



RAYN Vision System Analytics Software User Manual

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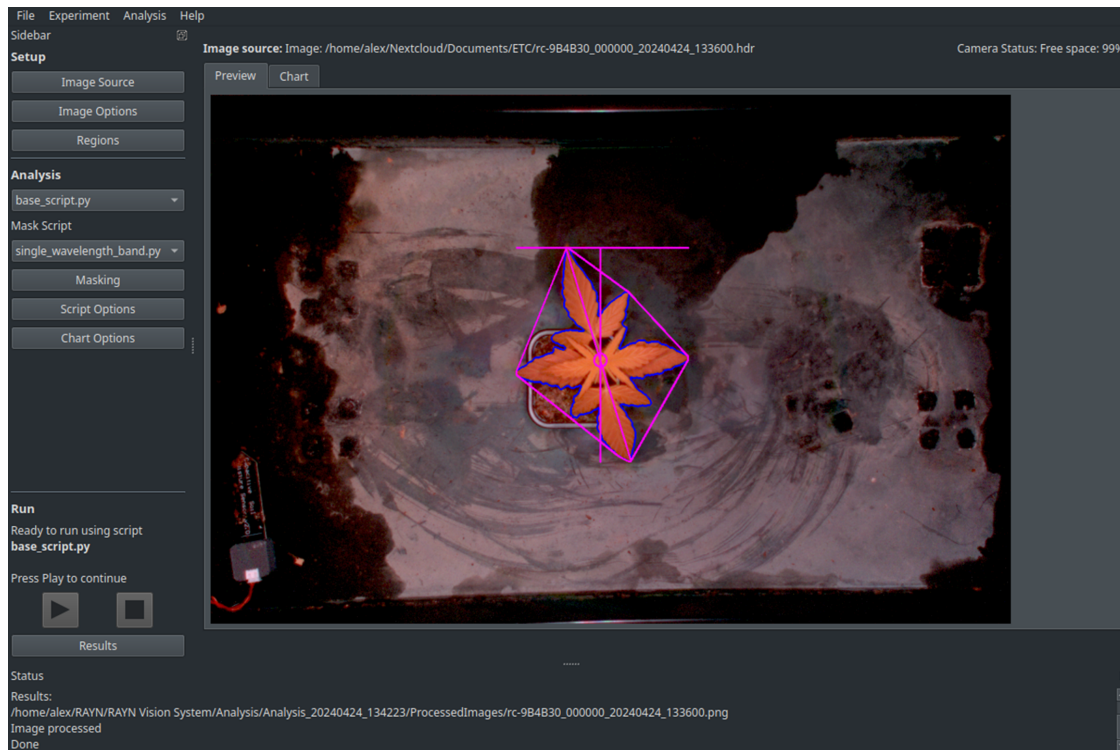
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RAYN Vision System Analytics

Welcome to the RAYN Vision System v1.0.0 Analytics Software User Manual. RAYN Vision System (RVS) Analytics is an open-source Windows application for the processing and analysis of multispectral image cubes from multiple sources, including RVS Cameras online in the same network.

Overview



The software user interface contains the following key areas:

- The horizontal bar of **Menus** in the top left.
- The vertical sidebar of **Setup** and **Analysis** options.
- The **Preview** display.
- The **Status** information feed.

If a connected RVS Camera is detected, its available storage will be indicated in the top right.

The pop-out buttons in the top right of the status feed and sidebar will separate them from the main application window, allowing them to be freely moved and positioned onscreen. Status can be docked to the software again by dragging it over the top, bottom, left, or right edge of the main window. The sidebar can be docked to the left or right. Both can be freely resized by dragging the divider icon.

The software color scheme will change to automatically match your computer's selected light or dark UI mode.

Compatibility

RAYN Vision System Analytics can be installed on computers running Windows® 10 or 11. The software can also be used in conjunction with the RAYN Vision System Camera (RVS-C).

Installation Instructions

To install the RAYN Vision System Analytics software on your compatible PC, you will need to acquire the software from your RAYN Growing Systems provider. Follow the instructions below to install the software.

1. If the .exe installer has been provided as a zipped archive, unzip the file.
2. Double-click the installer. The RAYN Vision System Setup window will appear.
3. Follow the Setup prompts to begin software installation.
4. Click "Finish" when prompted. The software is now ready to use on your PC.

Resources

For more information about this RVS Analytics software release, see the *RAYN Vision System Analytics v1.0.0 Release Notes*. For more information about the [RAYN Vision System Camera](#), see the *RAYN Vision System Camera Setup Guide* and *RAYN Vision System Camera Firmware Release Notes*.

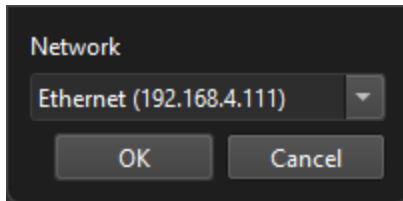
User documentation and technical support are available via our website, rayngrowingsystems.com, or by contacting your RAYN Growing Systems provider.

Menus

The drop-down menus in the top left provide options for managing key settings and files.

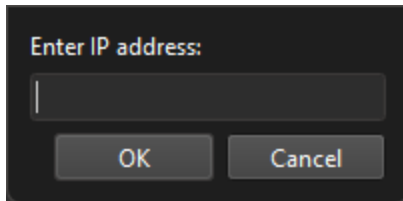
File

Select network...



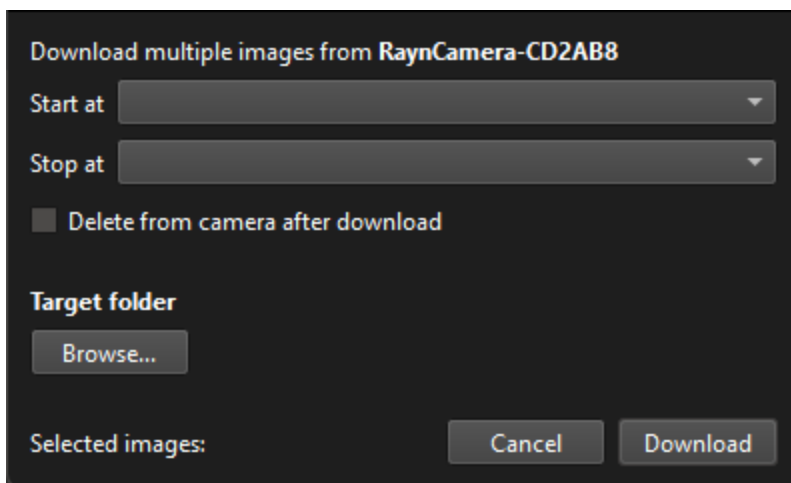
Choose from a drop-down list of available network interfaces. To pull images directly from an RVS Camera, you must connect directly to that camera's network using a WiFi interface.

Set MQTT Broker...



Optionally enter the IP address of an MQTT broker. This allows you to export analysis results as MQTT topics for external storage or plotting.

Download images from camera...



Use this dialog to force a download of a selected image range to a folder on or accessible to the PC.

The following settings are available:

- **Start at** - the first image in the range that will be downloaded from the camera.
- **Stop at** - the last image in the range.
- **Delete from camera after download** - removes the images from the camera after they are transferred to the target folder.

Use the **Browse...** button to choose a specific folder to store the images copied from the camera. The **Download** button in the bottom right will copy the images from the camera and close the window. The **Cancel** button will close the window without downloading images.

Exit

Close the RAYN Vision System Analytics software.

Experiment and Analysis

These menus provide options for managing the saving of configuration and analysis settings. Analysis files contain saved settings from the [Analysis](#) section of the sidebar. Experiment files contain saved settings from both the [Setup](#) and Analysis sections.

New Experiment or Analysis

Resets all experiment or analysis settings back to their defaults.

Open Experiment or Analysis

Locate a saved experiment (.xp) or analysis (.af) file of settings to load.

Save Experiment or Analysis

Save settings changes to an existing saved experiment or analysis file.

Save As Experiment or Analysis

Save settings changes to a new experiment or analysis file.

Help

The **Help...** menu option opens a window containing the software's user manual.

About

Opens a window displaying information about this installation of RAYN Vision System Analytics, and a copy of the End User License Agreement (EULA).

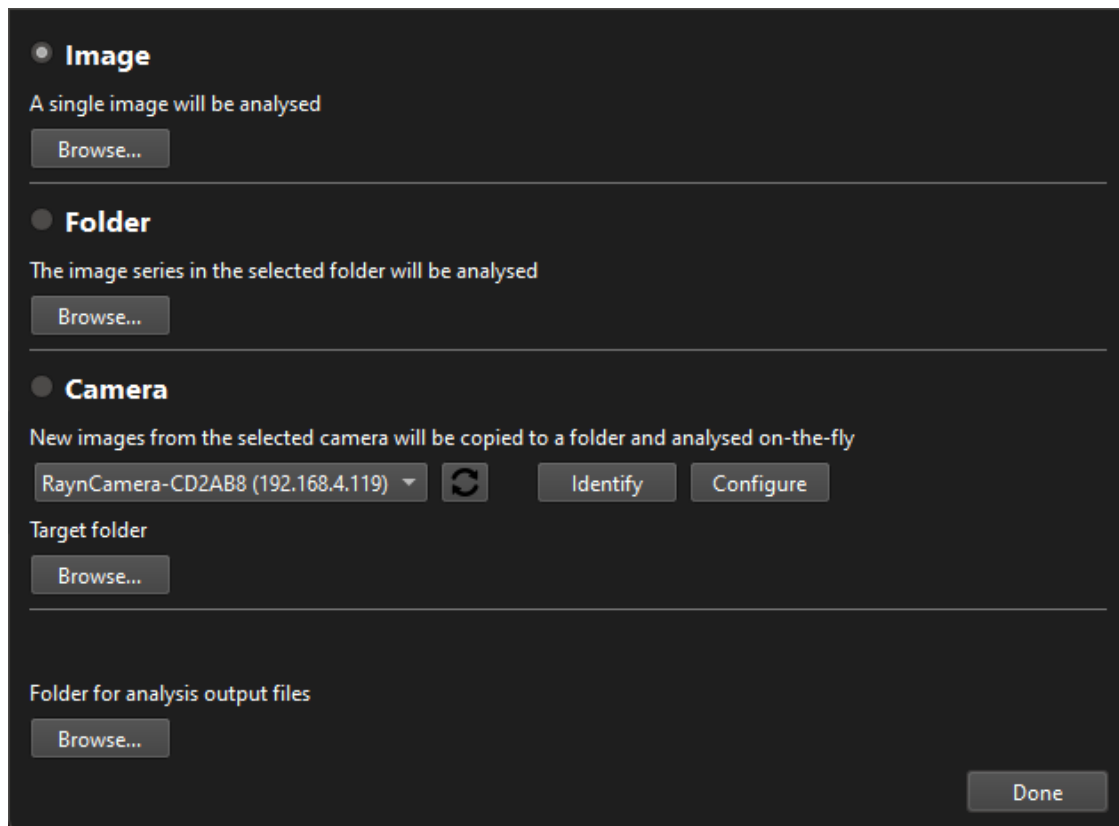
Setup

This section of the sidebar contains settings for importing and processing images, and defining which areas of those images should be analyzed.

Image Source

The **Image Source** button in the sidebar launches a window containing options for adding images to the software for analysis. A valid source of images must be selected before analysis can continue.

The **Done** button in the bottom right will apply any changes and close the window.



RVS Analytics supports the standard multispectral image ENVI (.hdr) format. There are three primary ways to add images for analysis.

Image

Choose this option when analyzing a single image. Use the **Browse...** button to locate and select the image file.

Folder

Choose this option when analyzing a saved set or series of multiple image files in a folder. Use the **Browse...** button to locate and select the folder containing the images.

Camera

Choose this option when pulling images directly from an RVS Camera for analysis. Pick an available RVS Camera from the drop-down list. The following additional options are available:

- **Refresh** - refreshes the list of detected RVS Cameras.
- **Identify** - the selected RVS Camera will blink white once.
- **Configure** - launches the web configuration page for the selected RVS Camera.

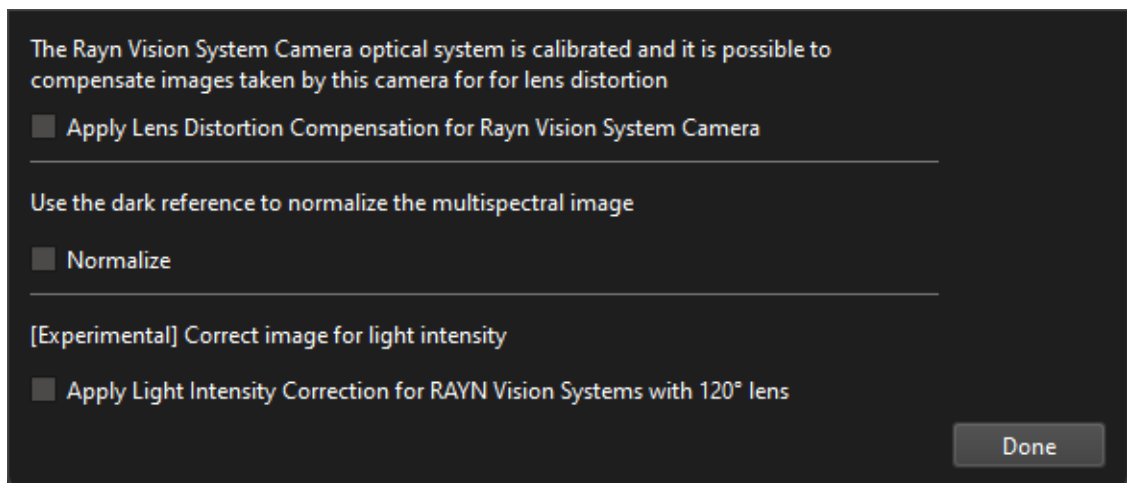
Use the **Browse...** button to choose a specific folder to store the images copied from the camera.

Saving Results

At the bottom of the **Image Source** window, you can use the **Browse...** button to specify a folder where the software will save analysis output **Results**. The output location defaults to ...\\Documents\\RAYN\\Rayn Vision System\\Analysis.

Image Options

The **Image Options** button in the sidebar launches a window with additional settings for processing the images added to the software.



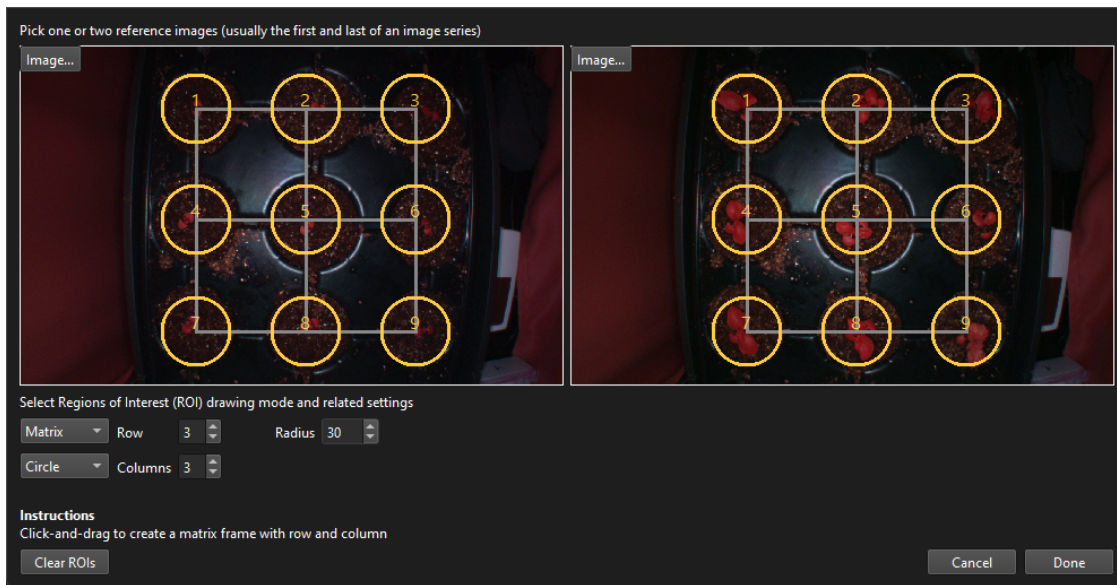
The following options are available

- **Lens distortion compensation** allows the software to reduce the fish-eye camera effect when analyzing images from an RVS Camera. Choose from the following dropdown menu options:
 - **No compensation** - no compensation is applied to the analyzed images.
 - **60° lens** - compensation for a 60 degree camera lens.
 - **120° lens (legacy)** - compensation for a 120 degree camera lens.
- **Normalize** - when checked, the software will use a "dark" image (taken by the RVS Camera without lighting) to normalize images and compensate for stray light in the environment.
- **Light Intensity Correction** - when checked, the software will adjust the light intensity when analyzing images from an RVS Camera with a 120° lens.

The **Done** button in the bottom right will apply any changes and close the window.

Regions of Interest

The **Regions** button in the sidebar launches a window of settings for defining regions of interest (ROIs). These regions determine the areas in your images that will be analyzed, and must be set up before analysis can continue.

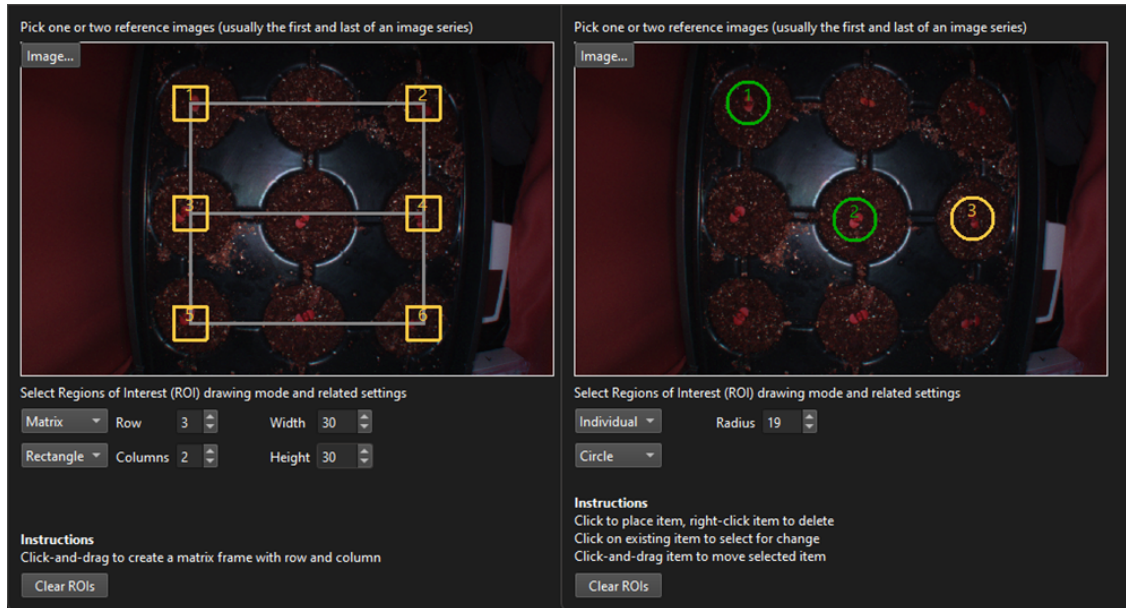


The **Done** button in the bottom right will apply any changes and close the window. The **Cancel** button will close the window without applying changes.

Use the **Image...** buttons in the top left of either preview window to define one or two images to reference while defining ROIs. It is often best for this to be the first and last image in the series, to ensure your ROIs contain the full range of growth captured by your images. When the left image is defined in a new experiment, the last image in the same folder will be automatically selected on the right.

Defining Regions

Once reference images have been chosen, ROIs can be created according to the settings below.



Region layout is determined by the top drop-down menu:

- **Matrix** - clicking and dragging within a reference image creates a matrix of connected regions spaced at fixed relative distances apart. The **Rows** and **Columns** settings are shown, allowing you to adjust vertical and horizontal region layout. Click again to clear the matrix.
- **Individual** - clicking within a reference image creates a single region which can be freely moved and positioned individually. Click again to create additional regions, or to select specific regions for editing. Right-click on a region to clear it.

Region shape is determined by the bottom drop-down menu:

- **Circle** - creates circular regions. The **Radius** setting is shown, allowing you to adjust circle size.
- **Rectangle** - creates rectangular regions. The **Width** and **Height** settings are shown, allowing you to adjust rectangle size in pixels, starting at 5px. While there is no upper limit, an error will appear when an ROI extends outside of an image.

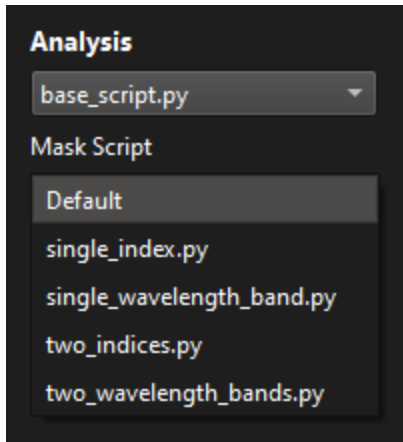
Regions are highlighted in green once created, and yellow when selected. Changing the layout mode will clear any existing ROIs. ROIs can also be cleared with the **Clear ROIs** button in the bottom left.

Analysis

This section of the sidebar contains the list of available analysis scripts and access to any masking or options for the selected script.

Analysis and Masking Scripts

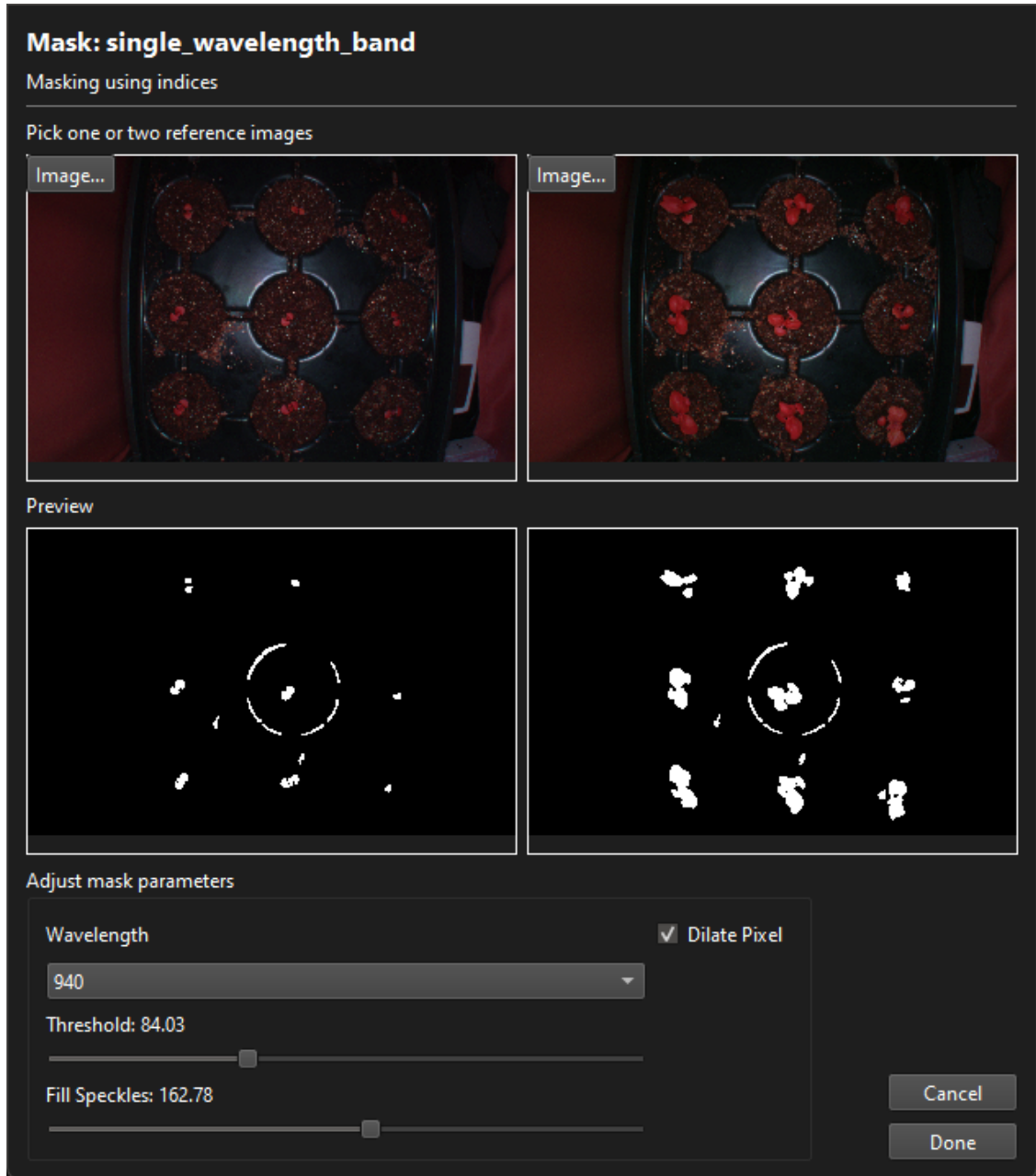
RVS Analytics uses two separate Python (.py) scripts to determine the processing and filtering parameters used when analyzing images: an analysis script and a mask script. A default analysis script, *base_script.py*, is provided, allowing analysis of a single reflection index using a variety of masking options.



Available scripts are chosen via the drop-down menus in the sidebar. Once scripts are chosen, the analysis can be configured via [Script Options](#), and unwanted data filtered out via [Masking](#).

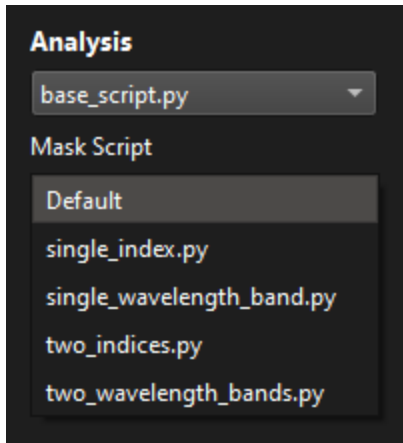
Masking

The **Masking** button in the sidebar launches a configuration window of masking options used to filter out unwanted background image data during analysis.



Mask Script

Each mask script provides different filtering options for segmenting plants from background data you may wish to exclude from your analyses. While a default mask script is applied when an analysis script is chosen, other available mask scripts can be chosen from the drop-down menu.



The included mask scripts allow you to filter on a single wavelength or reflection index, or simultaneously filter for two.

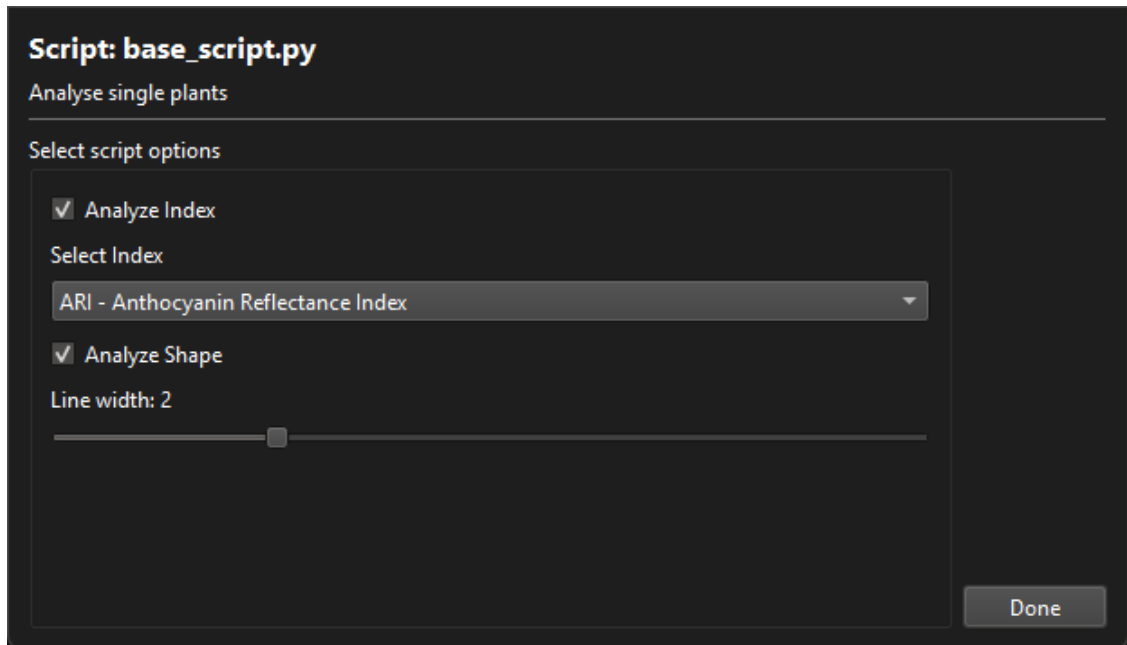
Mask Parameters

Depending on the chosen mask script, the following mask parameters may be available:

- **Wavelength** - choose from a list of available wavelength bands to use for thresholding.
- **Threshold** - set up to two wavelength thresholds.
- **Select Index** - choose from a list of available reflection indices to use for thresholding.
- **Index Threshold** - set up to two index thresholds.
- **Logical Operation** - perform a logical operation with two or more threshold masks using (and, or, xor).
- **Fill Speckles** - fills holes in the binary mask up to the maximum given pixel size.
- **Dilate Pixel** - enlarges pixels, which may help smooth the boundaries of individual objects.

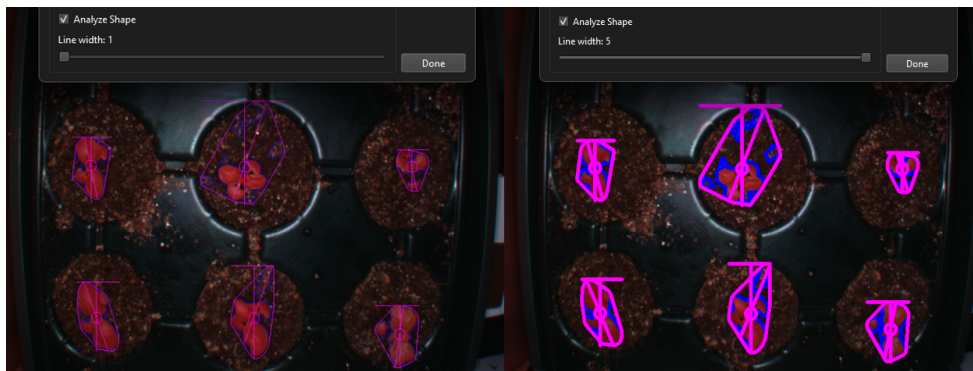
Script Options

The **Script Options** button in the sidebar launches a new window containing any additional options associated with the selected analysis script.



The **Done** button in the bottom right will apply any changes and close the window.

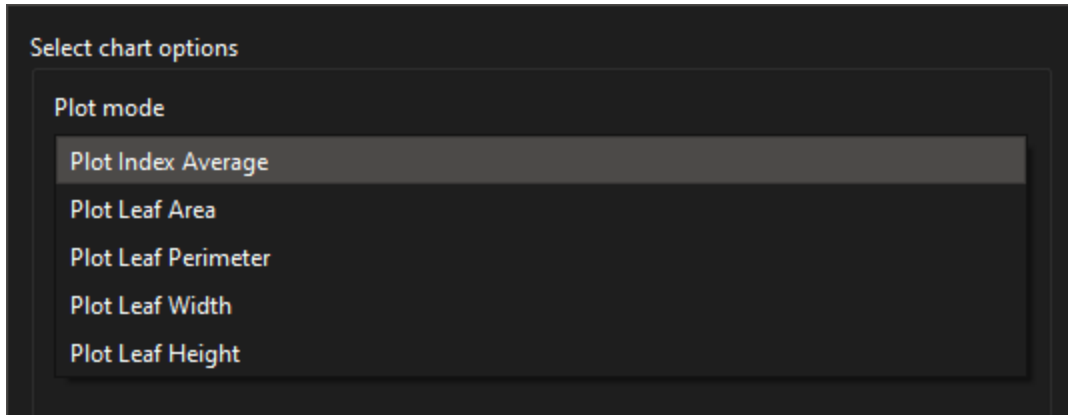
- **Analyze Index** - when checked, the included default base script allows for analysis of a single reflection index. Choose an available index from the drop-down menu.
- **Analyze Shape** - when checked, the software will analyze shape changes within ROIs and outline them in the results.



- **Line width** - sets the width of the shape analysis outline between 1 and 5.

Chart Options

The **Chart Options** button in the sidebar launches a window containing options to choose which analysis results will be plotted on the chart. After analysis, the chart is available in the **Chart** display and saved to a file in the **Results** folder.

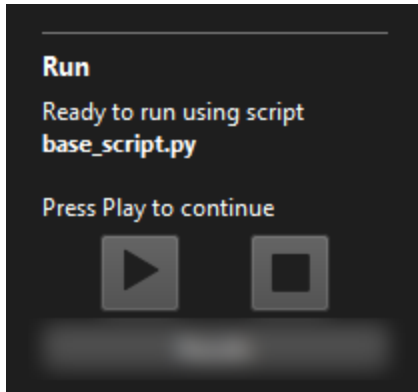


The following metrics can be plotted via the plot modes in the drop-down menu:

- **Index Average** - takes an average of the selected reflectance index, returning a mean value for the plant.
- **Leaf Area**
- **Leaf Perimeter**
- **Leaf Width** - width is measured across the X axis of the 2D image.
- **Leaf Height** - height is measured across the Y axis of the 2D image.

Running Analyses

Analyses can be started and stopped from this area at the bottom of the sidebar.

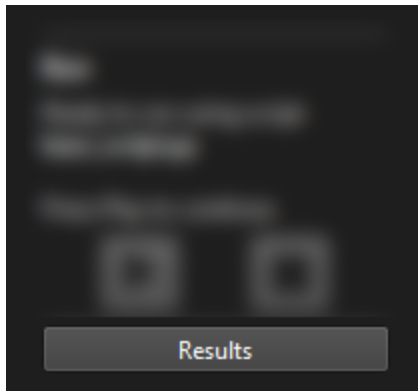


The software will prompt if any required setup or configuration steps need to be completed before the analysis can be run. When setup is complete, the prompt will indicate the analysis is ready to run.

Use the **Play** and **Stop** buttons to start and stop an analysis. A progress bar will appear under the [Preview](#) window, and updates will appear in the [Status](#) display.

Results

Once an analysis is complete, the results will be saved to a folder as multiple files. The **Results** button at the bottom of the sidebar will open this folder.



Each analysis run will create a new date- and time-stamped folder of results. The folder save location can be configured in the [Image Source](#) window.

Output Files

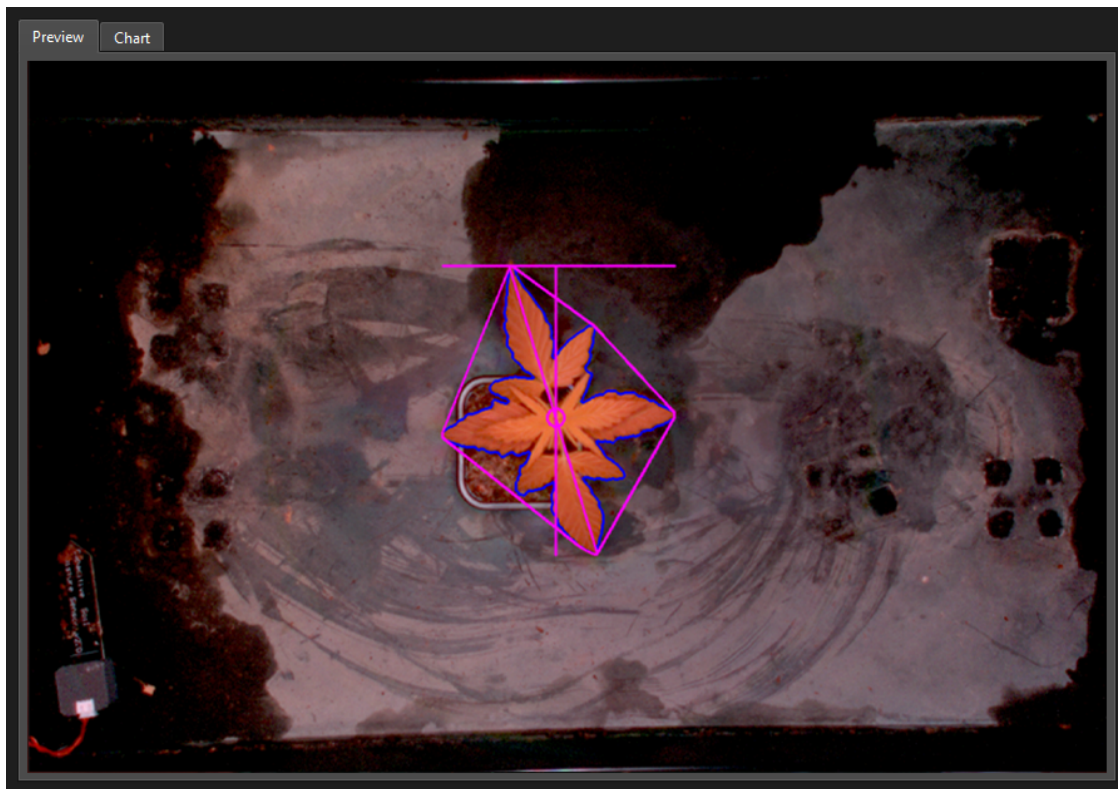
Analysis results will be output as the following files:

- A folder of the processed RGB image outputs in .png format. These images can be seen in the [Preview](#) display during analysis.
- The plotted results determined in [Chart Options](#) in .html format. These results can also be viewed in the [Chart](#) display.
- A spreadsheet of data in .csv format.
- Session parameters used during the analysis in .json format.

If an MQTT broker has been defined in the [File](#) menu, ROI values will be sent as MQTT topics for display by other systems.

Preview

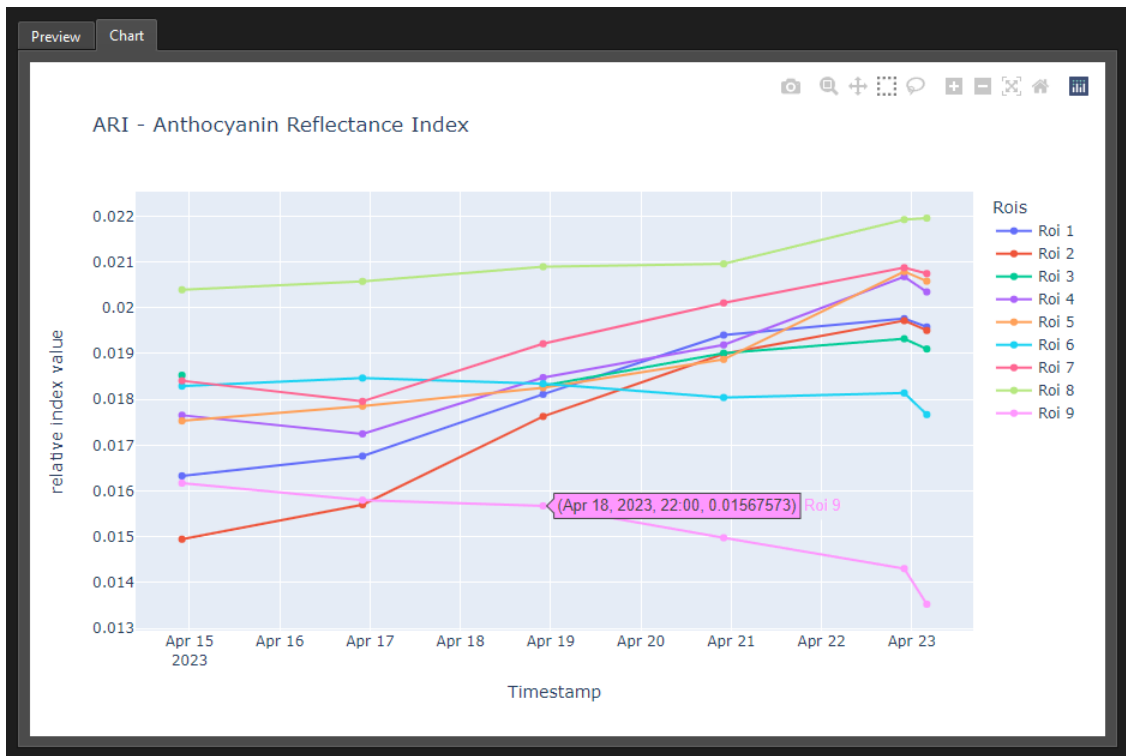
The **Preview** tab is one of the two primary display areas of the software. During analysis, image outputs will appear here as they are processed.



Shape and size changes within defined [Regions of Interest](#) are outlined in magenta. Once an analysis has been completed, previewed images are available as files in the [Results](#) folder.

Chart

The **Chart** tab is the second primary display area of the software, where the data chosen in [Chart Options](#) is plotted. Results for individual ROIs are color-coded. Refer to the [Regions of Interest](#) window to check ROI numbers.

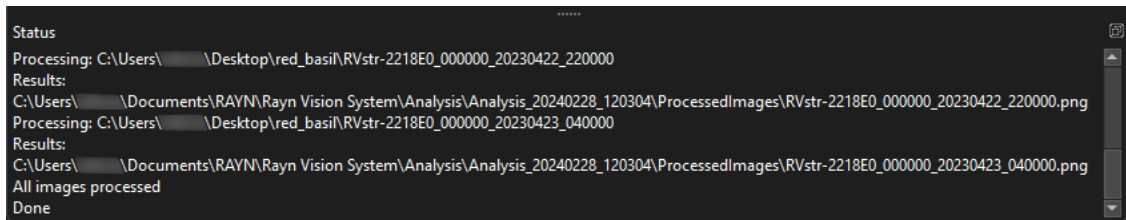


A non-interactive chart preview is displayed during the analysis, which can help identify trends or issues without having to run an entire image set. Once an analysis has been completed, the chart becomes interactive. Hover over data points for more information. Additional selection and zoom tools are available in the top right.

The chart is also output as a file to the [Results](#) folder.

Status

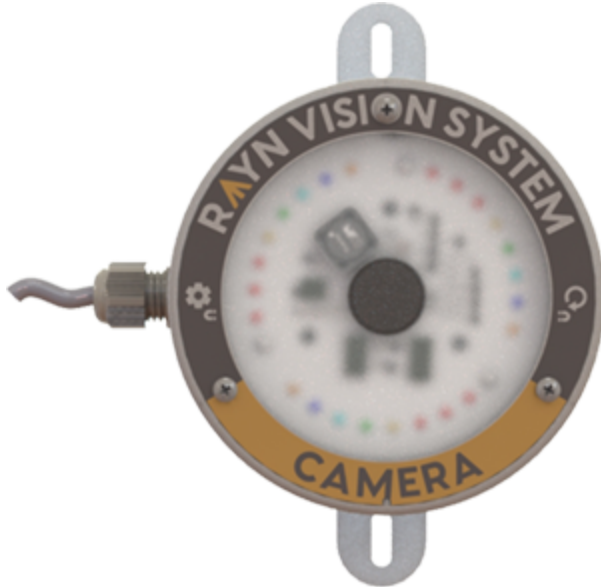
The status display provides a real-time report of the software's analysis functions. Images are listed as they are processed, and analysis status messages are provided.



The pop-out buttons in the top right of the status feed and sidebar will separate them from the main application window, allowing them to be freely moved and positioned onscreen. Status can be docked to the software again by dragging it over the top, bottom, left, or right edge of the main window. The sidebar can be docked to the left or right. Both can be freely resized by dragging the divider icon.

RAYN Vision System Camera

The RAYN Vision System (RVS) Camera is a compact research tool for observing and recording across multiple light wavebands, and includes a variety of connectivity options for remote and automated image capture, processing, and analysis.



For more information, see the *RAYN Vision System Camera Setup Guide* and *RAYN Vision System Camera Firmware Release Notes*.

User documentation and technical support are available via our website, rayngrowingsystems.com, or by contacting your RAYN Growing Systems provider.

