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Segmentation Technique of SAR Imagery using Entropy

Debabrata Samanta1*,Mousumi Paul†,Goutam Sanyal‡
*Department of CSE
National Institute of Technology, Durgapur
Mahatma Gandhi Avenue, West Bengal, India - 713209
Email:debabrata.samanta369@gmail.com
†Department of CSE,
National Institute of Technology, Durgapur
Mahatma Gandhi Avenue, West Bengal, India - 713209
Email: mousumipaul.88@gmail.com
‡Department of CSE,
National Institute of Technology, Durgapur
Mahatma Gandhi Avenue, West Bengal, India - 713209
Email: nitgsanyal@gmail.com

***Abstract*—SAR Image Segmentation plays an important role in image of SAR plays an important role in image analysis and computer vision .The good performance of recognition algorithms depend on the quality of segmented image. An important problem in SAR image application is correct segmentation.It is the basis of the understanding of SAR images,such as the chnge detection of regions for maps updating and classify the land, forest, hills, oceans etc. The ability of SAR image is to penetrate cloud cover to predict the weather condition at any particular instant of time.**

This paper presents a novel algorithm for SAR images segmentation based on entropy based and RGB color intensity together. Since entropy is a statistical measure of randomness that can be used to characterize the texture of the input image.

***Keywords*-Threshold value; Image segmentation; Probability image; Probability; Entropy;**

I. Introduction

Synthetic aperture radar (SAR) is an active remote-sensing system : microwave radiation is beamed down to the earth's surface from a plane or satellite and the a sensor detects that reflected signal and formed the SAR images.Segmentation of SAR images has received a tremendous amount of research attention since it is unaffected by seasonal variations and weather conditions. It has its own specific characteristics that are quite different from optical and infrared remote sensing.As a basic technique of digital image processing, segmentation should separate the image into some meaningful region and with an ultimate goal of improving the SAR image for scene description.

In case of SAR image, segmentation is based on global features. Basically gray level is taken as the primary features and the average of the gray level returns entropy.

The motivation of this work is to develop a novel segmentation algorithm, which can be used to segment the SAR images and improve the overall accuracy. The term of Entropy is not a new concept in the field based on information theory.

Yanhui Guo,H.D. Cheng, Wei Zhao1, Yingtao Zhang [2]have proposed neutrosophic set approach in image segmentation, based on fuzzy c-means cluster analysis .Theodor Richardson [3] has proposed algorithms to aid the accuracy of the entropy image registration algorithm, which is based on the maximization of mutual information. A. Nakib, H. Oulhadj and P. Siarry[8] proposed a microscopic image segmentation method with two-dimensional (2D) exponential entropy based on hybrid micro canonical. Wang Lei, Shen Ting-zhi [5] used two-dimensional entropy followed by both the gray value and the local average gray value of a pixel.Wen-Bing Tao,Jin-Wen Tian, Jian Liu[4] has proposed fuzzy entropy probability analysis based on three parts, namely, dark, gray and white part of an image.Wenbing Tao,Hai Jin,Liman Liu[7] investigate the performance of the fuzzy entropy approach when it is applied to the segmentation of infrared objects of images.H. B. Kekre, Saylee Gharge, Tanuja K. Sarode[9] proposed segmentation using vector quantization technique on entropy image based on Kekres FastCodebook Generation (KFCG) algorithm.Roberto Rodrguez and Ana G. Suarez [5] used as stopping criterion in the segmentation process by using recursively the mean shift filtering .

In this work, a new SAR image segmentation strategy is proposed by using the Entropy and K-means algorithm. Entropy collects the information of small change in properties of SAR images to measure statistical value of randomness that can be used to characterize the texture of the input SAR image. Other hand kmeans (S, N) partitions the points in the n-by-p data matrix S into N clusters. This iterative partitioning minimizes the sum, over all clusters, of the within-cluster sums of point-to-cluster-centroid distances to get the different region.

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II. Proposed Methodology

This paper introduced a methodology to segment the SAR image using the intensity of three main colors RED, GREEN and BLUE separately and extract.
This work definition of image segmentation is as follows.
If P(0) is a homogeneity predicate defined on groups of connected pixels, then the segmentation is a partition of the set I into connected components or regions C1; : : : Cn such that..

$$\bigcup_{i=1}^{n} C_i \text{ with } C_i \cap C_j = \emptyset ,\forall\ i \neq j$$

The uniformity predicate $P(Ci)$ is true for all regions C_i and $P(C_i \bigcup C_j)$ is false when i $\neq$ j and sets C_i and C_j are neighbors.

A. Mean value of pixel

The average intensity of a particular region is defined as the men of that pixel intensities within that region.The mean M of the intensities over 'K' is given by :

$$M=\frac{1}{k}\sum_{i=1}^{k} X_i$$

B. Variance value of pixel

The Variance of the intensities within a region 'R' with 'K' pixels is given by:

$$\delta^2=\frac{1}{k}\sum_{i=0}^{k}(X_i - M)^2$$

C. Entropy of SAR images

Entropy means to consider the neighborhood of the pixel of an image. Entropy is a measure of disorder, or more precisely unpredictability.The probability of a SAR images intensity occurring at particular pixel in 'k',where 'k' is the set of all pixels in a SAR image, is defined as $p\{n\}log(p\{n\}$.The sum of all of these probability makes the Entropy of 'P',So,

$$G(k) = -\sum_{n \in k} p\{n\}log(p\{n\})$$

Where $P\{n\}$ is the probability mass function of particular pixel in 'k'.As its magnitude increases more uncertainty and thus more information is associated with the source.
In this paper probability image has been taken as an input image to find entropy. Here it becomes necessary to select analyzing window size to find entropy for neighborhood of each pixel in the input image. After that 3x3 and 5x5 window sizes were used to find entropy. By moving analyzing window on complete image, calculating entropy for each window, new entropy image was formed by replacing the central pixel of the particular window by entropy and displayed as entropy image. Since these values are used for image segmentation.

D. K-MEANS CLUSTERING ALGORITHM

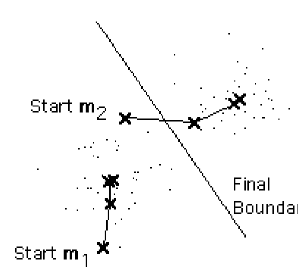
K-means clustering algorithm is a method of cluster analysis which aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean. K-means clustering Algorithm, known as also C-means clustering, has been applied to variety of areas, including image and speech data compression. The K-means algorithm starts with K-cluster canters or centriodes. Cluster centriodes can be initialized to random values or can be derived from a priori information. The objective function is defined as..

$$W= \sum_{j=1}^{k}\sum_{i=1}^{n} \mid (E_i{}^{(j)} - V_j) \mid^2$$

where $\mid (E_i{}^{(j)} - V_j) \mid^2$ is a chosen distance measure between a data point $E_i{}^{(j)}$ and the cluster centre V_j is an indicator of the distance of the n data points from their respective cluster centers. We consider n sample feature vectors E_1, E_2, ..., E_n all from the same class, and we know that they fall into k compact clusters, $k < n$. Let mi be the mean of the vectors in cluster i. If the clusters are well separated, we can use a minimum-distance classifier to separate them. That is, we can say that U is in cluster i if $\parallel U - m_i \parallel$ is the minimum of all the k distances. This suggests the following procedure for finding the k means:

- Make initial guesses for the means m_1, m_2, ...,m_k
- Until there are no changes in any mean.
  - Use the estimated means to classify the samples into clusters.
  - For i from 1 to k .
    - Replace mi with the mean of all of the samples for cluster i
  - end for.
- end until.

Here is an example showing how the means m_1 and m_2 move into the centers of two clusters.
In this work k-means treats each observation in SAR image



data as an object having a location in space. It finds a partition in which objects within each cluster are as close to each other as possible, and as far from objects in other clusters as possible. We can choose five different distance measures, depending on data that are clustering.

III. Proposed Algorithm

- Input: SAR Images of variable size.
- Output: Segmented region.

1) Start.
2) Taken a SAR images.
3) Consider a 3X3 window .
4) Calculate the Mean,Variance and Entropy of That SAR Images.
5) Store the color feature as the color intensity of three primary color Red, Green and Blue with respect to Threshold value.
6) Segmentation is obtained using K-means clustering Algorithm.
7) Stop.

IV. Experimental result

Now SAR images are used to test proposed algorithm. First mean,variance,entropy was calculated from probability for original image. Images were tested for analyzing window size of 3x3 and 5x5 to find entropy. Finally K-means clustering Algorithm was used on entropy image for segmentation. The figure (Fig 1 to Fig 4) shows the original SAR images and the figure (Fig 1(a) to Fig 4(a)) shows the segmented SAR images.

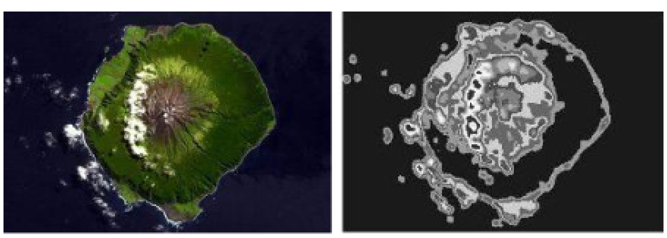


Figure 1. Input SAR image and Segmented SAR image

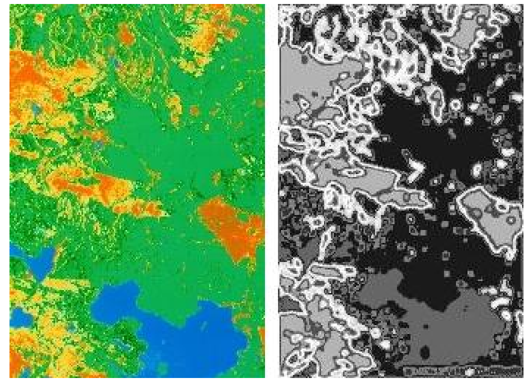


Figure 2. Input SAR image and Segmented SAR image

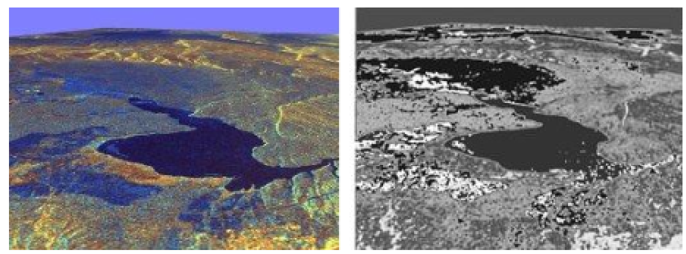


Figure 3. Input SAR image and Segmented SAR image

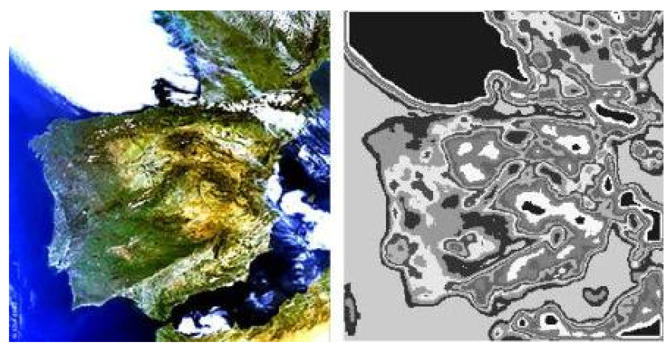


Figure 4. Input SAR image and Segmented SAR image

V. Conclusion and Discussion

In this paper , we proposed a novel Entropy based image segmentation technique for SAR image . This technique based on considering a 3X3 window and calculates the men,variance and Entropy of that SAR Images then store the color feature as the color intensity with respect to color model Red, Green and Blue. Next, Segmentation is obtained using K-means clustering Algorithm. It was evidenced that this segmentation procedure is a straightforward extension of the filtering algorithm based on Entropy. For this reason, our algorithm did not make mistakes; that is, a segmented image very different to get the originality of the SAR images. This may be extended to the color image segmentation.

The results from this preliminary study indicated that the proposed strategy was effective.

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