VAESTRO™

IMAGE ANALYSIS TOOLKIT

User Guide

version 2.3.1

installation, image analysis & review

160315

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1. INSTALLATION

Requirements

Make sure your computer system meets the minimum requirements:

- Quad-core processor
- Windows 7 64-bit
- 8 GB of RAM
- DVD-ROM Drive
- Available USB Port

Prerequisite

- VISIA-CR capture device v2.1 or higher using a Canon 5D camera. (*Note:* Images must be captured using a booth with a valid SN.)

Installation

- Run VAESTRO Image Analysis Toolkit Installer
- If using a Mirror database, install Mirror v.7.3.5 or newer with SQL Database

2. STARTING A PROJECT

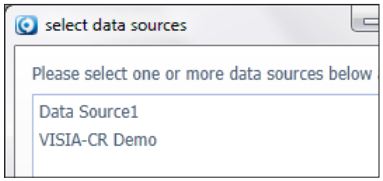
Initial Screen

- Select **create new project** to perform a new analysis on a set of images.
- Select **open project** to continue or modify analysis on a set of images.

Project Information

- Enter a project name.
- Select a project category from the drop-down menu. Click **edit project categories** to add, rename, or remove categories.
- *Optional:* Add project notes to identify the type of analysis being performed. This description would be useful at a later time when referencing this project.

Data Sources



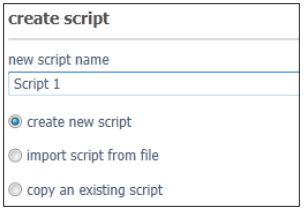
- Click **add** to choose a data source that contains images for analysis. Images can be captured by either Mirror or Canfield Capture software. Click the appropriate data source type, then select the database root folder. Select the desired data source(s) from the list, then enter a data source name.
- Click **rename** to edit the name of a data source.
- Click **remove** to delete a data source from the list.

Output Folder

- Click **browse** to select a root folder to store all output images and data for this project. (*Note:* Target folder must be empty.)

3. SCRIPTS

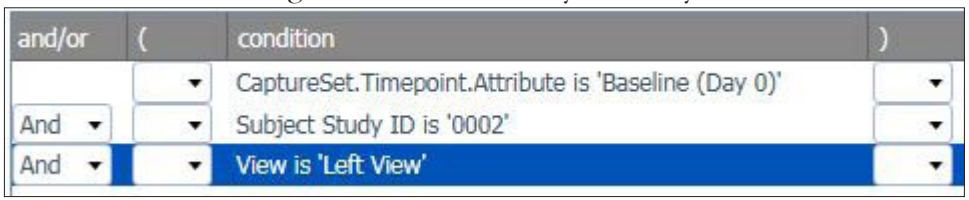
Creating a Script



- A script is a list of tasks to be performed by the VAESTRO Image Analysis Toolkit against a defined set of images. This includes application of masks to images for analysis and various feature detection/processing modules.
- Enter a script name.
- Click **create new script** to create an entirely new customizable set of tasks.
- Click **import script from file** to choose a pre-existing script. User will be prompted to select a script after clicking **next**.
- Click **copy an existing script** to bring up a list of previous analysis projects and the scripts used in them.

Input Filter

- Use the input filter to select images for analysis based on existing attributes such as subject ID, view, etc. You can search by standard or custom defined attributes.
- Click **add** to choose criteria that will define the list of image attributes necessary for analysis. Images can be filtered based on inclusion or exclusion of assigned attributes.
- The **insert** button will add a filter before the currently selected filter, **add** will insert a filter after the currently selected filter.
- Click **modify** to edit a filter.
- Use the "and/or" column and the "**(**" and "**)**" columns to further refine the attribute list images will need to satisfy for analysis.



and/or	(	condition	)
		CaptureSet.Timepoint.Attribute is 'Baseline (Day 0)'	
And		Subject Study ID is '0002'	
And		View is 'Left View'	

- Click **clear filter** to remove all filters.
- The **input filter preview** window will display a written list of your image selection parameters, as well as the number of images selected compared to the number of images available.

- Click **view resulting images** to display a thumbnail of each images series selected for analysis along with the attributes assigned to that image series.

Module Selection

- Analysis modules appear in the list on the left side of the module selection screen. Click on a module to view a description of the input and output data that each one will generate. Double-click to add a module to the script.
- Most analysis projects will require a form of masking as the first task performed. A mask determines the region being analyzed and is required for all feature detection modules. **Automasking** (zonal mask) or **Manual Masking** may be selected.
- **Automasking** uses image landmarks to automatically generate a mask area.
- Use **Manual Masking** to create a custom mask.
- For details on feature detection and image processing modules see section 6, *Feature Detection Modules*, page 14.

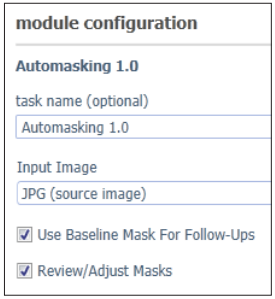
Module Configuration

- Module configuration will default to the recommended input image and parameters. A description of the inputs and parameters appears in the middle of the screen.
- Click **add another task** to add additional tasks to the script. (*Note:* The same mask can be used for all feature analysis modules.)
- After adding each module click **next** to define the parameters of the selected module.

- When all tasks have been selected click **finish script**.

Masking

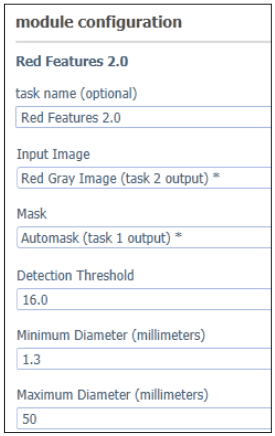
- Select the input image to use for masking. If images were captured in RAW format they may be used for masking instead of JPG images. CR2 RAW images will generate the best quality images, but will take additional time for processing. (*Note:* User has the option of changing the lighting mode of the input image, but results may not be as consistent as the recommended default lighting mode.)



- **Use Baseline Mask for Follow-Ups** will apply the mask from the baseline photo to all follow-up visits.
- Select **Review/Adjust Masks** to adjust the mask area to best capture detectable features. Leaving this box unchecked will result in the software automatically accepting each generated mask.

Feature Detection

- Some feature detection modules may require a masking module to be implemented. In such cases, if no masking module is added to the script, the module input requiring masking will be displayed in blue.
- Select the input image to use for analysis. CR2 raw images will generate the best quality images, but will take up additional time for processing.
- The preferred input image is defined by an asterisk. If you select a non-preferred input image type, the software will prompt you, but will let you proceed in customizing the analysis module.



- Select the masking module to apply for current feature detection.

- Feature detection modules will default to recommended detection thresholds such as minimum and maximum size or severity of a certain feature. These can be adjusted based on the level of detection desired. For details on feature detection parameters see section 6, *Feature Detection Modules*, page 14.

Output Summary

- Review the project information, data sources, and output folder.
- Choose to export all lighting modes or export only the lighting modes required for analysis to the output folder.
- Choose to export JPEG images or RAW images. JPEG images will minimize file size and RAW images will maximize image quality.
- Adjust the filename format in the **file name format** text box. An example of how the filename will output is under the text box. The default filename includes the subject ID, view, session name, and lighting mode. To add an attribute click in the text box at the point where the attribute should appear in the filename and click **insert data field**. To remove attributes delete them from the text box.
- Review the script summary and make changes if necessary. Double-click on an analysis task to reconfigure or delete the task.
- Click **preview input data** to display a thumbnail of each images series selected for analysis, along with the attributes assigned to that image series.
- Click **add task** to insert a task in the middle of the script or add a task to the end of the script.
- Click **save & close** to save the script and run at a later date.
- Click **run script now** to perform analysis.

Incremental Analysis

- Additional images can be analyzed under a previously run script. Their output images and data can be added to the output folder of the original script.
- Select **open project** from the VAESTRO Image Analysis Toolkit home screen.
- From the project overview screen select the script that you would like to run by clicking on the **<** and **>** arrows.
- Click **run script**.
- Select job output options.
- Masks and previously performed analyses can be re-used and only additional output information from new images will be added to the output folder. You can also override any previous masking or analysis and generate new output data for all images in the script.

1 If manual masking was selected or the **Review/Adjust Masks** button was checked prior to running the script each subject will have their baseline image side by side with a follow up image.

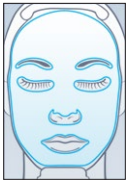
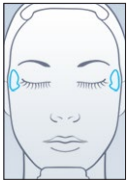
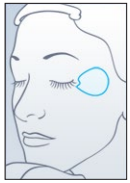
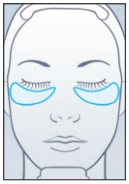
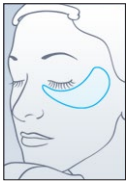
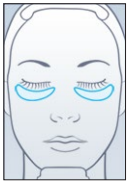
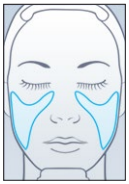
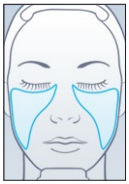
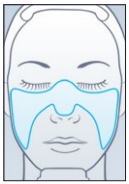
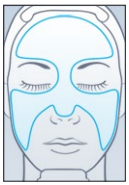
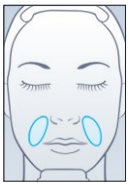
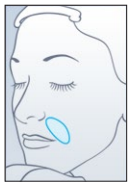
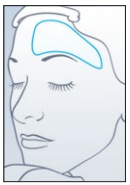
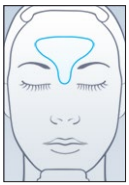
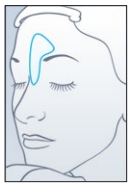
2 Cycle through visits using the controls above each image.

3 When all masks for a subject have been reviewed click **accept mask set** to move onto the next subject. If there are no additional subjects to be analyzed clicking **accept mask set** will prompt the script to move onto the next task.

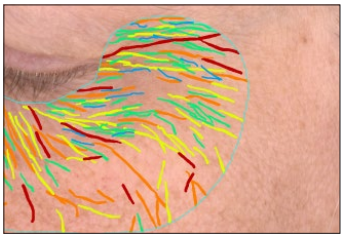
Masking Tool	Description
	Pan image by clicking and dragging
	Select and move mask
	Draw freehand
	Draw by clicking to create points
	Create rectangular shape
	Create elliptical shape
	When selected, drawing tools will add to mask
	When selected, drawing tools will remove from mask
	Undo previous action
	Reset mask, user can select which mask to reset
	Copy right mask to left image
	Copy right mask to all images
	Copy left mask to right image
	Copy left mask to all images

5. ZONAL MASK MODULES

The auto mask module provides various choices of zonal masks that may be applied onto the selected image(s).

Full-face			Crows Feet		
Periorbital			Under Eye		
Cheek			Full-cheek		
Pore			Mid-face		
Full-upper			Nasolabial		
Forehead			Glabellar		

Wrinkles Analysis v3.2

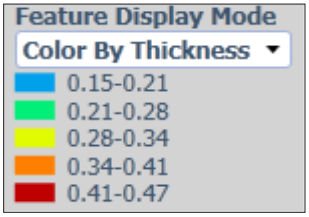


Algorithm Description:

- The Wrinkle Analysis algorithm provides quantitative data and scoring for assessing the severity of facial wrinkles and fine lines under uniform white light. The analysis is performed on a high-resolution image captured with a Canfield research capture device.

User-Defined Input Parameters

- Detection Threshold - An adjustable value to define the level of sensitivity for wrinkle detection. The lower the value, the more sensitive the detection.
- Minimum Length [millimeters] - An adjustable value to define the smallest length of detected wrinkle (in millimeter). This parameter eliminates wrinkles that are less than the value defined for length.
- Maximum Length [millimeters] - An adjustable value to define the largest length of detected wrinkle (in millimeter). This parameter eliminates wrinkles that are greater than the value defined for length.
- Fine Coarse Divider - Defines the separation between fine lines and coarse wrinkles. This will affect the Fine and Coarse Area output measurements.
- Feature Display Mode - An option to display the output image as **Monochrome** or **Color by Thickness**. **Color by Thickness** mode displays the wrinkles in color, pre-defined by thickness range.



Wrinkles Analysis v3.2 Scores	Definition
Count	The number of individual features detected within the region of interest (ROI) mask area.
Mean Length	The mean length (in millimeters) of major axis of the detected features within the masked region of interest (ROI). This represents cumulative measurement value divided by feature count.
Total Area	The total area (in square millimeters) of detected features within the masked region of interest (ROI). This represents cumulative measurement value.
Mean Intensity	The cumulative mean intensity of detected features within the masked region of interest (ROI) measured against the input image. Intensity is defined as sum of mean Red, mean Green, mean Blue, divided by 3. The value ranges from 0 (black) to 255 (white).
Mean Thickness	The mean widths (in millimeters) of major axis of the detected features within the masked region of interest (ROI). This represents cumulative measurement value divided by feature count.
Background Intensity	The mean intensity within the masked region of interest (ROI), excluding detected features, measured against the input image. Intensity is defined as sum of mean Red, mean Green, mean Blue, divided by 3. The value ranges from 0 (black) to 255 (white).
Mask Area	The total area (in square millimeters) of the masked region of interest (ROI). In the case of multiple ROIs, this represents the cumulative total areas of all masked regions.
Fine Area	The total area (in square millimeters) of detected features within the masked region of interest (ROI), that corresponds to fine lines, defined by the Fine Coarse Divider parameter. This represents cumulative measurement value.
Coarse Area	The total area (in square millimeters) of detected features within the masked region of interest (ROI), that corresponds to coarse lines, defined by the Fine Coarse Divider parameter. This represents cumulative measurement value.

Wrinkles Analysis v3.2 Scores	Definition
Area 1 - Very Fine Lines	The total area (in square millimeters) of detected features within the masked region of interest (ROI), that coresponds to thickness 0.15 - 0.21mm. This represents cumulative measurement value.
Area 2 - Fine Lines	The total area (in square millimeters) of detected features within the masked region of interest (ROI), that coresponds to thickness 0.21- 0.28mm. This represents cumulative measurement value.
Area 3 - Medium Lines	The total area (in square millimeters) of detected features within the masked region of interest (ROI), that coresponds to thickness 0.28 - 0.34mm. This represents cumulative measurement value.
Area 4 - Coarse Lines	The total area (in square millimeters) of detected features within the masked region of interest (ROI), that coresponds to thickness 0.34 0.41mm. This represents cumulative measurement value.
Area 5 - Very Coarse Lines	The total area (in square millimeters) of detected features within the masked region of interest (ROI), that coresponds to thickness 0.41 - 0.47mm. This represents cumulative measurement value.

Wrinkles Analysis v3.0

Algorithm Description:

- The Wrinkle Analysis algorithm provides quantitative data and scoring for assessing the severity of facial wrinkles and fine lines under uniform white light. The analysis is performed on a high-resolution image captured with a Canfield research capture device.

User-Defined Input Parameters

- Detection Threshold - An adjustable value to define the level of sensitivity for wrinkle detection. The lower the value, the more sensitive the detection.

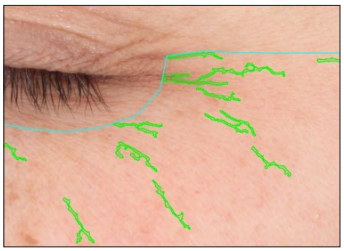
- Minimum Length [millimeters] - An adjustable value to define the smallest length of detected wrinkle (in millimeter). This parameter eliminates wrinkles that are less than the value defined for length.
- Maximum Length [millimeters] - An adjustable value to define the largest length of detected wrinkle (in millimeter). This parameter eliminates wrinkles that are greater than the value defined for length.
- Minimum Thickness [millimeters] - An adjustable value to define the average minimum width of detected wrinkle (in millimeter). This parameter eliminates wrinkles that are less than the value defined for thickness.
- Maximum Thickness [millimeters] - An adjustable value to define the average maximum width of detected wrinkle (in millimeter). This parameter eliminates wrinkles that are greater than the value defined for thickness.
- Feature Display Mode - An option to display the output image as **Monochrome** or **Color by Thickness**. **Color by Thickness** mode displays the wrinkles in color, pre-defined by thickness range.

Wrinkles Analysis v3.0 Scores	**Definition**
Count	The number of individual features detected within the region of interest (ROI) mask area.
Mean Length	The mean length (in millimeters) of major axis of the detected features within the masked region of interest (ROI). This represents cumulative measurement value divided by feature count.
Total Area	The total area (in square millimeters) of detected features within the masked region of interest (ROI). This represents cumulative measurement value.
Mean Intensity	The cumulative mean intensity of detected features within the masked region of interest (ROI) measured against the input image. Intensity is defined as sum of mean Red, mean Green, mean Blue, divided by 3. The value ranges from 0 (black) to 255 (white).

Mean Thickness	The mean widths (in millimeters) of major axis of the detected features within the masked region of interest (ROI). This represents cumulative measurement value divided by feature count.
Weighted Mean Thickness	The sum (in millimeters) of the product of mean thickness and length of the feature, divided by the total length. This represents mean feature thickness weighted by its length.
Background Intensity	The mean intensity within the masked region of interest (ROI), excluding detected features, measured against the input image. Intensity is defined as sum of mean Red, mean Green, mean Blue, divided by 3. The value ranges from 0 (black) to 255 (white).
Mask Area	The total area (in square millimeters) of the masked region of interest (ROI). In the case of multiple ROIs, this represents the cumulative total areas of all masked regions.

Wrinkles Analysis v2.0

Algorithm Description:



- The Wrinkle Analysis algorithm provides quantitative data and scoring for assessing the severity of facial wrinkles and fine lines under uniform white light. The analysis is performed on a high-resolution image captured with a Canfield research capture device.

User-Defined Input Parameters

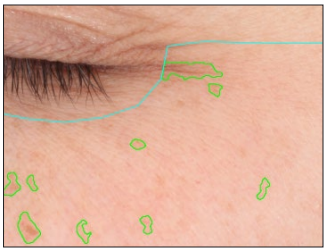
- Detection Threshold - An adjustable value to define the level of sensitivity for wrinkle detection. The lower the value, the more sensitive the detection.
- Minimum Length [millimeters] - An adjustable value to define the smallest length of detected wrinkle (in millimeter). This parameter eliminates wrinkles that are less than the value defined for length.
- Maximum Length [millimeters] - An adjustable value to define the largest length of detected wrinkle (in millimeter). This parameter eliminates wrinkles that are greater than the value defined for length.

- Shine Compensation - A control to use for images that have excessive amount of shine due to oily or wet skin, or excessive amount of lighting. This option will suppress false positive wrinkles detections caused by shine. Default is On.
- False Elimination - This option will reduce false positive wrinkle detection caused by noise, erroneous wrinkle extensions, and wrinkle-like features. Default is Off.

Wrinkles Analysis v2.0 Scores	**Definition**
Count	The number of individual features detected within the region of interest (ROI) mask area.
Total Length	The total length (in millimeters) of major axis of the detected features within the masked region of interest (ROI). This represents cumulative measurement value.
Total Area	The total area (in square millimeters) of detected features within the masked region of interest (ROI). This represents cumulative measurement value.
Mean Intensity	The cumulative mean intensity of detected features within the masked region of interest (ROI) measured against the input image. Intensity is defined as sum of mean Red, mean Green, mean Blue, divided by 3. The value ranges from 0 (black) to 255 (white).
Mean Contrast Intensity	The mean intensity of detected features, measured against the contrast image. Intensity is defined as sum of mean Red, mean Green, mean Blue, divided by 3.
Background Intensity	The mean intensity within the masked region of interest (ROI), excluding detected features, measured against the input image. Intensity is defined as sum of mean Red, mean Green, mean Blue, divided by 3. The value ranges from 0 (black) to 255 (white).
Mask Area	The total area (in square millimeters) of the masked region of interest (ROI). In the case of multiple ROIs, this represents the cumulative total areas of all masked regions.

Visible Spots Analysis v2.0

Algorithm Description:



- The Visible Spots Analysis algorithm provides quantitative data and scoring for spots visible under standard daylight conditions. The analysis is performed on a high-resolution image captured with a Canfield research capture device.

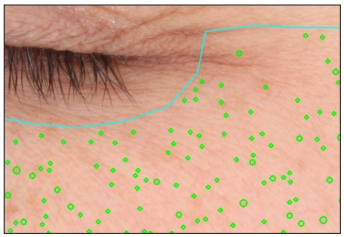
User-Defined Input Parameters:

- Detection Threshold - An adjustable value to define the level of sensitivity for visible spots detection. The lower the value, the more sensitive the detection.
- Minimum Diameter [millimeters square] - An adjustable diameter value to define the smallest area of detected visible spots (in millimeter square). This parameter eliminates visible spots that are less than the value defined.
- Maximum Diameter [millimeters square] - An adjustable diameter value to define the largest area of detected visible spot (in millimeter square). This parameter eliminates visible spots that are greater than the value defined.

Spots Analysis Scores	Definition
Count	The number of individual features detected within the region of interest (ROI) mask area.
Total Area	The total area (in square millimeters) of detected features within the masked region of interest (ROI). This represents cumulative measurement value.
Mean Intensity	The cumulative mean intensity of detected features within the masked region of interest (ROI) measured against the input image. Intensity is defined as sum of mean Red, mean Green, mean Blue, divided by 3. The value ranges from 0 (black) to 255 (white).

Background Intensity	The mean intensity within the masked region of interest (ROI), excluding detected features, measured against the input image. Intensity is defined as sum of mean Red, mean Green, mean Blue, divided by 3. The value ranges from 0 (black) to 255 (white).
Mask Area	The total area (in square millimeters) of the masked region of interest (ROI). In the case of multiple ROIs, this represents the cumulative total areas of all masked regions.

Pores Analysis v3.0



Algorithm Description:

- The Pores Analysis algorithm provides quantitative data and scoring for visible facial pores. The analysis is performed on a high-resolution image captured with a Canfield research capture device.

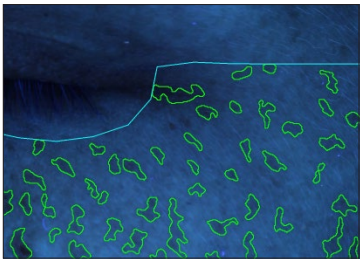
User-Defined Input Parameters:

- Detection Threshold - An adjustable value to define the level of sensitivity for pore detection. The lower the value, the more sensitive the detection.
- Minimum Diameter [millimeters] - An adjustable value to define the smallest radius of detected pores (in millimeter). This parameter eliminates pores that are less than the value defined for radius.
- Maximum Diameter [millimeters] - An adjustable value to define the largest radius of detected pores (in millimeter). This parameter eliminates pores that are greater than the value defined for radius.
- Stubble Elimination Sensitivity - This option will reduce false positive pore detections caused by beard stubble.

Pores Analysis Scores	Definition
Count	The number of individual features detected within the region of interest (ROI) mask area.
Total Area	The total area (in square millimeters) of detected features within the masked region of interest (ROI). This represents cumulative measurement value.
Mean Intensity	The cumulative mean intensity of detected features within the masked region of interest (ROI) measured against the input image. Intensity is defined as sum of mean Red, mean Green, mean Blue, divided by 3. The value ranges from 0 (black) to 255 (white).
Background Intensity	The mean intensity within the masked region of interest (ROI), excluding detected features, measured against the input image. Intensity is defined as sum of mean Red, mean Green, mean Blue, divided by 3. The value ranges from 0 (black) to 255 (white).
Mask Area	The total area (in square millimeters) of the masked region of interest (ROI). In the case of multiple ROIs, this represents the cumulative total areas of all masked regions.

Invisible Spots Analysis v2.0

Algorithm Description:



- The Invisible Spots Analysis algorithm provides quantitative data and scoring for hyperpigmented spots that are visible under UV-fluorescence or Blue light excitation lighting modalities. The analysis is performed on a high-resolution image captured with a Canfield research capture device.

User-Defined Input Parameters

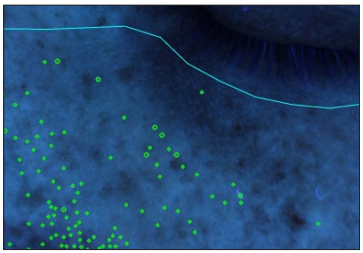
- Detection Threshold - An adjustable value to define the level of sensitivity for invisible spot detection. The lower the value, the more sensitive the detection.

- Minimum Diameter [millimeters square] - An adjustable diameter value to define the smallest area of detected invisible spot (in millimeter square). This parameter eliminates invisible spots that are less than the value defined.
- Maximum Diameter [millimeters square] - An adjustable diameter value to define the largest area of detected invisible spot (in millimeter square). This parameter eliminates invisible spots that are greater than the value defined.

Invisible Spots Analysis Scores	**Definition**
Count	The number of individual features detected within the region of interest (ROI) mask area.
Total Area	The total area (in square millimeters) of detected features within the masked region of interest (ROI). This represents cumulative measurement value.
Pigmentation Intensity	The cumulative mean intensity of detected features within the masked region of interest (ROI), measured against the blue channel image. The value ranges from 0 (black) to 255 (white).
Background Pigmentation Intensity	The mean intensity within the masked region of interest (ROI), excluding detected features, measured against the grayscale image. The value ranges from 0 (black) to 255 (white).
Mask Area	The total area (in square millimeters) of the masked region of interest (ROI). In the case of multiple ROIs, this represents the cumulative total areas of all masked regions.

Porphyrins Analysis v3.0

Algorithm Description:



- The Porphyrins Analysis algorithm provides quantitative data and scoring for Porphyrins that are visible as bright spots under UV-fluorescence or Red lighting modalities. The analysis is performed on a high-resolution image captured with a Canfield research device.

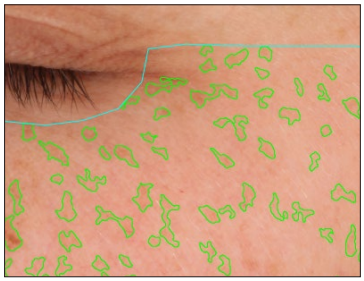
User-Defined Input Parameters:

- Detection Threshold - An adjustable value to define the level of sensitivity for porphyrins detection. The lower the value, the more sensitive the detection.
- Minimum Diameter [millimeters square] - An adjustable diameter value to define the smallest area of detected porphyrins (in millimeter square). This parameter eliminates porphyrins that are less than the value defined.
- Maximum Diameter [millimeters square] - An adjustable diameter value to define the largest area of detected porphyrins (in millimeter square). This parameter eliminates porphyrins that are greater than the value defined.

Porphyrins Analysis Scores	**Definition**
Count	The number of individual features detected within the region of interest (ROI) mask area.
Total Area	The total area (in square millimeters) of detected features within the masked region of interest (ROI). This represents cumulative measurement value.
Porphyrin Intensity	The cumulative mean intensity of detected features within the masked region of interest (ROI), measured against the red channel image. The value ranges from 0 (black) to 255 (white).
Background Pigmentation Intensity	The mean intensity within the masked region of interest (ROI), excluding detected features, measured against the inverted image. The value ranges from 0 (white) to 255 (black).
Mask Area	The total area (in square millimeters) of the masked region of interest (ROI). In the case of multiple ROIs, this represents the cumulative total areas of all masked regions.

RBX Brown Spots Analysis v2.0

Algorithm Description:



- The RBX Brown Spots Analysis algorithm provides quantitative data for areas of high concentration of hyperpigmented spots that are visible under the Cross-Polarized lighting modality. The analysis is performed on a high-resolution image captured with a Canfield research capture device.

User-Defined Input Parameters:

- Detection Threshold - An adjustable value to define the level of sensitivity for brown spot detection. The lower the value, the more sensitive the detection.
- Minimum Diameter [millimeters square] - An adjustable diameter value to define the smallest area of detected brown spots (in millimeter square). This parameter eliminates brown spots that are less than the value defined.
- Maximum Diameter [millimeters square] - An adjustable diameter value to define the largest area of detected brown spots (in millimeter square). This parameter eliminates brown spots that are greater than the value defined.

RBX Brown Spots Analysis Scores	Definition
Count	The number of individual features detected within the region of interest (ROI) mask area.
Total Area	The total area (in square millimeters) of detected features within the masked region of interest (ROI). This represents cumulative measurement value.

Mean Brown Intensity	The cumulative mean intensity of detected features within the masked region of interest (ROI), measured against the inverted RBX grayscale image. The value ranges from 0 (white) to 255 (black). This represents how brown (pigmentation) the detected features are.
Background RBX Intensity	The mean intensity within the masked region of interest (ROI), excluding detected features, measured against the inverted RBX grayscale image. The value ranges from 0 (white) to 255 (black).
Global Intensity	The cumulative mean intensity within the masked region of interest (ROI), measured against the inverted RBX grayscale image. The value ranges from 0 (white) to 255 (black). This represents the average brownness (pigmentation) or redness (hemoglobin) of the skin within the ROI.
Mask Area	The total area (in square millimeters) of the masked region of interest (ROI). In the case of multiple ROIs, this represents the cumulative total areas of all masked regions.

RBX Red Features Analysis v2.0

Algorithm Description:

- The RBX Red Features Analysis algorithm provides quantitative data for small red spots and vascular features that are visible under the Cross-Polarized lighting modality. The analysis is performed on a high-resolution image captured with a Canfield research capture device.

User-Defined Input Parameters:

- Detection Threshold - An adjustable value to define the level of sensitivity for RBX red features detection. The lower the value, the more sensitive the detection.
- Minimum Diameter [millimeters square] - An adjustable diameter value to define the smallest area of detected for RBX red features (in millimeter square). This parameter eliminates red features that are less than the value defined.

- Maximum Diameter [millimeters square] - An adjustable diameter value to define the largest area of detected for RBX red features (in millimeter square). This parameter eliminates red features that are greater than the value defined.

RBX Red Features Analysis Scores	Definition
Count	The number of individual features detected within the region of interest (ROI) mask area.
Total Area	The total area (in square millimeters) of detected features within the masked region of interest (ROI). This represents cumulative measurement value.
Mean Red Intensity	The cumulative mean intensity of detected features within the masked region of interest (ROI), measured against the inverted RBX grayscale image. The value ranges from 0 (white) to 255 (black). This represents how red (hemoglobin) the detected features are.
Background RBX Intensity	The mean intensity within the masked region of interest (ROI), excluding detected features, measured against the inverted RBX grayscale image. The value ranges from 0 (white) to 255 (black).
Global Intensity	The cumulative mean intensity within the masked region of interest (ROI), measured against the inverted RBX grayscale image. The value ranges from 0 (white) to 255 (black). This represents the average brownness (pigmentation) or redness (hemoglobin) of the skin within the ROI.
Mask Area	The total area (in square millimeters) of the masked region of interest (ROI). In the case of multiple ROIs, this represents the cumulative total areas of all masked regions.

RBX Redness Analysis v1.0

Algorithm Description:

- The RBX Redness Analysis algorithm provides quantitative data for large areas of redness that are visible under the Cross-Polarized lighting modality. The analysis is performed on a high-resolution image captured with a Canfield research capture device.

User-Defined Input Parameters:

- Minimum Diameter [millimeters square] - An adjustable diameter value to define the smallest area of detected for RBX redness (in millimeter square). This parameter eliminates red areas that are less than the value defined.

RBX Redness Analysis Scores	Definition
Total Area	The total area (in square millimeters) of detected features within the masked region of interest (ROI). This represents cumulative measurement value.
Mean Red Intensity	The cumulative mean intensity of detected features within the masked region of interest (ROI), measured against the inverted RBX grayscale image. The value ranges from 0 (white) to 255 (black). This represents how red (hemoglobin) the detected features are.
Background RBX Intensity	The mean intensity within the masked region of interest (ROI), excluding detected features, measured against the inverted RBX grayscale image. The value ranges from 0 (white) to 255 (black).
Global Intensity	The cumulative mean intensity within the masked region of interest (ROI), measured against the inverted RBX grayscale image. The value ranges from 0 (white) to 255 (black). This represents the average brownness (pigmentation) or redness (hemoglobin) of the skin within the ROI.
Mask Area	The total area (in square millimeters) of the masked region of interest (ROI). In the case of multiple ROIs, this represents the cumulative total areas of all masked regions.

RBX Red Spots Analysis v1.0

Algorithm Description:

- The RBX Red Spots Analysis algorithm provides quantitative data for small red spots that are visible under the Cross-Polarized lighting modality. The analysis is performed on a high-resolution image captured with a Canfield research capture device.

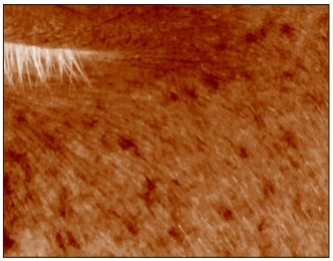
User-Defined Input Parameters:

- Detection Threshold - An adjustable value to define the level of sensitivity for RBX red spot detection. The lower the value, the more sensitive the detection.
- Minimum Diameter [millimeters square] - An adjustable diameter value to define the smallest area of detected for RBX red spots (in millimeter square). This parameter eliminates red spots that are less than the value defined.
- Maximum Diameter [millimeters square] - An adjustable diameter value to define the largest area of detected for RBX red spots (in millimeter square). This parameter eliminates red spots that are greater than the value defined.

RBX Red Spots Analysis Scores	Definition
Total Area	The total area (in square millimeters) of detected features within the masked region of interest (ROI). This represents cumulative measurement value.
Mean Red Intensity	The cumulative mean intensity of detected features within the masked region of interest (ROI), measured against the inverted RBX grayscale image. The value ranges from 0 (white) to 255 (black). This represents how red (hemoglobin) the detected features are.

Background RBX Intensity	The mean intensity within the masked region of interest (ROI), excluding detected features, measured against the inverted RBX grayscale image. The value ranges from 0 (white) to 255 (black).
Mask Area	The total area (in square millimeters) of the masked region of interest (ROI). In the case of multiple ROIs, this represents the cumulative total areas of all masked regions.

RBX Processing



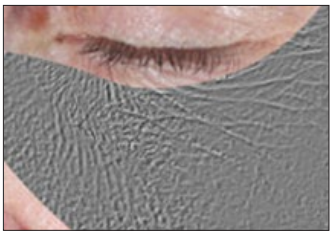
Algorithm Description:

- RBX processing transforms an RGB image into a Red and Brown images. These images can be used to identify and highlight features that are visible under the Cross-Polarized lighting modality, e.g., hyper-pigmented spots and vascular structures. The processing is performed on a high-resolution image captured with a Canfield research capture device.

Output Data:

- Outputs RBX image(s). No data is generated.

Texture v1.0



Algorithm Description:

- The Texture Analysis algorithm provides quantitative data and scoring for skin texture under standard daylight conditions. The analysis is performed on a high-resolution image captured with a Canfield research capture device.

User-Defined Input Parameters:

- Texture Granularity - An adjustable value to specify the level of detail, or granularity, of texture detection. With lower values, the texture is measured on a coarser scale. With higher values, the texture is measured on a finer scale.

Texture Analysis Scores	Definition
Roughness	Average magnitude of textural content of the image. It's the reciprocal of evenness.
Mask Area	The total area (in square millimeters) of the masked region of interest (ROI). In the case of multiple ROIs, this represents the cumulative total areas of all masked regions.

Color Measurement v1.0

Algorithm Description:

- The Color Analysis algorithm provides color measurements under standard daylight conditions. The analysis is performed on a high-resolution image captured with a Canfield research capture device.

Color Analysis Scores	Definition
Mean R/RGB	Mean Red value from the RGB color space, for the detected features within the masked region of interest (ROI).
Mean G/RGB	Mean Green value from the RGB color space, for the detected features within the masked region of interest (ROI).
Mean B/RGB	Mean Blue value from the RGB color space, for the detected features within the masked region of interest (ROI).
Mean L*	Mean L* value from the L*a*b* (CIELab) color space, for the detected features within the masked region of interest (ROI). It correlates to mean RGB, but values may differ since RGB to Lab calculation varies.
Mean a*	Mean a* value from the L*a*b* (CIELab) color space, for the detected features within the masked region of interest (ROI).
Mean b*	Mean b* value from the L*a*b* (CIELab) color space, for the detected features within the masked region of interest (ROI).

Color Evenness	Measurement on overall variation in color values across the defined area, and how rapidly those colors change spatially within the defined area. An image with few distinguishable colors (determined from a* and b* color channels from L*a*b* color space), with very gradual changes in color will achieve a high color evenness score. Score is on a scale of 0.0 to 1.0.
Std Dev R/RGB	Standard deviation of Red values from the RGB color space, for the detected features within the masked region of interest (ROI).
Std Dev G/RGB	Standard deviation of Green values from the RGB color space, for the detected features within the masked region of interest (ROI).
Std Dev B/RGB	Standard deviation of Blue values from the RGB color space, for the detected features within the masked region of interest (ROI).
Std Dev L*	Standard deviation of L* values from the L*a*b* (CIELab) color space, for the detected features within the masked region of interest (ROI).
Std Dev a*	Standard deviation of a* values from the L*a*b* (CIELab) color space, for the detected features within the masked region of interest (ROI).
Std Dev b*	Standard deviation of b* values from the L*a*b* (CIELab) color space, for the detected features within the masked region of interest (ROI).

7. JOB SUMMARY

A job summary screen will appear after the script has completed. A job represents the combination of input filters, all scripts created and run, and all tasks within the given scripts. The job summary will also display the time that the job was started and finished and also a review of the input criteria and tasks that were run.

Output Folder

The output folder contains all the input and analyzed images. It also contains the Result Viewer application that can be launched to view results independent of VAESTRO. (*Note:* VAESTRO Viewer uses the content of the output folder to display images and data. Therefore it is not recommended to edit, modify, and/or remove this content. If such actions are necessary, it is best to first copy the content of the output folder into a separate working directory.)

Images

- The input folder contains the images that were used for analysis. It may also contain additional lighting modality images if the **copy all lighting modes to job output folder** option is selected in VAESTRO.
- The analyzed images along with the mask area and feature detection overlays are saved in the Task folder(s). The images are associated to the task that they were run under.

Data

- The analysis results are exported as a CSV file, associated with each task number/name.
- Open the CSV files using MS Excel or import to a statistical application to view the analysis result data and/or perform data analysis.

Results Viewer

The VAESTRO Viewer application provides a convenient method to quickly view the images and data generated by VAESTRO software. It provides a visual correlation to the data so that the mask area and features detected within are easily evaluated. The VAESTRO Viewer application is included as part of the output folder generated by each script analyzed in VAESTRO – the output folder along with VAESTRO Viewer can be exported and viewed on any PC and does not require a license for distribution.

Opening the VAESTRO Viewer Application

- From the Job Summary screen click the **View Results** button.
- You can also access the VAESTRO Viewer application from the output folder by clicking on the **View Results.exe** file.
- When finished viewing the VAESTRO images, simply close the window to return to the job results screen in VAESTRO, or the output folder of the script.

Viewing an Image

- The image navigation pane (left side) contains a list of the images that were analyzed. The images are sorted in order of task performed, and subdivided by subject, view, and timepoint of the input images.
- Click on ▶ in the image navigation pane to expand the options within each category.
- Double-click on a timepoint and select display on left or display on right to display the analyzed image in the image viewing pane. You can also drag and drop the timepoint into the image viewing pane to display the image.
- To zoom in or zoom out use the slide bar above the thumbnail on the bottom left of the screen, or use the scroll wheel on the mouse.

Image Viewing Options

Use the drop-down menu under each image to select the lighting modality of the displayed image(where applicable).

	Display the mask overlay on a selected image
	Hide the mask overlay on a selected image
	Show the mask blinking on and off on a selected image

Data Display Options

- Information generated by VAESTRO analysis as well as details of the task performed and the capture settings for a given image are shown in a window underneath the displayed image. These are three tabs which will show various details of analysis.
- Click the **Results** tab to show measurements generated by the image analysis module. Float the mouse over each measurement to view description.
- Click the **Task** tab to show analysis module details, including input image and mask used. This tab displays the detection threshold and parameters used for analysis.

- Click the **Capture Set** tab to show information from the image capture software (Mirror or Canfield Capture). This tab displays the subject, image view, and session information, as well as the camera and capture device used with corresponding serial numbers.
- Click the **Script Details** button above the thumbnail at the bottom left of the screen to review information about the script that was run including masking module descriptions, input parameters, and custom thresholds.

Project Overview

Click **close** to return to the project overview where the user can view a list of jobs and their status within the project. From this screen users can create another script, edit a script, edit project details, or return to the home screen to begin/continue a different project.