Statistical Approach for Classification of SAR Images

Debabrata Samanta, Goutam Sanyal

Abstract— ***The statistical parameters contain high order image statistics which portray the outline and symmetry of the different image region. The good feat of recognition algorithms based on the quality of classified image. The main problem in SAR image function is accurate classification. In this paper a novel methodology has been carried out to classify SAR images using the statistical approach based on skewness. A comparison has been carried out with histogram based classification on same images for measuring the accuracy.***

Index Terms— ***SAR image, Skewness, symmetrical, normal distribution.***

I. INTRODUCTION

SAR images fall upon gradually more wide applications, as SAR sensor does not based on weather condition and can infiltrate clouds. SAR image Segmentation is a main examples of low-level operators that providing the basic information for classification of different region. An analyst attempts to classify features in an SAR image by using the elements of visual interpretation to identify homogeneous groups of pixels that represents various features or land cover classes of interest. Environmental monitoring, earth-resource mapping, and military systems necessitate broad-area imaging at high resolutions. Synthetic Aperture Radar (SAR) grants such a capability. SAR systems take advantage of the long-range propagation characteristics of radar signals and the complex information processing capability of modern digital electronics to provide high resolution imagery. Synthetic Aperture Radar (SAR) image classification is becoming more and more increasingly important in military or scientific research.

The motivation of this work is to develop a novel classification algorithm, which can be used to classify the SAR images and recover the overall accuracy.

Classical methods of SAR images occupy convolving the image with an operator i.e. filter, which is constructed to be sensitive to large gradients in the SAR image while returning values of zero in uniform regions. The abrupt changes in intensity pixel value indicate class, its detection in binary or segmented image is quite straightforward. However, the classes of SAR images having minimum variations in nature.

During the past years, different techniques were in use for classification of synthetic aperture radar (SAR) images, based on the Maximum Likelihood (ML)[1], artificial Neural Networks (NN)[2,3], fuzzy methods[4] or other approaches. The NN classifier depends only on the training data and the discrimination power of the features. Fukuda and Hirosawa[5] proposed the wavelet-based texture feature sets for classification of multi frequency polar metric SAR images. So the Classification accuracy depends on quality of features and the employed classification algorithm.

In this paper a novel methodology will be proposed a very simple and less complexive where we used the gradient approach for classification based on histogram and proposed a five order mask to convolute the image which not only find the gradient of the SAR image but also reduced the noises by giving the maximum values at the center of the original signal. After obtaining the gradient of each pixel we have generated the threshold value dynamically region wise. Then the points whose histogram pick value is greater than the skewness value those points are considered as class.

II. PROPOSED METHODOLOGY

In our methodology first we consider the image with a three order mask according to the X and Y direction respectively to obtain the first order moments of each point. Then the statistical values are obtained by the following steps:

A. Mean

The statistical mean gives us the average value of all the pixels for a particular feature. Mathematically, the statistical mean of a set of variables is expressed as

$$\mu = \sum w_{ij} p(w_{ij}) ------------(1)$$

The summation is carried out over all the gray level values in the set. It is important to notice that, even though the mean gives a good estimate of the characteristics of a feature, it might not give a good representation of the damage or change in the region.

B. Variance

Variance is the second moment of a matrix and is a measure of gray-level contrast that can be used to establish descriptors of relative smoothness. Mathematically, it is defined as the mean of squares of differences between respective samples (gray-level intensities) and their mean and is expressed as

$$\delta^2 = \frac{\sum (W_{ij} - \mu)^2}{n} ------------(2)$$

Where δ^2 the variance or square of the standard deviation, and n is the number of samples in the region. An estimate of the difference in the variance values of the region between the predicator and post-disaster images is an indication of the level of change.

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C. Skewness

Skewness, or the third standardized moment, is a measure of the asymmetry of the probability distribution of a real valued random variable.

If skewness is negative, the data are spread out more to the left of the mean than to the right. If skewness is positive, the data are spread out more to the right. The skewness of the normal distribution (or any perfectly symmetric distribution) is zero.

Skewness characterizes the degree of asymmetry of a distribution around its mean. The skewness of a distribution is a non-dimensional quantity calculated as

$$Skewness = \frac{1}{N}\sum\left[\frac{\left(W_{ij}-\mu\right)^{3}}{\delta^{3}}\right]-----(3)$$

Where δ is the standard deviation or the square root of the variance. A positive value indicates a deviation of the distribution more towards the brighter side and a negative value towards the darker side.

A distribution is symmetrical if it shows two identical mirror images when it is split down the middle as the normal distribution when a distribution is not symmetrical, it has elongated tail at one side (left or right) and there are more data in this side tail that would be expected in a normal distribution. When it happens at the left, the distribution is negatively skewed or skewed to the left, and the in same way, when it happens at the right the distribution is positively skewed or skewed to the right.

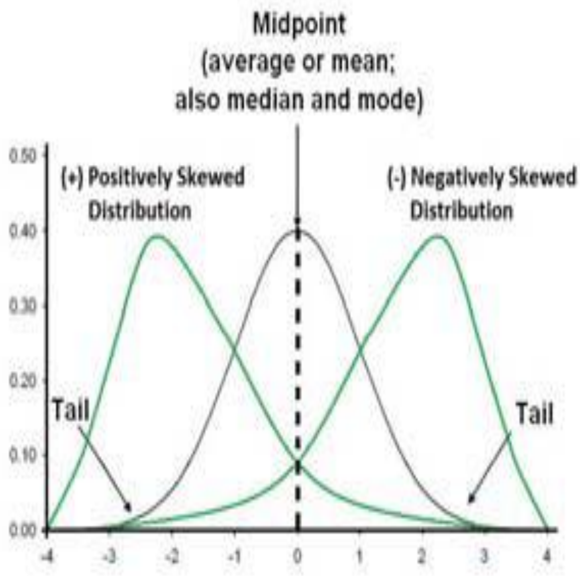

Figure1:- Example of symmetrical, positively skewed and negatively skewed distributions

Now we calculate the features table given below.

Features	Image1	Image2
Mean	106.2200	105.1209
Correlation coefficient	0.9714	0.9199
Standard deviation	36.6332	34.2693
Median	103	96
Mode	43	37
1st order skewness	7	8
2nd order skewness	21	20

If the pixel value is greater than or equal to this skewness then only the pixel is treated as one class otherwise it is discarded.

III. PROPOSED ALGORITHEM

- Input: SAR Images of variable size.
- Output: Classification of SAR image.

1) Start.
2) Taken a SAR images.
3) Consider a 3X3 window.
4) calculate the mean, variance of that SAR Images.
5) Classification is obtained using skewness.
6) Stop.

IV. EXPERIMENT RESULT

In this thesis work, we have considered synthetic aperture radar images. The SAR images are classified by using Statistical approach based on skewness.

The figure (Fig 1 to Fig 2) shows the original SAR images and corresponding histograms and the figure (Fig 1(a) to Fig 2(a)) shows the histograms of classified SAR images.

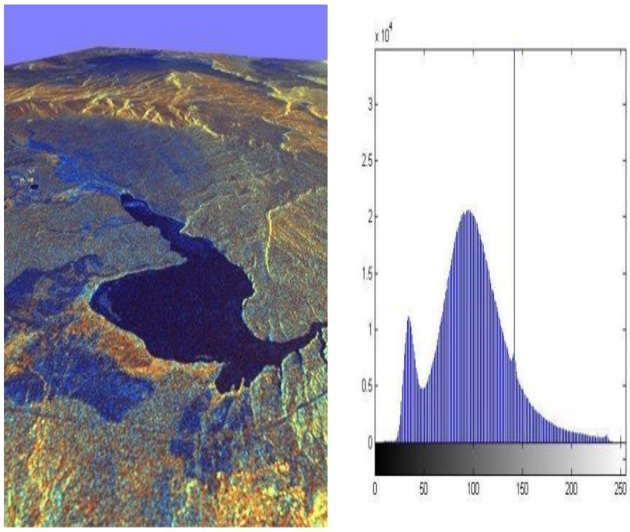

Fig1: SAR image1 and Histogram

If we taking the pick values we get the no. of class are 4.

After using our methodology we get the Histogram given below:

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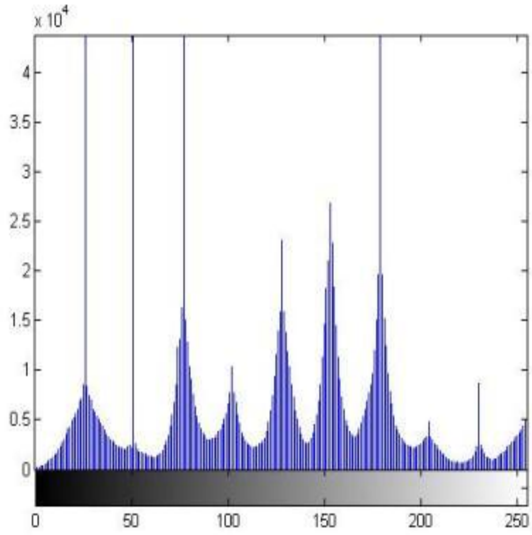

Fig1a: Classified Histogram

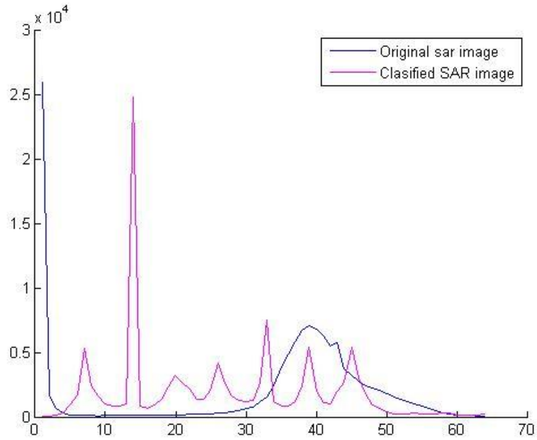

Fig1b: Comparison of Original image and Classified SAR image using Skewness.

If we taking the pick values we get the no. of class are 10.

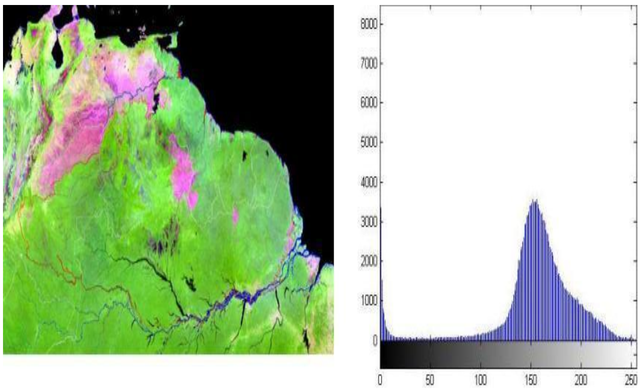

Fig2: SAR image2 and Histogram

If we taking the pick values we get the no. of class are 3.

After using our methodology we get the Histogram given below:

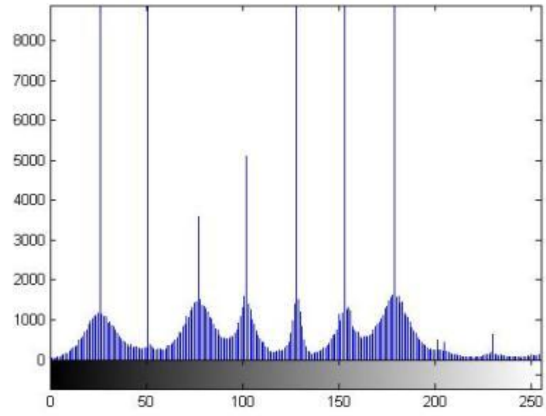

Fig2a: Classified Histogram based on skewness

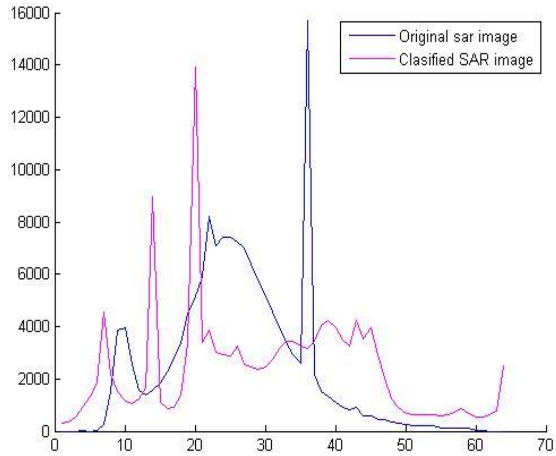

Fig2b: Comparison of Original image and Classified SAR image using Skewness.

If we taking the pick values we get the no. of class are 9.

Table1:-Class Table of SAR images.

SAR IMAGE	CLASS BASED ON	
	NORMAL HISTOGRAM	SKEWNESS HISTOGRAM
Image1	4	10
Image2	3	9

V. CONCLUSION

In this paper, a novel algorithm based on the skewness for classification of SAR images is proposed. This technique is based on considering a 3X3 window and calculates successively the corresponding First, mean and variance of the SAR Images. Then store the color feature using Skewness of same SAR image for better result. The proposed algorithm gives better result compared with Histogram based classification of SAR images.

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Debabrata Samanta is a member of the IAENG, Board member of the Seventh Sense Research Group Journals (SSRGJ), member of Editorial Board of IJSCE. He obtained his B.Sc. (Physics Honors) in the year 2007, from the Vivekananda Collage, Takurpukur, under Calcutta University; Kolkata, India .He obtained his MCA in the year 2010, from the Academy Of Technology, under WBUT. He is working his PhD in Computer Science and Engg. In the year 2010 from National Institute of Technology, Durgapur, India in the area of Image Processing .He is presently working as a Lecturer of CSE in Abacus Institute of Engg. And Management, West Bengal, India. His areas of interest are Artificial Intelligence, Natural Language Processing and Image Processing. He has guided 3 PG and 15 UG thesis. He has published 26 papers in International Journals / Conferences.

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