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Preface

This document is a formal layout of the implementation of the Vegetation Mapping System at both a high and low level. It differs from previous documents in that rather than functioning as a design tool, the Implementation Manual documents the features and design of the finished product. It serves as a tool for understanding the Vegetation Mapping System as well as troubleshooting or adding to the system.

Document Change History

> Initial version: May 1, 2001
### Glossary

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<th>Term</th>
<th>Definition</th>
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<td><strong>band</strong></td>
<td>a 1-month collection of data points (pixels) abstracted in a 2D array. Multiple bands exist in an .ipw image file.</td>
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<td><strong>Fourier analysis/ Discrete Fourier Transform (DFT)</strong></td>
<td>(see <a href="http://www.intersrv.com/~dcross/fft.html#section3">http://www.intersrv.com/~dcross/fft.html#section3</a> for an overview) – an algorithm which converts a sampled complex-valued function of time into a sampled complex-valued function of frequency. Applied here, allows filtering of noise, bias, etc., to obtain the discrete elements of patterns forming the image.</td>
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<tr>
<td><strong>harmonic</strong></td>
<td>a wave whose frequency is a whole-number multiple of that of another. Successive harmonics reveal patterns in immediately preceding ones from the output of the Fourier analysis.</td>
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<td><strong>IPW/ IPWtool3</strong></td>
<td>an application that manipulates and calls other applications to perform operations on .ipw image files (which are composed of ASCII header information followed by binary image data). Integrates the Tcl/Tk gui and will eventually have hooks for all applications the group writes.</td>
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<tr>
<td><strong>Polar Graphing Tool (PGT)</strong></td>
<td>a tool (currently conceptualized in the SPlus statistical language) that will take as input .ipw image files that have been processed by the DFT program and will construct polar plots with axes mapped correctly (division by month quadrants, color, etc.) of magnitude versus phase of groups of pixels from the original satellite image.</td>
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<tr>
<td><strong>SPlus</strong></td>
<td>(see <a href="http://www.isds.duke.edu/computing/S/Snotes/node2.html">http://www.isds.duke.edu/computing/S/Snotes/node2.html</a> - SECTION0002000000000000000000 for an overview) - an integrated suite of software facilities for data manipulation, calculation and graphical display of statistical methods.</td>
</tr>
<tr>
<td><strong>Tcl/Tk</strong></td>
<td>(see <a href="http://www.scriptics.com/software/tcltk/">http://www.scriptics.com/software/tcltk/</a> for an overview)</td>
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<tr>
<td>- Tcl (Tool Command Language) is a program scripting language available for most modern operating environments that integrates diverse resources. Tk is a graphical user interface toolkit that makes it possible to create powerful guis.</td>
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<tr>
<td><strong>Vegetation Mapping System (VMS)</strong></td>
<td>the group's name for the core application integrating the Tcl/Tk gui, the DFT application, the PGT application, and IPWtool3.</td>
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1. Introduction

In the user environment the product looks and acts as a single system where all functionality is accessed through the GUI. This was intended in order to accomplish a user-friendly environment. However, in order to better understand the system it is helpful to break the system into four separate components as follows:

1. Graphical User Interface
2. IPWTool3
3. Discrete Fourier Transform
4. Polar Graphing Tool

These four components make up the Vegetation Mapping System and will be examined at length throughout the rest of this document.

All features discussed in this manual have been implemented and are fully functional. When updating this product the Implementation Manual should also be updated and changes recorded in the Document Change History section.
2. High-Level Implementation Specification

2.1 Structural Models

![Diagram showing structural models and their connections]
Distribution of subsystems:

We are considering the GUI and IPWTool3 as separate components. From the GUI the functions of the DFT and PGT and IPWTool3 are accessible. All the routines have read and write access to IPW files, and the GUI is able to select IPW files for read access through IPWTool3. IPWTool3 allows one to view both the original satellite IPW images and the post-DFT IPW images in addition to the statistics and coordinates files output from the DFT. Our single interface is the pre-existing GUI written for IPWTool3.

2.2 Control Model Diagram:
3. Detailed Implementation Specification

- Legend for Object Model Diagram:

- Routine Component
  - Functions
  - Variables
  - Classes
  - Operations

3.1-A Tcl – Tk GUI

3.1-A.1 IPW Tool3
- Menus Boxes
- Radio Buttons
- Drop-down
- Scroll-bars
- ... Widgets
- Menu hooks to PGT/DFT

3.1-A.2 DFT
- Procedure Calls
- Execute shell script

3.1-A.3 PGT
- Procedure Calls
- Produces graph from processed image
3.1-B DFT

3.1-B.1 |M|
\[ \text{magn}[i] = \sqrt{\text{real}[i]^2 + \text{imag}[i]^2} \]
Calculate |M|

3.1-B.2 Phase
Use trig function to calculate real and imag parts of phase
- Calculate phase
- Scale phase for consistency and maximize for 8-bit res
- Adjust phase signs to make sure angles are consistent with S-Plus implementation
3.1-C.1 Graph Processing
- Point Class (Array of Points)
- Color Scheme (Record)
- Scaling Function
- Graphing Function

- Create Axis
- Load Coordinates
- Select Coordinates
- Draw Polar Graph

3.1-C.2 Mean Value
- Inherits Graph Classes
- Mean Value Functions
- Calculate Mean Value
- Select Region

3.1-C.4 Elliptical Standard Deviation
- Inherits Graphing Classes
- Standard Deviation fn
- Elliptical Graphing fn
- Draw Standard Deviation

듭시오플라멘킨 스펙시피케이션 (cnt'd)

3.1-C PGT
3.1-D IPWTool3

3.1-D.1 IPW Image Manipulation
- Image Bands (n 2-d arrays)
- IPW headers
- Load Image
- New Image
- Save Image

3.1-D.2 Region Select
- Mouse Actions
- Color Coded Regions
- Choose Color Schemes
- Select Polygon
- Close Polygon
- Clear Selection
- Assign Colors to Selection

3.1-D.3 Charting Functions
- Scatter plots
- Functionality included in current product
- Scatter plots
* PGT is considered a separate charting function

Detailed Implementation Specification (cont’d)
Detailed Implementation Specification (cont’d)

3.1-E Param Files

3.1-E.1 Original Satellite Images (IPW File)
- ASCII Header
  - Revision History
  - Region Selected
  - Original Image Size
  - Date and Time
  - Binary Image

  - Load IPW File
  - Save IPW File

3.1-E.2 DFT Processed Images (IPW File Produced by DFT)
- ASCII Header
  - Revision History
  - Region Selected
  - Original Image Size
  - Date and Time
  - Binary Image

  - Load IPW File
  - Save IPW File

3.1-E.3 PGT Graph File
- Binary Graph Image

  - Load Graph
  - Save Graph
4. Interface Specs

This section is closely related to the Data Flow Diagram following. Here we examine exactly how each of our main objects interact. The Data Flow diagram following takes it a step further to include data flowing through the complete functional system.

All components of the system interact solely through the GUI. The user also interacts with all components through the GUI. This preserves a user-friendly environment while maintaining a modular system design.

> 4.1 Interface diagram (The only interaction is between the GUI and each of the three modules. The modules are in no way connected.)
These items within the blue dashed line are important characteristics of the IPW image produced by the DFT, not components of the system.