Color and Wavelet Based Identification of Urban and Agricultural Area Using Texture Features in Satellite Images

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***Abstract*— This paper represents unsupervised method of color based segmentation using clustering to classify vegetated and urban area in Satellite images. Now a day due to the progresses in spatial resolution of satellite imagery, the methods of segment-based image analysis for generating and updating geographical information are becoming more important. In this work, one method proposed a segmentation of various clusters by La*b* color space and Texture Feature was analyzed. The Second method proposed a segmentation of image by wavelet and Texture Feature was anlyzed. Algorithm is verified for simulated images and applied for a selected satellite image processing.**

***Keywords*— *Euclidean Metric, La*b* colour space, K-M*eans.**

I. INTRODUCTION

With the use of wavelet transform approach the accuracy of urban land use and land cover feature is improved in multispectral image[1].Using region based method urban land use information is extracted by exploiting spatial metrics and texture measurements in high resolution satellite imagery (i.e.) IKONOS[2].With the frequency based contextual classifier (FBC) land use classification is compared between gray level reduction and different texture spectrum encoding methods from a panchromatic IKONOS image[3].With textural analysis and by two change detection methods, classification of land cover areas are observed from ENVISAT ASAR image[4].

Geostatistical feature extraction set of intensity and texture feature are extracted for more accurate boundary localization in land cover areas from high resolution satellite image[5].By use of the Transformed Divergence (TD) seperability measures land covers were identified and classify the urban areas from RADARSAT2 and with the decision tree classifier accuracy of classification was able to increase in land cover areas from ETM+ multispectral data and panchromatic images and with the fuzzy neuron classifier, the wetland zone and agricultural zone are classified in land cover classification from IKONOS images.

occurrence matrix (GLCM), obtained a good result to improve land cover classification from SPOT5 and with the maximum likelihood, K-nearest neighbour and parzen classifiers some of the missed features are handled due to cloud and snow in land cover areas from land sat ETM+image[6].

Clustering is useful in several exploratory pattern-analysis, grouping, decision-making, and machine-learning situations, including data mining, document retrieval, image segmentation, and pattern classification. In image segmentation coding techniques, image is segmented to different regions separated with contours, and coded with different coding techniques.

Clustering approach can integrate any number of training images of an object into a single model. Training images from similar viewpoints are clustered into single model views [7].Clustering problems arise in many different applications, such as data mining and knowledge discovery, data compression and vector quantization and pattern recognition and pattern classification. Among clustering formulations that are based on minimizing a formal objective function, perhaps the most widely used and studied is k-means clustering. Clustering based on k-means is closely related to a number of other clustering and location problems. One of the most popular heuristics for solving the k-means problem is based on a simple iterative scheme for finding a locally minimal solution. This algorithm is often called the k-means algorithm [8].

II. COLOUR BASED SEGMENTATION

A. Feature Extraction

The first three components of the feature vector are R,G,B values for every pixel in the image. There have been efforts to distinguish stain colors using an unmixing algorithm such as [9]. While such algorithms help in quantification and also to compute statistical metrics such as one required for image registration, they may not aid segmentation. The non linear nature of the RGB color space introduces interdependence between the channels and any such relationship – reflected in the combination of R, G, B

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values for a particular tissue type, from a particular acquisition - will provide important information for the classifier. Hence we retain this color space for feature extraction.

B. Clustering

Clustering is one of methods widely applied in image segmentation and statistic. The main concept of data clustering is to use the centroid to represent each cluster and base on the similarity with the centroid of cluster to classify. According to the characteristics of clustering algorithm, we can roughly divide into "hierarchical" and "partitional" clustering.

The concept of hierarchical clustering is to construct a dendrogram representing the nested grouping of patterns (for image, known as pixels) and the similarity levels at which groupings change. The hierarchical clustering can be divided into two kinds of algorithm: the hierarchical agglomerative algorithm and the hierarchical divisive algorithm. The partitional clustering algorithm obtains a single partition of the data. It is useful to implement in large data sets, but for hierarchical clustering, the construction of dendrogram needs lots of computation time. The problem of partitional clustering is that we have to select the number of desired output clusters before we start to classify data [10]. Clustering is a process for classifying objects or patterns in such a way that samples of the same group are more similar to one another than samples belonging to different groups. Many clustering strategies have been used, such as the hard clustering scheme and the fuzzy clustering scheme, each of which has its own special characteristics [8].

Although hierarchical methods can be more accurate, partitional methods are used in applications involving large data sets, like the ones related with images, due to the fact the construction of a dendrogram is computationally prohibitive. a partitional clustering algorithm usually produces clusters by optimizing a criterion function, the combinatorial search over the set of possible results would solve the inherent problems that it presents.

Clustering algorithms assume that pixels belonging to the same cluster have a similar behaviour, which is explained by uniform features like grey levels, texture or colour[9].

The clustering process is performed by using a classical algorithm, such as K-means, but including one important restriction: pixels with a high gradient are not classified.

C. K-Means Clustering

K-means is one of the simplest unsupervised learning algorithms that solve the well-known clustering problem. The procedure follows a simple and easy way to classify a given data set through a certain number of clusters fixed priori. The main idea is to define k centroids, one for each cluster. Clustering is the way to separate group of objects. Kmeans clustering treats each object having a location in space. It finds partition such that objects within each cluster are as close to each other as possible, and as far from objects in other clusters as possible. K-means clustering requires that you specify the number of clusters to be partitioned and a distance metric to quantify how close two objects are to each other.

Clustering is a popular method (historicallyalso known as Forgy's method or MacQueen'salgorithm). K-Means algorithm typically converges to a local minimum of mean-squared error(MSE). The K-Means algorithm is often initialized with a randomly chosen partition. K-Means is a well-known technique in unsupervised learning and vector quantization[11]. The K-Median algorithm searches each cluster centroid from data samples such that the centroid minimizes the summation of the distances from all data points in the cluster to it.

D. Colour Based Segmentation

Colour image segmentation attracts more and more attention because colour images can provide more information than gray level images. A colour image is a combination of some basic colours. In MATLAB breaks each individual pixel of a colour image (termed 'true colour') down into Red, Green and Blue values[12]. Histogram thresholding is one of the widely used techniques for image segmentation but for colour images, the situation is different due to the multi features. Since the colour information is represented by tristimulus and/or some linear/nonlinear transformation of RGB, representing the histogram of a colour image in a three dimensional array and selecting threshold in the histogram is not a trivial job [2].

Colour extraction technique based on probabilistic partitioning of the colour space using K-means algorithm. The advantage of using this strategy is minimal since this does not assure that the K-Means algorithm will not be trapped itself in local minima decisions. The cluster centres by extracting the dominant colours that are used to initialize the K-means algorithm from the colour histograms. The algorithm consists of filtering the colour image in order to improve the local colour homogeneity and to reduce the level of image noise. Then extraction of dominant colours from the filtered colour image that are used to initialize the K-means algorithm. The colour segmentation result is further refined by joining the image regions resulting after the application of the EM algorithm based on the evaluation of the inter region variability[13].

It propses the color based satellite image classification. First Cluster index had formed according to the pixel values. Then based on the cluster index value the image area was classified and grouped as cluster 1, cluster 2 and cluster 3. Cluster 1 has the pixel value of the not vegetated area. Cluster 2 and cluster 3 has the vegetated and urban area.

III. WAVELET BASED SEGMENTATION

Wavelet were used for feature extraction of texture information. Once preprocessing was completed, the Histogram of each of the co-occurences matrix was calculated. Wavelet co-occurrence measures the frequency distribution of contrast level. Mean and standard deviation texture extracted from the Histogram of each coefficient

matrix. A Co-occurrence matrix capture the spatial dependence of contrast values depending on different direction and distance specified. Since the texture are calculated based on 2D Harr wavelet. A Discrete wavelet transform is any wavelet transform for which the wavelets are sampled.

IV. GLCM FEATURE FOR CLASSIFIED IMAGES

There are number of Texture Features available. In this approach only 5 features were taken and calculated on color based and wavelet based classified images. They are 1. Homogeneity (H), Angular Second Moment(ASM), Entropy(E), Contrast(C), Energy(En).

Homogeneity :H= $\sum_i \sum_j \frac{P_{d,r}^{(i,j)}}{1+(i-j)^2}$

ASM :ASM= $\sum_i \sum_j \left[P_{d,r}^{(i,j)}\right]^2$

Entropy :E= $\sum_i \sum_j P_{d,r}^{(i,j)} \left[-ln\left[P_{d,r}^{(i,j)}\right]\right]$

Contrast :C= $\sum_i \sum_j (i-j)^2 P_{d,r}^{(i,j)}$

Energy :En= g(i,j)

V. EXPERIMENT RESULTS

In this paper, various satellite images have taken to classify vegetation plants. These images are taken from GeoEye which are of parts of India(south region). The proposed method has implemented on Matlab7.12.0 (The Mathworks Inc.).



Figure a. Original Image

A. Colour Based Segmentation

Figure a was the original Satellite image. Figure c was the cluster index of vegetated and urban area. Figure b was the cluster 1 of not vegetated area. Figure c and e were the vegetated area of the land. Then Texture Feature was calculated for each cluster. Result was shown in Table 1 and 2.

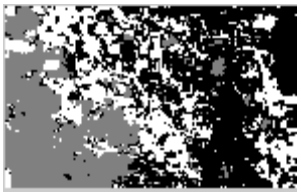


Figure b. Cluster 1 Object

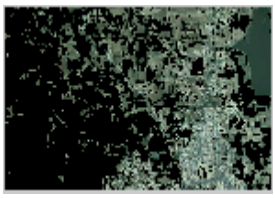


Figure c.Cluster 2 Object

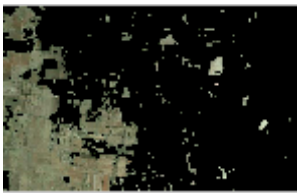


Figure d. Cluster Index

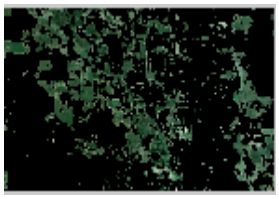


Figure e. Cluster 3 object

TABLE I: Glcm values for each cluster images (H: Homogeneity, A : ASM, E: Energy)

	H	ASM	E
Cluster 1	**0.5216**	**0.1583**	**0.3979**
Cluster 2	**0.8169**	**0.5348**	**0.7313**
Cluster 3	**0.6798**	**0.3435**	**0.5861**

TABLE I1: Glcm values for each cluster images (H: Homogeneity, A : ASM, E: Energy)

	C	En
Cluster 1	**67.4129**	**5.6729 + 0.2066i**
Cluster 2	**22.0624**	**3.0635 + 0.4151i**
Cluster 3	**37.6972**	**4.1376 + 0.3114i**

B.Wevelet Based Segmentation

Figure a was the First Level decomposition of wavelet, Figure b was the Second level Decomposition and Figure c was the Third Level Decomposition. Then Texture Feature was calculated for each level. Result was shown in Table 1 and 2.



Figure a. First Level Image

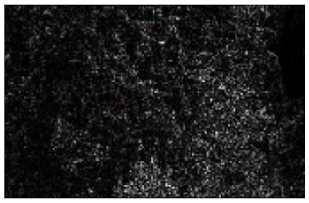


Figure b. Second Level Image



Figure c. Third Level Image

TABLE III: Glcm values for each cluster images (H: Homogeneity, A : ASM, E: Energy)

	H	ASM	E
WLevel 1	**0.5197**	**0.0455**	**0.2134**
WLevel 2	**0.3321**	**0.0062**	**0.0784**
WLevel 3	**0.5295**	**0.0084**	**0.0915**

TABLE IV : Glcm values for each cluster images (C: Contrast, E: Entropy)

	C	En
WLevel 1	**22.0879**	**4.4117 + 0.0016i**
WLevel 2	**66.0710**	**6.4028 + 0.0010i**
WLevel 3	**43.2290**	**5.9172 + 0.0034i**

VI. CONCLUSION

Using colour based and wavelet based image segmentation, the image was classified as vegetated and urban area. Although this approach provides result when segmenting the image but still we found that there is a scope of improvement in it. We are not still able to segment the plants properly whose colours are nearly same. In future the more texture property may be taken to segment the clusters perfectly. Hence we are trying to extend our approach on color images to segment images more precisely and try to compare the results to get the best from it.

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