Creating a Program in Mat Lab to Classify CRISM Data

Joyce Bevins, Justin Deloatch, MyAsia Reid
Mentor Dr. Eric Akers
Elizabeth City State University
1704 Weeksville Rd
Elizabeth City, NC, 27909

Abstract

The 2009-2010 undergrad Research team primary focus was to create a program using MAT LAB that will classify CRISM data in a shorter time frame than what it will take to classify by hand. The CRISM research consisted of manually classifying images from Mars and placing them into a Microsoft EXCEL data base, downloading images and storing them into Kitoto's server so that the program can read and return results of the overall images and mineral images. These images can be classified as excellent, fair, poor, and absent. The classification of each image will show whether there is a lot, little, or no water in each kind of mineral. The five minerals are oxidized iron, mafic minerals, hydroxylated silicates, bound water and frozen H_2O. The images that show the most signs of water in certain areas on Martian will be examined more closely. Currently, the CRISM team working is on creating this program in Mat Lab.

1. Introduction

For years many people have had questions concerning Mars atmosphere climate, and surface. Chief among these is the question of whether water has ever existed on Mars and if so where and when did it exist and if still present, in what form does it currently reside? Is Mars suitable for life? Can there be human exploration and colonization on Mars? NASA is using the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) instrument orbiting on board the Mars Reconnaissance Orbiter, to trace the past and present water on Martian Mars and answer these questions. The CRISM instrument takes images of the Martian surface in a variety of selected wavelengths in order to search for water or water bearing minerals.

CRISM is "one of NASA's high-tech Detectives seeking traces of past and present water on the Martian surface." CRISM is an expression of NASA's Mars exploration strategy that can be summarized in the phrase: "follow the water." The CRISM instrument is a Visible-infrared imaging spectrometer. It can cover wavelengths from 0.362 to 3.92 microns at 6.55 nanometer/channel. Combining images in a variety of different visible and near infrared wavelength bands provides a method of visualizing the areographic mineral signature of five specific forms of water, including oxides of iron, mafic minerals, hydroxylated silicates, minerals containing bound or adsorbed water and regolith comprised of some fraction of water ice. NASA researchers sent the CRISM Instrument to Mars to record data on specific locations that indicate a potential for water or mineral indications of current of past water.

CRISM consists of three component boxes which are the OSU (the optical Sensor Unit Sensor), the GME (Gimbals Motor Electronics and the DPU (Data Processing Unit. Each of these boxes has their own duties to perform. The GME contains the optics, gimbal, focal planes, cryocoolers, Radiators, and focal plane electronics.

2. CRISM data and Spread Sheet

Hyperlinks to web resident CRISM image data products were placed into an EXCEL spreadsheet. The spreadsheet contains an identifying number for each locale's set of data products and spaces for data quality and content ellucidation. When accessed, each data product granule contained five mineral identifying image combinations. The CRISM undergraduate reseach Team was given the spread sheet to analyze and classify each image manually before being able to create a program in Mat Lap that would do it autally.

3. Classifying Images

The ECSU CRISM team decided to have four categories for classifying images, which were excellent, fair, poor, and absent. Each overall data granule was classified so that NASA-JHU/APL researchers would know the quality of the images taken by the CRISM instrument. The mineral signature signal-strength apparent in each of the five mineral-specific images was also described as:

- absent,
- weak,
- moderate
- strong.

Columns of Spreadsheet cells allowed the data quality of an image to be recorded with a separate column for recording a description of the presence or absence of one of the five classes of water bearing minerals as depicted in the figures 1 a and b and figures 2 a-e.

Figure 1a. An example of an MRO-CRISM visible image (Target ID: 31973 and Target ID (hex) 7ce5).

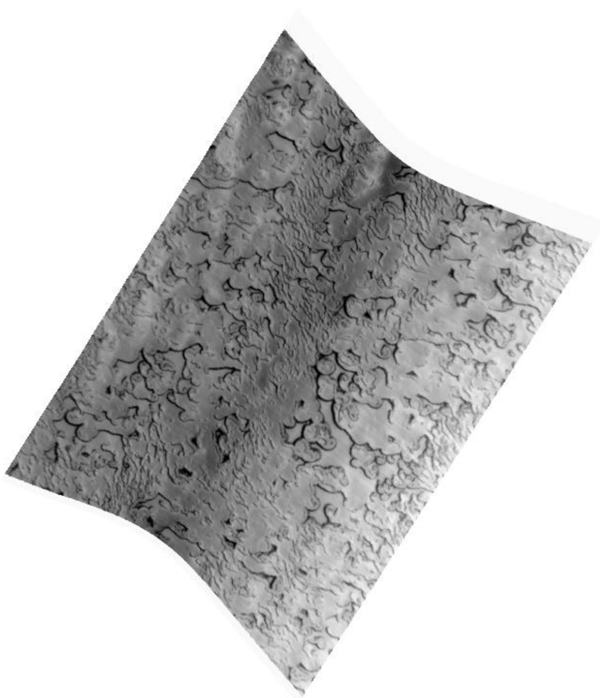


Figure 1b. An example of an MRO-CRISM infrared image (Target ID: 31973 and Target ID (hex) 7ce5).

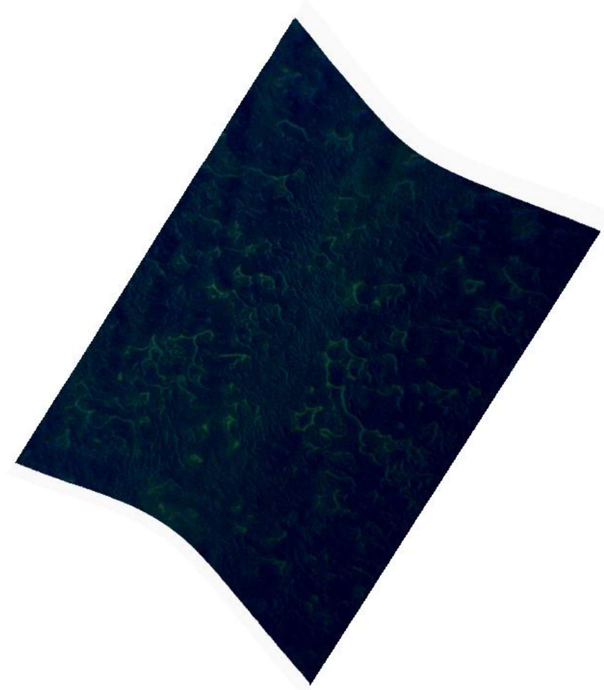


Figure 2a. An example of the Iron Oxide data product described as having a ***strong*** signal for iron oxide (Target ID: 31973 and Target ID (hex) 7ce5).

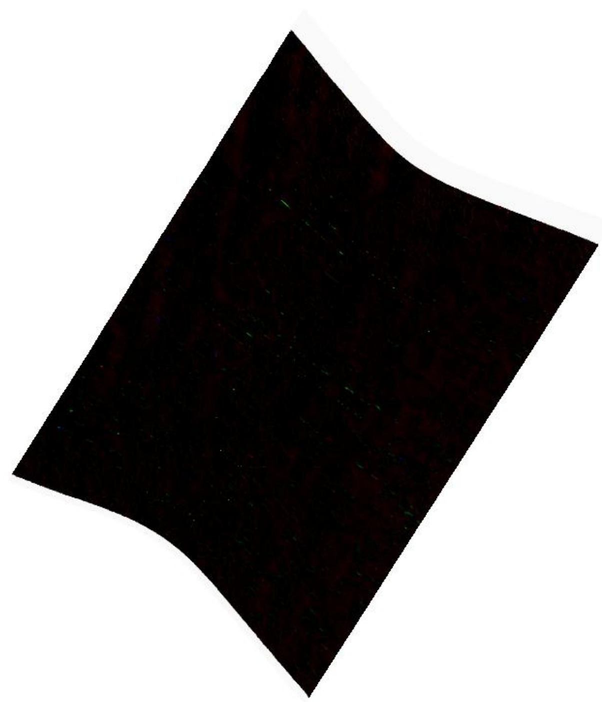


Figure 2b. An example of the Iron Oxide data product described as ***absent*** in mafic minerals (Target ID: 31973 and Target ID (hex) 7ce5).

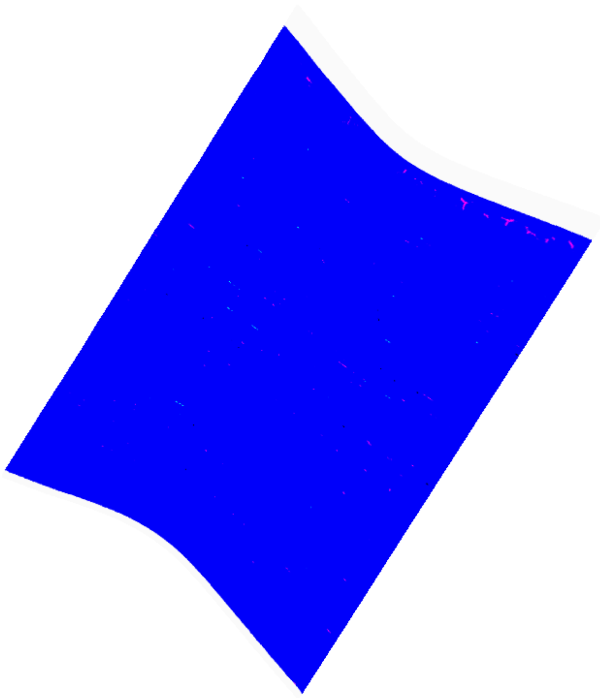


Figure 2c. An example of the phylosilicate (hydroxylated silcate) data product described as ***absent*** in phylosilicates (Target ID: 31973 and Target ID (hex) 7ce5).

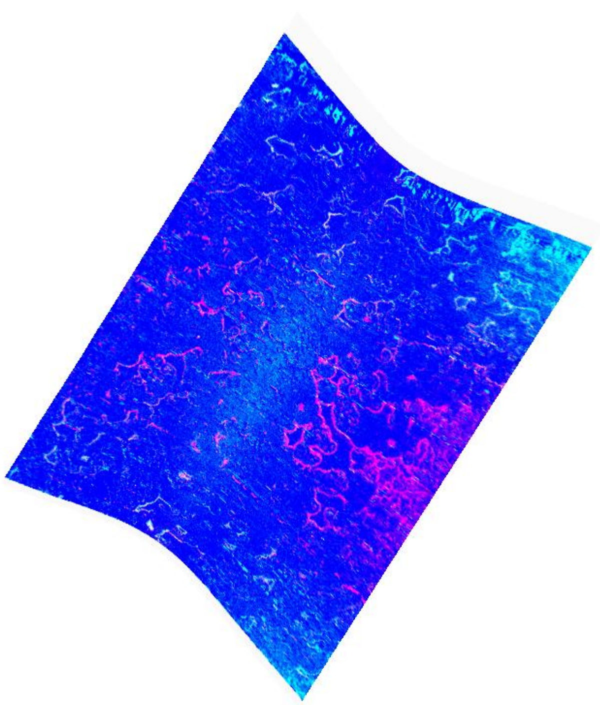


Figure 2d. An example of the bound water or hydrated mineral data product described as having a ***strong*** signal for hydrated minerals (Target ID: 31973 and Target ID (hex) 7ce5).

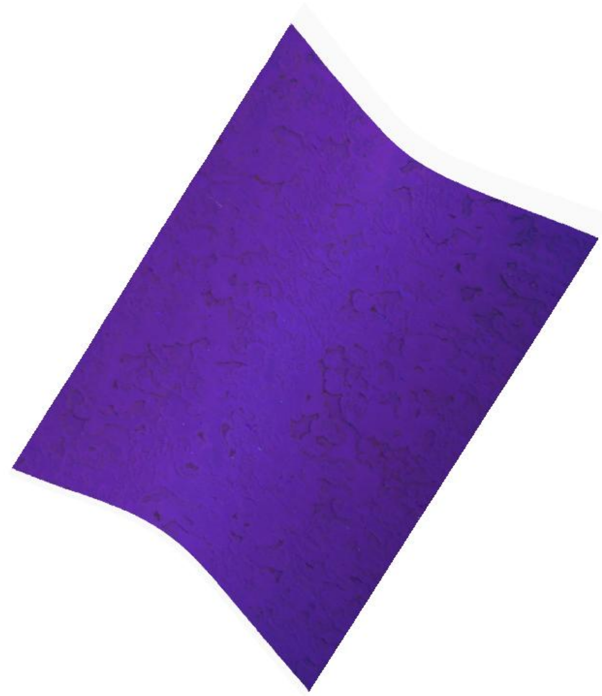


Figure 2e. An example of the ice data product described as having a ***strong*** signal for the presence f ice in image (Target ID: 31973 and Target ID (hex) 7ce5).

All five products were unlikely to have positive signals based on mutually exclusive mineralogical considerations. “Water and H_2O Ice” were noticed to be typically absent in data recorded at latitudes away from the polar regions. Signal strength for iron oxide, mafic mineralogy, bound water and hydroxylated silicates varied across the planet.

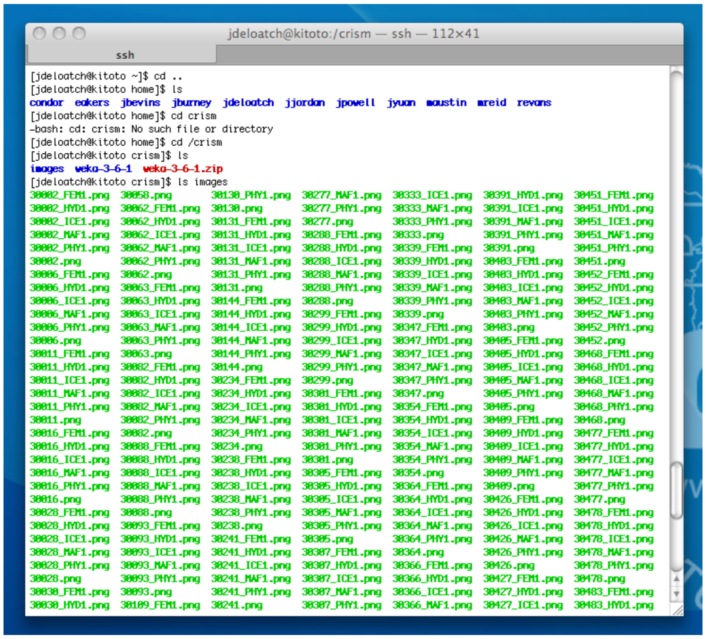
4. Downloading Images

Selecting the hyperlink loaded a CRISM webpage containing a visible and infrared image of a particular area bounded by the instrument field of view. Five image data products were also displayed for analysis.

To make data granules available for automatic processing, all images were downloaded, and saved to a destination directory where the data products could be accessed.

5. Moving Images into Kitoto

Kitoto is a server with 76.3 gigs of space in which to store our image data and data products.



6. Creating Program in Mat Lab and Results

The CRISM team was unable to create a program in MAT LAB to automatically classify and analyze images.

All CRISM data granules were ultimately processed and surveyed individually and manually by a number of ECSU students including:

High School:

Latoya Simpson

Undergraduate:

Joyce Bevins

Justin Deloatch

Kaiem Frink

Karl Mohr

MyAsia Reid

Graduate:

Kevin Jones

References

[1] JHU.APL Webmaster. CRISM Compact Reconnaissance Imaging Spectrometer for Mars. March 15, 2010; from http://crism.jhuapl.edu/.

[2] Jim Wilson. NASA http://www.nasa.gov