ETM+ image for 4 band and first two are the most important as they contain most of the information (97%).The

southern of its . the original image having 28.5m spatial resolution was in RGB 1234 combination.

I used erdas8.4 program for made PCA and TCT techniques and using envi4.3 program for statically (min value,maxvalue,standardddivation and egien value) .

The first image is the Combination 1234 bands as a figure 2 that shows study area in which the vegetation is red and the soil is a gray color and the river is the dark green line

Figure 2: the Combination 1234 bands that shows study are in which the vegetation is red

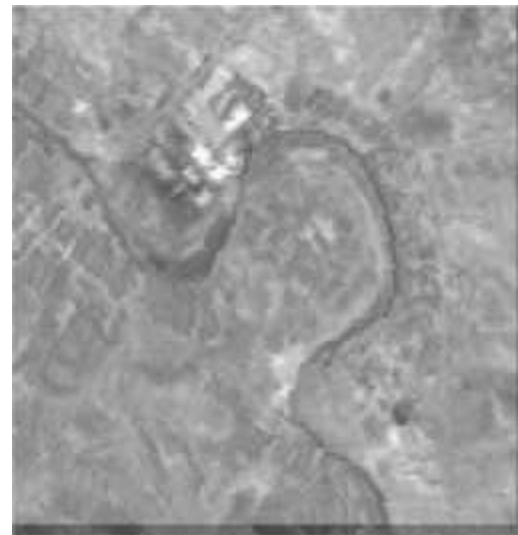


Figure 3: combination pc1 pc2 pc3 pc4

clear in all study area as red and the river shows a green line and the oil is a brawn color

third image is bands combination after tct transform as figure4 that shows vegetation is yellow and the river shows a red line and the soil is a blue

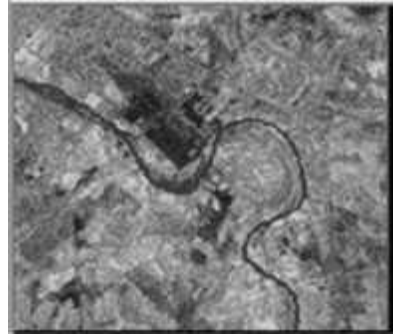


Figure4: combination image after TCT

tct image	pca image	Com Image	eigenval
488.59	2223.11	495.7	band1
16.16	818.99	116.33	band2
3.97	442.19	9.01	band3
	220.15	1.62	band4

Table 2: the standard deviation for three images above

tct i	pca i	I	S D
21.83	17.59	10.36	band1
4.02	32.07	11.03	band2
3.94	33.84	16.37	band3
	34.93	11.19	band4

Table 1: show the egein values for three images above

That show the egein values for images. This values is high on band 1 in (pca i) and is low down in other bands as shown as in figure 5 (a,b,c)

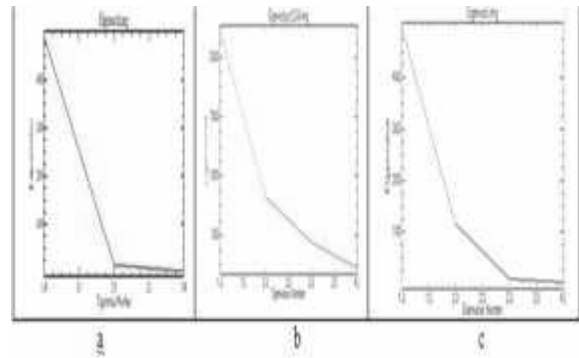
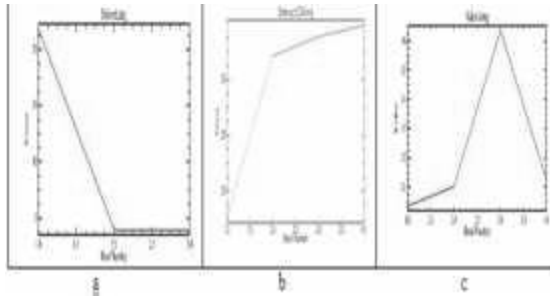


Figure5: the egein values ,a:tct image ,b:pca image ,c:com image



**Figure 6: the standard deviation values ,
a:tct image ,b:pca image ,c:com image**

4. Conclusions

Observing the results show that the eigen values of the pca image was high in all four bands than the tct image . the standard deviation values of pca image was high in bands 2,3,4 except band 1 is smallest than band1 in tct image .

This results show that pca and tct was proved to be a reliable and convenient

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That show the standard deviation for images ,there's a big different in values as figure 6

methods of landsat ETM+ data .the information on vegetation and soil easier to display and understand but pca is best than tct in the resolution of information .

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وتحليل المكون الرئيسي لصورة فضائية لمنطقة من مدينة الديوانية tasseled cap استخدام تحويل

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الخلاصة

وتحليل المكون الرئيسي لصورة فضائية للقمر لاندسات7 tasseled cap في هذا البحث تم استخدام (ETM+) تحويل

اخذت بتاريخ 25 اذار من عام 2001 تتضمن منطقة بين مركز الديوانية والجنوب منها .ان النتائج التي تم الحصول عليها لكلا التحويليين تبين انها موثوقة وملائمة لبيانات لاندسات .ان المعلومة حول الغطاء النباتي والتربة اصبحت اسهل من ناحية العرض والفهم لكن تحليل المكون الرئيسي افضل من ناحية الدقة في المعطيات . اما التقنية الثانية فلها ميزة في اعطاء المعلومة عن نوعية الغطاء النباتي والتربة وان الرطوبة تظهر اعلى كما يتبين من لون النهر .

كلمات مفتاحية:

, وتحليل المكون الرئيسي,القمر لاندسات (ETM+) tasseled cap7 تحويل