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Structural Boundaries Detection of Ice Floe of Sea Ice using T-Snake GVF

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Abstract: Image processing is one of the upgrading research areas to find out the relevant pattern. It can be applied in many fields of medical, satellite records, analyzing data. Satellite records of image plays an important role in image processing. Satellite view of Sea ice image has been taken to detect the boundaries of the ice floe. Sea ice is a formation of sea water freezing. When the sea ice is broken ice floes were formed from them and ice floe is large pack of floating ice. Detecting the ice floes many Image Processing techniques has proposed. But they prove some of the drawbacks like missing data, inaccurate structural analysis because of difficulties in ice floe identification, separation of boundaries connected ice floes, it is an important issue for the climate and wave and structural ice analysis. To solve these problems here proposed a T-Snake algorithm on GVF, which provide an accurate identification of related pattern and structural boundaries for ice floe.

Keywords: Image processing, Ice floe, Weak boundary solving and T-Snake on GVF.

I. INTRODUCTION

Image processing is any form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it. Image processing usually refers to digital image processing, but optical and analog image processing also are possible. This article is about general techniques that apply to all of them. The acquisition of images (producing the input image in the first place) is referred to as imaging [1]. In every research area they analyze the problem, mostly image analysis involves manipulating the image data to determine exactly the information necessary to help to solve a computer imaging problem. This analysis is typically part of a larger process which involves preprocessing, feature extraction, segmentation, remove noise data, etc. Image processing is done with the help of the digital image, which is captured from the digital format or satellite view, capturing the image are used to identify the problem in any fields. Capturing and analyzing image in image processing is the most important research area. Updating fields of the sea water research is an ongoing process of every research area through image processing sector.

Sea ice is formed with the result of seawater freezing based on the seasonal ice zone. In the seasonal ice zones, there are various types of sea ice floes of which the sizes range from about one meter to a few kilometers. The size distribution of ice floes plays an important role in the dynamical and thermo dynamical process of sea ice area as well as ice concentration and ice thickness [2]. Ice thickness is transferred from atmosphere to ice varies depending on the ice floe size and the melting rate of ice floes depends on the ice floe size because the lateral melting becomes more significant for smaller ice floes. Therefore, it can be said that the ice floe distribution is a key parameter in the seasonal ice zones. The floe size distribution is a basic parameter of sea ice that affects the behavior of sea-ice extent, both dynamically and thermodynamically. Particularly for relatively small ice floes, it is critical to the estimation of melting rate. Hence, estimating floe size distributions contributes to the understanding of the behavior of the sea-ice extent on a global scale. In addition to this, the floe size distribution is also important min ice management for Arctic offshore operations. In addition, the size distribution and shape of ice floes possibly provide a clue to the understanding of ice floe formation processes [3]. It is generally noticed that the distribution of ice floe sizes does not have a characteristic size scale. The magnified figure of the partial ice area coincides almost with its original figure; that is, it has a self-similar feature. If this characteristic is confirmed in the ice area, it may give a suggestion on the ice formation process [4]. To separate connected sea-ice floes into individual floes, the watershed transform have to use. Manually removed these over-segmented lines, while those in automatically removed the over segmented lines whose endpoints were both convex. However, over- and under segmentation still affected the ice floe detection results. This method is operated on the binary images and focused on the morphological characteristics of ice floes rather than on the real boundaries [5]. To solve this problem, Topology adaptive snake algorithm was proposed on GVF to avoid manual interaction and reduce

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the time required to run the algorithm and managed ice resulting from offshore operations in sea ice using K-Means clustering algorithm. Once individual ice floes have been identified, the floe boundaries are obtained, and the floe size distribution can be calculated from the resulting data.

II. LITERATURE REVIEW

T. Toyota and H. Enomoto [6] Using ADEOS/AVNIR images in the 1997 winter, the size distribution of sea ice floes in the southern Sea of Okhotsk is analyzed. These images have the high horizontal resolution of 16 m and enable us to recognize ice floes of the diameter from tens of meters to several kilometers. The area and perimeter of each floe are measured by means of image processing, and their statistical features are examined for four ice areas, including the interior ice pack regions, the marginal ice region, and the coastal region. As a result, it is shown that the floe size distribution has self-similarity characteristics within the range of 100 m to 1 km in individual areas and the fractal dimension is estimated to be 2.1 to 2.5, and that the perimeter is highly correlated with the diameter. These results may suggest the ice floe formation process in this size range.

Devyani Patil et al [7], An unmanned aerial vehicle was used as a mobile sensor platform to collect sea-ice features and several image processing algorithms have been applied to samples of Sea-Ice images to extract useful information about sea-ice. The sea-ice statistics given by the floe size distribution, being an important parameter for climate and wave and structure ice-analysis, is challenging to calculate due to difficulties in ice floe detection, particularly the separation of seemingly connected ice floes. Gray scale and OTSU algorithm will be applied to solve this problem. To evolve the Gray Scale and OTSU algorithm automatically, an initialization based on the distance transform is proposed to detect individual ice floes, and the morphological cleaning is afterward applied to smoothen the shape of each identified ice floe. Based on the identification result, the image is separated into four different layers: ice floes, brash pieces, slush, and water. This makes it further possible to present a color map of the ice floes and brash pieces based on sizes, and the corresponding ice floe size distribution histogram.

Vaibhav A. Desale [8] study the ice which was situated on the sea on the poles or at low temperature places an unmanned aerial vehicle was used for capturing images. The vehicle was able to capture the images of sea ice floes and by using the such images and by applying several image processing algorithm important information was collected. The information extracted is very useful statics for the climate and wave. But difficult problems are challenge of the identification of ice floe, mainly the separation of the ice floes. For this paper GVF algorithm is used mainly to solve the above difficulties. Given GVF algorithm is based on the distance transform propose for detecting the separate and individual ice-floe on the sea and after that morphological cleaning is applied to that detected individual ice-floe along with the GVF also OTSU algorithm is used for calculating results and canny edge detection for detecting boundaries. This result was being helpful for classifying the image into the four classifications like ice floes, brash pieces, slush and water. By using this algorithm it was made possible to make the color maps for the given ice floe, brash pieces. Study made acceptable information and results and also the effectiveness.

G.Ram Kumar and T.Sheik Yousuf [9] The sea ice, which is defined as any form of ice that forms as result of seawater freezing when broken into small pieces called as ice floes. Ice floes are the large pack of floating ice. Many Image Processing techniques have applied on the sea-ice to extract the useful information. Here there is a challenge that to calculate the structural analysis, due to the difficulties in ice floe identification , such as separation of seemingly connected ice floes, this sea statistics is given by the floe size distribution, is an important parameter for the climate and wave and structural ice analysis. To solve these problems, propose a gradient vector flow (GVF) snake algorithm which evolves automatically by using initialization based on the distance transform which detects individual ice floes and applying morphological cleaning for the smoothen the shape of every identified ice floes. Based on these results, the image is separated into four layers such as Ice floes, brash, pieces, slush, and water. This method yields an acceptable identification result, and its effectiveness is demonstrated.

T.Ravichandra Babu and Eman Bhattacharjee [10], An unmanned aerial vehicle was used as a mobile sensor platform to collect sea-ice features at NyÅlesund in early May 2011, and several image processing algorithms have been applied to samples of sea-ice images to extract useful information about sea ice. The sea-ice statistics given by the floe size distribution, being an important parameter for climate and wave- and structure-ice analysis, is challenging to calculate due to difficulties in ice floe identification, particularly the separation of seemingly connected ice floes. In this paper, the gradient vector flow (GVF) snake algorithm is applied to solve this problem. To evolve the GVF snake algorithm automatically, an initialization based on the distance transform is proposed to detect individual ice floes, and the morphological cleaning is afterward applied to smoothen the shape of each identified ice floe. The proposed algorithm yields an acceptable identification result, and its effectiveness is demonstrated in a case study.

III. PROBLEM DEFINITION

Automatic identification of individual floe edges is a key tool for extracting information of floe size distribution from satellite images. In an actual ice covered environment, ice floes typically touch each other, and the junctions may be difficult to identify in satellite images. This issue challenges the boundary detection of individual

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ice floes and significantly affects ice floe size analysis. Several researchers have tried to mitigate this issue like separated closely distributed ice floes by setting a threshold higher than the ice-water segmentation threshold and separated the connected ice floes manually when the threshold did not work well. When compared derivative and morphology boundary detection algorithms in both model ice and sea-ice images will not work in proper manner. The boundaries are too weak to be detected directly, which significantly affects the ice floe statistical result [11]. However, non-closed boundaries are often produced by traditional derivative boundary detection, while some boundary information is often lost by morphology boundary detection.

IV. PROPOSED WORK TO SOLVE WEAK BOUNDARY ON ICE FLOE

A. Ice Pixel Detection

Pixel detection is one of the important factors for sea ice image. With the capture of object from the satellite detection of pixel is an essential factor. Here ice and water have same molecules as ice is formed from the water itself. But in fact Ice is much whiter than the water. So it clearly shows the pixel difference between them pixels of ice have higher intensity. Intensity for an ice can be calculated from the given threshold method. Now we can also compare among the various pixels between different ices [12]. From the observations only light ice have the large intensity than threshold. Dark ice is having the double threshold between ice and water. Here K-means algorithm is used, which is a statistical data analysis technique that minimizes the within-cluster sum of distance to partition a set of data into groups and image is converted into three or more clusters. The cluster with the lowest average intensity value is considered to be water, while the other clusters are considered ice. So the classification is done and pixels are detected.

B. Ice Edge Detection:

Detection of the edge is very important and most difficult issue in the study. It might happen that some of ice floes have very less distance between them means they are very close from each other which means separating distance between them is close at that time edge detection becomes more difficult. It is most challenging task. So here in the edge detection we use the sequential analysis algorithm [13]. sequential analysis operates on the grayscale image in which real boundary information, particularly "weak" boundaries. The snake algorithm is based on the external and internal forces influence. Algorithm comes to conclusion when the both external and internal forces become in equilibrium. External forces define the boundary. This can be used in the case of the weak boundary condition. Sequential analysis is faster and less restricted by the initial contour.

This algorithm is able to detect the weak connections between floes and ensures that detected boundary area is

Sequential analysis (node n = (s1, ..., sk), Sn , In)
Begin
(1) Stemp = φ.
(2) Itemp = φ.
(3) For each (i Sn)
(4) if ((s1, ..., sk , {i}) is frequent)
(5) Stemp = Stemp {i}
(6) For each (i Stemp)
(7) DFS-Pruning((s1,…………..,sk,{i}),Stemp,
all elements in Stemp greater than i)
(8) For each (i In)
(9) if ((s1, ... , sk » {i}) is frequent)
(10) Itemp = Itemp {i}
(11) For each (i Itemp)
(12) DFS-Pruning ((s1, ..., sk {i}), Stemp,
all elements in Itemp greater than i)
End

Algorithm 1: Sequential Analysis

closed to the initial contour does not need to be as close to the true boundary as for in the traditional snake algorithm. The distance transform of a binary image is the minimum distance from every pixel in an object to the background.

C. Ice Type Classification and Floe Size Distribution

To distinguish brash ice from ice floes in our algorithm, we define a brash-ice threshold parameter (pixel number or are) that can be tuned for each application. The ice pieces with size larger than the threshold are considered to be ice floes, while smaller pieces are considered to be brash ice. The remaining ice pixels were labeled as slush. The result is four layers of a sea-ice image: ice floe, brash ice, slush, and water .The ice floe (brash) size can be determined by the number of pixels in the identified floe (brash) [14]. If the focal length f and camera height are available, the actual size in SI unit of the ice floes and floe size distribution can be also calculated by converting the image pixel size to its SI unit size. The ice floe size (calculated by counting the pixel number of the floe) distribution. The residue ice, which is the detected boundary pixels between the connected floes, was previously considered as slush. However, the residue ice, as shown in can be also handled specifically according to the applied subsequent processing by the user.

D. Identifying Individual Ice Floes

To identify individual ice floes in the sea-ice image, in particular separating the floes that are very close or connected to each other. The boundaries between apparently connected floes have a similar brightness to the floes themselves. The boundaries are too weak to be detected directly, which significantly affects the ice floe statistical result. Therefore, the T-Snake on GVF snake algorithm is proposed to solve this problem. T-snakes model as a closed 2D contour consisting of a set of nodes connected in series. A T-snake is a discrete approximation to a conventional parametric snake's model and retains

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many of its properties [15]. The internal forces act as a smoothness constraint on sea ice and users can interact with the model using spring forces and other Ice floes. An 'inflation' force is used to push the model towards image edges until it is opposed by external image forces. The deformation of the model is governed by K-Means cluster and groups the object and finds the individual ice floe. It also keep track of the interior region of the model by 'turning on' any grid vertices passed over by the T-snake during its motion. By re- parameterzing the model at user-specified iterations of the evolutionary process, we create a simple, elegant and

For each deformation step (*M* time steps):

1. For *M* time steps: (a) compute the external and internal forces acting on T-snake nodes and elements; and (b) update the node positions using (8).
2. Perform reparameterization phase I.
3. Perform reparameterization phase II.
4. For all current T-snake elements, determine if the T-snake element is still valid. A T-snake element is valid if its corresponding grid cell is still a boundary cell. Discard invalid T-snake elements and unused nodes.
5. Use the grid vertices turned on in phase II above (if any) to determine new boundary cells and hence new T-snake nodes and elements.

Algorithm 2: T-Snake

The T-snake is considered to have reached its equilibrium state when all of its elements have been inactive for a user-specified number of deformation steps. T-snake element activity or movement is measured via the grid, again using a flame propagation analogy. A weak connection will also be detected if the initial contour is located on it. However, when the initial contour is located near the floe boundary inside the floe, the snake may only find a part of the floe boundary near the initial contour. It should be noted that the curve is always closed, regardless of how it deforms. Which appear to be non closed curves.

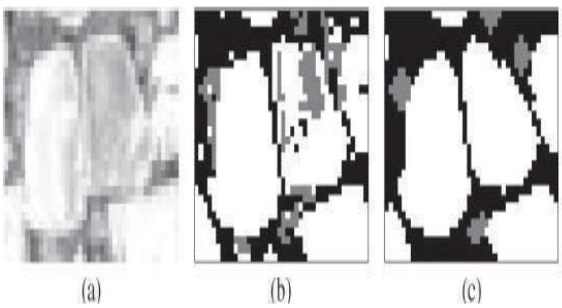

Fig: (a) Ice floe image (b) Segmentation (c) Identifying individual ice floe

This behavior occurs because the area bounded by the closed curve tends toward zero. This fact is beneficial for connected floe segmentation and the initial contours should be located inside the floes and centered as close to the ice floe center as possible.

V. EXPERIMENTAL RESULTS

In the experimental analysis is used to analyze the sequential pattern extraction in the sea ice image. The proposed method where implemented in the field of image processing to analyze the weak boundaries detection. Our proposed system is very helpful to find out the individual identification of ice floe and result shows the better one when compared to existing work in the case of accuracy, edge detection and boundaries.

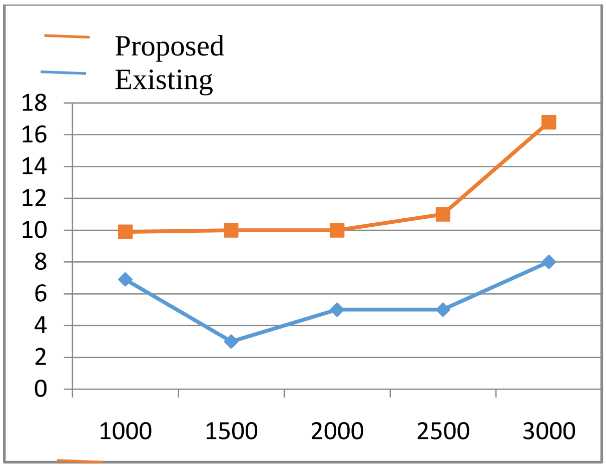

Chart 1: Accuracy Improvement

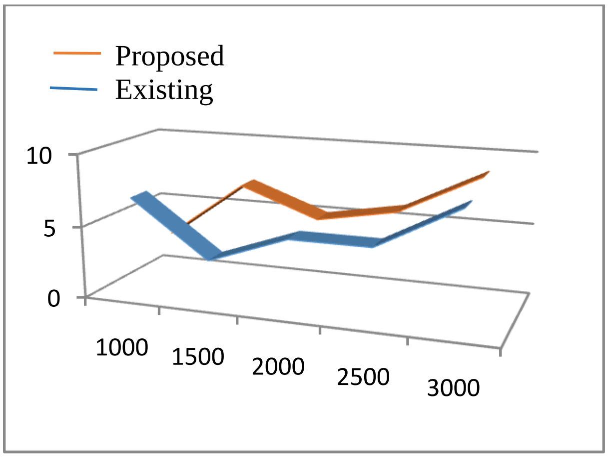

Chart 2: Edge Detection

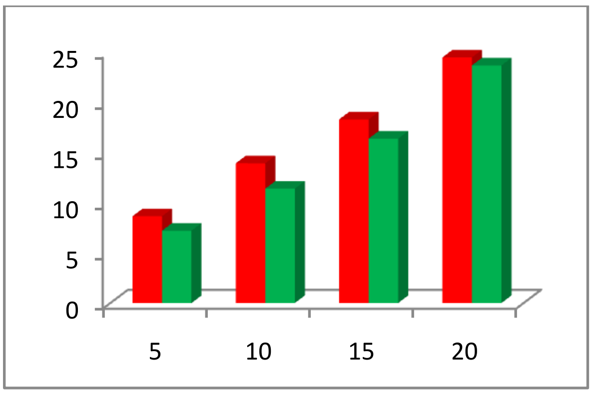

Chart 3: Boundary Detection

Our proposed methodology improved the accuracy, edge detection, boundaries, etc and is used to create the experimental setup.

The performance of the proposed method is evaluated in terms of,

- Accuracy
- Edge detection and
- Boundaries

VI. CONCLUSION

The most challenging task is to identify individual ice floes in the sea-ice image, in particular separating the floes that are very close or connected to each other. The boundaries between apparently connected to ice floes. The boundaries are too weak to be detected directly, which significantly affects the ice floe statistical result. Therefore, with the help of the MATLAB we propose a T-Snake algorithm to solve the problem based on the GVF algorithm. Hence our result shows a better way to find the boundaries of the ice floe and provide an accurate identification of related pattern and structural boundaries for ice floe.

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BIOGRAPHY

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