

Introduction to Image Processing

Computer Lab #1: October 4, 2023

Due: October 18, 2023

I. Introduction

This will be the first laboratory exercise that is graded, so please make sure you follow the directions closely. The instructions, questions, and blank spaces below are meant to guide you through several ENVI processing routines that are slightly more advanced than the pre-lab exercise. You should fill in all blanks and answer all questions on this hand-out. You must also prepare a written **2-page** summary report that includes a concise description of the science in Sections V and VI (*any required figures can be on extra pages*). See instructions at the end of this document (*as well as the posted Lab Guide*). Remember to put your name and PeopleSoft number in the upper left hand corner of your report. Finally, please turn in your completed lab report and this handout to the TA by **Oct. 18th**.

II. Background & Basic image exploration

- log in to the computer, create a named directory on the desktop (*if you had not done so in the pre-lab*), and start the ENVI image processing software
- on the main menu bar, go to *File* → *Open Image File*
 - use the directory window that opens and navigate to the folder for Lab 1
 - in there you should have an image file called **lab1.img**
- what are the wavelength regions displayed in the image? _____
- on the main menu bar, go to *File* → *Edit ENVI Header* and then select **lab1.img** to examine the File Information, but **do not** click the *OK* button
 - how big is the file (e.g., number of lines (NL), number of samples (NS), number of bands (NB)? _____
 - what sensor collected these data? _____
 - what is the pixel size? _____
 - calculate the swath width in kilometers _____
 - *hint: how many pixel across is the image?*
 - now, using the dwell-time equation (*and certain constants*) given in the notes, calculate the dwell time for this image for a cross-track (push-whisk) scanner _____
 - what if it was an along-track (push-broom) scanner _____
 - click 'cancel' to close the ENVI Header window

III. Gray scale image analysis

- select the *Gray Scale* button on the "Available Bands List" window and load the first band

- three windows should appear as in the pre-lab:
 - *image* window (large), *scroll* and *zoom* window (smaller)

- take some time and use the red box in the scroll window to explore the scene and the red box in the image window to explore small-scale features
 - how would you describe the general environment shown in this image?

 - what are the dark gray/black circle-shaped areas across the scene?

 - at the center top of the scene is a large white region
 - what do you think that is? _____
 - what are the approximate DN values of this white/bright feature? _____
 - *hint: right click in the image window and scroll down to: Cursor Location/Value ...*

 - locate the main urban area in the image (*hint: linear/grid pattern features are your friend here*)
 - move the red rectangle in the image window to position the zoom window over this area
 - you can zoom in/out by clicking on the red rectangles at the bottom left corner of the zoom window

- on the image window, go to the menu and click *Enhance* → [*Scroll*] *Linear 2%* and note the change in the image _____
- now click on *Enhance* → [*Image*] *Linear* to remove that 2% stretch
- go to the *Enhance* → *Interactive Stretching ...* to call up the histogram for this image
 - describe the histogram _____
 - perform a user-defined linear stretch using the slider bars (the dotted lines on the input histogram) to stretch the pixels in the large peak at the left hand side of the histogram; and then click the apply button

- what DN range did you chose? _____
- what area in the image was enhanced using this stretch? _____
 - do you see any patterns in these newly highlighted areas and what might they be caused by? *Hint: remember the wavelength of the image you are examining* _____

 - finally, reset the stretch by clicking *Options* → *Reset Stretch* on the histogram window and then close that window

- now analyze the basic statistics by right-clicking in the *image* window and choosing the *Quick Stats ...* option
 - what is the max/min/mean data values in the image? _____
 - close the stats window, load band 3 and repeat the statistics analysis noting how (if at all) the max/min/mean values have changed? _____

- close the stats window and navigate to pixel (1083, 3468) and note the DN.
hint: right click in the image window and scroll down to: Pixel Locator ...
 - what is the latitude/longitude of that pixel in decimal degrees (DDEG)?
hint: use the double arrow button first _____
 - what might this feature be? _____
- now measure the area of this feature by clicking *Tools* → *Measurement Tools*
 - in the new window click *Units* → *km*
 - what is the approximate area of this feature in km²? _____

IV. Confirmation using Google Earth/Google Maps

- open Google Earth/Maps by double clicking on the desktop icon
 - use the latitude/longitude found in the last part and navigate to this general area in Google Earth
 - what country is this? _____
 - is your location in Google Earth the same as in ENVI? _____
 - can you better identify the features located in the ENVI image? _____
- now, minimize Google Earth and go back to ENVI

V. Color image analysis

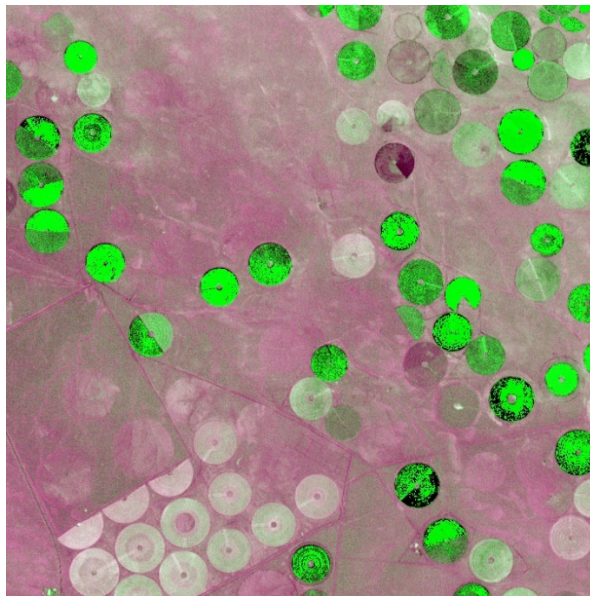
- go back to the “Available Bands List” window and click the RGB color button to load the 3 available bands into the R, G, B fields (**band2** → **R**; **band3** → **G**; **band1** → **B**)
- enhance the colors by applying a *[Scroll]* *Equalization* stretch to the data
 - what happened to the scene? _____
 - try the other *[Scroll]* stretch options
 - are any of them better for discrimination? _____
 - go back to the *[Scroll]* *Linear* stretch
- what does the green color signify in the image? _____
- what are the brightest green areas in the image? _____
- go to pixel (1815, 2071) and list the DN values for each band _____
- does the color of the pixel make sense based on the DN values and your knowledge of R,G,B color theory? _____
 - check Google Earth again to identify what is in this area

VI. NDVI

- select the *NDVI* button under the *Transform* menu on the main menu bar
- select the file name (lab1.img) from the window that appears
 - this will bring up a new NDVI window
 - you should note that the sensor that acquired these data is not listed in the pull down menu

- what is important here is selecting the correct band number for the 'Red' and 'Near IR' fields. *Hint, check your notes if you forget the NDVI equation.*
 - click the 'Memory' button for the Output Result and then click OK
 - this image will appear in your available bands list – double click to load it as a grayscale image
 - describe what this image is showing you specifically over the circular regions
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- again, click the RGB Color button on the Available Bands List window, and load the following bands in the R, G, B fields (**band2 → R; NDVI → G; band1 → B**)
- save this color image centered over a vegetation region, by clicking on the File menu of the Image window for this image and scroll down to *Save Image as → Image File*
 - change the Resolution to 24-bit Color (BSQ)
 - change the Output file type to JPEG
 - change the Compression Factor to 1.0 (*meaning no compression*)
 - give the file a name and use the Choose button to place it in your folder on the desktop
 - before you click OK, click on the Spatial Subset button, and then click on *Image* on the next window that appears
 - change the Samples and Lines to 800 each and move the red box over a region in the image you wish to save, and which may be important for your lab report discussion
 - click OK on that window and then OK again on the previous (*Spatial Subset*) window and finally OK again on the last window (*Output Display to Image File*)
 - ***include your color image as Figure 1 in your lab report (example below)***



- once the file is saved, exit the ENVI software and you are done

VII. Summary Report

- the report should contain the sections described in the Lab Guide posted on the class web page
 - remember, ***do not just list the steps from this worksheet, but make sure you describe your methods and your results in your own words***
 - *pay particular attention to the differences (or lack thereof) between the RBG image created in Section V and V1*
 - remember to also refer to and describe the figure that you created in your report
 - *that figure should be labeled "Figure 1" and have a caption*
- **this is due to Poushalee by October 18th**