



NI Vision Builder AI Vision Assistant Help

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NI Vision Assistant is a tool for prototyping and testing image processing algorithms or applications. After prototyping and testing the algorithm, use the LabVIEW VI Creation Wizard to create a diagram of the algorithm, or use the C Code Creation Wizard to create the C code of the algorithm, and then use the NI Vision machine vision and image processing libraries to implement the solution in LabVIEW, LabWindows™/CVI™, Visual Basic, or most other ActiveX containers.

For more information about concepts covered in this help file, refer to the *NI Vision Concepts Manual*.

To navigate this help file, use the **Contents**, **Index**, and **Search** tabs to the left of this window.

For more information about this help file, refer to the following topics:

[Using Help](#)

[Related Documentation](#)

[Glossary](#)

[Important Information](#)

[Technical Support and Professional Services](#)

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Related Documentation

The following documents contain information that you might find helpful as you use this help file:

- *NI Vision Concepts Manual*—Describes the basic concepts of image analysis, image processing, and machine vision. This document also contains in-depth discussions about imaging functions for advanced users.
- *NI Vision Builder for Automated Inspection: Configuration Help*—Contains information about using the Vision Builder for Automated Inspection Configuration Interface to create a machine vision application.

Getting Help in Vision Assistant

You can get help in Vision Assistant in any of the following ways:

- Refer to the Embedded Help window for context-sensitive help that applies to the currently selected tab or function.
- Select **Help»Online Help**.
- Move the mouse pointer over the buttons in the toolbar, Script window, Reference window, Acquisition window, or Image Browser for tooltips that describe what each button does.
- Select **Start»All Programs»National Instruments»Vision Builder AI»Documentation»NI Vision Concepts Manual** to launch the *NI Vision Concepts Manual*. This manual contains information about the algorithms, utilities, and tools available in Vision Assistant and the NI Vision library.

Using Help

[Conventions](#)



[Navigating Help](#)

[Searching Help](#)

[Printing Help File Topics](#)

Conventions

This help file uses the following conventions:

- < > Angle brackets that contain numbers separated by an ellipsis represent a range of values associated with a bit or signal name—for example, AO<0..3>.
- » The » symbol leads you through nested menu items and dialog box options to a final action. The sequence **File»Page Setup»Options** directs you to pull down the **File** menu, select the **Page Setup** item, and select **Options** from the last dialog box.
-  This icon denotes a tip, which alerts you to advisory information.
-  This icon denotes a note, which alerts you to important information.
- bold** Bold text denotes items that you must select or click in the software, such as menu items and dialog box options. Bold text also denotes parameter names.
- green Underlined text in this color denotes a link to a help topic, help file, or Web address.
- italic* Italic text denotes variables, emphasis, cross references, or an introduction to a key concept. This font also denotes text that is a placeholder for a word or value that you must supply.
- monospace Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames, and extensions.

Navigating Help (Windows Only)

To navigate this help file, use the **Contents**, **Index**, and **Search** tabs to the left of this window or use the following toolbar buttons located above the tabs:

- **Hide**—Hides the navigation pane from view.
- **Locate**—Locates the currently displayed topic in the **Contents** tab, allowing you to view related topics.
- **Back**—Displays the previously viewed topic.
- **Forward**—Displays the topic you viewed before clicking the **Back** button.
- **Options**—Displays a list of commands and viewing options for the help file.

Searching Help (Windows Only)

Use the **Search** tab to the left of this window to locate content in this help file. If you want to search for words in a certain order, such as "related documentation," add quotation marks around the search words as shown in the example. Searching for terms on the **Search** tab allows you to quickly locate specific information and information in topics that are not included on the **Contents** tab.

Wildcards

You also can search using asterisk (*) or question mark (?) wildcards. Use the asterisk wildcard to return topics that contain a certain string. For example, a search for "prog*" lists topics that contain the words "program," "programmatically," "progress," and so on.

Use the question mark wildcard as a substitute for a single character in a search term. For example, "?ext" lists topics that contain the words "next," "text," and so on.



Note Wildcard searching will not work on Simplified Chinese, Traditional Chinese, Japanese, and Korean systems.

Nested Expressions

Use nested expressions to combine searches to further refine a search. You can use Boolean expressions and wildcards in a nested expression. For example, "example AND (program OR VI)" lists topics that contain "example program" or "example VI." You cannot nest expressions more than five levels.

Boolean Expressions

Click the ► button to add Boolean expressions to a search. The following Boolean operators are available:

- **AND** (default)—Returns topics that contain both search terms. You do not need to specify this operator unless you are using nested expressions.
- **OR**—Returns topics that contain either the first or second term.
- **NOT**—Returns topics that contain the first term without the second term.
- **NEAR**—Returns topics that contain both terms within eight words of each other.


Search Options

Use the following checkboxes on the **Search** tab to customize a search:

- **Search previous results**—Narrows the results from a search that returned too many topics. You must remove the checkmark from this checkbox to search all topics.
- **Match similar words**—Broadens a search to return topics that contain words similar to the search terms. For example, a search for "program" lists topics that include the words "programs," "programming," and so on.
- **Search titles only**—Searches only in the titles of topics.

Printing Help File Topics (Windows Only)

Complete the following steps to print an entire book from the **Contents** tab:

1. Right-click the book.
2. Select **Print** from the shortcut menu to display the **Print Topics** dialog box.
3. Select the **Print the selected heading and all subtopics** option.
 **Note** Select **Print the selected topic** if you want to print the single topic you have selected in the **Contents** tab.
4. Click the **OK** button.

Printing PDF Documents

This help file may contain links to PDF documents. To print PDF documents, click the print button located on the Adobe Acrobat Viewer toolbar.

Processing an image

1. Load the image into the Processing window.
2. Select the appropriate function from the **Image**, **Color**, **Grayscale**, or **Binary** menu.



Tip You can run a particular step of a script by selecting the step in the Script window.

Related Topics

[Magnifying an image](#)

[Printing an image](#)

Selecting a region of interest (ROI)

1. Select an ROI tool from the toolbar.
2. Click and drag the tool on the image to select the ROI.



Note The ROI tools are accessible only for particular functions.



Tip If you want to select an ROI on an image and save it, click **Image»Image Mask** or select **Image Mask** in the **Image** tab of the Processing Functions palette. When you use the Broken Line and Polygon ROI tools, you must double-click to release the tool. When you release the mouse button after drawing an ROI, the ROI is green.

Related Topics

[Tools Palette](#)

Tools Palette

The tools palette is located at the top of the Processing window of Vision Assistant. You can use the tools palette to perform several functions, as described in the following list.



Print Image



Display image at 2:1 ratio and enlarge image further each time you click on the tool



Display image at 1:2 ratio and reduce image further each time you click on the tool



Return image to 100% view



Launch Vision Assistant online help



Display the color palette for the current image. You can change the palette to one of five predefined image palettes to show details not perceived with the current palette. Changing the palette here does not change the content of the image.

- **Gray Levels**—Gradual grayscale variation from black to white. Each value is assigned an equal amount of the RGB intensities.
- **Binary**—16 cycles of 16 different colors, where g is the grayscale value and $g = 0$ corresponds to $R = 0, G = 0, B = 0$ (black); $g = 1$ corresponds to $R = 1, G = 0, B = 0$ (red); $g = 2$ corresponds to $R = 0, G = 1, B = 0$ (green); and so on.
- **Gradient**—Gradation from red to white with a prominent range of light blue in the upper range. 0 is black and 255 is white.
- **Rainbow**—Gradation from blue to red with a prominent range of greens in the middle value range. 0 is black and 255 is white.
- **Temperature**—Gradation from light brown to dark brown. 0 is black and 255 is white.



Point tool—Click to select a point in an image.



Line tool—Click and drag to select pixels along that line.



Broken Line tool—Click and drag repeatedly to select a region. Double-click when you select the final point of the broken line to release the ROI tool.



Rectangle ROI tool—Click and drag to select a rectangular region. Hold down the <Shift> key while you click and drag to constrain the region to a square.



Rotated Rectangle ROI tool—Click and drag to select a rectangular region. Hold down the <Shift> key while you click and drag to contain the region to a square, and then click the lines inside the rectangle and drag to adjust the rotation angle.



Oval ROI tool—Click and drag to select an oval region. Hold down the <Shift> key while you click and drag to constrain the region to a circle.



Annulus ROI tool—Click the center position and drag to the size you want. Adjust the inner and outer radii and the start and end angles.



Polygon ROI tool—Click and drag repeatedly to select a polygon region. Double-click to complete the polygon.



Freehand ROI tool—Click and drag to select a region of the image. To select a region with this tool, verify that the ending point lies on the starting point to enclose a region.



Magic Wand tool—Create an image mask by extracting a region surrounding a reference pixel, called the origin, and using a tolerance (+ or –) of intensity variations based on this reference pixel. Using this origin, the Magic Wand Tool searches for its neighbors with an intensity equal to or falling within the tolerance value of the point of reference.



Tolerance—Set the maximum allowable deviation from the origin. All pixels satisfying the tolerance criteria ($\text{origin pixel} - \text{tolerance} / \text{origin pixel} + \text{tolerance}$) become part of the region.

Printing an image

1. Select the image that you want to print.
2. Click **File»Print Image**.
3. Type the title of the image and comments, if necessary. You can leave these options blank if you do not need them.
4. Check **Print Results Overlaid on the Image** to print overlay information such as templates you use for pattern matching and lines drawn with the Edge Detector function.
5. Click **Set Printer** to select a printer.
6. Click **OK**.

Related Topics

[Magnifying an image](#)

Zooming In and Out on Images

Use the **Zoom In** and **Zoom Out** tools to change the view of an image. The following magnification factors are displayed in the lower, left corner of the Processing window:

- 1/1 indicates 100% magnification (default)
- 2/1 indicates a 200% magnified view
- 1/2 indicates a 50% demagnified view

Reducing the magnification of an image

Click the **Zoom Out** tool located in the toolbar.



Tips

- Click the **Zoom In** or **Zoom 1:1** tool to return to the original magnification.
- Magnification factors are displayed in the lower, left corner of the processing window. 1/1 specifies 100% magnification (default). 2/1 specifies a 200% magnified view, and 1/2 specifies a 50% demagnified view.

Related Topics

[Magnifying an image](#)

[Printing an image](#)

Scripting

The Vision Assistant scripting feature records a series of image processing steps and the parameters you specified for each of those steps. You can run scripts on single images or image collections (batch processing). You also can modify and save scripts.

A script is a list of image processing and analysis functions and the parameters for each of those functions. As you prototype the image processing application, Vision Assistant records each function and its parameters.

Complete the following steps to develop a script:

1. Process an image.

When you finish processing the image and exit the Parameter window, Vision Assistant adds the processing step to the current script.

2. Save the script.

You can use the script, which is also called a Builder file, to implement the image processing application using the NI Vision machine vision and image processing library in LabVIEW, LabWindows/CVI, Visual Basic, or other ActiveX containers.

If you have LabVIEW 6.1 or later and NI Vision 6.1 or later installed, you can use Vision Assistant to create the LabVIEW VI implementing the image processing steps you prototyped.

Related Topics

[Creating a new script](#)

[Opening a script](#)

[Running a script](#)

[Saving a script](#)

[Script Window](#)

[Stepping through a script](#)

Script Window

The Script window lists a series of image processing steps and the settings for each of those steps. The Script window contains several tools you can use to create, open, save, or run a script as well as remove or edit a step in the script. The Script window also contains tools that allow you to step through the script. As you step through the script or select any step in the script, the image you are currently processing changes to display the results of all image processing steps up to and including the selected step.

Related Topics

[Opening a script](#)

[Running a script](#)

[Saving a script](#)

[Scripting](#)

[Stepping through a script](#)

Creating a new script

You create a script when you [process an image](#). You also can create a new script by clicking the **New** button in the [Script window](#).

Related Topics

[Adding a step to a script](#)

[Editing a step in a script](#)

[Opening a script](#)

[Removing a step from a script](#)

[Running a script](#)

[Saving a script](#)

[Stepping through a script](#)

Opening a script

1. Click **File»Open Script** or click the **Open** button in the Script window.
2. Browse to the script you want to open.
3. Select the script.
4. Click **OK**.

Related Topics

[Adding a step to a script](#)

[Editing a step in a script](#)

[Removing a step from a script](#)

[Running a script](#)

[Stepping through a script](#)

Running a script

Click **Run Once** in the Script window. Running a script applies all steps in the script to the current image. If the last step is an analysis function, the results are automatically displayed.

Related Topics

[Adding a step to a script](#)

[Editing a step in a script](#)

[Removing a step from a script](#)

[Stepping through a script](#)

Saving a script

1. Click **File»Save Script** or click the **Save** button in the Script window.
2. Type the name of the script file.
3. Click **OK**.

Related Topics

[Adding a step to a script](#)

[Editing a step in a script](#)

[Removing a step from a script](#)

[Running a script](#)

[Stepping through a script](#)

Editing a step in a script

1. Double-click the step that you want to edit or select the appropriate step in the Script window and click **Edit Step**.
2. Change the function parameters in the Parameter window.
3. Click **OK**.



Tips

- If you modify the image and then decide that you do not want to save the changes, click **Cancel** in the Parameter window.
- You also can use **Edit Step** to modify the currently selected step.

Related Topics

[Adding a step to a script](#)

[Removing a step from a script](#)

[Running a script](#)

[Saving a script](#)

[Stepping through a script](#)

Adding a step to a script

You can insert a new step anywhere in an existing script.

1. In the script list, select the step that you want to precede the new step.
2. Select the image processing function that you want to apply.
3. Set the function parameters.
4. Click **OK**. Vision Assistant adds the step to the script below the selected step.

Related Topics

[Editing a step in a script](#)

[Removing a step from a script](#)

[Running a script](#)

[Saving a script](#)

[Stepping through a script](#)

Removing a step from a script

Select the step that you want to remove from the script and click **Edit»Cut** or right-click the step and select **Cut**.



Note Removing steps from a script can dramatically alter the final result of the script. As you delete steps, especially steps that change image type (such as [conversion](#) and [color threshold](#)), consider the how the rest of the script will run. The steps following the one you delete might try to process an image of an unexpected type, and you might receive unexpected results.



Tip You can use the **Previous Step** and **Next Step** buttons to step through the script. The image you are currently processing changes to reflect the effects of the function.

Related Topics

[Adding a step to a script](#)

[Editing a step in a script](#)

[Running a script](#)

[Saving a script](#)

[Stepping through a script](#)

Stepping through a script

Use the **Previous Step** and **Next Step** buttons in the [Script window](#) to step through the script. The image you are currently processing changes to reflect the effects of the function. You also can step through a script by clicking on the steps you want to view.

Related Topics

[Adding a step to a script](#)

[Editing a step in a script](#)

[Removing a step from a script](#)

[Running a script](#)

Performance Meter

You can use the Performance Meter to estimate how long (in milliseconds and frames/second) the script takes to complete in NI Vision on a given image.



Note The speed of some functions in the script varies depending on the image you process.

1. Open the script you want to test.
2. Select **Tools»Performance Meter**. Vision Assistant evaluates the performance of the functions in the script and displays an estimate of the total time NI Vision would take to complete the script.
3. Click **Details** to view an estimate of the time NI Vision would take to complete each function in the script.
4. Click **OK** to close the Performance Meter.

3D View (Image»3D View)

Displays the light intensity in a three-dimensional coordinate system, where the spatial coordinates of an image form two dimensions and the light intensity forms the third dimension. Each pixel from the image source is represented as a column of pixels in the 3D view. The pixel value corresponds to the altitude.



Note The 3D View function analyzes the image and displays information for you to review. This function does not modify the image.

3D View

- **Northwest**—Sets the viewing orientation for the 3D view in the Northwest direction.
- **Northeast**—Sets the viewing orientation for the 3D view in the Northeast direction.
- **Southwest**—Sets the viewing orientation for the 3D view in the Southwest direction.
- **Southeast**—Sets the viewing orientation for the 3D view in the Southeast direction.
- **Height**—Maximum height of a pixel drawn in 3D from the image source.
 - α —Angle between the horizontal axis and baseline. α must be between 0° and 45° .
 - β —Angle between the horizontal axis and second baseline. β must be between 0° and 45° .
- **Reduction**—Sets the size reduction. Reduction is a divisor that is applied to the image source when determining the final height and width of the 3D view image.
- **Invert**—Inverts the 3D view when selected.

Related Topics

[Viewing an image in 3D](#)

Viewing an image in 3D



Notes

- The 3D View function analyzes the image and displays information for you to review. This function does not modify the image.
- The 3D View function works only with 8-bit images.

1. Click **Image»3D View**, or select **3D View** in the **Image** tab of the Processing Functions palette.
2. Set the direction orientation.
3. Specify the maximum **Height** of a 3D pixel.
4. Specify the angle between the horizontal axis and baseline in α .
5. Define the angle between the horizontal axis and second baseline in β .
6. Set the size **Reduction**.
7. Click **OK** to close the Parameter window.




Tips Select **Invert** to invert the 3D image, which can be useful in distinguishing details in the darkest part of the image.

Related Topics

[3D View \(Image»3D View\)](#)

Brightness, Contrast, Gamma Correction (Image»Brightness)

Alters the brightness, contrast, and gamma of an image.

- **Brightness**—Brightness of the image. Brightness is expressed in gray levels, centered at 128. Higher values (up to 255) result in a brighter image, and lower values (down to 0) result in a darker image.
- **Contrast**—Contrast of the image, expressed as an angle. A value of 45° specifies no change in contrast. Higher values (up to 89°) increase contrast, and lower value (down to 1°) decrease contrast.
- **Gamma**—Gamma value used in Gamma Correction. The higher the Gamma coefficient, the stronger the intensity correction.
- **Lookup Table**—Displays the lookup table with the specified settings of Brightness, Contrast, and Gamma.
- **Color Plane**—Specifies the color plane to which you want to apply the transform.
 -  **Note** This parameter appears only when an RGB (color) image is loaded.
- **Reset**—Reverts **Brightness**, **Contrast**, and **Gamma** to neutral default settings.

Related Topics

[Modifying brightness, contrast, and gamma values of an image](#)

Modifying brightness, contrast, and gamma values of an image



Note The Brightness function works only with 8-bit images.

1. Click **Image»Brightness** or select **Brightness** in the **Image** tab of the Processing Functions palette.
2. Modify the **Brightness**, **Contrast**, and **Gamma** values with the slide or by manually entering the value. When you process a color image, you can apply **Brightness**, **Contrast**, and **Gamma** modifications to each **Color Plane** separately, or you can apply the same transformation to all color planes at the same time.
3. Click **OK** to add the step to the script.



Tips

- If you modify the values and want to return to the source image, click the **Reset** button.
- You can modify the brightness of a portion of an image by drawing an ROI.

Related Topics

[Brightness, Contrast, Gamma Correction \(Image»Brightness\)](#)

Color Operators (Color»Color Operators)

Performs arithmetic and logical operations on images.

- **Operators**

| | |
|--------------------|--|
| Image Source | Opens the original input image. |
| Add | Adds a constant or an image to the original input image. This is a pixel-by-pixel operation. |
| Subtract | Subtracts a constant or an image from the original input image. This is a pixel-by-pixel operation. |
| Multiply | Multiplies the original input image by a constant or another image. This is a pixel-by-pixel operation. |
| Divide | Divides the original input image by a constant or another image. This is a pixel-by-pixel operation. |
| And | Performs a logical AND operation between the original input image and a constant or another image stored in the buffer. This is a bit-wise operation. |
| Not And | Performs a logical NAND operation between the original input image and a constant or another image stored in the buffer. This is a bit-wise operation. |
| Or | Performs a logical OR operation between the original input image and a constant or another image stored in the buffer. This is a bit-wise operation. |
| Not Or | Performs a logical NOR operation between the original input image and a constant or another image stored in the buffer. This is a bit-wise operation. |
| Exclusive Or | Performs an Exclusive OR operation between the original input image and a constant or another image stored in the buffer. This is a bit-wise operation. |
| Not Exclusive Or | Performs an Exclusive NOR operation between the original input image and a constant or another image stored in the buffer. This is a bit-wise operation. |
| Logical Difference | Finds the logical difference between the original input image and a constant or another image stored in the |

buffer. This is a bit-wise operation.

Mask Replaces pixels in the original input image that correspond to pixels with value 0 in the image mask as 0. The image mask is an 8-bit image that specifies the regions in the original input image to be modified. This is a pixel-by-pixel operation.

- **Constant**—Constant value to be used in an operation, when selected.
- **Image**—Image from an active buffer to be used in an operation, when selected. You can select only those image buffers that contain 8-bit or RGB images of the same size as the image source. Click **Image**»**Image Buffer** or select **Image Buffer** in the **Image** tab of the Processing Functions palette to store an image in an empty image buffer.

Related Topics

[Adding a constant to a color image](#)

[Adding an image to a color image](#)

[Comparing a color image with a constant](#)

[Comparing a color image with another image](#)

[Dividing a color image by a constant](#)

[Dividing a color image by another image](#)

[Multiplying a color image by a constant](#)

[Multiplying a color image by another image](#)

[Subtracting a constant from a color image](#)

[Subtracting an image from a color image](#)

[Using the Color Operators function](#)

Using the Color Operators function

1. Click **Color»Color Operators** or select **Color Operators** in the **Color** tab of the Processing Functions palette.
2. Select one of the [functions](#) from the **Operators** list.
3. Select either the **Constant** or **Image** option. The **Constant** option uses a constant and the current image in the operation. The **Image** option uses the current image and an image stored in an image buffer.
4. Enter the constant or select the image buffer that contains the image you are adding to the source image or enter the constant value.
5. Click **OK** to add the step to the script and close the Parameters window.



Note You must already have an image stored in an image buffer before you can perform an operation using the current image and another image. The buffered image must be the same size as the source image and must be an 8-bit or RGB image.

Related Topics

[Color Operators \(Color»Color Operators\)](#)

Adding a constant to a color image

1. Click **Color»Color Operators** or select **Color Operators** in the **Color** tab of the Processing Functions palette.
2. Select **Add** from the **Operators** list.
3. Select the **Constant** option.
4. Set the constant value.
5. Click **OK** to add the constant to the image.

Related Topics

[Adding an image to a color image](#)

[Color Operators \(Color»Color Operators\)](#)

[Comparing a color image with a constant](#)

[Comparing a color image with another image](#)

[Dividing a color image by a constant](#)

[Dividing a color image by another image](#)

[Multiplying a color image by a constant](#)

[Multiplying a color image by another image](#)

[Subtracting a constant from a color image](#)

[Subtracting an image from a color image](#)

[Using the Color Operators function](#)

Adding an image to a color image

1. Click **Color»Color Operators** or select **Color Operators** in the **Color** tab of the Processing Functions palette.
2. Select **Add** from the **Operators** list.
3. Select the **Image** option.
4. Select the image buffer that contains the image you are adding to the source image.
5. Click **OK** to add the images together and add this step to the script.



Notes

- You must already have an image stored in an image buffer before you can add, subtract, multiply, or divide two images. Click **Image»Image Buffer** to store a copy of the processed image in a buffer. You can insert the **Image»Image Buffer** step anywhere in a script.
- The buffer image must be the same size as the source image and must be an 8-bit or RGB image.

Related Topics

[Adding a constant to a color image](#)

[Color Operators \(Color»Color Operators\)](#)

[Comparing a color image with a constant](#)

[Comparing a color image with another image](#)

[Dividing a color image by a constant](#)

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[Subtracting an image from a color image](#)

[Using the Color Operators function](#)

Comparing a color image with a constant

1. Click **Color»Color Operators** or select **Color Operators** in the **Color** tab of the Processing Functions palette.
2. Select one of the logical operators from the **Operators** list.
3. Select the **Constant** option.
4. Set the constant value that you want to compare with the image.
5. Click **OK** to compare the constant with the image and add this step to the script.

Related Topics

[Adding a constant to a color image](#)

[Adding an image to a color image](#)

[Color Operators \(Color»Color Operators\)](#)

[Comparing a color image with another image](#)

[Dividing a color image by a constant](#)

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[Subtracting a constant from a color image](#)

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[Using the Color Operators function](#)

Comparing a color image with another image

1. Click **Color»Color Operators** or select **Color Operators** in the **Color** tab of the Processing Functions palette.
2. Select one of the logical operators from the **Operators** list.
3. Select the **Image** option.
4. Select the image buffer that contains the image you want to compare.
5. Click **OK** to compare the images and add this step to the script.



Notes

- You must already have an image stored in an image buffer before you can add, subtract, multiply, or divide two images. Click **Image»Image Buffer** to store a copy of the processed image in a buffer. You can insert the **Image»Image Buffer** step anywhere in a script.
- The buffer image must be the same size as the source image and must be an 8-bit or RGB image.

Related Topics

[Adding a constant to a color image](#)

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[Subtracting a constant from a color image](#)

[Subtracting an image from a color image](#)

[Using the Color Operators function](#)

Dividing a color image by a constant

1. Click **Color»Color Operators** or select **Color Operators** in the **Color** tab of the Processing Functions palette.
2. Select **Divide** from the **Operators** list.
3. Select the **Constant** option.
4. Set the constant value.
5. Click **OK** to divide the image by the constant.

Related Topics

[Adding a constant to a color image](#)

[Adding an image to a color image](#)

[Color Operators \(Color»Color Operators\)](#)

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[Using the Color Operators function](#)

Dividing a color image by another image

1. Click **Color»Color Operators** or select **Color Operators** in the **Color** tab of the Processing Functions palette.
2. Select **Divide** from the **Operators** list.
3. Select the **Image** option.
4. Select the image buffer that contains the image by which you will divide the source image.
5. Click **OK** to divide the images and add this step to the script.



Notes

- You must already have an image stored in an image buffer before you can add, subtract, multiply, or divide two images. Click **Image»Image Buffer** to store a copy of the processed image in a buffer. You can insert the **Image»Image Buffer** step anywhere in a script.
- The buffer image must be the same size as the source image and must be an 8-bit or RGB image.

Related Topics

[Adding a constant to a color image](#)

[Adding an image to a color image](#)

[Color Operators \(Color»Color Operators\)](#)

[Comparing a color image with a constant](#)

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[Using the Color Operators function](#)

Multiplying a color image by another image

1. Click **Color»Color Operators** or select **Color Operators** in the **Color** tab of the Processing Functions palette.
2. Select **Multiply** from the **Operators** list.
3. Select the **Image** option.
4. Select the image buffer that contains the image by which you will multiply the source image.
5. Click **OK** to multiply the images and add this step to the script.



Notes

- You must already have an image stored in an image buffer before you can add, subtract, multiply, or divide two images. Click **Image»Image Buffer** to store a copy of the processed image in a buffer. You can insert the **Image»Image Buffer** step anywhere in a script.
- The buffer image must be the same size as the source image and must be an 8-bit or RGB image.

Related Topics

[Adding a constant to a color image](#)

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[Color Operators \(Color»Color Operators\)](#)

[Comparing a color image with a constant](#)

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[Using the Color Operators function](#)

Multiplying a color image by a constant

1. Click **Color»Color Operators** or select **Color Operators** in the **Color** tab of the Processing Functions palette.
2. Select **Multiply** from the **Operators** list.
3. Select the **Constant** option.
4. Set the constant value.
5. Click **OK** to multiply the image by the constant.

Related Topics

[Adding a constant to a color image](#)

[Adding an image to a color image](#)

[Color Operators \(Color»Color Operators\)](#)

[Comparing a color image with a constant](#)

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[Subtracting an image from a color image](#)

[Using the Color Operators function](#)

Subtracting a constant from a color image

1. Click **Color»Color Operators** or select **Color Operators** in the **Color** tab of the Processing Functions palette.
2. Select **Subtract** from the **Operators** list.
3. Select the **Constant** option.
4. Set the constant value.
5. Click **OK** to subtract the constant from the image.

Related Topics

[Adding a constant to a color image](#)

[Adding an image to a color image](#)

[Color Operators \(Color»Color Operators\)](#)

[Comparing a color image with a constant](#)

[Comparing a color image with another image](#)

[Dividing a color image by a constant](#)

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[Multiplying a color image by a constant](#)

[Multiplying a color image by another image](#)

[Subtracting an image from a color image](#)

[Using the Color Operators function](#)

Subtracting an image from a color image

1. Click **Color»Color Operators** or select **Color Operators** in the **Color** tab of the Processing Functions palette.
2. Select **Subtract** from the **Operators** list.
3. Select the **Image** option.
4. Select the image buffer that contains the image that you are subtracting from the source image.
5. Click **OK** to subtract the images and add this step to the script.



Notes

- You must already have an image stored in an image buffer before you can add, subtract, multiply, or divide two images. Click **Image»Image Buffer** to store a copy of the processed image in a buffer. You can insert the **Image»Image Buffer** step anywhere in a script.
- The buffer image must be the same size as the source image and must be an 8-bit or RGB image.

Related Topics

[Adding a constant to a color image](#)

[Adding an image to a color image](#)

[Color Operators \(Color»Color Operators\)](#)

[Comparing a color image with a constant](#)

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Conversion (Grayscale»Conversion)

Converts the current image to the specified image type.

- **From**—Image type for the current image.
- **To**—Image type that you want to convert the current image to. Valid values include 8-bit, 16-bit, and float.
- **Method**—Conversion method used to convert the image to a smaller data type.

Adjust Adjusts the dynamic of the image so that the lowest dynamic intensity in the image corresponds to the smallest value available in the new image type and the highest value corresponds to the highest value available in the new image data type. All pixel intensities within those limits are distributed linearly.



Note The Adjust dynamic function is not always available.

Shift # Available only for 16-bit to 8-bit conversion. Performs Shift # to the 16-bit image prior to converting it to an 8-bit data type. The value of Shift # depends on the dynamic of the image. For example, if you acquired the image with a 12-bit camera and you want to convert it to an 8-bit image, keep the most significant bits. To keep the most significant bits in this case, perform 4 (12–8) shifts to retrieve the 8 most significant bits of the image.

Cast Casts the values too large to be represented in the new data type to the largest value available and values too small to the smallest value available.

Related Topics

[Converting grayscale images](#)

Converting grayscale images

1. Click **Grayscale»Conversion** or click **Conversion** in the **Grayscale** tab of the Processing Functions palette.
2. Select the data type that you want to convert the current image to. If you are converting the image to a smaller data type, select the method of conversion.
3. Click **OK** to convert the image, add this step to the script, and close the Conversion window.

Related Topics

[Conversion \(Grayscale»Conversion\)](#)

Extract color planes (Color»Extract Color Planes)

Extracts one of the three color planes (Red, Green, Blue, Hue, Saturation, Luminance, Value) from an image.

| | |
|-----------------------|--|
| Image Source | Original input image. |
| RGB: Red Plane | Extracts the red plane from an RGB image. |
| RGB: Green Plane | Extracts the green plane from an RGB image. |
| RGB: Blue Plane | Extracts the blue plane from an RGB image. |
| HSL: Hue Plane | Extracts the hue plane from an HSL image. |
| HSL: Saturation Plane | Extracts the saturation plane from an HSL image. |
| HSL: Luminance Plane | Extracts the luminance plane from an HSL image. |
| HSV: Value Plane | Extracts the value plane from an HSV image. |
| HSI: Intensity Plane | Extracts the intensity plane from an HSI image. |

Related Topics

[Extracting color planes from an image](#)

Extracting color planes from an image

1. Click **Color»Extract Color Planes** or select **Extract Color Planes** in the **Color** tab of the Processing Functions palette.
2. Select the color plane that you want to extract.
3. Click **OK** to add this step to the script.



Note Because each color plane is made up of 8 bits, the color plane you extract is an 8-bit grayscale image.

Related Topics

[Extract color planes \(Color»Extract Color Planes\)](#)

FFT Filter (Grayscale»FFT Filter)

Applies a frequency filter to the image. This function performs three steps. First, it finds the fast Fourier transform (FFT) of the source image, which is a complex image. Then the function filters (truncates or attenuates) the complex image. Finally, it computes the inverse FFT. Generally, the FFT Filter is used to compute backgrounds in order to correct light drifts.

- **FFT Filtering**
 - Image Source Opens the original input image.
 - Truncate Truncates the frequencies of a complex image.
 - Attenuate Attenuates the frequencies of a complex image.
- **Mode**—Determines which frequencies to truncate or attenuate.
 - Low Pass Removes high frequencies.
 - High Pass Removes low frequencies.
- **Truncation Frequency %**—Percentage of the frequencies retained within a Fourier-transformed image. This percentage is expressed with respect to the length of the diagonal of the FFT image and the **Mode** value.
- **Display FFT**—Shows the complex image after filtering.

Related Topics

[Applying an FFT filter to an image](#)

Applying an FFT filter to an image

1. Click **Grayscale»FFT Filter** or click **FFT Filter** in the **Grayscale** tab of the Processing Functions palette.
2. Select the [Truncate](#) or [Attenuate](#) option.
3. Select the **Mode**. **Low Pass** removes or attenuates high frequencies, and **High Pass** removes or attenuates low frequencies.
4. If you selected **Truncate**, set the **Truncation Frequency %**. Otherwise, proceed to the next step.
5. Click **OK** to apply the FFT Filter, add this step to the script, and close the Parameter window.



Note This function is computer-intensive and can take several seconds.



Tip If you want to see the complex image created by the FFT Filter, select the **Display FFT** option. To see details of the FFT Filter, select the Gradient color palette from the **Display Color Palette** control in the toolbar.

Related Topics

[FFT Filter \(Grayscale»FFT Filter\)](#)

Filters (Grayscale»Filters)

Prepares an image for processing so you can extract only the information you need from the image. Most of these filters apply a kernel across the image. A kernel represents a pixel and its relationship to neighboring pixels. The weight of the relationship is specified by the coefficients of each neighbor.

- **Filters**

Image Source Original input image.

Smoothing-Lowpass Lowpass filtering. Smooths images by eliminating details and blurring edges.

Smoothing-Local Average Local averaging of the image pixels based on the kernel.

Smoothing-Gaussian Gaussian filtering based on the kernel. Attenuates the variations of light intensity in the neighborhood of a pixel. The Gaussian kernel has the following model: $a \ d \ c \ b \ x \ b \ c \ d \ a$

where a , b , c and d are integers and $x < 1$.

Smoothing-Median Median filtering. Each pixel is assigned the median value of its neighborhood.

Edge Detection-Laplacian Laplacian filtering. Extracts the contour of objects and outlines details. The Laplacian filter kernel has the following model: $a \ d \ c \ b \ x \ b \ c \ d \ a$

where a , b , c , and d are integers and x is greater than or equal to the sum of the absolute values of the outer coefficients.

Edge Detection-Diff. Differentiation filtering. Produces continuous contours by highlighting each pixel where an intensity variation occurs between itself and its three upper left neighbors.

Edge Detection-Prewitt Prewitt filtering. A highpass filter that extracts the outer contours of objects.

Prewitt

Edge Detection- Sobel
Sobel filter. A highpass filter that extracts the outer contours of objects.

Edge Detection- Roberts
Roberts filter to detect edges. Outlines the contours that highlight pixels where an intensity variation occurs along the diagonal axes.

Convolution- Highlight Details
Convolution kernel that highlights the edges of an image.

Convolution- Custom
Custom filtering using the kernel coefficients and size that you specify.

- **Kernel Size**—Size of the structuring element. Valid values include 3 x 3, 5 x 5, and 7 x 7.
- **Filter Size**—Sets the size of the filter for the Lowpass and Median functions.
- **Kernel**—Specifies the kernel coefficients.



Tip The kernel coefficients for each filter are set to default values. You may need to experiment with different coefficients and the kernel size to get the results you want.

Related Topics

[Detecting edges with filters](#)

[Filtering an image with a custom convolution filter](#)

[Highlighting details in an image](#)

[Smoothing an image with filtering](#)

Smoothing an image with filtering

1. Click **Grayscale»Filters** or click **Filters** in the **Grayscale** tab of the Processing Functions palette.
2. Select one of the smoothing functions from the **Filters** list.
3. Set the **Kernel Size** and coefficients if you are using a Local Average or Gaussian filter. Set the filter size if you are using the Lowpass or Median filter.
4. Click **OK** to filter the image and add this step to the script.



Tip Experiment with different coefficients and the **Kernel Size** to get the results you want.

Related Topics

[Detecting edges with filters](#)

[Filling holes and smoothing right angles](#)

[Filtering an image with a custom convolution filter](#)

[Filters \(Grayscale»Filters\)](#)

[Highlighting details in an image](#)

[Smoothing object boundaries in binary images](#)

[Smoothing object boundaries in grayscale images](#)

Detecting edges with filters

1. Click **Grayscale»Filters** or click **Filters** in the **Grayscale** tab of the Processing Functions palette.
2. Select one of the edge detection filters from the **Filters** list. If you are using the Laplacian filter, set the **Kernel Size** and coefficients.
3. Click **OK** to filter the image and add this step to the script.



Tip Experiment with different coefficients and the **Kernel Size** to get the results you want.

Related Topics

[Filtering an image with a custom convolution filter](#)

[Filters \(Grayscale»Filters\)](#)

[Highlighting details in an image](#)

[Smoothing an image with filtering](#)

Highlighting details in an image

1. Click **Grayscale»Filters** or click **Filters** in the **Grayscale** tab of the Processing Functions palette.
2. Select **Convolution-Highlight Details** from the **Filters** list.
3. Adjust the **Kernel Size** and coefficients, if necessary.
4. Click **OK** to filter the image and add this step to the script.



Tip Experiment with different coefficients and the **Kernel Size** to get the results you want.

Related Topics

[Detecting edges with filters](#)

[Filtering an image with a custom convolution filter](#)

[Filters \(Grayscale»Filters\)](#)

[Smoothing an image with filtering](#)

Filtering an image with a custom convolution filter

1. Click **Grayscale»Filters** or click **Filters** in the **Grayscale** tab of the Processing Functions palette.
2. Select **Convolution – Custom** from the **Filters** list.
3. Set the **Kernel Size** and coefficients.
4. Click **OK** to filter the image and add this step to the script.



Tip Experiment with different coefficients and the **Kernel Size** to get the results you want.

Related Topics

[Detecting edges with filters](#)

[Filters \(Grayscale»Filters\)](#)

[Highlighting details in an image](#)

[Smoothing an image with filtering](#)

Geometry (Image»Geometry)

Modifies the geometrical representation of an image.

- **Image Source**—Original input image.
- **Symmetry**—Transforms an image through its symmetry.
 - **Horizontal**—Horizontal axis of the image.
 - **Vertical**—Vertical axis of the image.
 - **Central**—Center of the image.
- **Rotation**—Rotates an image.
 - **Angle (degrees)**—Angle through which the image is rotated. To set the angle, type the angle in degrees or turn the knob.
- **Resampling**—Resamples an image based on user settings.
 - **X Resolution**—Image size in the x direction (in pixels).
 - **Y Resolution**—Image size in the y direction (in pixels).
 - **Keep Image Ratio**—Maintains the original ratio when selected.
 - **Interpolation**—Type of interpolation. Valid values include Zero Order, Bi-linear, Quadratic, or Cubic Spline.

Related Topics

[Computing the symmetry of an image](#)

[Resampling an image](#)

[Rotating an image](#)

Computing the symmetry of an image

1. Click **Image»Geometry** or select **Geometry** in the **Image** tab of the Processing Functions palette.
2. Select **Symmetry**.
3. Select a type of symmetry.
4. Click **OK** to add this step to the script.

Related Topics

[Geometry \(Image»Geometry\)](#)

[Resampling an image](#)

[Rotating an image](#)

Rotating an image

1. Click **Image»Geometry** or select **Geometry** in the **Image** tab of the Processing Functions palette.
2. Select **Rotation**.
3. Turn the knob to select the angle of rotation or manually enter an angle.
4. Click **OK** to add this step to the script.

Related Topics

[Computing the symmetry of an image](#)

[Geometry \(Image»Geometry\)](#)

[Resampling an image](#)

Resampling an image

1. Click **Image»Geometry** or select **Geometry** in the **Image** tab of the Processing Functions palette.
2. Select **Resampling**.
3. Select **Keep Image Ratio** to maintain the original image ratio. Deselect this option to change the image aspect ratio.
4. Set the **Interpolation Type**.
5. Set **X Resolution** and **Y Resolution**.
6. Click **OK** to add this step to the script.

Related Topics

[Computing the symmetry of an image](#)

[Geometry \(Image»Geometry\)](#)

[Rotating an image](#)

Get Image (Image»Get Image)

Opens an image from a file. Use this function when you need to open an image as a step in a script.

- **Path**—Browse to the location of the file you want to open.




Note You can use only the **Image»Get Image** function to configure a script to open an image.

Related Topics

[Getting a new image](#)

Getting an image

1. Click **Image»Get Image** or select **Get Image** in the **Image** tab of the Processing Functions palette.
2. Click the  **Browse** button to navigate to the image you want the script to open.
3. Click **Open**.
4. Click **OK** to add this step to the script and close the Parameter window.



Note You can use only the **Image»Get Image** or select **Get Image** in the **Image** tab of the Processing Functions palette function to configure a script to open an image.

Related Topics

[Get New Image \(Image»Get New Image\)](#)

Get Image FAQs

Which image file formats are supported?

Vision Assistant supports the following image file formats: BMP, TIFF, JPEG, JPEG200, and PNG.

Is there a size limit for images I want to load?

Vision Assistant does not have an image size limit.

Operators (Grayscale»Operators)

Performs arithmetic and logical operations on images.

- **Operators**

| | |
|--------------------|--|
| Image Source | Opens the original input image. |
| Add | Adds a constant or an image to the original input image. This is a pixel-by-pixel operation. |
| Subtract | Subtracts a constant or an image from the original input image. This is a pixel-by-pixel operation. |
| Multiply | Multiplies the original input image by a constant or another image. This is a pixel-by-pixel operation. |
| Divide | Divides the original input image by a constant or another image. This is a pixel-by-pixel operation. |
| And | Performs a logical AND operation between the original input image and a constant or another image stored in the buffer. This is a bit-wise operation. |
| Not And | Performs a logical NAND operation between the original input image and a constant or another image stored in the buffer. This is a bit-wise operation. |
| Or | Performs a logical OR operation between the original input image and a constant or another image stored in the buffer. This is a bit-wise operation. |
| Not Or | Performs a logical NOR operation between the original input image and a constant or another image stored in the buffer. This is a bit-wise operation. |
| Exclusive Or | Performs an Exclusive OR operation between the original input image and a constant or another image stored in the buffer. This is a bit-wise operation. |
| Not Exclusive Or | Performs an Exclusive NOR operation between the original input image and a constant or another image stored in the buffer. This is a bit-wise operation. |
| Logical Difference | Finds the logical difference between the original input image and a constant or another image stored in the |

| | |
|------|--|
| | buffer. This is a bit-wise operation. |
| Mask | Replaces pixels in the original input image that correspond to pixels with value 0 in the image mask as 0. The image mask is an 8-bit image that specifies the regions in the original input image to be modified. This is a pixel-by-pixel operation. |
| Min | Extracts the smallest value between the original input image and a constant or another image stored in the buffer. This is a pixel-by-pixel operation. |
| Max | Extracts the largest value between the original input image and a constant or another image stored in the buffer. This is a pixel-by-pixel operation. |

- **Constant**—Constant value to be used in an operation, when selected.
- **Image**—Image from an active buffer to be used in an operation, when selected. Vision Assistant allows you to select only image buffers that contain images of the same type and size as the image source. Click **Image»Image Buffer**, or select **Image Buffer** in the **Image** tab of the Processing Functions palette to store an image in an empty image buffer.

Related Topics

[Adding a constant to a grayscale image](#)

[Adding a grayscale image to a grayscale image](#)

[Comparing a grayscale image with a constant](#)

[Comparing grayscale images](#)

[Dividing a grayscale image by a constant](#)

[Dividing a grayscale image by a grayscale image](#)

[Image Buffer \(Image»Image Buffer\)](#)

[Multiplying a grayscale image by a constant](#)

[Multiplying a grayscale image by a grayscale image](#)

[Retrieving an image from an image buffer](#)

[Storing an image in an image buffer](#)

Subtracting a constant from a grayscale image

Subtracting a grayscale image from a grayscale image

Using the Operators function

Using the Operators function

1. Click **Grayscale»Operators** or click **Operators** in the **Grayscale** tab of the Processing Functions palette.
2. Select one of the [functions](#) from the **Operators** list.
3. Select either the **Constant** or **Image** option. The **Constant** option uses a constant and the current image in the operation. The **Image** option uses the current image and an image stored in an image buffer.
4. Enter the constant or select the image buffer that contains the image you are combining with the source image.
5. Click **OK** to perform the operation.



Note You must already have an image stored in an image buffer before you can perform an operation using the current image and another image. The buffered image must have the same size and type as the source image.

Related Topics

[Operators \(Grayscale»Operators\)](#)

[Retrieving an image from an image buffer](#)

[Storing an image in an image buffer](#)

Adding a constant to a grayscale image

1. Click **Grayscale»Operators** or click **Operators** in the **Grayscale** tab of the Processing Functions palette.
2. Select **Add** from the **Operators** list.
3. Select the **Constant** option.
4. Set the constant value.
5. Click **OK** to add the constant to the image.

Related Topics

[Adding a grayscale image to a grayscale image](#)

[Comparing a grayscale image with a constant](#)

[Comparing grayscale images](#)

[Dividing a grayscale image by a constant](#)

[Dividing a grayscale image by a grayscale image](#)

[Image Buffer \(Image»Image Buffer\)](#)

[Multiplying a grayscale image by a constant](#)

[Multiplying a grayscale image by a grayscale image](#)

[Operators \(Grayscale»Operators\)](#)

[Retrieving an image from an image buffer](#)

[Storing an image in an image buffer](#)

[Subtracting a constant from a grayscale image](#)

[Subtracting a grayscale image from a grayscale image](#)

[Using the Operators function](#)

Adding a grayscale image to a grayscale image

1. Click **Grayscale»Operators** or click **Operators** in the **Grayscale** tab of the Processing Functions palette.
2. Select **Add** from the **Operators** list.
3. Select the **Image** option.
4. Select the image buffer that contains the image you are adding to the source image.
5. Click **OK** to add the images together and add this step to the script.



Notes

- You must already have an image stored in an image buffer before you can add, subtract, multiply, or divide two images. Click **Image»Image Buffer** to store a copy of the processed image in a buffer. You can insert the **Image»Image Buffer** step anywhere in a script.
- The buffer image must be the same size and type as the source image.

Related Topics

[Adding a constant to a grayscale image](#)

[Comparing a grayscale image with a constant](#)

[Comparing grayscale images](#)

[Dividing a grayscale image by a constant](#)

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[Using the Operators function](#)

Averaging a grayscale image with a constant

1. Click **Grayscale»Operators** or click **Operators** in the **Grayscale** tab of the Processing Functions palette.
2. Select **Average** from the **Operators** list.
3. Select the **Constant** option.
4. Set the constant value that you want averaged with the image.
5. Click **OK** to average the constant with the image and add this step to the script.

Related Topics

[Adding a constant to a grayscale image](#)

[Adding a grayscale image to a grayscale image](#)

[Averaging grayscale images](#)

[Comparing a grayscale image with a constant](#)

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[Using the Operators function](#)

Averaging grayscale images

1. Click **Grayscale»Operators** or click **Operators** in the **Grayscale** tab of the Processing Functions palette.
2. Select **Average** from the **Operators** list.
3. Select the **Image** option.
4. Select the image buffer that contains the image you want to use in the averaging.
5. Click **OK** to average the images and add this step to the script.



Notes

- You must already have an image stored in an image buffer before you can add, subtract, multiply, or divide two images. Click **Image»Image Buffer** to store a copy of the processed image in a buffer. You can insert the **Image»Image Buffer** step anywhere in a script.
- The buffer image must be the same size and type as the source image.

Related Topics

[Adding a constant to a grayscale image](#)

[Adding a grayscale image to a grayscale image](#)

[Averaging a grayscale image with a constant](#)

[Comparing a grayscale image with a constant](#)

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[Using the Operators function](#)

Comparing grayscale images

1. Click **Grayscale»Operators** or click **Operators** in the **Grayscale** tab of the Processing Functions palette.
2. Select one of the logical operators from the **Operators** list.
3. Select the **Image** option.
4. Select the image buffer that contains the image you want to compare.
5. Click **OK** to compare the images and add this step to the script.



Notes

- You must already have an image stored in an image buffer before you can add, subtract, multiply, or divide two images. Click **Image»Image Buffer** to store a copy of the processed image in a buffer. You can insert the **Image»Image Buffer** step anywhere in a script.
- The buffer image must be the same size and type as the source image.

Related Topics

[Adding a constant to a grayscale image](#)

[Adding a grayscale image to a grayscale image](#)

[Comparing a grayscale image with a constant](#)

[Dividing a grayscale image by a constant](#)

[Dividing a grayscale image by a grayscale image](#)

[Image Buffer \(Image»Image Buffer\)](#)

[Multiplying a grayscale image by a constant](#)

[Multiplying a grayscale image by a grayscale image](#)

[Operators \(Grayscale»Operators\)](#)

[Retrieving an image from an image buffer](#)

[Storing an image in an image buffer](#)

[Subtracting a constant from a grayscale image](#)

[Subtracting a grayscale image from a grayscale image](#)

[Using the Operators function](#)

Comparing a grayscale image with a constant

1. Click **Grayscale»Operators** or click **Operators** in the **Grayscale** tab of the Processing Functions palette.
2. Select one of the logical operators from the **Operators** list.
3. Select the **Constant** option.
4. Set the constant value that you want to compare with the image.
5. Click **OK** to compare the constant with the image and add this step to the script.

Related Topics

[Adding a constant to a grayscale image](#)

[Adding a grayscale image to a grayscale image](#)

[Comparing grayscale images](#)

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[Subtracting a grayscale image from a grayscale image](#)

[Using the Operators function](#)

Dividing a grayscale image by a constant

1. Click **Grayscale»Operators** or click **Operators** in the **Grayscale** tab of the Processing Functions palette.
2. Select **Divide** from the **Operators** list.
3. Select the **Constant** option.
4. Set the constant value.
5. Click **OK** to divide the image by the constant.

Related Topics

[Adding a constant to a grayscale image](#)

[Adding a grayscale image to a grayscale image](#)

[Comparing a grayscale image with a constant](#)

[Comparing grayscale images](#)

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[Using the Operators function](#)

Dividing a grayscale image by a grayscale image

1. Click **Grayscale»Operators** or click **Operators** in the **Grayscale** tab of the Processing Functions palette.
2. Select **Divide** from the **Operators** list.
3. Select the **Image** option.
4. Select the image buffer that contains the image by which you will divide the source image.
5. Click **OK** to divide the images and add this step to the script.



Notes

- You must already have an image stored in an image buffer before you can add, subtract, multiply, or divide two images. Click **Image»Image Buffer** to store a copy of the processed image in a buffer. You can insert the **Image»Image Buffer** step anywhere in a script.
- The buffer image must be the same size and type as the source image.

Related Topics

[Adding a constant to a grayscale image](#)

[Adding a grayscale image to a grayscale image](#)

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[Using the Operators function](#)

Multiplying a grayscale image by a constant

1. Click **Grayscale»Operators** or click **Operators** in the **Grayscale** tab of the Processing Functions palette.
2. Select **Multiply** from the **Operators** list.
3. Select the **Constant** option.
4. Set the constant value.
5. Click **OK** to multiply the image by the constant.

Related Topics

[Adding a constant to a grayscale image](#)

[Adding a grayscale image to a grayscale image](#)

[Comparing a grayscale image with a constant](#)

[Comparing grayscale images](#)

[Dividing a grayscale image by a constant](#)

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[Image Buffer \(Image»Image Buffer\)](#)

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[Retrieving an image from an image buffer](#)

[Storing an image in an image buffer](#)

[Subtracting a constant from a grayscale image](#)

[Subtracting a grayscale image from a grayscale image](#)

[Using the Operators function](#)

Multiplying a grayscale image by a grayscale image

1. Click **Grayscale»Operators** or click **Operators** in the **Grayscale** tab of the Processing Functions palette.
2. Select **Multiply** from the **Operators** list.
3. Select the **Image** option.
4. Select the image buffer that contains the image by which you will multiply the source image.
5. Click **OK** to multiply the images and add this step to the script.



Notes

- You must already have an image stored in an image buffer before you can add, subtract, multiply, or divide two images. Click **Image»Image Buffer** to store a copy of the processed image in a buffer. You can insert the **Image»Image Buffer** step anywhere in a script.
- The buffer image must be the same size and type as the source image.

Related Topics

[Adding a constant to a grayscale image](#)

[Adding a grayscale image to a grayscale image](#)

[Comparing a grayscale image with a constant](#)

[Comparing grayscale images](#)

[Dividing a grayscale image by a constant](#)

[Dividing a grayscale image by a grayscale image](#)

[Image Buffer \(Image»Image Buffer\)](#)

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[Using the Operators function](#)

Subtracting a constant from a grayscale image

1. Click **Grayscale»Operators** or click **Operators** in the **Grayscale** tab of the Processing Functions palette.
2. Select **Subtract** from the **Operators** list.
3. Select the **Constant** option.
4. Set the constant value.
5. Click **OK** to subtract the constant from the image.

Related Topics

[Adding a constant to a grayscale image](#)

[Adding a grayscale image to a grayscale image](#)

[Comparing a grayscale image with a constant](#)

[Comparing grayscale images](#)

[Dividing a grayscale image by a constant](#)

[Dividing a grayscale image by a grayscale image](#)

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[Subtracting a grayscale image from a grayscale image](#)

[Using the Operators function](#)

Subtracting a grayscale image from a grayscale image

1. Click **Grayscale»Operators** or click **Operators** in the **Grayscale** tab of the Processing Functions palette.
2. Select **Subtract** from the **Operators** list.
3. Select the **Image** option.
4. Select the image buffer that contains the image that you are subtracting from the source image.
5. Click **OK** to subtract the images and add this step to the script.



Notes

- You must already have an image stored in an image buffer before you can add, subtract, multiply, or divide two images. Click **Image»Image Buffer** to store a copy of the processed image in a buffer. You can insert the **Image»Image Buffer** step anywhere in a script.
- The buffer image must be the same size and type as the source image.

Related Topics

[Adding a constant to a grayscale image](#)

[Adding a grayscale image to a grayscale image](#)

[Comparing a grayscale image with a constant](#)

[Comparing grayscale images](#)

[Dividing a grayscale image by a constant](#)

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Histogram (Image»Histogram)

Counts the total number of pixels in each grayscale value and graphs it. You can perform a histogram on an entire image or selected regions of the image. Use the ROI tools from the toolbar to select regions in an image.



Note The Histogram function analyzes the image and displays information for you to review. This function does not modify the image.

- **Histogram**—Graphical representation of the quantitative distribution of pixels per grayscale value.
- **Minimum Value**—Smallest pixel intensity found in the image or selected regions in the image.
- **Maximum Value**—Largest pixel intensity found in the image or selected regions in the image.
- **Mean Value**—Mean value of intensities found in the image or selected regions in the image.
- **Std Deviation**—Standard deviation of the pixel intensities.
- **Number of Pixels**—Number of pixels used to calculate the histogram.
- **Mapping mode**—Specifies if the vertical scale (y-axis) of the histogram is linear or logarithmic.
 - **Linear**—Displays the histogram in a linear scale.
 - **Logarithmic**—Displays the histogram in a logarithmic scale. Use the logarithmic scale if the linear values are too small to view.

Related Topics

[Performing a histogram](#)

[Selecting a region of interest \(ROI\)](#)

Performing a histogram

1. Click **Image»Histogram** or select **Histogram** in the **Image** tab of the Processing Functions palette. Vision Assistant displays the histogram for the entire image.
2. If you want to perform a histogram for a portion of the image, select an ROI tool and draw an ROI on the image. The histogram displays data for the currently selected region.
3. Click **OK** to exit the Parameter window.



Note The Histogram function analyzes the image and displays information for you to review. This function does not modify the image.



Tips

- To display the histogram for the entire image after you selected an ROI or to delete the selected ROI, click the image or press the <Delete> key.
- If you want to save the histogram data, click the **Send Data to Excel** button or the **Save Results** button.

Related Topics

[Histogram \(Image»Histogram\)](#)

[Selecting a region of interest \(ROI\)](#)

Image Buffer (Image»Image Buffer)

Stores and retrieves images from buffers.

- **Current Image**—Lists image currently displayed in the Processing window.
- **Store Copy**—Adds the current image to an empty Image Buffer.
- **Retrieve Copy**—Retrieves the image from the selected Image Buffer.
- **Image Buffer**—Specifies the buffer to which an image is sent or from which an image is retrieved.

Related Topics

[Retrieving an image from an image buffer](#)

[Storing an image in an image buffer](#)

Storing an image in an image buffer

1. Click **Image»Image Buffer** or select **Image Buffer** in the **Image** tab of the Processing Functions palette.
2. Select **Store**.
3. Select an empty image buffer from the **Image Buffer** list. If you do not have an empty buffer, select a buffer that contains an image that you no longer need.
4. Click **OK** to save the image to the selected image buffer and add this step to the script.

Related Topics

[Image Buffer \(Image»Image Buffer\)](#)

[Retrieving an image from an image buffer](#)

Retrieving an image from an image buffer

1. Click **Image»Image Buffer** or select **Image Buffer** in the **Image** tab of the Processing Functions palette.
2. Select **Retrieve**.
3. Select the image buffer that contains the image you want to restore.
4. Click **OK** to restore the image and add this step to the script.



Note You must already have an image stored in an image buffer before you can restore it.

Related Topics

[Image Buffer \(Image»Image Buffer\)](#)

[Storing an image in an image buffer](#)

Image Mask (Image»Image Mask)

Builds a mask from an entire image or a region of interest (ROI). An image mask is an image containing values of 1 and 0. Vision Assistant processes only those pixels in the image source that have a corresponding mask image value of 1.

- **Image Mask**

Create from ROI Creates an image mask from an ROI selected on the image.

Create from Image File Creates an image mask from an image file.

- **Mask Options (Create from ROI)**

Outside the ROI Sets all pixels outside the selected region to 0.

Inside the ROI Sets all pixels inside the selected region to 0.

Extract Masked Region Casts the resulting image to the bounding rectangle of the ROI. You can use this option with ROIs such as circles, ellipses, and freehand regions. When this option is not selected, the entire image is returned.

- **Mask Options (Create from Image File)**

Black in Image File Masks all pixels with a corresponding mask image value equal to 0 (black).

Not Black in Image File Masks all pixels not equal to 0 (non-black).

Extract Masked Region Casts the resulting image to the bounding rectangle of the ROI. You can use this option with ROIs such as circles, ellipses, and freehand regions. When this option is not selected, the entire image is returned.

Related Topics

[Masking an image from an image file](#)

Masking an image from an ROI

Selecting a region of interest (ROI)

Masking an image from an ROI

1. Click **Image»Image Mask** or select **Image Mask** in the **Image** tab of the Processing Functions palette.
2. Select **Create from ROI**.
3. Select an ROI tool from the toolbar and draw the region of interest.
4. Click **Set ROI**.
5. Select mask options.
6. Click **OK** to add this step to the script.



Tip You can select a new region of interest by selecting an ROI tool and selecting a new area in the image.

Related Topics

[Image Mask \(Image»Image Mask\)](#)

[Masking an image from an image file](#)

Masking an image from an image file

1. Click **Image»Image Mask** or select **Image Mask** in the **Image** tab of the Processing Functions palette.
2. Select **Create from Image File**.
3. Click the **Browse** button, navigate to the location of the image file, select the file, and click **OK**.
4. Select mask options.
5. Click **OK** to add this step to the script.

Related Topics

[Image Mask \(Image»Image Mask\)](#)

[Masking an image from an ROI](#)

[Selecting a region of interest \(ROI\)](#)

Invert Binary Image (Binary»Invert Binary Image)

Reverses the dynamic of an image containing two different grayscale populations.



Notes

- To convert the binary image to an image containing pixel values 0 and 255, use the Multiply function to multiply the image by a constant value of 255 or use the Lookup Table:Equalize function to increase the dynamic of a binary image.
- Increase the dynamic of the binary image when you are applying arithmetic operators between the image and other images or constants.

Related Topics

[Inverting a binary image](#)

Inverting a binary image

Click **Binary»Invert Binary Image** or click **Invert Binary Image** in the **Binary** tab of the Processing Functions palette and click **OK** to reverse the dynamic of an image containing two different grayscale populations.

Related Topics

[Invert Binary Image \(Binary»Invert Binary Image\)](#)

Line Profile (Image»Line Profile)

Displays the grayscale distribution along a line of pixels in an image. Using the **Line Tool**, **Broken Line Tool**, or **Freehand Line Tool** from the toolbar, click and drag to draw a line segment.



Note The Line Profile function analyzes the image and displays information for you to review. This function does not modify the image.

- **Line Profile**—Variations of intensity along a line.
- **Minimum Value**—Smallest pixel intensity found in the line profile.
- **Maximum Value**—Largest pixel intensity found in the line profile.
- **Mean Value**—Mean value of pixel intensities found in the line profile.
- **Std Deviation**—Standard deviation of pixel intensities from the line profile.
- **Number of Pixels**—Number of pixels found in the line profile.
- **Mapping mode**—Specifies if the vertical scale (y-axis) of the histogram is linear or logarithmic.
 - **Linear**—Displays the line profile in a linear scale.
 - **Logarithmic**—Displays the line profile in a logarithmic scale. Use the logarithmic scale if the linear values are too small to view.

Related Topics

[Performing a line profile](#)

[Selecting a region of interest \(ROI\)](#)

Performing a line profile

1. Click **Image»Line Profile** or select **Line Profile** in the **Image** tab of the Processing Functions palette.
2. Select one of the line tools from the toolbar and draw a line on the image. The line profile displays data for the currently selected pixels.
3. Click **OK** to exit the Parameter window.



Note The Line Profile function analyzes the image and displays information for you to review. This function does not modify the image.



Tips

- Use the arrow keys (←, ↑, →, ↓) to move the line one pixel in the corresponding direction.
- To save the data, click the **Send Data to Excel** button or the **Save Results** button.

Related Topics

[Line Profile \(Image»Line Profile\)](#)

[Selecting a region of interest \(ROI\)](#)

Lookup Table (Grayscale»Lookup Table)

Improves contrast and brightness by applying a lookup table to an image. A lookup table (LUT) contains values used to transform the grayscale values of an image. For each grayscale value in the image, the corresponding new value is obtained from the LUT and assigned to every pixel of that grayscale value.

- **Lookup Table**

Image Source Opens the original input image.

Equalize Increases the intensity dynamic by distributing a given grayscale interval [min, max] over the full grayscale [0,255]. This function redistributes pixel intensities in order to provide a linear cumulated histogram.

Reverse Reverses the pixel values, producing a photometric negative of the original image.

Logarithmic Applies logarithmic transformation on the image pixels, which increases brightness and contrast in dark regions.

Exponential Applies an exponential transformation on the image pixels, which decreases brightness and increases contrast in bright regions.

Square Reduces contrast in dark regions. Similar to Exponential but with a more gradual effect.

Square Root Reduces contrast in bright regions. Similar to Logarithmic but with a more gradual effect.

Power X Reduces contrast in dark regions.

Power 1/X Reduces contrast in bright regions.

- **Power Value**—Value of the power X for the Power X and Power 1/X functions. Default value is 1.5.

Related Topics

[Performing a lookup table transformation](#)

Performing a lookup table transformation

1. Click **Grayscale»Lookup Table** or click **Lookup Table** in the **Grayscale** tab of the Processing Functions palette.
2. Select the lookup table that you want to apply to the image.
3. Click **OK** to apply the lookup table and add this step to the script.

Related Topics

[Lookup Table \(Grayscale»Lookup Table\)](#)

Measure (Image»Measure)

Calculates measurement statistics associated with the region of interest (ROI).



Note The Measure function analyzes the image and displays information for you to review. This function does not modify the image.

Measurement

Types of measurement you can calculate, including position, length, angle, and area.

- **Position Results**

Position of the point that you selected on the image using an ROI tool from the toolbar.

- **X Pos.**—X-coordinate
- **Y Pos.**—Y-coordinate
- **Lev.**—Grayscale value of the pixel

- **Length Results**

Measurements associated with the ROI.

- **Length**—Length of the ROI in user-calibrated units.
- **Start X**—X-coordinate of the starting point of the ROI.
- **Start Y**—Y-coordinate of the starting point of the ROI.
- **End X**—X-coordinate of the ending point of the ROI.
- **End Y**—Y-coordinate of the ending point of the ROI.
- **Mean**—Mean of the grayscale values found in the ROI.
- **StdDev**—Standard deviation in the ROI.
- **Min**—Smallest grayscale value found in the ROI.
- **Max**—Largest grayscale value found in the ROI.

- **Angle Results**

- **Angle**—Angle between any two line segments on the image, measured in degrees, counterclockwise.

- **Area Results**

Measurements associated with the ROI.

- **Area**—Area of the ROI.
- **Ratio**—Ratio of the ROI area to the entire image area.
- **X1**—Top, left x-coordinate of the ROI bounding rectangle.
- **Y1**—Top, left y-coordinate of the ROI bounding rectangle.
- **X2**—Bottom, right x-coordinate of the ROI bounding rectangle.

- **Y2**—Bottom, right y-coordinate of the ROI bounding rectangle.
- **Mean**—Mean of all grayscale values found in the ROI.
- **StdDev**—Standard deviation of all grayscale values found in the ROI.
- **Min**—Smallest grayscale value found in the ROI.
- **Max**—Largest grayscale value found in the ROI.

Related Topics

[Calculating ROI measurements](#)

Calculating ROI measurements

1. Click **Image»Measure** or select **Measure** in the **Image** tab of the Processing Functions palette.
2. Select the type of measurement that you want to calculate.
3. Draw an ROI on the image.

Vision Assistant displays the results for that measurement in the **Results** table.



Notes

- The Measure function analyzes the image and displays information for you to review. This function does not modify the image.
- Angles are measured in degrees, counterclockwise.



Tips

- To save the data, click the **Send Data to Excel** button or the **Save Results** button.
- To remove the selected row, click **Delete Selection**. To delete all results, click **Delete All Results**.

4. Click **OK** to close the Parameter window.

Related Topics

[Measure \(Image»Measure\)](#)

[Selecting a region of interest \(ROI\)](#)

Morphological Functions

Use the following morphological functions to modify the shape of objects in an image.

Gray Morphology (Grayscale»Gray Morphology)

| | |
|-----------------|---|
| Dilate | Increases the brightness of each pixel surrounded by neighbors with a higher intensity. |
| Erode | Reduces the brightness of pixels that are surrounded by neighbors with a lower intensity. |
| Close | Removes dark spots isolated in bright regions and smoothes boundaries. |
| Open | Removes bright spots isolated in dark regions and smoothes boundaries. |
| Proper Close | Removes dark pixels isolated in bright regions and smoothes the boundaries of dark regions. |
| Proper Open | Removes bright pixels isolated in dark regions and smoothes the boundaries of bright regions. |
| Auto Median | Generates simpler objects with fewer details. |

Related Topics

[Expanding \(dilating\) objects in grayscale images](#)

[Filling gaps and holes \(close\) in grayscale images](#)

[Gray Morphology \(Grayscale»Gray Morphology\)](#)

[Reducing \(eroding\) objects in grayscale images](#)

[Removing small objects \(open\) from grayscale images](#)

[Smoothing object boundaries in grayscale images](#)

Basic Morphology (Binary»Basic Morphology)

| | |
|----------------|---|
| Erode objects | Eliminates pixels isolated in the background and erodes the contour of objects based on the structuring element. Erosion makes objects smaller. |
| Dilate objects | Eliminates tiny holes isolated in objects and expands the contour of the objects based on the structuring element. Dilation makes objects larger. |
| Open objects | Removes small objects and smoothes boundaries. An opening is an erosion followed by a dilation, which does not significantly alter the area or shape of objects. Borders removed by erosion are restored by dilation, but small objects that were absorbed during erosion do not reappear after dilation. |
| Close objects | Fills tiny holes and smoothes boundaries. A closing is a dilation followed by erosion, which does not significantly alter the area or shape of objects. Objects are expanded by the dilation and then reduced by erosion, so borders are smoothed and holes are filled. |
| Proper Open | Removes small particles and smoothes the contour of objects based on the structuring element. It is a finite and dual combination of openings and closings. |
| Proper Close | Fills tiny holes and smoothes inner contours of objects based on the structuring element. It is a finite and dual combination of closings and openings. |
| Gradient In | Extracts the interior contour of a particle. |
| Gradient Out | Extracts the exterior contour of a particle. |
| Auto Median | Simplifies objects based on the structuring element so that they have fewer details. The Auto Median function uses dual combinations of openings and closings. |
| Thick | Alters the shape of objects by adding parts to the object that match the pattern specified in the structuring element. Use thickening for filling holes and smoothing right angles along edges of objects. |
| Thin | Alters the shape of objects by eliminating parts of the object that match the pattern specified in the structuring element. Use thinning for removing single pixels isolated in the background and right angles along edges of objects. |

Related Topics

[Basic Morphology \(Binary»Basic Morphology\)](#)

[Expanding \(dilating\) objects in binary images](#)

[Extracting the contours of a particle](#)

[Filling gaps and holes \(close\) in binary images](#)

[Filling holes and smoothing right angles](#)

[Reducing \(eroding\) objects in binary images](#)

[Removing single pixels and right angles](#)

[Removing small objects \(open\) from binary images](#)

[Smoothing object boundaries in binary images](#)

Adv. Morphology (Binary»Adv. Morphology)

| | |
|-----------------------|---|
| Remove small objects | Removes small objects. |
| Remove large objects | Removes large objects. |
| Remove border objects | Eliminates particles that touch the borders of an image. |
| Fill holes | Fills the holes found in a particle. Holes are filled with a pixel value of 1. |
| Convex | Returns the convex hull of objects. You can use the convex hull of an object to make measurements when the object is amorphous (irregular). |
| Skeleton | Applies a succession of thinnings until the width of each object equals one pixel. |
| Separate objects | Breaks narrow isthmuses and separates objects that touch. |
| Label objects | Produces a labeled image using grayscale values equal to the number of objects in the image plus the grayscale 0 used in the background area. |
| Distance | Assigns to each pixel a grayscale value equal to the shortest distance to the border of the object, which might be to a hole within the object. |
| Danielsson | Creates a distance map similar to the Distance function. Danielsson uses a more accurate algorithm than Distance. |
| Segment image | Partitions a labeled image into segments, each centered on an object, so that the segments do not overlap and leave empty zones. |

Related Topics

[Adv. Morphology \(Binary»Adv. Morphology\)](#)

[Computing the convex hull of objects](#)

[Creating a distance map](#)

[Filling holes](#)

[Labeling objects](#)

[Reducing objects to their skeletons](#)

[Removing large objects](#)

[Removing objects touching the border of an image](#)

[Removing small objects](#)

[Segmenting an image](#)

[Separating objects](#)

Applying morphological operations

1. Select one of the following morphology groups:
 - Click **Grayscale»Gray Morphology** or select **Gray Morphology** in the **Grayscale** tab of the Processing Functions palette.
 - Click **Binary»Basic Morphology** or select **Basic Morphology** in the **Binary** tab of the Processing Functions palette.
 - Click **Binary»Adv. Morphology** or click **Adv. Morphology** in the **Binary** tab of the Processing Functions palette.
2. Select one of the functions from the morphology list.
3. Set the parameters for the function, if needed. You might need to set parameters for the structuring element, connectivity, or pixel frame.
4. Click **OK** to apply the morphology and add this step to the script.

Related Topics

[Adv. Morphology \(Binary»Adv. Morphology\)](#)

[Basic Morphology \(Binary»Basic Morphology\)](#)

[Computing the convex hull of objects](#)

[Creating a distance map](#)

[Expanding \(dilating\) objects in binary images](#)

[Expanding \(dilating\) objects in grayscale images](#)

[Extracting the contours of a particle](#)

[Filling gaps and holes \(close\) in binary images](#)

[Filling gaps and holes \(close\) in grayscale images](#)

[Filling holes](#)

[Filling holes and smoothing right angles](#)

[Gray Morphology \(Grayscale»Gray Morphology\)](#)

[Labeling objects](#)

[Reducing \(eroding\) objects in binary images](#)

Reducing (eroding) objects in grayscale images

Reducing objects to their skeletons

Removing large objects

Removing objects touching the border of an image

Removing single pixels and right angles

Removing small objects

Removing small objects (open) from binary images

Removing small objects (open) from grayscale images

Segmenting an image

Separating objects

Smoothing object boundaries in binary images

Smoothing object boundaries in grayscale images

Gray Morphology (Grayscale»Gray Morphology)

Affects the structure of objects in grayscale images. You can use these functions for tasks such as expanding or reducing objects, filling holes, closing particles, or smoothing boundaries, which are tasks you perform to delineate objects and prepare images for thresholding and quantitative analysis.

- **Gray Morphology**

Image Original input image.

Source

Dilate Grayscale dilation operation. Dilation increases the brightness of each pixel surrounded by neighbors with a higher intensity.

Erode Grayscale erosion operation. Erosion reduces the brightness of pixels that are surrounded by neighbors with a lower intensity.

Close Grayscale dilation followed by a grayscale erosion. Closing removes dark spots isolated in bright regions and smoothes boundaries.

Open Grayscale erosion followed by a grayscale dilation. Opening removes bright spots isolated in dark regions and smoothes boundaries.

Proper Close Finite and dual combination of closing and opening operations. Proper Closing removes dark pixels isolated in bright regions and smoothes the boundaries of dark regions.

Proper Open Finite and dual combination of opening and closing operations. Proper Opening removes bright pixels isolated in dark regions and smoothes the boundaries of bright regions.

Auto Median Dual combinations of openings and closings. Auto Median generates simpler objects with fewer details.

- **Structuring Element**



2D array used as a binary mask to define the neighbors of a pixel. You can modify the structuring element by clicking its

cells. If a cell is black, it has a value of 1. If a cell is white (empty), it has a value of 0. If cell is black, the corresponding pixel is considered to be a neighbor and its value is used during the morphology operation.

- **Size**—Size of the structuring element. Valid values include 3 x 3, 5 x 5, and 7 x 7.
- **Iterations (Dilate and Erode functions)**—Number of times the operation is applied to the image.

Related Topics

[Expanding \(dilating\) objects in grayscale images](#)

[Filling gaps and holes \(close\) in grayscale images](#)

[Reducing \(eroding\) objects in grayscale images](#)

[Removing small objects \(open\) from grayscale images](#)

[Smoothing object boundaries in grayscale images](#)

Expanding (dilating) objects in grayscale images

1. Click **Grayscale»Gray Morphology** or select **Gray Morphology** in the **Grayscale** tab of the Processing Functions palette.
2. Select **Dilate** from the **Gray Morphology** list.
3. Set the **Size** of the **Structuring Element**.
4. Click the cells of the structuring element that you want to have a value of 0.
5. Enter the number of times that you want the dilation applied to the image in **Iterations**.
6. Click **OK** to apply the dilation and add this step to the script.



Tips

- The structuring element is a 2D array used as a binary mask to define the neighborhood of a pixel. You can modify the structuring element by clicking its cells. If a cell is black, it has a value of 1. If a cell is white (empty), it has a value of 0.
- Experiment with different coefficients and the **Kernel Size** to get the results you want.

Related Topics

[Expanding \(dilating\) objects in binary images](#)

[Filling gaps and holes \(close\) in grayscale images](#)

[Gray Morphology \(Grayscale»Gray Morphology\)](#)

[Reducing \(eroding\) objects in grayscale images](#)

[Removing small objects \(open\) from grayscale images](#)

[Smoothing object boundaries in grayscale images](#)

Reducing (eroding) objects in grayscale images

1. Click **Grayscale»Gray Morphology** or select **Gray Morphology** in the **Grayscale** tab of the Processing Functions palette.
2. Select **Erode** from the **Gray Morphology** list.
3. Set the **Size** of the **Structuring Element**.
4. Click the cells of the structuring element that you want to have a value of 0.
5. Enter the number of times that you want the erosion applied to the image in **Iterations**.
6. Click **OK** to apply the erosion and add this step to the script.



Tips

- The structuring element is a 2D array used as a binary mask. You can modify the structuring element by clicking its cells. If a cell is black, it has a value of 1. If a cell is white (empty), it has a value of 0.
- Experiment with different coefficients and the **Kernel Size** to get the results you want.

Related Topics

[Expanding \(dilating\) objects in grayscale images](#)

[Filling gaps and holes \(close\) in grayscale images](#)

[Gray Morphology \(Grayscale»Gray Morphology\)](#)

[Reducing \(eroding\) objects in binary images](#)

[Removing small objects \(open\) from grayscale images](#)

[Smoothing object boundaries in grayscale images](#)

Filling gaps and holes (close) in grayscale images

1. Click **Grayscale»Gray Morphology** or select **Gray Morphology** in the **Grayscale** tab of the Processing Functions palette.
2. Select **Close** from the **Gray Morphology** list.
3. Set the **Size** of the **Structuring Element**.
4. Click the cells of the structuring element that you want to have a value of 0.
5. Click **OK** to apply the closing and add this step to the script.



Tips

- The structuring element is a 2D array used as a binary mask to define the neighborhood of a pixel. You can modify the structuring element by clicking its cells. If a cell is black, it has a value of 1. If a cell is white (empty), it has a value of 0.
- Experiment with different coefficients and the **Kernel Size** to get the results you want.

Related Topics

[Expanding \(dilating\) objects in grayscale images](#)

[Filling gaps and holes \(close\) in binary images](#)

[Gray Morphology \(Grayscale»Gray Morphology\)](#)

[Reducing \(eroding\) objects in grayscale images](#)

[Removing small objects \(open\) from grayscale images](#)

[Smoothing object boundaries in grayscale images](#)

Removing small objects (open) from grayscale images

1. Click **Grayscale»Gray Morphology** or select **Gray Morphology** in the **Grayscale** tab of the Processing Functions palette.
2. Select **Open** from the **Gray Morphology** list.
3. Set the **Size** of the **Structuring Element**.
4. Click the cells of the structuring element that you want to have a value of 0.
5. Click **OK** to apply the opening and add this step to the script.



Tips

- The structuring element is a 2D array used as a binary mask to define the neighborhood of a pixel. You can modify the structuring element by clicking its cells. If a cell is black, it has a value of 1. If a cell is white (empty), it has a value of 0.
- Experiment with different coefficients and the **Kernel Size** to get the results you want.

Related Topics

[Expanding \(dilating\) objects in grayscale images](#)

[Filling gaps and holes \(close\) in grayscale images](#)

[Gray Morphology \(Grayscale»Gray Morphology\)](#)

[Reducing \(eroding\) objects in grayscale images](#)

[Removing small objects \(open\) from binary images](#)

[Smoothing object boundaries in grayscale images](#)

Smoothing object boundaries in grayscale images

1. Click **Grayscale»Gray Morphology** or select **Gray Morphology** in the **Grayscale** tab of the Processing Functions palette.
2. Select one of the three following morphological functions from the **Gray Morphology** list:
 - **Proper Open**—Smooths boundaries of objects and fills small holes.
 - **Proper Close**—Smooths boundaries of objects and removes small particles.
 - **Auto Median**—Smooths boundaries of objects.
3. Set the **Size** of the **Structuring Element**.
4. Click the cells of the structuring element that you want to have a value of 0.
5. Click **OK** to apply the morphology and add this step to the script.



Tips

- The structuring element is a 2D array used as a binary mask to define the neighborhood of a pixel. You can modify the structuring element by clicking its cells. If a cell is black, it has a value of 1. If a cell is white (empty), it has a value of 0.
- Experiment with different coefficients and the **Kernel Size** to get the results you want.

Related Topics

[Expanding \(dilating\) objects in grayscale images](#)

[Filling gaps and holes \(close\) in grayscale images](#)

[Filling holes and smoothing right angles](#)

[Gray Morphology \(Grayscale»Gray Morphology\)](#)

[Reducing \(eroding\) objects in grayscale images](#)

[Removing small objects \(open\) from grayscale images](#)

[Smoothing an image with filtering](#)

[Smoothing object boundaries in binary images](#)

Basic Morphology (Binary»Basic Morphology)

Affects the shape of particles in binary images. Each particle or region is affected on an individual basis. You can use these functions for tasks such as expanding or reducing objects, filling holes, closing particles, or smoothing boundaries, which are tasks you perform to delineate objects and prepare images for quantitative analysis.

- **Basic Morphology**

| | |
|----------------|--|
| Image Source | Opens the original input image. |
| Erode objects | Eliminates pixels isolated in the background and erodes the contour of objects based on the structuring element. Erosion makes objects smaller. |
| Dilate objects | Eliminates tiny holes isolated in objects and expands the contour of the objects based on the structuring element. Dilation makes objects larger. |
| Open objects | Removes small objects and smoothes boundaries. An opening is an erosion followed by a dilation, which does not significantly alter the area or shape of objects. Borders removed by erosion are restored by dilation, but small objects that were removed during erosion do not reappear after dilation. |
| Close objects | Fills tiny holes and smoothes boundaries. A closing is a dilation followed by erosion, which does not significantly alter the area or shape of objects. Objects are expanded by the dilation and then reduced by erosion, so borders are smoothed and holes are filled. |
| Proper Open | Removes small particles and smoothes the contour of objects based on the structuring element. It is a finite and dual combination of openings and closings. |
| Proper Close | Fills tiny holes and smoothes inner contours of objects based on the structuring element. It is a finite and dual combination of closings and openings. |
| Gradient In | Extracts the interior contours of a particle. |

Gradient Out Extracts the exterior contours of a particle.

Auto Median Simplifies objects based on the structuring element so that they have fewer details. The Auto Median function uses dual combinations of openings and closings.

Thick Alters the shape of objects by adding parts to the object that match the pattern specified in the structuring element. Thickening is useful for filling holes and smoothing right angles along edges of objects.

Thin Alters the shape of objects by eliminating parts of the object that match the pattern specified in the structuring element. Thinning is useful for removing single pixels isolated in the background and right angles along edges of objects.

- **Structuring Element**



2D array used as a binary mask to define the neighbors of a pixel. You can modify the structuring element by clicking its cells. If a cell is black, it has a value of 1. If a cell is white (empty), it has a value of 0. If cell is black, the corresponding pixel is considered to be a neighbor and its value is used during the morphology operation.

- **Size**—Size of the structuring element. Valid values include 3 x 3, 5 x 5, and 7 x 7.
- **Iterations**—Specifies the number of 3 x 3 erosions to apply to the image.
- **Square/Hexagon**—Specifies the shape of the pixel frame during the transformation.



Square pixel frame. Each pixel is surrounded by eight neighbors. The vertical and horizontal neighbors have a distance d from the pixel. Diagonal pixels have a slightly greater distance because they are farther away from the central pixel.



Hexagon pixel frame. Each pixel is surrounded by six neighbors, which are each located at an equal distance from the central pixel.

Related Topics

[Expanding \(dilating\) objects in binary images](#)

[Extracting the contours of a particle](#)

[Filling gaps and holes \(close\) in binary images](#)

[Filling holes and smoothing right angles](#)

[Reducing \(eroding\) objects in binary images](#)

[Removing single pixels and right angles](#)

[Removing small objects \(open\) from binary images](#)

[Smoothing object boundaries in binary images](#)

Reducing (eroding) objects in binary images

1. Click **Binary»Basic Morphology** or select **Basic Morphology** in the **Binary** tab of the Processing Functions palette.
2. Select **Erode objects** from the **Basic Morphology** list.
3. Set the **Size** of the **Structuring Element**.
4. Click the cells of the structuring element that you want to have a value of 0.
5. Enter the number of times that you want the erosion applied to the image in **Iterations**.
6. Click **OK** to apply the erosion and add this step to the script.



Note The structuring element is a 2D array used as a binary mask. You can modify the structuring element by clicking its cells. If a cell is black, it has a value of 1. If a cell is white (empty), it has a value of 0.



Tip Experiment with different coefficients and the **Kernel Size** to get the results you want.

Related Topics

[Basic Morphology \(Binary»Basic Morphology\)](#)

[Expanding \(dilating\) objects in binary images](#)

[Extracting the contours of a particle](#)

[Filling gaps and holes \(close\) in binary images](#)

[Filling holes and smoothing right angles](#)

[Reducing \(eroding\) objects in grayscale images](#)

[Removing single pixels and right angles](#)

[Removing small objects \(open\) from binary images](#)

[Smoothing object boundaries in binary images](#)

Expanding (dilating) objects in binary images

1. Click **Binary»Basic Morphology** or select **Basic Morphology** in the **Binary** tab of the Processing Functions palette.
2. Select **Dilate objects** from the **Basic Morphology** list.
3. Set the **Size** of the **Structuring Element**.
4. Click the cells of the structuring element that you want to have a value of 0.
5. Enter the number of times that you want the dilation applied to the image in **Iterations**.
6. Click **OK** to apply the dilation and add this step to the script.



Note The structuring element is a 2D array used as a binary mask. You can modify the structuring element by clicking its cells. If a cell is black, it has a value of 1. If a cell is white (empty), it has a value of 0.



Tip Experiment with different coefficients and the **Kernel Size** to get the results you want.

Related Topics

[Basic Morphology \(Binary»Basic Morphology\)](#)

[Expanding \(dilating\) objects in grayscale images](#)

[Extracting the contours of a particle](#)

[Filling gaps and holes \(close\) in binary images](#)

[Filling holes and smoothing right angles](#)

[Reducing \(eroding\) objects in binary images](#)

[Removing single pixels and right angles](#)

[Removing small objects \(open\) from binary images](#)

[Smoothing object boundaries in binary images](#)

Removing small objects (open) from binary images

1. Click **Binary»Basic Morphology** or select **Basic Morphology** in the **Binary** tab of the Processing Functions palette.
2. Select **Open objects** from the **Basic Morphology** list.
3. Set the **Size** of the **Structuring Element**.
4. Click the cells of the structuring element that you want to have a value of 0.
5. Click **OK** to apply the opening and add this step to the script.



Note The structuring element is a 2D array used as a binary mask. You can modify the structuring element by clicking its cells. If a cell is black, it has a value of 1. If a cell is white (empty), it has a value of 0.



Tip Experiment with different coefficients and the **Kernel Size** to get the results you want.

Related Topics

[Basic Morphology \(Binary»Basic Morphology\)](#)

[Expanding \(dilating\) objects in binary images](#)

[Extracting the contours of a particle](#)

[Filling gaps and holes \(close\) in binary images](#)

[Filling holes and smoothing right angles](#)

[Reducing \(eroding\) objects in binary images](#)

[Removing single pixels and right angles](#)

[Removing small objects \(open\) from grayscale images](#)

[Smoothing object boundaries in binary images](#)

Filling gaps and holes (close) in binary images

1. Click **Binary»Basic Morphology** or select **Basic Morphology** in the **Binary** tab of the Processing Functions palette.
2. Select **Close objects** from the **Basic Morphology** list.
3. Set the **Size** of the **Structuring Element**.
4. Click the cells of the structuring element that you want to have a value of 0.
5. Click **OK** to apply the closing and add this step to the script.



Note The structuring element is a 2D array used as a binary mask. You can modify the structuring element by clicking its cells. If a cell is black, it has a value of 1. If a cell is white (empty), it has a value of 0.



Tip Experiment with different coefficients and the **Kernel Size** to get the results you want.

Related Topics

[Basic Morphology \(Binary»Basic Morphology\)](#)

[Expanding \(dilating\) objects in binary images](#)

[Extracting the contours of a particle](#)

[Filling gaps and holes \(close\) in grayscale images](#)

[Filling holes and smoothing right angles](#)

[Reducing \(eroding\) objects in binary images](#)

[Removing single pixels and right angles](#)

[Removing small objects \(open\) from binary images](#)

[Smoothing object boundaries in binary images](#)

Smoothing object boundaries in binary images

1. Click **Binary»Basic Morphology** or select **Basic Morphology** in the **Binary** tab of the Processing Functions palette.
2. Select a function from the **Basic Morphology** list. You can use one of three morphological functions to smooth the boundaries of objects:
 - **Proper Open**—Smooths boundaries of objects and fills small holes.
 - **Proper Close**—Smooths boundaries of objects and removes small particles.
 - **Auto Median**—Smooths boundaries of objects.
3. Set the **Size** of the **Structuring Element**.
4. Click the cells of the structuring element that you want to have a value of 0.
5. Click **OK** to apply the smoothing function and add this step to the script.



Note The structuring element is a 2D array used as a binary mask. You can modify the structuring element by clicking its cells. If a cell is black, it has a value of 1. If a cell is white (empty), it has a value of 0.



Tip Experiment with different coefficients and the **Kernel Size** to get the results you want.

Related Topics

[Basic Morphology \(Binary»Basic Morphology\)](#)

[Expanding \(dilating\) objects in binary images](#)

[Extracting the contours of a particle](#)

[Filling gaps and holes \(close\) in binary images](#)

[Filling holes and smoothing right angles](#)

[Reducing \(eroding\) objects in binary images](#)

[Removing single pixels and right angles](#)

[Removing small objects \(open\) from binary images](#)

[Smoothing object boundaries in grayscale images](#)

Extracting the contours of a particle

1. Click **Binary»Basic Morphology** or select **Basic Morphology** in the **Binary** tab of the Processing Functions palette.
2. Select **Gradient In** to extract the interior contours of a particle or **Gradient Out** to extract the exterior contours of a particle.
3. Set the **Size** of the **Structuring Element**.
4. Click the cells of the structuring element that you want to have a value of 0.
5. Click **OK** to apply the function and add this step to the script.



Note The structuring element is a 2D array used as a binary mask. You can modify the structuring element by clicking its cells. If a cell is black, it has a value of 1. If a cell is white (empty), it has a value of 0.



Tip Experiment with different coefficients and the **Kernel Size** to get the results you want.

Related Topics

[Basic Morphology \(Binary»Basic Morphology\)](#)

[Expanding \(dilating\) objects in binary images](#)

[Filling gaps and holes \(close\) in binary images](#)

[Filling holes and smoothing right angles](#)

[Reducing \(eroding\) objects in binary images](#)

[Removing single pixels and right angles](#)

[Removing small objects \(open\) from binary images](#)

[Smoothing object boundaries in binary images](#)

Filling holes and smoothing right angles

1. Click **Binary»Basic Morphology** or select **Basic Morphology** in the **Binary** tab of the Processing Functions palette.
2. Select **Thick** to alter the shape of objects by adding parts to the object that match the pattern specified in the structuring element.
3. Set the **Size** of the **Structuring Element**.
4. Click the cells of the structuring element that you want to have a value of 0.
5. Click **OK** to apply the thickening and add this step to the script.



Note The structuring element is a 2D array used as a binary mask. You can modify the structuring element by clicking its cells. If a cell is black, it has a value of 1. If a cell is white (empty), it has a value of 0.



Tip Experiment with different coefficients and the **Kernel Size** to get the results you want.

Related Topics

[Basic Morphology \(Binary»Basic Morphology\)](#)

[Expanding \(dilating\) objects in binary images](#)

[Extracting the contours of a particle](#)

[Filling gaps and holes \(close\) in binary images](#)

[Filling gaps and holes \(close\) in grayscale images](#)

[Filling holes](#)

[Reducing \(eroding\) objects in binary images](#)

[Removing single pixels and right angles](#)

[Removing small objects \(open\) from binary images](#)

[Smoothing an image with filtering](#)

[Smoothing object boundaries in binary images](#)

[Smoothing object boundaries in grayscale images](#)

Removing single pixels and right angles

1. Click **Binary»Basic Morphology** or select **Basic Morphology** in the **Binary** tab of the Processing Functions palette.
2. Select **Thin** to alter the shape of objects by eliminating parts to the object that match the pattern specified in the structuring element.
3. Set the **Size** of the **Structuring Element**.
4. Click the cells of the structuring element that you want to have a value of 0.
5. Click **OK** to apply the thinning and add this step to the script.



Note The structuring element is a 2D array used as a binary mask. You can modify the structuring element by clicking its cells. If a cell is black, it has a value of 1. If a cell is white (empty), it has a value of 0.



Tip Experiment with different coefficients and the **Kernel Size** to get the results you want.

Related Topics

[Basic Morphology \(Binary»Basic Morphology\)](#)

[Expanding \(dilating\) objects in binary images](#)

[Extracting the contours of a particle](#)

[Filling gaps and holes \(close\) in binary images](#)

[Filling holes and smoothing right angles](#)

[Reducing \(eroding\) objects in binary images](#)

[Removing small objects \(open\) from binary images](#)

[Smoothing object boundaries in binary images](#)

Adv. Morphology (Binary»Adv. Morphology)

Perform high-level operations on particles in binary images. Use these functions for tasks such as removing small particles from an image, labeling particles in an image, or filling holes in particles.

- **Advanced Morphology**

| | |
|-----------------------|---|
| Image Source | Opens the original input image. |
| Remove small objects | Removes small objects. A small object is defined by the number of erosions (specified in Iterations) needed to remove the object. |
| Remove large objects | Removes large objects. A large object is defined by the number of erosions (specified in Iterations) that do not remove the object. |
| Remove border objects | Eliminates particles that touch the borders of an image. |
| Fill holes | Fills holes found in a particle. Holes are filled with a pixel value of 1. |
| Convex Hull | Computes the convex hull of objects. |
| Skeleton | Applies a succession of thinnings until the width of each object equals one pixel. The Skeleton L function uses an L-shaped structuring element. The Skeleton M function extracts the skeleton with more dendrites. The Skiz function behaves like the Skeleton M function but it affects background regions, rather than object regions. |
| Separate objects | Breaks narrow isthmuses and separates objects that touch. |
| Label objects | Produces a labeled image using grayscale values equal to the number of objects in the image plus the grayscale 0 used in the background area. |
| Distance | Assigns to each pixel a grayscale value equal to the shortest distance to the border of the object, which might be to a hole within the object. |

Danielsson Creates a distance map similar to the Distance function. Danielsson uses a more accurate algorithm than Distance.

Segment image Partitions an image into segments, each centered on an object, so that the segments do not overlap and leave empty zones.

- **Mode (Skeleton)**—Specifies the type of Skeleton function you want to perform. The Skeleton L function uses an L-shaped structuring element. The Skeleton M function extracts the skeleton with more dendrites. The Skiz function behaves like the Skeleton L function but it affects background regions, rather than object regions.

- **Structuring Element**



2D array used as a binary mask to define the neighbors of a pixel. You can modify the structuring element by clicking its cells. If a cell is black, it has a value of 1. If a cell is white (empty), it has a value of 0. If cell is black, the corresponding pixel is considered to be a neighbor and its value is used during the morphology operation.

- **Size**—Size of the structuring element. Valid values include 3 x 3, 5 x 5, and 7 x 7.
- **Iterations**—Specifies the number of 3 x 3 erosions to apply to the image.
- **Connectivity 4/8**—Specifies how the algorithm determines if an adjacent pixel is the same or a different particle.



Connectivity-8. All adjacent pixels are considered neighbors.



Connectivity-4. Only pixels adjacent in the horizontal and vertical directions are considered neighbors.

- **Square/Hexagon**—Specifies if the pixel frame is treated as a square or hexagon during the transformation.



Square pixel frame. Each pixel is surrounded by eight neighbors. The vertical and horizontal neighbors have a distance d from the pixel. Diagonal pixels have a slightly greater distance because they are farther away from the central pixel.



Hexagon pixel frame. Each pixel is surrounded by six neighbors. Each neighbor is at an equal distance from the central pixel.

Related Topics

[Computing the convex hull of objects](#)

[Creating a distance map](#)

[Filling holes](#)

[Labeling objects](#)

[Reducing objects to their skeletons](#)

[Removing large objects](#)

[Removing objects touching the border of an image](#)

[Removing small objects](#)

[Segmenting an image](#)

[Separating objects](#)

Removing small objects

1. Click **Binary»Adv. Morphology** or click **Adv. Morphology** in the **Binary** tab of the Processing Functions palette.
2. Select **Remove small objects**.
3. Specify the number of 3 x 3 erosions that need to be applied to completely remove a small object in **Iterations**.
4. Click **OK** to remove small objects and add this step to the script.

Related Topics

[Adv. Morphology \(Binary»Adv. Morphology\)](#)

[Computing the convex hull of objects](#)

[Creating a distance map](#)

[Filling holes](#)

[Labeling objects](#)

[Reducing objects to their skeletons](#)

[Removing large objects](#)

[Removing objects touching the border of an image](#)

[Segmenting an image](#)

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Removing large objects

1. Click **Binary»Adv. Morphology** or click **Adv. Morphology** in the **Binary** tab of the Processing Functions palette.
2. Select **Remove large objects**.
3. Specify the number of 3 x 3 erosions to apply in **Iterations**. The particles that remain after the erosion operations are removed from the image and the rest of the particles are restored.
4. Click **OK** to remove large objects and add this step to the script.

Related Topics

[Adv. Morphology \(Binary»Adv. Morphology\)](#)

[Computing the convex hull of objects](#)

[Creating a distance map](#)

[Filling holes](#)

[Labeling objects](#)

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[Removing objects touching the border of an image](#)

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Removing objects touching the border of an image

1. Click **Binary»Adv. Morphology** or click **Adv. Morphology** in the **Binary** tab of the Processing Functions palette.
2. Select **Remove border objects**.
3. Click **OK** to remove all objects touching the border of the object and add this step to the script.

Related Topics

[Adv. Morphology \(Binary»Adv. Morphology\)](#)

[Computing the convex hull of objects](#)

[Creating a distance map](#)

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Filling holes

1. Click **Binary»Adv. Morphology** or click **Adv. Morphology** in the **Binary** tab of the Processing Functions palette.
2. Select **Fill holes**.
3. Click **OK** to fill the holes and add this step to the script.

Related Topics

[Adv. Morphology \(Binary»Adv. Morphology\)](#)

[Computing the convex hull of objects](#)

[Creating a distance map](#)

[Filling gaps and holes \(close\) in binary images](#)

[Filling gaps and holes \(close\) in grayscale images](#)

[Filling holes and smoothing right angles](#)

[Labeling objects](#)

[Reducing objects to their skeletons](#)

[Removing large objects](#)

[Removing objects touching the border of an image](#)

[Removing small objects](#)

[Segmenting an image](#)

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Computing the convex hull of objects

1. Click **Binary»Adv. Morphology** or click **Adv. Morphology** in the **Binary** tab of the Processing Functions palette.
2. Select **Convex**.
3. Click **OK** to close objects and add this step to the script.



Note This function is computer-intensive and can take several seconds.



Tip Use this function to close particles so you can make measurements even when the contour of the object is irregular.

Related Topics

[Adv. Morphology \(Binary»Adv. Morphology\)](#)

[Creating a distance map](#)

[Filling holes](#)

[Labeling objects](#)

[Reducing objects to their skeletons](#)

[Removing large objects](#)

[Removing objects touching the border of an image](#)

[Removing small objects](#)

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[Separating objects](#)

Reducing objects to their skeletons

1. Click **Binary»Adv. Morphology** or click **Adv. Morphology** in the **Binary** tab of the Processing Functions palette.
2. Select **Skeleton**.
3. Select the type of skeleton you want to see.
 - **Skeleton L**—Uses an L-shaped structuring element.
 - **Skeleton M**—Extracts the skeleton with more dendrites.
 - **Skiz**—Uses an L-shaped structuring element that affects background regions, extracting the watershed line in an image.
4. Click **OK** to add this step to the script.



Note This function is computer-intensive and can take several seconds.

Related Topics

[Adv. Morphology \(Binary»Adv. Morphology\)](#)

[Computing the convex hull of objects](#)

[Creating a distance map](#)

[Filling holes](#)

[Labeling objects](#)

[Removing large objects](#)

[Removing objects touching the border of an image](#)

[Removing small objects](#)

[Segmenting an image](#)

[Separating objects](#)

Separating objects

1. Select **Binary»Adv. Morphology** or select **Adv. Morphology** in the **Binary** tab of the Processing Functions palette.
2. Select **Separate objects**.
3. Set the **Size** of the **Structuring Element**.
4. Click the cells of the structuring element that you want to have a value of 0.
5. Enter the number of erosions that you want the function to apply to the image in **Iterations**.
6. Click **OK** to separate objects and add this step to the script.



Notes

- The structuring element is a 2D array used as a binary mask. You can modify the structuring element by clicking its cells. If a cell is black, it has a value of 1. If a cell is white (empty), it has a value of 0.
- This function is computer-intensive and can take several seconds to process.



Tip Experiment with different coefficients and the **Kernel Size** to get the results you want.

Related Topics

[Adv. Morphology \(Binary»Adv. Morphology\)](#)

[Computing the convex hull of objects](#)

[Creating a distance map](#)

[Filling holes](#)

[Labeling objects](#)

[Reducing objects to their skeletons](#)

[Removing large objects](#)

[Removing objects touching the border of an image](#)

[Removing small objects](#)

[Segmenting an image](#)

Creating a distance map

1. Click **Binary»Adv. Morphology** or click **Adv. Morphology** in the **Binary** tab of the Processing Functions palette.
2. Select **Distance** or **Danielsson**.
3. Click **OK** to add this step to the script.



Note This function assigns, to each pixel, a grayscale value equal to the shortest distance to the border of the object. The border might be to a hole within the object. **Danielsson** uses a more accurate algorithm than **Distance**.

Related Topics

[Adv. Morphology \(Binary»Adv. Morphology\)](#)

[Computing the convex hull of objects](#)

[Filling holes](#)

[Labeling objects](#)

[Reducing objects to their skeletons](#)

[Removing large objects](#)

[Removing objects touching the border of an image](#)

[Removing small objects](#)

[Segmenting an image](#)

[Separating objects](#)

Labeling objects

1. Click **Binary»Adv. Morphology** or click **Adv. Morphology** in the **Binary** tab of the Processing Functions palette.
2. Select **Label objects**.
3. Click **OK** to add this step to the script.



Tip Labeling is especially useful when viewing images containing many objects that are not clearly separated.

Related Topics

[Adv. Morphology \(Binary»Adv. Morphology\)](#)

[Computing the convex hull of objects](#)

[Creating a distance map](#)

[Filling holes](#)

[Reducing objects to their skeletons](#)

[Removing large objects](#)

[Removing objects touching the border of an image](#)

[Removing small objects](#)

[Segmenting an image](#)

[Separating objects](#)

Segmenting an image

1. Click **Binary»Adv. Morphology** or click **Adv. Morphology** in the **Binary** tab of the Processing Functions palette.
2. Select **Segment image**.
3. Click **OK** to add this step to the script.



Notes

- This function partitions an image into segments, each centered on an object, so that the segments do not overlap and leave empty zones.
- This function is computer-intensive and can take several seconds.

Related Topics

[Adv. Morphology \(Binary»Adv. Morphology\)](#)

[Computing the convex hull of objects](#)

[Creating a distance map](#)

[Filling holes](#)

[Labeling objects](#)

[Reducing objects to their skeletons](#)

[Removing large objects](#)



[Removing objects touching the border of an image](#)

[Removing small objects](#)

[Separating objects](#)

Particle Filter (Binary»Particle Filter)

Removes or keeps particles in an image as specified by the filter criteria.

- **Filter Criteria**—[List of measurements](#) that you use as criteria to keep or remove particles from the image.
- **Parameter Range**
 - Minimum Specifies the minimum value of the parameter range.
value
 - Maximum Specifies the maximum value of the parameter range.
value
 - Exclude Interval Specifies the range to filter. When this option is deselected, the selected range is [Minimum value, Maximum value]. When this option is selected, the selected range is [– ¥ , Minimum value] [Maximum value, + ¥]
 - Unit Specifies the unit of the minimum and maximum value. The unit is either pixels or real-world values.
- **Current Parameter**—The minimum value, maximum value, and mean value for the selected filter criteria, which is calculated using all of the particles in the image.
- **Action**
 - Remove Removes particles that do not fit in the range bounded by the minimal and maximal values for the selected measurement.
 - Keep Keeps particles that fit in the range bounded by the minimal and maximal values for the selected measurement.
- **Connectivity 4/8**—Defines which of the surrounding pixels for any given pixel constitute its neighborhood.
 -  Connectivity-8. All adjacent pixels are considered neighbors.
 -  Connectivity-4. Only pixels adjacent in the horizontal and vertical directions are considered neighbors.

Related Topics

Filtering objects based on particle measurements

Filtering objects based on particle measurements

1. Click **Binary»Particle Filter** or click **Particle Filter** in the **Binary** tab of the Processing Functions palette.
2. Double-click each object measurement in the **Particle Filter** list that you want the particle filter to include as criteria.
3. Enter the parameter range for each filter criteria.
4. Select the action you want to perform. **Remove** removes particles that do not fit in the range bounded by the minimum and maximum values for the selected measurement. **Keep** keeps particles that fit in the range bounded by the minimum and maximum values for the selected measurement.
5. Click **OK** to filter the image and add this step to the script.



Tip If you want the filter to be applied outside of the specified parameter range, check the **Exclude Interval** option.

Related Topics

[Filter Criteria](#)

[Particle Filter \(Binary»Particle Filter\)](#)

Threshold (Grayscale»Threshold)

Segments pixels in grayscale images. The Manual Threshold operation enables you to select ranges of grayscale pixel values. Local threshold operations select pixels using a locally adaptive thresholding algorithm. Use local thresholds in applications whose images exhibit non-uniform lighting changes that may result from a strong illumination gradient or shadows. Automatic threshold operations select threshold ranges for you. Use automatic thresholds when you expect uniform lighting changes from image to image.

- **Look For**

- | | |
|----------------|--|
| Bright Objects | Isolates pixels whose intensity values range from a user-specified value to 255. |
| Dark Objects | Isolates pixels whose intensity values range from 0 to a user-specified value. |
| Gray Objects | Isolates pixels whose intensity values lie within a user-specified range. |

- **Threshold Type**

- | | |
|--|---|
| Image Source | Opens the original input image. |
| Manual Threshold | Applies a threshold to the image based on the Minimum and Maximum threshold values that you enter. All pixels not contained between the Minimum and Maximum values are set to 0. All pixels that fall in the range are replaced by 1. |
| Local Threshold: Niblack | Calculates a threshold value for each pixel based on the statistics of surrounding pixels. This algorithm compensates for high lighting variations. |
| Local Threshold: Background Correction | Performs a background correction to eliminate non-uniform lighting effects and then performs thresholding using the interclass variance thresholding algorithm. |
| Auto Threshold: Clustering | Applies a threshold to an image based on a statistical technique called clustering. |

Auto Threshold: Entropy Applies a threshold to an image based on an image analysis technique called entropy.

Auto Threshold: Metric Applies a threshold to an image by calculating the optimal threshold, which depends on the surfaces representing the initial grayscale, using the metric technique.

Auto Threshold: Moments Applies a threshold to an image by using a statistical tool called moments, which recalculates a theoretical binary image.

Auto Threshold: Inter Variance Applies a threshold to an image based on a classical statistical technique called interclass variance.

- **Threshold Range**—Configurable only with a Manual Threshold.

Minimum Lowest grayscale pixel value included in the manual threshold range. You can adjust the black cursor on the histogram to set the lower bound for this range when you are looking for bright or gray objects.


Maximum Highest grayscale pixel value included in the manual threshold range. You can adjust the white cursor on the histogram to set the upper bound for this range when you are looking for dark or gray objects.

- **Histogram**—Displays the total number of pixels in each grayscale value. From the histogram, you can discern if the image contains distinct regions of a certain grayscale value, and you can select grayscale pixel regions of the image by sliding the white and black cursors.



Tips

- You can display the histogram of a portion of an image by drawing an ROI around the area of interest with one of the tools from the toolbar. The local histogram gives you valuable information about the threshold range you can select to keep or reject certain parts of the image.

- Thresholding an image produces a binary images with pixel values of 0 and 1. You must use a binary color palette to display binary images.
- **Kernel Size**—Size of the neighborhood around each pixel used to compute the mean value. The Kernel Size is typically the size of the object you want to isolate with the threshold. This control is configurable only with a local threshold.
 - 💡 **Tip** You can get the approximate size of an object in your image by drawing an ROI around the object. ROI Size displays the size of the last ROI drawn. Click  to apply the ROI Size to the Kernel Size.
- **Deviation Factor**—Determines the sensitivity of the algorithm. Values range from 0 to 1, with 0 being the most sensitive to noise. The lower the Deviation Factor, the closer the pixel value must be to the mean value to be selected as part of a particle. This control is configurable only with the Local Threshold: Niblack Threshold Type.


Related Topics



[Color Threshold \(Color»Color Threshold\)](#)

[Thresholding a grayscale image](#)

Color Threshold (Color»Color Threshold)

Applies a threshold to the three planes of a color image and places the result into an 8-bit image.

- **Color Model**—Color encoding scheme: RGB, HSL, HSV, or HSI.
 - **Preview Color**—Color used to highlight the pixels selected by the threshold **Min** and **Max** values. Default value is red.
 - **Histogram**
 - Linear Displays the histograms in a linear scale.
 - Logarithmic Displays the histograms in a logarithmic scale. Use the logarithmic scale if the linear values are too small to view using a linear scale.
 - **Red/Hue**—Thresholding range for the red or hue plane (depending on **Color Model**). Any pixel values not included in this range are reset to zero in the destination image. You can modify the **Min** and **Max** values by clicking and dragging on the blue and red markers on the histogram.
 - **Green/Saturation**—Thresholding range for the green or saturation plane (depending on **Color Model**). Any pixel values not included in this range are reset to zero in the destination image. You can modify the **Min** and **Max** values by clicking and dragging on the blue and red markers on the histogram.
 - **Blue/Luminance/Value/Intensity**—Thresholding range for the blue, luminance, value, or intensity plane (depending on **Color Model**). Any pixel values not included in this range are reset to zero in the destination image. You can modify the **Min** and **Max** values by clicking and dragging on the blue and red markers on the histogram.
-  **Note** You can use the Hue indicator to select all pixels with a certain hue when you set **Color Model** to HSL, HSV, or HSI. Select a specific hue that you want to isolate in the image using the ROI tools. The histograms display the pixels that you need to select in order to isolate all of pixels with that hue. Drag the blue and red markers on the histograms until all pixels with that hue are selected.

- **Min**—Lowest pixel value included in the manual threshold range. For manual thresholds, you can adjust the blue cursor on the histogram to set the lower bound for this range.
- **Max**—Highest pixel value included in the manual threshold range. For manual thresholds, you can adjust the red cursor on the histogram to set the upper bound for this range.
- **In/Out Range (Valid for HSL, HSV, or HSI)**
 -  **In**—Hue is included in the threshold range. Threshold range: [Min, Max]
 -  **Out**—Hue is not included in the threshold range. Threshold range: [0, Min] [Max, 255]



Tip You can display the histogram of a portion of an image by drawing an ROI around the area of interest. The local histogram gives you valuable information about the threshold range you can select to keep or reject certain parts of the image.

Related Topics

[Grayscale Threshold \(Grayscale»Threshold\)](#)

[Thresholding an image](#)

Thresholding an image

You can threshold [grayscale](#) and [color](#) images.

Related Topics

[Color Threshold \(Color»Color Threshold\)](#)

[Grayscale Threshold \(Grayscale»Threshold\)](#)

Watershed Segmentation (Grayscale»Watershed Segmentation)

Performs segmentation on images using the [watershed](#) transform. Refer to the *NI Vision Concepts Manual* for information about the watershed transform.

- **Number of Zones**—Displays the total number of zones detected in the image.
- **Connectivity 4/8**—Defines which of the surrounding pixels for any given pixel constitute its neighborhood.
 - **Connectivity-8**—All adjacent pixels are considered neighbors.
 - **Connectivity-4**—Only pixels adjacent in the horizontal and vertical directions are considered neighbors.
- **Display**—Controls how Vision Assistant displays the image after watershed segmentation.
 - **Labeled Binary Output**—Displays the labeled binary image returned by the watershed algorithm.
 - **Image Source with Separation Overlay**—Overlays the watershed lines in red on top of the input image. This display is helpful to see if the zones found are correct. This is for viewing purposes only and does not change the output of the step.



Note The Display options control how the results are displayed in the Processing window when the Setup window is open. However, the output image of the step is always a labeled binary image.

Related Topics

[Segmenting an image](#)

Segmenting an image using a watershed transform



Note The watershed function works only with 8-bit and 16-bit images.

The following steps illustrate one method of segmenting objects.

1. Threshold—(**Grayscale»Threshold**) [Threshold](#) the image to isolate the objects you want to segment from the rest of the image.
2. Remove Noise—(**Binary»Advanced Morphology** or **Binary»Particle Filter**) Remove extraneous information from the binary image using various morphology operations. For example, you can fill in holes with the Advanced Morphology option [Fill holes](#) or remove noise with the [Particle Filter](#) function.
3. Create Distance Map—(**Binary»Advanced Morphology**) Use the [Danielsson](#) option to transform the binary image into a grayscale image in which the center of each object represents a local maximum in the image. If you were to look at the topographical surface of the image after applying the distance map, each object would appear as a smooth, gradual peak.
4. Apply Watershed Transform—(**Grayscale»Watershed Segmentation**) Apply the watershed transform to segment the image into local zones. A zone is determined by the watershed line that separates the influence zone of each peak.

Refer to the *NI Vision Concepts Manual* for more information about thresholding, morphology, distance transforms, or watershed transforms.

Related Topics

[Threshold \(Grayscale»Threshold\)](#)

[Morphology \(Binary»Advanced Morphology\)](#)

[Particle Filter \(Binary»Particle Filter\)](#)

Watershed Segmentation FAQs

How can I label more than 255 zones?

The watershed transform accepts 8-bit and 16-bit images. The maximum number of labels in an 8-bit image is 255. Zones over 255 are saturated at 255. The maximum number of labels in a 16-bit grayscale image is 32,766. If an 8-bit image requires more than 255 labels, cast the image to a 16-bit image before using the Watershed Segmentation step.

If 8-bit images can label up to only 255 zones, is the Number of Zones result still accurate if more than 255 zones are detected?

Watershed Segmentation returns the correct number of zones found even if the number of zones is greater than the maximum number of labels for a particular bit depth.

Can I use the output of the watershed transform to separate touching objects?

The Watershed Segmentation algorithm partitions an image based on the topographic surface of the image. The image is separated into non-overlapping segments. Each segment contains a unique particle. Complete these steps to separate touching particles by masking the segmentation lines.

1. Store a copy of the binary image in Buffer #1 with the Image Buffer step (**Image»Image Buffer**).
2. Use the Danielsson option (**Binary»Adv. Morphology»Danielsson**) to assign to each pixel a grayscale value equal to the shortest distance to the border of the object.
3. Use the Watershed Segmentation step (**Grayscale»Watershed Segmentation**) to partition the image.
4. Store the watershed image in Buffer #2 with the Image Buffer step.
5. Retrieve the thresholded image from Buffer #1 using the Image Buffer step.
6. Mask the thresholded image with the watershed image by using the Mask Buffer step (**Grayscale»Operators»Mask**).

Glossary

Numbers A B C D E F G H I J K L M N O
P Q R S T W

Numbers

1D One-dimensional.

2D Two-dimensional.

3D Three-dimensional.

3D view Displays the light intensity of an image in a three-dimensional coordinate system, where the spatial coordinates of the image form two dimensions and the light intensity forms the third dimension.

A

| | |
|----------------------|---|
| area threshold | Detects objects based on their size. |
| arithmetic operators | Multiply, divide, add, subtract, and remainder operations you can perform on images. |
| auto-median function | A function that uses dual combinations of opening and closing operations to smooth the boundaries of objects. |

B

| | |
|-------------------|---|
| binary image | An image containing objects usually represented with a pixel intensity of 1 (or 255) and the background of 0. |
| binary morphology | Functions that perform morphological operations on a binary image. |
| BMP | Bitmap. Image file format commonly used for 8-bit and color images (extension .bmp). |
| border function | Removes objects (or particles) that touch the image border in a binary image. |
| Builder file | Vision Assistant script file. Builder files are ASCII text files that list the processing functions and relevant parameters for an image processing algorithm that you created in Vision Assistant. |

C

| | |
|----------------------|---|
| caliper | A function that calculates distances, angles, circular fits, and the center of mass based on positions given by edge detection, particle analysis, centroid, and search functions. |
| circle function | Detects circular objects in a binary image. |
| class | A category representing a collection of similar samples. |
| classification | An operation that assigns samples to classes based on predefined features. |
| classification score | Degree of certainty that a sample is assigned to one class instead of other classes. |
| classifier | A function or VI that assigns a sample to a class. |
| closing | A dilation followed by an erosion. A closing fills small holes in objects and smoothes the boundaries of objects. |
| clustering | Technique where the image is sorted within a discrete number of classes corresponding to the number of phases perceived in an image. The gray values are determined and a barycenter is determined for each class. This process is repeated until a value is obtained that represents the center of mass for each phase or class. |
| color images | Images containing color information, usually encoded in the RGB form. |
| complex images | Save information obtained from the FFT of an image. The complex numbers that compose the FFT plane are encoded in 64-bit floating-point values: 32 bits for the real part and 32 bits for the imaginary part. |
| connectivity | Defines which of the surrounding pixels of a given pixel constitute its neighborhood. See also connectivity-4 and connectivity-8. |
| connectivity-4 | Connectivity where only pixels adjacent in the horizontal and vertical directions are considered neighbors. Two pixels are considered as part of a same object if they are horizontally or vertically adjacent. They are considered as part of two different objects if they are diagonally adjacent. |
| connectivity-8 | Connectivity where all adjacent pixels are considered neighbors. Two pixels are considered as part of a same object if they are horizontally, vertically, or diagonally adjacent. |
| convex function | Computes the convex regions of objects in a binary image. |
| convolution | See linear filter. |
| convolution kernel | 3×3 , 5×5 , or 7×7 matrices (or templates) used to represent the filter in the filtering process. The contents of these kernels are a discrete two-dimensional representation of the impulse response of the filter that they represent. |

D

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|------------------------|---|
| Danielsson function | Similar to the distance functions, but with more accurate results. |
| definition | The number of values a pixel can take on, which is the number of colors or shades that you can see in the image. |
| dendrite | Branches of the skeleton of an object. |
| density function | For each gray level in a linear histogram, it gives the number of pixels in the image that have the same gray level. |
| device | Plug-in data acquisition device that can contain multiple channels and conversion devices. |
| differentiation filter | Extracts the contours (edge detection) in gray level. |
| dilation | Increases the size of an object along its boundary and removes tiny holes in the object. |
| distance calibration | Determination of the physical dimensions of a pixel by defining the physical dimensions of a line in the image. |
| distance function | Assigns, to each pixel in an object, a gray-level value equal to its shortest Euclidean distance from the border of the object. |
| driver | Software that controls a specific hardware device, such as a data acquisition device. |

E

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|----------------------|---|
| edge | Defined by a sharp change (transition) in the pixel intensities in an image or along an array of pixels. |
| edge contrast | The difference between the average pixel intensity before and the average pixel intensity after the edge. |
| edge steepness | The number of pixels that corresponds to the slope or transition area of an edge. |
| entropy | Method based on a classical image analysis technique that is best suited for detecting objects present in minuscule proportions on the image. For example, this function would be suitable for default detection. |
| equalize function | See histogram equalization. |
| erosion | Reduces the size of an object along its boundary and eliminates isolated points in the image. |
| exponential function | Decreases the brightness and increases the contrast in bright regions of an image, and decreases contrast in dark regions. |

F

| | |
|-------------------|---|
| feature | A measurement from or attribute of a sample. |
| feature vector | A 1D array in which each element represents a different feature of a sample. |
| FFT | Fast Fourier Transform. A method used to compute the Fourier transform of an image. |
| Fourier spectrum | The magnitude information of the Fourier transform of an image. |
| Fourier transform | Transforms an image from the spatial domain to the frequency domain. |
| frequency filters | Counterparts of spatial filters in the frequency domain. For images, frequency information is in the form of spatial frequency. |

G

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|-----------------------------|---|
| Gaussian filter | A filter similar to the smoothing filter, but using a Gaussian kernel in the filter operation. The blurring in a Gaussian filter is more gentle than a smoothing filter. |
| grab | Acquisition technique that acquires and displays a continuous sequence of images using an image acquisition device. Use this acquisition technique when you need to focus the camera. |
| gradient convolution filter | See gradient filter. |
| gradient filter | Extracts the contours (edge detection) in gray-level values. Gradient filters include the Prewitt and Sobel filters. |
| gray level | The brightness of a pixel in an image. |
| grayscale image | An image with monochrome information. |
| grayscale morphology | Functions that perform morphological operations on a grayscale image. |

H

| | |
|---------------------------|--|
| highpass attenuation | Applies a linear attenuation to the frequencies in an image, with no attenuation at the highest frequency and full attenuation at the lowest frequency. |
| highpass FFT filter | Removes or attenuates low frequencies present in the FFT domain of an image. |
| highpass filter | Emphasizes the intensity variations in an image, detects edges (or object boundaries), and enhances fine details in an image. |
| highpass frequency filter | Attenuates or removes (truncates) low frequencies present in the frequency domain of the image. A highpass frequency filter suppresses information related to slow variations of light intensities in the spatial image. |
| highpass truncation | Removes all frequency information below a certain frequency. |
| histogram | Indicates the quantitative distribution of the pixels of an image per gray-level value. |
| histogram equalization | Transforms the gray-level values of the pixels of an image to occupy the entire range (0 to 255 in an 8-bit image) of the histogram, increasing the contrast of the image. |
| hole filling function | Fills all holes in objects that are present in a binary image. |
| HSI | Color encoding scheme in Hue, Saturation, and Intensity. |
| HSL | Color encoding scheme in Hue, Saturation, and Luminance. |
| HSV | Color encoding scheme in Hue, Saturation, and Value. |

I

| | |
|----------------------|--|
| identification score | Degree of similarity between a sample and members of the class to which the sample is assigned. |
| image | Light intensity as a function of the spatial coordinates $f(x, y)$ where x and y denote spatial coordinates and the value f at any point (x, y) is the light intensity at that point. |
| image border | A user-defined region of pixels surrounding an image. Functions that process pixels based on the value of pixel neighbors require image borders. |
| Image Browser | Vision Assistant feature that displays all of the images currently loaded. Through the Image Browser, you can select an image that you want to process by double clicking it. |
| image buffer | Memory location used to store images. |
| image file | A file containing pixel data and additional information about the image. |
| image mask | A binary image that isolates parts of a source image for further processing. A pixel in the source image is processed if its corresponding mask pixel has a non-zero value. A source pixel whose corresponding mask pixel has a value of 0 is left unchanged. |
| image palette | The gradation of colors used to display an image on screen, usually defined by a color look-up table. |
| image processing | Encompasses various processes and analysis functions that you can apply to an image. |
| image source | Original input image. If you start processing an image and want to revert back to the original image, select Source Image from the list box. When you click Source Image, the image reverts to the original image, and any processing done on the image prior to selecting Image Source is cancelled. |
| inner gradient | Finds the inner boundary of objects. |
| inspection functions | Detects specific features in an image. The features detected include edges, peaks, and rotational shifts. |
| intensity range | Defines the range of gray-level values in an object of an image. |
| intensity threshold | Characterizes an object based on the range of gray-level values in the object. If the intensity range of the object falls within the user specified range, it is considered an object; otherwise it is considered part of the background. |
| interclass variance | Classical statistic technique used in discriminating factorial analysis. This method is best suited for images in which classes are not too disproportionate. For satisfactory results, the smallest class must be at least five percent of the largest one. This method has the tendency to underestimate the class of the smallest standard deviation if the two classes have a significant variation. |
| interpolation | The technique used to find values in between known values when resampling an image or array of pixels. |

J

JPEG Joint Photographic Experts Group. Image file format for storing 8-bit and color images with lossy compression (extension .jpg).

K

kernel Structure that represents a pixel and its relationship to its neighbors. The relationship is specified by weighted coefficients of each neighbor.

L

| | |
|--------------------------|--|
| labeling | A morphology operation that identifies each object in a binary image and assigns a unique pixel value to all the pixels in an object. This process is useful for identifying the number of objects in the image and giving each object a unique pixel intensity. |
| LabVIEW | Laboratory Virtual Instrument Engineering Workbench. Program development environment based on the G programming language. LabVIEW is used commonly for test and measurement applications. |
| Laplacian filter | Extracts the contours of objects in the image by highlighting the variation of light intensity surrounding a pixel. |
| line profile | Represents the gray-level distribution along a line of pixels in an image. |
| logarithmic function | Increases the brightness and contrast in dark regions of an image, and decreases the contrast in bright regions of the image. |
| logic operators | The image operations AND, NAND, OR, XOR, NOR, difference, mask, mean, max, and min. |
| look-up table | Table containing values used to transform the gray-level values of an image. For each gray-level value in the image, the corresponding new value is obtained from the look-up table and applied to the image. |
| lowpass attenuation | Applies a linear attenuation to the frequencies in an image, with no attenuation at the lowest frequency and full attenuation at the highest frequency. |
| lowpass FFT filter | Removes or attenuates high frequencies present in the FFT domain of an image. |
| lowpass filter | Attenuates intensity variations in an image. You can use these filters to smooth an image by eliminating fine details and blurring edges. |
| lowpass frequency filter | Attenuates high frequencies present in the frequency domain of the image. A lowpass frequency filter suppresses information related to fast variations of light intensities in the spatial image. |
| lowpass truncation | Removes all frequency information above a certain frequency. |
| L-skeleton function | Uses an L-shaped structuring element in the Skeleton function. |

M

- median filter A lowpass filter that assigns to each pixel the median value of its neighbors. This filter effectively removes isolated pixels without blurring the contours of objects.
- metric Technique used in situations similar to interclass variance. For each threshold, a value is calculated that is determined by the surfaces representing the initial grayscale. The optimal threshold corresponds to the smallest value.
- moments Technique best suited for images that have poor contrast (an overexposed image is better processed than an underexposed image). The moments method is based on the hypothesis that the observed image is a blurred version of the theoretically binary original. The blurring that is produced from the acquisition process (electronic noise or slight defocalization) is treated as if the statistical moments (average and variance) were the same for both the blurred image and the original image. This function recalculates a theoretical binary image.
- M-skeleton Uses an M-shaped structuring element in the skeleton function.

N

| | |
|--------------------------------|--|
| neighbor | A pixel whose value affects the value of a nearby pixel when an image is processed. The neighbors of a pixel are usually defined by a kernel or structuring element. |
| nonlinear filter | Replaces each pixel value with a nonlinear function of its surrounding pixels. |
| nonlinear gradient filter | A highpass edge-extraction filter that favors vertical edges. |
| nonlinear Prewitt filter | A highpass edge-extraction filter that favors horizontal and vertical edges in an image. |
| nonlinear Sobel filter | A highpass edge-extraction filter that favors horizontal and vertical edges in an image. |
| Nth order filter | Filters an image using a nonlinear filter. This filter orders (or classifies) the pixel values surrounding the pixel being processed. The pixel being processed is set to the Nth pixel value, where N is the order of the filter. |
| number of planes (in an image) | The number of arrays of pixels that compose the image. A gray-level or pseudo-color image is composed of one plane, while an RGB image is composed of three planes (one for the red component, one for the blue, and one for the green). |

O

- offset The coordinate position in an image where you want to place the origin of another image. Setting an offset is useful when performing mask operations.
- opening An erosion followed by a dilation. An opening removes small objects and smooths boundaries of objects in the image.
- operators Allow masking, combination, and comparison of images. You can use arithmetic and logic operators in NI Vision.
- outer gradient Finds the outer boundary of objects.

P

| | |
|-------------------|---|
| palette | The gradation of colors used to display an image on screen, usually defined by a color look-up table. |
| particle | A connected region or grouping of pixels in an image in which all pixels have the same intensity level. You can identify particles in binary images as black objects on white backgrounds. |
| particle analysis | A series of processing operations and analysis functions that produce some information about the particles in an image. |
| pattern matching | The process of locating a grayscale template in a grayscale image. |
| picture element | An element of a digital image. Also called pixel. |
| pixel | Picture element. |
| pixel calibration | Directly calibrating the physical dimensions of a pixel in an image. |
| pixel depth | The number of bits (n) used to code the intensity of a pixel. For a given n , a pixel can take 2^n different values. For example, if n equals 8-bits, a pixel can take 256 different values ranging from 0 to 255. If n equals 16 bits, a pixel can take 65,536 different values ranging from 0 to 65,535 or 32,768 to 32,767. |
| pixel frame | Describes the neighborhood. For a square pixel frame, each pixel is surrounded by eight neighbors. The vertical and horizontal neighbors have a distance d from the pixel. Diagonal pixels have a slightly greater distance because they are farther away from the central pixel. For a hexagonal pixel frame, each pixel is surrounded by six neighbors. Each neighbor is at an equal distance from the central pixel. |
| PNG | Portable Network Graphic. Image file format for storing 8-bit, 16-bit, and color images with lossless compression (extension .png). |
| Prewitt filter | Extracts the contours (edge detection) in gray-level values using a 3×3 filter kernel. |
| Processing window | Vision Assistant feature that updates the image as you change parameters. The Processing window is located on the right side of the Vision Assistant window. |
| proper-closing | A finite combination of successive closing and opening operations that you can use to fill small holes and smooth the boundaries of objects. |
| proper-opening | A finite combination of successive opening and closing operations that you can use to remove small particles and smooth the boundaries of objects. |

Q

quantitative analysis Obtaining various measurements of objects in an image.

R

| | |
|--------------------|--|
| Reference window | Vision Assistant feature that displays the original version of the image (image source) as you manipulate it in the processing window. The Reference window appears in the upper left corner of the Vision Assistant window. |
| region of interest | An area of the image that is graphically selected from a window displaying the image. This area can be used to focus further processing. Also called ROI. |
| resolution | The number of rows and columns of pixels. An image composed of m rows and n columns has a resolution of $m \times n$. This image has n pixels along its horizontal axis and m pixels along its vertical axis. |
| Reverse function | Inverts the pixel values in an image, producing a photometric negative of the image. |
| RGB | Color image encoding using red, green, and blue colors. |
| Roberts filter | Extracts the contours (edge detection) in gray level, favoring diagonal edges. |
| ROI | Region of interest. |
| ROI tools | Collection of tools that enable you to select a region of interest from an image. These tools let you select a point or line; polygon, rectangle, and oval regions; and freehand lines and areas. |

S

| | |
|-----------------------|---|
| sample | An object in an image that you want to classify. |
| script | List of image processing and analysis functions and the parameters for each of those functions. Vision Assistant records each function and relevant parameters as you prototype the image processing application. |
| Script window | The window in which Vision Assistant displays a script. From the scripting window, you can edit or remove steps and run scripts. |
| segmentation function | Fully partitions a labeled binary image into non-overlapping segments, with each segment containing a unique object. |
| separation function | Separates objects that touch each other by narrow isthmuses. |
| sequence | Acquisition technique that acquires images according to settings that you specify in the acquisition property pages. |
| shape matching | Finds objects in an image whose shape matches the shape of the object specified by a template. The matching process is invariant to rotation and you can set it to be invariant to the scale of the objects. |
| skeleton function | Applies a succession of thinning operations to an object until its width becomes one pixel. |
| skiz function | Obtains lines in an image that separate each object from the others and are equidistant from the objects that they separate. |
| smoothing filter | Blurs an image by attenuating variations of light intensity in the neighborhood of a pixel. |
| snap | Acquisition technique that acquires and displays a single image. |
| Sobel filter | Extracts the contours (edge detection) in gray-level values using a 3×3 filter kernel. |
| spatial calibration | Assigning physical dimensions to the area of a pixel in an image. |
| Square function | See exponential function. |
| Square Root function | See logarithmic function. |
| structuring element | A binary mask used in most morphological operations. A structuring element is used to determine which neighboring pixels contribute in the operation and to what degree. |

T

- template Pattern, shape, or color that you are trying to match in an image using the Pattern Matching, Shape Matching, or Color Matching functions. A template can be a region selected from an image or it can be an entire image.
- thickening Alters the shape of objects by adding parts to the object that match the pattern specified in the structuring element.
- thinning Alters the shape of objects by eliminating parts of the object that match the pattern specified in the structuring element.
- threshold Separates objects from the background by assigning all pixels with intensities within a specified range to the object and the rest of the pixels to the background. In the resulting binary image, objects are represented with a pixel intensity of 255 and the background is set to 0.
- TIFF Tagged Image File Format. Tagged Image File Format. Image format commonly used for encoding 8-bit and color images (extension .tif).
- toolbar Collection of tools that enable you to select regions of interest, zoom in and out, and change the image palette. These tools are located in the toolbar at the top of the Vision Assistant dialog box.

W

watershed A technique used to segment an image into multiple regions.

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Particle

Use any of the following measurements or a combination of the following measurements to keep or remove particles from the image.

- **Center of Mass X and Center of Mass Y**—X- and Y-coordinates of the particle center of mass.
- **First Pixel X and First Pixel Y**—X- and Y-coordinates of the first pixel of the particle.
- **Bounding Rect (Left, Right, Top, and Bottom)**
 - X-coordinate of the leftmost point in the particle
 - Y-coordinate of highest point in the particle
 - X-coordinate of the rightmost point in the particle
 - Y-coordinate of the lowest point in the particle
- **Max Feret Diameter Start X and Max Feret Diameter Start Y**—X- and Y-coordinates of the particle center the Max Feret Diameter Start.
- **Max Feret Diameter End X and Max Feret Diameter End Y**—X- and Y-coordinates of the particle center the Max Feret Diameter End.
- **Max Horiz. Segment Length (Left, Right, and Row)**
 - X-coordinate of the leftmost pixel in the Max Horiz. Segment. Always given as a pixel measurement.
 - X-coordinate of the rightmost pixel in the Max Horiz. Segment. Always given as a pixel measurement.
 - Y-coordinate for all of the pixels in the Max Horiz. Segment. Always given as a pixel measurement.
- **Bounding Rect (Width, Height, and Diagonal)**
 - Distance between Bounding Rect Left and Bounding Rect Right
 - Distance between Bounding Rect Top and Bounding Rect Bottom
 - Distance between opposite corners of the Bounding Rect
- **Perimeter**—Length of the outer boundary of the particle. Because the boundary is comprised of discrete pixels, Vision Assistant

subsamples the boundary points to approximate a smoother, more accurate perimeter.

- **Convex Hull Perimeter**—Perimeter of the Convex Hull.
- **Hole's Perimeter**—Sum of the perimeters of each hole in the particle.
- **Max Feret Diameter**—Distance between the Max Feret Diameter Start and the Max Feret Diameter End.
- **Equivalent Ellipse (Major Axis, Minor Axis, and Minor Axis (Feret))**
 - Length of the major axis of the Equivalent Ellipse
 - Length of the minor axis of the Equivalent Ellipse
 - Length of the minor axis of the ellipse with the same area as the particle, and Major Axis equal in length to the Max Feret Diameter
- **Equivalent Rect (Long Side, Short Side, Diagonal, and Short Side (Feret))**
 - Longest side of the Equivalent Rect
 - Shortest side of the Equivalent Rect
 - Distance between opposite corners of the Equivalent Rect
 - Shortest side of the rectangle with the same area as the particle, and longest side equal in length to the Max Feret Diameter
- **Average Horiz. Segment Length**—Average length of a horizontal segment in the particle. Sum of the horizontal segments that do not superimpose any other horizontal segment. Always given as a pixel measurement.
- **Average Vert. Segment Length**—Average length of a vertical segment in the particle. Sum of the vertical segments that do not superimpose any other vertical segment. Always given as a pixel measurement.
- **Hydraulic Radius**—Particle area divided by its perimeter.
- **Waddel Disk Diameter**—Diameter of a disk with the same area as the particle.
- **Area**—Area of the particle.

- **Holes' Area**—Sum of the areas of each hole in the particle.
- **Particle & Holes' Area**—Area of a particle that completely covers the image.
- **Convex Hull Area**—Area of the Convex Hull of the particle.
- **Image Area**—Area of the image.
- **Number of Holes**—Number of holes in the particle.
Vision Assistant can detect holes inside a particle as small as one pixel.
- **Number of Horiz. Segments**—Number of horizontal segments in the particle. always given as pixel measurements.
- **Number of Vert. Segments**—Number of horizontal segments in the particle. Always given as pixel measurements.
- **Orientation**—Angle of the line passing through the particle center of mass with the lowest moment of inertia.
- **Max Feret Diameter Orientation**—Angle of the Max Feret Diameter.
- **%Area/Image Area**—Percentage of the particle's Area covering the Image Area.
- **%Area/(Particle & Holes' Area)**—Percentage of the particle's Area in relation to its Particle & Holes' Area.
- **Ratio of Equivalent Ellipse Axes**—Equivalent Ellipse Major Axis divided by Equivalent Ellipse Minor Axis.
- **Ratio of Equivalent Rect Sides**—Equivalent Rect Long Side divided by Equivalent Rect Short Side.
- **Elongation Factor**—Max Feret Diameter divided by Equivalent Rect Short Side (Feret). The more elongated the shape of a particle, the higher its elongation factor.
- **Compactness Factor**—Area divided by the product of Bounding Rect Width and Bounding Rect Height. The compactness factor belongs to the interval [0, 1]. The closer the shape of a particle is to a rectangle, the closer to 1 the compactness factor.
- **Heywood Circularity Factor**—Perimeter divided by the circumference of a circle with the same area. The closer the shape of a particle is to a disk, the closer the Heywood circularity factor to 1.

- **Type Factor**—Factor relating area to moment of inertia.
- **Angle**—Degrees of rotation counterclockwise from the x-axis. Range: [0 °, 180 °).
- **Sum...**—Moments of various orders relative to the x- and y-axes.
- **Moment of Inertia...**—Moments about the particle Center of Mass. Gives a representation of the distribution of the pixels in a particle with respect to its center of gravity. Shift invariant.
- **Norm. Moment of Inertia...**—Moment of Inertia normalized with regard to the particle Area. Shift and scale invariant.
- **Hu Moment...**—Moments derived from the Norm. Moment of Inertia measurements. Shift, scale, and rotation invariant.

Thresholding a grayscale image

1. Click **Grayscale»Threshold** or click **Threshold** in the **Grayscale** tab of the Processing Functions palette.
2. Select whether you want the function to look for bright, dark, or gray objects.
3. Select the type of threshold you want to perform.



Note You cannot adjust the threshold levels of the local and automatic thresholds. If none of the local or automatic thresholding options work for the image, select **Manual Threshold** and adjust the pointers on the histogram until all of the particles of interest are highlighted in red.

3. Click **OK** to threshold the image and add this step to the script.



Tips

- If you have trouble finding a manual threshold range that selects all of the pixels in the range, draw an ROI around the portion of the image that you want to keep. The histogram displays the intensities of the ROI only. Use the minimum and maximum values for the threshold.

Related Topics

[Threshold \(Grayscale»Threshold\)](#)

Thresholding an image

1. Click **Grayscale»Threshold** or click **Threshold** in the **Grayscale** tab of the Processing Functions palette.
2. Select the type of threshold you want to perform.



Note You cannot adjust the threshold levels of the automatic thresholds. If none of the automatic thresholds work for the image, select **Manual Threshold** and adjust the pointers on the histogram until all of the particles of interest are highlighted in red.

3. Click **OK** to threshold the image and add this step to the script.



Tips

- If you have trouble finding a threshold range that selects all of the pixels in the range, draw an ROI around the portion of the image that you want to keep. The histogram displays the intensities of the ROI only. Use the minimum and maximum values for the threshold.
- You can display the histogram in either linear or logarithmic form.

Related Topics

[Grayscale Threshold \(Grayscale»Threshold\)](#)

Thresholding an image

1. Click **Color»Color Threshold** or click **Color Threshold** in the **Color** tab of the Processing Functions palette.
2. Select the color model (RGB, HSL, HSV, or HSI) you want to use to process the image.
3. Adjust the blue and red lines on the **Red (Hue)**, **Green (Saturation)**, and **Blue (Luminance/Value/Intensity)** histograms until all of the particles of interest are highlighted with the color specified in **Preview Color**.
4. Click **OK** to threshold the image and add this step to the script.



Tips

- If you have trouble finding a threshold range that selects all of the pixels in the range, draw an ROI around the portion of the image that you want to keep. The histogram displays the intensities of the ROI only. Use the minimum and maximum values for the threshold.
- You can display the histogram in either linear or logarithmic form.

Related Topics

[Color Threshold \(Color»Color Threshold\)](#)

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