PRESET STRUCTURE FOR OIL DRIBBLE DARK BLEMISH DETECTION

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Abstract - *Dark-spot detection is a critical step in oil-spill detection. In this paper, a novel approach for automated dark-spot detection using synthetic aperture radar imagery is presented. A new approach from the combination of Weibull multiplicative model (WMM) and Artificial neural network(ANN) techniques is proposed to differentiate between the dark spots and the background. First, the filter created based on WMM is applied to each sub image. Second, the sub image is segmented by PCNN techniques. As the last step, a very simple filtering process issued to eliminate the false targets. The proposed approach was tested on 60 Envisat and RADARSAT-1 images which contained dark spots. The same parameters were used in all tests. For the overall dataset, an average accuracy of 95% was obtained. The average computational time for dark-spot detection with a 512x512 image is about 5 s usingWindows Operating System XP(32-BIT System),MATLAB 2013,Xilinx which is the fastest one in this field at present. Our experimental results demonstrate that the proposed approach is very fast, robust, and effective. The proposed approach can be applied on any kind of synthetic aperture radar imagery.*

***Key Words*: WMM, ANN, PCNN, EnviSAT, RADARSAT-1**

1.INTRODUCTION

As a major aspect of marine pollution, oil release into the sea has become a common phenomenon, and it can have serious biological and economic impacts. Cargo ships and pipelines submerged in the marine environment carry huge amounts of petroleum across the open ocean and in coastal areas. Normally, small-scale release of oil into the sea is ascribed as “slicks,” while large-scale ones are called “spills” Accurate detection and forecast of oil spill in a timely manner would be beneficial to resource management for monitoring and conservation of the marine environment. It is one of the most important applications for operational oceanography. In recent years, remote sensing instruments have become one of the most effective methods in marine oil-spill detection. Moreover, it has been demonstrated to be a tool that offers .A non-destructive investigation method and has a significant added value to traditional methods. A number of remote sensing systems are available for detecting oil slicks, namely, passive (i.e., optical sensors, infrared/ultraviolet systems, and microwave radiometers) and active(i.e., laser fluorosensors and radar systems), . Among them, synthetic aperture radar (SAR) can provide valuable synoptic information about the position and size of the oil spill due to its wide area coverage and day/night and all-weather capabilities. Detection of oil spills from SAR imagery can be divided into three steps: 1) dark feature detection; 2) computation and extraction of physical and geometrical features characterizing the dark feature; and 3) accurate discrimination between oil spills and look-alikes such as ice, internal waves, kelp beds, natural organics, jellyfish, algae, threshold wind speed areas (wind speed <3 m/s), and rain cells. These procedures can be done manually or automatically. As a preliminary task, dark-spot detection is a critical step prior to feature information extraction and classification. Furthermore, the accuracies of feature extraction and classification greatly rely on the accuracy of dark-spot detection. In addition, dark-spot detection is traditionally the most time-consuming of the three steps. Thus, an efficient and effective dark-spot detection approach is essential for developing automated oil spill detection systems. In the literature, various types of models have been proposed for detecting dark spots, namely, manual selection by cropping a broader area containing the dark formation threshold algorithms (adapted or not) marked point and spatial density thresholding methods, wavelets fractal dimension estimation, support vector machines, and neural networks.

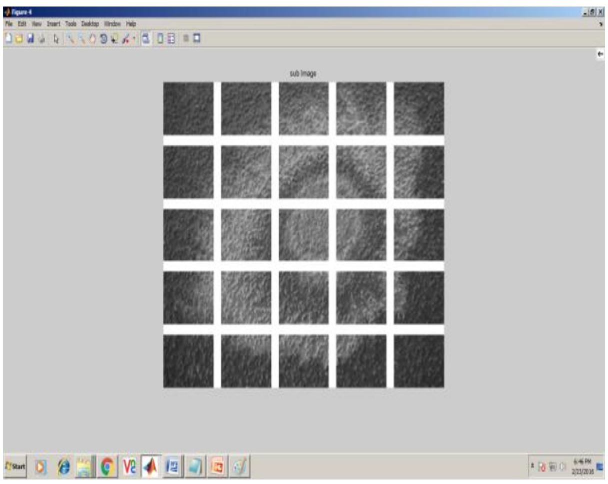
In the present paper, an attempt has been made to develop a fast, robust, and effective automated approach that is adequate for practical oil-spill monitoring. A new approach from the combination of Weibull multiplicative model (WMM) and artificial neural network (ANN) technique is proposed for achieving this goal. The popular model is the Weibull distribution which has shown a high degree of success in modelling urban scenes and sea clutter (most of the models were suggested based on empirical observations and were case specific). In this paper, we have used WMM (with the assumption that the amplitude or the intensity image has the Weibull distribution)in order to remove speckle and to enhance the contrast between the dark spot and the background. In SAR images, the texture is embedded in the speckle, which is originated by the coherent reflection of waves in a rough surface. WMM applies a nonlinear transformation to generate the texture image from the original speckled image. The extraction of the texture image from the Weibull-distributed SAR image employs the local estimation of the scale and form parameters of the Weibull distribution.

2. METHODS

Two main difficulties occur when using the automatic model for dark-spot detection: 1) the speckles in SAR imagery due to the constructive and destructive interferences of the reflections from surfaces of objects and 2) the contrast between the dark spots and the background can vary, depending on the type of dark spot, the local sea state, and the resolution and incidence angle of the SAR imagery. A new approach for dark-spot detection is proposed based on the principles described in the following discussion. In this approach, the combination of WMM, ANN techniques is proposed to differentiate between the dark spots and the background. First, the filter created based on WMM is applied to each sub image which contains dark spots. Second, the sub images are segmented by ANN techniques. As the last step, a very simple filtering process is used to eliminate the false targets.

2.1 WMM

The first step of dark feature detection is applying a filter. Filtering an original SAR image has two aims: first, to remove image speckles and, second, to smooth the image values .The first step toward removing speckle noise is to understand its statistical properties. Traditionally, invoking the central limit theorem, it has been assumed that the real and imaginary parts of the received wave follow Gaussian distribution, which, in turn, leads to the Rayleigh distribution. Another popular model is the Weibull distribution which has shown a high degree of success in modelling urban scenes and sea clutter (most of the models were suggested based on empirical observations and were case specific). In this paper, we have used WMM (with the assumption that the amplitude or the intensity image has the Weibull distribution) in order to remove speckle and to enhance the contrast between the dark spot and the background. In SAR images, the texture is



embedded in Speckle, which is originated by the coherent reflection of waves in a rough surface. WMM applies a nonlinear transformation to generate the texture image from the original speckled image. The extraction of the texture image from the Weibull-distributed SAR image employs the local estimation of the scale and form parameters of the Weibull distribution.

The code for WMM :

global Oil Img

Sub=sub image (Oil Img);

axes (handles.axes2)

Fig.1: WMM Output

2.2 ANN

Artificial Neural Network: Neural networks, can be used to extract patterns and detect trends that are too complex to be noticed by either humans or other computer techniques. The advantages of using neural Network are Adaptive learning, Self-Organization, Real Time Operation, Fault Tolerance via Redundant Information Coding.

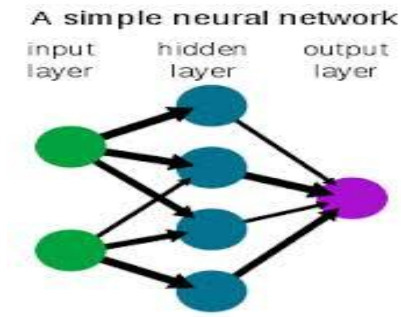


Fig.2: Simple Neural Network

3. EXPERIMENTAL RESULTS

The data set has been categorized into four groups (TABLE1) based on different types of dark spot and different sea status

Dark Spot Types	Description
Massive Well-Defined Dark Spot	A massive Dark Spot located within a homogeneous background where the boundary between the dark spot and the surrounding water is very clear
Linear Well-Defined Dark Spot	A Linear dark spot located within a homogeneous background where the boundary between the dark spot and the surrounding water is very clear(e.g. Oil sills discharged by ships)

Massive Not Well-Defined Dark Spot	A massive dark spot within a homogeneous background where the boundary between the dark features and the surrounding water is not well defined.
Linear Not Well-Defined Dark Spot	A Linear dark spot within a homogeneous background where the boundary between the dark feature and the surrounding water is not well defined

Table 1: Different types of Dark Spot

After the calibration process, sub images containing the SAR image is processed by the pre-processing unit.

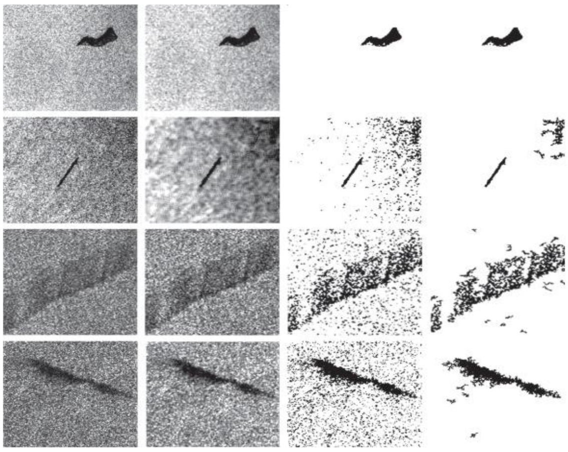


Fig 3: Results of the proposed approach on four typical examples. (First column) Original SAR images after pre-processing

As Conversion of RGB color image to grayscale image. Resize image to a standard format of 256 X 256. Increase the contrast using IMADJUST command which Adjust image intensity of the pixel values. It is similar to filter concept. The output of preprocessing is shown below:

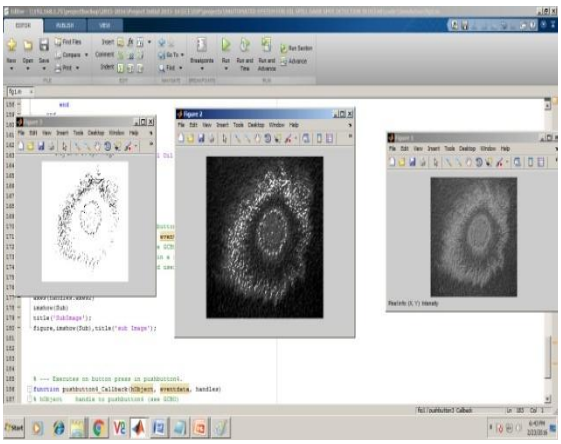


Fig 4: Preprocessing Output

4. CONCLUSION

In the present paper, an attempt has been made to demonstrate the power of using the combination of WMM and ANN as an automated method for dark-spot detection in SAR images. To test the capability of the proposed approach, we have applied it to a data set containing 60 Envisat and RADARSAT-1

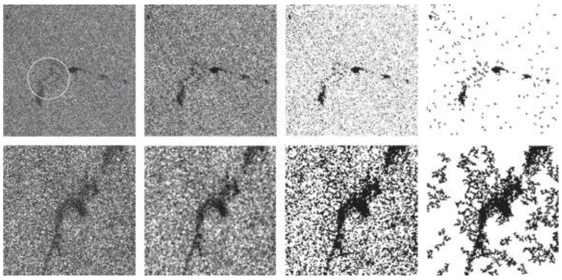


Fig 5: Results of the proposed approach.

1. The first row is an example where a very fresh oil spill is presented in a homogeneous background
2. The second row is an example where a not well-defined dark spot is located in a very heterogeneous background.

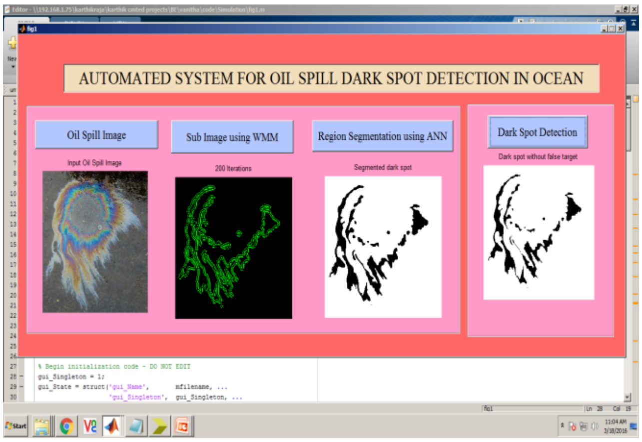


Fig 6: Dark Spot Detection Output.

The average accuracy for the overall data set was 93.66%, and the average computational time for a detection window was 5 s using Windows Operating System XP(32BIT,System),MATLAB2013,XILINX To study the detect ability of different types of dark spots, we have divided the test data set into four groups. Results showed that this approach works best when the dark spots are well-defined or are located within a homogeneous background. It is less effective when the dark spots are not well defined or are located within a heterogeneous background. Overall, the results demonstrate that the proposed approach for dark-spot detection is effective, fast, and robust. Further research is necessary to improve the accuracy of dark spot detection when the dark spots are not well defined. The proposed approach can be applied to the future space borne C-band

SAR which will replace Sentinel-1 mission, just with some parameter adjustments based on the type of data.

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