Iceberg Detection and Tracking

Sania Bandekar and Victoria Le
Department of Computer Science, San Jose State University, California

***Abstract*—This proposal will discuss the use of despeckling [1] techniques on Synthetic Aperture Radar (SAR) [2] images to detect icebergs, which are helpful indicators of climate change. This project aims to gather helpful information to make better predictions on the effects of climate change and ocean circulation.**

***Index Terms*—Synthetic Aperture Radar, despeckling**

I. Introduction

DATA regarding icebergs can be very crucial to monitoring climate change as well as sea levels [3]. Using SAR imaging combined with despeckling techniques can provide ways to examine these icebergs more closely, and obtain the necessary information required to make predictions on the effects of climate change as well as the effects of the icebergs themselves on the ecosystem.

II. Proposed Methodology

There will be multiple steps taken to reach the goals of this project, including implementing the algorithm for despeckling, preparing data for training the model, and then analyzing the information acquired from the despeckled images to identify any patterns or trends related the impact of climate change and changes in ocean circulation.

1) Despeckling
   - We use despeckling techniques to reduce the noise in the SAR images for improved clarity and accurate classification of the iceberg. This technique consists of applying filters like the Lee filter. The Lee filter reduces noise by estimating the pixels values and replacing each of them with a weighted average of the neighbors. The goal is to find the balance between the reduction of the noise and preserving the image details.
2) Data Preparation
   - Gathering SAR images of various speckle noise levels for training the model
3) Convolutional Neural Network
   - The model will need to be able to interpret the pixels and extract the key features in order to detect the iceberg and distinguish it from other objects that may be captured in the images.
   - With adequate data, the model should then be able to make predictions and approximate the size of the iceberg in addition to predicting where it is in its life cycle.
4) Analysis of Resulting Data
   - Determining the size, essentially how quickly it is melting or forming, of the iceberg and the stage of its life cycle it is in can help draw a relationship to the affects of climate change.
   - Information stated above can also provide helpful insight into ocean circulation.
5) Development of User Interface
   - To properly organize and present the information acquired from the model, we will develop a front end application to

III. Challenges

A. Limited Data for Model Training

It may be difficult to find enough SAR images with different levels of speckle noise for icebergs to properly train the model, but we can make use of already existing datasets and combine them to better train the model.

B. Model Training and Complexity

The datasets used for training will have to be adequate enough to get an accurate and precise model, while not being too complex to avoid overfitting.

C. Intuitiveness of User Interface

The application will need to be designed to be easy to use and organized such that a wide range of users will not have issues with navigating the application or getting the data they want.

IV. Evaluation Metrics

There are many things to take into consideration when training the model and we work with the following metrics in mind:

A. Quality of Resulting SAR Images

B. Accuracy

C. Precision

D. Peak Signal-to-Noise Ratio (PSNR)

E. Mean Squared Error (MSE)

F. F1-Score

V. Expected Outcomes

This project strives to create an application that makes use of advanced despeckling techniques and machine learning to detect icebergs and analyze them. In addition, the information obtained would allow for a deeper understanding of the relationship between icebergs and the effect they have on the environment and vice versa. This kind of application could help provide valuable data for experts whose fields center around climate change, the ocean, and glaciology.

REFERENCES

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[3] Peter Wadhams. Climatic impacts of icebergs.