

Using a MATLAB/Photoshop Interface to Enhance Image Processing in the Interpretation of Radar Imagery

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Abstract— The Center for Remote Sensing of Ice Sheets (CReSIS) has developed many radars that operate over the frequency range from 140 to 230 MHz with multiple receivers developed for airborne sounding, and imaging of ice sheets. Understanding the echogram data depends on knowing the process of how radar waves interact with natural surfaces. The purpose of this project was to use the Bas Relief filter for image processing in order to improve the interpretation of radar imagery. The filter Bas Relief, currently in Photoshop, was once a sculpture technique in which figures or other design elements were just barely more prominent than the overall background. [3] The University of Kansas CReSIS office heavily relies on the use of MATLAB along with Photoshop to perform several tasks. MATLAB is a high-level programming language and interactive environment with strong mathematical and graphics capabilities while Adobe Photoshop CC allows you to use advanced image processing algorithms that are not available in MATLAB. With Adobe Photoshop Extended we hoped to combine MATLAB commands with Photoshop's image editing features to further interpret imagery. With the implementation of this algorithm in MATLAB, it would allow researchers to conveniently retrieve and use the newly edited image. By comparing the original image versus enhanced, researchers would be able to improve tracking of features such as internal layers and the ice bottom.

Key Words— Image Processing, Radar Image Interpretation

I. Introduction

The Center for Remote Sensing of Ice Sheets (CReSIS) is a Science and Technology Center (STC) established by the National Science Foundation (NSF) in 2005 with the mission of developing new technologies and computer models to measure and predict the response of sea level change to the mass balance of the ice sheets in Greenland and Antarctica. [1] As a result of the various ice sheets, CReSIS has invested in several remote sensors to gather data. To increase their knowledge about what was under the ice surface. Radar Echogram images have helped field researchers scan over ice surfaces to study the depth. Depth edges can often show clues

toward the understanding and interpretation of image transformation. [2] A radar echogram is generated by collecting these reflected signals as the aircraft flies over the target. From above a pulse is transmitted to the ground, if it hits a new layer a signal wave is returned to the aircraft. After looking at the rate of reflection, we can estimate the depth of the ice. Although original images have been long viewed, new techniques would allow for more attention to certain attributes. Locating the surface/bottom of ice layers can be very hard to do with a noise based image. Noise being whether the image is not very clear and hard to interpret. Little things like discovered edges could benefit from the use of the filters. Researchers could use filtering to manipulate their final results to be more precise. Among other filters, Bas Relief is the filter that CReSIS researchers have focused on. This filter eliminates all vertical and horizontal blank spots in the image. Anything perpendicular to light will be removed leaving a clean surface to analyze. This image processing technique was first used for paintings and sculptures to make the overall image stand out opposed to the background scene itself. Created in the late 1970's, MATLAB was a high level scripting language for general scientific and technical computation. Named from the terms Matrix and Laboratory, it introduced an interactive development environment along with mathematical functional libraries. Researchers have used MATLAB to not only work with data analysis but algorithm development. [6] Later in 1988 Thomas and John Knoll created Adobe Photoshop. It has been one of the leading graphics editing software. With its wide range of applications and editing features it provided users with endless possibilities. MATLAB and Adobe Photoshop CC have developed a new integration between their respective processing toolboxes. They both offer another perspective to define an image. Researchers can edit and enhance images right from the MATLAB script with a wide range of Photoshop functions. The idea is that you will be able to apply Photoshop operations on the image you pass from MATLAB. We hope to accomplish creating an automated interface for efficiency

II. Methodology

The basic fundamentals of the programming language MATLAB were required in order to begin this project. We were provided MATLAB lessons from a graduate student along with accessible tutorials and videos. Since MATLAB was heavily used at The University of Kansas CReSIS office, plenty of help was available along the course of this project. [4] After two weeks of training with MATLAB, research about the purpose began. Beginning questions were asked and answered by the student to fully understand what was needed for the final results.

First, the history between Adobe Photoshop and the MATLAB interface was researched. We found what it was useful for and how it could be manipulated. Although it had not been tested yet we knew it was a powerful tool with many capabilities. Problems started to arise after not finding the specific filter we wanted to work with, Bas Relief. Although it was well known in Adobe Photoshop the information elsewhere was insufficient. Because of limited time spent with the interface previously we learned about it as we continued further into research.

After speaking with my mentor after the failed attempts we proceeded with what we could. Every asset we had knowledge about, we reviewed and tested it on its own. A list of more functions from the Adobe Photoshop Toolbox was discovered and primarily worked with after that. [5]

Once the program began being written, we first simply wrote an automated function to send an image to Photoshop. After that we progressed to find only that MAT files were the only file format we could send through the load radar function. But, while testing any format image could be sent. Next, since we still had not found a Bas Relief function, we tried editing the image with test filters. Limitations were that we could not automatically switch to Bas Relief, send an edited image back to MATLAB and, write in a filter in the program yet.

III. Literature Review

The document viewed was about Gradient and Laplacian Edge Detection. An edge is a boundary or contour that separates adjacent image regions having relatively distinct characteristics according to some feature of interest. [2] It interprets the images according to distinct features found. It is not guaranteed that the radar will produce clear edges because of lighting and surface properties. Depending on noise or any cross interference, you could receive missing or false edges. While CReSIS heavily focuses on viewing ice surfaces and ice bottoms, not all edges are constant. In this case, the use of edge detection is needed. Edge detection determines boundaries of objects within images using pixels. The pixels construct a map and then find the location where it seems to rise. [2] There are points at which abrupt changes occur and multiple areas must be viewed for longer periods of time. For this project we wanted to determine how Bas Relief worked when used to detect these same edges. Bas Relief is a derivative of the edge detection filter but from a different approach than the classic edge detection. This filter works in a way that any lines

horizontal or vertical on the image disappear. The filter enhances the underlying surface and brings forward anything that was not visually seen before. It essentially enhances the image and places emphasis on those same distinct characteristics

IV. Radar Echogram

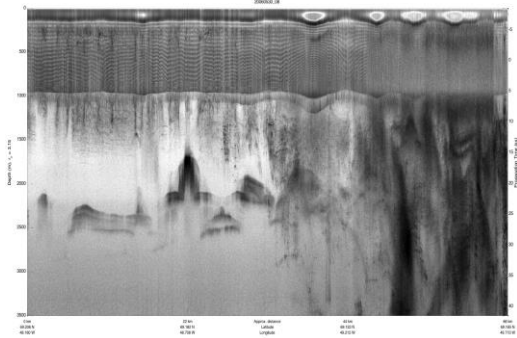


Figure 1. Original Radar Echogram

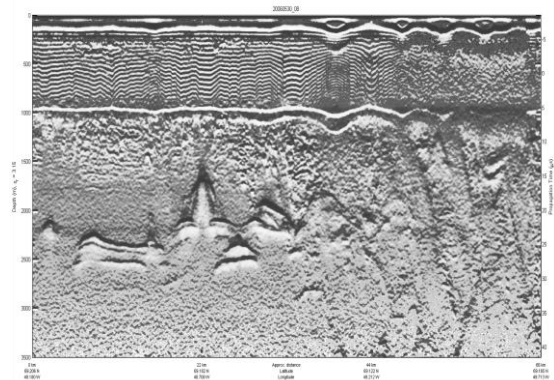


Figure 2. Applied Bas Relief Filter (light shining from the bottom)

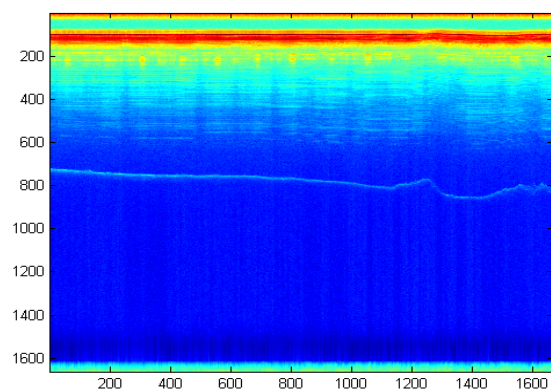


Figure 3. CReSIS Echogram File from Greenland

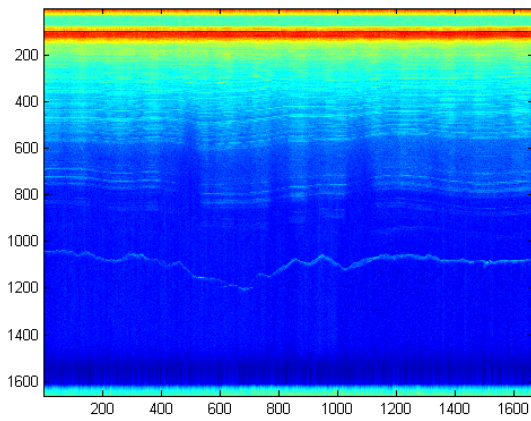
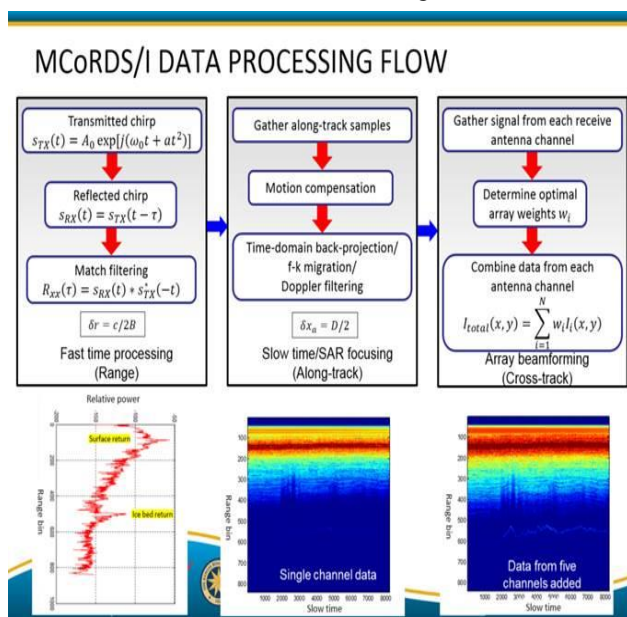


Figure 4. Another CReSIS Echogram File from Greenland

V. Airborne Platform Signal



VI. Conclusion

The purpose of this project was to use the Bas Relief filter for image processing in order to improve the interpretation of radar imagery. By utilizing the MATLAB/Photoshop Interface, an automatic functional image processing approach took place. This would provide a new technique for researchers at the CReSIS office along with other users to reevaluate their data from a different approach. In order to first begin the automated approach, installation of the Photoshop and MATLAB path had to take place. Upon completion of that several workshops about MATLAB took place to teach the fundamentals. After completing the workshops then trial programs were ran in order to produce the correct function format. Test cases of a smaller program simply opened radar echogram data by itself. The first effective program converted the

selected image to the correct file format, sent the image to Photoshop, applied the specific filter, and then returned the image back into MATLAB. This was the basis of the next several test programs created. After several test cases, a final program was created. It would allow the user to send the selected radar echogram data from the load radar function. The load radar function simply loads CReSIS echogram data files saved on the network. After the data was loaded a scaling function was applied to adjust the size. The re-scaling function scaled the image between 0-255 and a uint8 data type. After being scaled the Psnewdocmatrix function was applied. This created a new document in Photoshop with the sent image. While the sending process occur, the selected filter was applied, and then Psetpixels was called from the Imshow function. This gathered the pixels of the current image in Photoshop and directly opened it in MATLAB along with Photoshop.

VII. Future Work

To complete this research first the re-scaling function must be corrected. In order to use the appropriate radar echogram, It should be re sized to 0-255 and a data type conversion of uint8. Although it did that, the image is missing its color. All regular images will fall under the requirements by default. Next, attempt at sending not only 8-bit channel images but also 16-bit and 32-bit channels. Lastly, the Bas Relief operation must be written. Because the Photoshop functions seem to be based off the JavaScript functionality, script listener could be used. With script listener it will allow access to view what has happened from Photoshop. It would log any current happenings from Photoshop and from there be used to recreate the filter Bas relief in MATLAB.

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