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

The National Science Foundation **(NSF)**
National Aeronautics and Space Administration **(NASA)**
Kansas Board of Regents **(KBOR)**

The University of Kansas **(KU)**
Elizabeth City State University **(ECSU)**
The Pennsylvania State University **(PSU)**
Indiana University **(IU)**
University of Washington **(UW)**
Association of Computer and Information Sciences and Engineering Departments at Minority Institutions **(ADMI)**
Los Alamos National Laboratory **(LANL)**
Centre for Ice and Climate, Niels Bohr Institute, University of Copenhagen **(CIC)**
Center for Polar Observations & Modeling **(CPOM)**
Indian Institute of Technology Kanpur **(IITK)**
University of Magallanes **(UM)**

CReSIS
Center for Remote Sensing of Ice Sheets

Kalyx McDonald
Mississippi Valley State University

Mentor
John Paden
The University of Kansas

CReSIS
Center for Remote Sensing of Ice Sheets

Overview

- Abstract
- Purpose
- Introduction
- MATLAB/Photoshop Interface
- Bas Relief
- MATLAB/Photoshop toolbox
- Radar Echogram
- Example programs
- Scrip Listener
- Conclusion
- Future research
- Acknowledgements & Questions

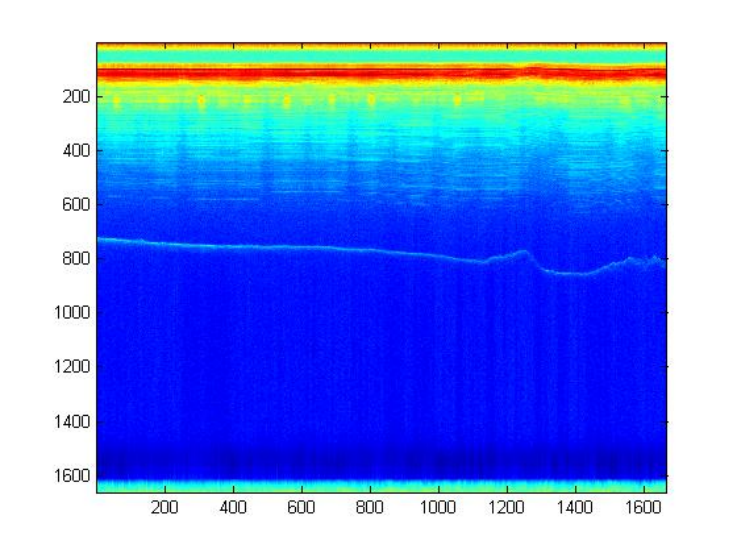
CReSIS
Center for Remote Sensing of Ice Sheets

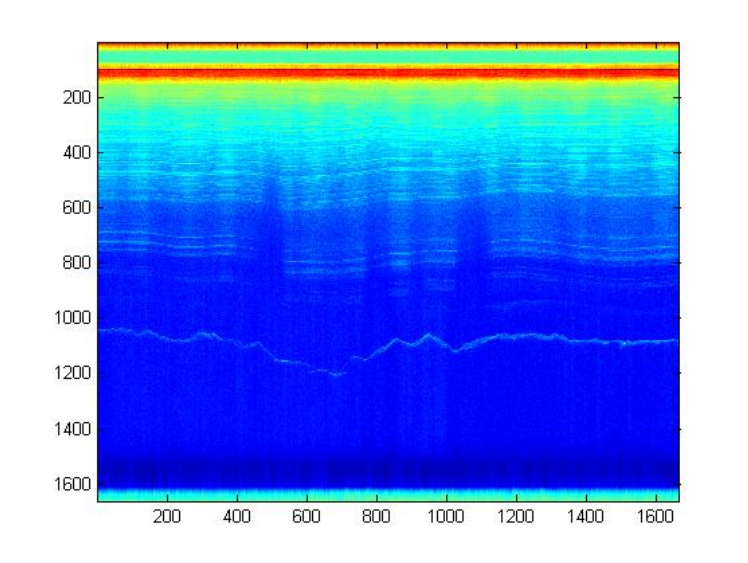
Abstract

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. 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.

Purpose

- Use the Bas Relief filter for image processing in order to improve the interpretation of radar imagery.

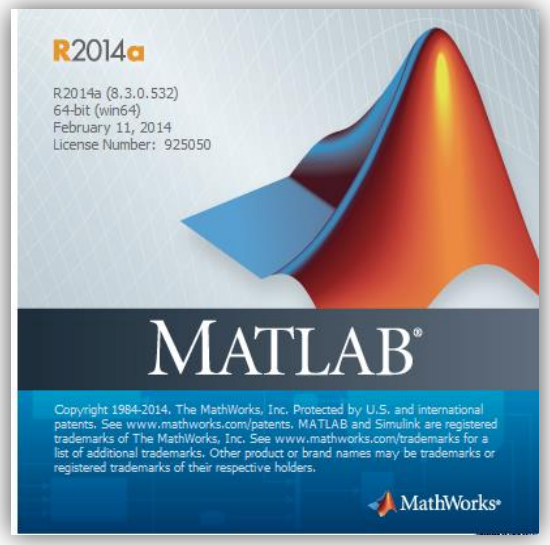


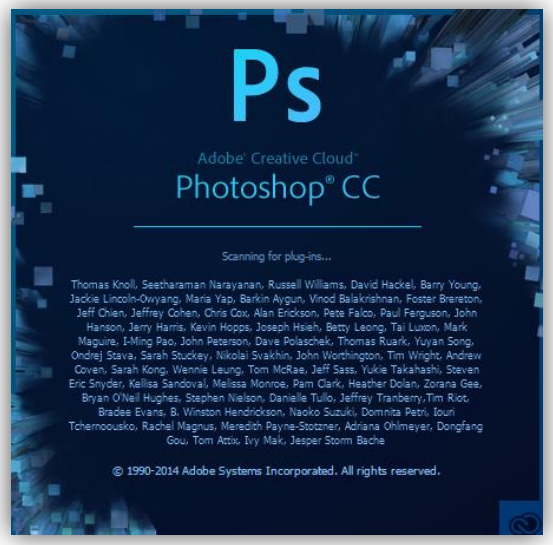


CReSIS
Center for Remote Sensing of Ice Sheets

MATLAB/Photoshop Interface

- Photoshop JavaScript interface and the MATLAB library interface.
- Not many people have worked with this yet
- Very powerful tool

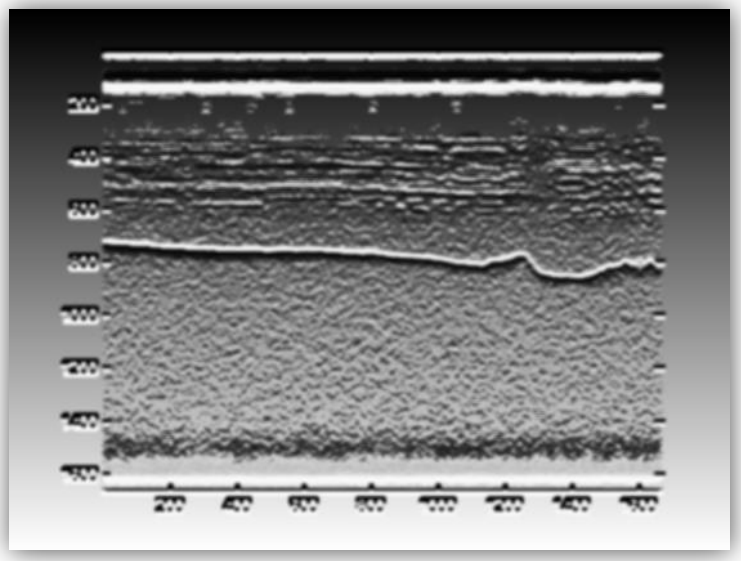


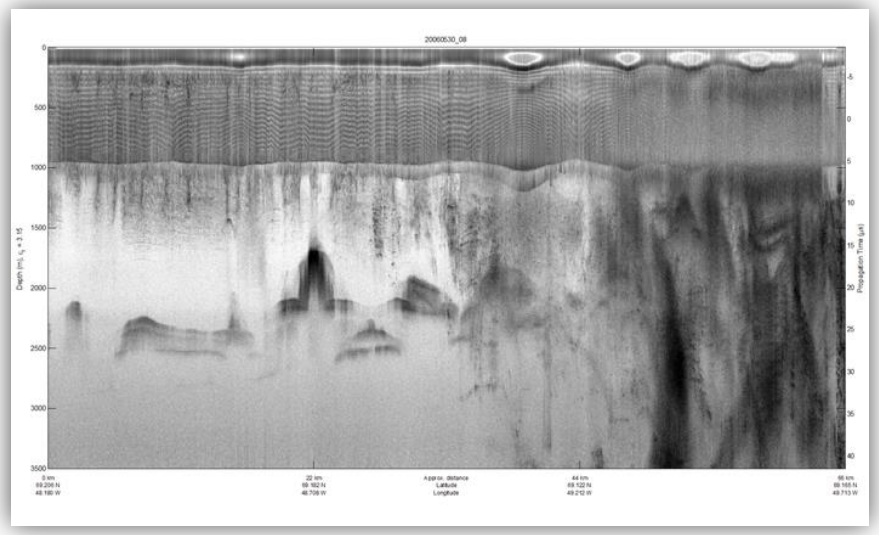


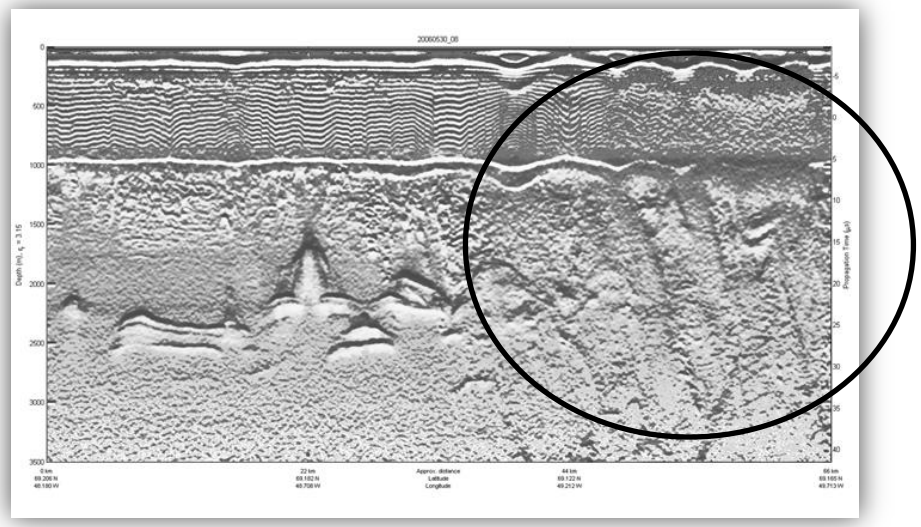
CReSIS
Center for Remote Sensing of Ice Sheets

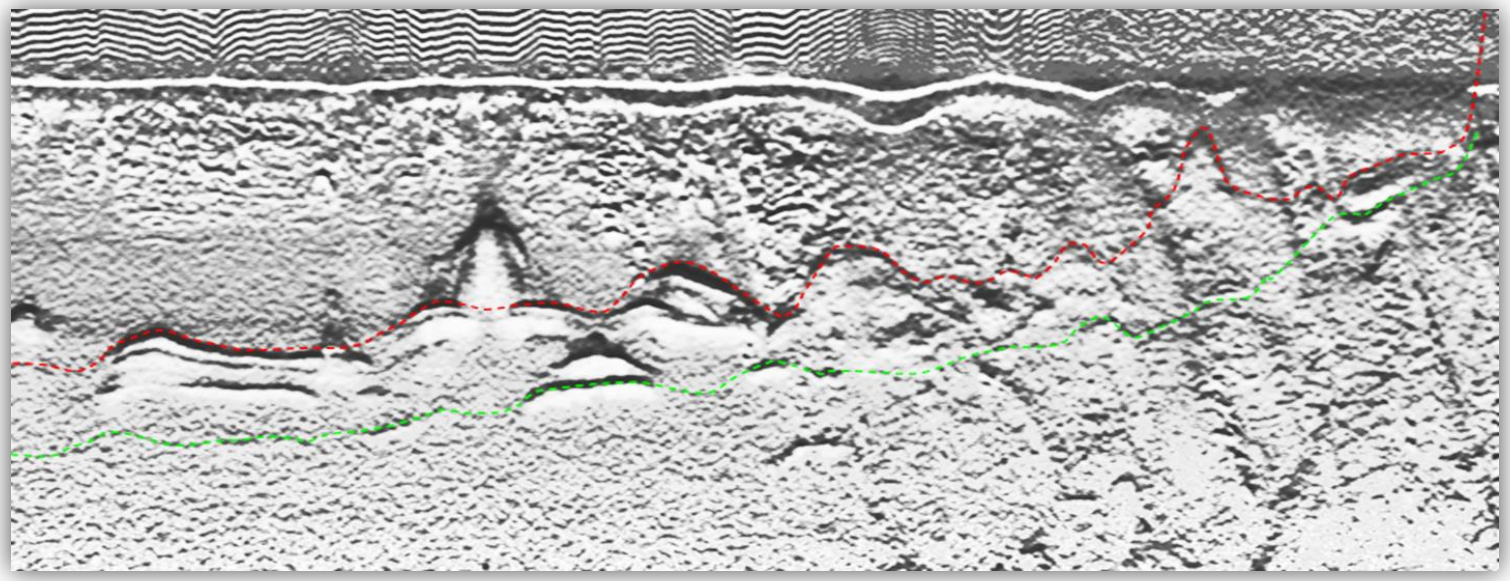
Bas Relief

- Type of edge detection
- Eliminates all vertical and horizontal blank spots in the image









CReSIS
Center for Remote Sensing of Ice Sheets

Photoshop Toolbox

- Psnewdocmatrix – creates a new Photoshop document from a matrix ands send an image from in MATLAB
- Psgetpixels() – reads the pixel data of the current visible layer back into MATLAB

```
Filter functions.
  psaddnoise          - Run the Add Noise filter.
  psaverage           - Run the Average filter.
  psblur              - Run the Blur filter.
  psblurmore          - Run the Blur More filter.
  psboxblur           - Run the Box Blur filter.
  pscustom            - Run the Custom filter.
  psdustandscratches  - Run the Dust and Scratches filter.
  psgaussianblur      - Run the Gaussian Blur filter.
  pshighpass          - Run the High Pass filter
  pslensblur          - Run the Lens Blur filter.
  psmaximum           - Run the Maximum filter.
  psmedian            - Run the Median filter.
```

Example program

Editor - C:\Users\kmcdonald\Documents\MATLAB\test2.m*

test2.m* | test_radar.m | test_radar2.m | openradar.m | +

```
1
2       % This program converts a .PNG file format to a .MAT or .NC file format. Then
3       % after it reads the image it will display the image in Adobe Photoshop
4       % with the specific filter assigned, and then displays that image back in
5       % MATLAB.
6
7
8 -     fn = imread('radar_img1.png','png'); % Reads image from graphics file
9 -     save ('radar_img1.mat','fn'); % Saves image under new file format
10 -    data = load_L1B('radar_img1.mat'); % Loads the image
11 -    A1 = data.fn;
12 -    psnewdocmatrix(A1); % Opens the image in Photoshop
13      psboxblur % Specific filter
14 -    imshow(psgetpixels()) % Sends the image back to MATLAB
15
16
17
```

“Final” Draft

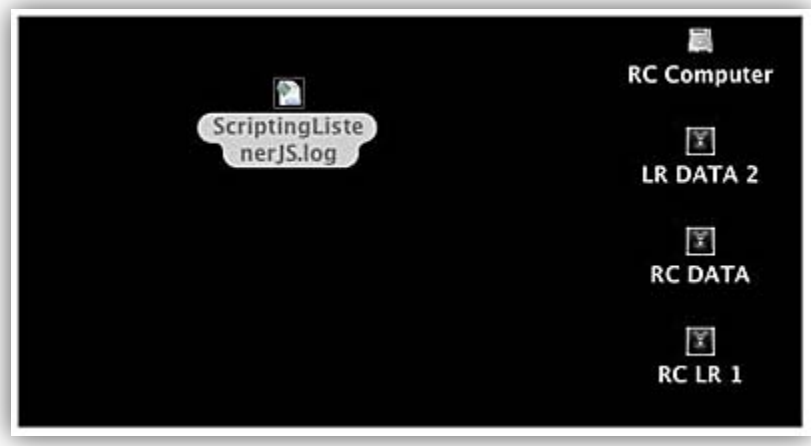
Editor - C:\Users\kmcdonald\Documents\MATLAB\interface.m

test2.m | test_radar.m | test_radar2.m | openradar.m | interface.m

```
1     %This program loads a Radar Echogram Image, Scales it, applys the filter
2     %then sends to photoshop along with reopens in MATLAB. Both images are grey
3     %though
4     %7/10/14 ~ Final Test Run
5     %A_scaled = data type conversion((0-255(orginal image value-min value of image))))/max val
6
7 -   fn = 'Data_20140515_02_006.mat';
8 -   mdata = load_L1B(fn);
9 -   fx = (10*log10(double(mdata.Data)));
10 -  A_scaled = uint8((255.0.*(fx - min(min(fx)))./(max(max(fx)) - min(min(fx))));
11 -  psnewdocmatrix(A_scaled);
12 -  pssharpenedges  % Add whatever filter here
13 -  imshow(psgetpixels()) %sends image back to MATLAB
```

Script Listener

- AppleScript – Mac OS
- VBScript - Windows
- JavaScript - Both



ScriptingListenerJS.log

```
// ===========================================================
var idMk = charIDToTypeID( "Mk  " );
    var desc1 = new ActionDescriptor();
    var idNw = charIDToTypeID( "Nw  " );
        var desc2 = new ActionDescriptor();
        var idpreset = stringIDToTypeID( "preset" );
        desc2.putString( idpreset, "640 x 480" );
    var idDcmn = charIDToTypeID( "Dcmn" );
    desc1.putObject( idNw, idDcmn, desc2 );
executeAction( idMk, desc1, DialogModes.NO );

// ===========================================================
var idMk = charIDToTypeID( "Mk  " );
    var desc3 = new ActionDescriptor();
    var idnull = charIDToTypeID( "null" );
        var ref1 = new ActionReference();
        var idLyr = charIDToTypeID( "Lyr " );
        ref1.putClass( idLyr );
    desc3.putReference( idnull, ref1 );
executeAction( idMk, desc3, DialogModes.NO );
```

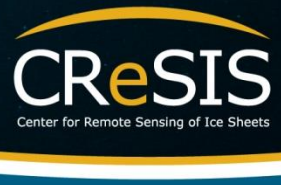
CReSIS
Center for Remote Sensing of Ice Sheets

Conclusion

- Provided a new technique for researchers
- MATLAB workshops
- Extensive test programs

Future Research

- Re Scaling function
- Multiple Images
- Script Listener
- Bas Relief operation must be written

I would like to thank CReSIS for the opportunity to continue performing research with the program.
John Paden for assisting me even while out of the office
Darryl Monteau and the rest of the CReSIS staff at KU for making us feel at home.

Questions?