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An Enhanced Semi Supervised Learning For Hyper Spectral Image Classification

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ABSTRACT

In recent years, the trend in remotely sensed imaging system has considerably changed from multispectral to hyperspectral due to huge combination of very narrow contiguous spectral bands which provides detail imaging. These hyperspectral images are widely used for various application viz., geosciences, mineralogy, agricultural, land cover studies, urban & surveillance.

The classification of high resolution hyperspectral images is considered to be an emerging discipline but faces several challenges owning to huge scale of pixel data involved. Hyper spectral image comes with high dimensional feature spaces and many of the contents are not visible by humans. Therefore handling the image with traditional supervised or unsupervised classification methods is found to be a difficult task due to unbalance between the high dimensionality of the data and the limited availability of labeled training. Initially, the hyperspectral images were segmented using K-mean cluster algorithm. An enhanced graph based Semi Supervised Learning (SSL) method is adopted for classification. Though the present strategy focuses on image classification but equal significance will be provide to image segmentation since the resultant classified output depends on the trained input i.e. the segmented image. Further, the proposed method will provide better classified output with high overall accuracy.

Keywords: Hyperspectral, Semi Supervised Learning, Segmentation, Classification.

I.INTRODUCTION

Classification is a data mining technique that assigns categories to a collection of data in order to aide in more accurate predictions and analysis. Learning can be divided in to three major categories supervised learning, Unsupervised Learning and Semi supervised Learning in that Generative models, Low–Density models, Graph-Based methods and Heuristic approaches In Hyper-spectral images the relationships among the different spectra in a neighborhood provide more accurate segmentation and classification of the image. Image classification refers to the task of extracting information classes from a multiband raster image. Hyper-spectral image comes with high dimensional feature spaces and many of the contents are not visible to humans. Hyper-spectral images can easily distinguish materials which are spectrally similar.

Limitation: Significant data storage capacity is necessary for hyper-spectral cubes. Increase the cost of acquiring and processing hyper-spectral data.

II.METHODOLOGY

1. Pre-processing of hyper spectral imagery is required to reduce data dimensionality &computational complexity.

Dimensionality Reduction: It is an effective approach to downsizing data. Most of the data mining technique may not be effective for high dimensional data.

Noise Filtering: It is used to filter unnecessary information from an image. Dimensionality Reduction and noise filtering is used for improving visualization, Noise removal and Data compression.

2. Clustering Method: It means grouping the objects based on the information found in the data describing the objects or their relationship. The goal is that objects in a group will be similar to one other and different from objects in other group. The K-means algorithm is an iterative technique that is used to partition an image into *K* clusters.

Algorithm:

First Pick *K* cluster centers, then Assign each pixel in the image to the cluster that minimizes distance between the pixel and the cluster center, Re-compute the cluster centers by averaging all of the pixels in the cluster, Repeat steps 2 and 3 until convergence is attained.

Distance is the squared or absolute difference between a pixel and a cluster center. The difference is typically based on pixel color, intensity, texture, and location, or a weighted combination of these factors. *K* can be selected manually, randomly, or by a heuristic. This algorithm is guaranteed to converge, but it may not return the optimal solution. The quality of the solution depends on the initial set of clusters and the value of *K*.

The algorithm has a loose relationship to the k-nearestneighbor classifier, a popular machine learning technique for classification that is often confused with *k*-means because of the *k* in the name. One can apply the 1-nearest neighbor classifier on the cluster centers obtained by *k*-means to classify new data into the existing clusters. This is known as nearest centroid classifier or Rocchio algorithm.

3. Graph-based methods for semi-supervised learning use a graph representation of the data, with a node for each labeled and unlabeled example. In this method each sample spreads its label information to its neighbors until a global stable state is achieved on the whole dataset.

It relies upon the construction of a graph representation where the vertices are the samples and edges. The performance of technique were compared with some predominant classification algorithms to find the classification accuracy for the same data set.

The graph may be constructed using domain knowledge or similarity of examples. Two common methods are to connect each data point to its k nearest neighbours or to examples within some distance. The weight W_{ij} of an edge between x_i and x_j and is then set to -:

$$e^{\frac{-\|x_i - x_j\|^2}{\epsilon}}$$

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Within the framework of manifold regularization, the graph serves as a proxy for the manifold. A term is added to the standard Tikhonov regularization problem to enforce smoothness of the solution relative to the manifold (in the intrinsic space of the problem) as well as relative to the ambient input space. The minimization problem becomes :

$$\underset{f\in\mathcal{H}}{\operatorname{argmin}}\left(\frac{1}{l}\sum_{i=1}^{l}V(f(x_i),y_i)+\lambda_A\|f\|_{\mathcal{H}}^2+\lambda_I\int_{\mathcal{M}}\|\nabla_{\mathcal{M}}f(x)\|^2dp(x)\right)$$

Where $\mathcal{H}$ is a reproducing kernel Hilbert space and $\boldsymbol{M}$ is the manifold on which the data lie. The regularization parameters λ_A and λ_I control smoothness in the ambient and intrinsic spaces respectively. The graph is used to approximate the intrinsic regularization term. Defining the graph Laplacian $\boldsymbol{L= D\text{-}W}$ where :

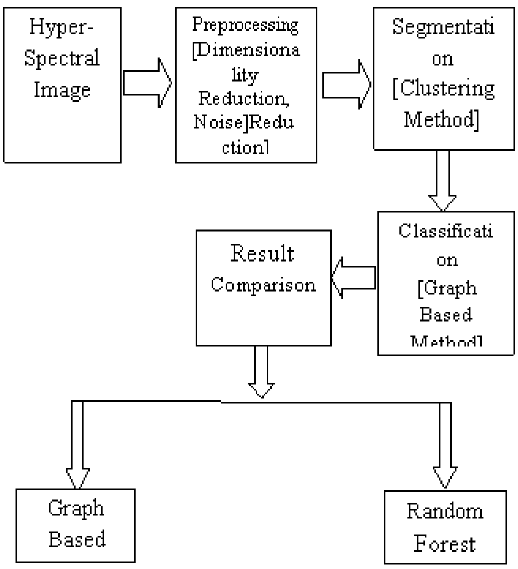
$$D_{ii}=\sum_{j=1}^{l+u}W_{ij}$$

and **f** the vector **[*f(x₁)……f(x_{l+u})*] ,** we have :

$$\mathbf{f}^T L\mathbf{f}=\sum_{i,j=1}^{l+u}W_{ij}(f_i-f_j)^2\approx\int_{\mathcal{M}}\|\nabla_{\mathcal{M}}f(x)\|^2dp(x)$$

The Laplacian can also be used to extend the supervised learning algorithms : regularized least squares and support vector machines (SVM) to semi-supervised versions Laplacian regularized least squares and Laplacian SVM.

III.BLOCK DIAGRAM



IV.EXPERIMENTAL RESULTS

First we require a hyper-spectral image to perform our analysis. The hyper-spectral image can be obtained from various locations. Hyper-spectral image is costly and hence we use semi-supervised learning algorithm as if requires only minimum amount of Labeled data and maximum unlabeled data for the study.

Hyper-Spectral image is of high quality and large size; hence we make use of preprocessing methods such as data dimensionality and noise reduction to reduce the size of the image and any noise or disturbance in the image.

After Preprocessing, we move on to Segmentation method, where we make use of clustering method. Image segmentation is the process of partitioning a digital image into multiple segments. The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics. Here K-means clustering method is used for the process of clustering.

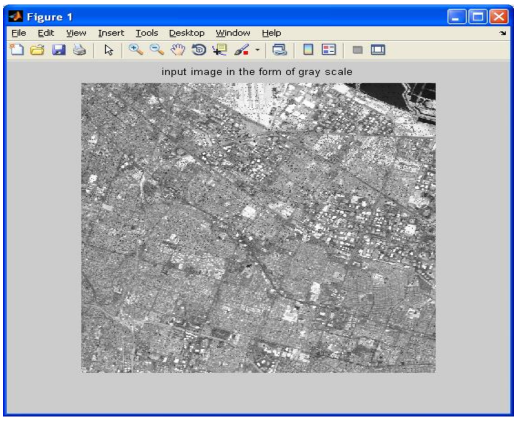
Then Image classification is done on the image after segmentation process. The intent of the classification process is to categorize all pixels in a digital image into one of several land cover classes, or "themes". This categorized data may then be used to produce thematic maps of the land cover present in an image. The objective of image classification is to identify and portray, as a unique gray level (or color), the features occurring in an image in terms of the object or type of land cover these features actually represent on the ground. For classification of image, graph-based method is employed. The graph-based framework efficiently characterizes the relationships among the data and allows for convenient mathematical manipulation. Further the performance of the algorithm is evaluated and compared with predominant existing algorithms using the same data set.

After classification, we check the results and compare the result with other predominant methods and this method provides better classified output and at a high accuracy.

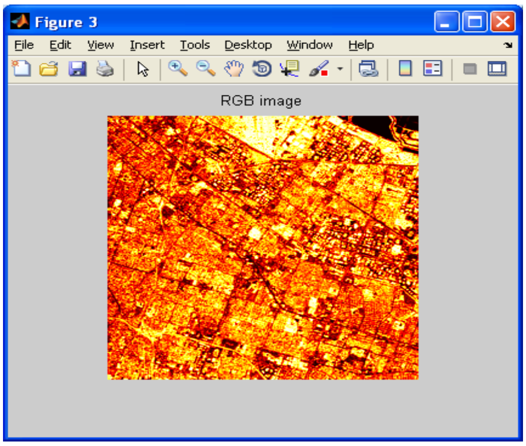
V. SCREENSHOTS

STEP 1: INPUT IMAGE:

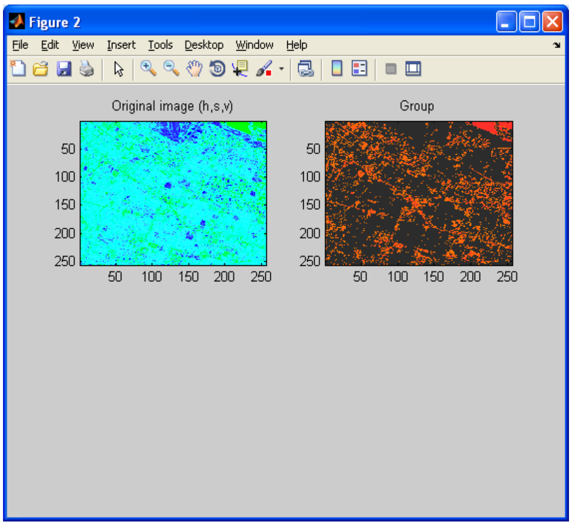
STEP 2 : INPUT IMAGE IN GRAY SCALE



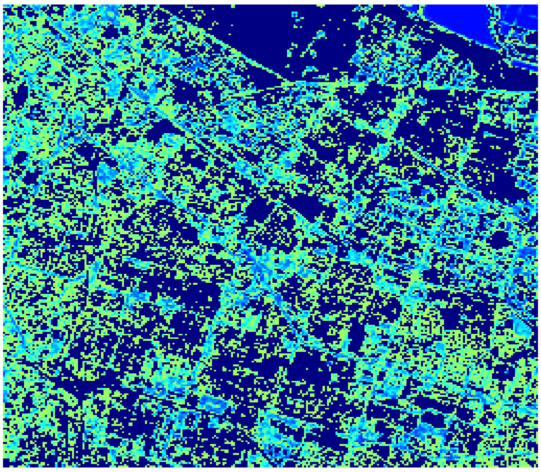
STEP 3 : INPUT IMAGE IN RGB FORM



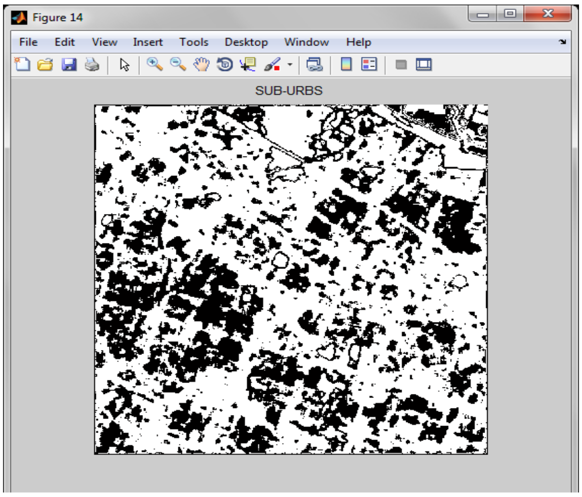
STEP 4 : SEGMENTATION USING K-Mean CLUSTER



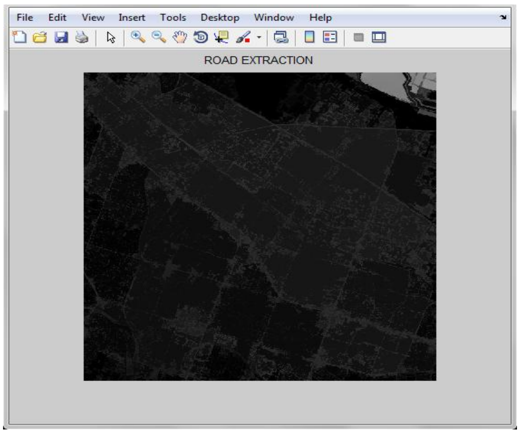
STEP 5 : PSEUDO MAP CONSTRUCTION



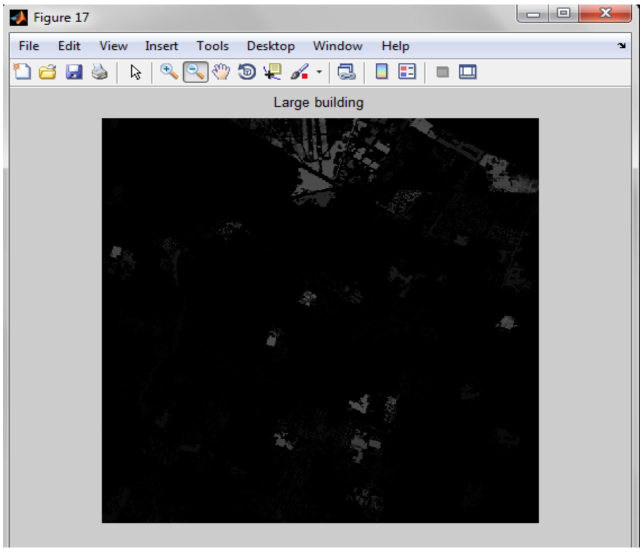
Step 6: SUBURBS



Step 7: ROAD EXTRACTION



Step 8: large building



VI.CONCLUSION

An enhanced Graph based method is adopted for classifying hyperspectral image. The nodes represent labeled and unlabeled examples in a dataset and the edges reflect the similarity of examples. It should be close to the given labels on the similar labeled nodes it should be smooth on the whole graph. A graph connects all similar data points. The proposed method will provide better classified output with high accuracy.

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