

**Classification of Synthetic Aperture Radar Images**Devang Maheta¹¹ME Student, Electronics & Communication Department, G. H. Patel College of Engineering
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Abstract —In current research, classification of SAR (Synthetic Aperture Radar) image technology is being used to monitor agriculture field, forest, and terrain analysis, is one of the fastest growing fields in image processing. To analyze the information included in SAR images, robust and efficient classification algorithms are required. The intent is to explore the application of information obtained from fully polarimetric data for land cover classification. Various land cover classification techniques are available in the literature, but still uncertainty exists in labeling various clusters to their own classes without using any a priori information. Therefore, the present work is focused on analyzing useful intrinsic information extracted from SAR observables. The classification approach has been evaluated for ALOS PALSAR, Radarsat data. Here, supervised wishart classification and H/A/Alpha decomposition methods are used for classification. POLSARPRO_v5.0 toolbox is used for this purpose.

Keywords- SAR (Synthetic Aperture Radar), feature extraction, POLSARPRO, fully polarimetric, wishart classification.

I. INTRODUCTION

Synthetic-aperture radar (SAR) is used to generate images of a target, such as a landscape. For provide good spatial resolution SAR uses the movement of the SAR antenna over an object region. SAR is put on an active platform such as an aircraft. The mileage the SAR device voyages over a specified object region creates a large "synthetic" antenna aperture (the "size" of the antenna). Image resolution is increase as aperture is increase, regardless whether physical aperture or synthetic aperture. So with small physical antennas this allows SAR to create high resolution images. Synthetic Aperture Radar (SAR) images can be acquired from satellites such as ERS and RADARSAT [7]. Special care require when figure out SAR images because radar interacts with the ground features in ways distinct from the optical emission.

The vegetated regions have midway tone while the urban region manifest bright in the SAR image. Very bright objects may become visible in the image due to the corner reflector or double bounce effect. In corner reflector effect radar pulse bounces from horizontal ground and then directed in the direction of the object, and then returned from one vertical boundary of the object back to the sensor. The water manifests black in the image. At different time if more than one radar images of the identical region obtained are accessible, then by combined them create a multi temporal color composite image of the region.

Two main types of image classification approaches include supervised (human-guided) classification and unsupervised (calculated by software). In supervised classification scheme user select some representative pixels from an image that are represent some definite classes and then use software to use these sample pixels as referral for classification of other pixels in image. Training sites are picked based on the awareness of the operator. The operator also specifies the limitations for how almost identical other pixels must be to organize them together. These limitations are decided based on some characteristics of training area. The operator also determines the number of classes that the image is classified into.

If the outcomes are based on software which analyze image without prior knowledge of sample class then classification is known as unsupervised classification. In this classification scheme computer employs algorithms to find which pixels are associated to each other and organizes them into classes. In this technique user can particularize specific algorithm which is used by software and can also specify desired number of output classes but otherwise does not assist in the classification technique. User must have awareness of region after classification is performed when the groupings of pixels with familiar characteristics developed by the computer have to be related to verified features on the ground.

The classification techniques for SAR images have been explored by many researchers [1] – [4]. Recently case based reasoning method has been introduced [5]. ISM (Improve Subspace Method) has also been proposed for SAR image classification which is based on subspace method [6]. The main objectives of the research are as follows:

1. To develop an efficient and robust algorithm for Supervised Classification of SAR Image.
2. To evaluate the performance measurement parameter of the developed algorithm using some of the available standard image datasets.

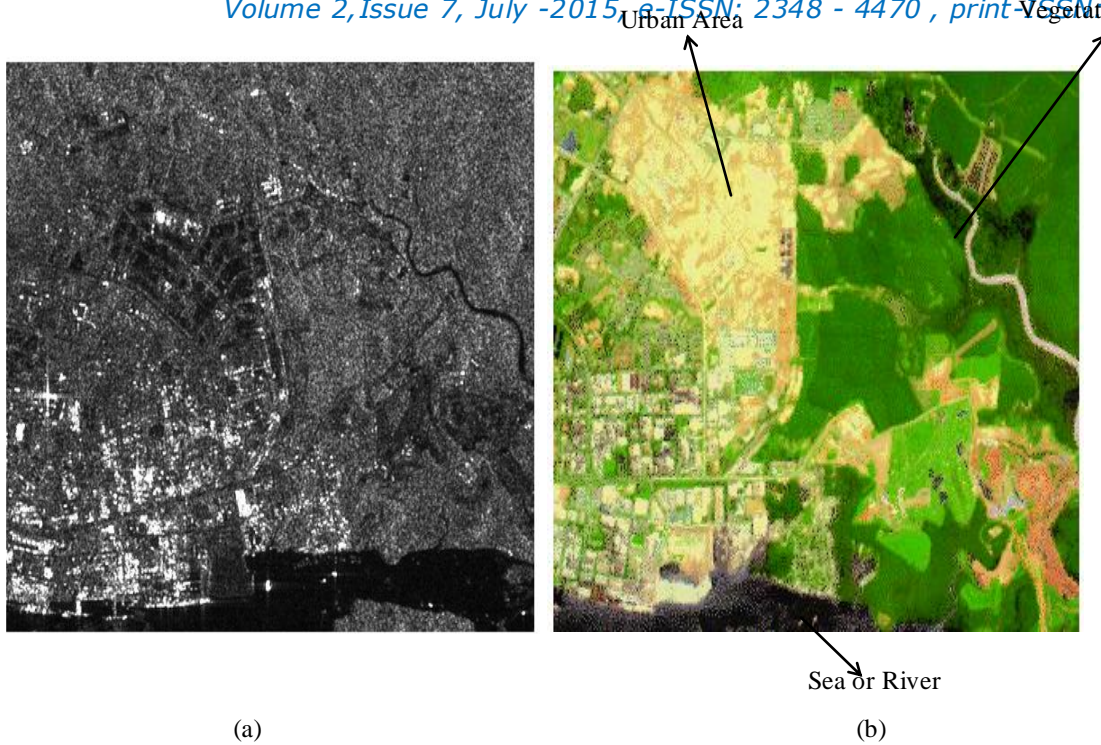


Figure 1. (a) Original SAR image (b) Target output image [7]

II. STUDY AREA AND DATA

Here POLSAR image of San Francisco Bay from NASA/JPL AIRSAR data base is used. It is a L band image with pixel resolution of 10m x 10m. The final Land Use Land Cover Classification (LULC) map displays categories including urban area, vegetated area and water area.

III. METHODOLOGY

H/A/Alpha Wishart Classification

According to H/A/Alpha decomposition theorem, the 3x3 coherency matrix T_3 can be decomposed as follows:

$$T_3 = \begin{bmatrix} u_1 & u_2 & u_3 \end{bmatrix} \begin{bmatrix} \lambda_1 & 0 & 0 \\ 0 & \lambda_2 & 0 \\ 0 & 0 & \lambda_3 \end{bmatrix} \begin{bmatrix} u_1 & u_2 & u_3 \end{bmatrix}^{-1}$$

Where λ_1, λ_2 and λ_3 are the eigenvalues of T_3 and u_i for $i=1, 2, 3$ are eigenvectors of T_3 .

The pseudo-probabilities of T_3 expansion elements are defined from the set of sorted eigenvalues

$$p_i = \frac{\lambda_i}{\sum_{k=1}^3 \lambda_k} \text{ with } p_1 \geq p_2 \geq p_3$$

Where p_i is called probability of eigenvalue λ_i .

Anisotropy can be defined as:

$$A \equiv \frac{\lambda_2 - \lambda_3}{\lambda_2 + \lambda_3}$$

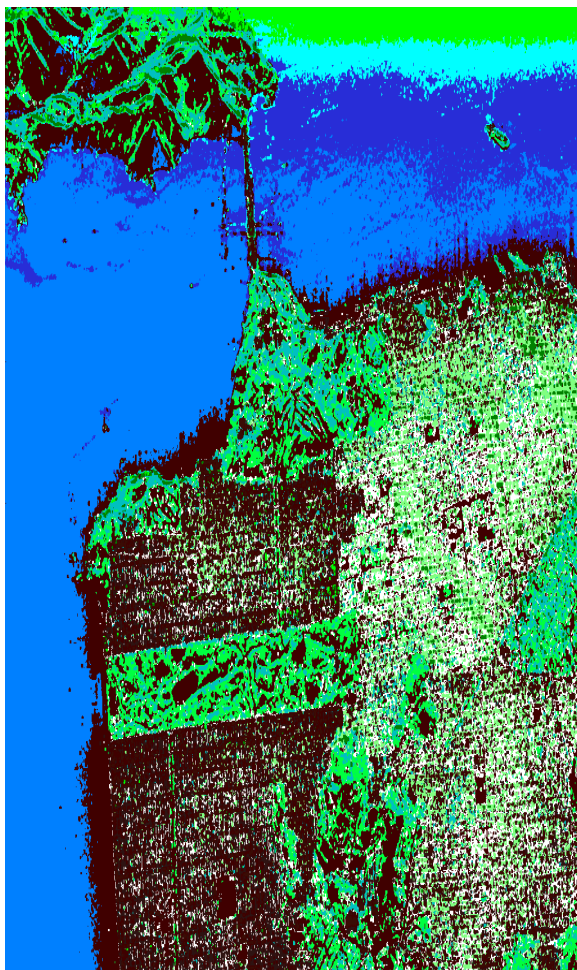
The eigenvectors and eigenvalues are primary parameters of this decomposition. Various secondary polarimetric descriptors are provided by H/A/Alpha decomposition of T_3 :

- Entropy (H)
- Anisotropy (A)
- Combination between H and A
- Target randomness parameter

Here PolSARPro_v5.0 toolbox was used to implement H/A/Alpha decomposition. Anisotropy knowledge grants the betterment of the capability to differentiate between various classes whose cluster centers end in the same entropy (H) – alpha (α) region.

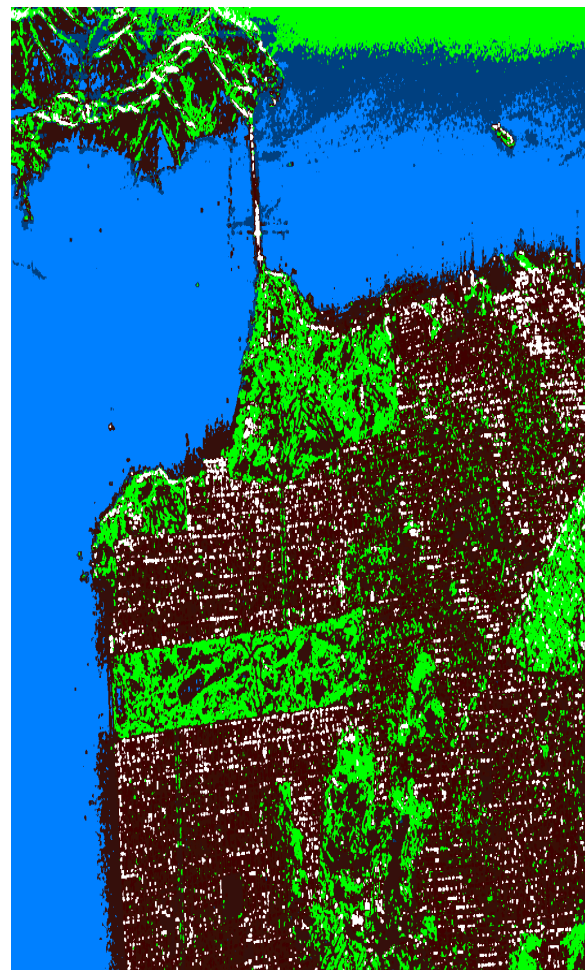
IV. RESULTS

Figure 2 and Figure 3 represent LULC mapdisplay for NASA/JPL AIRSAR data base. Supervised wishart classification was also performed for SAR image classification using known training sets.



Water Urban Vegetated

(a)



Water Urban Vegetated

(b)

Figure 2. (a) Wishart H/A/Alpha Classifiaction (b) WishartH/Alpha classification

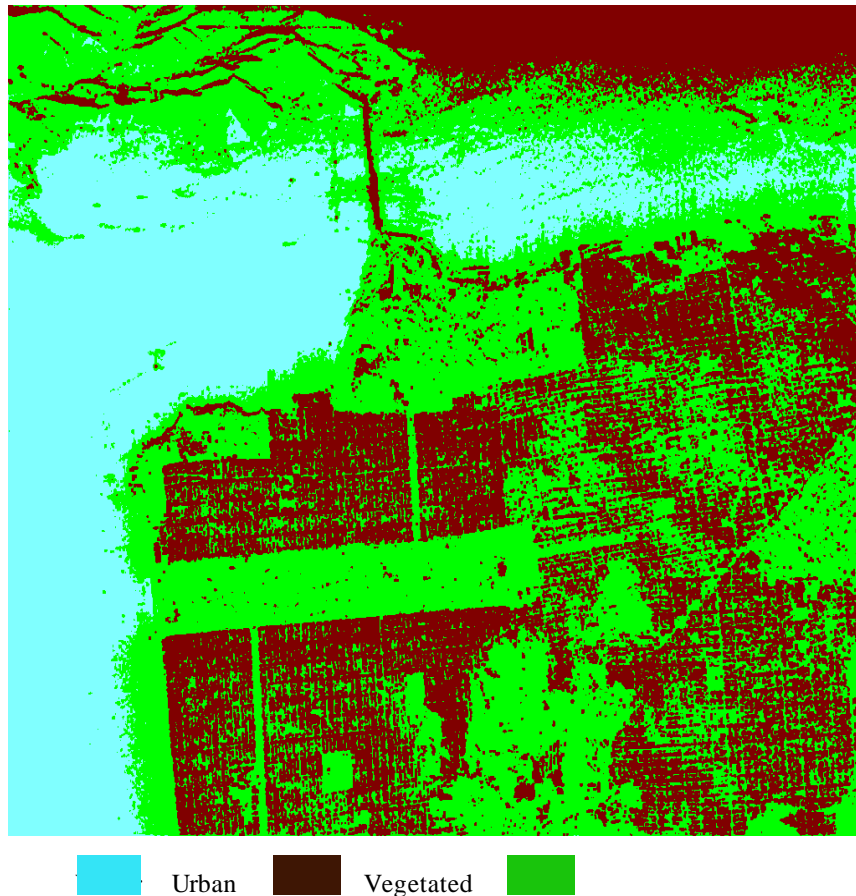


Figure 3. Supervised Wishart Classification

Table 1. Confusion Matrix for AIRSAR image

Class	C1	C2	C3
C1	95.34	0.00	4.66
C2	0.00	94.15	5.85
C3	0.00	17.53	82.47

Wishart supervised classification was also implemented using PolSARPro_v5.0 toolbox.

$$Accuracy = \frac{\text{number of true positives} + \text{number of true negatives}}{\text{number of true positives} + \text{false positives} + \text{number of true negatives} + \text{false negatives}}$$

So from above confusion matrix accuracy using supervisedwishart classification was 90.65%.

V. CONCLUSION

Here two classification method have been performed from which one is based on supervised approach and second is based on unsupervised approach. When ground truth values are known then wishart classification provide better

efficiency. For unknown ground truth values H/A/Alpha classification is more useful. H/A/Alpha classification can reduce incontinuous phenomenon effectively compare to H/Alpha classification by including anisotropy information. We can use backscattering coefficient for classification of full polarized SAR image.

VI REFERENCES

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