

Contents

Introduction	10
What is ENVI?	10
ENVI + IDL, ENVI, and IDL	10
What's New in ENVI 5.3	11
Sensors and Data Formats	11
Image Processing	11
User Interface	2
ENVI Resources	1
Contacting Exelis Visual Information Solutions	1
Training	1
Tutorials	1
ENVI Support	1
Contacting Technical Support	2
Online Resources	2
Website	2
IDL Newsgroup	2
About this Training Manual	2
Chapter 1: Mastering The Basics	3
Learning Objectives	4
Prerequisites	4
Required Tools	4
Associated Data	4
Fundamentals	4
Exercise #1: Starting ENVI and Exploring the Toolbox	4
Setting Preferences and Display Management	6
Exercise #2: Setting Preferences	6
Exercise #3: Opening and Displaying Images	7
Open and Display the Landsat 8 Imagery	7
The Data Manager	9
Working with Layers and Multiple Views	11
Exercise #4: Working with ENVI's Buttons and Sliders	14
Exercise #5: Contrast Stretching and Other Tools	18
Exercise #6: Portals	19
Exercise #7: Blend, Flicker, and Swipe	20
Chipping and Saving	21
Exercise #8: Saving the Display	21
Exercise #9: Using ENVI Help	21
Closing Files	23

Introduction

Exercise #10: Close Files	23
Skills Check	24
Self Test	24
Chapter 2: Data Types, Image Display Concepts and Introducing Vectors	25
Learning Objectives	26
Prerequisites	26
Required Tools	26
Associated Data	26
Reading Raster Image Data	26
ENVI's Image Format	27
About Header Values: Data Types	27
Interleave	27
Byte Order	28
Stretching Image Data	28
Exercise #1: Comparing Data and Stretched Values	29
What is meant by "contrast stretch"?	30
The Default Stretch Hierarchy	33
Color Tables	33
Exercise #2: Applying Color Tables	34
Raster Color Slices	35
Exercise #3: Applying Raster Color Slices	36
Working with Vectors in ENVI	38
Exercise #4: Adding Vector Data to a Raster Image	39
Changing Vector Properties	40
Skills Check	43
Self Test	43
Chapter 3: Burn Severity and Ecological Risk Assessment	44
Learning Objectives	45
Prerequisites	45
Required Tools	45
Associated Data	45
Background	45
Exercise #1: Conduct Atmospheric Correction and Convert Radiance Data to Reflectance Values	46
Atmospheric Correction	46
Important Step!! –	47
Exercise #2: Conduct Slope Analysis Using Elevation Data	48
Use Raster Color Slices to Visualize Data Ranges	49
Exercise #3: Subsetting Imagery and Creating Masks	49
Subsetting an Image Using the Extents of a Pre-defined Region of Interest (ROI)	49

Build a Mask from a Range of Values in an Image	52
Exercise #4: Characterize Levels of Burn Severity within Fire Area	53
Use Raster Color Slices to Visualize Analysis Results	56
Exercise #5: Produce a Report of Analysis Findings and Share Results	58
Sending Your Work to PowerPoint.....	59
Skills Check	60
Self Test	60
Chapter 4: Pre-Processing WorldView-2 Data	61
Learning Objectives.....	62
Prerequisites.....	62
Required Tools	62
Associated Data	62
Background	62
Exercise #1: Preprocessing of WorldView-2 Data	63
Calibration to Radiance	63
Dark Object Subtraction	64
RPC Orthorectification.....	66
Skills Check	68
Self Test	68
Chapter 5: Exploring & Understanding SWIR Data.....	69
Learning Objectives.....	70
Prerequisites.....	70
Associated Data	70
Background Information	70
Why SWIR?.....	70
Benefits.....	71
Background: Details for WorldView3 Data	71
Exercise #1: Starting ENVI 5 and Setting Preferences	72
Exercise #2: Loading and Visualizing Data	72
Exercise #3: Understanding Spectra	73
Quick Atmospheric Correction (QUAC).....	73
Spectral Signatures	73
Turning Wavelength Data into an Image.....	75
Displaying Data	75
Understanding the New World View 3 Bands	77
Displaying Color Composites with WorldView 3	79
Exercise #4: Collecting Endmember Spectra and Performing Image Classification	81
Post Classification Cleanup.....	86
Chapter 6: Thematic Change of Agricultural Plots in Indiana	90

Introduction

Learning Objectives.....	91
Background	91
Calibration	91
Learning Tasks.....	92
Associated Data	92
Exercise #1: Working with Layers and Band Combinations	92
Exercise #2: Calibrate Landsat Data	96
Exercise #3: Define a Study Area by Spatial Subset.....	97
Exercise #4: Classification Workflow	101
Combine Classes	102
Exercise #5: Thematic Change Workflow	104
Exercise #6: ArcGIS Integration (Optional).....	107
Skills Check.....	107
Self Test	107
Chapter 7: Classification Using the New ROI Tool in ENVI 5.3	108
Learning Objectives.....	109
Prerequisites.....	109
Required Tools	109
Associated Data	109
Background Information: Landsat 8	109
What Are The Best Spectral Bands to Use For My Study?	110
Table 6.1.....	110
Background: Processing details of Landsat 8 Level 1 Products	111
Table 6.2.....	111
Naming Conventions for Landsat Scene Identifiers	111
Background: ENVI Landsat 8 Support	112
Downloading and Accessing Landsat 8 Data.....	112
Exercise #1: Loading and Visualizing Data	112
Exercise #2: Band Animation Tool	114
Raster Color Slices.....	117
Exercise #3: Exploring the ROI Tool.....	118
Exercise #4: Creating ROI's with the Scatter Plot Tool	123
Exercise #5: Creating ROIs on Your Own	131
Exercise #6: Running Maximum Likelihood Classification	132
Exercise #7: Post-Classification Cleanup	134
For ENVI 5.2 and Later: Classification Aggregation Tool	138
For Pre-ENVI 5.2 Users: Sieve and Clump Classes.....	139
Skills Check.....	143
Self Test	143

Chapter 8: Seamless Mosaic of Haiti Port Area	144
Learning Objectives.....	145
Required Tools	145
Associated Data	145
Background	145
Exercise #1: Creating a Mosaic	145
Ordering.....	148
Data Ignore Value	148
Seamlines.....	149
Defining Output Area (Subsetting)	155
Color Correction	155
Feathering Distance	158
Exercise #2: Annotating Your Imagery	160
Creating a PowerPoint Presentation	163
Exercise #3: Exporting Images to GeoTIFF Format	164
Skills Check.....	164
Self Test	164
Chapter 9: Hyperspectral Target Detection and Material ID	166
Learning Objectives.....	167
Prerequisites.....	167
Associated Data	167
Background	167
Calibration	167
Atmospheric Correction.....	168
Solar Irradiance Curve	168
Atmospheric Gas Absorptions.....	169
Atmospheric Scattering	169
QUAC (Quick Atmospheric Correction).....	170
Exercise #1: Converting to Reflectance with QUAC	170
FLAASH (Fast Line-of-sight Atmospheric Analysis of Spectral Hypercubes).....	172
Exercise #2: Converting to Reflectance With FLAASH	172
Target Detection	174
Exercise #3: Basic Target Detection with ACE.....	174
Exercise #4: Using ACE for Target Detection in THOR	177
Part 1: Simple Target Detection Results	178
Part 2: Target Detection Results with Confusers	180
Material Identification	183
Exercise #5: Basic Material ID with ACE	183
Exercise #6: Material ID with ACE and a Specialized Library	185

Introduction

Skills Check	187
Self Test	187
Chapter 10: Image Transforms and Exploring Hyperspectral Data	188
Learning Objectives.....	189
Prerequisites.....	189
Required Tools	189
Associated Data	189
Background	189
Exercise #1: Principal Components Rotation	190
Exercise #2: Viewing PCA Statistics.....	194
Exercise #3: Vegetation Indices with Hyperspectral data.....	196
Skills Check.....	197
Self Test	197
Appendix A: Mapping Gulf Coast Erosion With Feature Extraction and Thematic Change Detection	199
Learning Objectives.....	200
Prerequisites.....	200
Required Tools	200
Associated Data	200
Background	200
Exercise #1: Layer Stacking	200
Exercise #2: Coastline Mapping With Feature Extraction.....	202
Exercise #3: Mapping Coastal Erosion with Thematic Change.....	207
Exercise #4: Produce Report of Findings and Share Results (Optional).....	208
Skills Check.....	212
Self Test	212
Appendix B: Developing an Urban Map of Al-Fallujah, Iraq.....	213
Learning Objectives.....	214
Prerequisites.....	214
Required Tools	214
Associated Data	214
Background	214
Exercise #1: Rule-Based Feature Extraction	215
Exercise #2: Exporting Vector Files to ArcMap	224
Skills Check.....	227
Self Test	227