International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169
Volume: 6 Issue: 6 206 - 212

A Content Based Region Separation and Analysis Approach for SAR Image Classification

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Abstract:- SAR images are the images captured through satellite or radar to monitor the specific geographical area or to extract any information regarding the geographical structure. This information can be used to recognize the land areas or regions with specific features such as identification of water area or flood area etc. But the images captured from satellite covers larger land regions with multiple scene pictures. To recognize the specific land area, it is required to process all the images with defined constraints to identify the particular region. The images or the image features can be trained under some classification method to categorize the land regions. There are various supervised and unsupervised classification methods to classify the SAR images. But the SAR images are high resolution images with multiple region types in same images. Because of this, the existing methods are not fully capable to classify the regions accurately. There is the requirement of more effective classification that can identify the land regions more adaptively.

Keyword*: SAR*

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1. INTRODUCTION

SAR images are the satellite captured images which are having various associated applications to perform the region classification or the identification of some event or activity on some part of earth. As the images are captured from distances and through satellite, because of this these images are of larger size with high resolution. An image is able to cover the Kilometers of regions and because of this more effective, sensitive and accurate processing is required to process on SAR images. SAR images are having number of associated challenges and the application areas where the SAR image processing can be applied. In this chapter all the associated application, challenges and criticalities are discussed. This presented work is focused on the classification of SAR images in some of the defined classes. The paper has defined the experimentation on SAR images on images captured from the secondary sources. The complete work is here divided in separate chapters. This chapter is defined to explore the SAR image classification and associated features.

SAR images are basically defined to classify the particular terrain based on the featured analysis. As the images are captured from distance and with high resolution, It becomes difficult to process the SAR images. The classification of the SAR images can be done at the internal level i.e. to perform the individual region identification within the same image as well as the external image processing to divide the available images in the separate image classes.

As the SAR images are captured from distance satellite because of this, the capturing of these images are not much pure. The purity of these images depends on the environment. The rain, fog and other climate imbalance situations includes the different kind of distortion in these images. These all affects the image capturing and includes the noise within the image. The problem in the capturing can be in terms of noise, contrast unbalancing, color unbalancing etc. The quality of the camera device also affects the image quality. A low quality camera can result a low quality images. The capturing in night and in extra lighting also disrupts the image images and the quality of the image capturing.

Another associated problem with SAR images is the larger covered space captured by the SAR images. Sometimes the captured region is in few meters to several kilometers. Because of this it becomes difficult to map the image characterization to the actual image. If the quality of image is poor then it becomes more difficult to process this larger space image. When the image is captured, sometimes a captured image can be multiple mixed regions in it. The same image can have the water region, land region, hills etc. Because of this, it becomes difficult to measure the region. The quantification is also required to identify the size of each particular region so that the relative processing can be applied over the image. The region segmentation is required to process this mixed region images.

As the SAR images represents the land images and there are different forms of land cover images including the rivers, mountains, ponds, building, forests etc. There are 100s of the region variety that also different according the population density, country and the city. Because of this, there is the requirement of some intelligent mapping map that can identify the region more effectively and accurately. SAR image processing is very much dependent on the associated application for which the processing is defined.

Such as the identification of fire in forest is completely different to search for the water region. The separate set of features and different processing map is required to work on different applications and different image classes.

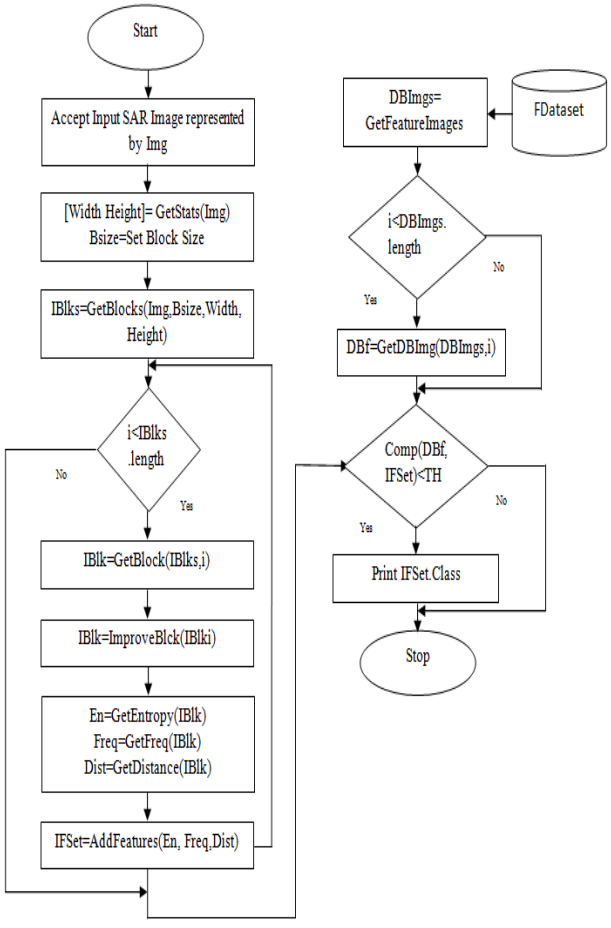
2. METHODOLOGY

In this work, an improved distance weight adaptive model is presented to analyze the regions effectively. The work is divided in three main stages.

In the first stage of this model, the moment analysis is performed under the intensity value observation to identify the area difference.

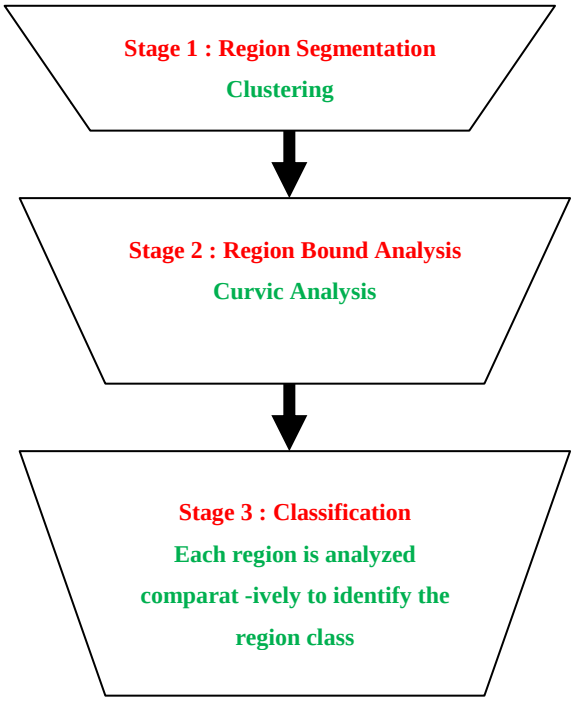
Along with this, the clustering model is applied to separate the region. Once the region is identified, the second stage of this work is to identify the region boundaries. The curvic analysis is here applied to generate the regions.

Once the clear regions are obtained, the parameter specific observations is applied on
different regions so that the class of the particular SAR image will be obtained.



Flow Chart for Proposed Work

In this work, an improved distance weight adaptive model is presented to analyze the regions effectively. The work is divided in three main stages. The work model applied in this work is shown here in figure-



Proposed Model

2.1 IMAGE SEGMENTATION

Segmentation is a fundamental task in image processing used to extract the region from images based on application requirement or the process requirement. In case of SAR images, the geographical regions can be extracted effectively using segmentation. The segmentation is required to identify the regions with particular characteristics, change identification, geographical damage identification etc. The characterization to the region can be done based on the pixel specification, featured region extraction and the extracted region block identification. The segmentation can be widely divided in two sub categories listed below.

2.1.1 REGION BASED METHOD

Region based methods basically adopt the correlation technique and are easy to calculate and implement but required large amount of calculations which is a serious problem.

2.1.2 FEATURES BASED METHOD

Different feature forms are available to describe the image characteristics in more effective form. The region bound identification, corners identification, statistical observations, colour and shape constraint are some common form of feature representation.

2.2CLUSTERING

The clustering methods are basically defined to divide the available data in smaller sets. Each set where signify the specific characterization. The clustering here identified as the distance based comparison so that the clusters can be formed. The adapted process for segment member identification is given here under

- Generate the number of segments or partitions with specification of centralized member
- Process each element of data and identify the distance from the centralized member of each partition.
- Identify the partition which is most closed to the particular data element
- Now take the average distance from all centralized elements
  Switch the cluster centre and repeat the process till the optimized clustering not achieved.

2.3 CLASSIFICATION

The main utility of SAR image processing system is to identify the image class based on the region processing in featured mode. The relative decision is required to process on SAR image to identify the image class. Once the segmentation is applied over the image and the image features are obtained, the next work is to apply the classification algorithm. The classifier is defined under the feature processing to divide the image in various region classes. These classes are based on the type of land cover. Some of the common classes for SAR image processing include

- Water Area with specification of Sub Areas
  - Rivers
  - Ponds
  - Floods
- Tree Regions with specification of Sub Areas
  - Forests
  - Mountains
- Buildings
  - Office Areas
  - Residential Societies

2.4 ALGORITHM

In this work two stages for Algorithm approaches are suggested.

Stage 1: Fileration

The first stage of this work is to apply the improvement to the input image based on the adaptive features. The feature exploration is here applied using sliding window based intensity improvement method. The algorithm for this stage is given here under-

Fileration(SARImg)

/* SARImg is the considered input image which is been analyzed for feature extraction*/

{

Stage 1.1 Define the Sliding window size and the content to improve the feature.

Step 1. [Read the SAR Image Horizontally]
For i=1 to SARImg.Width
{
Step 2. [Read the SAR Image Vertically]
For j=1 to SARImg.Height
{
Step 3. [Slide the winodw over the image and extract relative winodw area]
ExtractedBlock=Extract(SARImg,WindowSize)
Step 4. [Apply the sliding winodw matrix over the image block to improve the feature]
ExtractedBlock = ExtractedBlock x Window
Step 5. [Enhance the Block Features so that the enhanced featured over the block will be obtained]
FeaturedBlock =ImproveFeatures(ExtractedBlock)
Step 6. [Include the Block in new improved Image]
ReformedImage.Add(FeaturedBlock)
}
Return ReformedImage
}

Stage 2: Feature Extraction

This stage is basically defined to extract the image features based on which the classification can be done. The extraction of features is here based on the window adaptive analysis applied over the featured image. The algorithmic model for feature extraction for SAR image is given here under-

ExtractFeatures(SARImg)
/* In this section, the statistical features over the SAR image is extracted based on which recognition is performed */
{

Stage 2.1 Define the size of window respective to which the extraction will be formed.

Step 1. [Obtain the SAR Image extraction with specification]
For i=1 to SARImg.Width
{
Step 2. [Read the image]

```
        For j=1 to SARImg.Height
        {
Step 3. [Obtain the window area over the SAR image]
        SARImg=GetWindow(SARImg,Window)
Step 4. [Generate the featue over the image based on the convolutional winodw]
        FeatureImage=ApplyWindow(SARImg,Window)
Step 5. [Extract the feature image from the image]
        Features=ExtractFeatuers(FeatureImage)
Step 6. [Obtain the statistical featurs from the images]
        Featureset.Add(Features.Entropy)
        Featureset.Add(Features.Frequency)
        Featureset.Add(Features.Distance)
        }
        }
Return Featureset
}
```

3. RESULTS AND DISCUSSION

3.1 DATA COLLECTION:-

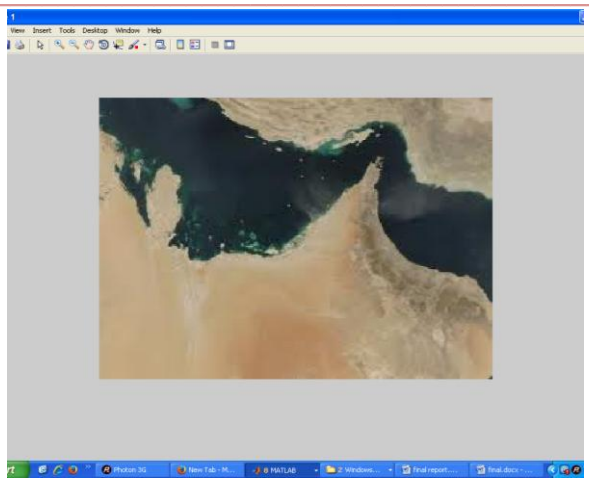
Data collection is the primary requirement of such classification model on which the implementation can be applied. The presented work is defined to classify the regions over the SAR images, for this there is the requirement to collect the radar images. For any image processing application different primary and secondary sources are available to collect the data.

In this present work the required data is collected from the secondary sources In this work, the high resolution building images are extracted from web source. The properties of collected dataset are given here under

Properties	Values
Image Type	Satellite Images
Type	Color
Size	600x600
Format	JPG
Number of images	50

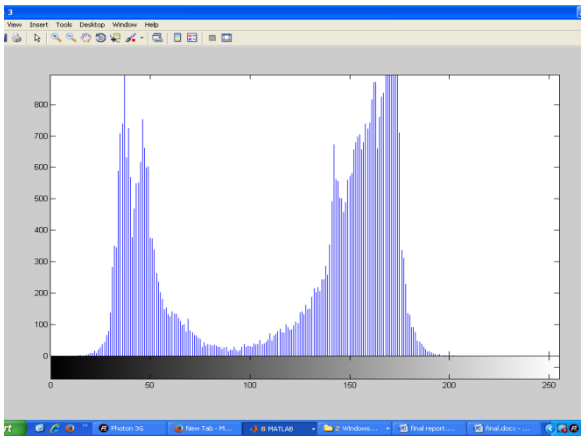
DATA SET PROPERTIES TABLE

3.2.SIMULATION RESULTS : SAMPLE IMAGE I



Sample Image I

Here figure is showing the results obtained for the sample image. The figure is showing a raster image taken from the web. The input image can be any of the satellite image taken from the web source. The figure is showing the qualified image under the SAR image specifications. The image is color with multiple regions. It is required to identify the most qualified region over the image.



Histogram Analysis (Sample 1)

Here figure is showing the histogram analysis applied over the image. The figure is showing the intensity level observations applied over the image. The figure is showing the frequency variation and the pixel strength analysis applied over the image. Here x axis is showing the intensity range and y axis is showing the frequency of each intensity value applied over the image.

 ISSN: 2321-8169
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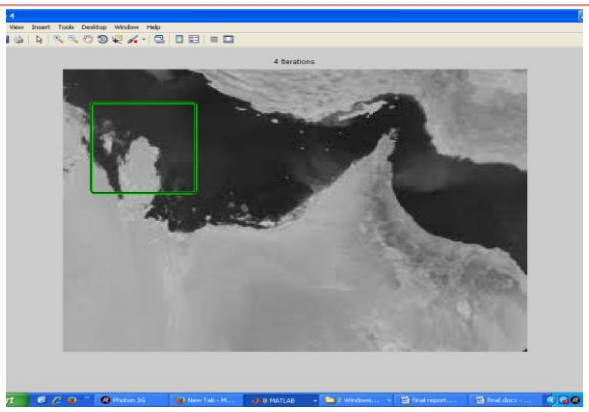
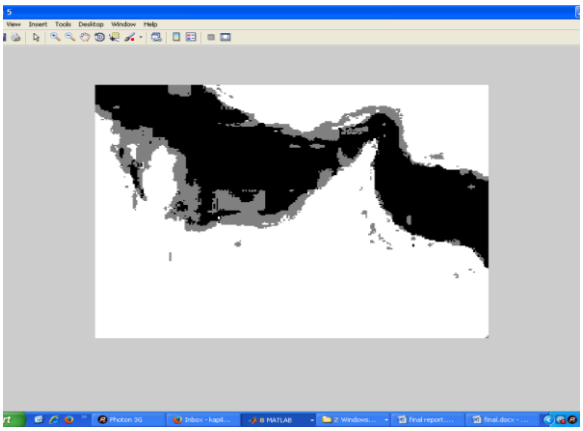


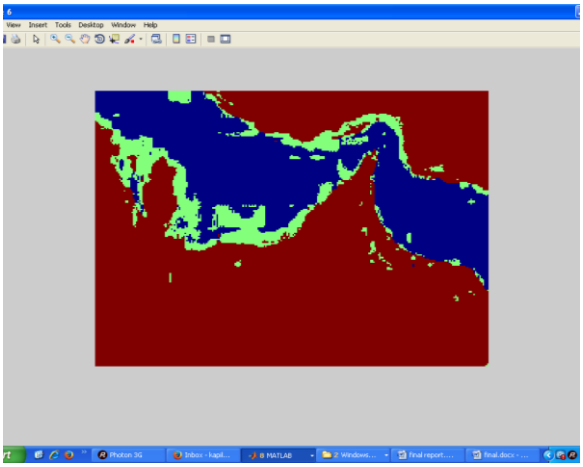
Iterative Window Based Segmentation (Sample 1)

Here figure is showing the Iterative process applied to perform window based segmentation over the image. This window segmentation is generated so that the relative region identification will be done more effectively. The window segmentation is analyzed under sliding mode.



Region Class Identification (Sample I)

Here figure is showing the region class based identification so that the region segmentation is done. The figure is showing the region level segmentation in the form of gray images.

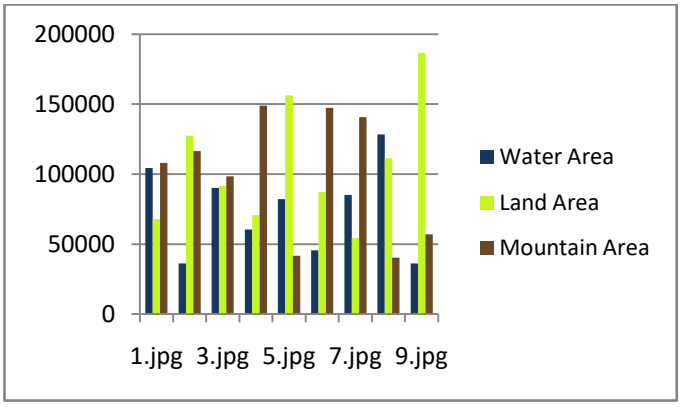


Colored Region Identification (Sample I)

Here figure is showing the identified regions in color form. The figure is showing the generated color map along with region level segmentation so that the region segmentation and the quantification will be done more accurately.

3.3 ANALYTICAL RESULTS

Here figure is showing the pixel level analysis applied over the image relative to three different regions. The figure is showing the contribution of each segmented region over the image. The highest region area is here considered as the classifier map so that the relatively higher effective region class is identified.



Region Classification

3.4 COMPARATVIE ANALYSIS

- In the existing work a moment based analysis is performed over the image. According to this approach a 3x3 size window is moved over the image to identify the pixel based analysis.
- The work cannot be completed in single visit of sliding window, as the analysis and colorization process over the image.

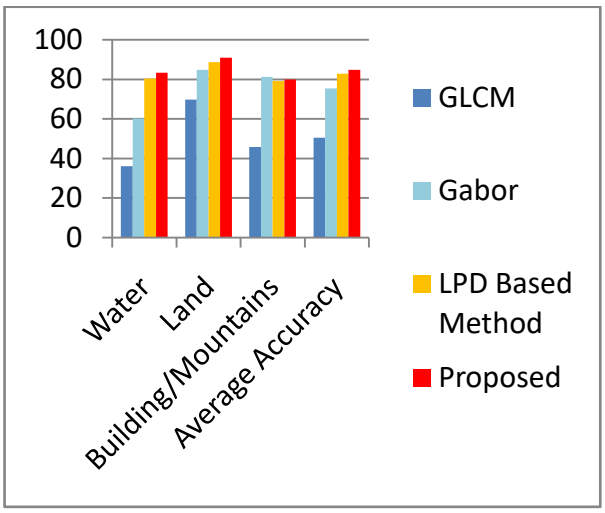
In the existing work, the comparative analysis is been performed under the histogram analysis. But in this work, we have used some analytical parameters such as entropy, visibility, standard deviation etc.

In this table the comparative accuracy analysis of proposed work is provided against each type of SAR image and the average accuracy. The table shows that the proposed method has improved the accuracy against each type of SAR image.

Area type	Existing			Proposed
	GLCM	Gabor	LPD Based Method	
Water	36.09	60.27	80.41	83.33
Land	69.71	84.77	88.73	90.91
Building/ Mountains	45.81	81.22	79.18	80
Average Accuracy	50.54	75.42	82.77	84.75

Comparative Analysis

The evaluation is provided against the GLCM, Gabor and LPD based method. Each of the class of SAR image and the average accuracy evaluation is shown in the graph. The comparative results show that method improved the overall accuracy.



Comparative Analysis

4. CONCLUSION

SAR images are the taken from satellite or considered as the radar images to obtain the region level observation. This observation is effective to identify the application specific observations such as identification or fire regions etc. The work is defined in three main stages. At the earlier stage, the region level map is applied to separate the individual regions. Once the regions are quantified, the next work is to generate the region curves for clear separation of regions. Finally, the featured comparison is applied to generate the region class. The work is applied on random sample set. The observations show that the model has provided the accurate region identification.

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