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Classification of Hyper Spectral Images using the Unsupervised Technique

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***Abstract*— The presence of a large number of spectral bands in the hyper spectral images increases the capability to distinguish between various physical structures. However, they suffer from the high dimensionality of the data. Hence, the processing of the hyper spectral images is applied in two stages: dimensionality reduction and unsupervised techniques. The high dimensionality of the data has been reduced with the help of Principal Component Analysis (PCA). The selected dimensions are classified using Niche Hierarchical Artificial Immune System (NHAIS). Pixels, together with different weighted local neighbours, are clustered iteratively, until the final clustering result is obtained. The method can be directly applied to the image without any filter and the experimental results over remote sensing images show that NHAIS not only effectively solves the problem of isolated and random distribution of pixels inside regions but also obtains high edge accuracies.**

***Index Terms*— Hyperspectral images, niche hierarchical artificial immune system, principal component analysis.**

INTRODUCTION

The remote sensing images require accurate classification for many practical applications, such as precision agriculture, monitoring and management of the environment, and security and defense issues. The advent of high resolution sensors and high speed data processing devices has prompted the use of hyper spectral images for image analysis and classification. They cover a wide range of spectral channels and spatial resolution. Thus, every pixel in a hyperspectral image contains values that correspond to the detailed spectrum of reflected light. This rich spectral information in every spatial location increases the capability to distinguish different physical structures, leading to the potential of a more accurate image classification.

Hyper spectral image data has been used for various applications such as mapping of several soil properties , crop stage identification etc. However, they suffer from the curse of high dimensionality. Various dimensionality reduction techniques have been used in the past to overcome this problem. The large number of dimensions is reduced to first few principal components (PCs) by the Principal Component Analysis (PCA) technique.

Two stages are applied for processing hyper-spectral image. Stage 1 uses dimensionality reduction technique namely PCA in order to reduce the dimension of hyperspectral image. In stage 2, NHAIS is applied on reduced dimension.

Using satellite images, different regions can be accurately plan and use land efficiently. Satellite images offer a method of extracting this temporal data that can be used in gaining knowledge regarding land use. Recent advances in the realm of computer science have allowed us to perform this “intelligent” job. This has established a vast research area in solving the land cover mapping problem for city planning and land-usage. Unsupervised techniques can be used for grouping distinct land cover regions, provided there is a lack of ground truth information. Based on certain similarity metric, the data is sub-divided into clusters, using unsupervised methods where the number of clusters is not known a priori. The objective is to maximize the inter-cluster distances while the intra-cluster distances are minimized. The clustering problems can be studied using hierarchical approach. Two approaches are used in this hierarchical clustering method: (i) divisive methods, where a large cluster is split into several small clusters; (ii) agglomerative methods, where many small clusters are merged to form a large cluster. The grouping of the same clusters is regarded as a fundamental task in land cover mapping problem, which transforms the remotely sensed images to generate thematic Land-use/land-cover maps. Several methods to compute a single-band gradient function from satellite images have been studied previously by Tarabalka *et al.* including pixel-wise classification methods. Studies show that hierarchical step-wise optimization and spectral clustering have given good results for analyses of satellite images. High dimensionality of hyper spectral data, usually coupled with limited reference data available, limits the performances of supervised classification techniques [1]. Semi supervised learning of the posterior class distributions followed by segmentation, which infers an image of class labels from a posterior distribution built on the learned class distributions and on a Markov random field. The posterior class distributions are modeled using multinomial logistic regression, where the regressors are learned using both labeled and, through a graph-based technique, unlabeled samples [2]. This letter presents a novel method for accurate spectral-spatial classification of hyper spectral images. The proposed technique consists of two steps. In the first step, a probabilistic support vector machine pixel wise classification of the hyper spectral image is applied. In the second step, spatial contextual information is used for refining the classification results obtained in the first step[3]. Pixel wise classification is performed, and the most reliable classified pixels are chosen as markers. Each

Classification-derived marker is associated with a class label[4]. New methods in computational intelligence namely artificial immune systems (AIS), which draw inspiration from the vertebrate immune system, have strong capabilities of pattern recognition [5].

METHODOLOGY

Proposed technique uses the NHAIS clustering algorithm, based on which image is divided into the different clusters and have to calculate the performance efficiency. Hyper spectral image is taken as input and image is enhanced using the PCA technique to convert to low dimensional data and clustering algorithm applied to calculate the performance efficiency of different regions and occupancy of the region shown fig1.1

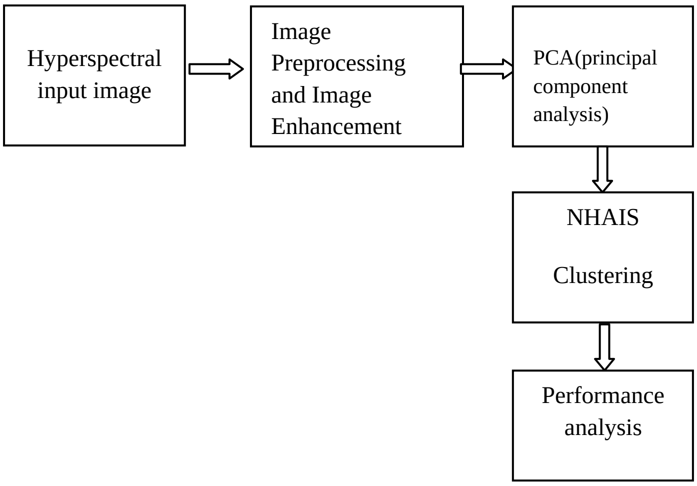

Figure 1.1 Module Flow

A. Input Image

Hyper spectral image is taken as a input and image is preprocessed and enhanced. The input image consists of the different large dimension spectral bands. High dimensional input image is converted into the low dimensional data.

B. Image Preprocessing And Enhancement

Image enhancement is the improvement of digital image quality (wanted e.g. for visual inspection or for machine analysis), without knowledge about the source of degradation. If the source of degradation is known, one calls the process image restoration. Both are iconical processes, viz. input and output are images.

Many different, often elementary and heuristic methods are used to improve images in some sense. The problem is, of course, not well defined, as there is no objective measure for image quality. Here, we discuss a few recipes that have shown to be useful both for the human observer and/or for machine recognition. These methods are very problem-oriented: a method that works fine in one case may be completely inadequate for another problem. PCA or KLT is a mathematical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. The number of principal components is less than or equal to the number of original variables. This transformation is defined in such a way that the first principal component has the largest possible variance (that is, accounts for as much of the variability in the data as possible), and each succeeding component in turn has the highest variance possible under the constraint that it be orthogonal to (i.e., uncorrelated with) the preceding components. Image enhancement as shown on fig 1.2 and image preprocessing shown on fig 1.3

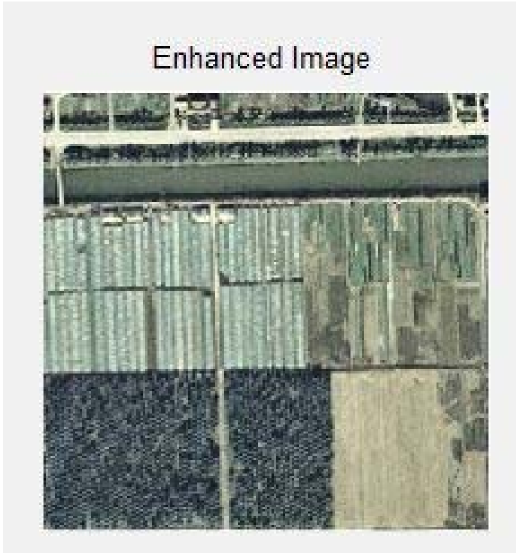

Figure 1.2 Image Enhancement

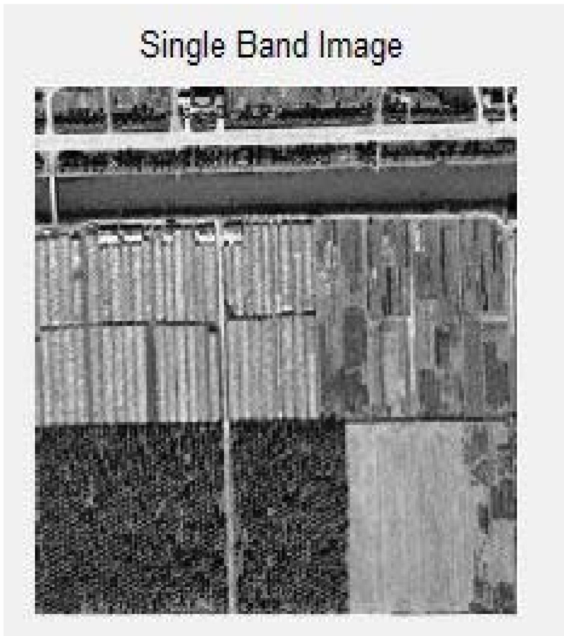

Figure 1.3 Image preprocessing

C. Image Classification Using The Clustering

NHAIS clustering algorithm is used to classify the images using different regions and to calculate the area of the different regions based on type. After applying NHAIS on it, NHAIS has split the data set into three cluster centers instead of two . This is because of the non-linearity in the data set. The data set is now merged according to the distance from the cluster centers. The data points closer to a cluster center are clubbed into one cluster. The NHAIS allows each feature vector to belong to every cluster with a fuzzy truth value (between 0 and 1), which is computed using Equation. The algorithm assigns a feature vector to a cluster according to the maximum weight of the feature vector over all clusters. **.** A more efficient algorithm is the new nhais. It computes the cluster center using Gaussian weights, uses large initial prototypes, and adds processes of eliminating, clustering and merging. In the following sections we nhais algorithm. Classified images shown as clusters on fig 1.4

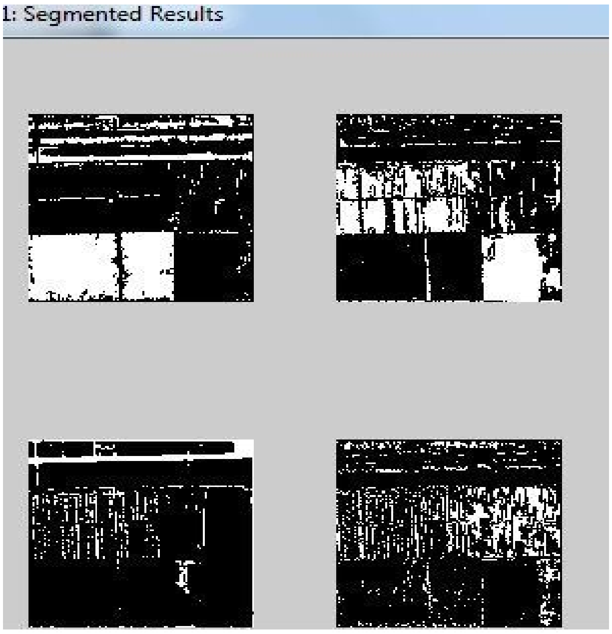

Figure 1.4 Clustered Regions.

D. Performance Measurements

Performance measurements images are classified into different clusters and based on these clusters image is again divides these cluster regions. Based on the above regions image efficiency like individual efficiency, overall efficiency, average efficiency. .

EXPERIMENTAL RESULTS

From experiment results calculate the different regions and based on the regions different parameters like occupancy percentage of different regions, object count distributed in different regions and area of the particular region in meters is calculated. In the following five color types of regions are identified and as shown on the fig 1.5 a occupancy percentage, object count and area is calculated in meters.

A niche hierarchical clustering method for crop stage classification and Indian pines data set of hyper spectral images is proposed and implemented in this paper. The proposed method could successfully perform data clustering using the principles of splitting and merging the cluster centers along with niching process.

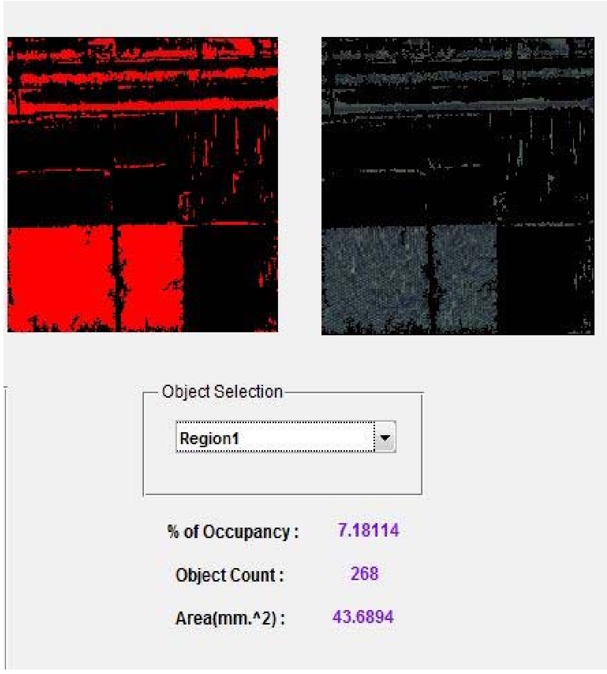

Figure 1.5.a Performance Measurement

From the above classified clusters into the regions of type1 and calculated the object count based on the object selection type and calculated the area of particular region in meters and followed by percentage of occupancy. Based on the above different efficiencies are calculated like overall efficiency etc…

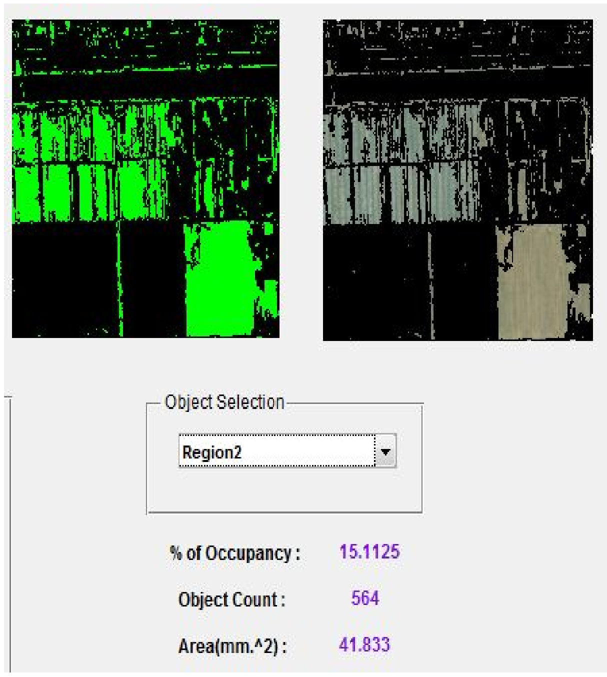

Figure 1.5.b Performance Measurement

From above fig 1.5 b calculate the different regions and based on the regions different parameters like occupancy percentage of different regions, object count distributed in different regions and area of the particular region in meters is calculated.

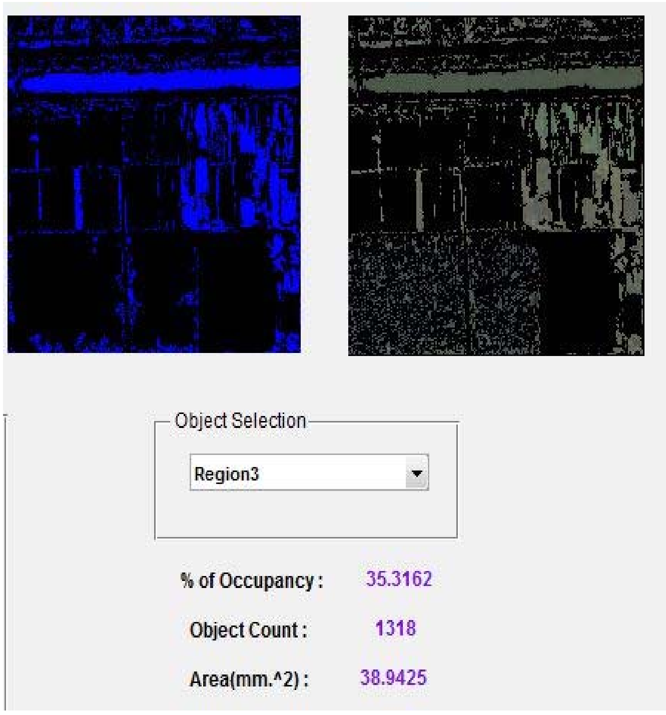

Figure 1.5.c Performance Measurement

From above fig 1.5 c calculated the different regions and based on the regions different parameters like occupancy percentage of different regions, object count distributed in different regions and area of the particular region in meters is calculated.

Figure 1.5.d Performance Measurement

From above fig 1.5 d calculate the different regions and based on the regions different parameters like occupancy percentage of different regions, object count distributed in different regions and area of the particular region in meters is calculated.

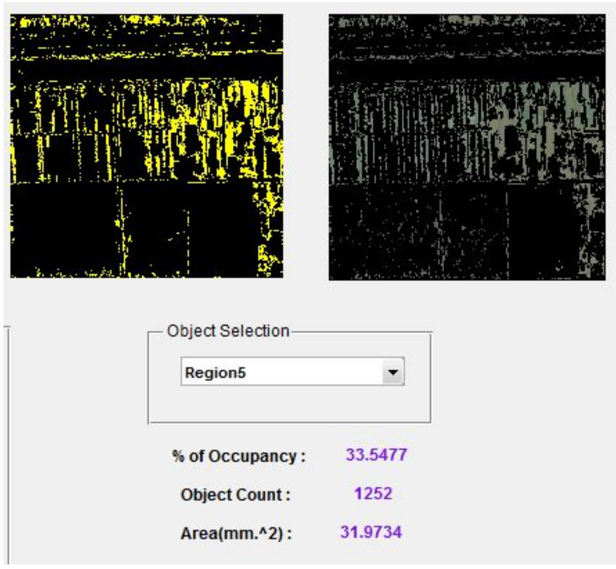

Figure 1.5.e Performance Measurement

From above fig 1.5 e calculated the different regions and based on the regions different parameters like occupancy percentage of different regions, object count distributed in different regions and area of the particular region in meters is calculated

V. Conclusion

The project presented the nhais clustering based image segmentation for classification of satellite images to avoid the problems of land cover mapping in space research. Here, unsupervised segmentation approach called nhais means with hierarchical and local information, which reduces the edge degradation by introducing the weights of pixels within local neighbor windows. The prior steps of segmentation involved the contrast limited adaptive method to enhance the image quality for effective segmentation and pca for dimensionality reduction. Niche hierarchical clustering used to classify the different individual objects with minimum error and this performance was measured with parametric such as individual class efficiency and Overall cluster efficiency.

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