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A Genetic approach to Segment a Remote Sensing Image by Removing Haze Distortion

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Abstract— As the images from satellite are increasing day by day with the growing digital world. Researchers are working in this field from last few decades. In this paper a genetic algorithm is proposed that segment the image in defined part. Here teachers learning algorithm is utilize for the segmentation which is a genetic approach. Proposed segmentation approach segment the data on the basis two phase learning where best probable solution is consider as the teacher phase while in second phase individual solution will learn from each other. In each phase new probable solution having high fitness value is preserve while low fitness value probable solution was discard. Experiment is done real as well as artificial dataset. Proposed work is compare with existing approach and results shows that proposed work is better as compare to previous work on different evaluation parameters.

Index Terms- ***Digital Image Processing, Haze , Information Extraction, Load Balancing.***

I. INTRODUCTION

Segmentation may be a one among the interesting area of analysis for image process. Images are thought of as most significant medium of transference data. to know the image, to extract and use of that information for alternative tasks is a very important facet of machine learning. One amongst the necessary steps in direction of understanding the image is to section them. It's the method of dividing the image into uniform region with relation to sure options & that hopefully correspond to real objects in actual scene. Image segmentation is that the foundation method within which we divide the image into disjoint regions that are meaning. The goal is to cluster pixels into regions comparable to individual surfaces, object natural elements of object. We tend to divide the complete image into multiple segments that area unit set of pixels, pixels in a very region are like one another in some criteria, therefore on find & determine objects and corresponding boundaries in an image. In segmentation, value is appointed to each constituent in a picture specified constituent with identical value share sure characteristics in a very explicit region. In general, segmentation is defined because the basic step in image process that subdivides a digital image f(x, y) into its continuous, disconnect and non-empty set f1, f2, f3….fn that provides convenience[5] Example of segmentation:

Figure 1Image with divided image [5]

II. RELATED WORK

In [5] segmentation was done by constant classifier: The parameters like mean vector and variance matrix are used. There's an assumption of distribution. The parameters like mean vector and variance matrix are oftentimes generated from coaching examples. Example: most chance, linear discriminate analysis. Thus a alternate methodology have to be compelled to be adopt for segmentation that don't needed predefined statics. Previous data of the DEM is needed for image analysis in pre-processing. Accuracy of the segmentation has to be compelled to be improved for locating correct changes. Execution time may be reduced by using alternating unsupervised, non-Gaussian. Complexity.

Abhinav Chopra et al. [2]. "Image Segmentation Using Active Contour Model". Image segmentation is one of the substantial techniques in the field of image processing. It is vastly used for medical purposes, tracking growth of tumor for surgical planning and simulation. This paper shows the application of an external force that largely solves both problems. This external force is called gradient vector flow (GVF). Using several examples to show that, GVF because of its large capture range moves snakes into boundary concavities.

D. Baswaraj et al. [9]. "Active Contours and Image Segmentation: The Current State of the Art". Image segmentation is a fundamental task in image analysis responsible for partitioning an image into multiple sub-regions based on a desired feature. Here in this paper we attempt to brief the taxonomy and current state of the art in Image segmentation and usage of Active Contours.

Arnaubec et al. [5] evaluated the precision of vegetation height estimations when an RVoG model was applied to P-band data at different or many polarizations. It was found that a loss in vegetation height precision could be calculated, independent of estimation method, when derived from an adaptation of the Cramer-Rao bound. It is possible that a similar theoretical derivation could be done for X-band data.

M. Airouche et al. [4]. "Image Segmentation Using Active Contour Model and Level Set Method Applied to Detect Oil Spills". In this paper we explore image segmentation using active contours model to detect oil spills. A partial differential equation based level set method, which represents the spill surface as an implicit propagation interface, is used. The proposed method has been illustrated by experiments to detect oil spills in real images.

III. PROPOSED WORK

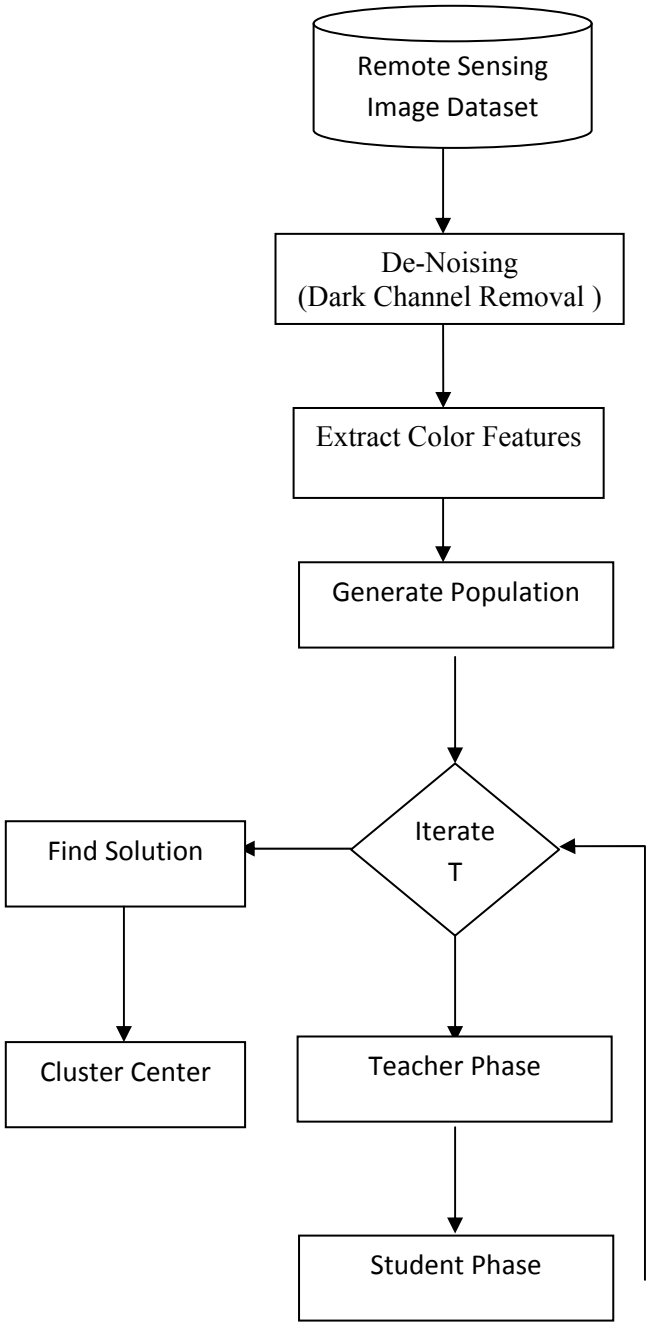


Figure 2. Block diagram of proposed work.

Dark channel prior: In [2] Dark channel technique is developed in order to calculate the atmospheric light in the image. So it is emerged as a common technique in non sky part of the image because few color channels has very less intensity in the few pixels. Here in dark color channel low intensity is present because of the below three components:
i). Surface Colourful objects such as grass, trees, etc.
ii). Shadow of tree, building, pillers, etc.
iii). Any high intensity object surface such as black stone, trunk, etc.

So most of outdoor image is full of above three points which include colorful object, few shadows and dark channels which fill image with noise. In presence of fog in environment image get brighter then actual image without fog. So it can be conclude that dark channel of the image have high intensity of image in region with higher haze. So in order to find the light intensity an approx value is find by estimating the thickness of the haze. In case of shady channel prior this technique use pre and post processing steps in order to improve results. In post processing stepladder technique use flexible matting or two-sided filtering etc. This can be understand as if J(x) is input image, I(x) is hazy image, t(x) is the transmission of the environment. The reduction of image because of presence of fog can be calculate by:

$$Iatt\ x = (x)\ *t(x)$$

the effect of fog is Air light effect and it is calculate as:

$$\text{AirLight}(x) = A(1 - t(x))$$

Shady channel for an random image J, uttered as J shady is defined as:

$$Jdar(x) = (min/y \in \Omega\ x)*(\min JC\ Y\ )$$

In this Jc is color image comprising of RGB components, represents a local patch which has its origin at x. The low intensity of dark channels is attributed mainly due to shadows in images, saturated color objects and dark objects in images.

After dark channel prior, we need to estimate transmission t(x) for proceeding further with the solution. Another assumption needed is that let Atmospheric light A is also known. We normalize (4) by dividing both sides by A:

$$Ic/Ac\ (x) = (t(x)*J\ c/Ac\ (x)\ )+ 1\text{-}t(x) \quad (4)$$

Middle: restored haze-free images. Bottom: depth maps.

Color Feature

Different image files available in different color formats like images have different colure format ranging from RGB which stand for red, green, and blue. This is a three dimensional representation of a single image in which two dimensional three matrixes is present for each color of red, green and blue. In order to make intensity calculation for each pixel gray format is use, which is a two dimension values range from 0 to 255. Binary color format of the image consist of the two value only first is 1 and other is 0 where 1 represent white color, 0 represent black color. This work utilize gray format of the image so if image is in RGB

Generate Population

Here assume some cluster set that are the combination of different pixel values. This is generate by the random function which select fix number of pixel values for the centroid. This can be understand as let the number of centroid be Cn and number of pixel values are N then one of the possible solution is {C1, C2, …..Cn}. In the similar fashion other possible solutions are prepared which can be utilize for creating initial population represent by ST matrix.

ST[x] ←Random(N, Cn)

Teacher Phase:
The Euclidean distance d between two solution X and Y is calculated by

$$D = \sqrt{sum((X - Y)^2)}$$

Following Step will find distance between the selected population for finding the teacher in the population.

1. Loop x = 1:ST
2. Loop n = 1:N
3. D[n, x] = Dist(Ds[n], x) // Here Dist is a Euclidean function
4. endLoop
5. endLoop
6. S←Sum(D) // Sum matrix rowwise
7. [V I]←Sort(S) // Sort matrix in increasing order

So the matrix D contain all the values of the centriod distance from the probable solutions then find the minimum distance which will evaluate specify best possible solution.

Top possible solution after sorting will act as the teacher for other possible solutions. Now selected teacher will teach other possible solution by replacing fix number of centroid as present in teacher solution. By this all possible solution which act as student will learn from best solution which act as teacher.

Main motive of this step is to find best solution from the generated population. Here each possible solution is evaluated for finding the distance from each centroid so that pixel closer to the centroid are cluster together. Then calculate the fitness value which give overall rank of the possible solution.
This difference modifies the existing solution according to the following expression

Xnew,i = Xold, i + Difference Meani,i

Where Xnew,i is the updated value of Xold,i. Accept Xnew,i if it gives better function value.

Student Phase
In this phase all possible solution after teacher phase are group for self-learning from each other. This can be understand as let group contain two student then each student who is best as compare to other will teach other solution. Teaching is similar as done in teacher phase, here replacing fix number of centroid is done which is similar as in best student of the group.

1. For i = 1: Pn
2. Randomly select two learners Xi and Xj, where i is not equal to j
3. If f (Xi) < f (Xj)
4. Xnew, i = Xold, i + ri (Xi − Xj) (for a minimization problem)
5. Else
6. Xnew, i = Xold, i + ri (Xj − Xi)
7. End If
8. End For

Accept Xnew if it gives a better function value. Once student phase is over then check for the maximum iteration for the teaching if iteration not reach to the maximum value then GOTO step of teacher phase else stop learning and the best solution from the available population is consider as the final centroid of the work. Now image is cluster as per centroid.

V. Experiment And Results

Experiment Setup
The tests were performed on an 2.27 GHz Intel Core i3 machine, equipped with 4 GB of RAM, and running under Windows 7 Professional. MATLAB 2012a is the tool use for the implementation of this work. It is used because of its rich library which have many inbuilt function that can be directly use in this work for different purpose. Out of different function few are intersection, comparing of the string, etc.

Dataset
In order to conduct the experiment an real dataset which is a collection of images from different category are utilize. As images are of different format so first it is necessary to make it in readable format for experiment tool MATLAB.

Evaluation Parameters

Execution time
This parameter evaluates execution time of the algorithm that is time taken by the proposed method for execution. It is expected time after the evaluation of the direct rules. Here algorithm is considered to be start since from the pre-processing steps. Execution time is measure in second.

Incorrect Segmentation Pixel
In this parameter detection of the segmented images are compare with the ground truth of those images. Here pixel values of the ground truth are compare with the pixel value of the change detection values.

ISP = (Total_Pixel_Changes-Similar_Pixel_Position)

Results

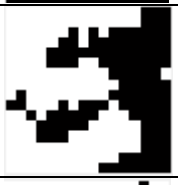
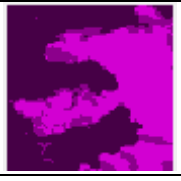
Images set	Proposed Work	Previous Work
Set1		
Set2		
Set3		

Table 1. Segmented Image of proposed and previous work.

From table 1 it can be seen that proposed work segmentation imafe gives output of multiclass segmentation where as previous work gives segmentation of two class only. So it is obtained that use of genetic approach for segmentation has increase the accuracy time in proposed work.

Images		Execution Time	
		Proposed Work	Previous Work
1	Set1	28.9905	43.3754
2	Set2	25.3518	60.8696
3	Set3	60.3692	50.0329
4	Set4	16.881	34.492

Table 2. Execution time Comparison of the proposed and previous work.

From table 2 it can be seen that proposed work segmentation time is quite low as compare to the previous time. Here values are compared on different image dataset. So it is obtained that use of genetic approach for segmentation has reduce the execution time in proposed work.

Images set		Incorrect Segmentation Pixel	
		Proposed Work	Previous Work
1	Set1	64894	3.0066e+06
2	Set2	151529	2.98096e+06
3	Set3	163128	3.28974e+06
4	Set4	73998	3.20278e+06

Table 3. Execution time Comparison of the proposed and previous work.

From table 3 it can be seen that proposed work segmentation accuracy is quite high as compare to the previous time. Here values are compared on different image dataset. So it is obtained that use of genetic approach for segmentation has increase the accuracy time in proposed work.

V. CONCLUSION

With the increase of digital world, image processing researchers are working in different field. This work has also focus on haze image segmentation. As use of proper pre-processing steps with genetic model makes a new approach for segmentation of SAR images from various remote sensing images. Here proposed work estimate the segment region which was TLBO algorithm. In order to test the work experiment dataset contain images from different environment with various scene of real dataset. Experiment output shows that proposed work is better as compare to previous approach of segmentation. Results shows that proposed work has improved the accuracy of segmentation in SAR images by removing unwanted information. Here execution time of the work was also reduce as genetic algorithm segmented image with less number of iterations. So it is obtained that proposed work has effective improved the different aspects of the segmentation with change detection.

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