A Survey on: Hyper Spectral Image Segmentation and Classification using FODPSO

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Abstract- The Spatial analysis of image sensed and captured from a satellite provides less accurate information about a remote location. Hence analyzing spectral becomes essential. Hyper spectral images are one of the remotely sensed images, they are superior to multispectral images in providing spectral information. Detection of target is one of the significant requirements in many are assuc has military, agriculture etc. This paper gives the analysis of hyper spectral image segmentation using fuzzy C-Mean (FCM)clustering technique with FODPSO classifier algorithm. The 2D adaptive log filter is proposed to denoise the sensed and captured hyper spectral image in order to remove the speckle noise.

Keywords: *Hyper spectral image segmentation, FODPSO-FCM*

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I. INTRODUCTION

The objective of this research is to provide a better spectral information about remotely sensed images which are the most significant requirement of various areas such as military and agriculture. The proposed algorithm is also used to segment the mineral information from the hyper spectral satellite images. However, the data so-obtained consist of high dimension (hundreds of bands) spectrum that needs to be processed to obtain classification data through which we can identify the existing minerals .This paper provides a better methodology to get image in good quality, provide low computational complexity, high visual quality and can achieve good performance.

In recent times a lot of work has been carried out in the field of image segmentation and classification. And all the techniques proposed have, in their unique way, proven to be very useful. But the main hindrance that remains is that degradation in the image quality, accuracy of the segmentation is not proper, the algorithms depends only on the intensities not on the shape and texture. Further research needs to be undertaken to tackle these drawbacks.

Even though lot of research has been carried out for hyper spectral image segmentation, unfortunately no credible techniques have been proposed for providing an efficient result which can give the spatial and contextual information. The automatic seed select is possible for image segmentation. So the accuracy of the segmentation is high. The algorithm depend not only the intensity but also depend on the shape and texture. So the segmentation of the object and pixel is proper.

II. Hidden Markov Random Field [HMRF]

MRFs can be described as 2-D statistic processes over discrete pixel lattices [5] as they are a family of random probabilistic models. MRFs can be considered as a powerful tool for incorporating spatial and contextual information into the classification framework [6]. Lately the Hidden Markov Random Field (HMRF) was introduced as a special case of the hidden Markov model (HMM). In HMRF, instead of Markov chains in HMM, the MRF is used as a statistic process. Hence , HMRF is not restricted to 1-D so it can be used in order to extract spatial information from 2-D and 3-D images also. There is extensive literature on the use of MRFs for increasing the accuracy of classification. For instance, in [7], also the result of the probabilistic SVM was regularized by an MRF. The mean field-based SVM regression was used for image classification In [5]. Also, in [6] and [7] for modeling spatial and contextual information to improve the accuracy of the classification the MRFs were taken into consideration. In addition, a generalized MRF, called conditional MRF, was developed for the spectral and spatial classification of sensed remote sensing images. For incorporating spectral and contextual information into a framework [7] the concept of HMM was used for performing unsupervised classification of sensed remote sensing multispectral images.

In addition, Gaussian MRF was employed in for the purpose of segmentation and anomaly detection. Based on the previous discussion, the integration of SVM classifiers and MRFs for the accurate classification of remote sensing images by considering both spectral information and spatial information into the same framework is completely obvious. A new fully automatic spectral and spatial approach is introduced for the classification of hyperspectral images. This approach was based on the SVM and HMRF. In order to preserve the edges in the classification map (CM), a gradient step based on the Sobel edge detector was taken into account.

III. Fuzzy Clustering Means[FCM]

In fuzzy clustering method each pixel can belong to several land cover classes partially. It gives membership vectors for each sample for each class with the ranges between 0 and 1. Thus a pixel can belong to a class to a certain degree and may belong to another class to another degree and the degree of belongingness is indicated by fuzzy membership values. In the feature space if any point lies closer to the centre of a cluster, then its membership grade is also higher (closerto1)for that cluster .In case of fuzzy membership grades feature space is not sharply partitioned into clusters, the main advantage of this approach is that no spectral information is lost like in the case of hard partitioning of feature space[1]. In hard partitioning one pixel is assigned to a single land cover class, thus there is some loss of information, but in case of fuzzy partitioning for a single pixel, there is partial belongingness to several land cover classes, it preserves information for a class.

Disadvantage: FCM is sensitive to initialization and is easily trapped in local optima.

IV. Particle Swarm Optimization[PSO]

Particle Swarm Optimization (PSO) is a population-based statistic optimization technique developed by Dr. Eberhart and Dott. in 1995, inspired by the social behavior of the neighborhood or aquaculture. PSO shares many analogies with evolutionary computing techniques, such as genetic algorithms (GAs). Partial swarm optimization is similar to a genetic algorithm [8] where the system is initialized with a random solution population. However, it is not a genetic algorithm, since every potential solution is also assigned at random speed and potential solutions, called particles, are "piloted" through hyperspace.

Each particle traces its coordinates in the hyperspace associated with the best solution (aptitude) it has achieved so far. The value of this aptitude is also stored and this value is called pbest. Another "best" value is also monitored. The "global" version of the particle swarm optimizer tracks the best overall value and position obtained so far by any particle in the population; the concept of optimizing particle transplantation is at each stage of time changing the speed (acceleration) of each particle to its pbest and gbest (global version). Acceleration is weighted by a random term, with separate random numbers generated for pbest and gbest acceleration.

Disadvantage:The disadvantages of particle swarm optimization (PSO) algorithm are that it is easy to fall into local optimum in high-dimensional space and have a low convergence rate in the iterative process.

V. Clustering with FCM-PSO

The Fuzzy clustering is an important issue that is the subject of active research in different real-world applications. The c-means Fuzzy (FCM) algorithm is one of the most popular fuzzy clustering techniques, because it is efficient, simple and easy to deploy. Particle Swarm Optimization (PSO) is a global stochastic optimization tool that is used in many optimization issues. In many areas, a hybrid diffused cluster based on FCM and diffused PSO (FPSO) has been proposed that uses the merits of both algorithms and this method is efficient and can reveal encouraging results. The diffusion of diffused particle swirls can be more effective in some cases. Fuzzy hybrid means and widespread particle swirling optimization can get the best results.

To solve the issues of the fuzzy clustering algorithm (FCM), when applied to segmentation of images, such as easy to cheat on optimum and huge local calculations, a segmentation algorithm based on modified particle swarm optimization (MPSO) and the FCM algorithm was proposed. The simulation results and comparison between the new algorithm and the FCM algorithm indicate that the new algorithm can achieve better segmentation effects and overcome the existing issues of FCM algorithm in different performance such as average dispersion, maximum distance between pixels and its cluster center and the minimum distance between any pair of clusters.

i) Clustering

Clustering is the process of assigning data sample objects to a set of disjoint groups called clusters, so that objects in each cluster are more similar to objects in different clusters. Clustering techniques are applied in many application areas,

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such as pattern recognition [1], data extraction [2], automatic learning [3], and so on. Grouping algorithms can typically be categorized as Hard, Fuzzy, Possible, and Probabilistic algorithms.

ii) K-means

K-means is one of the most widely used hard cluster algorithms that divides data objects into cluster k where the number of clusters k is decided in advance depending on the purpose of the application. This template is not appropriate for real data sets where there are no boundaries defined between clusters. After the widespread theory presented by LotfiZadeh, the researchers placed diffuse theory in a grouping. Fuzzy algorithms can partially assign to multi-cluster data objects. The degree of fuzzy cluster membership depends on the proximity of the data object to the cluster centers.

Disadvantage: K-means is not appropriate for real data sets where no boundaries exist between clusters.

iii) FCM-FPSO

The most popular fuzzy clustering algorithm is fuzzy c mean (FCM) clustering algorithm, introduced by [9] Bezdek in 1974, is now widely used. The Fuzzy c-mean cluster algorithm is effective, but random selection at the center points makes the iterative process easily fall off the local optimum solution. To solve this problem, evolutionary algorithms, such as genetic algorithms (GAs), simulated annealing (SA), ant colony optimization (ACO) and particle swarm optimization (PSO), have recently been successfully applied. Particle Swarm Optimization (PSO) is a population-based optimization technique that can be easily implemented and applied to solve the various problems of optimization features, or problems that can turn into optimization feature problems [8]. A version of particle swarm optimization for TSP called FPSO (Fuzzy Particle Swarm Optimization) was proposed by Pang et al. [10] In 2004.

An FCM and FPSO-based hybrid clustering algorithm called FCM-FPSO was also proposed. Experimental results over six real-life data series indicate that the FCM-FPSO algorithm is superior to the FCM algorithm and the FPSO algorithm for the problem. The rest of the document was organized as follows to show The FCM algorithm is faster than the FPSO algorithm because it requires less function evaluations, but generally falls into local optima. The FCM algorithm was integrated with the FPSO algorithm to form a hybrid clustering algorithm called FCM-FPSO that retains the merits of FCM and PSO algorithms. The FCM-FPSO algorithm applies FCM to particles in the swarm every number of iterations / generations so that the aptitude value of each particle is improved.

Disadvantage:A general problem with these techniques, such as the PSO and an FCM-PSO algorithm, is that they can be trapped in local optimum locations so that they can be successful in some problems, but not in others.

VI. Clustering and segmentation with FODPSO-FCM

Conventional hard grading techniques do not consider the continuous changes of the different soil cover classes from one to the other. For example, the crisp K-means standard can be considered as the most widely used clustering technique in the pattern recognition field [1]. However, this technique uses hard partitions, in which each data point belongs exactly to a cluster. To model the gradual changes of the limits, "soft" classifiers were used. To further improve the existing techniques, we combine the FCM with the fractional Order Darwin PSO (FODPSO) previously proposed by Couceiro et al. and Ghamisi et al. and applied for different applications [14]. The FODPSO algorithm takes advantage of a cooperative paradigm where particles within each swarm cooperate, while more swarm compete to find the most suitable solution, that is, the optimal solution.

By combining FODPSO with the FCM technique, named in this paper as FODPSO-FCM, each particle will be represented by a particular cluster configuration and the objective FCM function. FODPSO's emerging collective properties, along with fractional order velocity and a set of penalty award rules designed to simulate Darwin's natural selection mechanism, converge to optimum cluster configuration. In addition, in order to speed up the grouping process, you intend to use the image intensity histogram as input instead of raw image data. In this paper we propose a new widespread grouping approach based on evolution. This approach benefits from a fractional calculation approach to improve the convergence speed of traditional FCM, while at the same time benefiting from the same natural selection mechanism of the original PSO to avoid local optima stagnation[4] . Therefore, the proposed widespread clustering approach is used to improve the classification of hyperspectral images with FODPSO.

However, it is a difficult classifier and can not model temporary gradual changes between different classes. Conversely, the new Fuzzy-based clustering technique can model gradual changes between different classes. In the proposed method, the Combination of FODPSO and the new fuzzy- clustering strategy can be considered as a desirable strategy to classify hyperspectral imaging.The experimental result for the hyperspectral image demonstrates that the performance of the proposed method, which uses a biologically inspired behavior based on natural selection and noninteger convergence, results in a statistically significant improvement in terms of overall classification accuracy . It

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should be noted that because of the effective implementation of all clustering approaches in this proposed method based on an image histogram, clustering approaches here are very fast and can lead to a conclusion within a few seconds.

VII. CONCLUSION

This paper presents different clustering and segmentation methods and also included FCM with FODPSO as new method for clustering and segmentation which gives better performance than existing methods of clustering and segmentation. So the FCM-FODPSO can be used for clustering and segmentation with better performance.

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