A Novel Approach for Identification and Size Detection of Sea-Ice Floes

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Abstract— Earth is our home planet and 70% of its surface mass is covered with sea water. The sea and its attributes widely affect our planets characteristics, such as environment global temperature, biodiversity i.e. almost every aspect of human life is affected by sea in some form or other. Thus it is crucial for making to understand sea dynamics for better in sight about planetary and biological studies, trans-oceanic travel systems, weather forecasting systems etc. As a considerable part of earth's oceans fall in low temperature zone, gets frozen to ice. Thus the study of dynamics of sea ice is also crucial to better understanding of sea dynamics. The proposed work cost to the some need by doing sea ice floe identification and analysis automatically using image processing techniques. Already significant progress has been made in this area, but our proposed work provides for improved accuracy by employing adoptive while channel based ice estimation technology which can effectively segregate Ice areas from background image, thus improving overall accuracy of the algorithm.

Keywords- *Sea Ice Floe, Adaptive White Channel, Floe Edge Detection, Aerial Photography*

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I. INTRODUCTION

SEA ICE, defined as any form of ice Result of seawater freezing [1], covers about 7% the total area of the oceans [2]. It is turbulent because of wind, waves and temperature. Various types of Sea ice can be found in regions covered in ice. Ice floe, that is flat pieces of sea ice can vary from meters to miles The size The size distribution is a fundamental parameter of the sea Ice, which influences the behavior of sea ice extent, both dynamically and thermodynamic Especially for relatively small ice It is crucial for the estimation of the fusion rate [3]. That's why estimate size distributions of icebergs for understanding the behavior of the expansion of sea ice on a global scale. In addition, the size distribution of the loose layer in ice management is so important for operations at sea in the Arctic [4], [5],

Example:

• Quantifying the efficiency of ice management in the Arctic Offshore operations and automatically detect dangerous Conditions, for example the identification of large icebergs, Escape from the icebreaker of a protected farm Structure Size and shape of managed icebergs can identified by the image processing system compared to Value limit and processed by risk management system

• Estimate the ice loads in stationary structures in the sea in the Arctic through empirical formulas [6], [7].

• Initialize numerical models with high fidelity [8] - [13] and validate these at different times by adjusting the Icefield simulates with current.

• early warning of an ice compacting event This can be dangerous if the ice structure interacts The mode changes from a kind of "mortar flow" to a "pressure" Ice "type [7], [14].

Despite its importance, however, useful information has been restored Observation records are still limited due to Difficulty in the analysis and lack of efficient finishing tools for such records. Therefore, the evolution of time and spatially continuous field observations of sea ice conditions and determine the right distributions of the size of the ice cake needed One of the best ways to observe the conditions of ice in the oceans is through the use of aerial photography and the application of digital image processing Techniques for observations This method can reduce the number of Eliminate ambiguities, integrity deficiencies, uncertainties and mistakes in terms of an object and its environment, to be more specific and reliable information [15]. Cameras are usually called Sensors on mobile sensor platforms in ice-covered regions characterize ice conditions [16], [17]. Cameras can record exactly spatially continuous measurements, in particular suitable for detailed localized information on sea ice.

An important requirement, however, is a clear sky and visibility during the missions. A remote sensing mission to determine the conditions of the ice was carried out by the Northern Research Institute (NORUT) in 78◦55N 11◦56E, Hamnerabben, Ny-Ålesund, from 6 May to 8, 2011. An unmanned aerial vehicle (UAV) was considered mobile sensor platform due to its flexibility in the cover and in spatial and temporal resolution, the three are important Attributes of the sensor platform The use of cameras as sensors in one UAV was researched to measure ice statistics and characteristics. The goal of the mission was to collect information about ice Conditions in the Arctic. The other goal was the development of tools based on the processed ice data that can be used for the decision Assistance with Arctic operations on the high seas.

A CryoWing UAV [18], as shown in Fig. 1, is used to Mission This UAV was designed for cryospheric measurements and environmental monitoring and their technical specification found in Table I. The basic instrumentation of CrioWing is an on-board computer that controls the various payloads Instruments stores data on a solid state disk and transfers data to Earth The onboard payload system has a GPS receiver and a three-axis orientation sensor independent of the Avionics

system. The sensor device used in this analysis is a digital visual camera with the specifications given in Table II.
The UAV flew in the inner part of Kongsfjorden High resolution pictures of sea ice. Various image processing Algorithms were applied to these images to extract Useful information about sea ice, such as ice concentration, ice Limits of icebergs and ice types [17].

The automatic identification of the individual edges of the fleet is a key Tool for extracting information from the size distribution of the loose layer Aerial Pictures In a real ice-covered environment, ice floes typically touch each other, and the joints can be difficult too Identify in digital images. This problem challenges the limit Detection of individual ice floes and affects the ice considerably Plaice Size Analysis Several researchers have tried to mitigate this Question. In [19] and [20] the authors separated the distributed distance Ice floes set a higher threshold than ice-water segmentation Threshold and separated the ice floes manually connected if the threshold did not work well In [17] and [21],the authors used derivatives and morphology and compared Boundary detection algorithms in ice and sea ice models Images. However, closed borders are often through traditional detection of derived limits, while some limits the information is often lost through the detection of morphological boundaries. In order to separate the sea ice floes connected in individual icebergs, Basin transformation (widely used in the segmentation of connected objects) this was adopted in [22] and [23]. Due to an inevitable Problem of over-segmentation of the basin-based method the authors in [22] manually deleted these sorted lines, whereas those in [23] over-represent automatically Lines whose endpoints were both convex. Over- and Sub-segmentation still affected the iceberg detection results. In [24] and [25] the authors introduced a mathematical morphology along with grouping the main curve to identify the ice Icebergs and their limits almost fully automatic. His method works with binary images and focuses on morphological characteristics of the ice floes instead of the real ones Limits. It was through pictures with ice floes in which the ice floes in the mass were connected, and not You can find "holes" or concave areas after binarization. These are in our investigation due to these restrictions To be flooded in individuals, a gradient vector flow snake algorithm (GVF) [24] is applied in this investigation. However, to start the algorithm must be an outline is required for the GVF snake to develop properly. Therefore, manual initialization is usually required; in particular in the crowded segmentation of Floetas to solve this problem, the automatic initialization of the contour is suggested to the manual Interact and reduces the time to execute the algorithm. Once the individual icebergs have been identified, the boundaries of the iceberg are you get and you can calculate the size distribution the resulting data.

II. LITERATURE SURVEY

Qin Zhang and Roger Skjetne, Member, IEEE et al describe that An unmanned aerial vehicle was used as a mobile sensor platform to collect sea-ice features at Ny-Ålesund 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. 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. The proposed algorithm yields an acceptable identification result, and its effectiveness is demonstrated in a case study. Fig. Of . Initial contours located at different positions and their corresponding curve evolutions. The red curves are the initial contours, the yellow curves are iterative runs of the GVF snake algorithm, and the green curves are the final detected boundaries. (a) Initial contour 1 located at the water, and the water region boundary is found. (b) Initial contour 2 located at the center of an ice floe, and the whole floe boundary is found. (c) Initial contour 3 located at a weak connection, and the weak connection is found. (d) Initial contour 4 located near the floe boundary inside the floe, and only a part of floe boundary is found 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 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 GVF snake algorithm is proposed to solve this problem.[16,20]

The GVF snake operates on the grayscale image in which the real boundary information, particularly "weak" boundaries, is better preserved. The GVF snake algorithm is an extension of the snake or active contours algorithm. In the classic snake algorithm, a given initial curve can move under the influence of internal forces from the curve itself and external forces computed from the image data. The algorithm stops when the internal and external forces reach equilibrium. The internal and external forces are defined such that the snake will conform to an object boundary or other desired features within an image. The classic snake algorithm can solve a number of image segmentation problems effectively, particularly in "weak" boundary detections. The capture range of the external force fields, however, is limited with a difficulty to progress into boundary concavities. It is, therefore, sensitive to the initial contour, which should be somewhat close to the true boundary. Based on these limitations, the authors in introduced the dense vector field (GVF), which was derived from images by minimizing a certain energy functional in a vibrational framework, to expand the capture range of external force fields from boundary regions to homogeneous regions. The GVF snake is faster and less restricted by the initial contour.[23,25]

The GVF snake algorithm is able to detect the weak connections between floes and ensure that the detected boundary is closed. As an example, given an initial contour (red curve), the snake finds the floe boundary (green curve) after a few iterations (yellow curves). The GVF snake algorithm relaxes the requirements of the initial contour.

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However, a proper initial contour for an object is still necessary, particularly to identify the mass of ice floes in an ice image.Many initial contours are required when performing the GVF snake algorithm to identify all individual ice floes, and these should have proper locations and shapes. An automatic contour installation algorithm is therefore devised to increase the efficiency of the ice floe segmentation method based on the GVF snake algorithm.

An automatic method for identifying the outlines of ice floes is as follows: This is almost the same as the result of very careful manual digitization. This method consists of identifying a set of edge pixels and grouping them into clusters which are centered about a principal curve. Each cluster corresponds to a floe and the corresponding principal curve is the estimated floe outline. The method involves several new statistical techniques: A way of estimating closed principal curves that reduces both bias and variance and is robust to outliers. Here, outliers take the form of melt ponds on the surface of ice floes. The erosion-propagation (EP) algorithm provides initial estimates of floe outlines. This combines the existing idea of erosion front mathematical morphology with that of local propagation of information about floe boundaries.[21]

The marginal ice zone (MIZ) is defined as the area where open ocean processes, including specifically ocean waves, alter significantly the dynamical properties of the sea ice cover. Ocean wave fields comprise short waves generated locally and swell propagating from the large ocean basins. As they encroach on the ice cover, ocean waves are scattered, cause the ice cover to bend and potentially to break into smaller fragments that can also eventually be reduced to a slurry. The horizontal components of the wave motion make ice floes collide with each other, which further alters their shape and size. There are two theories on which sea ice dynamics rely. The first one deals with continuum ice sheets scattered with cracks and ridges, where the deformation field follows a plastic constitutive rule. From this theory has originated the so-called viscous-plastic class of numerical models, which is used in virtually all large-scale models of the Arctic. It gives a good representation of the sea ice behavior in the central ice pack, but its validity is questioned in certain flow regimes, especially in the MIZ where sea ice is all broken-up. Because waves are the main factor influencing the nature of the ice cover in the MIZ, for example by limiting the size of the floes and altering atmosphere to ocean coupling, an adequate model must include their effects in some way. 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 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 GVF snake algorithm is proposed to solve this problem.[20]

III. METHODOLOGY

First we take input ice image and convert to Grey scale and take extract red channel from original image similarly extract green channel from original image, and extract blue channel from original image then estimate white channel balance to identify ice pixels by using ice pixel =[R>150 && G>150 && B>150] and estimate grey threshold of ice pixel image using Ostu method then convert ice pixel image to binary image using grey threshold after that perform morphological erosion on the binary image using structural element of type disc and radius two pixel then remove objects from binary image having area smaller than 300 pixels after that perform CANNY edge detection on the binary image to estimate sea ice floe boundaries than perform connected component labeling on binary image and show labeled image using color space JET [½, ½, ½] after that compute labeled region properties such as bounding box, centroid and area.

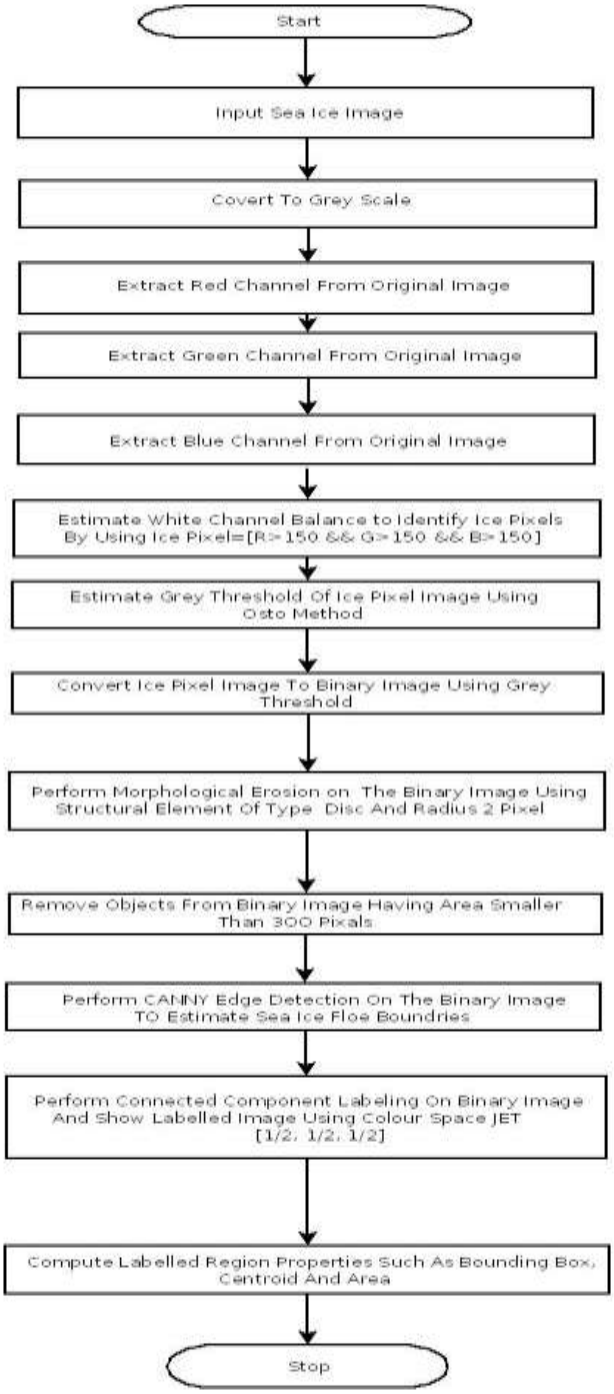

Fig. 1: flowchart

IV. SOFTWARE

MATLAB is widely used in all areas of applied mathematics, in education and research at universities, and in the industry. MATLAB stands for MATrix LABoratory and the software is built up around vectors and matrices. This makes the software particularly useful for linear algebra but MATLAB is also a great tool for solving algebraic and differential equations and for numerical integration. MATLAB has powerful graphic tools and can produce nice pictures in both 2D and 3D. It is also a programming language, and is one of the easiest programming languages for writing mathematical programs. MATLAB also has some tool boxes useful for signal processing, image processing, optimization, etc. [12]

MATLAB (matrix laboratory) is a multi-paradigm numerical computing environment and fourth-generation programming language. A proprietary programming language developed by MathWorks, MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, C#, Java, Fortran and Python.[14]

Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the MuPAD symbolic engine, allowing access to symbolic computing abilities. An additional package, Simulink, adds graphical multi-domain simulation and model-based design for dynamic and embedded systems.In 2004, MATLAB had around one million users across industry and academia. MATLAB users come from various backgrounds of engineering, science, and economics.[16]

Namly MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. Typical uses include: [13]

- Math and computation
- Algorithm development
- Modeling, simulation, and prototyping
- Data analysis, exploration, and visualization
- Scientific and engineering graphics
- Application development, including Graphical User Interface building.[17]

V. RESULTS

Table 1

S.N.	Centroid (x)	Centroid (y)	Area
1.	91	290	462
2.	119	266	649
3.	177	5	564
4.	207	95	7631
5.	154	296	325
6.	185	292	553
7.	193	205	585
8.	204	250	970

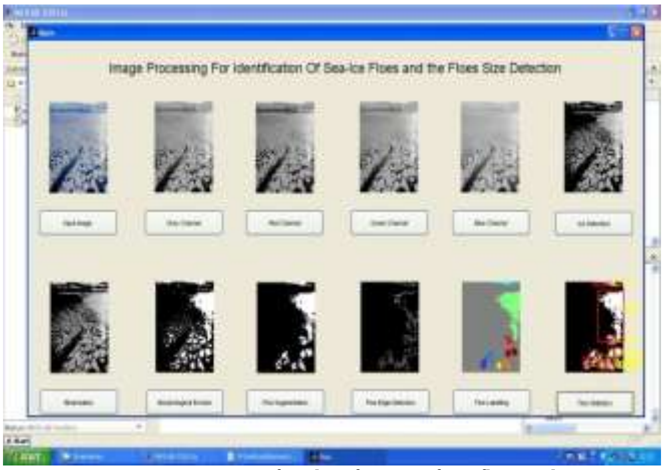

Fig.2a: image processing for identification of sea floes and size 1

Table 2

S.No.	Centroid(x)	Centroid(y)	Area
1.	34	218	947
2.	37	151	847
3.	55	288	924
4.	61	171	383
5.	66	224	1216
6.	87	57	827
7.	97	257	1385
8.	96	97	402
9.	116	183	821
10.	115	306	761
11.	133	79	384
12.	169	212	1440
13.	175	281	899
14.	210	181	319

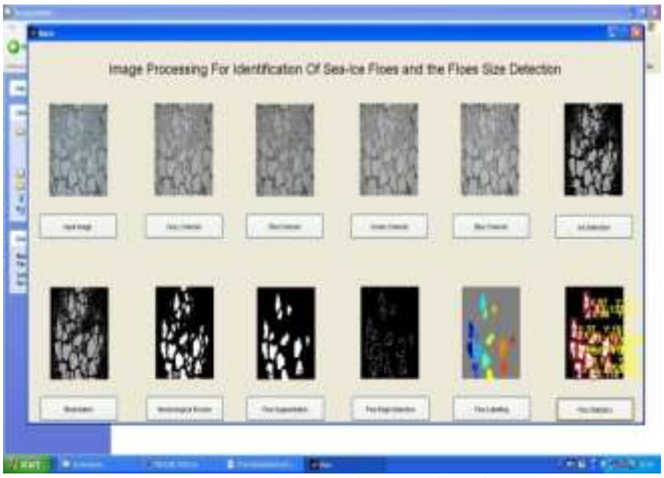

Fig.2b: image processing for identification of sea floes and size 2

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VI. CONCLUSION AND FUTURE SCOPE

Conclusion

As proposed in this Paper, and validated by the results, the proposed system is able to detect ice in aerial sea ice images and further able to segregate floes from detected ice. Also the proposed system is able to mark floe boundaries or edges, does floe segmentation and labeling, and also performs basic geometry parameters means remints such as surface area etc. Thus if can be concluded that the proposed system is able to cater to the demand of the work i.e. identification and estimation of parameters of sea ice floes from Ariel / UAV imagery. Our proposed system will bring advances in oceanographic studies, relating to sea ice formation, their accumulation, their meting parameters. Also the study of sea ice floe parameters can enhance broader studies such as global warming or weather forecasting.

Future Scope

As presented in this paper, automated identification and study of sea ice floe parameters is crucial to various studies of importance to human civilization. The proposed work is able to cater to the basic demands of automated sea ice floe detection and analysis. This technology relies on combination of Ariel photography and image processing and is in its nascent stage, and plethoras of advance are proposed to make this technology more commercially acceptable. One of the most important advances sought is automated UAV aerial photography using automatic area navigating way paints and ice floe detection.

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