

OIL SPILL DETECTION USING ACTIVE CONTOUR TECHNIQUEMukta Jagdish¹, Dr. Jerritta.S², Badal Dev Roy³

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ABSTRACT - This research work determines oil spill detection using active contour technique. This work is carried out using ASAR RADARSAT-2 image, which is capture from Gulf of Mexico region. Active contour describe boundary and shape in Synthetic aperture radar images. It is also known as snakes. It solves problems based on boundary with its shape and also helps to monitor image noise with motion tracking. Active contour works on adaptive and autonomous search, Gaussian smoothing in images. Here active contour techniques can be used as a good tool for monitoring and identifying the occurrence of oil spill and Synthetic aperture radar image serves as a good sensor for surveying of oil spill. In conclusion, active contour serves as excellent method for detection of oil spill with low time complexity.

KEY WORDS: Oil spill, Active contour, pattern, tracking, RADARSAT-2.

1. INTRODUCTION

Extraction of oil from ocean is a fundamental work done for agencies to regular monitoring the sea. In this scenario satellite image play an important role for data acquisition. Oil spill is one of the most important problem occurs in the world which become one of the biggest issue in marine life. So regular monitoring is important, which helps to solve problems based on oil spill. In ever year oil spill accident take place in history it was on the Gulf of Mexico in Deepwater Horizon on April, 20, 2010, with explosion in July 15, 2010. It effected on wildlife habitats and maritime spices. To overcome this problem radar image was used for regular monitoring which improves over all oil spill problems by various approaches. To survey oil spill SAR image provide various advantage for detection and tracking of oil spills. Several satellite SAR sensors are involved in the oil spill detection and survey. These data are from ERS-1/2, (Brekke and Solberg 2005) ENVISAT (Marghany 2013), ALOS, (Zhang et al. 2011, 2012), RADARSAT-1/2, (Zhang et al. 2012) and Terra SAR-X (Velotto et al. 2011) which have been globally used to identify and monitor the oil-spill. Recently, the multi polarimetric SAR high-resolution data have become a vital research area for oil spill detection (Skrunes et al. 2012; Shirvany et al. 2012). Topouzelis et al. (2007, 2009) and Marghany, Hashim (2011) confirmed that neural network technique could give precise difference among look-alike and oil- spill in SAR data. Topouzelis et al. (2007) has used neural networks in finding both oil-spill and dark patches detection. Experimental results shows, 89 % accuracy and 94 % dark patches segmentation but certain disadvantages like they cannot efficiently detect small and fresh spills. Skrunes et al. (2012), reports that there are several disadvantages associated with SAR sensors based oil spill detection. So they suggested using multi-polarization acquisition data, such as Terra SAR-X satellites and RADARSAT-2. Oil spill detection and monitoring using SAR technology, data are scarce job, because of barely discrimination between oil spill and other features of look-alike ,shadows, wind speed that appear patches in SAR data as Dark patches (Topouzelis 2008). The problems faced in oil spill automatic using SAR data, is achievements in past decades. Simultaneously, Frate et al. (2000) proposed semi-automatic oil spill detection by using neural network, in which a vector defining features of an oil-spill is used.



2. DATA ACQUIRED

RADARSAT-2 SAR data acquired by RADARSAT-2 operating with Scan SAR Narrow single mode beam on 27th April, 2010; 1st May 2010; and 3rd May, 2010 are investigated for detection of oil spill in the Gulf of Mexico. The satellite armed with Synthetic Aperture Radar (SAR) with multiple modes of polarization, which includes fully polar metric mode of operation in which HH, VV and VH polarized data's were acquired (Maurizio et al. 2012). It has got highest resolution of 1 m in Spotlight beam mode (Ultra Fine mode of 3 m) with 100 m of positional accuracy. In the Scan SAR Wide Beam mode (WBM), the SAR has nominal width of 500 km and 100 m imaging resolution. The ground data obtained are based on study of Garcia-Pineda et al. (2013) where majority of oil types are emulsion and silver sheen.

Sl. No	Beam mode	Place	Date	Nominal pixel spacing(m)	Resolution (m)	Incident angle	Polarization
1.	ENVISAT ASAR	Gulf Of Mexico	27 April 2010	25 x 25	79.9-37.7 x 60	20-55	HH
2.	ENVISAT ASAR	Gulf Of Mexico	1 May 2010	25 x 25	79.9-37.7 x 60	20-46	HH
3.	ENVISAT ASAR	Gulf Of Mexico	3 May 2010	25 x 25	79.9-37.7 x 60	25-50	HH

Table1. ENVISAT ASAR IMAGE



Figure1. Input images

3. MATERIAL AND METHODOLOGY

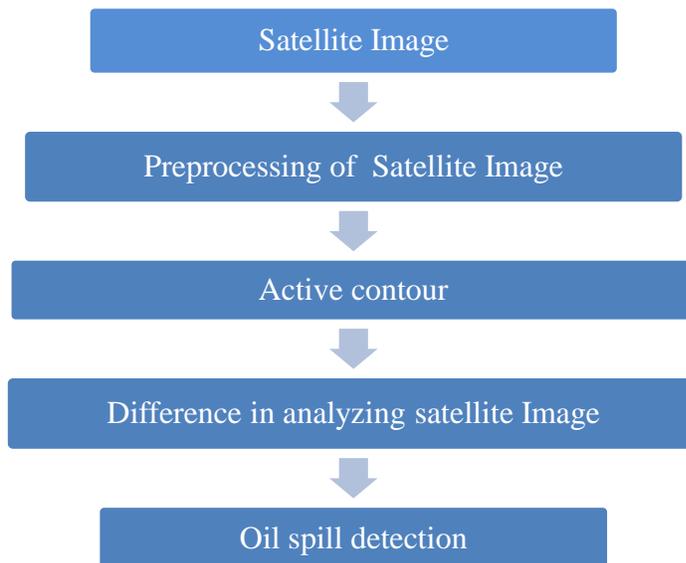


Figure2. Methodology

Active contour

Active contour describe boundary and shape in SAR images. it is also known as snakes. It solves problems based on boundary and its shape. It is deformable model, so active contour help to monitor image noise and motion tracking. It also helps to find Illusory contours in the data by information of missing boundary. Active contour works on adaptive and autonomous search, Gaussian smoothing in image, track object dynamically.

Let us consider point's m_i with set of s where $x = 0,1,2,\dots,n-1$, ' $B_{external}$ ' external energy edge based help to control fitting in image, external energy is a force combination to image itself and ' $B_{internal}$ ' internal energy based energy help to control deformation in image. The sum of external and internal energy sources form energy function in the input image.

$$A_{active\ contour} = \int_0^1 A_{contour}(v(s))ds = \int_0^1 (A_{inter}(v(s)) + A_{img}(V(s)) + E_{exter}(v(s)))ds$$

To find out boundary in image it work under intensity, $A_{Line} = I(p, q)$, line attracted towards in darker and lighter lines in the images. Image smoothing and noise deletion can be done using formula.

$$A_{Line} = filter(I(p, q)),$$

$$A_{internal} = A_{contour} + A_{curve}$$

$A_{contour}$, A_{curve} It defines corresponds continuity and curvature terms.

4. RESULTS AND DISCUSSION

In this approach, Active contour were used which helps to regular monitoring and detection of oil spills in the ocean. This research work is carried out using SAR RADARSAT-2 image. This technique examined SAR image to find structure of the oil spill with levels of gray corresponding to less damp / most damped area of sea surface roughness. Radar images confirmed grey level mask containing structure of the slick in Gulf of Mexico. Oil spill happened on 27 April 2010 where crude oil spread in 49,500 km² across 19,112 square miles in Gulf of Mexico. As we know oil spill is one of the biggest issue in marine environment. Here active contour algorithms are applied to find out pattern, dark patches and tracking of oil spill with low time complexity in the given ENVISAT ASAR images. In this research different days images has been taken for regular monitor and observe occurrence of oil spill in ocean. For detection of oil spill incidence angle with HH polarization is suitable for research. According to HH polarization and incidence angles it helps to reduce noise which is created during bad weather conditions. For detection of spill ASAR width increase to 300km- 350km. Advance synthetic aperture radar provide high level of sensor images. Figure-3 indicates spills with patterns, dark patches, oil spill tracking and surrounding area of the images. To determine positive and negative pattern it compared with neighborhood pixels. It define active contour techniques is more convenient and good for oil spill detection because in ASAR images it slowly varies gray level point based on image location and positions which help to monitor and detect oil spill region in fast way with low time complexity based on different weather condition.

Figure3. Oil spill Detection Results

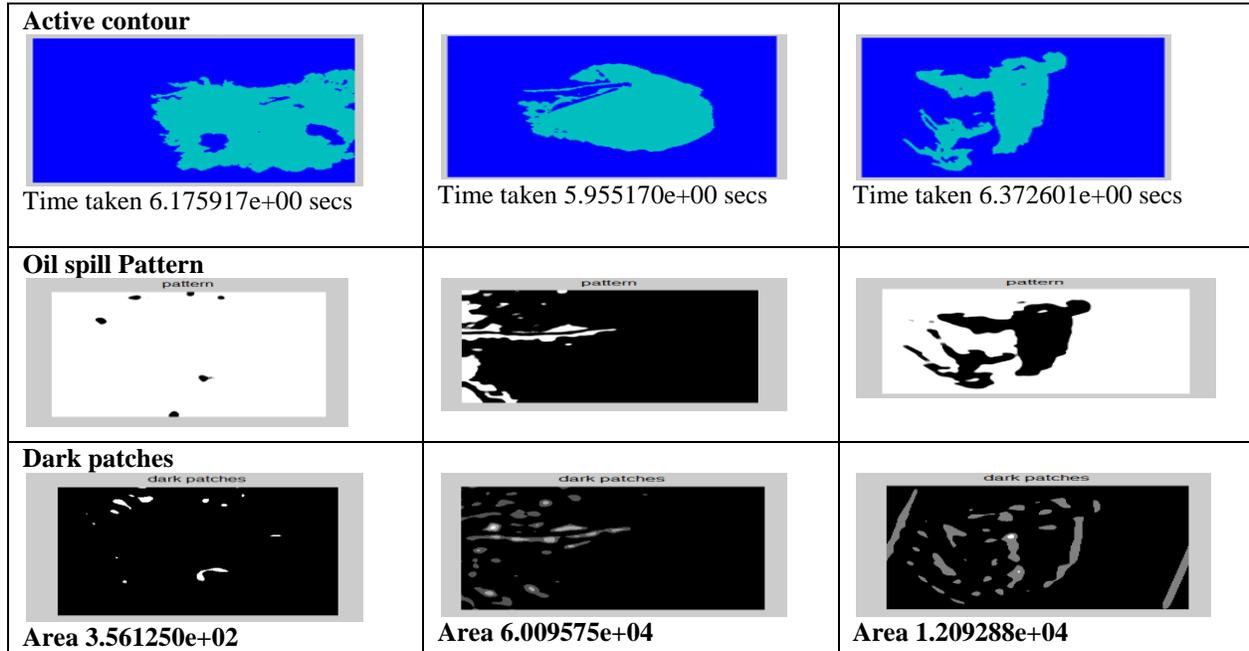


Table2. Experimental Results for oil spill Detection Time

Sl. No	Beam mode	Place	Date	Resolution (m)	Time Taken	Area Covered (m)	Polarization
1.	ENVISAT ASAR	Gulf Of Mexico	27 April 2010	79.9-37.7 x 60	6.175917e+00 secs	3.561250e+02	HH
2.	ENVISAT ASAR	Gulf Of Mexico	1 May 2010	79.9-37.7 x 60	5.955170e+00 secs	6.009575e+04	HH
3.	ENVISAT ASAR	Gulf Of Mexico	3 May 2010	79.9-37.7 x 60	6.372601e+00 secs	1.209288e+04	HH

CONCLUSION

This research work determines oil spill detection using active contour technique. This work is carried out using ASAR RADARSAT-2 image, which is capture from Gulf of Mexico region. Active contour describe boundary and shape in Synthetic aperture radar images. It is also known as snakes. It solves problems based on boundary with its shape and also helps to monitor image noise with motion tracking. Active contour works on adaptive and autonomous search, Gaussian smoothing in images. Here active contour techniques can be used as a good tool for monitoring and identifying the occurrence of oil spill and Synthetic aperture radar image serves as a good sensor for surveying of oil spill. In conclusion, active contour serves as excellent method for detection of oil spill with low time complexity.

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