Hyper Spectral Image Segmentation and Classification Using Least Square Clustering Based on FODPSO

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Abstract- The spatial analysis of the image detected and acquired by a satellite provides less accurate information on a remote location. Hyperspectral images are one of the images detected remotely, they are superior to multispectral images that provide spectral information. detailed information is one of the important requirements in many areas, such as military, agriculture, etc. The FODPSO classifier algorithm is used with the grouping technique of least squares for image segmentation. The 2D adaptive filter is proposed to eliminate the noise of the hyperspectral image detected and captured in order to eliminate the noise of the spot. Denoising the hyperspectral image (HSI) is an essential pre-processing step to improve the performance of subsequent applications.

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

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I. INTRODUCTION

The main objective of this research is to provide some important and better spectral information on images, which are the most important requirement in several areas, such as the army and agriculture since these are sensed from remote. The proposed algorithm is also used to segment minute information from hyperspectral satellite images. However, the data thus obtained consist of a high-dimensional spectrum (hundreds of bands) that must be processed to obtain classification data through which we can identify the existing minute details.

This document provides a better methodology for obtaining good quality images, providing low computational complexity, high visual quality and achieving good performance. In recent times, much work has been done in the field of image segmentation and classification. And all the proposed techniques have, in their unique form, proved very useful. But the main obstacle that remains is that the degradation in image quality, the accuracy of segmentation is not adequate, the algorithms depend only on the intensity, not the form and the plot. Further research is needed to solve these problems.

The goal of this study is to provide better spectral information on the use of spectral image segmentation, unfortunately there are no credible techniques. and contextual information. Automatic seed selection is possible for image segmentation. Thus, the accuracy of segmentation is high. The algorithm depends not only on the intensity but also on the form and the plot. So the segmentation of the object and the pixel is appropriate.

II. RELATED WORKS

In the fuzzy grouping method, each pixel can belong partially to different land cover classes. Provides the membership vectors for each sample for each class with intervals between 0 and 1. Therefore, a pixel may belong to a class to a certain extent and may belong to another class in another degree and the degree of membership is indicated from widespread adhesion values. In feature space, if a point is closer to the center of a cluster, its membership level is also higher (closer to 1) for that cluster. In the case of widespread degrees of belonging, the function space is not clearly divided into groups, the main advantage of this approach is that no spectral information is lost, as in the case of the hard partitions of the function space [2]. In hard partitions, a pixel is assigned to a single class of land cover, so there is a loss of information, but in the case of a diffuse partition for a single pixel, there is a partial subscription to different classes of coverage of the soil, keep information for a class.

Particle Swarm Optimization (PSO) is a population-based statistical optimization technique developed in 1995, inspired by the social behavior of neighborhood or aquaculture. Genetic algorithms (GA) shares some similarities with PSO. PSO is similar to a genetic algorithm [8] in which the system is initialized with a population of random solutions. But, it is not a GA, because each potential solution is also assigned at random speed and potential solutions, called particles, are "driven" through hyperspace.

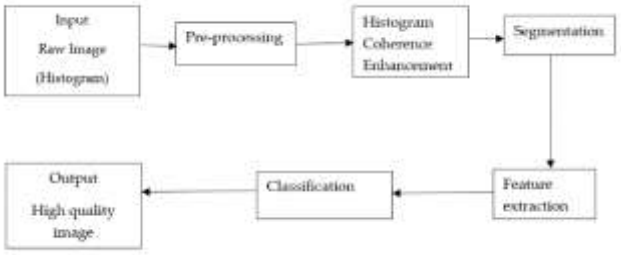
FCM with FODPSO this new technique uses hard partitions, in which each data point belongs exactly to a cluster. To model the gradual changes of the limits, "soft" classifiers were used. To further improve the existing techniques, we

combine the FCM with the fractional Order Darwin PSO (FODPSO). 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.

III. PROPOSED METHOD

The proposed system uses a fuzzy c mean algorithm for the segmentation. An automatic seed is selected for the segmentation. Image denoising manipulates the image data to produce a visually high quality image[8]. 2D adaptive log filter is used to filter the image after getting it from the satellites. Coherence technique is used for the enhancement of the image. FODPSO algorithm is used as a classifier to get a better enhanced image quality.

Architecture



Proposed Algorithm 1 : 2D Adaptive Log Filter

It is a challenge to reduce the noise of medical images or a satellite image, etc. in the processing of digital images. There are several approaches to reducing noise. The noise of speckles is commonly found in radar images with synthetic aperture, satellite images and hyperspectral images. This article proposes filtering techniques called 2D adaptive log filter to eliminate the cracking noise of digital images.

Steps :

1) Read an image (histogram image)
2) Convert image into gray-scale.
3) Add Gaussian noise to the image.
4) Display the image.
5) Remove the noise using the 2D adaptive log filter function.

ProposedAlgorithm2:Fuzzy c-means(FCM)

For the number of problems related to feature analysis, clustering and classifier design FCM is successfully applied as an unsupervised cluster algorithm[1]. This algorithm was proposed by Bezdek [8], as an improvement of the rigid K-means clustering principles [2]. The FCM algorithm can be described as follows. Let X = {X1 ,. . . , Xb ,. . ., Xq} is the set of objects q and Z = {z1 ,. . ., zb ,. . ., zk} is the set of k centroids in a space of d-dimensional characteristics. The FCM divides X into clusters minimizing the following objective function:

$$J = \sum_{j=1}^{q}\sum_{i=1}^{k}(\mu_{ij})^m \|X_j - Z_i\|^2$$

where the *fuzzifier*, *Zi*is the *i*th centroid corresponding to cluster βi, $1 < m \leq \infty$ and $\mu ij \in [0, 1]$ is the fuzzy membership of the pattern *Xj*to cluster βj , such that

$$Z_i = \frac{1}{q_i}\sum_{j=1}^{q}(\mu_{ij})^m X_j, \text{ where } q_i = \sum_{j=1}^{q}(\mu_{ij})^m$$

and

$$\mu_{ij} = \frac{1}{\sum_{c=1}^{k}(\frac{d_{ij}}{d_{cj}})^{\frac{2}{m-1}}}, \text{ where } d_{ij}^2 = \|X_j - Z_i\|^2.$$

FCM is started by randomly choosing the k objects as centroids (means) of the k clusters. Based on the relative distance of the Xj object to the centroids memberships are calculated . Once the membership of all objects are found, the centroids of the clusters are calculated. The process ends when the standard difference between two consecutive iterations is less than a predefined threshold [2].

ProposedAlgorithm3: DPSO algorithm

In Darwinian PSO, there may be many swarms of test solutions at any time. Each swarm behaves individually as a normal PSO algorithm with some rules that regulate the collection of swarms designed to simulate natural selection[9]. within a constantly changing swarm collection the selection process is implemented.

1. For each swarm in the collection
   Evolve the swarm (Evolve Swarm Algorithm)
2. For each swarm in the collection
   Allow the swarm to generate "failed" swarms
3. For each particle in the swarm
   Update the fitness of particles
4. For each particle in the swarm
   Update the best particle results
5. For each particle in the swarm
   Move the particles
6. If the swarm improves
   Reward swarm: spawn particle: prolongs the swarming life
7. If the swarm has not improved
   Punish swarm : possibly delete particle : reduce swarm life

ProposedAlgorithm3:FODPSOalgorithm for segmentation and classification

Step-1: Initialize the algorithm constants

Step-2: Then initiate the random velocity particles (i).

Step-3: evaluate objective function

Step-4: Update the particle and swarm best values.

Step-5: Then update the velocity of particle.

Step-6: If stopping criteria is satisfied, the output results will be displayed.

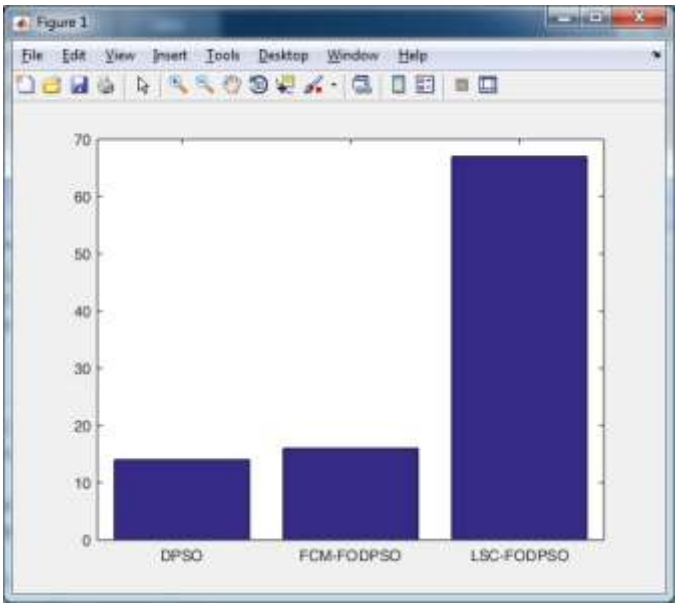
Step-7: If the stopping criteria is not satisfied, then the value of i is incremented

Step-8: If the value of i is greater than the total number of particles,

the value is incremented and go to step 3.

IV. IMPLEMENTATION AND EXPERIMENTALRESULTS

In this research paper PSNR has been compared with different algorithms. The observation proves that the new technology i.e FCM-FODPSO with least square clustering gives the better result than the previously existing algorithms for the hyper spectral images[11]. Here the PSNR values for DPSO, FCM-FODPSO and FCM-FODPSO with least square clustering are 14.872, 16.354, 67.892 respectively.



V. CONCLUSION

This document presents different methods of grouping and segmentation and also includes FCM with FODPSO as a new grouping and segmentation method, which offers better performance than existing grouping and segmentation methods. Therefore, FCM-FODPSO with least square clustering can be used to group and segment with better performance

REFERENCES

[1] W. Wang, Y. Zhang, Y. Li, and X. Zhang, "The global fuzzy c-means clustering algorithm," in Intelligent Control and Automation, vol. 1, pp. 3604–3607, 2006.

[2] A. Dutta, "Fuzzy c-means classification of multispectral data incorporating spatial contextual information by using Markov random field," M.S. thesis, Geoinformatics, ITC, 2009.

[3] J. Kennedy and R. Eberhart, "A new optimizer using particle swarm theory," in Proc. IEEE 6th Int. Symp. Micro Mach. Hum. Sci., 1995, vol. 34, no. 2008, pp. 39–43.

[4] M. S. Couceiro, R. P. Rocha, N. M. F. Ferreira, and J. A. T. Machado, "Introducing the fractional order darwinian PSO," Signal Image VideoProcess., vol. 102, no. 1, pp. 8–16, 2007.

[5] G. Moser, S. B. Serpico, and J. A. Benediktsson, "Land-cover mapping by Markov modeling of spatial–contextual information in very-high resolution remote sensing images," Proc. IEEE, vol. 101, no. 3, pp. 631– 651, Mar. 2013.

[6] J. Kennedy and R. Eberhart, "A new optimizer using particle swarm theory," in Proc. IEEE 6th Int. Symp. Micro Mach. Hum. Sci., 1995, vol. 34, no. 2008, pp. 39–43.

[7] Z. Xian-cheng, "Image segmentation based on modified particle swarm optimization and fuzzy c-means clustering algorithm," in *Proc. 2nd Int.Conf. Intell. Comput. Technol. Autom.*, 2009, pp. 611–616.

[8] H. Izakian and A. Abraham, "Fuzzy c-means and fuzzy swarm for fuzzy clustering problem," *Expert Syst. Appl.*, vol. 38, no. 3, pp. 1835–1838, 2011.

[9] Y.del Valle *et al.*, " Darwinian Particle swarm optimization: Basic concepts, variants and applications in power systems," *IEEE Trans. Evol. Comput.*, vol. 12, no. 2, pp. 171–195, Apr. 2008.

[10] P. Ghamisi and J. A. Benediktsson, "Feature selection based on hybridization of genetic algorithm and particle swarm optimization," *IEEE Geosci.Remote Sens. Lett.*, vol. 12, no. 2, pp. 309–313, Feb. 2015.

[11] S. P. Lloyd, "Least squares quantization in PCM," IEEE Trans. Inf., vol. 28, no. 2, pp. 129–136, Mar. 1982.