International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2163
Volume 1 Issue 10 (November 2014) www.ijirae.com

Home Land Security through Coastal Region Monitoring Using SAR Images - A Review

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Abstract - In recent world, it is very challenging for any country to provide security along the coastal regions. It is very easy for the attackers to enter and cause many damages to the country. In order to protect our country from threats it is mandatory to monitor the coastal regions. To provide the home land security the coastal regions need to be monitored. In order to do so in the coastal regions the Synthetic Aperture Radar (SAR) imagery plays a key role. The ocean wave spectra of SAR data is used for regular and global monitoring observations. Additionally, systematic use of SAR imagery system includes pollution control, bottom mapping and fisheries. SAR imagery is also used to detect and locate the oil spills, bathymetric features in shallow water. Furthermore, SAR imagery data applications understand the coastal region of current and feature monitoring. Recently, a new application has also been developed for coastal region monitoring of atmospheric boundary layer process. In this paper a review is carried out for providing a home land security through SAR images in coastal regions using SAR images and is presented.

Keywords - SAR Images, Radar, Satellites, Security, Coastal Monitoring, Coastal Region

I. INTRODUCTION

The SAR is a coherent technique with high-resolution and other planet observations. An important phase of SAR imagery is the direction of workstation scene portrayal of coastal regions. The process of SAR imagery is initiated at Norwegian Defense Research Establishment (NDRE) for immediate processing of the SAR data received from the ground station. The contribution of Norwegian coastline areas in European Remote Sensing (ERS-1) development for detection of ship and ship wakes are presented in [1]. Previously, European Space Agency (ESA) is to be performed on the subject of mathematics section of NDRE. The primary object improvement is to understand the complex modulation of the radar backscatter and a variety of ocean surface conditions [2]. The SAR processing is concerning the image techniques for automatic detection on coastal monitoring areas. In SAR imagery process, radar system organization is distinguishing the sea surface from coastal monitoring. Before the coastal monitoring regions are to be found out problems from sea surface areas. The coastal monitoring system measures to be issued such as the related economic, social and environmental of coastal regions, sea basins and the naval trade about from industry regions. In the European Union, a naval policy called 'Blue Book' integration commission is adapted for coastal monitoring regions [3].

Since, coastal areas are attractive settling grounds for human population due to plentiful marine resources; it has also led to high threats for home land security. At present, in the world nearly 1.2 billion peoples are living in coastal regions. However, the characteristics of coastal environments and difficult challenges are directed to human habitation. Thus, the SAR image model could be used to improve the current features are combined with increased temporal and spatial structures for retrieval and monitoring of coastal sea heads and current fronts.

About this coastal monitoring region with the regular use of SAR imagery high resolution data validation (1km) is needed for the context of growing activities [4]. If the coastal regions of SAR imagery system basics can be enhanced to collect more information about this validation function. In coastal monitoring SAR images are to be contains the information about coastal observation of ocean lands. Then identifying to using the coastal edge maps are defining periphery controls is not continuous.

If the SAR image processing system includes some difficulties that are associated with the nature of boundary lines from ocean and land areas. The knowledge required for processing coastal regions include the position, orientation and outline for essential activities such as navigation, verification of locations, the target of geolocation (e.g., ships) etc. [5]. In order to achieve this, the evaluation of resources and environmental monitoring approaches are needed to stress the coastal management through remote sensing [6]. But, SAR imagery process of remote sensing data is relatively new and complementary sources. The SAR imagery system RADARSAT-1 satellite primarily acquired potential of coastal monitoring regions. RADARSAT-1 satellite operates at various spatial resolution monitoring tasks potentially provide SAR imagery data on a weekly basis in tropical latitudes. Considering the coastal monitoring regions are obtained for results of SAR imagery analysis of ERS-1 and JERS-1 satellites. The use of ERS-1 SAR imagery describes the determination of shoreline and designed for specific application called Digital Elevation Model (DEM) in coastline detection [7].

The DEM method involves finding the position of shoreline from remotely sensed images and to register the coastal region boundary base maps. The advantages of satellite SAR imagery process include constructing an intertidal DEM

over large areas. Because SAR multi-sensors are particularly suited on this task of multi-temporal sequences and it can be built up more easily than by using visible SAR imagery process. Suppose, if the coast was a static entity, then the statistical approach requires not same satellite images to be necessary. In previously, the statistical approaches of SAR imagery remote sensing satellite images are distributed to physical asset of ocean surface modeling. The quality of high-resolution statistical data acquisition combines both RADARSAT and SAR images.

The coastal monitoring SAR imagery is obtained by the radar backscatter results and resolutions of image techniques to be applying remoteness are within 30 meters. If the, ERS-1 satellite SAR imagery data sends 1700 pluses a second to accomplish the above said tasks [8]. But different types of satellite tasks are used for monitoring the SAR imagery data in coastal ocean regions.

II. BACKGROUND

The coastal monitoring regions are inside SAR imagery data process acquires along the presence of low-resolution images are transmitted from radar satellite stations to remote sensing environments. This image data transmission is processed and analysis of remote sensing environments. These environments are considered to extending from the coastal grasslands to outer coastal edges. Coastal region surrounds several earth resources and consist of complex ecosystems are sensitive, to mortal involvement as well as environment change. By the environments are characterized, to the interaction of complex system upper ocean boundary-layer processes at spatial and temporal scale ranging from meters to hundreds of kilometers. But, these several processes and their primary result of lack of observations are not well known. And their validation of the coastal ocean models is consequently poor.

In situ multi-sensors seaside monitoring and structure prediction of remote sensing observations of coastal currents, current fronts, eddies, upwelling patterns, and high-resolution wind fields must be organized and shared with fine-resolution geometric sea models. These models are providing to combine the structure of a realistic representation of early state used for reliable and accurate coastal monitoring instances of eddies location, upwelling patterns and high awareness.

The further research and development efforts are addressed and characterized the current role of SAR in that areas of coastal monitoring and applications are undergoing. The state of art global SAR observation continues the use of SAR application in technical research, effective usage and environmental problems in coastal regions. At present coastal monitoring regions are highly productive and dynamic backgrounds. Because of major environmental issues protection for fast growth of industry and pollution. The most efficient method is remote sensing with frequent reporting to monitoring and study the marine productivity and pollution. The use of satellite image wavelet transforms is to be real-time screening of satellite data, binary image, and image enhancement. In the coastal region can be providing the wavelet analysis is important elements in the effective monitoring of coastal watch system. To automated detection and tracking of wavelet analysis algorithms and techniques developed for the ocean features from the satellite imagery.

For example, the National Oceanic and Atmospheric Admission (NOAA) Coast-Watch arrange for mapping the real-time satellite data and information for U.S. coastal liquids appropriate for ocean observing and location controlling. For this, one project is developed underway to add SAR imagery data and artifact to the Coast-Watch product matching set.

The simultaneous monitoring of ocean surface SAR imagery data and optical imagery data can enlarge the capability of interpret surface features compared with available SAR data. The SAR satellite images have to detect the coastal current boundaries. The coastal region environmental features are different types of methods affect to influence and involve the process of framing by near-shoreline. This organization of remote sensing coastal monitoring system observes the coastal current fronts and eddies, development patterns, and high-resolution wind fields combined with purpose of statistical models. The coastal monitoring methods are discussed in section 3. An accurate integrated structure of the SAR imagery system observation is to provide intervention results of image objects identifies. For example, SAR image processing is using the onboard processing. This method firstly used in the McDonald's company.

The purpose of the SAR simulation method is to simulate systems such as ERS-1, 2 and we are not trying for high-resolution systems. This model consider to adding the different backscatter characteristics of regional maps. In this simulation not detailed geometric comparison is discuss. For this one, SAR simulation tool suggest to the SAR fundamental geometric characteristics are archived through visual results. This SAR simulation is discussed in section 4.

The SAR imagery having the some radar bands for performing image processing operations. There are three operations are using to performing the SAR image processing such as strip map, stop and scan. These bands with frequency and wavelength ranges are as shown in below *Table 1*.

TABLE 1 - RADAR BAND TYPES WITH FREQUENCY AND WAVELENGTH RANGES

Frequency Band	Wavelength (CM)	Frequency (GHZ)
X	2.4-3.8	12.5-8
C	3.8-7.5	8-4
L	15-30	2-1
P	30-100	1-0.3

In the coastal monitoring of SAR imagery system the strip map operation is used most predominantly. In this case, the radar antenna points along a fixed direction with respect to flight platform path and antenna foot print covers. And also, it involves the two imaging geometries such as bore-sight and squinted. Mostly the coastal monitoring regions are using spatial data. For this, the SAR image processing is used different types of Radars and it is shown in *Table 2* with their operational agency and frequency band used.

The satellite ERS-1 is launched in 1999 and it operates SAR C-band model function. This model covers 100km swath and the spatial resolution range is 30m. Next version satellite ERS-2 is lunched in 1995 and operation is continued with SAR C-band model function using. Present version satellite Envisat is lunched in 2000 and operation is approved with SAR C-band model function. These three satellites are organized by ESA. In 1992, satellite JERS-1 is launched and its onboarding operates the SAR L-band model function. This model can use to cover the swath of this 75 km and surface resolution is 18m [9]. The SAR data is processed by the Sigma-SAR processor [10]. The L-band model function is developed [11] using the JERS-1 SAR imagery. Next version is Advanced Land Observation Satellite (ALOS) lunched in 2001 and operates with SAR L-band model function. The JERS-1 and ALOS satellites are organized by NASDA. The satellite RADARSAT-1 launched in 1995 and operates with C-band model function. Next version of satellite RADARSAT-2 is lunched in 2001 and operates with SAR C-band model function. The RADARSAT-1/-2 is organized by Canadian Space Agency/National Aeronautics and Space Administration (CSA/NASA). LightSAR satellite is lunched in 2001 and operates with L-band model function.

TABLE 2- RADAR TYPES, OPERATIONAL FREQUENCY BAND AND AGENCY

Satellite	Agency	Band Type	Launch	Status
ERS-1	ESA	C-band	1991	Operation Terminated
JERS-1	NASDA	L-band	1992	Operation Terminated
ERS-2	ESA	C-band	1995	Operating
Radarsat-1	CSA/NASA	C-band	1995	Operating
Envisat	ESA	C-band	2000	Approved
Radarsat-2	CSA/NASA	C-band	2001+	Approved
ALOS	NASDA	L-band	2001+	Approved
LightSAR	NASA	L-band	2001+	Unclear

III. METHODS FOR MONITORING THE COASTAL REGIONS

In SAR imagery processing, the methods which are predominantly used are boundaries detection, dynamic threshold for further analysis. They are explained below.

A. Boundary Detection Method

The region is in between the background and object of coastal monitoring regions is called boundaries. Unluckily, boundaries are not applied in universal operational definitions. The recognized boundary methods have been devised based upon such as

1. *The adjacent possessions of boundaries or photometric amount variations faster than the further regions, and*
2. *The located boundaries possessions are in between the lower and higher intensity.*

Generally, first property is applied for 3-D (i.e., spatial data) differentiation such as to distinguish the boundaries of gradients and laplacian operations. These both operations are infrequently grind for low-resolution images, because the high spatial mechanisms are used only for 3-D differentiations. Usually, both operations are dominants the noise.

The second property is to determine an optimal threshold prime value is separated into two categories. This threshold value obtained by percentile method or a context oriented method and there usage is limited. However, there is no methods are found for considering the low image quality of entire image and it is not feasible to set of single threshold values to separate the objects from SAR image background settings.

B. Dynamic Threshold Method

The statistical intensity variation completed on any coastal monitoring region and characterized by statistical distribution.

The fundamental analysis of this method is empirically shows [12] for the small coastal regions with the low-probability distribution of intensity level. In this method, the small coastal region is subsequently distributing the mixture of two uni-modal distributions and general bimodal variations.

For example, [12] a small region marked by following Fig. 2. Consider a small region image contains a boundary region of image pixel. Fig. 2 is derived from figure 1 with the logarithmic process and image subtraction. Fig. 1 specifies the frame of a sample image. In this image information is obtained quantitatively. In this method to detect boundaries of the sample image and also this method is applicable to other object extraction in low-quality images.

This method describes a series of frames from a sample image study and the frames are shown in subsequent figures. Also frames were directly injected into the left ventricle frames subsequent to injection shows outlines of left ventricle. This particular study is chosen by Dr. John H. siegel of Einstein College.

Generally, these applications overlap the two distributions, due to the occurrence of a different cause. The determining problem for reducing boundary distribution belongs to each individual image point. Still, the boundary distribution determining has two questions occur:

1) *Uni-modal distribution function form and*
2) *Identifiability function form*

The above both questions are possible to finding the unique distribution solution.

In this normal distribution requires mean and variance of two limitations are needed for identifying and characterizing. This assumption is found to be fairly good.

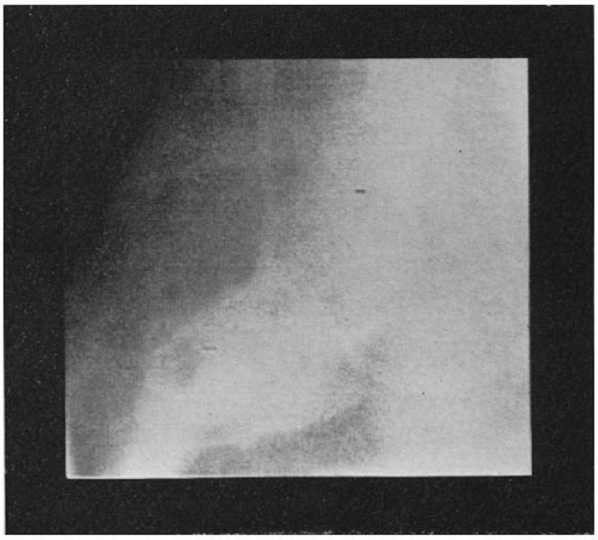

Fig. 1 Sample image.

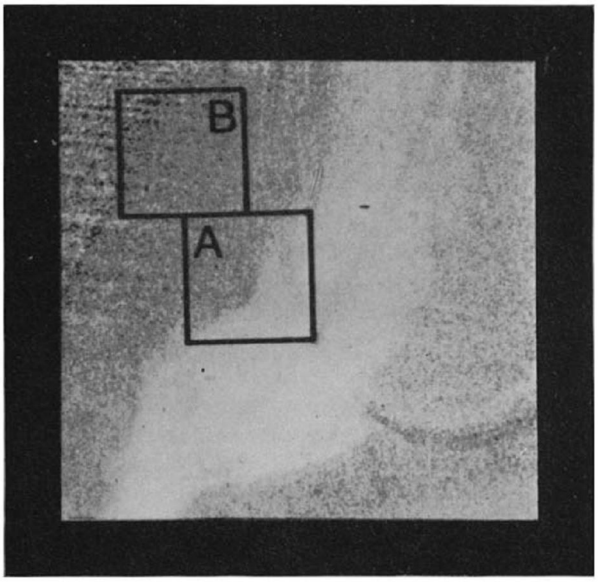

Fig. 2 The above figure after subtraction of the regions A and B

This method consists of the following steps:

1. *First the entire image is divided into the smaller pixels and then overlapping the regions.*
2. *Calculate the each histogram regions and select the large variances.*
3. *Using the curve fit algorithm to estimate the distribution of components and coefficients.*
4. *Test the estimated distributions for bimodality and calculate the threshold from estimated distributions.*
5. *For all image points the thresholds calculated in (4).*
6. *The binary decision for each image point using threshold in (5).*

The boundary detection algorithm is applied for scanned images. This is performed by using transformation function to reset emitting radiation background of image subtraction. The image subtraction of major objective is using to eliminate the image of spinal column in each pixel. Now in this image subtraction using two considerations. One consideration of subtraction technique is the registration of two images. Second consideration technique is optimal subtraction of location image. Hence, many average frames are before image subtraction can be used as the reference of all frames.

C. Statistical Speckle Method

Speckle method is produced by the common nosiness of a set of ocean wave-fronts. The result of speckle effects is same frequency in many waves. In this each wave is modeled by a vector together with random angles. But the speckle image is formed of coastal sea surface which is observed in the image plane. In SAR imagery, the rational interaction of radar images is designing by micro wave transmission with the targets of optical images. In future, the speckle noise method suffers from SAR imagery data effects, which is arises from rational signal synopsis spread from the ground scatters distribution randomly within each image pixel.

The SAR images developed under the statistical method using Seasat radar satellite. It is established speckling distribution of a negative exponential and its standard deviation is equal to mean. The SAR processing complexity and pre-image application development reduction techniques are under the speckling effect verified by statistical method. The SAR image frame approximate dimension of 6144 X 5000 image features.

IV. SAR IMAGE SIMULATION

The SAR simulation purpose is used to simulate radar system such as ERS and it was not used for simulating the high-resolution systems. The SAR image simulation models are quantifies to the geophysical parameters from SAR imagery and this model is affected by radar cross section and to determine unique relationship between the image expressions. But, the SAR simulation models are based on the two-scale backscatter model with action equation. In particularly X and C bands are to be observed SAR simulation of radar cross-section features and under-predict the absolute results. The SAR simulation models applied to determine the combination of convergence or divergence operations are produce for bright and dark image features. And also, by the coastal observing system orientation of linear features are in the image constraints of frontal characteristics.

For example, to changes of coastal sea surface fronts while the characteristic of sea surface orientation is much larger than the additional inferences can be drawn from the images. This method only used for changes in radar cross section and not required for absolute results.

In 1991 Lyzenga is used to developing the SAR simulation model and coordinating system defined there. In the local coordinate system to define the x-axis is orthogonal to the front and the y-axis is parallel to the front at a given location.

For this model, in coastal monitoring is to be provided by the Coastal-Watch instant satellite image maps and in situ data information about for the coastal waters right caution and their environmental management [14]. The coastal monitoring region project is underway development of SAR imagery data and Coast-Watch product suite. In SAR, AVHRR and SeaWIFS analysis wavelet transformation techniques are automated to detect sea surface features and these are evaluated for the Coast-Watch applications.

This simulation model used simple geometric representation is possible by considering an image pixel. This image pixel is suitable for representing to include the coastal current fronts of radar cross-section perturbations. For example, the radar cross-section image pixel is to converging fronts on the left side and diverging fronts on right side. Most of the fronts are encountered in the dominated by the share with converging and diverging.

The representations of 2-D system fronts are along with wind field directions, to be measured in counter clockwise from x-axis. The front has constant of 5 X 10^{-3} s^{-1} current share along with combination of convergence and divergence. Since, these are uncertainly difficult to draw the accurate model quantity and comparison is not necessary for these quantitative models. In general, this model is used to underestimate the observed images. The limitations of the SAR image simulation modeling is short wave-current interactions along the frontal boundaries.

V. SUMMARY

The number of SAR images observed with help of radar satellites in the coastal monitoring regions and the use of SAR image model as following to discuss

1. *In the summer months during the coastline eddies dumping with the radar cross section of up to 6-10 DB. Mostly, coastline fronts are expressed by the short wave current interaction of cross-section background perturbations.*
2. *The image conditions cross link between the sea surface roughness pattern by SAR and surface temperature distribution imaged by AVHRR. The further more to suggested for monitoring of coastal ocean circulation and derived from current boundaries.*
3. *In SAR imagery data, the coastal monitoring regions were characterized by the natural occurrence of slicks. The upwelling of slicks observed data suggests the high biological activity. The nature of the slicks is still now required for in situ verification.*
4. *SAR data observation shows the potential studying and monitoring the onset and evolution of upwelling in coastal regions. In 1998, this verification experiment is carrying and also 100 SAR images collected from the RADARSAT satellite and from ERS-2 satellite.*
5. *In developing and implementing a SAR analysis and interpretation system for specific application to test the coastal regions.*
6. *The future SAR imagery systems have many more frequencies, polarizations and functional parameter modes (i.e., image, width and global monitoring) which are characterized by various spatial resolutions.*
7. *The local algorithms do not require prespecified parameters. These parameters interactively adjust the efficient computations.*
8. *In this the spatial domain and efficient computations are easily present for the use of radar image noisy. The radar system model can be presented to derive the feature extraction and classification analysis patterns of radar images.*
9. *The further improvement in accuracy for the purpose of geographic mapping would require the additional processing guided by the coastal detection of global information.*

Finally, we will visualize result of SAR image tools suggesting to the fundamental SAR geometric characteristics are archived and comparison of geometric is not detail discussed. Consider adding the region maps to design the different backscatter characteristics. In this the model is evaluate the quantitatively geometric quality of simulation.

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