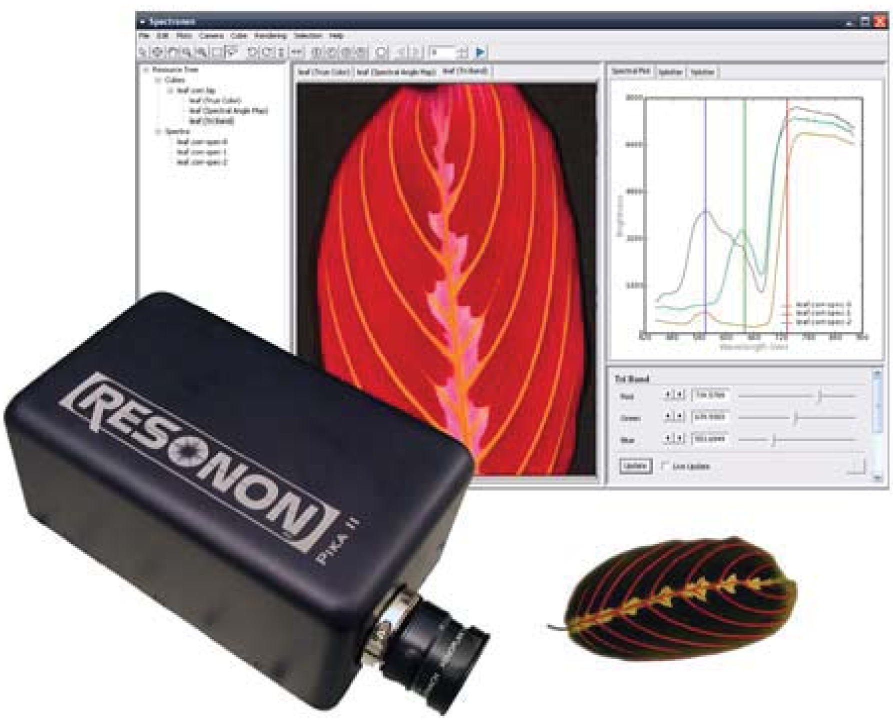
PIKA SERIES IMAGING SPECTROMETERS AND SPECTRONON SOFTWARE

User Manual



Document Change History

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V1.1	9/12/08	Cws	Updated
V1.2	5/28/09	RCS	Updates

Updated 5/28/2009

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Version 1.1 (April 2007)

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Customer support forum	www.spectronon.com/bb
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Table of Contents

Introduction

Resonon's Pika imaging spectrometers are compact, high-fidelity, digital instruments for industrial and scientific applications. Spectronon is a powerful hyperspectral data collection and analysis software package. Spectronon's data collection tools are highly integrated with the Pika imaging spectrometers to streamline the collection of spectral images. Spectronon's data viewing and analysis functions can also be used without a Pika imaging spectrometer. For data viewing and analysis, Spectronon is easy to learn, offers efficient workflow, and is highly extensible by the user for custom applications.

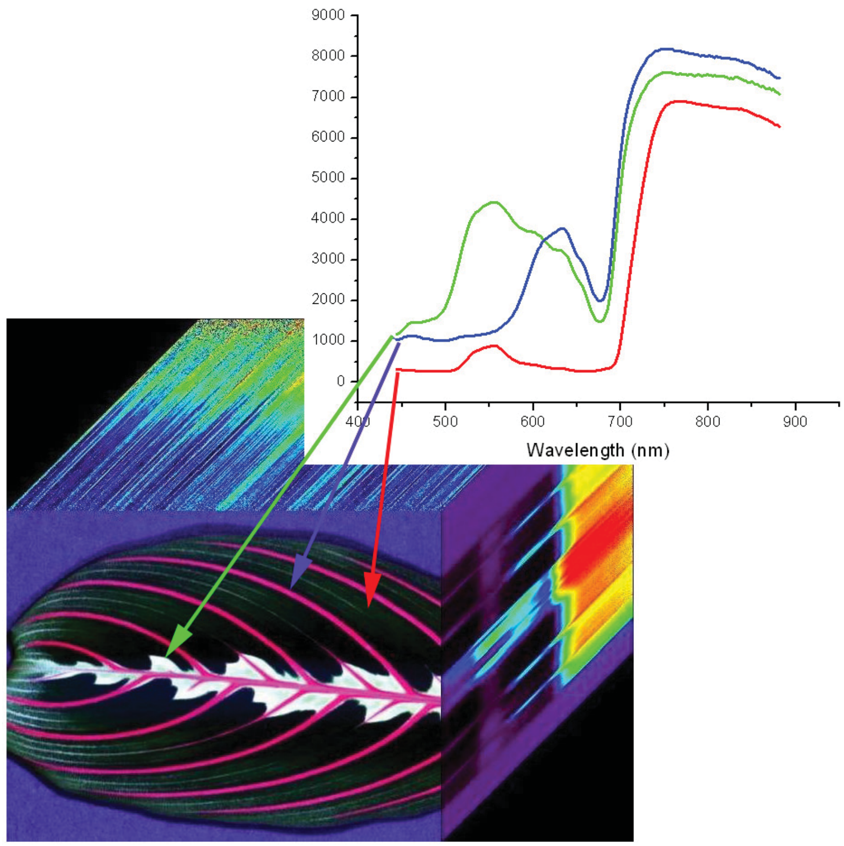
This User Manual covers the installation and use of Pika series imaging spectrometers and Spectronon software. Due to the tight integration between the Pika series imaging spectrometers and Spectronon, both topics are covered together. Users of Spectronon without a Pika can skip sections specific to the Pika II.

Topics covered in this manual:

- *Introduction to Hyperspectral Imaging*
- *Setting up the Imaging Spectrometer and Additional hardware*
- *Installing Spectronon Software*
- *Collecting Hyperspectral Data*
- *Viewing and manipulating Data*
- *Advanced Features of Spectronon Software*
- *Advanced Data Manipulation and Analysis*

Brief Introduction to Hyperspectral Data

Hyperspectral Imaging, or imaging spectroscopy, refers to the creation of a digital image containing very high spectral (color) resolution. Each spatial point (pixel) in a hyperspectral image represents a continuous curve of incoming light intensity versus wavelength. The data can also be interpreted as a stack of images, with each layer in the stack representing the scene at a different wavelength.



Hyperspectral imaging has a long heritage as a remote sensing tool, operating from satellites and airplanes. In this capacity, it has proven itself as a useful tool for scene discrimination; the Pika series imaging spectrometers provide this powerful capability in a cost-effective, compact package.

Requirements

- Windows® XP Service Pack 2
- 512MB of RAM, 1 Gig or more recommended
- Intel® Pentium 4 2.0GHZ or compatible processors
- AGP video card with 64 MB video memory
- 32-bit standard PCI slot for IEEE-1394 card
- Firewire 800 port with Texas Instruments OHCI Compliant IEEE 1394b Host Controller

Installation

This chapter covers:

- Installing the Hardware
- Installing the Software

Installing the Hardware

The Pika series spectrometers are *linescanning* instruments; meaning that they collects one line of image data per frame. In order to collect a 2D image, a Pika imaging spectrometer or the object to be imaged must be physically moved, or *scanned*. Resonon sells two options for scanning: a Rotation Stage, which is a tripod-based unit intended for outdoor use, and a Linear Stage which is intended for scanning objects under controlled lighting.

Rotation Stage

First, attach the Rotation Stage mounting bracket to the bottom of the Pika imaging spectrometer using the provided screws (low-head, 1/8”, #¼ -20) as shown below:

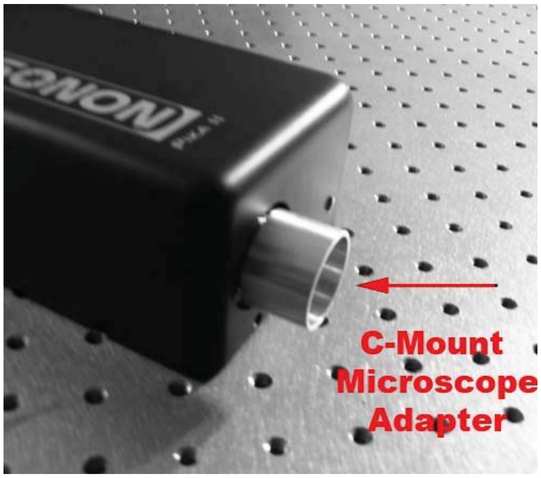
Second, attach the Pika imaging spectrometer to the Rotation Stage and tighten the set screw in the Rotation Stage mounting bracket.

Translation Stage

To use the translation stage, attach mounting posts to the mounting holes in the base of the Pika imaging spectrometer, then insert the mounting posts to the post-holders on the stage frame.

Microscope Option

First, screw in the C-Mount Microscope adapter into the threads on the front of the Pika imaging spectrometer. (Note: If your Pika spectrometer was purchased with an objective lens as well as a C-Mount Microscope adapter, you will have to remove the objective lens before you can attach the Microscope adapter. This should be done in a low-dust environment to decrease the chances of getting particulate contamination in the slit.) This is shown below:



Second, mount the Pika II on the camera port of your microscope and lock down the set screw in the C-Mount Microscope adapter.

Adjust the focus of the microscope while viewing the focusing object through the microscope's eyepieces. Then, adjust the focus on the camera port of your microscope until the instrument is focused simultaneously.

Cables

Before installation of the software, please connect the USB Stage Controller and the Pika II (via the provided Firewire 800 cable) to your computer.

Lighting

Proper lighting is very important to collecting high fidelity data. A brief introduction to lighting techniques is covered in Chapter 3.

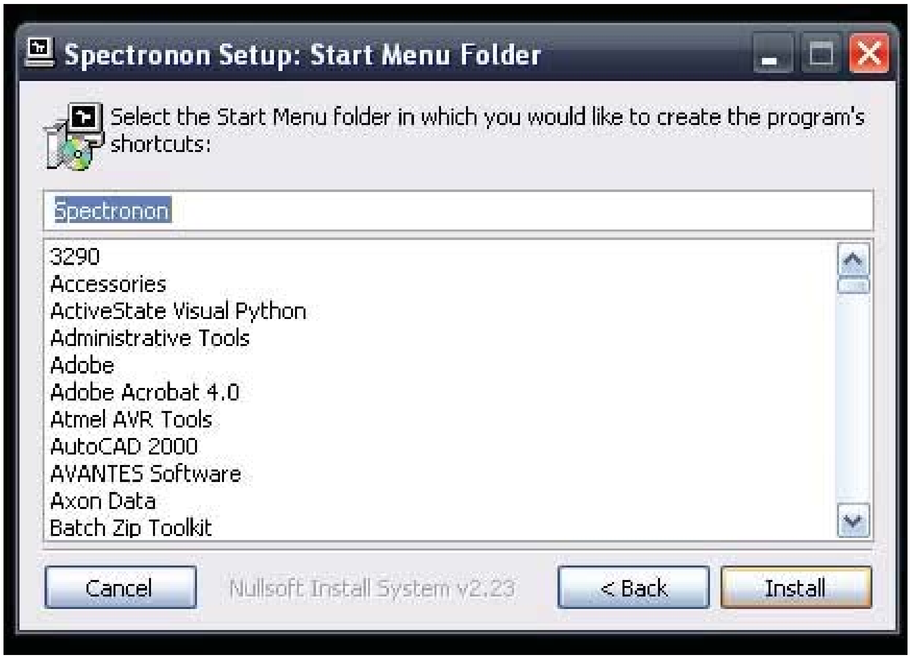
Installing the Software

Resonon's hyperspectral data collection and analysis software, Spectronon, provides the user interface for collecting data from Pika spectrometers. The software also includes data viewing and manipulation functionality, which can be used without a Pika spectrometer on any hyperspectral data of the proper format (.bil, .bip, or .bsq, with an ENVI© formatted header file). To use the software for data acquisition, the Pika imaging spectrometer and scanning stage controller must be plugged in before the installation process begins. If Spectronon has been installed previously without the Pika or scanning stage controller plugged in, the software must be reinstalled with those units plugged in before they can be used. Once installed, Spectronon can be run with or without the hardware attached.

First, download Spectronon software from www.resonon.com/downloadPro. A username and password are included with your spectrometer, or contact Resonon if you have lost your username and password.

To install Spectronon, **double-click Setup.exe** and follow the screens below:

Click Next



Click Install

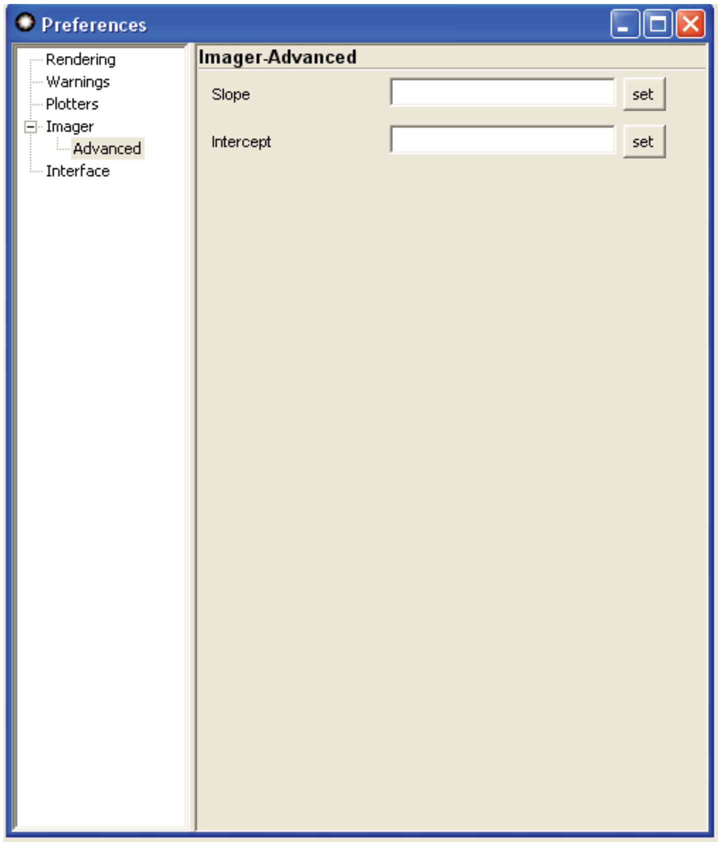
Click Continue Anyway

Click Continue Anyway

Once finished, please **restart your computer**. Spectronon software is now installed.

Calibration: Before using your new Pika spectrometer you will need to put in the calibration values for your spectrometer. These values are included on a sheet with your spectrometer. If you have lost your calibration values, please contact Resonon.

To install the calibration values for your Pika Spectrometer: Window→ Preferences→ Imager → Advanced. This will bring up the window below.



Type in the Slope and Intercept values for your Pika spectrometer and click the "set" buttons for each.

Note: Windows XP Service Pack 2 contains a bug that limits to maximum bandwidth of Firewire 800. In Spectronon, this bug limits the maximum framerate of the Pika II to 7.5 FPS. Patches are available, but change frequently. Please contact Resonon for support for the current patch.

Collecting Data

This chapter covers:

- Lighting Fundamentals
- Using the Autoexposure feature
- Focusing the Pika II
- Dark Current and Response Correction
- Collecting and Saving Data
- Adjusting the Scanning Stage settings

Lighting Fundamentals

Proper lighting is essential in the process of collecting high fidelity hyperspectral data. The three most important factors for lighting are:

1. Stable (spectral stability and intensity stability)
2. Diffuse
3. Spectrally Continuous (not fluorescent or discharge)

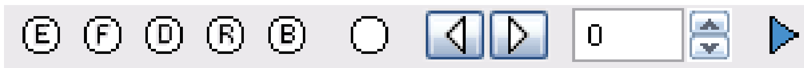
Halogen lights are good, inexpensive sources. Incandescent lamps are also acceptable, but are not as bright as halogen. Fluorescent or discharge lamps, contain sharp spectral features of high intensity at some wavelengths and low intensity at other wavelengths. These lamps are not recommended, as they do not provide sufficient illumination at many of the wavelengths of interest**. If the blue and UV spectral regions are of particular importance, a high color temperature (>4500ºK) or 'Daylight' halogen bulb should be used as most conventional halogen bulbs do not emit much light in the low blue/UV region.**

To improve the stability of halogen or incandescent lights, let the lights warm up for at least 5 minutes prior to collecting data. Additionally, a regulated power supply for the lights is highly recommended.

To diffuse the light sources, ground glass plates or plastic diffusers are recommended. Integrating spheres are ideal but expensive and often impractical. Diffusers should be positioned between the light sources in a manner to maximize the uniformity of the illumination on the object.

Preparing for Data Collection

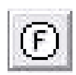
To begin the data collection process, ensure that the imager and scanning stage are plugged in and that the lights are on and properly warmed-up. Launch Spectronon. The imager and stage controls should be active (not grayed), as shown below.



Focusing

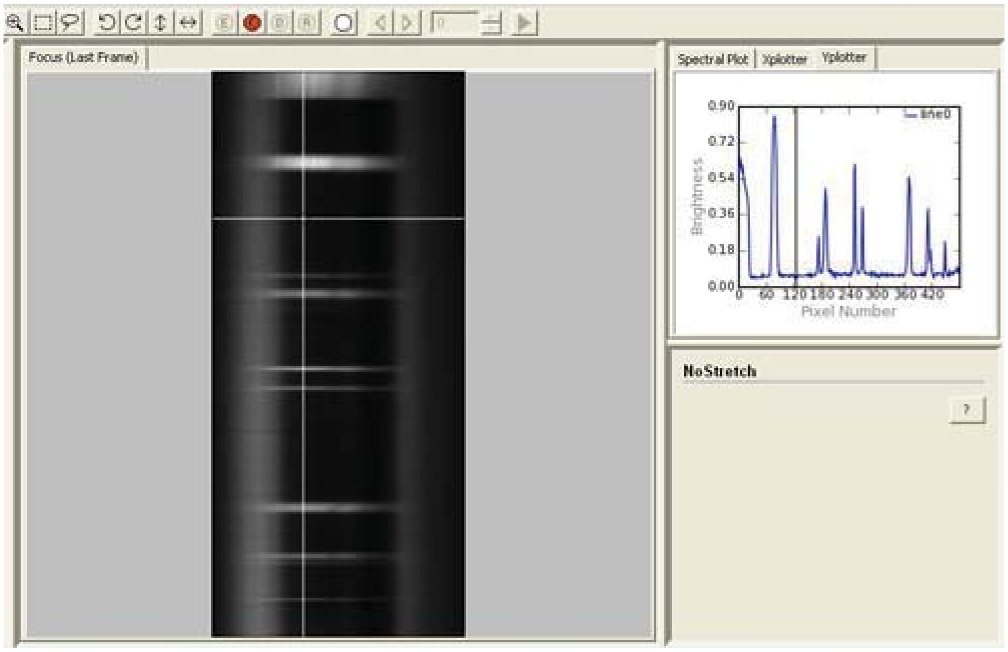
Place the Spectralon© or Teflon© sheet in the field of view of the imager, in place of the object to be imaged. Press the AutoExposure button, shown below.

This function will automatically set the exposure time and gain setting of the imager. It is helpful to do this before focusing to make sure the camera settings are adjusted such than you can see the object under your lighting conditions. Once the AutoExposure is complete, press the Focuser button.



This function shows live data from the imager. It is used to focus the imager and also to place the Spectralon© or Teflon© in the proper location for collecting correction data. By waving your hand under the imager near the white reference, you should see movement in the main Spectronon window. Place the object to scan in the field of view of the instrument, using the data window for feedback. Unscrew the lock ring on the objective lens of the imager, as shown below.

Screw the main body of the objective lens in or out until the lines in the data window begin to sharpen. For assistance in focusing, click on the Inspector tool, and then click on the data screen over the sharpest spatial features. Then click on the YPlotter tab on the right side of the Spectronon window. Your screen should look like the screencapture below.



When Focuser is running, the YPlotter graph shows the Y cross section of the live data. Spatial features of the object show up as dips or rises in the cross section. Focus the imager to maximize the contrast (steepness) of these features. You may use the Zoom and Pan tools (on the toolbar) to zoom in and navigate the features in the graph. For objects without fine spatial features to use for focusing, it is recommended that graph paper or another suitable target with sharply contrasted features be placed on top of the object.

Using AutoExposure

Position the Spectralon© or Teflon© (watching the data window) to fill the entire field of view of the imager. Because of its high reflectance, the white reference will look much brighter in the data window than its surroundings. Interpreting the live data is an acquired skill, but is learned quickly.

Once the white reference fills the field of view of the imager, press the AutoExposure button again to properly set the exposure and gain.

Adjusting the Aperture

The aperture of most objective lenses can be adjusted across a wide range. For the Pika II, f/#s below f/3 are not recommended, and for the Pika NIR f/#s below f/2 are not recommended because this will increase the amount of scattered light inside of the instrument. Choosing an f/# is a trade; the higher the f/#, the less light the instrument will collect but the depth of focus of the instrument will increase. A smaller f/# means more light will be collected but the depth of focus will be shorter. For cases in which the user wishes to post-correct the data from a reference object in the scene (for example, when the user is using the Rotation Stage and the Teflon© reference does not fill the entire field of view), it is required that the f/# be set no lower than f/4 for good results.

Again, after adjusting the aperture, you will need to run AutoExposure to set optimum exposure and gain levels.

Modes

Pika imaging spectrometers can collect data in 3 modes: Raw Data, Reflectance, and Irradiance. To select the mode of operation, navigate to the Mode menu item and select the desired mode. Each mode is described below.

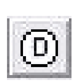
Raw Data

In Raw Data mode, data is recorded without any processing. The result is thus a product of the reflectance of the object, the spatial and spectral distribution of the lightning, and the response of the instrument.

Reflectance

For many applications, the absolute Reflectance of the scene is desired. Because all light sources (including halogen lamps and the sun) have spectral structure, it is necessary to remove the spectral component of the light source from the collected data. Additionally, spectral imagers have non-uniform spectral and spatial response which also must be removed from the data. In order to do this, data from a uniform reference is collected. A flat sheet of Teflon© is an inexpensive reference with a nearly flat spectral reflection near .95 (95%). However, for high fidelity applications it is recommended to use a Spectralon© (www.labsphere.com) panel instead.

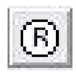
The first step in collecting Reflectance data is to set the exposure using Autoexposure as described in the preceding section. Next, a Dark Current Correction Cube is necessary.

Press the Dark Current button. 

You will be instructed to cover the lens of the imager to block all incoming light. This is best done with the included lens cap. Once the lens is covered, select OK. After recording this data, the Dark Current button will show a red checkmark, indicating that the dark current noise of the imager will be automatically removed from the data.

Next, a Response Correction Cube must be collected.
(*Users of the Rotation stage for which the white reference does not fill the entire field of view, skip this step. Correcting the data in this case is explained in Chapter 5)*

Once the collection of the Dark current is complete, press the Response Correction Cube button.



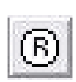
This will instruct you to place the white reference (e.g. Teflon©) in front of the imager. Make sure the reference target fills the field of view of the imager. Press OK to continue. Once complete, the Response Correction button will show a red checkmark. The data will now be automatically corrected for the illumination spectrum and instrument response. The resultant data is in units of 0-4095, representing Reflectance from 0-100%. In Float Mode (covered in Chapter 6), the units are 0-1.0.

Anytime the aperture, gain, exposure time, or light source changes, the Dark Current and Response Correction collection processes (as described above) must be repeated.

Radiance

In Radiance Mode, data is recorded in relative units of Radiance. (To produce absolute units of radiance, additional steps are required. This will be discussed later.) In order to use Radiance Mode, a black body light source with a calibrated color temperature or a radiance calibration standard is necessary.

First, set up the imager so the field of view is filled by the reference light source. The intensity of the reference light should be adjusted to approximate the intensity of the scene illumination. Set your exposure using the Autoexposure feature, as described above. Cover the lens and collect a Dark Current correction cube. Then collect the Radiance Correction cube by pressing the Response Correction Cube button. .



Then press the Set Black Body Temperature button:

When prompted, enter the Color Temperature of the reference light source.

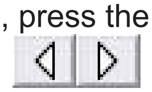
In order to produce absolute units of radiance, keep the exposure settings of the system at the same level they were at when the datacube of interest was collected. Position the imager to ensure that the reference light is filling the field of view. Collect a data cube in Radiance mode and find the peak intensity value. Scale this number by the intensity reading of your reference light (in $W/m^2/sr$). Using the Unit Conversion tool within the Process to new Cube menu, produce a new datacube using this number as the conversion factor.

Collecting and Saving Data

Collecting Data

To collect data, click the Start and Stop Recording button. 

The stage will begin moving, and lines of image data will be displayed in the data window. By default, the image data is represented by a True Color rendering of the scene. More information on Renders and Filters is available in Chapter 4.
To stop, press the button again. The stage should move back to its starting location. To adjust the starting location of the stage, press the Move Stage buttons, shown below.

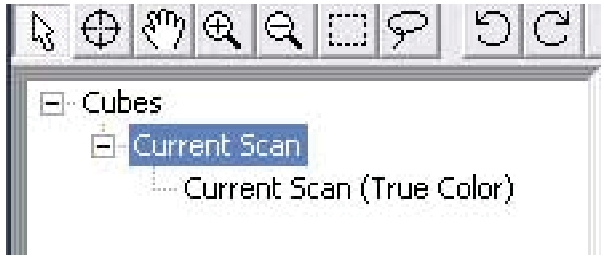


Once the Start Recording button is pressed, data recording will continue until the button is pressed again. If you would like to record a specific number of frames, enter in the desired number of frames in the Frame Number window, show below.

If zero is entered, the software will record indefinitely. A non-zero number allows the software to allocate the necessary resources for the data, which improves performance. A scan can be stopped at anytime using the stop button.

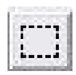
Saving Data

Once data has been collected, it is temporarily stored and represented in the left side of Spectronon, called the Resource Tree, as shown below.



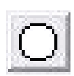
To save the data, right-click on the Current Scan item (colored blue above). Select Save Cube or Save Cube As to save to disk. You may also select the menu item Cube → Save Cube instead of the right-clicking method.

If you would like to only save a portion of the cube, click the Select Areas tool on the toolbar.



Select the portion of the image you would like to save by dragging a square over the area. Right click inside of the square and select Crop Into New Cube. Alternatively, you may select the menu item Selection → Crop Into New Cube. Once this is done, right-click on the newly generated cube in the Resource Tree and save as described above.

Saturation Alarm

The Saturation Alarm  warns the user of potentially erroneous data due to detector saturation or bit overflow. This icon will turn yellow when saturation or bit overflow occurs.

Detector saturation happens because too much light is incident on the detector for the given gain and exposure settings. Saturated data is evident by flat-topped spectra. It is recommended to run AutoExposure again to solve this problem.

Bit overflow occurs when a reflectivity greater than 100% is reported. Most likely, this is caused by data noise while recording scenes of reflectivity near 100%, where the noise pushes values over the 100% threshold. It can also occur when faceted sample produces a glint from a non-diffuse light source directly into the scanner, or it may be caused by light source fluctuations or a poorly recorded Response Correction file. It is recommended to record a new Response Correction file when bit overflow occurs.

Adjusting the Scanning Stage

Once data has been collected, examine the image to determine if the *aspect ratio* (the ratio of the X dimension scale to the Y dimension scale) is correct. If the image looks compressed in the direction of the scan, the stage step size is too large. If the image looks stretched in the direction of the scan, the stage step size is too small. To adjust the step size, find Window in the Menu bar, and select Preferences. Find Stage in the tree, and select it. Change the Steps Per Frame setting until the aspect ratio is correct. Scanning an image of a circle is often useful for setting the aspect ratio correctly.

Viewing and Manipulating the Data

This chapter includes the following topics

- Opening a Datacube
- Zoom, Pan, and Rotate Tools
- Selecting Regions of Interest
- Spectral Plot and XY Plotter Windows
- Renders and Filters
- Saving Spectra, Cubes, and Renders

Opening a Datacube

To open a datacube in Spectronon, select the File → Open menu item and select the datacube to open.   Spectronon can open any datacube with an ENVI© formatted header.

Datacubes collected from a source other than a Resonon instrument need another parameter to be added into the header file for certain functions to operate. If prompted for the Reflectance Scale Factor (RSF), enter that value now. The RSF for an imaging spectrometer is the data value that corresponds to 100% reflectivity.

By default, the data is opened with a True Color render of the data. This render approximates the appearance of the object under normal lighting conditions by combining red, green, and blue bands from the datacube. In general, a Render is a 2D visualization of the datacube. Renders and Filters will be covered in detail later in this chapter.

Zoom, Pan, Flip, and Rotate Tools

To Zoom into a specific area of the image, click the Zoom In tool from the toolbar. 

By clicking in the Render, the view will zoom in. It is also possible to click and drag a window within the render to zoom into the windowed area. To Zoom Out, use the Zoom Out tool available on the toolbar.

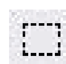
The user may also Zoom In and Out using the mouse scroll wheel, if available.

To Pan the image while Zoomed In, select the Pan tool.  Click and Drag inside of the Render to pan.

To Flip or Rotate the image, use these tools: 

Selecting Regions of Interest

A Region of Interest is a selectable group of pixels within the datacube. The associated spectra from these pixels can then be saved, averaged, or copied to the clipboard.

To select a Region of Interest, select either the  or  tools from the menu bar. Click and drag a rectangle of interest with the first tool, or click and drag any shape with the second.

Once selected, right-click within the selected areas for options.

Spectral Plot and XY Plotter Windows

Plotting Data to the Spectral Plot and XY Plotter Windows

The Spectral Plot window shows the spectrum of a selected pixel or the spectrum open in the Resource Tree (far left side of the Spectronon window). To show the spectrum of a pixel within the Render, select the Inspector tool.

Click a point inside of the Render to see the spectrum of that pixel. One can also click and hold while dragging to update the Spectral Plot window continuously.

The X and Y Plotter Windows show cross-sections of the current Render (X and Y cross sections respectively) at the point of the Inspector tool pointer. The black line in the X or Y Plotter window represents the location of the Inspector tool pointer in the alternate dimension (Y or X respectively).

Zooming and Panning

Zooming and Panning function in the plotting windows just as in the render window. To zoom in, select the Zoom In tool from the toolbar. Click in the appropriate plot window, or click and drag a rectangle in the plot window to zoom to that area. Select the Zoom Out tool and click to zoom out. To Pan, select the Pan tool, then click and drag in the plot window.

Clearing the Spectral Plot Window

To clear the Spectral Plot or XY Plotter Windows, select the Plot menu item, then Clear Spectral Plot. This is useful to force a rescale of the Spectral Plot.

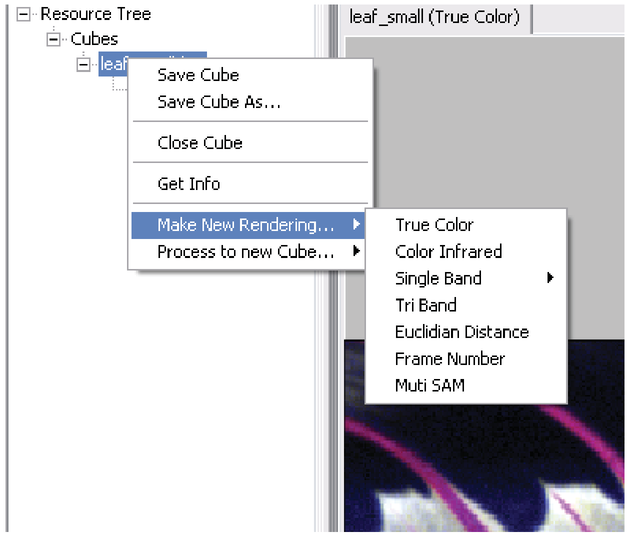
Renders and Filters

A Render is a 2D representation of a datacube. This representation can be monochrome or full color, be one or more bands of a datacube, or contain the results of analysis. A Filter is a set of rules that apply to a Render to alter its appearance. In this section, two examples of using Renders and Filters will be presented.

The Color Infrared (CIR) Render

The Color Infrared Render maps an infrared band (~860 nm) of the datacube to the red color channel of the display, a red band (~650 nm) to the green color channel, and a green band (~550 nm) to the blue color channel. This Render may be useful in viewing scenes containing vegetation, as chlorophyll is very reflective at 860 nm, making plant life appear red in this Render.

To try the CIR Render, open the datacube *leaf_small.bip* located in the C:\Program Files\Spectronon\examples folder. The datacube will show up in the left-side Resource Tree and a True Color render of the datacube will appear. Right click on the leaf_small object in the Resource Tree and select Make New Rendering → Tri Band → Color Infrared. This can also be accessed by the menu item Cube → Make New Render → Tri Band → Color Infrared.



The Color Infrared render will appear with the default Two Percent filter. To switch filters, click on Rendering button on the toolbar and select Change Filter from the pull-down menu. Choose from rendering options given. You should see the view of the render change slightly. The Two Percent filter is a contrast enhancement where the brightest 2% of pixels are set to 1.0 brightness (white), and the darkest 2% pixels are set to 0.0 brightness (black). The middle 96% of the pixels are then scaled from 0 to 1.0 brightness. A Linear filter is similar, but sets the brightest and darkest pixels to 1.0 and 0.0 respectively. This could be thought of as a 0% stretch. The Stretch Filter (also available in the filter menu) allows the user to interactively set the upper and lower stretch percentages. Note that these functions do not change the data, just its rendering on your screen.

Another example of using Renders and Filters is covered in Chapter 5.

Saving Spectra, Plots and Renders

Once a spectrum has been added to the Spectra List in the Resource Tree (by encircling the Region of Interest with the Lasso or Rectangular Area tool and right-clicking in its center), it can be save to disk as either a Spectrum file (for opening later in Spectronon) or as text (for importing into Excel or other graphing program).

Similarly, the entire Spectral Plot window can be saved as an image or as text. This is done by choosing the Plotters menu item, then choose the plot you wish to save, then selecting either Save as Image or Save as Text.

Advanced Data Manipulation and Analysis

This chapter provides an overview of advanced data analysis features of Spectronon.

Topics in this chapter are:

- Binning
- Spectral Correction
- The Spectral Angle Map Render
- Adding Functionality Through Plugins

Cube Tools

Cube tools are datacube processing methods that return a new datacube as a result. This resultant datacube may be a resampling of the original cube (like the Binning example below), or it may be an entirely different cube, such as a colorspace conversion tool.

Binning

The Binning tool is used to average spectral or spatial channels together to reduce the size of the cube or to increase the signal-to-noise ratio.

To use the Binning tool, right-click on the cube of interest in the Resource Tree. Select Process to New Cube → Utilities→Bin Cube. Alternatively, you may select the menu item Cube→ Process to New Cube → Utilities→Bin Cube. This is followed by a dialog box requesting the Binning parameters. Spectral binning reduces the spectral resolution of the data, Sample binning reduces the spatial resolution of the data in the X axis (unless the data has been rotated on screen), and Line binning reduces the Y axis spatial dimension.

The Float Mode check box allows the data to be returned as a floating point datacube. For more information on Float Mode vs. Integer Mode, please see Chapter 5 *Advanced Settings* → Float Mode.

After selecting OK in the Binning parameter dialog box, the binned datacube will be returned to the Resource Tree.

Spectral Correction

The Spectral Correction cube tool is used to correct a datacube for the response function of the imager and the spectral component of the illumination source in situations where the reflectance reference does not cover the entire field of view of the imager. To use this tool, the datacube must contain a reflectance reference. It is also required that the aperture of the imager be set at f/4 or higher.

First, create a Spectrum object in the Resource Tree from the reflectance reference in the datacube. To do this, choose the appropriate ROI Tool, select the reflectance reference in the image, and right-click to Make ROI and Mean. The mean spectra from your selected ROI will be added to the Spectra list in the Resource Tree. Right click on the datacube to correct in the Resource Tree, and select Process to New Cube → Utilities →Correct from Spectrum (or select menu item Cube→ Process to New Cube → Utilities →Correct from Spectrum). In the resulting dialog, select the Spectrum you created before, and press OK. The entire cube will be corrected.

Radiance Correction

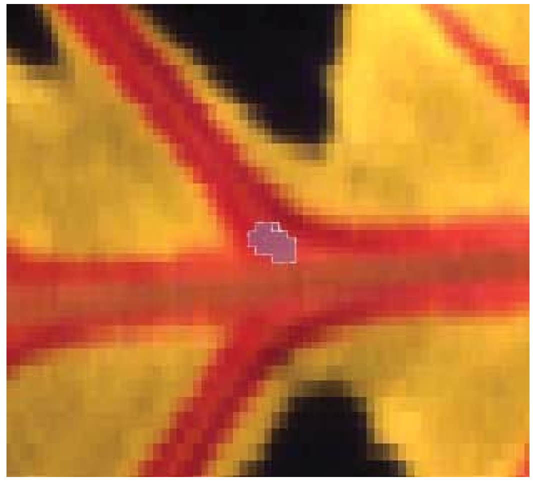
This procedure is used to correct a datacube for the response of the instrument and leave the data in terms of relative radiance. To perform this procedure, select the Correct from Cube tool from the Cube→Process to New Cube→Utilities menu item. Select the correction datacube and input the blackbody temperature of the correction cube. A new, corrected cube will be generated. For more information on obtaining a correction cube for use in this procedure, please contact Resonon.

Cube Tools Example

The Spectral Angle Map cube tool

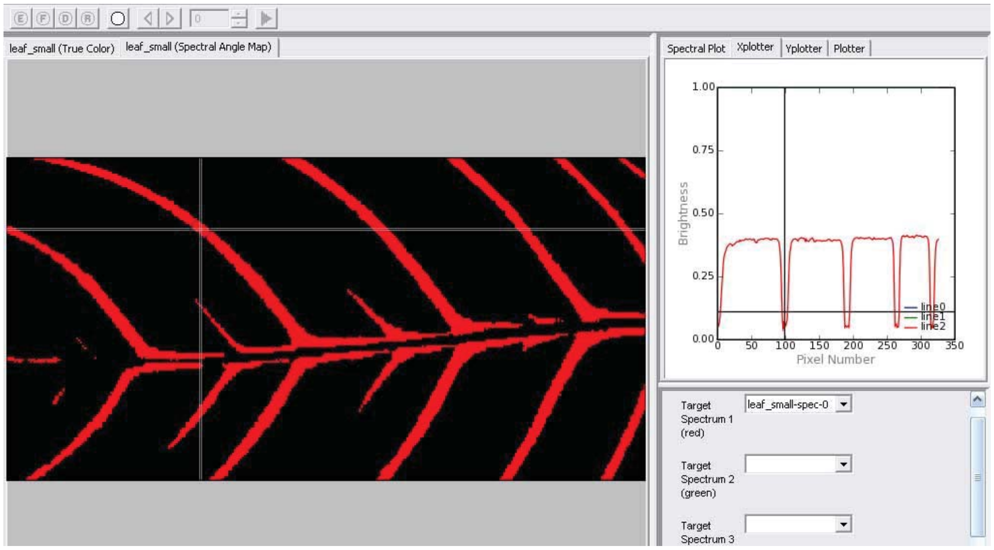
The Spectral Angle Map (SAM) function is a powerful analysis tool for computing the similarity between two spectra. SAM returns an n-dimensional angle that represents the similarity of the spectra of a pixel in a datacube to a reference spectrum, where n = the number of spectral bands in the datacube. This technique is relatively insensitive to the intensity of the compared spectra; it is comparing the 'shape' of the spectra instead.

To use SAM, first create a Region Of Interest (ROI) to define the *reference* spectrum. To do this, use the Lasso tool to encircle a small area of the red center vein of the leaf_small.bip image (you may want to zoom in first), as shown below.



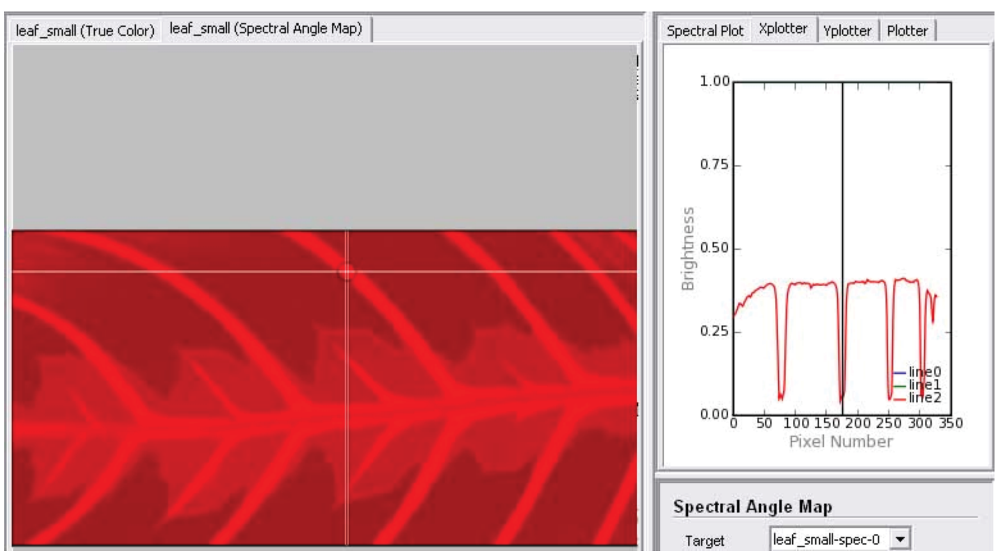
Right-click inside the selected area, and select Make ROI and Mean. Now, right-click on the *leaf_small.bip* in the Resource Tree and select Process to new Cube → Classification →SAM. In the Member count dialog, input the number of Member Spectra you wish to classify. In this case, this number is one. Next, in the Member Spectrum 0 dropdown, select the leaf_small-spec-0 spectrum that you created, and click "OK." The controls for this Render will show up on the right side of Spectronon, as shown below:

Enter 0.1 for a Threshold. Now press update. The resulting render will appear. To see the raw data from the SAM algorithm, use the Inspector tool and the X or Y Plotter window (shown).



You may select a Live Update to interactively select a threshold. This option is processor intensive and is only recommended on higher performance computers. (Note: for scanned datacubes that have not yet been saved, the Live Update feature may not be available under default settings. See Chapter *6 Advanced Settings* → Disk/Memory Mode for more information).

Next, we will render the SAM data in a grey scale. Right click on the MultiSam cube in the Resource Tree. Select Make New Rendering → Single Band → By Band Number. This will produce a rendering where the dark pixels are very similar in spectra to your Member spectra and the light pixels are quite dissimilar. Generally, one would like the reverse rendering. This can be obtained by checking the "Inverse" box, which will yield a rendering similar to that shown below.



Advanced Settings

This chapter provides an explanation of the advanced settings of Spectronon.

- Imager Settings
- Stage Settings

Imager Settings

Framerate

By default, the framerate of the imager is set to 30 frames per second (FPS). The framerate can be set as high as 60 FPS at normal detector settings, and as low as 1.875 FPS. (The imager can be set at higher frames rates for specialty applications, please contact Resonon for more information). The lower the framerate, the more integration time the imager has, increasing the signal-to-noise ratio (SNR), but also increasing the amount of time necessary to collect data.

To adjust the Framerate of the imager, go to Window in the menu bar, then Preferences→ Scanner.

Gain and Shutter

The gain and shutter settings of the imager are determined automatically during the AutoExposure mode. To override or adjust these settings, go the Window → Preferences→ Scanner. It is necessary to re-record Dark Correction and Response Correct cubes after adjusting these settings.

Binning

Binning of the datacube increases the SNR of the data, decreases its size, but decreases the spectral or spatial resolution of the data. To adjust the binning, select Window → Preferences→ Scanner.

Calibration Cube Sizes

The size of the calibration cubes used in the data correction may be adjusted at Window → Preferences→ Scanner. The size of the Dark Correction cube does normally not need to be adjusted. It may be necessary to increase the size of the Response Correction cube if the reflection standard shows obvious spatial variability.

Recording Modes

Four options for recording data are available. To change these options, see Window → Preferences→ Imager. The options are reviewed below.

Buffer Mode: The Buffer Mode is the method of buffering data as it streams from the imager. In Memory mode, the data is placed in the computers Random Access Memory (RAM). This method is typically faster, allowing higher speed operation of the imager, but is limited to the amount of available RAM on the computer. It is recommended for smaller datacubes where speed is a priority. In Disk Mode, data is buffered to the hard drive. It is recommended for most applications.

Float Mode: Data can be stored as Integers or Floats. Float mode has the advantage of higher data fidelity in low signal applications (because the dark current is removed more accurately) and has the convenience that reflectance is scaled from 0-1. However, it requires twice the space on disk as the integer mode and requires more time to load data.

Slope and Intercept (Calibration)

The calibration of the imager is stored in see Window→ Preferences→ Imager→ Advanced. These settings should only be changed during the initial setup or under consultation from Resonon.

Stage Settings

Steps Per Frame

The Steps Per Frame setting changes the distance that the stage moves between frames. This setting should be adjusted to maintain proper aspect ratio. Go to Window→ Preferences→ Stage to change this setting. If the image appears stretched in the direction of scan, the Steps Per Frame setting is too low. Similarly, if the image is compressed in the direction of scan, the setting is too high.

Seconds per Step

This setting is found in Window→ Preferences→ Stage→ Advanced and is used to adjust the time delay in between steps while positioning the stage. It should normally be set to 0.0, as a non-zero setting will limit the line rate of the system.

Interface

Video Update Speed

On lower performance computers, the responsiveness and line rate of Spectronon may be increased by lowering the update rate of the data display. To adjust this setting, go to Window→ Preferences→ Interface.

Problem Resolutions

If you have questions or are experiencing problems regarding your Pika imaging spectrometer or Spectronon, please start your inquiry at http://www.spectronon.com. The FAQ section may have the answer you or looking for.

Also, the solutions to many problems might also be found at the Forum section at http://www.spectronon.com/bb/. If you do not see the answer to your question, post your question and a Resonon support member will answer it as soon as possible.