Vegetation Area Classification Using Modis Imagery

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ABSTRACT   *The information about the location and area of vegetation fields has great impact on emerging Remote sensing applications. Remote sensing techniques have been developed to allow researchers to accurately classify large vegetation area at reduced cost. In this paper the ultimate intention is to develop an operational method for assessing vegetation area that would facilitate developing remote sensing based algorithms for assessing vegetation fields and land surfaces in major areas. The Moderate Resolution Imaging Spectroradiometer (MODIS) onboard the Terra satellite offers a good potential for assessing vegetation area. Here MOD13A3 of the MODIS/Terra Vegetation Indices is used. By applying segmentation techniques vegetation area is differentiated from non crop area. It provides opportunity to retrieve parameters that can be used to assess fields whether the acquired field is vegetation area (crop) or land surface. This significant improvement can help researchers to create superior crop type classification maps and therefore have the opportunity to make better informed decisions.*
General Terms
Segmentation, Classification, Training, Testing.

1. INTRODUCTION

The rapid expansion of crop cultivation will have major impact on the environment and has to be balanced with proper management strategies. Mechanization of crop production and identification of vegetation area is essential for management strategies. Since the goal of this paper is to find over all vegetation area and differentiating the land surfaces. An operational method is developed for assessing crop area and non crop area using MODIS (The Moderate Resolution Imaging Spectroradiometer) Imagery.

This paper deals with four themes: The Moderate Resolution Imaging Spectroradiometer (MODIS) onboard the Terra satellite offers a good potential for assessing vegetation area as well as provide opportunity to retrieve parameters that can be used to assess vegetation yields.

1. It describes the use of MODIS Terra data at 500 m resolution for classification of vegetation area in cuddalore district of Tamil Nadu.

2. Imfilter is used for pixel correction. Since the majority of the area in the provinces were natural vegetation (trees, shrubs, rangeland) it was important to develop a vegetation classification to monitor the vegetation condition during the growing season.

3. The normalized difference vegetation index was tracked through the growing season to assess the changes in vegetation area that is an indication of potential yields for the current season in comparison with previous years.

4. K-means clustering is applied to segment vegetation and land surface area as it is a partitioning method. The function k-means partitions data into *k* mutually exclusive clusters, and returns the index of the cluster to which it has assigned each observation.

The iterative algorithm minimizes the sum of distances from each object to its cluster centroid, over all clusters. This algorithm moves objects between clusters until the sum cannot be decreased further. The result is a set of clusters.

2. RELATED WORK

Accurate and timely information on the location and area of major vegetation area has significant economic, food, policy, and environmental implications. Remote sensing, either alone or in combination with ground surveys, has been used in vegetation acreage assessment for many years. An accurate and objective vegetation type map can be used to assess agricultural use as well as other management decisions. Jefferson Alex dos Santos proposed a method for interactive classification of remote sensing images considering multiscale segmentation. Aim is to improve the selection of training samples using the features from the most appropriate scales of representation [1]. Ya ozhong proposed a hard classification models (HCMs) which yield good results in large homogeneous areas where pure pixels are dominant, but they fail in fragmented areas where mixed pixels are dominant. Conversely, soft classification models (SCMs) are thought to have greater accuracy in fragmented areas than in regions with pure pixels. To take advantage of both methods, they developed a hard and SCM (HSCM) based on existing HCMs and SCMs [2]. Paula Beatriz Cerqueira Leite. The author proposed a Hierarchical based technique to classify agricultural crops. The method uses Hierarchical based algorithm to relate the varying spectral response along the crop cycle with plant phenology, for different crop classes, and recognizes different agricultural crops by analyzing their spectral profiles over a sequence of images [3]. A.Camargo reported a machine vision system for the identification of the visual symptoms of plant diseases, from colored images. Disease d regions shown in digital pictures of cotton crops were enhanced, segmented, and a set of features were extracted from each o f them. Features were then used as inputs to a Support Vector Machine (SVM) classifier and tests were performed to identify the best classification model [4].

3. PROPOSED METHOD

In our proposed method, Source image is acquired from MODIS Imagery which is a remote sensing process. The region acquired is Cuddalore district of Tamil Nadu which is extracted from MODIS dataset with required function .The data product is MODIS13A3 vegetation Indices which is a terra product. Figure: 1 show the block diagram of proposed system. The image is pre-processed by converting RGB into Color Infrared Image and it is enhanced by decor relation method. Next the pre-processed image is treated for feature extraction in which NDVI, RGB mean, NIR, Visible Red features were extracted. Then Clustering is applied by using K-means clustering which partitions the area into separate clusters as vegetation area, land surface and water body.
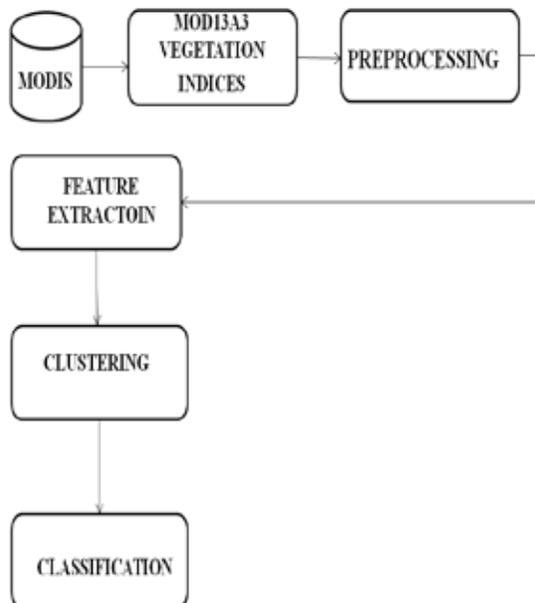
Figure: 3.Block diagram of the Proposed System.

Imfilter is used to enhance the clustered images. Finally Support Vector Machine is used for Classification which classifies vegetation area and land surfaces respectively by using the cluster values and features extracted.

Image Acquisition
It is a process of acquiring data from the source. After acquisition, processing and pre processing will be made into the data image. Here image is acquired from MODIS satellite.

The system describes the use of MODIS Terra data for classification of vegetation. The sensor used here is MODIS terra product. By using this product vegetation area of India is acquired from the terra product. Latitude and Longitude is selected for acquiring the required region.
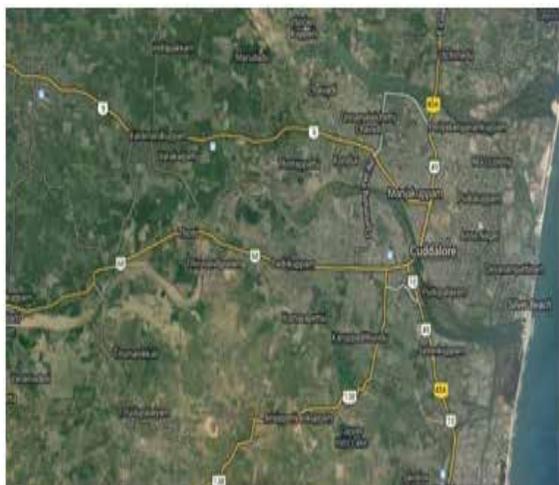

Figure 2: Acquired region of Cuddalore District.

Finally data sets will be created it may be vegetation area, land surface, terra or some other fields. By selecting appropriate field with selection criteria, required region of cuddalore district is acquired which provides vegetation and land surface of that district together. Figure: 2 shows the acquired region of cuddalore district. The latitude and longitude selected here is N E. Then feature class is applied for generating results.

Pre-processing
The segmentation and Pre-Processing task are the initial stage

before the image is used for the next process.
a) Color Infrared Image conversion (CIR)
b) Enhancing CIR by correlation

3.2.1 Color Infrared Image conversion (CIR)
To identify areas containing significant vegetation, differences between the visible red and near-infrared (NIR) bands should be identified. When near infer red, visible red and visible green bands are mapped on RGB planes respectively, Color-Infrared (CIR) composite image will be produced. Red signifies the NIR band, green signifies the visible red band, and blue signifies the visible green band in the displayed image.

Enhancing CIR by De-correlation
After acquiring CIR image, it is necessary to enhance it so as to ignore the subtle colors of original correlated image. Therefore de-correlation stretch is applied which highlights the vegetation area by making near infrared band as significant. Figure: 3 shows the CIR image of cuddalore district.

Figure3: CIR Composite image.

Thus color image is converted into Color Infrared (CIR composite) image when the Near Infrared, visible red and visible green bands were mapped into RGB plane.

FEATURE EXTRACTION
Extracting features from multiple images to identify the fields and properties. The process of defining a set of features, or image characteristics which will represent the information that is important for analysis and classification. In our approach, features based on entropy, range of image, red mean, green and blue mean were calculated and property values were observed.

The features are discussed below:
1) Extracting RGB values: The mean value of RGB is calculated which is used to map CIR on it. The mean is the arithmetic average of a set of values, or distribution.

2) Near Infrared (NIR): Near Infrared is calculated which provides significant vegetation area by applying image into NIR class single operator.

3) NDVI: NDVI is nothing but Normalized Difference Vegetation Index which provides significant vegetation area. Atmospheric correction errors are partly reduced using a normalize vegetation index such as NDVI.

An error in reflectance caused by atmospheric condition always decreases the NDVI value. Therefore filter is used to correct the error.

CLUSTERING
Here k-means clustering is used which is a partitioning method, it partitions data (acquired area) into *k* mutually exclusive clusters, and returns the index of the cluster to which it has assigned each observation. K-means uses an iterative algorithm that

minimizes the sum of distances from each object to its cluster centroid, over all clusters.

This algorithm moves objects between clusters until the sum cannot be decreased further. The result is a set of clusters that are as compact and well-separated as possible. The clustering area is selected by using required dimension and is clustered by applying index values. Here vegetation and land surface area will be clustered separately from the acquired image by calculating the cluster centroids.

Area will be calculated according to the mean value and is clustered to its required observation. Therefore by applying k-means algorithm vegetation and land surface area were classified separately which provides significant details about crop and non crop area.

Table I: Centroids of Clusters

S. NO	Cluster Centroids 1	Cluster Centroids 2
1	123.85	130.28
2	125.21	148.14
3	118.63	138.50

Table I: shows the Centroid values of the cluster after segmentation which consist of values of both vegetation and land surface area.

Table II: Results of K-means clustering (mean cluster values)

S.NO	Mean cluster Values
1	127.07
2	136.68
3	128.56

Table II: shows the mean cluster values of the cluster after segmentation.

FILTERING
Filtering is a technique for modifying or enhancing an image. For example, we can filter an image to emphasize certain features or remove other features. Here imfilter is applied to enhance the segmented images. The imfilter function can handle both multidimensional images and multidimensional filters.

I=imfilter (image, h);

3.6 CLASSIFICATION
The extracted features are classified as vegetation or non vegetation area using SVM classifier.

3.6.1 SVM (Support Vector Machine)
The overall objective of classification is to automatically categorize all pixels in an image into land cover or vegetation class [6]. Here Support vector machine (SVM) is used for classification which is based on the principle of structural risk minimization (SRM). Support vector machines can be used for pattern classification and nonlinear regression. A classification task in SVM or any other classifier requires first separating the dataset into two different parts. One is used for training and the other for testing. Each instance in the training set contains a class label and the corresponding image features.

Based on the training data, SVM generates a classification model which is then used to predict the class labels of the test data when only the feature values are provided. Each instance is represented by an n -dimensional feature vector. To evaluate the proposed method, the full dataset can be divided into two subsets: the training dataset and test dataset. The training set is used to train the SVM classifier which is processed by using the extracted features of the images and SVM classification will be done with different clustered centroids, while the test set is used to predict the accuracy of the classifier.
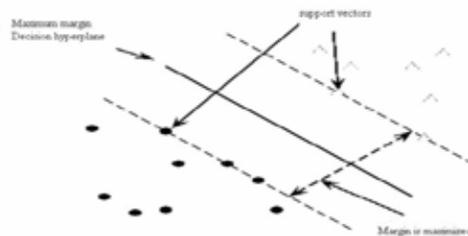

Figure: 4.Optimal hyper plane, maximizing margin and support vectors.

Support vector machines (SVM's) are a set of related supervised learning methods used for classification and regression. As shown in Figure: 4, a support vector machine, construct a hyperplane or set of hyper planes in a high or infinite dimensional space, which can be used for classification, regression or other tasks.

4.   RESULTS AND DISCUSSION
In this work, the results presented are preliminary analyses on improved techniques for potential use of MODIS Terra data for vegetation area estimation. The preliminary analyses shown in this system is to demonstrate two important findings. MODIS imagery can be used for regional classification when screened for data anomalies and contaminations due to clouds and compositing procedures.

A clustering algorithm k-means partitions data into k mutually exclusive clusters, and returns the index of the cluster to which it has assigned each observation and classification technique based on vegetation penology was successfully used to classify vegetation area in Cuddalore district. The ultimate intention of this project is to develop an operational method for assessing crop classification using MODIS Imagery (The Moderate Resolution Imaging Spectroradiometer).

Figure:5 shows the classified land surface area and Figure:6 shows the classified vegetation surface area which is acquired by applying K-means algorithm.

Figure:7 shows the Normalized Difference vegetation Index which predicts the major vegetation area ratio with required time period and reflectance.
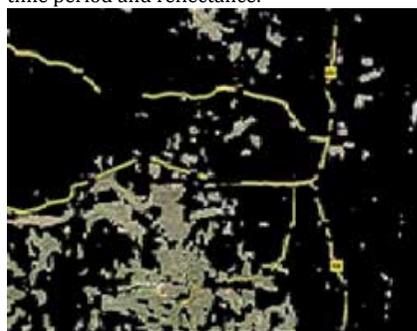

Figure: 5. Differentiated Land Surface Area

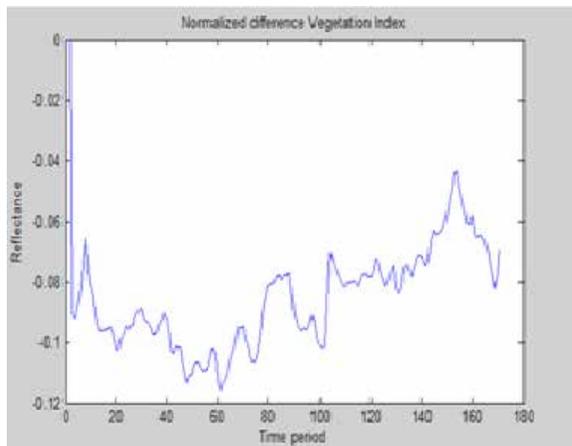**Figure: 6.Differentiated Vegetation Area after clustering.**

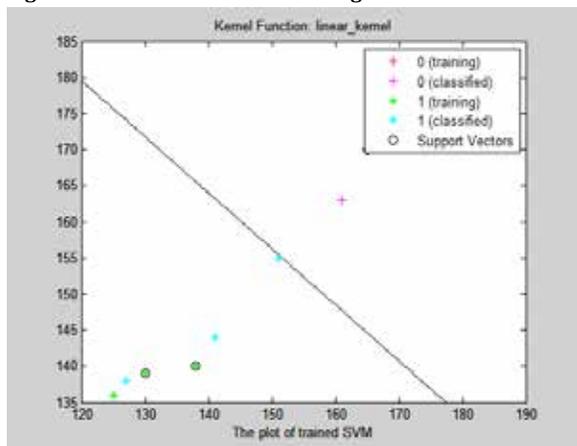**Figure: 7. Normalized Difference Vegetation Index**

Figure: 8. The plot of trained SVM

Figure:8 shows the trained SVM which provides information about the trained and classified datasets with support vectors. It distinguish the vegetation area from land surfaces and predicts the class label for vegetation area as 1. Therefore class value 1 indicates the acquired and classified vegetation crop area.

5. PERFORMANCE EVALUATION

In the proposed method Specificity is the percentage of vegetation area classified as vegetation by the procedure. Sensitivity is the percentage of land surface area classified as land area by the procedure. The higher the sensitivity and specificity values, the better the procedure.

From these quantities, Sensitivity, Specificity is chosen as measurement of accuracy and is calculated using the following equation.

Sensitivity = TP/ (TP + FN)
Specificity = TN/ (TN + FP)
Accuracy = (TP + TN)/ (TP + TN + FP + FN)
CCR=Correctly Classified Rate.

Table III: Comparison of SVM kernels and its percentage of sensitivity, specificity and accuracy.

Kernel type	Sensitivity (%)	Specificity (%)	Accuracy (%)
Linear	100	100	100
Polynomial	100	100	100
Radial basis	100	100	100
sigmoid	100t	100	100

The percentage of Cases Correctly Classified (CCR) is the most obvious accuracy measure. It is mainly for evaluate performance and accuracy of classifier.

Table III: shows the Comparison of SVM kernels and its percentage of sensitivity, specificity and accuracy.

6. CONCLUSION

Thus remote sensing techniques have been developed for classification and identification of agricultural fields and surfaces through some advanced techniques and process which provides information about the dense vegetation area. Classification algorithm which provides vegetation classification is acquired by applying clustering algorithm.

This work provides accurate and objective vegetation type map that can be used to assess agricultural fields, water use as well as other management decisions. In future work, the system will be enhanced by using high resolution multi temporal images with advanced algorithm and classification techniques. Performance will be evaluated and increased by using multiple remotely sensed data which enhance vegetation classification.

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