An Efficient Cuckoo Search Algorithm for Segmentation of Satellite Images

[1] K.Bharathi, [2] Mr.M Ravi Kishore, [3] Mr. J Damodhar
PG Student, AITS, Rajampet ,Kadapa, Andhra Pradesh, India,
Assistant Professor, Dept.of ECE, AITS Rajampet, Kadapa, Andhra Pradesh, India

Abstract - **Satellite imaging is being the most attractive source of information for the governmental agencies and the commercial companies in last decade. Satellite images are characterized by weak local correlation between pixels, complete randomness and small multiple regions of interest which makes difficult to segment. The quality of the images is very important especially for the military or the police forces to pick the valuable information from the details. Satellite images may have unwanted signals called as noise in addition to useful information for several reasons such as heat generated electrons, bad sensor, wrong ISO settings, vibration and clouds. There are several image enhancement algorithms to reduce the effects of noise over the image to see the details and gather meaningful information. Satellite images are acquired with remote sensing. Remote sensing is the science and art of obtaining information about an object or area through a device that is not in contact with the object or the area under investigation. The classification can be done by using Image segmentation via various thresholding algorithms where segmentation is the process of dividing an object into several homogeneous regions such that union of no two adjacent regions is homogeneous. In this work an efficient cuckoo search algorithm is developed for segmentation of satellite images.**

1. INTRODUCTION

According to reference, the image segmentation approaches can be divided into four categories: Thresholding, clustering, edge detection and region extraction. In this paper, a thresholding based method for image segmentation will be considered. Image segmentation approach aims to partition a given image into several homogeneous regions such that the union of no two adjacent regions is homogeneous. Satellite images are characterized by weak local correlation between pixels, complete randomness, and ambiguous regions and small multiple regions of interest which makes it difficult to segment. A fore mentioned definition for segmentation makes us to think deep about the great difficulty in deciding the homogeneity measure which can be used to discriminate between the objects present in the image. Optimization algorithms were developed with an intention to solve such complex problems where time and resources are limited. The optimization algorithm used in this work was cuckoo search algorithm. The optimization algorithm works on the random search in a suitable region depending on the problem. The cuckoo search algorithm was developed by Xin-SheYang and Suash Deb. It was developed by inspiring with obligate brood parasitism of some cuckoo species by laying their eggs in to the nest of host birds. Those female parasitic cuckoos can imitate the colors and pattern of the eggs of the host species. So there are fewer chances that the host bird may identify and destroy the

eggs. But, by chance, if the host bird discovers that the eggs are different, it will either destroy the eggs or may destroy the nest completely and build a new nest at different place. The timing of egg-laying of some species is also amazing. The parasitic cuckoo often chooses a host nest where the eggs are just laid. In general, the cuckoo eggs are hatched little earlier than the host eggs. As soon as the first cuckoo chick is hatched, it starts throwing out the host eggs blindly out of the nest so that it can increase the share of its food provided by the host bird. The animals search for food in random manner. Their search path is made up of step by step random walk or flight which is based on the current location and the transition probability to the next location. Certain Cuckoo species are clever enough to mimic the color and texture of the egg of the host birds which reduces the chances of being caught.

2. EXISTING METHOD

Fuzzy c-means clustering technique has been popularly used for remote sensing image data classification. The classical fuzzy c means clustering algorithm has been able to achieve less accuracy due to spatial relationship existence and multi class existence in remotely sensed images.
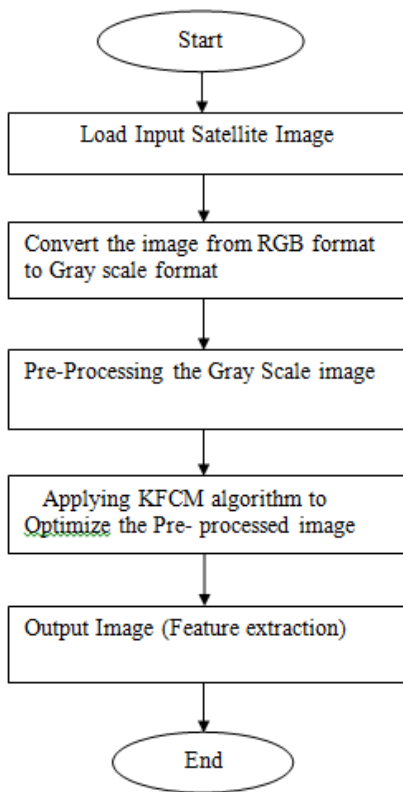
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Fig 2.1: Block Diagram For existing Method

KFCM Algorithm:

Fig 2.2:KFCM algorithm

Fuzzy clustering has emerged as an important tool for discovering the structure of data. Among the fuzzy clustering methods, fuzzy c-means (FCM) algorithm is the most popular method used in image segmentation because it has robust characteristics for ambiguity and can retain much more information than hard segmentation methods Kernel methods have been applied to fuzzy clustering and the Kernelized version is referred to as kernel-based fuzzy clustering. The essence of kernel-based methods involves performing an arbitrary non-linear mapping from the original d-dimensional feature space Rd to a space of higher dimensionality (kernel space).

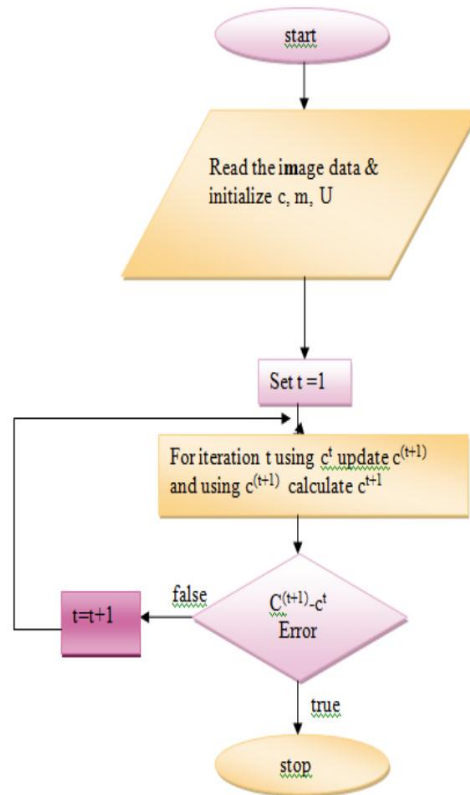The kernel space could possibly be of infinite dimensionality.

KFCM Algorithm steps:
Step 1: Fix c, tmax , m > 1 and ε > 0 for some positive constant;
• Step 2: Initialize the memberships $uik0$;
• Step 3: For t =1,2,…, tmax , do:
(a) Update all prototypes vit; (b) Update all memberships uikt ; (c) Compute Et, if Et ≤ ε , stop; else t=t+1.
The rationale for going to higher dimensions is that it may be possible to apply a linear classifier in the kernel space while the original problem in the feature space could be highly non-linear and not separable linearly. The proposed cuckoo search algorithm provides better segmentation when compared to other segmentation algorithms.

3. PROPOSED METHOD

Image segmentation approaches can be divided into four categories: Thresholding, clustering, edge detection and region extraction. In this paper, a thresholding based method for image segmentation will be considered. Thresholding techniques are most commonly used for segmentation of images. For gray scale images these thresholds decides the intensity values for classifying the image in to different groups. Image segmentation approach aims to partition a given image into several homogeneous regions such that the union of no two adjacent regions is homogeneous. Satellite images are characterized by weak local correlation between pixels, complete randomness, and ambiguous regions and small multiple regions of interest which makes it difficult to segment. A fore mentioned definition for segmentation makes us to think deep about the great difficulty in deciding the homogeneity measure which can be difficult to segment.

In this project an optimization algorithm was developed depending on the reproduction policy of certain Cuckoo species developed by Yang and Deb. They lay eggs other bird's nest and even remove host eggs to increase the probability of their eggs getting hatched. These birds exhibit mainly 3 types of blood parasitism: (1) Intra-specific (2) Cooperative breeding (3) Nest takeover. Some species of host birds simply throw out cuckoos eggs or even leave their nest and put up a new one when alien eggs are discovered. Certain Cuckoo species are clever enough to mimic the color and texture of the egg of the host birds which reduces the chances of being caught. For simplifying the whole process we consider these three conditions

1. One egg will be laid at a time by each cuckoo in any nest cho- sen randomly.

2. Nest which have the best quality eggs are carried over to the forthcoming generation.

3. The probability of host species discovering cuckoo's egg lies within the probability range p a [0, 1] and the total number of nests is fixed.

Cuckoo Search Algorithm:
The Cuckoo search algorithm starts its initial iteration with a randomly generated solution set. Once the host species discovers the cuckoo's egg in its nest, it will abandon the nest or throw away that egg which is implemented in the algorithm by replacing pa of the total number of nests by new. Each egg corresponds to a feasible solution and its fitness value is calculated. The iterative process continues till it reaches the global optima. This preferably avoids the problem of being caught in local optima.
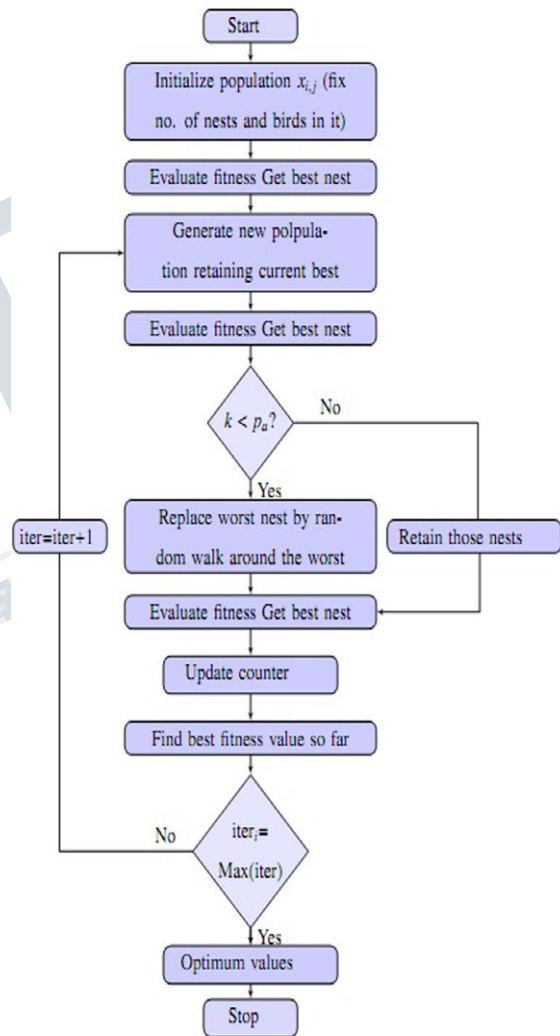

Fig 3.1:Flow Chart Of Cuckoo Search Algorithm

IMPLEMENTATION:

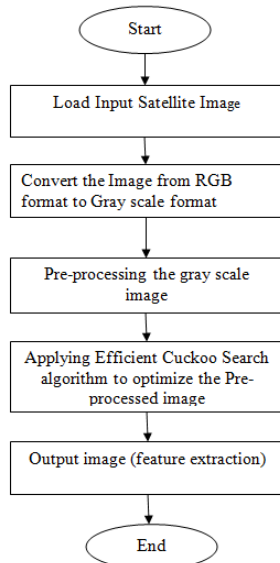The block diagram of proposed work is given as follows

Fig 3.2:Block Diagram of Proposed Method

Satellite images which process and collects the information from EM spectrum. The goal is obtain spectrum for each pixel in the image of scene with purpose of finding objects and identifying materials.

Grayscale conversion which converts the colour image into gray scale image. Canny edge detector is a popular method for detecting edges that begins by smoothing an image(used to reduce noise in an image)by convolving it with a Gaussian of given sigma value. It achieve less error rate while dividing the objects in an image.

Cuckoo Search Algorithm is the optimization algorithm which made a random search depending on the problem. In this project an optimization algorithm was developed depending on the reproduction policy of certain Cuckoo species developed by Yang and Deb. They lay eggs other bird's nest and even remove host eggs to increase the probability of their eggs getting hatched. These birds exhibit mainly 3 types of blood parasitism: (1) Intra-specific (2) Cooperative breeding (3) Nest takeover. Some species of host birds simply throw out cuckoos eggs or even leave their nest and put up a new one when alien eggs are discovered. Certain Cuckoo species are clever enough to mimic the color and texture of the egg of the host birds which reduces the chances of being caught. For simplifying the whole process we consider these three conditions

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4. RESULTS

The below figure shows the original image which is hyper spectral image (satellite image, Courtesy: Google maps)

The original image consists of various textures such as buildings (with different roof structures and colours), roads, trees, clay land, vehicles and much more unidentified objects. In order to achieve good and proper classification, image is subjected to proposed cuckoo search image segmentation methods.

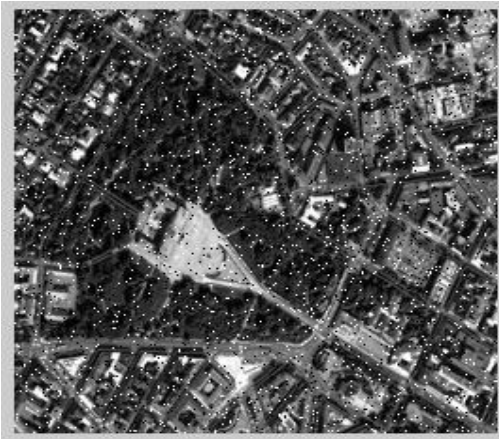
Fig 4.1:Original Image

Fig 4.2:RGB to Gray scale image

black[low contrast]
Segmentation   *segmented image*

White [High Contrast] Segmentation

Fig 4.3:Noisy image
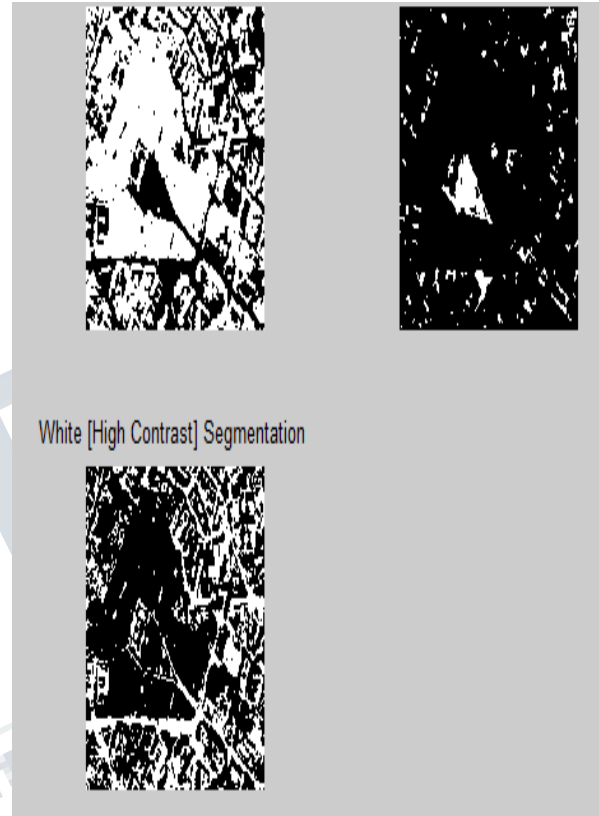
Fig 4.5.: Segmented image

Fig 4.4 De noised image

Fig 4.6: Segmented part

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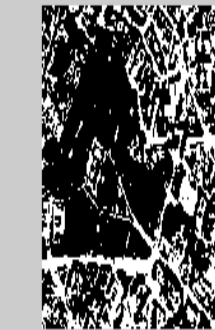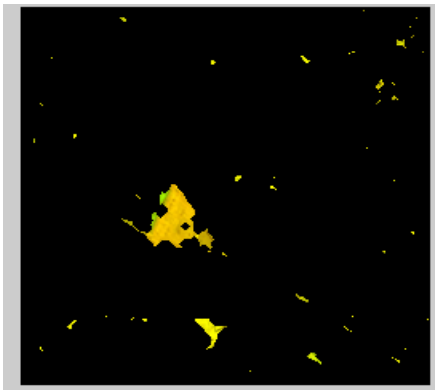**Vol 4, Issue 7, July 2017**

fig 4.7: Color Image of Segmented Part

fig 4.8:CSO image

Parametric Analysis:
Sensitivity and specificity are statistical measures of the performance of a test.
Sensitivity is the true positive rates that measure the proportion of positives that are correctly identified.
Specificity is the negative rate that measures the proportion of negatives that are in correctly identified.
PSNR is most commonly used to measure the quality of reconstructed image. Signal is original data and noise is error introduced by compression.MSE is the squared error between the compressed and original image.
Entropy is the statistical measure of randomness that can be used to characterize the texture of the input

image.MSE and PSNR measures estimate absolute errors.

TABLE 1: PARAMETERS

PARAMETER	CUCKOO SEARCH OPTIMIZATION OUTPUT
1.Sensitivity	86.5056
2.Specificity	50
3.Accuracy	86.4878
4.Variance	74.8224
5.MSE	251.5299
6.PSNR	24.1249
7.Entropy	0.3660

5. CONCLUSION AND FUTURE SCOPE

In this work an efficient cuckoo search algorithm has been implemented on a satellite image. The aim is to improve the quality of segmentation and hence it is achieved. The proposed Methods are also applicable for the Real Time applications in future for different fields i.e., tsunami identification, Military areas etc, for both Gray Scale Images and color Images.

REFERENCES

[1] X. -S. Yang., S. Deb.“Cuckoo search via LévyFlights”,in Proceedings of World Congress on Nature & Biologically Inspired Computing (NaBIC 2009), India,IEEE publications, USA, pp 210-214.

[2]http://cambridge.academia.edu/XinSheYang/Teaching

[3] http://people.unipmn.it/scalas/report1_eng.pdf

[4] H.Soneji., R. C.Sanghvi. “Towards the Improvement of Cuckoo Search Algorithm”, in Proceedings of World Congress on Information and

Communication Technologies (WICT), 2012,   pp. 878-883.

[5]S. Walten., O. Hassan., K. Morgan., M. R. Brown."Modified Cuckoo Search: A new Gradient Free Optimization Algorithm", Chaos, Solitons and Fractals,Vol. 44, issue 9, pp. 710-718.

[6]H.Salimi.,D.Giveki.,M.Settanshahi.,J.Hatami.Exten ded Mixture of MLP Experts by Hybrid of Conjugate Gradient Method and Modified Cuckoo Search",International Journal of Artificial Intelligence & Applications (IJAIA), Vol. 3, No. 1, Jan. 2012, pp. 1-13.

[7]A. Kaveh., T. Bakshpoori."Optimum Design of Space Trusses using Cuckoo Search algorithm with Lévy Flights",IJST Transactions of Civil Engineering, Vol. 37, No. C1,pp. 1-15.

[8]A. R. Yildiz. "Cuckoo Search Algorithm for the Selection of Optimal Machining Parameters in Milling Operations", The International Journal of Advanced manufacturing technology, Vol. 64, issue 1-4, pp. 55-61

[9]M. Tuba., M. Subotic., N. Stanarevik. "Modified Cuckoo search algorithm for unconstrained optimization problems", in Proceedings of the European Computing Conference, pp. 263-268.

[10]E.Valian., S. Mohanna.,S.Tavakoli."Improved Cuckoo Search Algorithm for Global Optimization", International Journal of Communications and Information Technology, IJCIT, Vol. 1, No. 1, Dec. 2011, pp. 31-44.