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An Approach to Identify the Coconut Crop in the Study Area using Multispectral Images

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Abstract— **In general, remote sensing provides important coverage, mapping and classification of land-cover features, such as vegetation, soil, water and forests. A chief use of remotely sensed data is to produce a classification map of the identifiable or meaningful features or classes of land cover types in a scene. As a result, the chief product is a thematic map with themes such as land use, geology and vegetation types. In the field of remote sensing, image classification is a process in which pixels or the basic units of an image are assigned to classes. By comparing pixels to one another and to those of known identity, it is possible to assemble groups of similar pixels into classes that match the informational categories of interest to users of remotely sensed data. Numerous methods of image classification exist and classification has formed an important part of not only remote sensing, but also of the fields of image analysis and pattern recognition. Classification results from applying the Spectral Mixture Analysis (SMA) were assessed by comparison with ground-truth data. SMA was performed and evaluated based onLandsat-7ETM+ (Enhanced Thematic Mapper Plus) data.**

Index Terms—**Digital Number (DN), Normalized Difference Vegetation Index (NDVI), Remote sensing, Spectral Mixture Analysis, Sub pixel Classification.**

I. INTRODUCTION

Remote Sensing plays a key role in providing the land coverage mappings and classification of land cover features which mainly includes vegetation, roads, water bodies etc. A chief use of remotely sensed data is to produce a classification map of the identifiable or meaningful features or classes of land cover types in a scene1.Classification of remotely sensed data is used to assign corresponding levels with respect to groups with homogeneous characteristics, with the aim of discriminating multiple objects from each other within the image. The level is called the class. Classification will be executed on the base of spectral or spectrally defined features such as density, texture etc. in the feature space. It can be said that classification divides the feature space in to several classes based on the decision rule.

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Extraction of thematic information from remotely sensed images into the form of a thematic map is a key area of research into the applications of remote-sensing data. By definition, a thematic map is an informational representation of an image, which conveys information regarding the spatial distribution of particular themes. Themes may be as diversified as their areas of interest.

In some instances, the classification itself may form the object of the analysis and serve as the final product. In other instances, the classification may form only an intermediate step in more elaborate analyses, such as land-degradation studies, process studies, landscape modelling, coastal zone management, resource management and other environment monitoring applications. Therefore, image classification forms an important tool for examining digital images. Accordingly, the selection of which classification technique to employ can have substantial effect on the results of whether the classification is used as a final product or as one of several analytical procedures applied to derive information from an image for further analyses.

As a result, image classification has emerged as a significant tool for investigating digital images. Moreover, the selection of the appropriate classification technique to employ can have considerable upshot on the results, of whether the classification is used as an ultimate product or as one of numerous analytical procedures applied for deriving information from an image for additional analyses Several methods of image classification exist and a number of fields apart from remote sensing like image analysis and pattern recognition make use of a significant concept, classification. In some cases, the classification itself may form the entity of the analysis and serve as the ultimate product. As a result, image classification has emerged as a significant tool forinvestigating digital images. Moreover, the selection of the appropriate classification technique to be employed can have a considerable upshot on the results of whether the classification is used as an ultimate product or as one of numerous analytical procedures applied for deriving information from an image for additional analysis.

II. STUDY AREA

In the proposed paper, Surroundings of Thirthahalli, Tiptur and Hunsur, Karnataka State and some part of Kasaragod, Kerala state were considered for the purpose of the study is as shown in Fig1. The area considered for analysis purpose is a

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rectangular area between the points Lat: 11° 95' 11.4" N and Lon: 78° 30' 29.1" E. It has an average elevation of 25 meters.

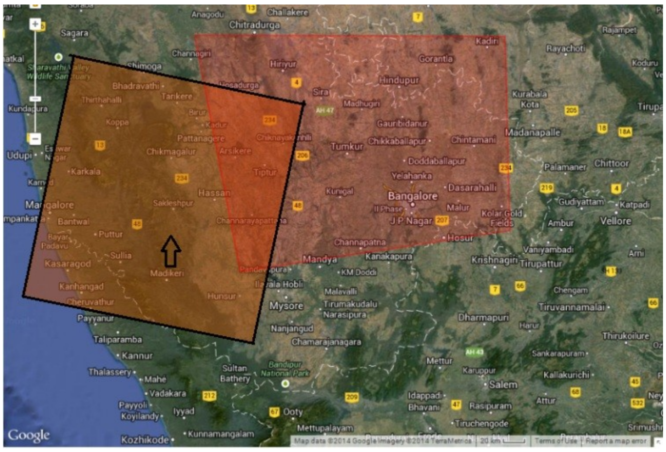

Fig1.Study area(black box)
(Earth Explorer-2014)

III. SYSTEM DESIGN AND IMPLEMENTATION

Spectral Mixture Analysis (SMA) uses Linear Mixture model which will be applied for Six-band Landsat image. The mixture model becomes

Digital Number (DN) = Spectral Reflectance * Fraction coefficient for all the eight bands.

Digital Number obtained from the above analysis should be converted into satellite radiance values using Gain and Bias values extracted from the metadata.

Satellite radiance (L) = DN .Gain + Bias (for all the eight bands)

Where L is in terms of m W $cm^{-2}sr^{-1}$.
The proposed method needs ENVI4.7 tool for the classification of image.ENVI V4.7 helps the user view and manipulates satellite images across a broad landscape, as opposed to using aerial photograph interpretation. By manipulating the colour bands, one can analysevegetation patterns, fire management, land cover, land use, forest harvesting, urban sprawl, land pattern changes over time, and environmental disturbances such as oil spills. ENVI software provides us different types of classification techniques.
In this study, three different classification algorithms were performed for crop identification and multitemporal change detection. The first two of them are ISODATA unsupervised classification and Minimum distance supervised classification techniques which are two main pixel based classification algorithms and the last one is the object based classification algorithm. Table Igives the specification of image data products used in this paper work.The classification process breaks down into two categories Training and classifying. Training is the process of defining the criteria by which these patterns are recognized.

Table I. Specification of image data product

Origin	Satellite name	File_date	Sensor_ID	Latitude and Longitude
Image courtesy of the U.S. Geological Survey	LANDSAT_8	11-Feb-2014	OLI_TIRS	Lat: 11° 95' 11.4" N Lon: 78° 30' 29.1" E

Various stages in the data analysis using project flow diagram shown in Fig2.

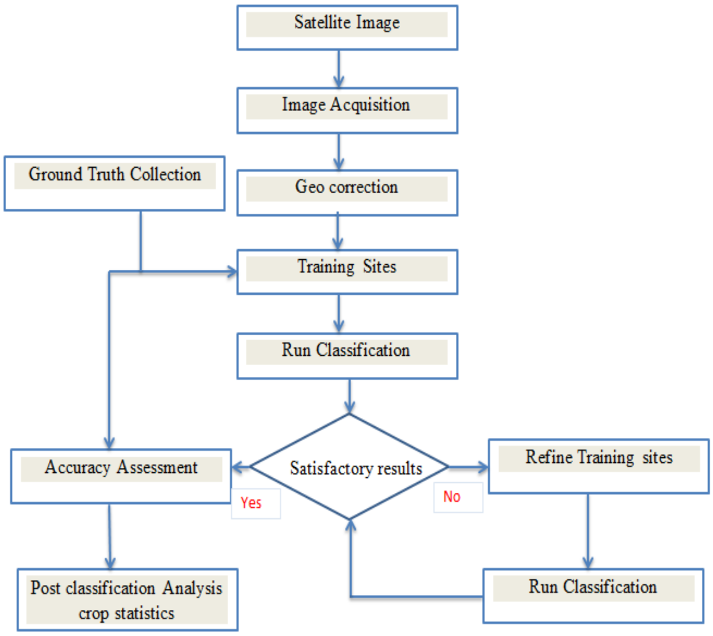

Fig2. Flow diagram of the proposed method

Training can be performed with either a supervised or unsupervisedmethod. Supervised training is closely controlled by the analyst. In this process, you select pixels that represent patterns or land cover features that you recognize, or that you can identify with help from other sources, such as aerial photos, ground truth data or maps. Knowledge of the data, and of the classes desired, is therefore required before classification.

IV. CLASSIFICATION METHODS

Under Supervised Classification again there are three types of classification. Minimum distance classification, Maximum likelihood classification and Mahalanbios distance classification.
Minimum distance classification is a “centroid” for each class is determined from the data by calculating the mean value by band for each class. For each image pixel, the distance in n-dimensional distance to each of these centroids is calculated, and the closest centroid determines the class. If minimum distance is greater than the threshold, the pixel will be considered unclassified. It is a faster technique than the maximum likelihood classification.

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Maximum likelihood classification Maximum likelihood classification uses mean and variance-covariance in class spectra to determine classification scheme. It assumes that the spectral responses for a given class have normal distribution. A pixel with the maximum likelihood is classified into the corresponding class.

Mahalanbios distance classification is similar to minimum distance classification, except that the covariance matrix is used in the equation. Variance and covariance are figured in so that clusters that are highly varied lead to similarly varied classes, and vice versa. For example when classifying urban areas-typically a class whose pixels vary widely-correctly classified pixels may be farther from the mean than those of a class for water, which is usually not a highly varied class.

V. RESULTS AND DISCUSSION

Multispectral image obtained after pre-processing is as shown in Fig3.

Fig3.Multispectral image obtained from the satellite

In this study we are concentrating only on the Minimum distance classification. Classified image obtained from the satellite image is as shown in Fig4.

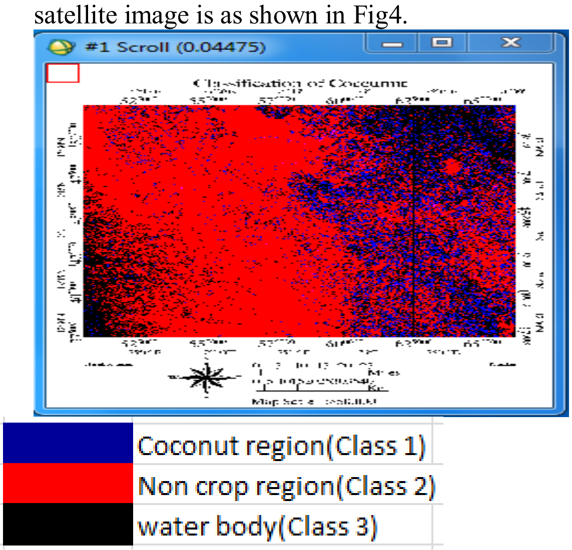

Fig4.Minimum distance classified image

Fig4. also illustrates the Normalized Difference Vegetation index (NDVI). NDVI is the index which is used for vegetation cover analysis. Digital Number obtained for all the three classes for the Bands 1,2,3,4 and their respective Mean and Standard deviation plots are as shown below.

Table II. Class 1 Mean and Std dev. values

Class 1				
	Min	Max	Mean	Std. dev.
Band 1	8228	8609	8396.570325	63.269609
Band 2	7466	8026	7640.938949	66.515565
Band 3	6580	7651	7016.465224	151.721429
Band 4	5912	7425	6257.307573	141.048267

Fig5.Mean and Std dev. Curves for class 1

Table III. Class 2 Mean and Std dev. values

Class 2				
	Min	Max	Mean	Std dev.
Band 1	9095	9413	9227.979553	42.758701
Band 2	8177	8559	8330.688818	47.847554
Band 3	7263	7927	7583.966773	103.977601
Band 4	6406	7228	6673.589776	91.828194

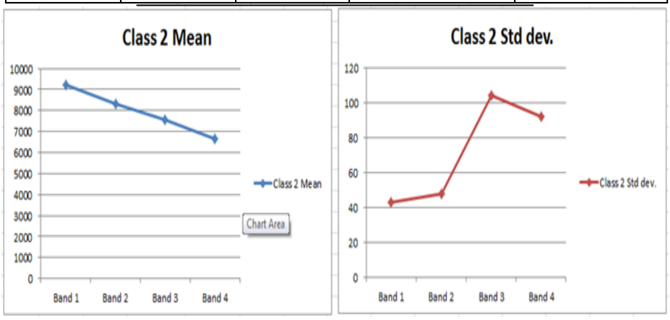

Fig6.Mean and Std dev. Curves for class 2

Table IV. Class 3 Mean and Std dev. values

Class 3				
	Min	Max	Mean	Std dev
Band 1	8713	9607	8873.268898	63.181256
Band 2	7886	8947	8060.852856	71.765083
Band 3	7107	8741	7410.781304	122.24326
Band 4	6365	9294	6665.305251	181.38992

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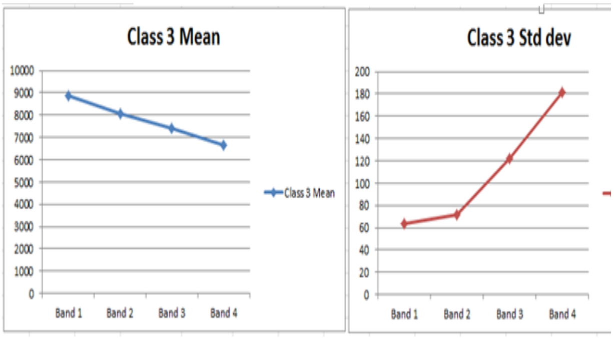

Fig7. Mean and Std dev. Curves for class 3

Graphs shown in Fig5, Fig6 and Fig7 indicates that the Digital Number obtained for all the three classes will differ from one another

VI. CONCLUSION

This paper demonstrates the possibilityof using SMA as a sub pixel technique to mapcoconut land-cover in the study area. The results show considerable capability ofthis technique to classify the main land-cover types. It isclear that this technique gives more accurate results incase of homogenous coconut land-cover. SMA could beused successfully to classify different vegetation coversin intensive agricultural areas. It is also to be noted thatthe method is easy to implement and has low computationalcost.

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