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COMPUTER ASSISTED IMAGE CLASSIFICATION PROCEDURES USING A DEVELOPED FEATURE SELECTION ALGORITHM

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ABSTRACT

Classification techniques of remotely sensed data are of the most powerful tools to acquire land use and land cover information in a cost effective means. When applied to a temporal data set, it becomes extremely useful to determine landuse/ landcover changes and their trends.
In this paper a features (bands) selection algorithm has been developed to determine the optimal bands that can be used in the classification process . Also, a classification scheme is developed using the information extracted from the classified images, visual interpretation and the available maps. A Database is designed using the proposed classification scheme .

KEY WORDS

Classification, Landuse, Landcover, Feature selection, Landsat, SPOT and GIS.

INTRODUCTION

The electromagnetic energy that emanates from the earth's surface can be recorded by instruments sensitive to various bands of the spectrum . Although the radiation measured by a sensor is limited by the spectral sensitivities of the sensor, the object being sensed reflects and emits energy at a wide bands of wavelengths. It has been found that each feature tends to exhibit almost a unique spectral signature all over the electromagnetic spectrum [1,2]. Having many channels of data, are of course most valuable in researching problems than employing only a single channel. Panchromatic (black and white) image which is less useful than color one.
Unfortunately, no more than three spectral images may be combined in a color composite image. When dealing with more than three bands, as in multispectral scanner and thematic mapper, it is very difficult to evaluate the spectral information

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presented by the image data. This limitation is overcome when digital data is used in the computer assisted image analysis procedures of spectral interpretation . In this process, we use the computer to look at the multiple channels digital data numerically . Dealing with the image data quantitatively, the spectral information in any number of channels can be fully evaluated.There are two methods for classification, supervised and unsupervised classification. Supervised classification consists of three distinct stages [1,2,3]. The first is the training stage, which is performed by examining representative sample sites of known cover type, called training areas. Next is the classification stage, where each pixel in the image data set is compared to each category in the numerical interpretation key. This comparison is made numerically, using an efficient classifier to decide which category an unknown pixel value looks most like. The third stage is the output where the classified pixels are assigned to certain classes .

OBJECTIVE

The objective of this paper is to develop feature selection algorithm to determine the most effective bands that can be used in the classification process. The developed algorithm is implemented in the classification of Landsat and SPOT images. The extracted information is used for the design of a classification scheme. A Database for the study area is designed using the developed classification scheme. This database is used as an input for a developed GIS model .

FEATURE SELECTION ALGORITHM

For best classification the band separability of training sample should be maximal as possible. So, the mean pixels value for each training sample at different bands is calculated , Also, the difference between the mean pixels value for each training sample at different bands is calculated. The maximum three differences distance which express the best mean values of maximum separation of a class from other classes are chosen to determine best 3 bands to be used in the classification process. This concept is illustrated in Fig.1.
An algorithm for feature selection has been developed where its input is a set of samples. The mean values (mean pixels value) for each class in all available bands are given, and the required output from this algorithm is the selection of best separable features (bands). This algorithm contains two steps as illustrated in the following [1] :

Step1 : Construction of Signature Array

```
For each class C
        For each band I
                Calculate the mean pixels value of the selected region
                Construct signature array ( C , i )
        End
End
```

Step2 : Feature Selection

Begin feature selection

For each band i
For each class C
For each class C_k , $C \neq C_k$
Calculate distance d_i between C_k , $C \neq C_k$
End
End
Select minimum distances
Construct array (i) = minimum distance
End

Select maximum 3 differences
Find their band indices
End .

The flowchart describing feature selection algorithm is shown in Fig.2 , where step 1 and step 2 are illustrated in Fig.2-a and Fig. 2-b respectively

METHODOLOGY AND IMPLEMENTATION

Satellite imagery has been widely employed in land cover change studies in a variety of applications. The main intent of satellite data is to provide information about the physical attributes of the earth's surface with minimal direct contact .

The selected study area represents a subset of Cairo city which includes Nasr city and Heliopolis area and surrounding. The Landsat image dated 1993, represent the study area is shown in Fig.3 .
In this paper, Landsat Thematic Mapper data – TM (30 m resolution and 6 spectral bands) acquired in 1993 and SPOT imagery (20 m resolution with 3 bands) acquired in 1986 were classified employing the developed feature selection algorithm. Six training classes were selected for supervised classification using a maximum likelihood classifier [4, 5].
Using the obtained results and with the help of other available data (maps), a classification scheme has developed [6, 7] . The proposed classification scheme is tabulated in Table1. This classification scheme is used to build a database for the study area. This database can be used as an input for Geographic Information System (GIS) .

RESULTS

In the classified image, we can discriminate two classes of barren lands and two types of built up areas. The first type of built up areas contains high dense and mid dense buildings, while the second one contains some scattered housing, low-income housing and slums area. Also, the water and vegetation can be well discriminated. The obtained results helped in building a classification scheme. This classification scheme is flexible hierarchical system for use at multiple levels. The developed classification scheme is superior where the fifth level of classification could be reached in some categories.

CONCLUSION

The developed spectral features selection algorithm is very useful in determining the most effective bands to be used for classification. Using the developed algorithm the accuracy of classification process has greatly been improved. This leads to a considerably enhance for the interpretation, discrimination and identification for urban features of the given study area.

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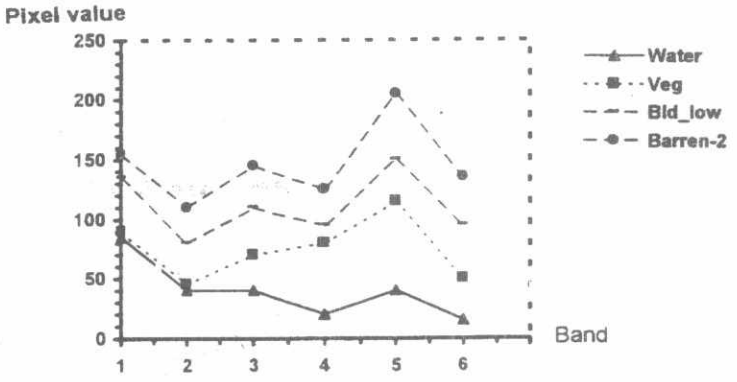

Fig. 1. Band selection illustration

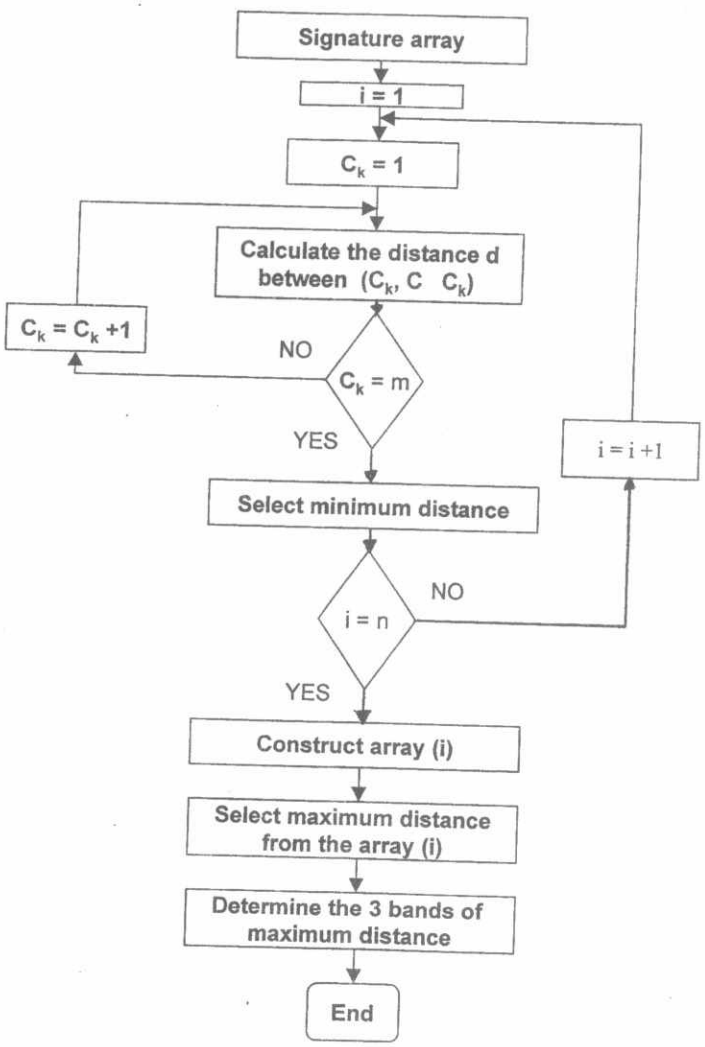

Fig.2-b Flowchart of feature selection algorithm (step 2)

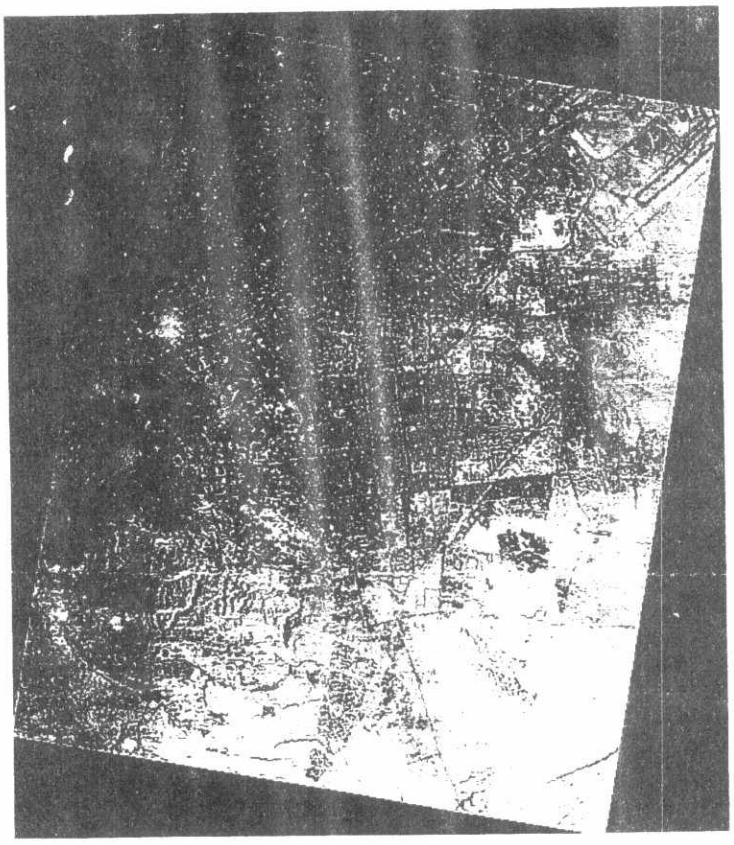

Fig. 3. Landsat image for the study area

Table 1. The proposed Land-use classification scheme

	Area [m^2]
1- Urban and Built up Area	**1.27 E+08**
11 Residential Area	**8.48 E+07**
111 Continuous urban .	2.93 E+07
1111 very dense.	6.91 E+06
1112 high dense.	2.06 E+07
1113 mid dense	1.78 E+06
112 Discontinuous urban fabric .	5.55 E+07
1121 mid dense built up cover .	2.83 E+07
11211 linear housing with gardens	1.15 E+06
11212 linear housing in streets .	2.78 E+07
1122 collective housing .	6.15 E+06
11221 big blocks and towers (high)	1.04 E+06
11222 medium blocks and towers	1.32 E+05
11223 small blocks .	4.98 E+06
1123 detached housing .	2.11 E+07
11231 low dense .	4.55 E+06
11232 mid dense .	1.17 E+07
11233 scattered housing .	4.07 E+06
12 Institutional	**1.97 E+07**
121 Universities .	2.67 E+06
122 Hospital .	1.56 E+06
123 Cemetries .	6.22 E+06
124 Military facilities .	7.75 E+06
125 Hotels .	7.45 E+04
126 Service facility .	8.30 E+05
127 Governmental facility .	5.73 E+05

13 Recreational .	**6.76 E+06**
131 Parks.	2.12 E+06
1311 gardens	4.61 E+05
1312 parks between houses.	6.71 E+05
1313 governmental .	9.84 E+05
132 Stadium .	1.42 E+05
133 Clubs .	1.53 E+06
134 Horse race .	1.05 E+06
135 Sports halls .	1.49 E+06
136 exhebit .	4.77 E+05
14 Transportation .	**1.04 E+07**
141 Airports .	1.04 E+07
1411 military .	1.90 E+06
1412 civilian .	8.53 E+06
15 Open land and others .	**3.37 E+06**
151 land being developed .	2.45 E+06
152 Undeveloped land .	7.75 E+05
153 Electric station .	1.44 E+05
16 Industrial .	**2.17 E+06**
161 Heavy industrial .	1.08 E+06
162 Light industrial .	1.09 E+06