Land Cover Classification of SSC Image: Unsupervised and Supervised Classification Using ERDAS Imagine

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***ABSTRACT*- NASA's Earth Sciences program is primarily focused on providing high quality data products to its science community. NASA also recognizes the need to increase its involvement with the general public, including areas of information and education. The main objective of this study is to classify the vegetation, man-made structures, and miscellaneous objects from the Satellite Image of NASA Stennis Space Center (SSC), Mississippi, and USA, by using the software, ERDAS Imagine 8.5.**

The ERDAS Image software performs the classification of an image for identification of terrestrial features based on the spectral analysis. For classification of the SSC image, the multispectral data was used for categorization of terrestrial objects, vegetation and shadows of the trees. These are two ways to classify pixels into different categories: Supervised and unsupervised. The classification of unsupervised data through ERDAS Image helped in identifying the terrestrial objects in the Study Image (SSC). The spectral pattern present within the data for each pixel was used as the numerical basis for categorization.

The first analysis of the Image SSC involved the use of generalized Unsupervised Classification with 4 categories (Grass, Trees, Man-Made and Unknown). The result of the Unsupervised Image was used to create another image by using Supervised classification. The key difference between the two images is the ability of supervised image to decipher similar images, such as the roofs of the buildings and the shadows of the trees. Image stacking was conducted to create a fully classified image to separate shadow, grass, man-made, and trees.

This poster will describe the procedures for viewing and measuring image, Computer-guided (Unsupervised) and User-guided (Supervised) Procedures will be described on image stacking to view each classification one at a time and stack them into a complete Classified Image. The application of unsupervised and supervised classification in agriculture will be discussed by giving examples of measurement of field reflectance of two classes of giant salvinia [green giant salvinia (green foliage) and senesced giant salvinia (mixture of green and brown foliage)], and invasive aquatic weed in Texas.

Keywords: Image Classification, supervised classification, unsupervised classification

I INTRODUCTION:

Geographic Information Systems (GIS), Global Positioning System (GPS) and Image classification are powerful tools for acquiring and studying geographic data quickly and accurately [1] GIS is a computer-based tool for mapping and analyzing features and events on earth. GIS technology integrates common database operations such as query and statistical analysis, with maps. GIS is a tool used by schools, governments, and businesses seeking innovative ways to solve problems and increase the quality of decision making. NASA's Earth Science Division has undertaken the task of promoting and educating private and academic organizations in the use of GIS, GPS, and Image Classification technologies. The scientists at NASA' s John Stennis Space Center in Mississippi encourage students and educators to avail the images and data for developing skills in the use of GIS and image classification technologies. Image Classification is a simple way to visualize major features of a remote sensing image. Classification works by identifying visual or data values for each and every pixel on an image. ERDAS Imagine Software Package is a simple and useful tool for visualizing and manipulating geographic imaging data [2]. IMAGINE software is geared to entry-level users, but is also capable of executing a wide variety of tasks from basic classification to higher-level modification.

The main task utilized in this project was the Classification function of I.MAG1NE software for unsupervised and supervised classification of aerial image of John Stennis Space Center. Once this is done IMAGiNE identifies areas of similar appearance, in the case of photographic images, or similar signatures, in the case of spectral or data images. Based on this information the software can "classify" the image into multiple areas of similarity. Image Classification can be separated in to two categories Unsupervised Classification and Supervised Classification [3]. Unsupervised Classification is carried largely by the software with the user only defining the number of classifications while Supervised Classification allows the user td define certain signatures from which the image is classified [4].

A. *Statement of Problem*

At NASA's John Stennis Center, scientists are engaged in research and development of many Earth-sensing satellites which have diverse sensors mounted on sophisticated platforms. These are in Earth orbit or soon to be launched. These sensors are designed to cover a wide range of electromagnetic spectrum and are generating enormous amounts of data that must be processed, stored, and made available to the user community.

This project is a continuation of work undertaken by faculty advisor (Shobha Sriharan) by Wilbert Long (Graduate Student at Virginia State University. To learn the use of the software ERDAS or classification, the Stennis Space Center (SCC) image was selected because it is available in digital form. The purpose of this classification was to identify the various classes of physical structures and vegetation by spatial quantification.

The interest in classification of SSC Image is to learn the process of classification: supervised and unsupervised.

B. *Objective*

The objective of this project is to learn the use of software Imagine for image classification using available image with data. By availing the information on John Stennis Center image through the faculty advisor (Shobha Sriharan), Wilbert Long (student author) conducted the unsupervised and supervised classification of this image with ERDAS Imagine. The purpose of this study was to perform Unsupervised and Supervised Classification in order to get a greater degree of accuracy. The classified image was visualized using a method called Image-stacking. Once Unsupervised Classification, Supervised Classification, and Image Stacking were done to the image.

II. METHODOLOGY

A. *Image Classification:*

Classification involves labeling the pixels as belonging to a particular spectral and thus information classes using the spectral data available. The image classification procedure is to automatically categorize all pixels in an image into land cover classes or themes. Image classifiers are used in hybrid mode and the approach depends upon the nature of the data being analyzed, the computational resources available, and the intended application of the classified data

B. *Unsupervised Classification*

The analysis of distribution of natural habitats allow us to describe the ecosystem which include forest, wetlands, farmland, pastures, and community (cities, counties. The unsupervised classification facilitates illustration of physical features in any given image. The process involves taking a sample of pixels observations from two-channel digital image data set. The two dimensional digital values (*measurement vector*) attributed to each pixel may be expressed graphically by plotting them on a scatter diagram (scatter plot).

The procedure carried out in this project is outlined in Chapter 4 of the IMAGINE tutorial ([1] The first step in carrying out Unsupervised Classification is to open the Classifier Tool from the IMAGINE toolbar. Once the Classifier Dialog box is open the user then selects Unsupervised Classification from the Menu. The user will then be prompted to select the input image file, or the file to be classified. The file being classified in this project was "Building 2105" from the "kingfish" network directory.

B. Supervised Classification:

The first step in Supervised Classification was opening the Signatures Editor from the Classifier Menu. After opening the Signature Editor the image being classified was opened using the Viewer. After opening the Signature Editor the image being classified must be opened using the Viewer. Once the file was opened in the viewer, we selected the areas that defined the signatures. In order to do this, the Polygon Tool from the Attributes Editor was used. Using the Polygon Tool and by zooming in and out of the image, we selected specific areas of the image where the features were known. Once the selected an area of known characteristics, we then added to the signature editor by using the "add signature button." To capture multiple areas known to have the same feature, we added several polygon signatures and then merged. , we then labeled the signature with the name of the feature. After several features were identified, the signatures were saved as a signature file (*.sig) The image was also saved as an image file (*.img) with the same name. In order to view the classified image both the image file and the signature file was opened in the Viewer.

B. Image-Stacking

Image Stacking is not a built-in function of IMAGINE software, but rather is a useful visualization method that the user can employ using several of IMAGINE's tools. The first step in image-stacking was opening the original image in the Viewer. The next step was to select Open Raster Layer from the File menu in the Viewer. In the Open File dialogue, the image and signature files of the classified image were opened. The fit to window option was selected and the replace image options were deselected so that the classified image does not replace the original image. The classified image now sits on top of the original image. Each classification can now be viewed be selecting opacity of all other signatures and setting them to zero. In this way, each classification was viewed on top of the original image and then stacked to create a completely classified image.

III. FINDINGS

Figure 1 shows the original image of Building 2105 used for this project. In this image, like most Remote Sensing photographs taken in the color-infrared range, the vegetation shows up as a red color. Man-made structures appear as white, gray, or bright yellow surfaces. In the first classification of the image 6 categories were selected in an Unsupervised Classification. The result was an over classification of the image with many of the signatures representing incorrect features. To correct this, the number of categories was reduced to 4 and the image was reclassified. Figure 2 shows the image Unsupervised Classified into 4 categories: 1) Trees 2) Grass 3) Man-made and ***4)*** Shadow. As one can see the image is quite clear but there is still some misclassification due to the fact that the software could not distinguish between the dark areas of some of the rooftops and the shadows of the trees. In order to further increase the preciseness of the classification Supervised Classification was then applied to the image. Figure 3 shows Supervised Classification of the Building 2105 now with the rooftops distinguished from the shadows of the trees. Finally Figures 4 & 5 show the extension of Classification to an entire Stennis Space Center. Figure 4 shows the raw picture while Figure 5 shows a Supervised Classification of the same image.

IV APPLICATIONS

The application of classification in agricultural discipline can be seen by taking few examples. In this paper, few examples are shown by citing the work conducted by the scientists at the USDA-ARS Remote Sensing Laboratory, Weslaco, Texas. Two particular studies highlighted in this project are the tracking of Giant Salvinia (*Salvinia molesta* Mitche!l) in Southeastern Texas and Waterlettuc (*Pistia stratiotes*) in Texas waterways.

Figure 6 shows the tracking of Giant Salvinia (light yellow) in an aquatic field while Figure 7 shows the same tracking done on Waterlettuce (yellow). Both Figures were classified unsupervised, yet are still capable of identifying the particular invasive species. Figures 8-14 show some more applications of Remote Sensing in agriculture. Figure 8 is a color-infrared image of sorghum grain fields affected by chlorosis (white areas on the image). Figure 9 and 10 show color-infrared and near-infrared images of sooty mold deposits caused by the

Citrus Blackfly, respectively. The near-infrared image (left) is more sensitive to the mold deposits and as a result is able to show more clearly its spread. Finally Figure 11 -14 show an image of Cotton fields divided into four bands (1) color-infrared (CIR), 2) near infrared (NTR), 3) red and *4)* green wavelengths.

V. CONCLUSION

This project allowed us to demonstrate the effectiveness of ERDAS Imagine in performing unsupervised and supervised classification iof an image with data. First, the use of tutorial from ERDAS Tour Guide [1] for acquiring and classifying GIS and Remote Sensing images. Classification is a simple and useful tool, especially when done supervised, for viewing and measuring GIS images. Classification can be done in two ways, Unsupervised (Computer Guided) or Supervised (User Guided). Image stacking is a way to view each classification one at a time and stack them into a complete Classification can be extended into agriculture research and is especially useful for tracking parasitic and infective species. Images can be divided into bands of the color-infrared spectrum in order to get an even clearer of picture of infestation

Directions for Future Research

The classification can be applied to solving agricultural and environmental issues. It is proposed to apply unsupervised and supervised classification for tracking of parasitic species in agricultural fields. ERDAS Imagine software will be appropriate software to perform the classification.

VII. ACKNOWLEDGEMENTS

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VII REFRENCES

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FIGURES

Figure 1: Building 2105 (Original)

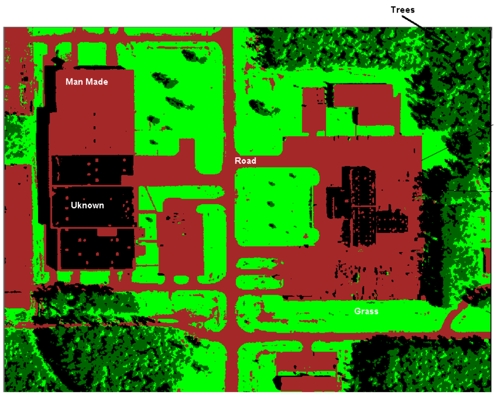

Figure 2: Building 2105 (Unsupervised Classification)

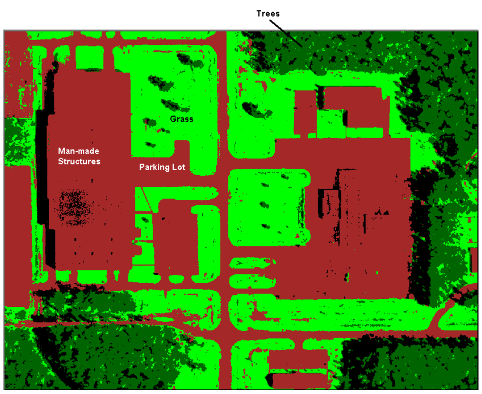

Figure 3: Building 2105 (Supervised Classification)

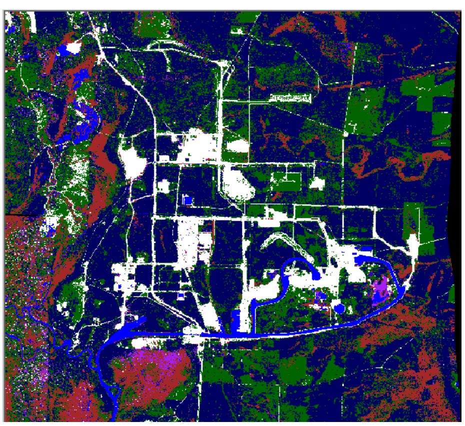

Figure 4: Stennis Space Center(Original)

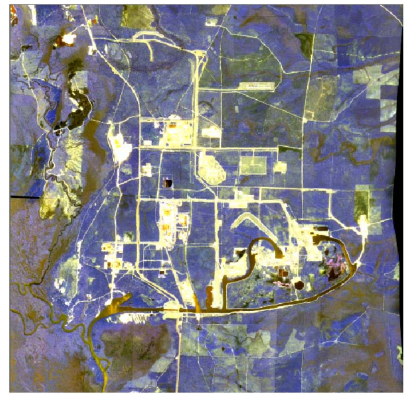

Figure 5: Stennis Space Center (Supervised Classification)

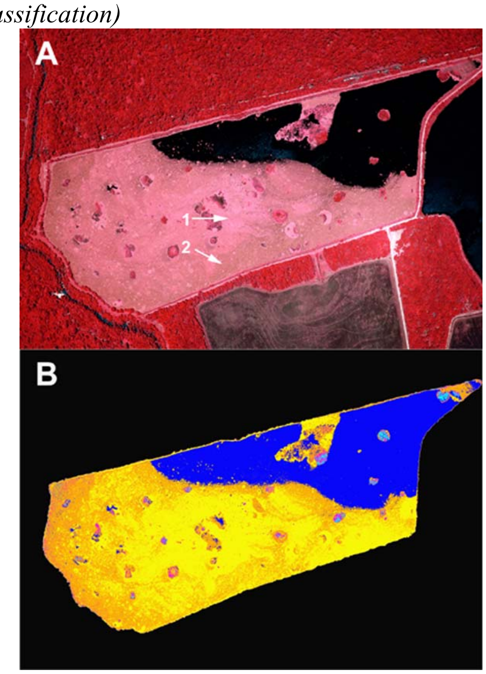

Figure 6: Giant Salvinia (light yellow)

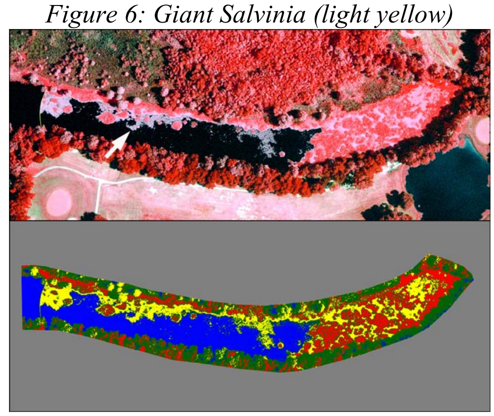

Figure 7: Waterlettuce (yellow)

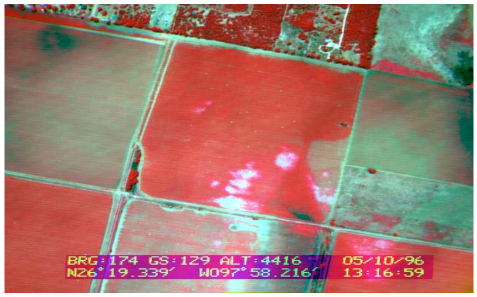

Figure 8: Color-infrared Image of Sorghum Grain Fields

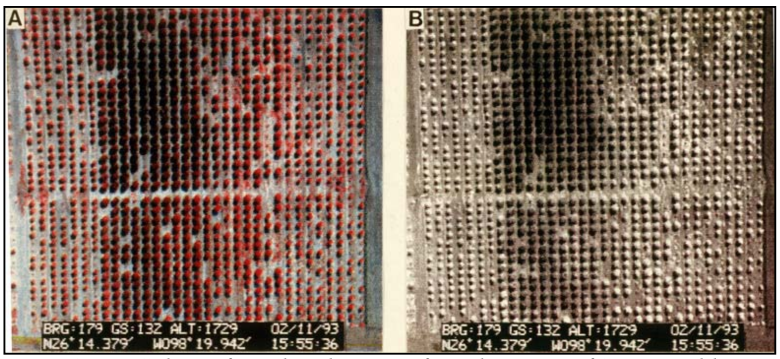

Figure 9 & 10: Color-infrared and Near-infrared Images of Sooty Mold Deposits

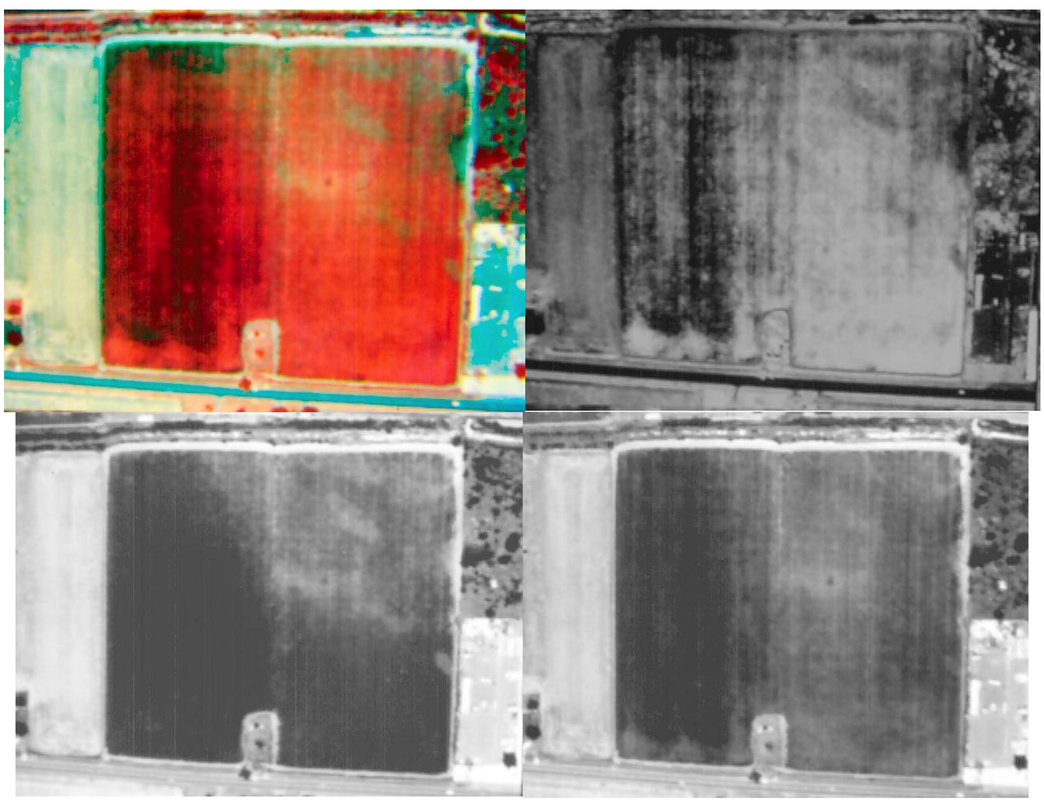

Figure 11: Color-infrared of Cotton Field (top left)
Figure 12: Near-infrared of Cotton Field (top right)
Figure 13: Red wavelengths of Cotton Field (bottom left)
Figure 14: Green wavelengths of Cotton Field (bottom right