Investigation on Oil Spills Detection Using Genetic Algorithm in Satellite Images: Advance Study

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Background: In this research work algorithm based genetic technique used to identify the arises of a oil spill in the marine world. Oil spills affect the lifecycle of marine animals which is considered a deadly environment for ecosystems as well as marine animals. Sources of oil spills divided into three categories sea-based, natural, and land-based sources.
Methods: For analysis, a genetic algorithm technique was used. In this research work, two stages have been investigated oil spill detection and tracking. In oil spills, detection with the Genetic Algorithm technique was used for SAR data. In the second stage oil spill tracking which helps to work on trajectory modal using SAR images, which was acquired over the same spilled area at different times, duration, and days.
Results: The study demonstrates that the genetic based algorithm can perform good and advance tool for oil spill detection using satellite images. As a result, it is clearly shown that the Genetic Algorithm can be used as a good tool for tracking spills using satellite images with the highest covering spilled area.

Keywords- Satellite Image, Oil Spills, Markov Random Fields, Tracking, Detection

1. INTRODUCTION

Oil Spill: A release of liquid petroleum hydrocarbon into the marine environment is known as oil spills, which occur due to human activity such as blowouts of well, breakage of pipeline, collisions of ship or grounding, transporting and waste management. According to the NRC report, the oil used

perspective with main four sources of categories such as oil spills discharge through natural seeps discharge, discharge based on the extraction of oil, oil transportation, and oil consumption which include land-based source and sea-based sources. Natural sources of oil spill marine pollution such as natural gas seeps and crude oil naturally fissure in ocean floors and eroding rock sedimentary. A genetic algorithm to extract features of an oil spills, roughness of sea surface and look-alike for the database RADARSAT-2 to monitor the accuracy of the spill, which works on current based structure with ROC curve representations which gives mapping structure of oil slick structure over a certain duration and observation, this method helps in discriminating features for oil spills disaster [1, 2, 3]. On working oil spills and look-alike features classification using genetic algorithm technique for SAR dataset aims to detect dark spot detection, this work illustrates oil spills detection part over the Mexico region, results represent dark spot and look-alike substance detection with a total accuracy [4,5,6]. In the past year segmentation technique used for oil spills detection using ENSAT1 which helps to classify oil spills, sea surface roughness, and look-alike features extraction, segmentation algorithm used with watershed transform method to achieve color difference and oil spills with classifications extraction using SAR data set [7,8]. Fuzzy logic for oil spills detection using dataset SAR to find oil spills and look-alike features and cluster-based observation, it works on clustering techniques with c mean methods where it finds the nearest neighbor classification over the spilled area, it categories the similar features together and perform classification [9,10]. A morphological operation using satellite image RADARSAT-2 for oil spills detection and sea surface roughness, methodology explains about oil spills erode and dilation process, it helps to detect the oil spills through the satellite image with other features corresponding to SAR data, this work defines the dark spot detection technique with regular monitoring [11,12]. In Entropy technique using RADARSAT-2 images for oil spills detection and monitoring, it also represents features related to oil spills and look-alike features detection, this work represents a darker area with dark spot detection using entropy algorithm using RADARSAR satellite image which defines a more clear vision of effected area [13,14]. The research was conducted on the thresholding technique using RADARSAT-2 images for oil spills detection, this research work on thresholding which works on a clear vision of oil spills and related features over the satellite image with a threshold value greater than 0.001 with a medium base capacity where help to discriminate feature among each sea surface and oil spills [15,16]. On multi Scale method using satellite image SAR for dark spot detection, this research helps to discriminate oil spills features such as dark spot detection and sea surface roughness, it main advantage of doing this work to establish a methodology with better detection of dark spot over the disaster area and location and faster cleanup methods to be established for better recovery modal establishment [17].

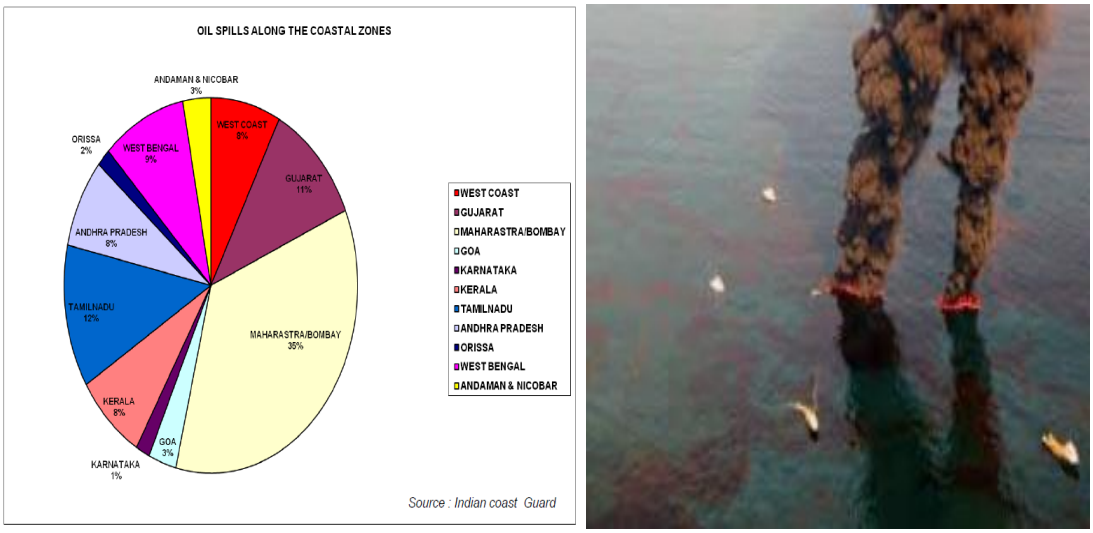

Figure 1- Oil spills along the coastal zones

Figure 2-Effects of oil spills

2. EXPERIMENTAL SETUP

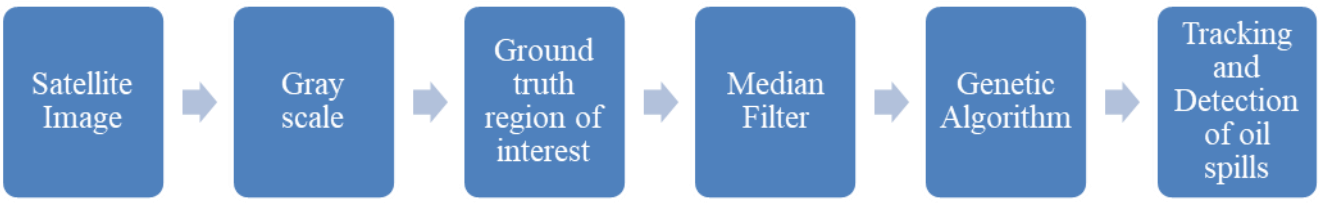

Fig. 3 Methodology

3. SATELLITE IMAGE

The satellite essentially represents the presence of eyes in the sky. The capture images represent the behavior of the overall atmosphere by depicting an exact, clear, and precise representation of all the events that are occurring by unfolding through captured images. There are different types of satellites used to capture images like SCATSAT-1, ENVISAT-ASAR, INSAT-3DR. The

image captured can be hourly, half-hourly, depend on changes occurring in the earth's atmosphere. The microwave and infrared images are captured from the satellite. The figure depicts the captured image of INSAT 3D taken on the half-hourly basis of Delhi City, India. The default timing between two successive images can be kept as per the requirement of data. The infrared images are mostly not used by researchers and meteorologists due to the disadvantages of not capturing a hidden or embedded image, which is overcome by using microwave images. In microwave images, the hidden artifacts and embedded objects can be easily detected or located using EM waves in the range of ~300MHz to 300 GHz.

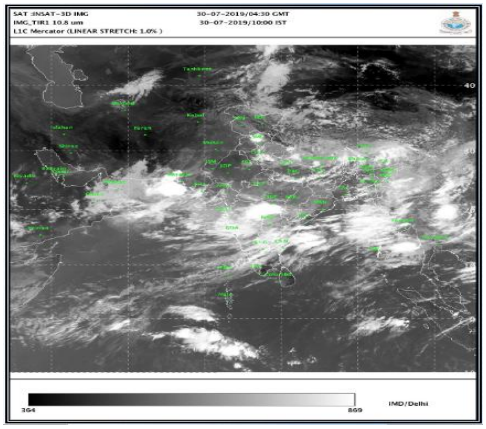

Figure: 4- Satellite image of INSAT -3D

3.1 GRAYSCALE

In grayscale the value of each pixel represents a single sample, it carries intensity information, it is in the form of gray or black and white. The intensity of black at the weakest range and white at the strongest range. It works on measuring the intensity of light at each pixel level. It resizes the image values and changes the color image into a grayscale image.

3.2 GROUND TRUTH IMAGE

Ground truth image helps to gather a region of interest for observation which has to be examined based on overall input images. Ground truth image it allows input data interrelated to features which are real. It also enables calibration of satellite data and provides interpretation and observation of what it senses to monitor for detection oil spills affected area over the time of practical observation. Ground truth image helps in finding the region of interest which is to be examined and extracted over the located portion of the satellite image for testing. The resulted figures represent data accusations, sizing, median filter for noise removal, and ground truth image for a region of the interest portion of the given satellite data sets.

3.3 MEDIAN FILTER

It is statistical non-linear filters that help to smooth the image which is utilized by a median of pixel neighborhoods. It performs two following tasks all pixels are arranged in ascending and descending order of representation and sorted value is computed as median and chosen as processed resulted image. It is a part of preprocessing which work on the cleaning process and removing noise over the input image. For detecting the dark spot of highly accumulated oil over the ocean, the oil spills detection technique is used. Initially take input image then apply preprocessed method which helps to remove noise and converted into grayscale 512*512 sizing, it uses high pass filtering which reduces amplifies noise so it often improves image sharpening details, next steps obtaining ground truth image which helps to gather region of interest for observation which has to be examined based on overall input images. Ground truth image it allows input data interrelated to features which are real. It also enables calibration of satellite data, and provide interpretation and observation of what it senses to monitor for detection oil spills affected area over the time of practical observation. Ground truth image helps in finding the region of interest which is to be examined and extracted over the located portion of the satellite image for testing. The resulted figures represent data accusations, sizing, median filter for noise removal, and ground truth image for the region of the interest portion of the given satellite data sets.

4. GENETIC ALGORITHM

It is an adaptive heuristic searching algorithm according to evolutionary ideas of genetics and natural selection. The genetic algorithm is intelligent exploitation of a random search which helps to find out solutions for optimization problems. In a genetic algorithm, it performs through the initial population which allocated through randomly selected backscatter pixel or surrounding pixel values, then obtain selection steps by using fitness individuals from the overall population. During the selection process value of threshold is calculated by using population max fitness value. The fitness individuals present as dark patches in SAR images, the values greater than thresholding. Then computer the number of individuals, it is done through a total number of population individuals and fitness determination to calculate the similarity between oil spills and dark patches using satellite images. After computing member of individuals then create paring and crossover operation, in crossover operation genes are manipulate and interchange among the chromosomes and replace genes with the parent, then apply mutation process, in mutation the probability of given chromosome is flipped within such as ‘1 become 0 & 0 become 1’. Every time the chromosome selected over the larger population, the algorithm initially check the chromosome where to apply then iterates the length down of each chromosome by applicable bit mutation. In this algorithm the crossover ‘1’ and mutation ‘0’ are set for each, these values helps in covers to an appropriate solutions for global representation.

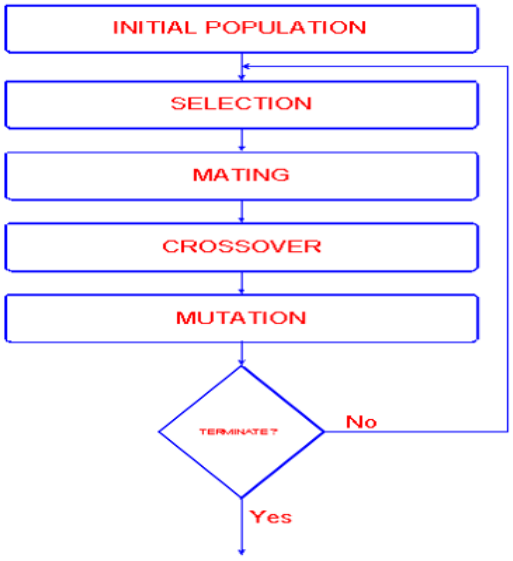

Figure 5- Genetic Algorithm

Population initialization

The genetic algorithm starts with the initial population. This initial population is randomly generated. The chromosomes help to represent populations. The chromosomes represented as strings character to encoded solutions to a problem.

Fitness Assignment

This section helps to evaluate the population in each chromosome. The results satisfied the criteria of fitness during evaluation and those criteria who do not match or satisfied will be discarded.

Selection process

In the genetic algorithm first step is the selection where the selection of the chromosome will satisfy the fitness function is done and this selection chromosome is utilized for the meeting after the genetic operation like mutation or crossover is utilized for a selected parent for new offspring generation. After the selection crossover and mutation are applied.

Crossover

In the crossover, the process involved two chromosomes, and the swapping of the data of the two chromosomes during the crossover process new offspring generation exchange copy of the parents. The solution that is a chromosome that is more fit is selected and replaces the next fit solutions. This way the new generation of the population is created.

Mutation

It is used to find out the diversity among the population. It reduces slight changes among the population and representative of the evaluation approach. The process repeats until conditions satisfied. The new offspring are placed in the new population and the new optimal solution is obtained on the bases of pre-specified criteria. Then it will terminate and written the best solution.

5. EXPERIMENTAL RESULT

The genetic algorithm performs through the initial population which allocates through randomly selected backscatter or surrounding pixel values, in this work the maximum possible fitness values are equal to 100. During the selection process threshold value is set to greater than threshold 0.5. In crossover, the probability ‘1’and mutation ‘0’ are set for each. The below results shows the output results of oil spills detection.

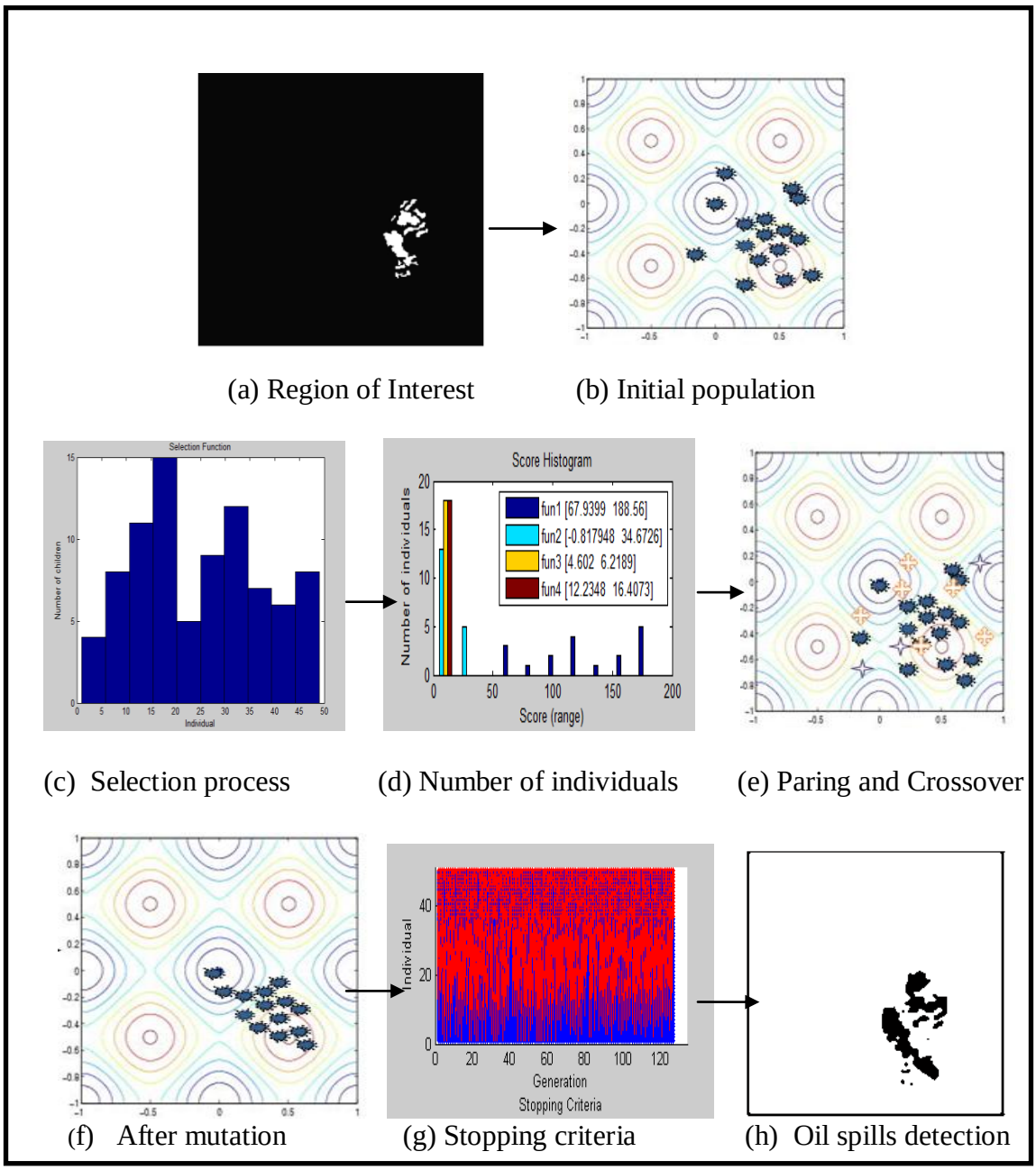

Figure 6: Results for Genetic Algorithm

Results display spills detection using a genetic algorithm. The population was selected based on random selection for dark patches and surrounding pixels with N population size. In the pairing and crossover process, the pixels indicate oil spills to genes interchange between chromosomes.

The results help to work on the trajectory model of the SAR image obtained using the Genetic algorithm.

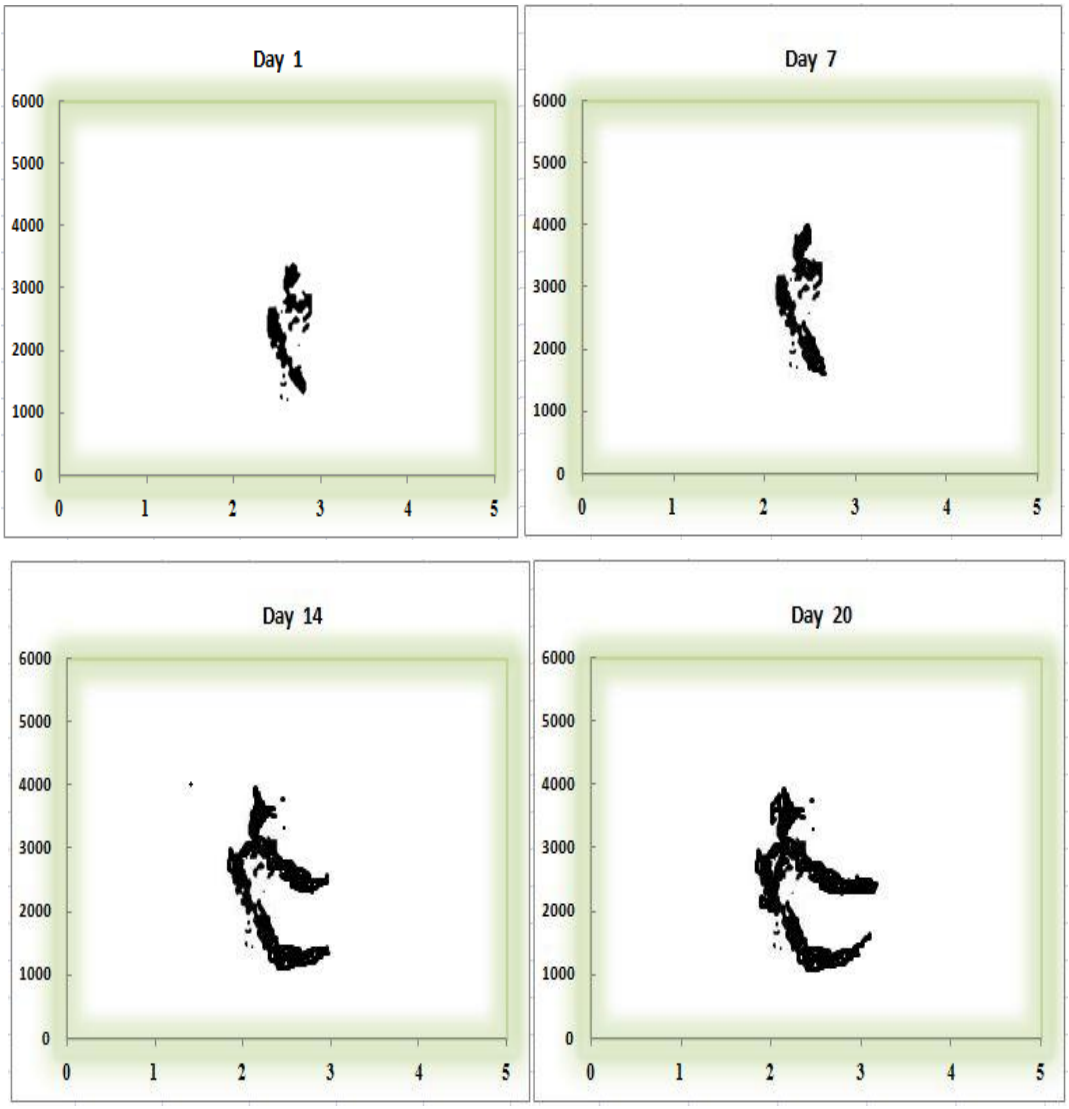

Figure 7: Oil spills tracking for SAR-1 Days 1,7,14,20 using a Genetic Algorithm

The figure represents an oil spills tracking model with different days 1, 7, 14, and 20 using a genetic algorithm. Day 1 image denotes present oil spills resulted in an image with an area of 431.2 km^2, Day 7 denotes resulted oil spills area with 533.23km^2, day 14 denotes with an area of 615.79 $km^2$and days 20 represents 876.44km^2oil spills with a movement direction of North-East.

CONCLUSION

The researcher investigated and monitors the occurrence of the oil spills in the ocean using image data obtained from the different satellites. In the oil spills detection Genetic Algorithm technique was used. The study demonstrates that the Genetic Algorithm technique can be used as a good tool for oil spills detection using satellite images. The researcher also investigates on tracking the spread of oil spills in the ocean using the satellite data of oil spills acquired on successive days or weeks. In the second stage oil spills tracking which helps to work on trajectory modal using SAR images, which was acquired over the same spilled area at different times, duration and days. In oil spills, the tracking technique used is a Genetic Algorithm technique. In which result illustrate that Genetic Algorithm technique can be used as a good tool for tracking and detection of oil spills using satellite image.

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