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Image Classification For SAR Images Using Modified ANN

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Abstract - *Classification of polarimetric SAR images has become a very important topic after the availability of Polarimetric SAR images through different sensors like SIR-C, ALOS-PALSAR etc. 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. There is need to devise accurate methods for classification of SAR images. The combinations of different polarizations from L- and C- band helps to improve the classification accuracy. It was found that the combinations of channels gave the best overall accuracies.. The proposed classifier is examined in Matlab with the help of Modified Artificial Neural Network using feed forward back propagation technique. The method finds 9 different land cover and sites.*

***Key Words*: Synthetic Aperture Radar(SAR), Artificial Neural Networks(ANN), Real Aperture Radar (RAR), Classification, Polarimetry**

1. INTRODUCTION

Synthetic Aperture Radar is a radar technology that is used from satellite or airplane. It produces high resolution images of earth‘s surface by using special signal processing techniques. Synthetic aperture radar has important role in gathering information about earth‘s surface because it can operate under all kinds of weather condition (whether it is cloudy, hazy or dark). Polarimetric SAR (PolSAR) image classification is arguably one of the most important applications in remote sensing. Classification is the process of assigning a set of given data elements to a given set of labels or classes such that various parameter of assigning the data element to a class is optimized. Radar polarimetry is a technique for classification of land use features. Various research work have reported the use of polarimetric data to map earth terrain types and land covers ([1], [2], [3], [4], [5]). Image classification can be mainly divided into supervised and unsupervised classification techniques. An unsupervised classification technique, classifies the image automatically by finding the clusters based on certain criterion. On the other hand in supervised classification technique the location and the identity of some cover type and terrain type , for example urban, forest, and water are known prior to us.The data is collected by a field work, maps,

and personal experience. The analyst tries to locate these areas on the remotely sensed data. These areas are known as "training sites". An analyst can guide a classifier with the help of these training sites to learn the relationship between the data and the classes. This manual technique of selecting training sets could be difficult when ground truth is not available. In this paper a new technique is proposed using modified ANN. It is a supervised classification technique. The proposed method is tested and analyzed in MATLAB.

1.1 Literature Survey

Both visual interpretation and automatic analysis of data from imaging radars are complicated by a fading effect called speckle, which manifests itself as a strong granularity in detected images (amplitude or intensity). For example, simple classification methods based on thresholding of gray levels are generally inefficient when applied to speckled images, due to the high degree of overlap between the distributions of the different classes. Speckle is caused by the constructive and destructive interference between waves returned from elementary scatterers within each resolution cell. It is generally modelled as a multiplicative random noise . Compared with optical image, SAR image has more legible outline, better contrast and more plentiful texture information. The objects of different shape and physical feature take on different texture character, which is a critical technique of identifying objects by radar. At present, there are many approaches to image classification, but there is not an approach to suit all kinds of images. During the past years, different methods were employed for classification of synthetic aperture radar (SAR) data, based on the Maximum Likelihood (ML), artificial Neural Networks (ANN) fuzzy methods or other approaches . The NN classifier depends only on the training data and the discrimination power of the features. Fukuda and Hirosawa applied wavelet-based texture feature sets for classification of multi frequency polarimetric SAR images. The Classification accuracy depends on quality of features and the employed classification algorithm. For a high resolution SAR image classification, there is a strong need for statistical models of scattering to take into account multiplicative noise and high dynamics. For instance, the classification process needs to be based on the use of statistics. Clutter in SAR images becomes non-Gaussian when the resolution is high or when the area is man-made. Many models have been proposed to fit with non-Gaussian

Scattering statistics (Weibull, Log normal, Nakagami Rice, etc.), but none of them is flexible enough to model all kinds of surfaces in our context.

For SAR image classification problem many fuzzy models have been proposed, Fuzzy c-means clustering (FCM) algorithm is widely applied in various areas such as image processing and pattern recognition. Co-occurrence matrix and entropy calculations are used to extract transition region for an image. This transition region approach is used to classify the SAR images.However most of the work remains restricted to maximum 6 training sites

1.2 Image Processing in SAR

The raw data received from the imaging sensors on the satellite platforms or aircrafts contains flaws and deficiencies. To overcome these flaws and deficiencies in order to get the originality of the data, it needs to undergo several steps of processing. This will vary from image to image depending on the type of image format, initial condition of the image and the information of interest and the composition of the image scenes. . Digital Image Processing undergoes three general steps:

i. Pre-processing
ii. Display and enhancement
iii. Information extraction

Pre-processing consists of those operations that prepare data for subsequent analysis that attempts to correct or compensate for systematic errors. The digital imageries are subjected to several corrections such as geometric, radiometric and atmospheric, though all these corrections might not be necessarily be applied in all cases. These errors are systematic and can be removed before they reach the user. The investigator should decide which pre-processing techniques are relevant on the basis of the nature of the information to be extracted from remotely sensed data. After pre-processing is complete, the analyst may use feature extraction to reduce the dimensionality of the data. Thus feature extraction is the process of isolating the most useful components of the data for further study while discarding the less useful aspects (errors, noise etc).

Image Enhancement operations are carried out to improve the interpretability of the image by increasing apparent contrast among various features in the scene. As an image enhancement technique often drastically alters the original numeric data, it is normally used only for visual (manual) interpretation and not for further numeric analysis. Common enhancements includes transect extraction, contrast adjustments, spatial filtering, Fourier transformations, etc.

Information Extraction is the last step toward the final output of the image analysis. After pre-processing and image enhancement the remotely sensed data is subjected to quantitative analysis to assign individual pixels to specific classes. Classification of the image is based on the known and unknown identity to classify the remainder of the image consisting of those pixels of unknown identity. After classification is complete, it is necessary to evaluate its accuracy by comparing the categories on the classified images with the areas of known identity on the ground. The final result of the analysis consists of maps (or images), data and a report. These three components of the result provide the user with full information concerning the source data, the method of analysis and the outcome and its reliability.

2. Classification Using ANN

Supervised classification methods for the polarimetric SAR data can be divided into statistical and neural network approaches. Neural network techniques (Hara, 1994; Chen *et al,* 1996)[6][7] have also been applied using the complete polarimetric information as input, and iterative training was normally necessary; Chen *et al.*(Chen *et al,* 1996)[7] applied a dynamic learning neural network and fuzzy neural network to classify multi frequency POLSAR. Ito *et al*. (1998) [8] have proposed a classification method using a competitive neural network trained by only two Learning. Vector Quantization (LVQ) algorithms. A method which selects a suitable feature vector using the JM distance is proposed. In addition, they introduce a pseudo-relative phase between polarimetries in order to obtain higher classification accuracy. Hellmann (1999) [9] has proposed a classification based on H-alpha decomposition theorem extended by the use of the first eigen value of the coherency matrix. Fuzzy logic as well as ANN strategies is used to improve the classification accuracy. Lorenzo Bruzzone (2004) [10] integrates an advanced pattern recognition methodology (based on machine learning techniques) with an accurate feature extraction phase (bases on the SAR signal physics analysis) for better classification accuracy. To classify a pattern, certain attribute values from that pattern are input into the directed graph at the corresponding source nodes. There is one sink node for each class. The output value that is generated indicates the probability that the corresponding input pattern belongs to that class. The pattern will then be assigned to the class with the highest probability of membership. The learning process modifies the labeling of the arcs to better classify patterns. After the classification is done for the training set the results are compared with the actual classification and the accuracy is computed. Learning process continues with different weights and with all the training data or until the classification accuracy is adequate.

3. Proposed Method

Data for classification problems can very often have textual or non-numeric information. In our case, classes are non-numeric (Light beach/Marshy/Flower Fields/Reeds/vegetation/Houses/River/Growing vegetation/Farmland). Neural networks however cannot be trained with non-numeric data. Hence there is a need to translate the textual data into a numeric form. There are several ways to translate textual or symbolic data into numeric data. Some of the common symbol translation techniques used is unary encoding, binary encoding and numbering classes. So unary encoding is used in this code to perform symbol translation.

[1] Data is prep-processed into a form that can be used with ANN. The neural network object in the Matlab toolbox recognizes its features along rows and samples along columns. Hence we work on transpose.

[2] The next step is to create a neural network (feed forward back propagation network) that will learn to identify the classes.The neural network starts with random initial weights , the results varies every time it is run. The random seed or twister is set to avoid the randomness.

[3] With 16 neurons in the hidden layer A 1-hidden layer feed forward network is created.

[4] Now the network can to be trained. The samples are automatically divided into training, validation and test sets. The training set is used to teach the network. Training will continue as long as the network continues improving on the validation set.

[5] Testing the classifier.
The trained ANN can now be tested with the testing samples of training sites. This will give us a sense of how well the network will do when applied to data from the real world.

[6] Calculation of classification accuracy using confusion matrix.

The network response can now be compared against the desired target response to build the classification matrix which will provide a comprehensive picture of a classifiers performance

3.1 Back Propagation Algorithm

Back propagation is a form of supervised learning for multilayer nets, also known as the generalized delta rule. the back propagation algorithm has been widely used as a learning algorithm in feed forward multilayer neural networks. Error data at the output layer is back propagated to earlier ones, allowing incoming weights to these layers to be updated. It is most often used as training algorithm in current neural network applications. The method calculates the gradient of loss function with respects to all the weights in the network. The gradient is fed to the optimization method which in turn uses it to update the weights, in an attempt to minimize the loss function. It requires a known, desired output for each input value in order to calculate the loss gradient function.

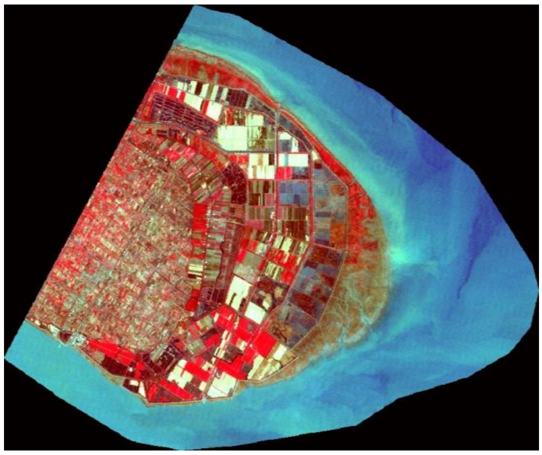


Fig -1: SAR Image

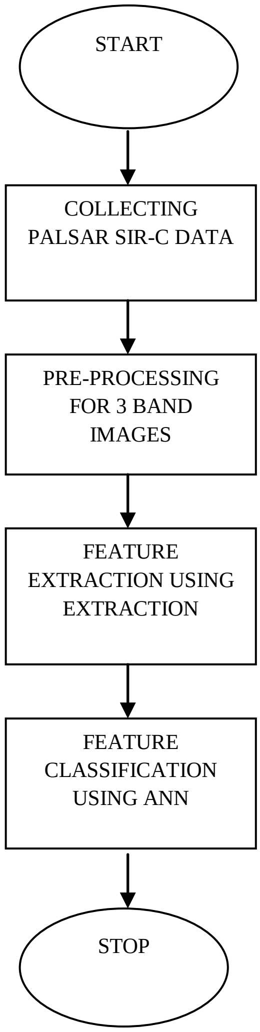
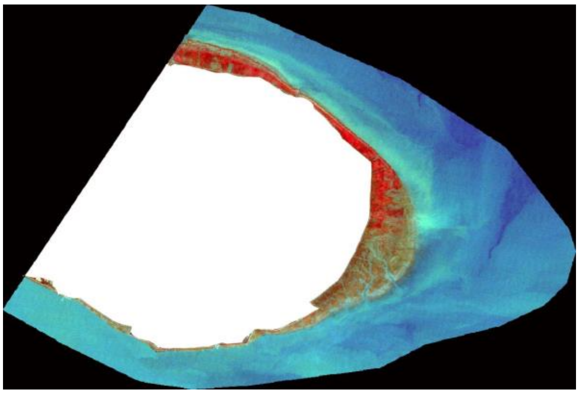
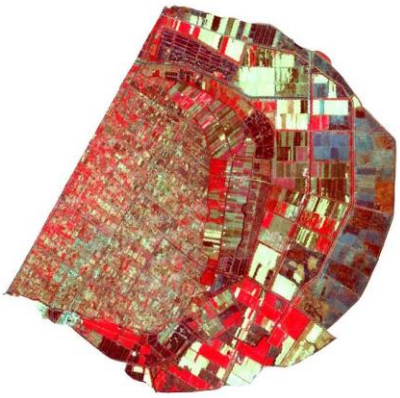


Fig -2: Flowchart



a)



b)

Fig -3 a & b: Areas for classification

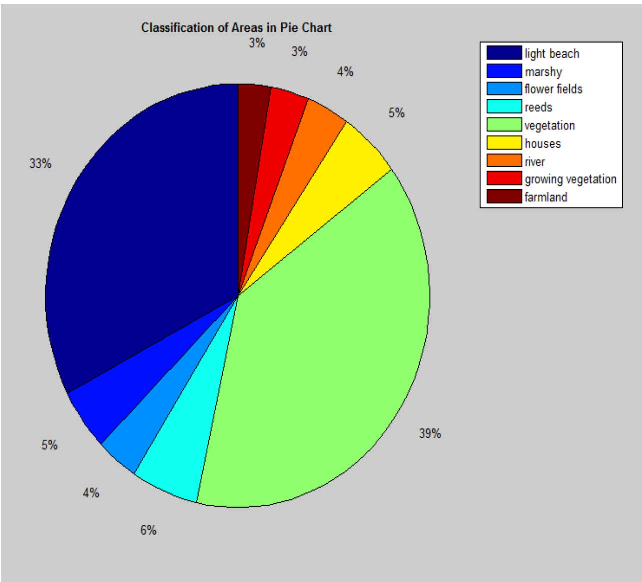


Fig -4 : Classification of Areas in Pie chart

Fig -5 Light beach

Fig -6 Marshy

Fig -7 Flower fields

Fig -8 Reeds

3. CONCLUSIONS

A modified algorithm based on the Artificial Neural Network was designed for SAR images classification. The new algorithm is successfully applied for classification of SAR images. The experimental results consistently show that the proposed algorithm has high classification precision. When compared with other two classifiers, K-means, and FCM, the average performance of ANN is better than them. The performance is evaluated by accuracy assessment. In terms of image classification accuracy evaluation, attention was mainly focused on subjective methods of evaluation. Confusion matrix, overall accuracy and Kappa coefficient are the main considerations in organizing and running subjective tests for method of image classification accuracy evaluation. The effectiveness of ANN algorithm was evaluated by accuracy assessment. We achieved more accuracy with ANN because it is a global searching technique. The performance of ANN technique is found to be satisfactory and the performance of outperformed FCM and K-means technique. The classification results are validated with various SAR images.

classified image	vegetation	Marshy	Flower fields	reeds	∑	User's accuracy
vegetation	75.2	10.8	8.4	0.3	94.7	79.40 %
Marshy	8.4	84.2	2.0	11.8	106.4	79.13 %
Flower fields	6.4	1.2	88.1	8.7	104.4	84.38 %
reeds	10	3.8	1.5	79.2	94.5	83.80
∑	100	100	100			
Procedure's accuracy	75.2	84.2	88.1	79.2		

Table -1: confusion Matrix

Classification Technique	Overall accuracy
ANN	81.67
FCM	78.3

Table -2: Comparison Table

REFERENCES

[1] R. Touzi, W.M. Boerner, J.S. Lee, and E. Lueneburg , "A review of polarimetry in the context of synthetic aperture radar: concepts and information extraction", *Can. J. Remote Sensing*, Vol. 30, No. 3, pp. 380–407, 2004.

[2] S.Cloude, E. Pottier "A Review of Target Decomposition Theorems in Radar Polarimetry", *IEEE Transactions of Geoscience and Remote Sensing,* Vol.34, No.2, pp. 498-518, March 1996.

[3] Van Zyl, J.J., "Unsupervised classification of scattering behavior using radar polarimetry data," *IEEE Transactions on Geoscience and Remote Sensing,* Vol. 27, No. 1, pp. 37–45, 1989.

[4] M Ouarzeddine, and B Souissi, "Unsupervised Classification Using Wishart Classifier", *USTHB, F.E.I,* BP No 32 EI Alia Bab Ezzouar, Alger.

[5] S. R. Cloude and E. Pottier, "An Entropy based classification scheme for land applications of polarimetric SAR," *IEEE IGRS,* vol.35, no.1, pp. 68-78, Jan.1997.

[6] Hara, Y., Atkins, R. G., Yueh, S. H., Shin, R. T., and Kong, J. A., " Application of neural networks to radar image classification," *IEEE T ransactions on Geoscience and Remote Sensing*, vol. 32**,** pp100-109.1994.

[7] Chen, K. S., Huang, W. P., Tsay, D. H., and Amar, F., "Classification of multifrequency polarimetric SAR imagery using a dynamic learning neural network," *IEEE Transactions on Geoscience and Remote Sensing*, vol. 34**,** pp 814- 820, 1996.

[8] Yosuke Ito and Sigeru Omatutt, "A Polarimetric SAR Data Classification Method Using Neural Networks", INT.J.Remtoe Sensting, Vol.19, No. 14, pp 2665-2684, 1998.

[9] M. Hellmann, G. Jager, E. Kratzschmar,M. Habermeyer, "Classification of h11 Polarimetric SAR-Data using Artificial Neural Networks and Fuzzy Algorithms"**,***IEEE Transactions***,** pp 1995-1997, 1999.

[10] Lorenzo Bruzzone, "An advanced system for the automatic classification of multitemporal SAR images," *IEEE Transactions on Geoscience and Remote Sensing,* Vol. 42, No. 6, June 2004.