Activating Your Software

How do I activate my software?

Use the NI Activation Wizard to obtain an activation code for your software. You can launch the NI Activation Wizard two ways:

- Launch the product and choose to activate your software from the list of options presented.
- Launch NI License Manager by selecting Start»All Programs»National Instruments»NI License Manager. Click the Activate button in the toolbar.
- Note You do not need to activate your software if it is managed by NI Volume License Manager as a part of a Volume License Agreement.

What is activation?

Activation is the process of obtaining an activation code to enable your software to run on your computer. An *activation code* is an alphanumeric string that verifies the software, version, and computer ID to enable features on your computer. Activation codes are unique and are valid on only one computer.

What is the NI Activation Wizard?

The NI Activation Wizard is a part of NI License Manager that steps you through the process of enabling software to run on your machine.

What information do I need to activate?

You need your product serial number, user name, and organization. The NI Activation Wizard determines the rest of the information. Certain activation methods may require additional information for delivery. This information is used only to activate your product. Complete disclosure of National Instruments licensing privacy policy is available at ni.com/activate/privacy. If you optionally choose to register your software, your information is protected under the National Instruments privacy policy, available at ni.com/privacy.

How do I find my product serial number?

You can find your serial number on the proof-of-ownership and registration card that you received with your product, as shown in the

following example.



What is a Computer ID?

The computer ID contains unique information about your computer. National Instruments requires this information to enable your software. You can find your computer ID through the NI Activation Wizard or by using NI License Manager, as follows:

- 1. Launch NI License Manager by selecting **Start**»All **Programs**»National Instruments»NI License Manager.
- 2. Click the **Display Computer Information** button in the toolbar.

For more information about product activation and licensing refer to ni.com/activate.

Related Documentation

Most NI Vision manuals also are available as PDFs. You must have Adobe Reader with Search and Accessibility 5.0.5 or later installed to view the PDFs. Refer to the <u>Adobe Systems Incorporated Web site</u> at www.adobe.com to download Adobe Reader. Refer to the <u>National</u> <u>Instruments Product Manuals Library</u> at ni.com/manuals for updated documentation resources.

To access the NI Vision Assistant documentation, select **Start»All Programs»National Instruments»Vision Assistant**.

- *NI Vision Assistant Tutorial*—Describes the NI Vision Assistant software interface and guides you through creating example image processing and machine vision applications.
- *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 Development Module Release Notes—Contains information about new functionality, minimum system requirements, installation instructions, and descriptions of the documentation for the following: NI Vision for LabVIEW, NI Vision for LabWindows/CVI, NI Vision for Visual Basic, and NI Vision Assistant.
- Application Notes—Contain information about advanced NI Vision concepts and applications. Application Notes are located on the <u>National Instruments Web site</u> at ni.com/appnotes.nsf.

Getting Help in Vision Assistant

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

- Click the **Context Help** button [?] on the Vision Assistant toolbar to launch the Context Help window. The content of the Context Help window automatically updates to reflect what is currently selected in Vision Assistant. 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.
- Click **HelpSolution Wizard** in the Vision Assistant menu to launch the Vision Assistant Solution Wizard and view typical uses of NI Vision in imaging and machine vision applications.
- Click Start»All **Programs»National Instruments»Vision Assistant»Vision Assis Tutorial** to launch the *NI Vision Assistant Tutorial*. This manual is designed to teach you the fundamental features of Vision Assistant through interactive discussions and examples, including particle analysis and part gauging examples.
- Click Start»All

Programs»National Instruments»Vision Assistant»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 Vision Development Module library.

- Refer to the NI Vision Acquisition Software Release Notes for more information about configuring NI-IMAQ driver software, NI image acquisition devices, and cameras using Measurement & Automation Explorer (MAX).
- 💡 🛛 Tips
 - The National Instruments Web site provides information about NI Vision hardware and software. Visit <u>NI Machine Vision</u> at ni.com/vision.
 - Visit the <u>NI Developer Zone</u> at ni.com/zone. NI Developer Zone is an essential resource for building measurement and automation systems. The NI Developer Zone allows easy

access to the latest example programs, system configurators, tutorials, technical news, as well as a community of developers ready to share their own techniques.

 Several example scripts are installed with Vision Assistant. You can run these scripts to learn more about Vision Assistant scripting capabilities. You also can customize these scripts for your own applications. By default, the scripts are installed at <Vision Assistant>\Examples, where <Vision Assistant> is the location to which Vision Assistant is installed.

Using Help

<u>Conventions</u> <u>Navigating Help</u> <u>Searching Help</u> <u>Printing Help File Topics</u>

Conventions

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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>.
- [] Square brackets enclose optional items—for example, [response].
- 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.
- This icon denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash.
- **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.
- **dark red** Text in this color denotes a caution.
- 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.

Acquisition Mode

Use the Acquisition mode to acquire one or more images for processing. You can acquire images from an image acquisition device or simulate an acquisition. Refer to <u>Image Acquisition in Vision Assistant</u> for information about hardware requirements and image acquisition methods.



- **Reference Window**—Displays a thumbnail view of an acquired image.
- Main Window—Displays the current image.
- Navigation Buttons—Switches between Vision Assistant modes.
- Acquisition Palette—Lists the types of image acquisition you can perform.

Browsing Mode

When you <u>acquire</u> or <u>open</u> images in Vision Assistant, the images are loaded into the Image Browser. Use the Browsing mode to view images in either thumbnail view or in full-size view. Use the Image Browser to select the image that you want to process. Click an image in the Image Browser to view information about the selected image, such as image size, location, and type. The images in the Image Browser can also be accessed from the Reference Window in Processing mode.

Selecting an Image

To begin processing an image, click the image and click **Process Images**. You can also select an image to process by double-clicking the image in the Image Browser.

If an image is not selected when you click **Process Images**, the last acquired image is displayed in the Main window. If you select more than one image and click **Process Images**, the last image selected opens in the Main window.

For more information about the Image Browser, refer to <u>Adding New</u> <u>Images to the Image Browser</u>, <u>Removing Images from the Image</u> <u>Browser</u>, and <u>Image Browser Controls</u>.



Processing Mode

After acquiring or opening an image in Vision Assistant, you can apply processing functions to the image to develop an image processing algorithm, known in Vision Assistant as a <u>script</u>. The image in the Processing window updates as you apply different processing functions. Continuous updating allows you to immediately view the result of a processing function.

The Processing Functions palette displays the image processing functions available to develop processing algorithms. Each function on the Processing Functions palette has a setup window where you set parameters for the function.

The Reference window displays a thumbnail view of the original image.

The Script window displays the image processing steps and the settings for each step in a processing algorithm. You can run scripts on a single image or on a series of images. You also can modify and save scripts for use in other applications.



Vision Assistant Toolbar

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

Launch the Vision Assistant context help window.

Open image.



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Save image.



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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.

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.

Freehand Line Tool—Click and drag to select a region. Release the mouse button when you are finished. Hold down the <Shift> key while you click and drag to draw straight lines.



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 Region 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 (origin pixel –

tolerance / origin pixel + tolerance) become part of the region.

Image Acquisition in Vision Assistant

To start acquiring images, select **File**»**Acquire Image** or click **Acquire Images**. You can acquire live images in Vision Assistant with various National Instruments Smart Cameras, digital and analog frame grabbers, DCAM-compliant IEEE 1394 cameras, and Gigabit Ethernet (GigE) Vision cameras. For information about driver software, refer to the *NI Vision Acquisition Software Release Notes*.

If the computer does not have an image acquisition device, you can simulate a live acquisition with the <u>Simulate Acquisition</u> function. You can interact with the simulated acquisition as you would with a live acquisition.

Vision Assistant offers three types of acquisitions: snap, grab, and sequence.

- A <u>snap</u> acquires and displays a single image.
- A <u>grab</u> acquires and displays images in a continuous mode at maximum rate, which is useful when you need to focus the camera.
- A <u>sequence</u> acquires images according to settings that you specify in the **Sequence** tab of the Acquisition Interface window and sends the images to the Image Browser.

Related Topics

Acquiring a sequence of images

Acquiring images in color

Grabbing an image (continuous image acquisition)

Snapping an image (single image acquisition)

Acquire Images

- 1. Select the NI image acquisition device connected to the camera to acquire an image.
- 2. Click the **Trigger** tab.
- 3. Enable the **Triggered Acquisition** control if you want to start the image capture with a trigger.
 - Note The trigger signal must be connected to a trigger line of the NI image acquisition device.
 - **Caution** The trigger input lines of NI image acquisition devices expect TTL signals and are not isolated. Do not provide anything other than TTL signals on these lines. Doing so could permanently damage the NI image acquisition device.
- 4. Select the trigger line to which the trigger signal is connected.
- 5. Select the trigger polarity. Select **Rising Edge** if you want to start the acquisition of a new image on the rising edge of the trigger signal. Select **Falling Edge** if you want to start the acquisition of a new image on the falling edge of the trigger signal.
- 6. Enter a timeout value.
- 7. Click the <u>Acquire Single Image</u>, <u>Acquire Continuous Images</u>, or <u>Sequence Acquisition</u> button.
- 8. Click **Close** to exit the Setup window.

Related Topic

Acquire images in color

Acquire Images in Color

- 1. Click **File**»Acquire Image. Vision Assistant displays the Acquisition window.
- 2. Click the appropriate acquisition step. The Devices window displays all NI image acquisition devices and channels or ports available for the computer.
- 3. Select an image acquisition device in the Parameter window.
 - Notes
 - You must have an NI PCI/PXI-1411, NI PCI/PXI-1422, NI PCI-1424, NI PCI/PXI-1428, or NI PCIe-1430 device installed to acquire color images. The NI PCI/PXI-1422 and NI PCI-1424 must be attached to a color digital camera to acquire color images.
 - Refer to the *NI Vision Acquisition Software Release Notes* for information about configuring the NI image acquisition device.
- 4. Click the <u>Acquire Single Image</u> button, <u>Acquire Continuous Image</u> button, or <u>Sequence Acquisition</u> button.
- 5. Process the images as you would any other image in Vision Assistant.

Related Topic

Acquire images

Acquire Image Controls

- Acquire Single Image—Acquires and displays a single image with the selected National Instruments image acquisition device. When you click this button, the step acquires and displays the next image provided by the camera. If you enabled the **Triggered** Acquisition control in the **Trigger** tab, the step waits for the next trigger signal to acquire and display an image.
- Acquire Continuous Images—Acquires and displays images in continuous mode at maximum frame rate with the selected NI image acquisition device. When you click this button, the step starts the continuous acquisition and display of images. If you enabled the **Triggered Acquisition** control in the **Trigger** tab, the step waits for the next trigger signal to acquire and display a new image for each iteration. Click the button a second time to stop the continuous image acquisition. If you enabled the **Triggered Acquisition** control in the **Trigger** tab, the step waits for a last trigger or timeout before stopping the acquisition.
- Sequence Acquisition—Acquires a sequence of images. You can choose to trigger the start of a sequence or to trigger each image of the sequence.
- Store Acquired Image in Browser—Sends the last acquired image to the Image Browser.

Main Tab

• **Devices**—List of available NI image acquisition devices and channels or ports you can use to acquire an image.

Trigger Tab

- **Triggered Acquisition**—When enabled, you can synchronize an image acquisition with events external to the computer, such as receiving a pulse from a sensor that indicates the position of an item on an assembly line. The trigger signal must be connected to a trigger input of the image acquisition device. The trigger input lines of NI image acquisition devices expect TTL signals and are not isolated.
 - **Trigger Line**—Specifies which external trigger line receives the incoming trigger signal.
 - **Polarity**—Specifies if you start the acquisition of a new image on the rising or falling edge of the trigger signal.
 - **Timeout (ms)**—Amount of time to wait for the trigger signal before returning a timeout error.

Acquire Image FAQs

What types of images does Vision Assistant support?

Vision Assistant supports the following image types: 8-bit, 16-bit, float, RGB, and HSL.

Can I wait for a trigger indefinitely?

No, the maximum amount of time you can wait for a trigger before timing out is 60,000 ms (60 seconds).

Which triggers can I use for my NI image acquisition device?

The PCI/PXI-1407 and PCI/PXI-1411 can use only external trigger 0. All other NI image acquisition devices can use all the trigger lines.

What are the voltage limits of the trigger signal?

The voltage limits are 0–5 V TTL.

What should I do if my device does not appear in the Devices list?

Save your work in Vision Assistant. Close Vision Assistant and open MAX. Refer to the *Measurement & Automation Explorer Help for NI-IMAQ* for troubleshooting tips. You can access the *Measurement & Automation Explorer Help for NI-IMAQ* in MAX by clicking **Help»Help Topics»NI-IMAQ**.

Acquire Images with an IEEE 1394 or GigE Camera

Main Tab

- 1. In the **Target** control, select the computer you want to use to acquire images.
- 2. In the **Devices** list, select the device you want to use to acquire an image.
- 3. For IEEE 1394 cameras, select the **IEEE 1394 Video Mode** you want to use.

Attributes Tab

- 5. Select and configure each camera feature you want to use for the acquisition.
- 6. Click the <u>Acquire Single Image</u>, <u>Acquire Continuous Images</u>, or <u>Sequence Acquisition</u> button.
- 7. Click **Close** to exit the Setup window.

Acquire Image (IEEE 1394 or GigE) Controls

- Acquire Single Image—Acquires and displays a single image from an IEEE 1394 or Gigabit Ethernet (GigE) camera. When you click this button, the step acquires and displays the next image provided by the camera. If the camera is in a triggered mode, the step waits for the next trigger signal to acquire and display an image.
- Acquire Continuous Images—Performs a continuous acquisition, or a triggered grab if the camera is in a triggered mode, and displays the image. When you click this button, the step starts the continuous acquisition and display of images. If the camera is in a triggered mode, the step waits for the next trigger signal to acquire and display a new image for each iteration. Click this button a second time to stop the continuous image acquisition.
- Refresh List of Devices—Refreshes the Devices list on the Main tab.
- Sequence Acquisition—Acquires a sequence of images. You can choose to trigger the start of a sequence or to trigger each image of the sequence.
- Store Acquired Image in Browser—Sends the image to the Image Browser.

Main Tab

- Target—Computer you want to use to acquire images.
 - **This Computer**—Selects the computer you are currently using.
 - Select Network Target—Launches the Select Target dialog box.
 - **IP Address**—IP address of the computer you want to use to acquire images.
 - **Password**—Network password for the computer you selected in **IP Address**.
- **Devices**—List of image acquisition devices installed in the computer you selected in **Target** and associated with the NI-IMAQdx driver software. Use Measurement & Automation Explorer (MAX) to associate the camera with the NI-IMAQdx driver software if the camera does not appear in the list.
- IEEE 1394 Video Mode—List of video modes available for the IEEE 1394 camera currently selected in **Devices**.

Attributes Tab

- Attribute—List of the attributes for the selected camera.
- Attribute Help—Information about the selected attribute returned by the camera.
- Value—Specifies the value for the currently selected attribute.
- **Show All Attributes**—Displays all of the attributes available on the selected camera, including attributes that cannot be configured.
- **Show Attribute Help**—Displays information about the selected attribute returned by the camera.
- **Reset All**—Resets all of the attributes to the default values configured in MAX.

Acquire Image (IEEE 1394 or GigE) FAQs

In the Acquire Images tab, why is the Acquire Image (IEEE 1394 or GigE) icon disabled?

The icon may be disabled for several reasons. Verify that the correct version of the NI-IMAQdx driver software is installed. If necessary, install the driver software. If the icon is still disabled after verifying that the correct driver is installed, refer to the *Measurement & Automation Explorer Help for NI-IMAQdx* for troubleshooting tips. You can access the *Measurement & Automation Explorer Help for NI-IMAQdx* in MAX by clicking **Help»Help Topics»NI-IMAQdx**.

My camera appears in Measurement & Automation Explorer (MAX) but does not appear in the Devices list. How can I get the name of my camera to appear in the Devices list?

Make sure that the camera is associated with the NI-IMAQdx driver in MAX. If the camera is listed under **Legacy NI-IMAQ IEEE 1394 Devices**, right-click the camera and select **Driver»NI-IMAQdx IIDC Digital Camera**. Refer to the *Measurement & Automation Explorer Help for NI-IMAQdx* for troubleshooting tips. You can access the *Measurement & Automation Explorer Help for NI-IMAQdx* in MAX by clicking **Help»Help Topics»NI-IMAQdx**.

I cannot acquire images when I press the Acquire Image or Continuous Acquisition buttons.

Close Vision Assistant. Open MAX, and verify the camera appears correctly in the Devices and Interfaces branch of the Configuration tree. Refer to the *Measurement & Automation Explorer Help for NI-IMAQdx* for troubleshooting tips. You can access the *Measurement & Automation Explorer Help for NI-IMAQdx* in MAX by clicking **Help*Help Topics*NI-IMAQdx**.

Why does my 16-bit image appear incorrectly?

Complete the following steps to adjust the 16-bit pixel representation parameters and correct the image:

- In the property page for the Acquire Image (IEEE 1394 or GigE) step, on the Main tab, select the camera from the Devices list.
- 2. Click the **Attributes** tab.
- 3. Select the **Show All Attributes** checkbox to list all of the attributes for the camera.
- 4. Adjust the values for the **BitsPerPixel**, **ShiftPixelBits**, and **SwapPixelBytes** attributes to correct the image.
- 5. Click **OK** to save the configuration settings.



Note Some image processing algorithms do not support 16-bit images.

Why do some attributes not have an effect on the image?

Even though an attribute is writable, the camera may be in a mode that ignores the attribute you are trying to set. For example, if the camera is in an 8-bit mode and you set the BitsPerPixel or ShiftPixelBits attribute, the image will not be affected because those attributes only apply to 16-bit images.

Why are no triggering modes listed in the Attribute tree?

Not all cameras support triggering. Only attributes supported by the camera are listed in the Attribute tree.

How to Acquire Images with a USB Device

- 1. In **Devices**, select the USB device you want to use to acquire the image.
- 2. Click the <u>Acquire Single Image</u>, <u>Acquire Continuous Images</u>, or <u>Sequence Acquisition</u> button.
- 3. Click **Close** to exit the Setup window.

Acquire Image (USB) Controls

- Acquire Single Image—Acquires and displays a single image from a USB device. When you click this button, the step acquires and displays the next image provided by the camera.
- Acquire Continuous Images—Performs a continuous acquisition and displays the image. When you click this button, the step starts the continuous acquisition and display of images. Click the button a second time to stop the continuous image acquisition.
- Sequence Acquisition—Acquires a sequence of images. You can choose to trigger the start of a sequence or to trigger each image of the sequence.
- Store Acquired Image in Browser—Sends the image to the image browser.

Main Tab

- **Devices**—List of USB devices you can use to acquire an image.
- Video Settings—Manufacturer video settings property page for the selected device.
- **Image Settings**—Manufacturer image settings property page for the selected device.

Acquire Image (USB) FAQs

What types of images does Vision Assistant support?

Vision Assistant supports the following image types: 8-bit, 16-bit, float, RGB, and HSL.

Why is my device not displayed in the device list?

When the step is opened, all USB-compliant cameras are found. Your camera may not have been plugged in or working when the step was opened, or your device may not be USB-compliant. Try opening the step again with the camera powered and working correctly if it is a USB-compliant camera.

Why is my device unavailable?

When you click on a device, it is initialized. If there are errors during initialization, the device name is grayed out in **Devices**, which indicates that the device is unavailable.

Why do the Video and Image settings property pages not work correctly?

These property pages are provided by the manufacturer. Report any problems with them to the manufacturer of the camera.

How to Acquire an Image with an NI 17xx Smart Camera

Main Tab

1. In the **Target** drop-down listbox, choose **Select Network Target** or select a configured smart camera to acquire images from.

Trigger Tab

- 1. Select **Triggered Acquisition** if you want to start the image capture with a trigger.
 - Note The trigger signal must be connected to the trigger line of the NI 17xx. Refer to the *NI 17xx User Manual* for information about connecting signals to the NI 17xx.
- 2. Select the trigger polarity. Select **Rising Edge** if you want to start the acquisition of a new image on the rising edge of the trigger signal. Select **Falling Edge** if you want to start the acquisition of a new image on the falling edge of the trigger signal.
- 3. Enter a **Timeout** value. If a trigger signal is not received within the timeout period, the step fails.
- 4. Select the **Acquisition Mode** you want to use for the acquisition.

Lighting Tab

1. If you want to use the internal Direct Drive lighting controller, enable the **Enable Direct Drive** control and <u>select the light</u> connected to the smart camera.

If you want to use an external lighting controller with the NI 17xx, use the **5 V TTL Strobe** or **24 V Strobe** control, depending on the voltage your lighting controller requires, to generate strobe signals for the lighting controller.

Compression Tab

1. Select the level of compression to apply to images.

Acquire Image (Smart Camera) Controls

The following controls are available on all tabs.

- Acquire Single Image—Acquires and displays a single image from the NI 17xx smart camera. When you click this button, the step acquires and displays the next image provided by the camera. If the camera is in a triggered mode, the step waits for the next trigger signal to acquire and display an image.
- Acquire Continuous Images—Performs a continuous acquisition, or a triggered grab if the camera is in a triggered mode, and displays the image. When you click this button, the step starts the continuous acquisition and display of images. If the camera is in a triggered mode, the step waits for the next trigger signal to acquire and display a new image for each iteration. Click this button a second time to stop the continuous image acquisition.
- Store Acquired Image in Browser—Sends the last acquired image to the Image Browser.

Main Tab

The following controls are available on the Main tab.

- Target—Smart camera you want to use to acquire images.
- **Exposure Time**—Time during which the camera sensor is exposed to light. **Exposure Time** can be adjusted in 31.2µs increments.
- **Gain**—Adjusts the gain of an image.
- Partial Scan—Specifies the scanning mode of the smart camera.
 - Full—Reads the full sensor.
 - Horizontal Middle Half—Reads the middle half of the sensor.
 - Horizontal Quarter Half—Reads the middle quarter of the sensor.
- **Binning**—Specifies the binning mode of the smart camera.
 - **Off**—Pixels are not combined.
 - 1×2 —Vertical pixels are combined.
- Max Frame Rate—Displays the maximum rate of frames per second.

Trigger Tab

The following controls are available on the Trigger tab.

- **Triggered Acquisition**—When enabled, you can synchronize an image acquisition with events external to the smart camera, such as receiving a pulse from a detector that indicates the position of an item on an assembly line. The trigger signal must be connected to the trigger input of the smart camera.
- **Trigger Polarity**—Specifies if you reset the camera and start the acquisition of a new image on the rising or falling edge of the trigger signal.
- **Exposure Delay**—Specifies the amount of time to delay the exposure of the smart camera sensor after receiving a trigger signal.
- Delay Unit—Specifies the units for Exposure Delay.



Note The **Encoder Counts** option is only available for smart cameras that support quadrature encoders.

• **Timeout**—Specifies the amount of time, in milliseconds, to wait for the trigger signal before returning a timeout error.

Lighting Tab

The following controls are available on the Lighting tab.

- **Configure Light**—Launches the <u>Configure Light</u> dialog box. Use the controls in the dialog box to configure your light.
- Enable Direct Drive Lighting—When enabled, this control allows you to use the smart camera internal lighting controller. Direct Drive lighting is not available on all NI Smart Cameras. Refer to the *NI 17xx Smart Camera User Manual* for information about the Direct Drive.
- **Direct Drive Lighting Mode**—Specifies the operation mode for the Direct Drive lighting controller. The following values are valid:
 - **Continuous**—Continuously powers the connected light.
 - **Strobe**—Drives the connected light only when the smart camera sensor is exposed. **Strobe** mode allows you to temporarily overdrive the light.
- **Desired Current Level**—Specifies the amount of current, in milliamperes, to use to drive the light. If the specified current is greater than the maximum current level for the connected light, the actual current level is lowered to protect the light.
- **5 V TTL Strobe**—When enabled, the NI 17xx generates a 5 V TTL strobe signal for use with an external lighting controller.
- **24 V Strobe**—When enabled, the NI 17xx generates a 24 V strobe signal for use with an external lighting controller.
- **Polarity**—Specifies whether the strobe pulse is high or low while the smart camera is acquiring. In the rising mode, the strobe pulse is high when the camera is acquiring. In the falling mode, the strobe pulse is low when the camera is acquiring.

Compression Tab

The following controls are available on the Compression tab.

- **Compress Image**—Compresses the acquired image according to the Image Quality setting you specify.
- **Image Quality**—Indicates the quality of the compressed image. 0 indicates the image is highly compressed and is lower quality. 1000 indicates the image is not compressed.

Acquire Image (Smart Camera) FAQs

How can I prevent my acquisition step from timing out?

The **Acquire Image (Smart Camera)** step returns a timeout error if the step is configured for a triggered acquisition and a trigger is not received before the specified **Timeout** period expires.

How to Configure Remote Targets

Remote targets are field programmable devices that you add to a subnet and run remotely. You configure a remote target from a host machine on the same subnet, defining settings such as the target name and description, network settings, and software revisions. Refer to *Getting Started with the NI 17xx Smart Camera* for information about configuring the NI 17xx.

If the remote target you want to select is on a different subnet than the development computer, it may not appear in the list of available targets. Click **Add Target**, enter the IP address of the remote target you want to configure, and click **OK** to add the target to the table.

Acquire Images on a Remote Target

- 1. In **Target**, select the computer you want to use to acquire images.
- 2. Select the device you want to use to acquire the image.
- 3. Click the **Parameters** tab.
- 4. If you want to compress the acquired images, select **Compress Images** and set the **Image Quality**.
- 5. Click Acquire Single Image or click Acquire Continuous Images.
- 6. Click **Close** to exit the Setup window.

Acquire Image (RT) Controls

- Acquire Single Image—Acquires and displays a single image from a remote NI image acquisition device. When you click this button, the step acquires and displays the next image provided by the camera.
- Acquire Continuous Images—Performs a continuous acquisition and displays the image. When you click this button, the step starts the continuous acquisition and display of images. Click the button a second time to stop the continuous image acquisition.
- Store Acquired Image in Browser—Sends the image to the Image Browser.

Main Tab

- Target—Computer you want to use to acquire images.
 - **This Computer**—Selects the computer you are currently using.
 - Select Network Target—Launches the Select Target dialog box.
 - **IP Address**—IP address of the computer you want to use to acquire images.
 - **Password**—Network password for the computer you selected in **IP Address**.
- **Devices**—List of image acquisition devices installed in the computer you selected in **Target**.

Parameters Tab

- **Compress Image**—Compresses the acquired image according to the **Image Quality** setting you specify.
- **Image Quality**—Indicates the quality of the compressed image. 0 indicates the image is highly compressed and is lower quality. 1000 indicates the image is lightly compressed and is higher quality.

Related Topics

How to Acquire Images on a Remote Target

Acquire Image (RT) FAQs

Currently, there are no FAQs associated with this processing function.

How to Simulate an Image Acquisition

- 1. Click File»Acquire Image or click Acquire Images.
- 2. Click **Simulate Acquisition** in the Acquisition functions list.
- 3. Click the Browse button to select a path to a directory of images, and click Select Cur Dir.
- 4. Click the <u>Acquire Single Image</u>, <u>Acquire Continuous Images</u>, or <u>Sequence Acquisition</u> button.
- 5. Click **Close** to exit the Setup window.

Simulate Acquisition Controls

- Acquire Single Image—Acquires and displays a single image. When you click this button, the step acquires and displays the next image in the sequence of images.
- Acquire Continuous Images—Acquires and displays images in continuous mode at a maximum frame rate from the sequence of images. When you click this button, the step starts the continuous acquisition and display of images. Click the button a second time to stop the continuous image acquisition.
- E Sequence Acquisition—Acquires a sequence of images.
- Store Acquired Image in Browser—Sends the last acquired image to the Image Browser.
- **Path**—Location of the currently specified image.
- Browse—When clicked, this button launches a dialog box from which you can select an image to open.

Simulate Acquisition FAQs

Which image file formats are supported?

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

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

Vision Assistant does not have an image size limit.

Open Images in Vision Assistant

- 1. Click **File**»**Open Image** or click **Gen Image**.
- 2. From the **Look In** list, select the drive on which the image is located.
- 3. Browse to the image and click **OK**. Vision Assistant loads the image file into the Image Browser.
- 4. Double-click the image to start processing it.
- Tip You can select all files in a folder by enabling the Select all files option, or you can select multiple files by pressing the <Shift> key while clicking filenames. When you select an image from the list, the Preview Image window displays the image, file type, image size, and image type. If you have selected a collection of images, the Preview window displays all images in a sequence. To view the sequence at a different rate, adjust the slide to the right of the Preview Image window.

Related Topics

Adding a processed image to the Image Browser Browsing images in the Image Browser Magnifying an image Printing an image Removing an image from the Image Browser Saving an image

Open AVI Files in Vision Assistant

- 1. Click **File**»**Open AVI File**. Audio Video Interleaved (AVI) files are movie files that include a collection of images.
- 2. From the **Look In** list, select the drive on which the AVI file is located.
- 3. Browse to the file and click **OK**. Vision Assistant loads the AVI file into the Image Browser.
 - **Tip** When you select a file from the list, the Preview Image window plays the AVI movie file. To view the sequence in a continuous play mode, enable the **Continuous Play** option. To view individual images of the AVI file, disable the **Continuous Play** option and adjust the slide below the Preview Image window. The **Frame** # indicator displays the index of the image in the Preview Image window. You can select all images by clicking the **All Images** radio button in the Images Selection section of the window, or you can enter a range of frames to select by entering values in the **From**, **To**, and **Step** controls.
- 4. Double-click the image to begin processing it.

Related Topics

Adding a processed image to the Image Browser

Browsing images in the Image Browser

Magnifying an image

Printing an image

Removing an image from the Image Browser

Saving an image

Add New Images to the Image Browser

You can add images to the Image Browser when you are processing images or when you are browsing images.

Add New Images to the Image Browser in Processing Mode

When you <u>open an image from a file</u> or <u>acquire an image</u>, you can send the image to the Image Browser by clicking **Store Image in Browser** in the Reference Window.



Note When you open an image file and there are already images in the Image Browser, Vision Assistant prompts you to remove the existing images from the Image Browser. Click No to retain the existing images and add the new image to the Image Browser. Click Yes to remove the existing images from the Existing images from the Image Browser.
Click Yes to remove the existing images from the Image Browser before adding the new image.

Add New Images to the Image Browser in Browsing Mode

When you are browsing images in the Image Browser, click **Den Image** or select **File»Open Image** to open new images in the Image Browser.



Note When you open an image file and there are already images in the Image Browser, Vision Assistant prompts you to remove the existing images from the Image Browser. Click No to retain the existing images and add the new image to the Image Browser. Click Yes to remove the existing images from the Existing images from the Image Browser.
Click Yes to remove the existing images from the Image Browser before adding the new image.

Browse and Remove Images in the Image Browser

The Image Browser displays thumbnail images in groups of 20. If there are more than 20 images open in the Image Browser, use the <u>image</u> <u>browser controls</u> to navigate the images. When you are viewing images in thumbnail view, you can begin processing an image by selecting the image and clicking **Process Images** or by double-clicking the image.

You can view the thumbnail images in full size by clicking the **Fall Thumbnail/Full-Size View** toggle button at the bottom of the Image Browser. When you are viewing the image in full-size view, use the <u>image</u> <u>browser controls</u> to navigate the images. You can use these buttons to scan the images in reverse or forward order and view the images continuously. Vision Assistant displays the current location, image size and type, and the file type below the image.

Remove Images from the Image Browser

You can remove images from the Image Browser in both the thumbnail and full-size views.



• If you click Close Selected Image while in thumbnail view without selecting an image, Vision Assistant prompts you to close all images in the Image Browser.

• If you remove images that you acquired and sent to the Image Browser, the images are deleted from memory and you cannot retrieve them.

To remove an image from the Image Browser in thumbnail view, select the image and click **Close Selected Image**. To remove multiple images from the Image Browser, click each image that you want to close, and then click **Close Selected Image**.

To remove an image from the Image Browser in full-size view, click **Close Selected Image** while the image is visible.

Note Removing an image from the Image Browser does not delete the image from disk.

Browse Images in the Reference Window

While you are processing an image, you can use the Reference Window controls to browse the images that are open in the Image Browser.

- **First Image**—Navigates to the first image stored in the Image Browser.
- Previous Image—Navigates to the previous image stored in the Image Browser.
- Next Image—Navigates to the next image stored in the Image Browser.
- **Last Image**—Navigates to the last image stored in the Image Browser.
- **Store Image in Browser**—Stores the image in the Image Browser. After processing an image, you can store the image in the Image Browser with this control.
- Sends the image in the Reference Window to the main window. The main window is where you apply processing functions to an image.

Access Images from the Reference Window

- 1. Use the <u>Reference Window controls</u> to navigate the images in the Image Browser and select one to process.
- 2. Click the Make Image Active button to process the image shown in the Reference Window.
- Tip You can send the image you are currently processing to the Image Browser to keep a copy of the image resulting from a process by clicking <a>Store Image in Browser in the Reference Window.

Add Processed Images to the Image Browser

You can keep a copy of the image you are currently processing by sending a copy to the Image Browser. Click Store Image in Browser to send the image to the Image Browser.

Related Topics

Browsing images in the Image Browser Magnifying an image Opening images in Vision Assistant Printing an image Removing an image from the Image Browser Saving an image

Save Images

You can save one or several images you acquired and processed to separate image files, or you can create an AVI file containing a sequence of images.

- 1. Click File»Save Image.
- 2. Browse to the location to which you want to save the file and type the filename for the image.
- 3. If you are saving a calibrated image and want to save the calibration information with the image, select **Save Image Calibration**.
- 4. Select the **File Format** for the image.
 - If you have calibrated the image and enable the **Save Image Calibration** checkbox, only the **PNG - Portable Network** format is available in the **File Format** list.
 - If you select **AVI AVI Movie File** from the **File Format** list, select a filter and a frame rate for the movie.
 - If you select **JP2 JPEG 2000** File Format from the File Format list, enable the **Lossless** checkbox if you want lossless compression, and specify a compression ratio.
- 5. Click Save.
- Note When you save binary images, select **Expand Dynamic of Binary Images** to view the image pixels without using a binary palette.

💡 🛛 Tips

- You can save a collection of images using the **All Images** or **From**, **To**, **Step** options.
 - **All Images** saves each image in the Image Browser with the specified filename and a number describing its position in the Image Browser.
 - The From, To, Step option saves images starting with the From parameter and ending with the To parameter. Step specifies if you want to repetitively skip images in the Image Browser. For example, if you set From=2, To=10, and Step=2, Vision Assistant saves the second, fourth, sixth, eighth, and tenth

images from the Image Browser.

Related Topics

Adding a processed image to the Image Browser

Browsing images in the Image Browser

Magnifying an image

Opening images in Vision Assistant

Printing an image

Removing an image from the Image Browser
Print Images

- 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. Enable the **Print Results Overlaid on the Image** option 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

Adding a processed image to the Image Browser

Browsing images in the Image Browser

Magnifying an image

Opening images in Vision Assistant

Removing an image from the Image Browser

Saving an image

Magnify an Image

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

Reduce the Magnification of an Image

Click the **Zoom Out** tool located in the toolbar to reduce the magnification of an image.



- 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

Adding a processed image to the Image Browser Browsing images in the Image Browser Magnifying an image Opening images in Vision Assistant Printing an image Removing an image from the Image Browser Saving an image

Scripting Concepts

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 7.1 or later and the NI Vision 8.2.1 Development Module or later installed, you can use Vision Assistant to create the LabVIEW VI implementing the image processing steps you prototyped.

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.

Creating a New Script

You create a script as you process an image. To create a new script, select **File**»**New Script** or click the **New** button in the <u>Script window</u>. Vision Assistant prompts you to save the current script before creating a new script.

Open a Script

Complete the following steps to open 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.

Save a Script

Complete the following steps to save 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.

Run a Script

To run 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.

Edit a Step in a Script

Complete the following steps to edit a script:

- 1. Select the appropriate step in the Script window and click B Edit Step or double-click the step that you want to edit.
- 2. Change the function parameters in the Setup 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 Setup window.
- You also can use **Edit Step** to modify the currently selected step.

Add a Step to a Script

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

- 1. In the Script window, 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 after the selected step.

Remove a Step from a Script

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

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 - **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 <u>conversion</u> and <u>color threshold</u>), consider 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 may receive unexpected results.
- You can use the Step Backward and Step Forward buttons to step through the script. The image you are currently processing changes to reflect the effects of the function.

Step through a Script

Use the Step Backward and Step Forward 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 can also step through a script by clicking on the steps you want to view.

Perform Batch Processing

1. Select Tools»Batch Processing.

- 2. Select an image source.
 - If you select **Hard Disk**, browse to the folder containing the images you want to process.
 - If you select **Acquisition**, complete the following steps:
 - a. Specify the acquisition module you want to use.
 - Note You must have previously defined the parameters for the acquisition module you select. Vision Assistant uses the parameter settings you defined the last time you used a particular acquisition module. For example, if you select **Image Capture RT**, you must have previously used the Acquire Image (RT) function in the **Acquire Images** tab of the Processing Functions. If you select an acquisition module you have not used previously, Vision Assistant prompts you to exit batch processing setup and acquire an image using the module you selected in **Acquisition Modules**.
 - b. In **Iterations**, specify the number of times you want to acquire an image during batch processing.
 - c. In **Period (s.)**, specify the length of the delay, in seconds, between acquisitions.
- 3. Select a step in the **Script Steps** list.
 - If the step processes the image under inspection, select one of the **Process Mode** options: Open Process Interface, Display Result Image, or Save Result Image.
 - If the step analyzes the image under inspection, select one of the **Analysis Mode** options: Open Results Panel or Save Results.
- 4. If you selected **Save Results** or **Save Result Image** in step 3, click **Setup** and <u>configure the save options</u>. Otherwise, proceed to step 6.
- 5. Click **OK** to close the save setup dialog box.

- 6. Click **Run** to start the batch process.
- 7. Click **Return** to exit batch processing mode.
- 💡 🛛 Tips
 - The progress window displays the current process, the number of iterations completed, the starting time, and an estimation of the time remaining.
 - To stop batch processing, click the **Cancel** button in the progress window. Vision Assistant stops the batch process when the current step is complete or is cancelled from the Parameter window.

Performance Meter

You can use the Performance Meter to estimate how long (in milliseconds and frames/second) the script takes to complete in the Vision Development Module 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 the Vision Development Module would take to complete the script.
- 3. Click **Details** to view an estimate of the time the Vision Development Module would take to complete each function in the script.
- 4. Click **OK** to close the Performance Meter.

Use Image Functions

This palette groups several functions that analyze the content of an image to obtain information you specify. This palette also contains functions you can use to modify the geometry of the image, calibrate the image so you can make measurements in real-world units, and correct the image.

Histogram

Use this function to count the total number of pixels in each grayscale value and graph the results. You can use the histogram to determine if the overall intensity of your image adequate for your inspection task or if the image contains distinct regions of certain grayscale values.

Line Profile

Use this function to analyze the grayscale distribution along a line of pixels in an image. You can use a line profile to examine boundaries between components, quantify the magnitude of intensity variations, and detect the presence of repetitive patterns.

Measure

Use this function to calculate the position, length, angle, or area of a region of interest in an image.

3D View

Use this function to display the light intensity of an image in a threedimensional coordinate system, where the spatial coordinates of the image form two dimensions and the light intensity forms the third dimension.

Brightness

Use this function to alter the brightness, contrast, and gamma of an image.

Set Coordinate System

Use this function to build a coordinate system based on the location and orientation of a reference feature.

Image Mask

Use this function to build a mask from an entire image or a selected region. You can use image masks to focus your processing or inspection on particular regions in the image.

Geometry

Use this function to modify the geometrical representation of an image by transforming, rotating, or resampling the image data.

Image Buffer

Use this function to store and retrieve images from buffers.

Get New Image

Use this function to open a new image from a file.

Image Calibration

Use this function to calibrate an image to make measurements in realworld units.

Calibrate from Image

Use this function to apply the calibration information in an image file to the current image.

Image Correction

Use this function to transform a distorted image acquired in a calibrated setup by correcting perspective errors and lens distortion.

Overlay

Use this function to overlay figures, text, and bitmaps onto an image without destroying the image data.

Run LabVIEW VI

Use this function to run a user-specified LabVIEW VI within the Vision Assistant script.

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.

Main Tab

The following controls are available on the Main tab.

- **Step Name**—Name to give the step.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.

Histogram Tab

The following controls are available on the Histogram tab.

- **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.

Perform a histogram

Main Tab

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Verify that the **Reposition Region of Interest** option is enabled if you want to link the region of interest specified in this step to a previously defined coordinate system.

Link the region of interest to a coordinate system if the position of the object under inspection changes from image to image, and you need to adjust the position of the region of interest to match the new location of the object.
Histogram Tab

- 1. 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.
- 2. Click **OK** to add the step to the script.
- 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.

Histogram FAQs

Currently, there are no FAQs associated with this processing function.

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.

Main Tab

The following controls are available on the Main tab.

- **Step Name**—Name to give the step.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.

Line Profile Tab

The following controls are available on the Line Profile tab.

- 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.

Perform a Line Profile

Main Tab

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Verify that the **Reposition Region of Interest** option is enabled if you want to link the region of interest specified in this step to a previously defined coordinate system.

Link the region of interest to a coordinate system if the position of the object under inspection changes from image to image, and you need to adjust the position of the region of interest to match the new location of the object.

Line Profile Tab

- 1. 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.
- 2. Click **OK** to add the step to the script.
- $\overline{\mathbb{N}}$
- **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.

Line Profile FAQs

Currently, there are no FAQs associated with this processing function.

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.

Main Tab

The following controls are available on the Main tab.

- **Step Name**—Name to give the step.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.

Measure Tab

The following controls are available on the Measure tab. You can calculate 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—Length 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 results associated with line segments drawn on the image.
 - **Angle**—Angle between any two line segments on the image, measured in degrees, counterclockwise.
- Area Results—Area 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.

Calculate ROI Measurements

Main Tab

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Verify that the **Reposition Region of Interest** option is enabled if you want to link the region of interest specified in this step to a previously defined coordinate system.

Link the region of interest to a coordinate system if the position of the object under inspection changes from image to image, and you need to adjust the position of the region of interest to match the new location of the object.

Measure Tab

- 1. Select the type of measurement that you want to calculate.
- 2. Draw an ROI on the image.

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



- 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**.
- 3. Click **OK** to add the step to the script.

Measure FAQs

Currently, there are no FAQs associated with this processing function.

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.

View 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. Set the direction orientation.
- 2. Specify the maximum **Height** of a 3D pixel.
- 3. Specify the angle between the horizontal axis and baseline in α .
- 4. Define the angle between the horizontal axis and second baseline in β .
- 5. Set the size **Reduction**.
- 6. Click **OK** to close the Parameter window.

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

3D View FAQs

Currently, there are no FAQs associated with this processing function.

Brightness, Contrast, Gamma Correction

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

- Step Name—Name to give the step.
- **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.



• **Reset**—Reverts **Brightness**, **Contrast**, and **Gamma** to neutral default settings.

Modify Brightness, Contrast, and Gamma Values of an Image

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 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.

Brightness, Contrast, and Gamma FAQs

Currently, there are no FAQs associated with this processing function.

Set Coordinate System Controls

Defines a coordinate system relative to a feature in the image. The following controls are available.

- **Coordinate System Name**—Name to give the coordinate system step.
- **Mode**—Directions in which you expect the object under inspection to move within the inspection images. The following options are available:
 - Horizontal Motion—When selected, Vision Assistant adjusts the region of interest positions for moves along the horizontal axis of the image for steps linked to this Set Coordinate System step. Select this mode when the position of the object under inspection is mechanically constrained so that the part cannot rotate or move vertically within the camera's field of view.
 - Vertical Motion—When selected, Vision Assistant adjusts the region of interest positions for moves along the vertical axis of the image for steps linked to this Set Coordinate System step. Select this mode when the position of the object under inspection is mechanically constrained so that the part cannot rotate or move horizontally within the camera's field of view.
 - Horizontal and Vertical Motion—When selected, Vision Assistant adjusts the region of interest positions for moves along the horizontal and vertical axes of the image for steps linked to this Set Coordinate System step. Select this mode when the position of the object under inspection is mechanically constrained so that the part cannot rotate within the camera's field of view.
 - Horizontal, Vertical, and Angular Motion—When selected, Vision Assistant adjusts the region of interest positions for moves along the horizontal and vertical axes as well as rotational changes for steps linked to this Set Coordinate System step. Select this mode when the position of the object under inspection is not mechanically constrained.

Tip This mode requires more time to reposition a

region of interest than the other modes. If the object does not rotate in the field of view, select another mode that meets your application needs.

- **Origin**—Feature whose x-coordinate and y-coordinate locations are used as the origin of the coordinate system. You may also use the value of a point variable as the origin.
- X-Axis Angle—Feature whose angle measurement you want to use to represent the angle made by the x-axis of the coordinate system and the horizontal axis of the system. This control is available only if you select the Horizontal, Vertical, and Angular Motion mode.

Set Up a Coordinate System

- 1. In the **Coordinate System Name** control, enter a descriptive name for the step.
- 2. Select the mode that best represents the position of the object under inspection. Take into account the position of the camera, lighting, and the type of synchronization between the image acquisition and the motion of the object under inspection.
- 3. Select the feature whose location and angle measurement you want to use to specify the origin and angle of the coordinate system.

Set Coordinate System FAQs

Why are there no measurements listed in the X-Axis Angle listbox?

You must configure a step that defines an x-axis angle or produces a numeric result for the **X-Axis Angle** listbox to contain items. You can use the Pattern Matching, Geometric Matching, Straight Edge (Rake), Adv. Straight Edge, and Geometry steps to define an x-axis angle.

I want to select an x-axis angle but the items in the X-Axis Angle list are dimmed. What should I do?

Select the **Horizontal, Vertical, and Angular Motion** option of the **Mode** control to enable the X-Axis Angle list.

What steps should I use to find features on which to base a coordinate system origin?

Coordinate system origins are based on feature locations. You can locate features using the following steps: Edge Detector, Straight Edge (Rake), Adv. Straight Edge, Circular Edge (Spoke), Detect Objects, Pattern Matching, Geometric Matching, Clamp, and Geometry.

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.

Main Tab

The following controls are available on the Main tab.

- **Step Name**—Name to give the step.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.

Mask Tab

The following controls are available on the Mask tab.

- Image Mask Creates an image mask from an ROI Create from ROI selected on the image. Create from Image File Creates an image mask from an image file. Mask Options (Create from ROI) Sets all pixels outside the selected region Outside the ROI 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 (nonblack).
 - 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 an Image

Main Tab

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Verify that the **Reposition Region of Interest** option is enabled if you want to link the region of interest specified in this step to a previously defined coordinate system.

Link the region of interest to a coordinate system if the position of the object under inspection changes from image to image, and you need to adjust the position of the region of interest to match the new location of the object.

Mask Tab

Choose one of the following methods to mask an image:

- Mask an image from a ROI
 - a. Select Create from ROI.
 - b. Select an ROI tool from the toolbar and draw the region of interest.
 - c. Click Set ROI.
 - d. Select mask options.
 - e. 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.
- Mask an Image from an Image File
 - a. Select Create from Image File.
 - b. Click the **Browse** button, navigate to the location of the image file, select the file, and click **OK**.
 - c. Select mask options.
 - d. Click **OK** to add this step to the script.

Image Mask FAQs

Currently, there are no FAQs associated with this processing function.

Geometry

Modifies the geometrical representation of an image.

Main Tab

The following control is available on the Main tab.

• **Step Name**—Name to give the step.

Geometry Tab

The following controls are available on the Geometry tab.

- 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.

Compute the Symmetry of an Image

Main Tab

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Verify that the **Reposition Region of Interest** option is enabled if you want to link the region of interest specified in this step to a previously defined coordinate system.

Link the region of interest to a coordinate system if the position of the object under inspection changes from image to image, and you need to adjust the position of the region of interest to match the new location of the object.
Geometry Tab

- 1. Select **Symmetry**.
- 2. Select a type of symmetry.
- 3. Click **OK** to add this step to the script.

Related Topics

<u>Resample an image</u> <u>Rotate an image</u>

Rotate 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

Compute the symmetry of an image

Resample an image

Resample 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

Compute the symmetry of an image

Rotate an image

Geometry FAQs

Currently, there are no FAQs associated with this processing function.

Image Buffer

Stores and retrieves images from buffers. The following controls are available.

- **Step Name**—Name to give the step.
- **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.

Store an Image in an Image Buffer

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 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

Retrieve an image from an image buffer

Retrieve an Image from an Image Buffer

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 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.



Related Topics

Store an image in an image buffer

Image Buffer FAQs

Currently, there are no FAQs associated with this processing function.

Get Image

Opens an image from a file. Use this function when you need to open an image as a step in a script. The following controls are available.

- Step Name—Name to give the step.
- Path—Browse to the location of the file you want to open.
- **Cycle Through Folder Images**—When enabled, the inspection cycles through all images in the folder each time the step is run.



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

Get an Image

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 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.

Get Image FAQs

Which image file formats are supported?

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

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

Vision Assistant does not have an image size limit.

Calibrate Images

Vision Assistant can calibrate images containing linear, perspective, or nonlinear distortions in order to return accurate measurements. The **Image Calibration** step calibrates images so that inspection results are returned in real-world units.

Calibrating an image is a two-step process. The first is an offline step during which you specify the type of calibration, the calibration parameters, and the real-world unit in which you want to express measurements. The second step of the calibration process applies the computed calibration to the image during the inspection process. This step is represented in the inspection as the **Image Calibration** step.

Vision Assistant supports three types of calibration, which depend on the position of the camera in relation to the object under inspection and the type of lens used in the application: **Simple Calibration**, **Calibration Using User-Defined Points**, and **Grid Calibration**.

- Select <u>Simple Calibration</u> when the camera angle is perpendicular to the image plane and lens distortion is negligible. **Simple Calibration** transforms a pixel coordinate to a real-world coordinate through scaling in the x (horizontal) and y (vertical) directions.
- Select <u>Calibration Using User-Defined Points</u> when lens distortion is negligible and when the camera is not perpendicular to the image plane, which causes perspective distortion in the image. This calibration type uses a set of known mappings between points in the image and their corresponding locations in the real world to compute the pixel-to-real-world mapping for the entire image.
- Select <u>Grid Calibration</u> when the image exhibits either perspective or nonlinear distortion. Nonlinear distortion usually occurs when you use a wide-angle lens. **Grid Calibration** uses the distances between dots in a calibration grid and the distances between dots in an image of the grid to generate a list of pixel-to-real-world mappings for the calibration process.
- **Tip** Whenever possible, position the camera perpendicular to the object to minimize perspective distortion in the image. Use a high quality lens or telecentric lens to minimize nonlinear distortion in the image.

Image Calibration

The **Choose a calibration type** dialog box appears when you select **Image Calibration** in the **Image** tab of the Processing Functions palette or select **Image**»**Image Calibration**.



Note To edit the settings in the **Calibration** and **Calibration Axis** tabs, click **Edit Calibration** to launch the Calibration wizard.

Main Tab

The following control is available on the Main tab.

• **Step Name**—Name to give the step.

Calibration Tab

The following controls are available on the Calibration tab.

- Simple Calibration
 - **Pixel Type**—Indicates if the image has square or nonsquare pixels.
 - **Correspondence Image Real World**—Gives the realworld size of a pixel in both the horizontal (x) and vertical (y) directions.

• User Points Calibration

- **Calibration Points**—Lists the points you selected for calibration in the Calibration wizard.
- **Image Coordinates**—Coordinates of the currently selected calibration point, given as the number of pixels from the origin.
- Real-World Coordinates—Coordinates of the currently selected calibration point, given as the number of *Units* from the origin.
- **Unit**—Unit of measure you selected in the Calibration wizard.
- **Distortion**—Type of distortion you selected in the Calibration wizard, either **Perspective** or **Nonlinear**.
- Grid Calibration
 - Pixel Type—Indicates if the image has square or nonsquare pixels.
 - **Correspondence Image Real World**—Gives the realworld size of a pixel in both the horizontal (x) and vertical (y) directions.
 - **Unit**—Unit of measure you selected in the Calibration wizard.
 - **Distortion**—Type of distortion you selected in the Calibration wizard, either **Perspective** or **Nonlinear**.
- Edit Calibration—Displays the Calibration wizard, allowing you to modify the calibration settings you specified.

Axis Tab

The following controls are available on the Axis tab.

- Axis Origin—X- and y-coordinates of the origin you selected in the Calibration wizard.
- Axis Reference—Direction of the y-axis, either Direct or Indirect.
- Angle Relative to Horizontal—Angle of the x-axis of the calibration axis you selected relative to horizontal.
- **Preview Corrected Image**—Option to preview the image with perspective errors and lens distortion errors corrected.

Perform a Simple Calibration

- 1. Click Image »Image Calibration or select Image Calibration in the Image tab of the Processing Functions palette.
- 2. Select **Simple Calibration** and click **OK**.
- 3. Select the **Pixel Type** that applies to the camera.
- 4. Click Next.
- 5. Select two points. You can select points that were defined by previous inspection steps by double-clicking the point in the list or clicking the point in the image. You also can define new points by clicking unspecified pixels in the image.
 - If you selected square pixels in the previous wizard step, enter the distance between the two selected points in realworld units and specify the correct unit. Proceed to the next step.
 - If you selected nonsquare pixels in the previous step, follow these instructions:
 - a. Enter the x projection of the two points in real-world units and specify the correct unit.
 - b. Click Next.
 - c. If you want to use different points to specify the pixel ratio along the y-axis, select two other points. Otherwise, go to the next substep.
 - d. Enter the y projection of the two points in real-world units and specify the correct unit.
- 6. Click **Next**.
- 7. Select the origin of the calibration axis by entering the X- and Y- coordinates or by selecting an **Existing Point** from the list.
- 8. Select the **User-Defined Angle** of the calibration or select an **Existing Angle**. If you choose an **Existing Angle** from the list, you can add 90°, 180°, or 270° to the value.
- 9. Select an Axis Reference.
- 10. Click **OK** to apply the calibration.
- 11. Click **OK** to save the step in the script and close the Setup window.
- Note To save an image calibrated with Simple Calibration,

complete the following steps.

- 1. Click File»Save Image.
- 2. In the Save Image window, select a location to save the image.
- 3. Enter a name in the File Name textbox.
- 4. Enable the **Save Extra Information** control.
- 5. Click Save.

Control Descriptions

- **Open Image**—Image on which you specify points to base the calibration. This image must be the same size as the image you want to calibrate. Vision Assistant does not run the script on this image.
- **Pixel Type**—Square or nonsquare pixels.
- List of points—Points defined in the image that you can use to calibrate the image.
- Point X and Y—Coordinates of the selected points.
- Length—Distance, in pixels, between the two selected points. This control appears only when you set **Pixel Type** to **Square**.
- **dX**—Projection of the segment specified by the two points onto the x-axis. This control appears only when you set **Pixel Type** to **Nonsquare**.
- **dY**—Projection of the segment specified by the two points onto the y-axis. This control appears only when you set **Pixel Type** to **Nonsquare**.
- Unit—Real-world unit of the measurement.
- Axis Origin
 - **User Defined**—X- and y-coordinates of the pixel that you want to use as the calibration axis origin.
 - **Existing Point**—Point defined in a previous step that you want to use as the calibration axis origin.
- X Axis Angle
 - **User Defined**—Angle you want to use between the x-axis of the calibration axes and the horizontal axis of the image.
 - Existing Angle—Angle defined in a previous step that you want to use between the x-axis of the calibration axes and the horizontal axis of the image. You can select a value from the + control to add to the Angle value.
- Axis Reference—Direction of the y-axis.

Perform Calibration with User-Defined Points

- 1. Click Image »Image Calibration or select Image Calibration in the Image tab of the Processing Functions palette.
- 2. Select Calibration Using User-Defined Points and click OK.
- 3. Select the type of **Distortion** that applies to the image.
- 4. Select a point. You can select a point that was defined by a previous inspection step by double-clicking the point in the list or clicking the point in the image. You also can define a new point by clicking an unspecified pixel in the image.
- 5. Enter the **Real-World Coordinates** of the point you selected.
- 6. Select at least three more points.
- 7. Click OK.
- 8. Click the **Specify Calibration Axis** tab.
- 9. Select the origin of the calibration axis by entering the X- and Y- coordinates or by selecting an **Existing Point** from the list.
- 10. Select the **User-Defined Angle** of the calibration or select an **Existing Angle**. If you choose an **Existing Angle** from the list, you can add 90°, 180°, or 270° to the value.
- 11. Select an Axis Reference.
- 12. Click **OK** to learn the calibration.
- 13. Browse to the directory you want to save the calibration information in, enter a **File name**, and click **OK**.
- 14. Click **OK** to save the step in the script and close the Parameter window.

Control Descriptions

Define Reference Points Tab

- **Open Image**—Image on which you specify points to base the calibration. This image must be the same size as the image you want to calibrate. Vision Assistant does not run the script on this image.
- **Distortion**—Type of image distortion.
- Select at least 4 points—Points defined in the image that you can use to calibrate the image.
- **Reset**—Option to deselect all points.
- **Unit**—Real-world unit of the measurement.
- Image Coordinates—Pixel coordinates of the selected point.
- **Real-World Coordinates**—Real-world coordinates of the selected point.

Specify Calibration Axis Tab

- Axis Origin
 - **User Defined**—X- and y-coordinates of the pixel that you want to use as the calibration axis origin.
 - **Existing Point**—Point defined in a previous step that you want to use as the calibration axis origin.
- X Axis Angle
 - **User Defined**—Angle you want to use between the x-axis of the calibration axes and the horizontal axis of the image.
 - **Existing Angle**—Angle defined in a previous step that you want to use between the x-axis of the calibration axes and the horizontal axis of the image. You can select a value from the + control to add to the **Angle** value.
- Axis Reference—Direction of the y-axis.

Related Topics

Calibrate Controls

Perform a Grid Calibration

- 1. Click Image»Image Calibration or select Image Calibration in the Image tab of the Processing Functions palette.
- 2. Select Grid Calibration and click OK.
- 3. Select the type of **Distortion** that applies to the image.
- 4. Click Next.
- 5. Select **Threshold Range** values to separate the dots of the grid from the rest of the image. When you select the **Threshold Range**, the following operations are performed on the image:
 - The image is <u>thresholded</u> using the range you provide in **Threshold Range**.
 - Particles that are touching the image borders are removed using the <u>Remove border objects</u> function.
 - Particles that are too small or that are larger than the largest dot are rejected using the <u>Particle Filter</u> function.
- 6. Click Next.
- 7. Select the real-world distance between the grid dots in the x and y directions.

If the grid does not cover the entire image, draw a region of interest around the grid or a portion of the grid to learn the calibration information only in this area.



Tip Double-click the last point of the polygonal region of interest to close the region.

- 8. Click Next.
- 9. Select the origin of the calibration axis by entering the X- and Y- coordinates or by selecting an **Existing Point** from the list.
- 10. Select the **User-Defined Angle** of the calibration or select an **Existing Angle**. If you choose an **Existing Angle** from the list, you can add 90°, 180°, or 270° to the value.
- 11. Select an Axis Reference.
- 12. Click **OK** to learn the calibration.
- 13. Browse to the directory you want to save the calibration information in, enter a **File name**, and click **OK**.
- 14. Click **OK** to save the step in the script and close the Parameter

window.

Control Descriptions

- **Open Image**—Grid image on which to base the calibration. This image must be the same size as the image you want to calibrate.
- **Distortion**—Type of image distortion.
- **Threshold Range**—Minimum and maximum intensity values to include in the threshold range.
- **X Spacing**—Distance between two dots in the x direction.
- **Y Spacing**—Distance between two dots in the y direction.
- Unit—Real-world unit of the distances.
- Axis Origin
 - **User Defined**—X- and y-coordinates of the pixel that you want to use as the calibration axis origin.
 - **Existing Point**—Point defined in a previous step that you want to use as the calibration axis origin.
- X Axis Angle
 - **User Defined**—Angle you want to use between the x-axis of the calibration axes and the horizontal axis of the image.
 - Existing Angle—Angle defined in a previous step that you want to use between the x-axis of the calibration axes and the horizontal axis of the image. You can select a value from the + control to add to the Angle value.
- **Axis Reference**—Direction of the y-axis.

Related Topics

Calibrate Controls

Image Calibration FAQs

Currently, there are no FAQs associated with this processing function.

Calibration from Image

Applies the calibration information saved in an image to the current image.

Pixel Calibration Tab

Defines physical dimensions of the area of a pixel in the image and the correspondence between pixels and real-world units. The following controls are available on the Pixel Calibration tab.

- **Step Name**—Name to give the step.
- Load Calibration from Image File—Selects the image file containing the calibration information to load.
- **Pixel Type**—Indicates the pixel type of the image you are using for calibration.
- **Correspondence Image Real World**—Indicates the real-world coordinates and units of the points used for calibration on the image you are loading from file.
- **Unit**—Unit of measurement.

Calibration Tab

Defines a reference coordinate system in the image. The following controls are available on the Calibration tab.

- Axis Origin—X- and y-coordinates of the origin of the coordinate system, in pixels.
- Axis Reference—Specifies the direction of the y-axis of the coordinate system with reference to the x-axis. The vertical axis direction can be either indirect (default) or direct.
- Angle Relative to Horizontal—Specifies the angle of the x-axis of the coordinate system with respect to the horizontal.
- **Corrected Image Scaling**—Specifies how to scale the corrected image when you apply the Image Correction function. Two scaling mode options are available: Scale to Fit and Scale to Preserve Area. With the Scale to Fit option, the corrected image is scaled to fit in an image the same size as the original image. With the Scale to Preserve Area option, the corrected image is scaled such that features in the image retain the same area as they did in the original image. Images that are scaled to preserve the area are usually larger than the original image.

Apply Calibration Information from One Image to Another

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Click Load Calibration from Image File.
- 3. Navigate to a calibrated image file and click **Open**.
- 4. Navigate through the tabs to see the calibration values.
- 5. Click **OK** to add this step to the script and close the Parameter window.

Note The size of the calibrated image you select must be the same size as the image you want to calibrate.

Related Topics

Calibration From Image (Image»Calibration from Image)

Image Correction (Image»Image Correction)

Calibration from Image FAQs

Currently, there are no FAQs associated with this processing function.

Image Correction

Transforms a distorted image acquired in a calibrated setup into an image where perspective errors and lens distortion are corrected. The following controls are available.

- **Step Name**—Name to give the step.
- Interpolation Type—Specifies the interpolation type (Zero Order or Bi-linear) used by the algorithm when correcting the image.

Correct Images

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Select the **Interpolation Type** you want to use to rescale the image. A Zero-Order interpolation is faster, but provides lower-quality results than a Bi-Linear interpolation.
- 3. Click **OK** to add this step to the script and close the Parameter window.

Note You must already have calibrated the image with the <u>Calibration from Image</u> function before you correct an image.

Image Correction FAQs

Currently, there are no FAQs associated with this processing function.

Overlay

Overlay figures, text, and bitmaps onto an image without destroying the underlying image data. Use the Overlay step to select and configure the overlay elements you want to display on images within Vision Assistant.

Note The Overlay function does not modify the image pixels.

Main Tab

The following controls are available on the Main tab.

• **Step Name**—Name to give the step.

Overlay Tab

The following controls are available on the Overlay tab.

- **Selection Tool**—Selects an overlay element in the image.
- Line Tool—Overlays a line.
- S Broken Line Tool—Overlays a broken line.
- -> Freehand Line Tool—Overlays a freehand line.
- ◇ Rotated Rectangle Tool—Overlays a rotated rectangle.
- **Oval Tool**—Overlays an oval.
- **Polygon Tool**—Overlays a polygon.
- **Freehand Region Tool**—Overlays a freehand region.
- Bitmap Tool—Overlays a bitmap.
- *A*α **Text Tool**—Overlays text.
 - **Overlays**—Lists the overlay elements that you create.
 - **Delete**—Deletes the selected overlay element.

Line Parameters

- **Start Point**—Point coordinates that define the starting point of the line.
 - **X**—X-coordinate of the start point.
 - **Y**—Y-coordinate of the start point.
- End Point—Point coordinates that define the ending point of the line.
 - **X**—X-coordinate of the end point.
 - **Y**—Y-coordinate of the end point.
- **Color**—Color of the overlay.

Broken Line Parameters

- **Points**—Array of point coordinates that define the ends of the line.
 - **X**—X-coordinate of a point in the array.
 - **Y**—Y-coordinate of a point in the array.
- Color—Color of the overlay.
Freehand Line Parameters

- **Points**—Array of point coordinates that define the ends of the line.
 - \mathbf{X} —X-coordinate of a point in the array.
 - **Y**—Y-coordinate of a point in the array.
- **Color**—Color of the overlay.

Rotated Rectangle Parameters

- Left—X-coordinate of the upper left corner of the rectangle.
- **Top**—Y-coordinate of the upper left corner of the rectangle.
- **Right**—X-coordinate of the bottom right corner of the rectangle.
- **Bottom**—Y-coordinate of the bottom right corner of the rectangle.
- **Rotation**—Rotation angle, in degrees, of the rectangle with its center as point of rotation. If the rotation angle does not equal 0, the Left, Top, Right, and Bottom coordinates are not the actual coordinates of the upper left and bottom right corner of the rectangle, but their positions if the rotation angle equaled 0.
- **Drawing Mode**—Specifies whether to draw only the frame of the rectangle or fill the rectangle with color.
- **Color**—Color of the overlay.

Oval Parameters



- **Note** The position of an oval is specified by the coordinates of the bounding rectangle that contains the oval.
- Left—X-coordinate of the upper left corner of the bounding rectangle.
- **Top**—Y-coordinate of the upper left corner of the bounding rectangle.
- **Right**—X-coordinate of the bottom right corner of the bounding rectangle.
- **Bottom**—Y-coordinate of the bottom right corner of the bounding rectangle.
- **Drawing Mode**—Specifies whether to draw only the frame of the oval or fill the oval with color.
- **Color**—Color of the overlay.

Polygon and Freehand Region Parameters

• **Points**—Array of point coordinates that define the ends of the line.

- **X**—X-coordinate of a point in the array.
- **Y**—Y-coordinate of a point in the array.
- **Drawing Mode**—Specifies whether to draw only the frame of the polygon or fill the polygon with color.
- **Color**—Color of the overlay.

Bitmap Parameters

- **Image File Path**—Complete pathname—including drive, directory, and filename—of the bitmap to overlay.
- **Insertion Point**—Location in the image where the top, left point of the bitmap is overlaid.
 - **X**—X-coordinate of the point.
 - **Y**—Y-coordinate of the point.
- Use Keying Color—Specifies whether to use a keying color.
- **Keying Color**—Color in the overlaid bitmap that you want to be transparent.

Text Parameters

- Text—Text to overlay.
- **Text Properties**—Launches a dialog box in which you select the specific font characteristics of the text to overlay.
- **Origin**—Location in the image where the bottom, left point of the first character is overlaid.
 - **X**—X-coordinate of the point.
 - **Y**—Y-coordinate of the point.
- **Text Color**—Color of the text.
- Background Color—Color of the text background.

Layer Management Tab

The following controls are available on the Layer Management tab.

- **Overlay Elements**—Lists the overlay elements created. You can use the Up and Down buttons to arrange the order in which elements are overlaid on the image. The first overlay element in the list is the topmost layer.
- **Color**—Foreground color of the selected overlay element.
- X—X-coordinate location of the first point of the selected overlay element.
- Y—Y-coordinate location of the first point of the selected overlay element.
 - Note When you modify the x-coordinate and y-coordinates of an element shown in the Overlay Elements table, the coordinates of the other points in the element are offset by the same amount so that the element maintains its shape.
- Up—Moves the selected overlay element up the drawing order.
- **Down**—Moves the selected overlay element down the drawing order.
- **Delete**—Deletes the selected overlay element.

Overlay Figures, Text, or Bitmaps on an Image

Main Tab

In the **Step Name** control, enter a descriptive name for the step.

Overlay Tab

- 1. Select the type of overlay you want to add to the image from the tools palette.
- 2. Draw the overlay in the image. Vision Assistant adds the element to the Overlays drop-down list.

You can adjust the size and position of the element by using the

Selection Tool or by modifying the element Parameters.



Note To delete an overlay element, select the element in the Overlays drop-down list and click **Delete**.

- 3. Set the overlay color.
- 4. Set any **Parameters** specific to the element you created, such as the overlay text.

Layer Management Tab

1. Use the Layer Management controls to set the order in which Vision Assistant overlays elements on the image. The Overlay Elements table lists all the overlays in the reverse order they were created. The first overlay in the table is the topmost layer.

To move an element up or down the stack of layers, select the element in the Overlay Elements table and click either **Up** or **Down**.

2. Click **OK** to add the step to the script.

Overlay FAQs

I can move only one overlay element in the image with my mouse. How can I select and move another overlay element?

Only the overlay element selected in the Overlays dropdown list box can be moved or modified with the mouse. If you want to use the mouse to move or modify another overlay element, select the desired element in the Overlays dropdown list or click the element with the Selection tool to select and modify any overlay.



Note When you click the selection tool, all overlay elements appear in white because you can modify all of them.



Tip To fine tune the position of an overlay element, modify the coordinates of the element in the Parameters window.

Run LabVIEW VI

Runs a user-specified LabVIEW VI.

Main Tab

The following controls are available on the Main tab.

- **Step Name**—Name to give the step.
- VI Path—Path of the VI to run.

VI Controls Tab

The following controls are available on the VI Controls tab.

- VI Controls—Displays the labels and current values of the VI controls.
- **Configure**—Launches the Select VI Value window where you can set or modify the values of the VI controls on the VI connector pane.
- VI Indicators—Displays the labels and current values of the VI indicators on the VI connector pane.
- **Debug Mode**—When enabled, the VI runs from within the LabVIEW environment, which allows you to use execution highlighting, breakpoints, and other LabVIEW debugging techniques.
- **Test**—Runs the selected VI to test your configuration.

Run a LabVIEW VI from Vision Assistant

Main Tab

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Click **Browse** to select the path to the VI you want to run.
- Note The Run LabVIEW VI step works only with VIs saved using LabVIEW 8.6. To share or redistribute a VI, you must first save the VI for distribution.

VI Controls Tab

- 1. Click **Configure** to launch the Select VI Value window.
- 2. Select a VI control name from the VI Controls list.
- 3. Specify a value for the control.
- 4. Repeat steps 2 and 3 as necessary.
- 5. Click **OK** to save the specified values and close the Select VI window.



Note The Select VI Value window displays only controls that are connected on the VI connector pane. Make sure to connect any controls or indicators that need to be accessed by this step.

Run LabVIEW VI FAQs

What types of controls and indicators can I use in my VI?

There are no restrictions about the types of controls or indicators you can use in the VI. However, to use measurements from a previous Vision Assistant step or set constant values, the controls must be numerics (I8, I16, I32, U8, U16, U32, DBL, SGL, or EXT), strings, Boolean values, or IMAQ Image controls. Indicators must be numerics, strings, or Boolean values to be accessible in future steps.

Do I need to update the connector pane for this step to use my indicators or controls?

Yes, the **Run LabVIEW VI** step can only use controls and indicators that are connected on the VI connector pane.

How do I use the current image from Vision Assistant and modify the image so subsequent steps use the modified image?

In the **VI Controls** tab, click **Configure**. If you have an IMAQ Image control on the specified VI, select **Images»Current Image** as the value for the IMAQ Image control. When the current image is associated with your image control, you can access the current Vision Assistant image. Any modification to the image is reflected in the resulting image after the VI is run. Image Buffer steps that store images are also accessible to the Run LabVIEW VI step.



Note If an image from an Image Buffer step is modified by the Run LabVIEW VI step, all subsequent steps that use that Image Buffer also use the modified image.

Because the image passed in is the same one to be modified, using an image display control can produce confusing results because it may not be clear if the image displayed is the original passed from Vision Assistant or the modified version after the VI has run. National Instruments recommends that you use the IMAQ Image control instead of the IMAQ Image Display control to avoid confusion.



Note If you pass the current Vision Assistant image to your VI, overlays in the image are preserved. However, any calibration information from previous steps is lost.

Why does Vision Assistant appear unresponsive when I run a VI?

The **Run LabVIEW VI** step waits for the specified VI to complete before executing additional steps in the application. If the VI runs continuously or requires a user interaction to stop the VI, the step waits indefinitely. To avoid this situation, be sure that the selected VI can complete without user interaction.

Why do I get an error about my VI or one of the subVIs being broken?

You need to save the VI for distribution to ensure that all the VI dependencies are available. Refer to <u>Saving a VI for Distribution</u> for instructions about saving a VI for distribution.

When I generate the LabVIEW code for my script containing a Run LabVIEW VI step and run the generated VI, I do not get the same results that I get in Vision Assistant. Why?

The only controls connected to the VI in the generated code are the image input and error clusters. You must connect the other controls manually. First, identify the VI that produces the value you want to connect to the control. If the value is a simple numeric, Boolean, or string, wire the output to the corresponding control on your VI. If the value is contained in an array or cluster, first use the LabVIEW primitives Index Array and/or Unbundle to access the value. Then, wire the output to the corresponding control on your VI.

Use Color Functions

This palette groups several image functions that analyze color images.

Color Operators

Use these functions to perform arithmetic and logical operations on color images. Common applications of these operators include time-delayed comparisons, identification of the union or intersection between images, correction of image backgrounds to eliminate light drifts, and comparisons between several images and a model. You also can use operators to threshold or mask images and to alter contrast and brightness.

Color Plane Extraction

Use this function to extract the RGB, HSV, and HSL planes from an image. The result of this function is a grayscale image with intensity values that correspond to the plane you extracted.

Color Threshold

Use this function to isolate color features for analysis and processing or to remove unnecessary features based on their color. The result of this function is a binary image.

Color Location

Use this function to locate regions in an image that contain a specified color. This function does not modify the image.

Color Pattern Matching

Use this function to locate color objects that match a predefined template. This function does not modify the image.

Color Matching

Use this function to compare the color content of an image or regions in an image to a template containing reference color information. This function does not modify the image.

Color Operators

Performs arithmetic and logical operations on images. The following controls are available.

- **Step Name**—Name to give the step.
- 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.
Multiply Divide	Computes a ratio between two images. Each pixel in the original image is multiplied by the constant before being divided by the equivalent pixel found in another image stored in the buffer. This is a pixel-by-pixel operation.
Modulo	Executes modulo division (remainder) of the original input image and a constant or another image stored in the buffer. This is a pixel-by-pixel operation.
Absolute Difference	Subtracts one image from another or a constant from an image and returns the absolute value of the difference.
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 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.

NotPerforms 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 Finds the logical difference between the original input Difference 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.

Use the Color Operators Function

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Select one of the operators 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.
 - Note For the Mask operator, you can select only the **Image** option. For the Multiply Divide operator, you must specify an **Image** and a **Constant**.
- 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.

Color Operators FAQs

Currently, there are no FAQs associated with this processing function.

Color Plane Extraction

Extracts one of the three color planes (Red, Green, Blue, Hue, Saturation, Luminance, Value, Intensity) from an image. The following controls are available.

- **Step Name**—Name to give the step.
- 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.

Extract Color Planes from an Image

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 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.

Color Plane Extraction FAQs

Currently, there are no FAQs associated with this processing function.

Color Threshold

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

Main Tab

The following control is available on the Main tab.

• **Step Name**—Name to give the step.

Color Threshold Tab

The following controls are available on the Color Threshold tab.

- 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.

Threshold a Color Image

Main Tab

In the **Step Name** control, enter a descriptive name for the step.

Color Threshold Tab

- 1. Select the color model (RGB, HSL, HSV, or HSI) you want to use to process the image.
- 2. 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**.
- 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.

Color Threshold FAQs

Currently, there are no FAQs associated with this processing function.

Color Location

Locates colors in a color image.
Main Tab

The following controls are available on the Main tab.

- Step Name—Name to give the step.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.

Template Tab

The following controls are available on the Template tab.

- **Template Image**—The image to use as the template.
- Template Size
 - Width—Width of the template in pixels.
 - Height—Height of the template in pixels.
- Ignore Black and White
 - **Disabled**—Specifies that black and white pixels are not ignored during the search phase.
 - **Ignore Black**—Specifies that black pixels are ignored during the search phase.
 - **Ignore White**—Specifies that white pixels are ignored during the search phase.
 - **Ignore Black and White**—Specifies that black and white pixels are ignored during the search phase.
- **Sat. Threshold**—Specifies the threshold used to distinguish between two colors having the same hue values. For more information about saturation threshold, refer to the *NI Vision Concepts Manual*.
- **Create Template**—Learns the selected ROI and saves the result as a template image file.
- Load from File—Launches a dialog box in which you can browse to a template image file and specify that file as the search template.
- **Template Path**—Displays the location of the template image file.

Settings Tab

The following controls are available on the Settings tab.

- Number of Matches to Find—Specifies the number of valid matches you expect the color location function to return.
- **Minimum Score**—Specifies the minimum score an instance of the template can have to be considered a valid match. This value can range from 0 to 1000, where a score of 1000 indicates a perfect match.
- **Search Strategy**—Specifies how the color features of the image are used during the search phase. You can choose from the following three strategies:
 - **Conservative** (default)—Uses the smallest step size, a subsampling factor of two, and all the color information present in the template to search for a template. The Conservative strategy is the most reliable method to look for a template in any image at potentially reduced speed.
 - Note Use the Conservative strategy if you have multiple matches located very close to each other in the image.
 - **Balance**—Uses values between the Aggressive and Conservative strategies.
 - **Aggressive**—Uses values between the Balanced and Very Aggressive strategies.
 - Very Aggressive—Uses the largest step size, the most subsampling, and only the dominant color from the template to search for the template. Use this strategy when the color in the template is almost uniform, the template is well contrasted from the background, and there is a good amount of separation between different occurrences of the template in the image. The Very Aggressive strategy is the fastest way to find templates in an image.
 - **Tip** You can specify a search area by drawing an ROI on the image with the Rectangle tool. Specifying a search area increases the speed and reliability of the color location function.

- **Color Sensitivity**—Specifies the level of color sensitivity in the image. The default is **Low** sensitivity.
- **Color Spectrum**—Represents the color information associated with the template.

Results

Displays the following information after searching the image for the template:

- **Center X**—X-coordinate of each object that matches the template.
- **Center Y**—Y-coordinate of each object that matches the template.
- **Score**—Score of each valid match. Score values can range from 0 to 1000, where a score of 1000 indicates a perfect match.

Search for Colors

Main Tab

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Verify that the **Reposition Region of Interest** option is enabled if you want to link the region of interest specified in this step to a previously defined coordinate system.

Link the region of interest to a coordinate system if the position of the object under inspection changes from image to image, and you need to adjust the position of the region of interest to match the new location of the object.

Template Tab

- 1. Create or select the template you want to use for comparison.
 - To create a new template, complete the following steps:
 - a. Click Create Template.
 - b. Select an ROI and click **OK**.
 - c. Enter a File Name for the template and click OK.
 - To use an existing template, complete the following steps:
 - a. Click Load from File.
 - b. Browse to the appropriate template image and click **OK**.
- 2. Modify the **Ignore Black and White** and **Sat. Threshold** parameters as necessary.

Settings Tab

- 1. Select the Number of Matches to Find and a Minimum Score.
- 2. Select the appropriate **Search Strategy** and **Color Sensitivity**.
- 3. Click **OK** to save this step to the script and exit the Parameter window.

Color Location FAQs

Currently, there are no FAQs associated with this processing function.

Color Pattern Matching

Searches for color templates in color images using Color Pattern Matching.

Main Tab

The following controls are available on the Main tab.

- Step Name—Name to give the step.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.

Template Tab

The following controls are available on the Template tab.

- **Template Image**—The image to use as the template.
- **Template Size**—Specifies the dimensions of the template.
 - Width—Width of the template in pixels.
 - Height—Height of the template in pixels.
- **Create Template**—Learns the selected ROI and saves it as a template image file. Specifies that file as the template to search for.
- Load from File—Launches a dialog box in which you can browse to a template image file and specify that file as the search template.
- **Ignore Black and White**—Specifies the pixels to ignore during the matching phase.
 - **Disabled**—Specifies that black and white pixels are not ignored during the matching phase.
 - **Ignore Black**—Specifies that black pixels are ignored during the matching phase.
 - **Ignore White**—Specifies that white pixels are ignored during the matching phase.
 - **Ignore Black and White**—Specifies that black and white pixels are ignored during the matching phase.
- **Sat. Threshold**—Specifies the threshold used to distinguish between two colors having the same hue values. For more information about saturation threshold, refer to the *NI Vision Concepts Manual*.

Settings Tab

The following controls are available on the Settings tab.

- Number of Matches to Find—Specifies the number of valid matches you expect the color pattern matching function to return.
- **Minimum Score**—Specifies the minimum score a template must have for the template to be considered a valid match. This value can range from 0 to 1000, where a score of 1000 indicates a perfect match.
- **Color Score Weight**—Determines the percent contribution of the color score to the final color pattern matching score. The software uses the color score weight for the final match ranking. For example, if you use a weight of 1000, the algorithm finds each match by using both color and shape information and then ranks the matches based on their color scores. If the weight is 0, the matches are ranked based on their shape scores. The default is 500, which indicates that the match score is based on an equal combination of the color and shape scores.
- **Search Strategy**—Specifies how the color features of the image are used during the search phase. You can choose from the following four strategies:
 - **Conservative** (default)—Uses the smallest step size, a subsampling factor of two, and all the color information present in the template to search for a template. The Conservative strategy is the most reliable method to look for a template in any image at potentially reduced speed.
 - Note Use the Conservative strategy if you have multiple matches located very close to each other in the image.
 - **Balance**—Uses values between the Aggressive and Conservative strategies.
 - **Aggressive**—Uses values between the Balanced and Very Aggressive strategies.
 - Very Aggressive—Uses the largest step size, the most subsampling, and only the dominant color from the template to search for the template. Use this strategy when the color in the template is almost uniform, the template is well

contrasted from the background, and there is a good amount of separation between different occurrences of the template in the image. The Very Aggressive strategy is the fastest way to find templates in an image.

• **Color Sensitivity**—Specifies the level of sensitivity used to describe the color features in the image. The default is **Low** sensitivity.

Results

Displays the following information after searching the image for the template:

- **Center X**—X-coordinate of each object that matches the template.
- **Center Y**—Y-coordinate of each object that matches the template.
- **Score**—Score of each valid match. Score values can range from 0 to 1000, where a score of 1000 indicates a perfect match.
- **Angle**—Rotation angle of each object that matches the template at the current match location. Angles are expressed in degrees. This output is valid only when you select rotation-invariant matching.

Use Color Pattern Matching

Main Tab

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Verify that the **Reposition Region of Interest** option is enabled if you want to link the region of interest specified in this step to a previously defined coordinate system.

Link the region of interest to a coordinate system if the position of the object under inspection changes from image to image, and you need to adjust the position of the region of interest to match the new location of the object.

Template Tab

- 1. Create or select the template you want to use for comparison.
 - To create a new template, complete the following steps:
 - a. Click **Create Template**.
 - b. Select an ROI and click **OK**.
 - c. Enter a File Name for the template and click OK.
 - To use an existing template, complete the following steps:
 - a. Click Load from File.
 - b. Browse to the appropriate template image and click **OK**.

By default, the center of the template is used as the focal point of the template. You can change the location of the focal point to any position in the template. Change the focal point of the template by dragging the red pointer in the template image or adjusting the **Match Offset** values.

2. Modify the **Ignore Black and White** and **Sat. Threshold** parameters as necessary.

Settings Tab

- 1. Modify Number of Matches to Find, Minimum Score, Color Score Weight, Color Sensitivity, and Search Strategy as necessary.
- 2. Select **Search for Rotated Patterns** to indicate that the match can be a rotated version of the template. You can restrict the amount of rotation you want to allow by specifying an acceptable angle range. You also can include the mirrored angle range by enabling **Mirror Angle**.
- 3. Click **OK** to save this step to the script.

Color Pattern Matching FAQs

Currently, there are no FAQs associated with this processing function.

Color Matching

Learns the color content of a region of an image and compares it to the color content of another region.

Main Tab

The following controls are available on the Main tab.

- Step Name—Name to give the step.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.

Template Tab

The following controls are available on the Template tab.

- **Template Path**—Displays the location of the template image file.
- **Create Template**—Learns the colors enclosed by the ROI you draw on the image and saves the ROI as a color image file. Specifies that file as the template color to match.
- Load from File—Launches a dialog box in which you can browse to a color image file and specify that file as the search template.
- **Color Sensitivity**—Specifies the level of color sensitivity in the image. The default is **Low** sensitivity. Select **High** sensitivity to distinguish small differences in hue.
- **Sat. Threshold**—Specifies the threshold used to distinguish between two colors having the same hue values. For more information about saturation threshold, refer to the *NI Vision Concepts Manual*.

Settings Tab

The following controls are available on the Settings tab.

• Minimum Match Score—Specifies the minimum score an instance of the template can have to be considered a valid match. This value can range from 0 to 1000, where a score of 1000 indicates a perfect match.

Results

Displays the following information after searching the ROI for colors:

- **Pass/Fail**—Indicates if the ROI contains colors that are equal to or greater than the **Minimum Match Score**.
- **Score**—Score of each valid match. Score values can range from 0 to 1000, where a score of 1000 indicates a perfect match.

Match Colors in an Image to a Template

Main Tab

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Verify that the **Reposition Region of Interest** option is enabled if you want to link the region of interest specified in this step to a previously defined coordinate system.

Link the region of interest to a coordinate system if the position of the object under inspection changes from image to image, and you need to adjust the position of the region of interest to match the new location of the object.

Template Tab

- 1. Create or select the template you want to use for comparison.
 - To create a new template, complete the following steps:
 - a. Click **Create Template**.
 - b. Select an ROI and click **OK**.
 - c. Enter a File Name for the template and click OK.
 - To use an existing template, complete the following steps:
 - a. Click Load from File.
 - b. Browse to the appropriate template image and click **OK**.

By default, the center of the template is used as the focal point of the template. You can change the location of the focal point to any position in the template. Change the focal point of the template by dragging the red pointer in the template image or adjusting the **Match Offset** values.

2. Modify the **Ignore Black and White** and **Sat. Threshold** parameters as necessary.

Settings Tab

- 1. Set the Minimum Match Score.
- 2. Click **OK** to add the step to the script and exit the Parameter window.

Color Matching FAQs

Currently, there are no FAQs associated with this processing function.

Use Grayscale Functions

This palette groups several image functions that analyze grayscale images.

Lookup Table

Use this function to improve the contrast and brightness in an image by applying a lookup table.

Filters

Use this function to enhance the quality of an image with spatial filters so that only the image information you need is extracted during processing.

Gray Morphology

Use this function to modify the shape of features in an image by altering pixel values.

FFT Filter

Use this function to remove high or low frequencies in the FFT plane. Removing high frequencies smooths noise, details, textures, and sharp edges. Removing low frequencies reduces overall patterns, such as variations in light intensity, and emphasizes details.

Threshold

Use this function to separate significant structures in an image from the rest of the image. Thresholding sets all pixels within the **Threshold Range** to 1 and sets all other pixels in the image to 0. The resulting image is a binary image.

Watershed

Use this function to segment an image containing noise, touching particles, or overlapping particles based on the topographic surface of an image.

Operators

Use this function to perform arithmetic and logical operations on grayscale images. Common applications of these operators include timedelayed comparisons, identification of the union or intersection between images, correction of image backgrounds to eliminate light drifts, and comparisons between several images and a model. You also can use operators to threshold or mask images and to alter contrast and brightness.
Conversion

Use this function to convert the current image to the specific image type.

Quantify

Use this function to quantify the content of an image or regions within the image.

Centroid

Use this function to calculate the energy center of the image.

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. The following controls are available.

- **Step Name**—Name to give the step.
- Lookup Tables
 - 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.

Apply a Lookup Table Transformation

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 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.

Lookup Table FAQs

Currently, there are no FAQs associated with this processing function.

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. The following controls are available.

- **Step Name**—Name to give the step.
- Filters

Image Source	Original input image.
Smoothing- Lowpass	Lowpass filtering. Smoothes 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 <i>a</i> , <i>b</i> , <i>c</i> and <i>d</i> 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 <i>a</i> , <i>b</i> , <i>c</i> , and <i>d</i> are integers and <i>x</i> 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	Prewitt filtering. A highpass filter that extracts the

Detection- outer contours of objects.

Prewitt

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

Sobel

EdgeRoberts filter to detect edges. Outlines the contoursDetection-that highlight pixels where an intensity variationRobertsoccurs along the diagonal axes.

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

Convolution- 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.

Smooth an Image with Filtering

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 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

Detect edges with filters

Filter an image with a custom convolution filter

Highlight details in an image

Detect 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

Filter an image with a custom convolution filter Highlight details in an image Smooth an image with filtering

Highlight 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

Detect edges with filters

Filter an image with a custom convolution filter

Smooth an image with filtering

Filter 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

Detect edges with filters

Highlight details in an image

Smooth an image with filtering

Filters FAQs

Currently, there are no FAQs associated with this processing function.

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. The following controls are available.

- Step Name—Name to give the step.
- Gray Morphology Operations

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

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

• Structuring Element

2D array used as a binary mask to define the neighbors of a

l		

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.
- *#* of Iterations (Dilate and Erode functions)—Number of times the operation is applied to the image.

Expand (Dilate) 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

Expand (dilate) objects in binary images

Fill gaps and holes (close) in grayscale images

Reduce (erode) objects in grayscale images

Remove small objects (open) from grayscale images

Smooth object boundaries in grayscale images

Reduce (Erode) 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

Expand (dilate) objects in grayscale images

Fill gaps and holes (close) in grayscale images

Reduce (erode) objects in binary images

Remove small objects (open) from grayscale images

Smooth object boundaries in grayscale images

Fill 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

Expand (dilate) objects in grayscale images Fill gaps and holes (close) in binary images Reduce (erode) objects in grayscale images

Remove small objects (open) from grayscale images

Smooth object boundaries in grayscale images

Remove 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.



- 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

Expand (dilate) objects in grayscale images Fill gaps and holes (close) in grayscale images Reduce (erode) objects in grayscale images Remove small objects (open) from binary images Smooth object boundaries in grayscale images

Smooth 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**—Smoothes boundaries of objects and fills small holes.
 - **Proper Close**—Smoothes boundaries of objects and removes small particles.
 - Auto Median—Smoothes 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

Expand (dilate) objects in grayscale images

Fill gaps and holes (close) in grayscale images

Fill holes and smooth right angles

Reduce (erode) objects in grayscale images

Remove small objects (open) from grayscale images

Smooth an image with filtering

Smooth object boundaries in binary images

Gray Morphology FAQs

Currently, there are no FAQs associated with this processing function.

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. The following controls are available.

- Step Name—Name to give the step.
- FFT Filters

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.

Apply an FFT Filter to an Image

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Select the <u>Truncate</u> or <u>Attenuate</u> 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.

FFT Filter FAQs

Currently, there are no FAQs associated with this processing function.

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.

Main Tab

The following control is available on the Main tab.

• **Step Name**—Name to give the step.

Threshold Tab

The following controls are available on the Threshold tab.

• 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: Backgrour 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.			

AutoApplies a threshold to an image by using a statisticalThreshold:tool called moments, which recalculates a theoreticalMomentsbinary image.

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

Threshold a Grayscale Image

Main Tab

In the **Step Name** control, enter a descriptive name for the step.

Threshold Tab

- 1. Select whether you want the function to look for bright, dark, or gray objects.
- 2. 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.
- P

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.

Grayscale Threshold FAQs

Currently, there are no FAQs associated with this processing function.

Watershed Segmentation

Performs segmentation on images using the <u>watershed</u> transform. Refer to the *NI Vision Concepts Manual* for information about the watershed transform. The following controls are available.

- Step Name—Name to give the step.
- **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.

Segment 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**) <u>Threshold</u> the image to isolate the objects you want to segment from the rest of the image.
- 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 <u>Danielsson</u> 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.

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).
- 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**).

Operators

Performs arithmetic and logical operations on images. The following controls are available.

- **Step Name**—Name to give the step.
- 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.
Multiply Divide	Computes a ratio between two images. Each pixel in the original image is multiplied by the constant before being divided by the equivalent pixel found in another image stored in the buffer. This is a pixel-by-pixel operation.
Modulo	Executes modulo division (remainder) of the original input image and a constant or another image stored in the buffer. This is a pixel-by-pixel operation.
Absolute Difference	Subtracts one image from another or a constant from an image and returns the absolute value of the difference.
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 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.

NotPerforms 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 Finds the logical difference between the original input Difference 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.
- Average Calculates the average of the original input image and a constant or another image stored in the buffer. 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.
- Clear if < If pixel (x, y) in the original input image is less than a constant or pixel (x, y) in another image, the resulting pixel (x, y) equals 0. Otherwise, the resulting pixel (x, y) equals pixel (x, y) in the original input image. This is a pixel-by-pixel operation.
- Clear if < If pixel (x, y) in the original input image is less than or or = equal to a constant or pixel (x, y) in another image, the

resulting pixel (x, y) equals 0. Otherwise, the resulting pixel (x, y) equals pixel (x, y) in the original input image. This is a pixel-by-pixel operation.

- Clear if = If pixel (x, y) in the original input image is equal to a constant or pixel (x, y) in another image, the resulting pixel (x, y) equals 0. Otherwise, the resulting pixel (x, y) equals pixel (x, y) in the original input image. This is a pixel-by-pixel operation.
- Clear if > If pixel (x, y) in the original input image is greater than or = 0 or equal to a constant or pixel (x, y) in another image, the resulting pixel (x, y) equals 0. Otherwise, the resulting pixel (x, y) equals pixel (x, y) in the original input image. This is a pixel-by-pixel operation.
- Clear if > If pixel (x, y) in the original input image is greater than a constant or pixel (x, y) in another image, the resulting pixel (x, y) equals 0. Otherwise, the resulting pixel (x, y) equals pixel (x, y) in the original input image. 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.

Use the Operators Function

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Select one of the operators 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.
 - Note For the Mask operator, you can select only the **Image** option. For the Multiply Divide operator, you must specify an **Image** and a **Constant**.
- 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

Retrieve an image from an image buffer Store an image in an image buffer

Operators FAQs

Currently, there are no FAQs associated with this processing function.

Conversion

Converts the current image to the specified image type. The following controls are available.

- Step Name—Name to give the step.
- 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 8bit 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.

Convert Grayscale Images

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 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.

Conversion FAQs

Currently, there are no FAQs associated with this processing function.

Quantify

Quantifies the contents of an image or regions within an image. You can select regions using the ROI tools from the toolbar.

Quantify Tab

The following controls are available on the Quantify tab.

- **Step Name**—Name to give the step.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.

Results

- Area (%)—Percentage of the analyzed surface in relation to the complete image.
- Mean Value—Mean value of the pixels.
- Standard Variation—Standard deviation of the pixel values.
- Minimum Value—Smallest pixel value.
- Maximum Value—Largest pixel value.

Quantify an ROI in an Image

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Select one of the ROI tools from the toolbar.
- 3. Select a region of interest from the image. Vision Assistant lists the intensity measurements for that ROI in the **Results** table.
- 4. Click **OK** to add this step to the script.
- 💡 Tips
 - You can select multiple regions of interest on the image. Vision Assistant numerically labels all of the ROIs selected and the corresponding measurements.
 - To save the data, click the **Send Data to Excel** button or the **Save Results** button.
 - You can remove the selected data with the **Delete Selection** button or delete all results with the **Delete All Results** button.

Quantify FAQs

Currently, there are no FAQs associated with this processing function.

Centroid

P

Calculates the energy center of the image. The following controls are available.

- **Step Name**—Name to give the step.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.
- **X Position**—X-coordinate of the energy center of the image.
- **Y Position**—Y-coordinate of the energy center of the image.
- **Tip** You can perform the centroid computation on a portion of the image by drawing a region of interest (ROI) around the region.

Compute the Energy Center of an Image

- 1. Vision Assistant calculates the energy center (centroid) of the image and returns the coordinates.
- 2. In the **Step Name** control, enter a descriptive name for the step.
- 3. Click **OK** to add this step to the script.
- **Tip** You can compute the centroid of a portion of the image by drawing an ROI.

Centroid FAQs

Currently, there are no FAQs associated with this processing function.

Use Binary Functions

This palette groups several image functions that analyze binary images.

Basic Morphology

Use this function to expand or reduce particles, smooth the particle borders, and isolate external or internal particle boundaries. You can use basic morphological transformations to prepare particles for quantitative analysis, to observe the geometry of regions, and to extract the simplest forms for modeling and identification.

Adv. Morphology

Use this function to fill holes in particles, remove particles that touch the border of the image, remove unwanted small and large particles, separate touching particles, find the convex hull of particles, and more.

Particle Filter

Use this function to remove or keep particles in an image as specified by the filter criteria.

Binary Image Inversion

Use this function to reverse the dynamic of an image, making the background pixels into particles and making particles into background pixels.

Shape Matching

Use this function to search an image for objects that have a shape similar to a template object.

Particle Analysis

Use this function to make shape measurements on particles in the image.

Circle Detection

Use this function to finds the center and radius of circular particles in an image.

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. The following controls are available.

- **Step Name**—Name to give the step.
- Basic Morphology Operations

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

Gradient Extracts the interior contours of a particle.

combination of closings and openings.

In

Gradient Extracts the exterior contours of a particle. Out

Auto 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

Expand (dilate) objects in binary images Extract the contours of a particle Fill gaps and holes (close) in binary images Fill holes and smooth right angles Reduce (erode) objects in binary images Remove single pixels and right angles Remove small objects (open) from binary images Smooth object boundaries in binary images

Reduce (Erode) 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

Expand (dilate) objects in binary images

Extract the contours of a particle

Fill gaps and holes (close) in binary images

Fill holes and smooth right angles

Reduce (erode) objects in grayscale images

Remove single pixels and right angles

Remove small objects (open) from binary images

Expand (Dilate) 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

Expand (dilate) objects in grayscale images

Extract the contours of a particle

Fill gaps and holes (close) in binary images

Fill holes and smoothing right angles

Reduce (eroding) objects in binary images

Remove single pixels and right angles

Remove small objects (open) from binary images

Remove 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.
- \mathbb{N}

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

Expand (dilate) objects in binary images

Extract the contours of a particle

Fill gaps and holes (close) in binary images

Fill holes and smooth right angles

Reduce (erode) objects in binary images

Remove single pixels and right angles

Remove small objects (open) from grayscale images

Fill Gaps and Goles (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)

Expand (dilate) objects in binary images

Extract the contours of a particle

Fill gaps and holes (close) in grayscale images

Fill holes and smoothing right angles

Reduce (erode) objects in binary images

Remove single pixels and right angles

Remove small objects (open) from binary images

Smooth 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**—Smoothes boundaries of objects and fills small holes.
 - **Proper Close**—Smoothes boundaries of objects and removes small particles.
 - Auto Median—Smoothes 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.
- P
 - **Tip** Experiment with different coefficients and the **Kernel Size** to get the results you want.

Related Topics

Expand (dilate) objects in binary images

Extract the contours of a particle

Fill gaps and holes (close) in binary images

Fill holes and smooth right angles

Reduce (erode) objects in binary images

Remove single pixels and right angles

Remove small objects (open) from binary images

Smooth object boundaries in grayscale images

Extract 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.



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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

Expand (dilate) objects in binary images

Fill gaps and holes (close) in binary images

Fill holes and smooth right angles

Reduce (erode) objects in binary images

Remove single pixels and right angles

Remove small objects (open) from binary images

Fill Holes and Smooth 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.



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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

Expand (dilate) objects in binary images

Extract the contours of a particle

Fill gaps and holes (close) in binary images

Fill gaps and holes (close) in grayscale images

Fill holes

Reduce (erode) objects in binary images

Remove single pixels and right angles

Remove small objects (open) from binary images

Smooth an image with filtering

Smooth object boundaries in binary images

Smooth object boundaries in grayscale images

Remove 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.



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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

Expand (dilate) objects in binary images

Extract the contours of a particle

Fill gaps and holes (close) in binary images

Fill holes and smooth right angles

Reduce (erode) objects in binary images

Remove small objects (open) from binary images

Basic Morphology FAQs

Currently, there are no FAQs associated with this processing function.

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. The following controls are available.

- **Step Name**—Name to give the step.
- Advanced Morphology Operations

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 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.

Remove 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

Compute the convex hull of objects

Create a distance map

Fill holes

Label objects

Reduce objects to their skeletons

Remove large objects

Remove objects touching the border of an image

Segment an image

Remove 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

Compute the convex hull of objects

Create a distance map

Fill holes

Label objects

Reduce objects to their skeletons

Remove objects touching the border of an image

Remove small objects

Segment an image

Remove Objects Touching the Image Border

- 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

Compute the convex hull of objects

Create a distance map

Fill holes

Label objects

Reduce objects to their skeletons

Remove large objects

Remove small objects

Segment an image

Fill 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

Compute the convex hull of objects

Create a distance map

Fill gaps and holes (close) in binary images

Fill gaps and holes (close) in grayscale images

Fill holes and smooth right angles

Label objects

Reduce objects to their skeletons

Remove large objects

Remove objects touching the border of an image

Remove small objects

Segment an image

Compute 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

Create a distance map Fill holes Label objects Reduce objects to their skeletons Remove large objects Remove objects touching the border of an image Remove small objects Segment an image Separate objects

Reduce Objects to 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

Compute the convex hull of objects

Create a distance map

Fill holes

Label objects

Remove large objects

Remove objects touching the border of an image

Remove small objects

Segment an image

Separate 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

Compute the convex hull of objects

Create a distance map

Fill holes

Label objects

Reduce objects to their skeletons

Remove large objects

Remove objects touching the border of an image

Remove small objects

Segment an image

Label 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

Compute the convex hull of objects

Create a distance map

Fill holes

Reduce objects to their skeletons

Remove large objects

Remove objects touching the border of an image

Remove small objects

Segment an image

Create 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

Compute the convex hull of objects

Fill holes

Label objects

Reduce objects to their skeletons

Remove large objects

Remove objects touching the border of an image

Remove small objects

Segment an image

Segment 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

Compute the convex hull of objects Create a distance map Fill holes Label objects

Reduce objects to their skeletons

Remove large objects

Remove objects touching the border of an image

Remove small objects

Advanced Morphology FAQs

Currently, there are no FAQs associated with this processing function.

Particle Filter

Removes or keeps particles in an image as specified by the filter criteria. The following controls are available.

- Step Name—Name to give the step.
- Filter Criteria—<u>List of measurements</u> 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 Specifies the range to filter. When this option is

- 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.

Filter Objects Based on Particle Measurements

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 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, enable the **Exclude Interval** control.

Particle Filter FAQs

Currently, there are no FAQs associated with this processing function.

Binary Image Inversion

Reverses the dynamic of an image containing two different grayscale populations. The following control is available.

• Step Name—Name to give the step.

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.

Invert a Binary Image

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Click **OK** to reverse the dynamic of an image containing two different grayscale populations.

Binary Image Inversion FAQs

Currently, there are no FAQs associated with this processing function.

Particle Analysis

Displays measurement results for selected particle measurements performed on the image.

- Step Name—Name to give the step.
- **Number of Objects**—Displays the total number of particles found 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.
- **Show Labels**—Vision Assistant assigns numeric labels to objects that it analyzes.
- Select Measurements—Displays a list of <u>object measurements</u> that can be calculated and displayed.
- **Results**—Displays the <u>measurements</u> for each particle in the image.

Perform a Particle Analysis

- 1. Vision Assistant calculates measurements for every particle in the image and displays the results.
- 2. In the **Step Name** control, enter a descriptive name for the step.
- 3. Click **OK** to add this step to the script.
- 💡 🛛 Tips
 - Vision Assistant assigns numerical labels to all particles in the particle analysis. Select **Show Labels** to display labels. When you click a labeled particle, Vision Assistant highlights the particle and the corresponding results in the table. You also can click the results to highlight the corresponding particle in the image.
 - To remove or add particle measurements displayed in the **Results** table, click the **Select Measurements** button and click the object measurements to select or deselect them. Vision Assistant places a check mark to the left of the measurements currently displayed.
 - To save the data, click the 🕒 Send Data to Excel button or the 💷 Save Results button.

Particle Analysis FAQs

Currently, there are no FAQs associated with this processing function.

Shape Matching

Finds objects in an image that are shaped like the object specified by the template. Images must be binary, and objects being searched must be white. The following controls are available.

Template Tab

- Step Name—Name to give the step.
- **Create Template**—Learns the selected ROI and saves the result as a template shape file. Specifies that file as the shape to search for.
- Load from File—Launches a dialog box in which you can browse to a template image file and specify that file as the search template.
- **Minimum Score**—Specifies the minimum score an instance of the template can have to be considered a valid match. This value can range from 0 to 1000, where a score of 1000 indicates a perfect match.
- **Scale Invariance**—Searches for any objects that match the shape specified in the template, regardless of size.

Results

Displays the following information after searching the image for the shape:

- **Results**—Numeric label associated with each of the matches found in the image.
- **Center X**—X-coordinate of each object that matches the shape template.
- **Center Y**—Y-coordinate of each object that matches the shape template.
- **Score**—Score of each valid match. Score values can range from 0 to 1000, where a score of 1000 indicates a perfect match.

Related Topics

Pattern Matching (Machine Vision»Pattern Matching) Searching a binary image for a shape Searching for templates using pattern matching Selecting a region of interest (ROI)

Search a Binary Image for a Shape

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Create a new template or select an existing template to use for shape matching:
 - Click Create Template, select an ROI, and click OK. Enter a File name for the template and click OK.

or

- Click **Load from File**, browse to the appropriate template file, and click **OK**.
- 3. Set **Minimum Score**, which is a threshold parameter between 0 and 1000. Shapes scoring above the specified value are considered matching shapes.
- 4. If you want all matching shapes returned regardless of size, select **Scale Invariance**.
- 5. Click **OK** to save this step to the script.

Shape Matching FAQs

Currently, there are no FAQs associated with this processing function.

Circle Detection

Finds the center and radius of circular particles in an image. The following controls are available.

- **Step Name**—Name to give the step.
- Number of Circles Found—Total number of circles found in the image.
- **Minimum Radius**—Specifies the smallest radius, in pixels, to detect. Circles with a radius smaller than this value are not returned in the Results table.
- **Maximum Radius**—Specifies the largest radius, in pixels, to detect. Circles with a radius larger than this value are ignored.

Results

Displays the results for all circles detected in the image.

- **Center X**—X-coordinate of the center of the circle.
- **Center Y**—Y-coordinate of the center of the circle.
- **Radius**—Radius of the circle.

Detect Circles

- 1. Vision Assistant finds the best circular fit in each particle and displays the results.
- 2. In the **Step Name** control, enter a descriptive name for the step.
- 3. Set up the **Minimum Radius** and **Maximum Radius** of the circles to be detected.
- 4. Click **OK** to add this step to the script.

Note This algorithm is dedicated to convex objects, and may find and return multiple circles in a single non-convex object.

Circle Detection FAQs

Currently, there are no FAQs associated with this processing function.

Use Machine Vision Functions

This palette groups several image functions that perform the following common machine vision inspection tasks:

- Detecting the presence or absence of parts in an image.
- Measuring the dimension of parts to determine if they meet specifications.
- Locating objects in an image.

Edge Detector

Use this function to find edges along a line that you draw with the Line Tool from the toolbar.

Straight Edge (Rake)

Use this function to find points within the edge of an object and fit a line to those points describing the edge.

Circular Edge (Spoke)

Use this function to locate the intersection points between a set of search lines within a circular area (annulus) and find the best fit circle.

Clamp

Use this function to find edges within a rectangular region drawn in the image and measures the distance between the first and last edge.
Pattern Matching

Use this function to locate regions of a grayscale image that match a predetermined template. Pattern Matching can find template matches regardless of poor lighting, blur, noise, shifting of the template, and rotation of the template.

Geometric Matching

Use this function to locate regions in a grayscale image that match a predetermined template. Geometric matching is designed to locate templates characterized by distinct geometric or shape information. The function can find template matches regardless of lighting variation, blur, noise, occlusion, and geometric transformations such as shifting, rotation, or scaling of the template.

Shape Detection

Use this function to locate circles, ellipses, rectangles, or lines that meet the specified geometric criteria.

Defect Inspection

Use this function to compare areas of an image to a learned template and return the differences found in the image.

Caliper

Use this function to compute measurements—such as distances, areas, and angles—based on results returned from other machine vision and image processing functions.

Edge Detector

Detects edges in grayscale images.

Main Tab

The following controls are available on the Main tab.

- Step Name—Name to give the step.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.

Edge Detector Tab

The following controls are available on the Edge Detector tab.

Edge Detector

Simple Finds step edges along a selected path based on a Edge Tool threshold of the grayscale values along the path. The Simple Edge Tool can return the first, both the first and the last, or all the edges found along the path.

Advanced Finds edges along a path defined in the image. A Edge Tool kernel operator is applied to the search region to detect edges in the image.

Look For

First Edge Finds and labels only the first edge along the line selected with the ROI tool.

First & Finds and labels only the first and last edge along the Last Edge line selected with the ROI tool.

All Edges Finds and labels all edges along the line selected with the ROI tool.

Best Edge Finds the strongest edge in the search region.

Advanced Edge Tool Controls

The following controls are available when the Edge Detector control is set to **Advanced Edge Tool**.

• Edge Polarity

All Edges Searches for all edges.

Rising Edges Searches for rising edges.

Falling Edges Searches for falling edges.

• Interpolation Type

Zero Rounds to the nearest integral edge location. Order

Bilinear Uses bilinear interpolation to compute the edge location.

Bilinear Uses the fixed-point computation of bilinear interpolation Fixed to determine the edge location.

- Kernel Size—Specifies the size of the edge detection kernel.
- Width—Specifies the number of pixels averaged perpendicular to the search direction to compute the edge profile strength at each point along the search ROI.
- **Min Edge Strength**—Specifies the minimum edge strength required for a detected edge.
- Edge Strength Profile—Plots the variations of intensity along the selected ROI.
- Edges Found—Number of edges found along the selected ROI according to the parameters you set.

Simple Edge Tool Controls

The following controls are available when the Edge Detector control is set to **Simple Edge Tool**.

• Level Type

Absolute Specifies the threshold level in pixel values. Value

Relative Specifies the threshold level as a percentage of the intensity range found along the ROI path.

- **Threshold Level**—Specifies the intensity level, expressed either in pixel values or as a percentage, that you expect to constitute an edge in the image. For example, when you set **Absolute Value** to 128, an edge occurs when there is a transition from below 128 to above 128.
- Line Profile—Plots the variations of intensity along the selected ROI.
- Edges Found—Number of edges found along the selected ROI according to the parameters you set.

Detect Edges in Grayscale Images

Main Tab

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Verify that the **Reposition Region of Interest** option is enabled if you want to link the region of interest specified in this step to a previously defined coordinate system.

Link the region of interest to a coordinate system if the position of the object under inspection changes from image to image, and you need to adjust the position of the region of interest to match the new location of the object.

Edge Detector Tab

You can find edges in grayscale images using the <u>Simple Edge Tool</u> or the <u>Advanced Edge Tool</u>.

Edge Detector FAQs

Currently, there are no FAQs associated with this processing function.

Straight Edge (Rake)

Finds points along the edge of an object and finds a line describing the edge.

Locates the intersection points between a set of search lines within a rectangular search area and the edge of an object. Edges are determined based on their contrast and slope. The function returns the line that best fits the edges found.

Main Tab

The following controls are available on the Main tab.

- **Step Name**—Name to give the step.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.

Settings Tab

The following controls are available on the Settings tab.

- **Auto Setup**—When enabled, the step automatically locates the strongest edge in the region of interest (ROI) and returns the parameters it used to find the edge.
 - Note Vision Assistant uses the Auto Setup parameters to compute the optimal parameters the first time you configure the step. After the optimal parameters are computed, they are saved in the script, and the Auto Setup parameters are disabled. Edits to the step will edit the optimal parameters.
- Search Lines
 - **Direction**—Direction in which you want the search lines to look for a straight edge within the ROI.
 - Gap—Number of pixels between search lines in the ROI.
 - **Edge Strength**—Minimum difference in the intensity values between the edge and its surroundings.
 - **Smoothing**—Number of pixels averaged to find the contrast at either side of the edge.
 - Steepness—Maximum distance in which the edge strength must occur. Steepness characterizes the slope of the edge. Use a higher Steepness value to detect edges in images whose pixel intensities gradually transition from the background to the edge.
- Edge Strength Profile—Edge strength along the search line located in the middle of the ROI.

Results Tab

Displays the results for edges detected in the image.

- **Current Angle**—Angle from the horizontal axis to the located edge.
- **Current Deviation**—Maximum distance found between the points of the edge and the fitted line.
- **Current Short Distance**—Indicates the shorter of the following distances:
 - The distance between the start point of the first search line and the intersection of the fitted line and the first search line.
 - The distance between the start point of the last search line and the intersection of the fitted line and the last search line.
- **Current Long Distance**—Indicates the longer of the following distances:
 - The distance between the start point of the first search line and the intersection of the fitted line and the first search line.
 - The distance between the start point of the last search line and the intersection of the fitted line and the last search line.

Displays the results of the edge detection.

Related Topics

Detecting circular edges in grayscale images

Detecting straight edges in grayscale images

Edge Detector (Machine Vision»Edge Detector)

Circular Edge (Spoke) (Machine Vision»Circular Edge (Spoke))

Finding edges in grayscale images

Detect Straight Edges in Grayscale Images

Note The Straight Edge (Rake) function works only with 8-bit images.

Main Tab

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Verify that the **Reposition Region of Interest** option is enabled if you want to link the region of interest specified in this step to a previously defined coordinate system.

Link the region of interest to a coordinate system if the position of the object under inspection changes from image to image, and you need to adjust the position of the region of interest to match the new location of the object.

Settings Tab

- 1. Select the appropriate ROI tool.
- 2. Draw a region of interest that includes the straight edge you want to find.

When you specify a region of interest, the step automatically tries to locate a straight edge in the region. If the automatically located edge corresponds to the edge you expected to find, click **OK** to close the Parameter window and add the step to the script. Otherwise, go to the next step.

- 3. Disable **Auto Setup** and manually adjust the edge location parameters.
 - a. Select the direction properties of the search lines. Select a search line orientation that is perpendicular to the edge.

Also, select the search direction along the line that has the least number of obstacles between the edge of the region and the object edge you want to find.

b. If the Edge Strength Profile contains a strong peak that corresponds to the edge you want to find, adjust the yellow edge strength line so that it lies slightly below the top of the edge peak but above all of the other peaks.

If the Edge Strength Profile does not contain a strong edge peak, adjust the **Smoothing** and **Steepness** controls until a peak appears.

If the step still cannot find the edge or the location of the detected edge is inaccurate, adjust the **Gap** between the search lines until you achieve the expected result.

Tip You can modify and move the ROI using context sensitivity. Click the ROI and move the contours as necessary. You also can select the complete ROI by clicking the middle of the ROI and dragging it.

Straight Edge (Rake) FAQs

What settings does Auto Setup use?

Auto Setup tries to determine the best straight edge in the region of interest by searching for edges in all directions. The values for **Gap**, **Edge Strength**, **Smoothing**, and **Steepness** are estimated to find the best edge from each search direction. The quality of the edge is based on the average deviation of the edge points from the fitted edge. The parameters that locate the edge with the smallest deviation are returned as the **Auto Setup** results. The parameter values estimated by **Auto Setup** appear in the dimmed setting controls.

Adv. Straight Edge

Locates a straight edge in a region of interest.

Main Tab

The following controls are available on the Main tab.

- **Step Name**—Name to give the step.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.

Edge Detector Settings Tab

The following controls are available on the Edge Detector Settings tab.

- **Suggest Values**—When enabled, the step suggests appropriate values for the Edge Detector controls.
- **Detection Method**—Specifies the method to use to find the straight edge. The following options are available:
 - **First Edge Rake**—Fits a straight edge on the first point detected using a Rake.
 - **Best Edge Rake**—Fits a straight edge on the best points detected using a Rake.
 - **Best Hough Edge Rake**—Fits the strongest straight edge using all points detected using a Rake.
 - **First Edge Projection**—Uses the location of the first projected edge as the straight edge.
 - **Best Edge Projection** Finds the strongest projected edge location to determine the straight edge.
- **Search Direction**—Direction in which you want the search lines to look for a straight edge within the region of interest. The following options are available:
 - Left to Right—Searches for edges within the region of interest from left to right.
 - **Right to Left**—Searches for edges within the region of interest from right to left.
 - **Top to Bottom**—Searches for edges within the region of interest from top to bottom.
 - **Bottom to Top**—Searches for edges within the region of interest from bottom to top.
- Edge Polarity—Specifies the pixel intensity transitions to use to determine edges. The following options are available:
 - **Any Edge**—Finds edges characterized by dark-to-bright and bright-to-dark pixel intensity transitions.
 - Dark to Bright—Finds only those edges characterized by dark-to-bright pixel intensity transitions along the direction of the search line.
 - Bright to Dark—Finds only those edges characterized by

bright-to-dark pixel intensity transitions along the direction of the search line.

- **Minimum Edge Strength**—Minimum difference in the intensity values between the edge and its surroundings.
- **Minimum Edge SNR**—Specifies the minimum signal to noise ration (SNR) of the edge points used to fit the straight line.
- Kernel Size—Specifies the size of the edge detection kernel.
- **Gap**—Specifies the size, in pixels, of the space between the search lines. This control is only used with a Rake-based **Detection Method**.
- **Projection Width**—Specifies the number of pixels averaged perpendicular to the **Search Direction** to compute the edge profile strength at each point along the region of interest.
- Interpolation—Specifies the interpolation method used to locate the edge position. The following options are available:
 - **Zero Order**—Rounds to the nearest integral edge location.
 - **Bilinear**—Uses bilinear interpolation to compute the edge location.
 - **Bilinear Fixed**—Uses bilinear fixed interpolation to compute the edge location.
- **Projection Method**—Specifies the method used to process the data extracted by the edge detector. The following options are available:
 - Average—Averaged the data extracted for edge detection.
 - **Median**—Computes the median of the data extracted for edge detection.
- **Straight Edges Found**—Displays the number of straight edges found by the step.
- Search Line Index—For a Rake-based Detection Method, specifies the search line used by the Edge Strength Profile and Edge Points Found on Search Line controls.
- Edge Index—For an Edge Projection Detection Method, specifies the index of the edge for which the Edge Strength Profile is shown.
- Edge Strength Profile—Displays a strength profile of the edges found along the specified Search Line Index based on the current

control settings.

- Edge Points Found on Search Line—Displays information about the edge points found on the specified Search Line Index. The following information is displayed for each edge:
 - X—X-coordinate of the edge.
 - **Y**—Y-coordinate of the edge.
 - **Strength**—Strength of the edge. Higher values indicate a stronger edge.
 - **STR**—Signal to threshold ratio for the edge.
 - **TNR**—Threshold to noise ratio for the edge.
 - **SNR**—Signal to noise ratio for the edge.

Straight Edge Settings Tab

The following controls are available on the Straight Edge Settings tab.

- **Suggest Values**—When enabled, the step suggests appropriate values for the Straight Edge Settings controls.
- **Minimum Score**—Specifies the minimum score of a detected straight edge.
- **Maximum Score**—Specifies the maximum score of a detected straight edge.
- **Angle Range**—Specifies the positive and negative range within which the straight edge is expected to be found.
- **Angle Tolerance**—Specifies the expected angular accuracy of the straight edge.
- **Minimum Coverage**—Specifies the number of points, as a percentage of the number of search lines, that need to be included in the detected straight edge.
- **Maximum Iterations**—Specifies the number of iterations used for a Hough **Detection Method**.
- **Straight Edges Requested**—Specifies the number of straight edges to find in the image.
- **Straight Edges Found**—Displays the number of straight edges found by the step.
- Search Line Index—For a Rake-based Detection Method, specifies the search line used by the Edge Strength Profile and Edge Points Found on Search Line controls.
- Edge Strength Profile—Displays a strength profile of the edges found along the specified Search Line Index based on the current control settings.
- Edge Points Found on Search Line—Displays information about the edge points found on the specified Search Line Index. The following information is displayed for each edge:
 - **X**—X-coordinate of the edge.
 - **Y**—Y-coordinate of the edge.
 - **Strength**—Strength of the edge. Higher values indicate a stronger edge.
 - **STR**—Signal to threshold ratio for the edge.

- **TNR**—Threshold to noise ratio for the edge.
- **SNR**—Signal to noise ratio for the edge.

Results Tab

Displays the results for edges detected in the image.

- **Straight Edge Results**—Displays information about the straight edges found in the image.
- **Straight Edges Found**—Displays the number of straight edges found by the step.

Detect a Straight Edge

Main Tab

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Verify that the **Reposition Region of Interest** option is enabled if you want to link the region of interest specified in this step to a previously defined coordinate system.

Link the region of interest to a coordinate system if the position of the object under inspection changes from image to image, and you need to adjust the position of the region of interest to match the new location of the object.

Edge Detector Settings Tab

1. Select the detection method and direction properties of the search lines. Select a search line orientation that is perpendicular to the edge. For example, the orientation of the edge in the following figure is vertical. Therefore, the search lines are horizontal.

Also, select the search direction along the lines that has the least number of obstacles between the edge of the region and the object edge you want to find. In the following figure, the search direction is right to left so that the step avoids detecting the edges of miscellaneous objects.



2. If the step does not locate the correct edge, disable the **Suggest Values** control, and adjust the blue edge strength line so that it lies slightly below the top of the edge peak but above all of the other peaks.

If the Edge Strength Profile does not contain a strong edge peak, adjust the edge detection controls until a peak appears.

If the step still cannot find the edge or the location of the detected edge is inaccurate, adjust the gap between the search lines until you achieve the expected result.

Straight Edge Settings Tab

- 4. In the **Straight Edges Requested** control, set the number of edges you want to find in the image.
- 5. If necessary, disable the **Suggest Values** control and use the other controls on the **Edge Settings** tab to specify additional criteria for determining edges.

Results Tab

- 6. Set the limits that correspond to the specifications of the edges you want to find in the image.
- 7. Click **OK** to add the step to the inspection.

Adv. Straight Edge FAQs

Currently, there are no FAQs associated with this processing function.

Circular Edge (Spoke)

Locates the intersection points between a set of search lines within a circular area, such as an annulus and the edge of a circular object. Edges are determined based on their contrast and slope. The function returns the circle that best fits the edges found.

Main Tab

The following controls are available on the Main tab.

- **Step Name**—Name to give the step.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.

Settings Tab

The following controls are available on the Settings tab.

- **Auto Setup**—When enabled, the software locates the strongest edge in the region of interest (ROI) and returns the parameters it used to find the edge.
 - Note Vision Assistant uses the parameters returned by the Auto Setup function to compute the optimal parameters the first time you configure the step. After the optimal parameters are computed, they are saved in the script, and the Auto Setup parameters are disabled. Edits to the step will edit the optimal parameters.
- Search Lines
 - **Direction**—Direction in which you want the search lines to look for a circular edge within the ROI.
 - **Gap**—Number of pixels between search lines in the ROI.
 - **Edge Strength**—Minimum difference in the intensity values between the edge and its surroundings.
 - **Smoothing**—Number of pixels averaged to find the contrast at either side of the edge.
 - Steepness—Maximum distance in which the edge strength must occur. Steepness characterizes the slope of the edge. Use a higher Steepness value to detect edges in images whose pixel intensities gradually transition from the background to the edge.
- Edge Strength Profile—Edge strength along the search line located in the middle of the ROI.
Results Tab

Displays the results of the edge detection.

- **Center X**—X-coordinate of the center of the circle.
- **Center Y**—Y-coordinate of the center of the circle.
- **Current Radius**—Radius of the circular edge found.
- **Current Deviation**—Maximum distance found between the points of the edge and the fitted circle.

Detect Circular Edges in Grayscale Images

Note The Circular Edge (Spoke) function works only with 8-bit images.

Main Tab

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Verify that the **Reposition Region of Interest** option is enabled if you want to link the region of interest specified in this step to a previously defined coordinate system.

Link the region of interest to a coordinate system if the position of the object under inspection changes from image to image, and you need to adjust the position of the region of interest to match the new location of the object.

Settings Tab

1. Draw and adjust a region of interest using the annulus tool that includes the circular edge you want to find.

When you specify a region of interest, the step automatically tries to locate a circular edge in the region. If the automatically-located edge corresponds to the edge you expected to find, skip the next step. Otherwise, go to the next step.

- 2. Disable the **Auto Setup** control and manually adjust the edge location parameters.
 - a. Select the direction properties of the search lines. Select the search direction along the lines that has the least number of obstacles between the edge of the region and the object edge you want to find.
 - b. If the Edge Strength Profile contains a strong peak that corresponds to the edge you want to find, adjust the yellow edge strength line so that it lies slightly below the top of the edge peak but above all of the other peaks.

If the Edge Strength Profile does not contain a strong edge peak, adjust the **Smoothing** and **Steepness** controls until a peak appears.

If the step still cannot find the edge or the location of the detected edge is inaccurate, adjust the gap between the search lines until you achieve the expected result.

Results Tab

- 1. Click the **Results** tab to view information about the center and radius of the circular edge the step found on the image.
- 2. Click **OK** to add this step to the script and close the parameter window.
- **Tip** You can modify and move the ROI using context sensitivity. Move the mouse close to the control points of the ROI to adjust their positions. You also can select the entire ROI by clicking the middle of the ROI and dragging it.

Circular Edge (Spoke) FAQs

What settings does Auto Setup use?

Auto Setup tries to determine the best circular edge in the region of interest by searching for edges in all directions. The values for **Gap**, **Edge Strength**, **Smoothing**, and **Steepness** are estimated to find the best edge from each search direction. The quality of the edge is based on the average deviation of the edge points from the fitted edge. The edge with the smallest deviation is returned as the **Auto Setup** result. The parameter values estimated by **Auto Setup** appear in the dimmed setting controls.

Clamp

Finds edges along a rectangular region of interest (ROI) that you draw in the image and measures the distance between the first and last edges found. The edges are located along multiple parallel search lines drawn within a rectangular ROI. Edges are determined based on their contrast and slope.

Main Tab

The following controls are available on the Main tab.

- Step Name—Name to give the step.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.

Clamp Tab

• **Process**—Type of caliper you want to use.

Horizontal Max Caliper—Measures a distance in the horizontal direction from the vertical sides of the ROI toward the center of the ROI.

Horizontal Min Caliper—Measures a distance in the horizontal direction from the center of the ROI toward the vertical sides of the ROI.

Vertical Max Caliper—Measures a distance in the vertical direction from the horizontal sides of the ROI toward the center of the ROI.

- Vertical Min Caliper—Measures a distance in the vertical direction from the center of the ROI toward the horizontal sides of the ROI.

- **Gap**—Number of pixels between search lines in the ROI.
- Edge Strength—Minimum difference in the intensity values between the edge and its surroundings. Only those edges whose strength is greater than this value are used in the detection process.
- **Smoothing**—Number of pixels averaged to find the contrast at either side of the edge.
- **Steepness**—Maximum distance in which the edge strength must occur. Steepness characterizes the slope of the edge. Use a longer Steepness to detect edges in images whose pixel intensities gradually transition from the background to the edge.
- Edge Strength Profile—Edge strength along the search line located in the middle of the ROI.
- Current Distance—Distance measured between the clamp arms.

Measure Distances Between Edges Using the Clamp Tool

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

Main Tab

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Verify that the **Reposition Region of Interest** option is enabled if you want to link the region of interest specified in this step to a previously defined coordinate system.

Link the region of interest to a coordinate system if the position of the object under inspection changes from image to image, and you need to adjust the position of the region of interest to match the new location of the object.

Clamp Tab

- 1. Select one of the ROI tools. Click and drag to select a path along which to search for edges and find the distance.
- 2. Select the appropriate **Process**. In the **Edge Strength Profile**, Vision Assistant displays the average of the line profiles of all the lines used for edge detection.
- 3. Adjust the **Gap**, **Edge Strength**, **Smoothing**, and **Steepness** parameters until the Process window indicates that the step has correctly detected the edges of the object you want to measure.
- 4. Click **OK** to add this step to the script and close the Parameter window.
- **Tip** You can modify and move the ROI using context sensitivity. Move the mouse close to the control points of the ROI to adjust their positions. You also can select the entire ROI by clicking the middle of the ROI and dragging it.

Clamp FAQs

Currently, there are no FAQs associated with this processing function.

Pattern Matching

Performs template matching on grayscale images using Pattern Matching.

Main Tab

The following controls are available on the Main tab.

- Step Name—Name to give the step.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.

Template Tab

The following controls are available on the Template tab.

- **Template Image**—Image you want to search for in an inspection image.
- **Template Size**—The width and height, in pixels, of the selected template image.
- **Match Offset**—Specifies the number of pixels you want to shift the focal point of the template from the center of the template. The focal point of the template is the coordinate location of the template match within an inspection image.
- **New Template**—Launches the NI Vision Template Editor wizard, in which you can learn a template and save the result as a template image file.
- Edit Template—Launches the NI Vision Template Editor wizard, in which you can modify a template and save the result as a template image file.
- Load from File—Launches a dialog box in which you can browse to a template image file and specify that file as the search template.
 - Note When you load a template from file, the template can be any valid NI Vision template file, such as a golden template. The Pattern Matching step prompts you to add pattern matching information to the file.
- **Template Path**—Displays the location of the template image file.

Settings Tab

The following controls are available on the Settings tab.

- Number of Matches to Find—Specifies the number of valid matches you expect the pattern matching function to return.
- **Minimum Score**—Specifies the minimum score an instance of the template can have to be considered a valid match. This value can range from 0 to 1000, where a score of 1000 indicates a perfect match.
- **Subpixel Accuracy**—When enabled, returns the match with subpixel accuracy.
- Search for Rotated Patterns—When selected, searches for the template in an image regardless of rotation and shift of the template. When unselected, this option searches for the image regardless of shifting along the x-axis and y-axis.
- **Angle Range**—Angles at which you want to search for the template image. The function searches for the template image at angles ranging from the positive angle to the negative angle.
- **Mirror Angle**—When enabled, the function searches for the template image in the angle range, which you specified in **Angle Range**, and in the mirror of that angle range.

Results

Displays the following information after searching the image for the template:

- **Center X**—X-coordinate of each object that matches the template.
- **Center Y**—Y-coordinate of each object that matches the template.
- **Score**—Score of each valid match. Score values can range from 0 to 1000, where a score of 1000 indicates a perfect match.
- **Angle**—Rotation angle of each object that matches the template at the current match location. Angles are expressed in degrees. This output is valid only when you select rotation-invariant matching.

Search for Templates Using Pattern Matching

Note The Pattern Matching function works only with 8-bit images.

Main Tab

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Verify that the **Reposition Region of Interest** option is enabled if you want to link the region of interest specified in this step to a previously defined coordinate system.

Link the region of interest to a coordinate system if the position of the object under inspection changes from image to image, and you need to adjust the position of the region of interest to match the new location of the object.

Template Tab

Choose one of the following methods to specify the template for the step:

1. Click **Create Template**, select an ROI, and click **OK**. Enter a **File name** for the template and click **OK**.

or

2. Click **Load from File**, browse to the appropriate template file, and click **OK**.

By default, the center of the template is used as the focal point of the template. You can change the location of the focal point to any position in the template. Change the focal point of the template by dragging the red pointer in the template image or adjusting the **Match Offset** values.

Settings Tab

- 1. Modify **Number of Matches to Find**, **Minimum Score**, and **Subpixel Accuracy** as necessary.
- 2. Select **Search for Rotated Patterns** to indicate that the match can be a rotated version of the template. You can restrict the amount of rotation you want to allow by specifying an acceptable angle range. You also can include the mirrored angle range by enabling **Mirror Angle**.
- 3. Click **OK** to save this step to the script.

Pattern Matching FAQs

What does the red pointer in the template image indicate?

The red pointer indicates the point on the template whose coordinate location you want returned when the step finds matches of the template in the inspection image.

When should I mirror the search angle?

Mirror the search angle when the fixture of the part under inspection constrains the location of the part along a specified axis. Another typical use for this parameter is to find templates that are symmetric along one axis.

What is the difference between the green and red regions?

The green region indicates the region of the image in which you want to search for matches to the template. The red region indicates an area that matches the template.

Geometric Matching

Performs template matching on grayscale images using Geometric Matching. Refer to the *NI Vision Template Editor Help* for information about the NI Vision Template Editor controls.

Main Tab

The following controls are available on the Main tab.

- Step Name—Name to give the step.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.

Template Tab

The following controls are available on the Template tab.

- **Template Image**—The image to use as the template.
- Template Size
 - Width—Width of the template in pixels.
 - Height—Height of the template in pixels.
- **New Template**—Launches the NI Vision Template Editor wizard, in which you can learn a template and save the result as a template image file.
- Edit Template—Launches the NI Vision Template Editor wizard, in which you can modify a template and save the result as a template image file.
- Load from File—Launches a dialog box in which you can browse to a template image file and specify that file as the search template.
 - Note When you load a template from file, the template can be any valid NI Vision template image file, such as a golden template. The Geometric Matching step prompts you to add geometric matching information to the file.
- **Template Path**—Displays the location of the template image file.

Curve Settings Tab

The following controls are available on the Curve Settings tab.

- **Extraction Mode**—Specifies how the algorithm identifies curves in the image.
 - **Normal**—Makes no assumptions about the uniformity of objects in the image or the image background.
 - **Uniform Regions**—Assumes that either the objects in the image or the image background consist of uniform pixel values. Use this mode to calculate the external curves of the objects with greater accuracy.
- **Edge Threshold**—Specifies the minimum contrast an edge pixel must have to be considered part of a curve. This value can range from 0 to 255. The default value is 75.
- Edge Filter Size—Specifies the kernel size to use for computing the edges in the image. The options are **Normal** and **Fine**. The default value is **Normal**.
- **Minimum Length**—Specifies the length, in pixels, of the smallest curve you want to extract. The default value is 25.
- **Row Search Step Size**—Specifies the distance, in the y direction, between the image rows that the algorithm inspects for curve seed points. Valid values range from 1 to 255. The default value is 15.
- **Column Search Step Size**—Specifies the distance, in the x direction, between the image columns that the algorithm inspects for curve seed points. Valid values range from 1 to 255. The default value is 15.

Settings Tab

The following controls are available on the Settings tab.

- Number of Matches to Find—Specifies the number of valid matches you expect the geometric matching function to return.
- **Minimum Score**—Specifies the minimum score an instance of the template can have to be considered a valid match. This value can range from 0 to 1000, where a score of 1000 indicates a perfect match.
- **Subpixel Accuracy**—When enabled, returns the match with subpixel accuracy.
- Search for matches that are—Defines the match modes and ranges used to match the template.
 - Rotated—When enabled, this function searches for the template image in the angle range you specify with the Range control. When disabled, this function searches for the image regardless of shifting along the x-axis and y-axis. You may specify a second angle range if needed.
 - Scaled—When enabled, this function searches for a template image that may be scaled in the inspection image. Specify the percentage of scale to search for with the Range control.
 - **Occluded**—When enabled, this function searches for a template image that may be occluded in the inspection image. Specify the amount of occlusion to search for with the Range control. The units for the Range control are the percentage of the template image that is occluded.

Results

Displays the following information after searching the image for the template:

- **X Position**—X-coordinate of each object that matches the template.
- **Y Position**—Y-coordinates of each object that matches the template.
- **Angle**—Rotation angle of each object that matches the template at the current match location. Angles are expressed in degrees.
- **Scale**—The change in scale, expressed as a percentage, of the object found in the image relative to the template.
- **Occlusion %**—The amount of occlusion, expressed as a percentage of the template curves, for each object that matches the template.
- **Score**—Score of each valid match. Score values can range from 0 to 1000, where a score of 1000 indicates a perfect match.
- **Template Target Curve Score**—Specifies how closely the curves in the template match the curves in the match region of the inspection image. Score values can range from 0 to 1000, where a score of 1000 indicates that all template curves have a corresponding curve in the match region of the inspection image.
- **Correlation Score**—Specifies how closely a match matches the template using a correlation metric that compares the two regions as a function of their pixel values.

Search for Templates Using Geometric Matching

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Note The geometric matching function works only with 8-bit images.

Main Tab

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Verify that the **Reposition Region of Interest** option is enabled if you want to link the region of interest specified in this step to a previously defined coordinate system.

Link the region of interest to a coordinate system if the position of the object under inspection changes from image to image, and you need to adjust the position of the region of interest to match the new location of the object.

Template Tab

Choose one of the following methods to specify the template for the step:

• Click **New Template** to launch the NI Vision Template Editor. Refer to the *NI Vision Template Editor Help* for instructions on how to create a geometric template. After creating a template, click **Finish** in the training interface to validate the template. Enter a **File name**, and click **OK**.

or

• Click **Load from File**, browse to the appropriate template file, and click **OK**.

Curve Settings Tab

By default, the values of the parameters in this tab are initialized to the values you selected in the training interface. You can adjust these values to improve edge detection in the inspection image.

Modify the Extraction Mode, Edge Threshold, Edge Filter Size, Minimum Length, Row Search Step Size, and Column Search Step Size to improve edge detection, if necessary.

Settings Tab

- 1. Set the Number of Matches to Find, Minimum Score, and Subpixel Accuracy.
- 2. Enable Search for matches that are: Rotated, Scaled, or Occluded to indicate that a match may be a rotated, scaled, or occluded version of the template. Specify an acceptable range for each parameter to restrict the amount of rotation, scale, or occlusion allowed in a valid match.
- 3. Click **OK** to save this step to the script.

Geometric Matching FAQs

What does the red pointer in the template image indicate?

The red pointer indicates the pixel of the template whose coordinate location you want returned when the step finds matches of the template in the inspection image.

What is the difference between the green and red regions?

The green region indicates the area of the image in which you want to search for matches to the template. The red region indicates an area that matches the template.

Additional edges are detected in the image, besides the curves of my template. Does this affect the accuracy of the matching?

Superfluous edge detection can negatively affect the accuracy of geometric matching. Adjust the curve parameters so that the algorithm detects only the curves of your template object. If the algorithm detects additional edges because of glare for example, use the NI Vision Template Editor to define regions whose edges you want the function to ignore.

Shape Detection

Detects shapes in grayscale images.
Main Tab

The following controls are available on the Main tab.

- **Step Name**—Name to give the step.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.
- View Contour Lines—Displays the edges detected in the image.

Curve Settings Tab

The following controls are available on the Curve Settings tab.

- **Extraction Mode**—Specifies how the algorithm identifies curves in the image.
 - **Normal**—Makes no assumptions about the uniformity of objects in the image or the image background.
 - **Uniform Regions**—Assumes that either the objects in the image or the image background consist of uniform pixel values. Use this mode to calculate the external curves of the objects with greater accuracy.
- **Edge Threshold**—Specifies the minimum contrast an edge pixel must have to be considered part of a curve. This value can range from 0 to 255. The default value is 75.
- Edge Filter Size—Specifies the kernel size to use for computing the edges in the image. The options are **Normal** and **Fine**. The default value is **Normal**.
- **Minimum Length**—Specifies the length, in pixels, of the smallest curve you want to extract. The default value is 25.
- **Row Search Step Size**—Specifies the distance, in the y direction, between the image rows that the algorithm inspects for curve seed points. Valid values range from 1 to 255. The default value is 15.
- **Column Search Step Size**—Specifies the distance, in the x direction, between the image columns that the algorithm inspects for curve seed points. Valid values range from 1 to 255. The default value is 15.
- Maximum Endpoint Gap—Specifies the maximum gap, in pixels, allowed between the endpoints of a curve for the step to identify the curve as closed. If the gap is larger than this value, the step identifies the curve as an open curve. The default value is 10.
- View Contour Lines—Displays the edges detected in the image.

Shape Tab

The following controls are available on the Shape tab.

- **Shape Type**—Specifies the type of shape to detect in the image. The options are Circles, Ellipses, Rectangles, and Lines.
- **Descriptor**—Descriptor associated with the selected Shape Type.
 - Max Radius (Circles)—Maximum length of the radius of the circle to detect.
 - **Min Radius** (Circles)—Minimum length of the radius of the circle to detect. This value must be 3 or higher.
 - Max Major Radius (Ellipses)—Maximum length of the major radius of the ellipse to detect. This value must be greater than Max Minor Radius.
 - Min Major Radius (Ellipses)—Minimum length of the major radius of the ellipse to detect. This value must be 3 or higher, and it must be greater than Min Minor Radius.
 - Max Minor Radius (Ellipse)—Maximum length of the minor radius of the ellipse to detect.
 - **Min Minor Radius** (Ellipses)—Minimum length of the minor radius of the ellipse to detect. This value must be 3 or higher.
 - **Max Width** (Rectangles)—Maximum width of the rectangle to detect. This value must be greater than Max Height.
 - Min Width (Rectangles)—Minimum width of the rectangle to detect. This value must be 3 or higher, and it must be greater than Min Height.
 - Max Height (Rectangles)—Maximum height of the rectangle to detect.
 - **Min Height** (Rectangles)—Minimum height of the rectangle to detect. This value must be 3 or higher.
 - Max Length (Lines)—Maximum length of the line to detect.
 - **Min Length** (Lines)—Minimum length of the line to detect. This value must be 3 or higher.
- View Contour Lines—Displays the edges detected in the image.

Settings Tab

The following controls are available on the Settings tab.

- **Minimum Score**—Specifies the minimum score a detected shape can have to be considered a valid match. This value can range from 0 to 1000, where a score of 1000 indicates a perfect match.
- Search for matches that are—Defines the match modes and ranges used to match the template.
 - **Rotated**—When enabled, this function searches for the shape in the angle range you specify. When disabled, this function searches for the shape regardless of shifting along the x-axis and y-axis. You may specify a second angle range if needed.
 - **Scaled**—When enabled, this function searches for a shape that may be scaled in the inspection image.
 - **Occluded**—When enabled, this function searches for a shape that may be occluded in the inspection image.
- View Contour Lines—Displays the edges detected in the image.

Results

Displays the following information after searching the image for a shape:

- **Score**—Score of each valid match. Score values can range from 0 to 1000, where a score of 1000 indicates a perfect match.
- Radius (Circles)—Length of the radius for each detected circle.
- **Major Radius** (Ellipses)—Length of the major radius for each detected ellipse.
- Minor Radius (Ellipses)—Length of the minor radius for each detected ellipse.
- Width (Rectangles)—Width of each detected rectangle.
- Height (Rectangles)—Length of each detected rectangle.
- Angle—Rotation angle, in degrees, of each detected shape.
- **Center X**—X-coordinate of the center of each detected circle or ellipse.
- **Center Y**—Y-coordinate of the center of each detected circle or ellipse.
- **Corner# X** (Rectangles)—X-coordinate of the corner of each detected rectangle.
- **Corner# Y** (Rectangles)—Y-coordinate of the corner of each detected rectangle.
- Start Point X (Lines)—X-coordinate of the start point of each detected line.
- Start Point Y (Lines)—Y-coordinate of the start point of each detected line.
- End Point X (Lines)—X-coordinate of the end point of each detected line.
- End Point Y (Lines)—Y-coordinate of the end point of each detected line.

Search for Shapes Using Shape Detection

Note The shape detection step works only with 8-bit images.

Main Tab

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Verify that the **Reposition Region of Interest** option is enabled if you want to link the region of interest specified in this step to a previously defined coordinate system.

Link the region of interest to a coordinate system if the position of the object under inspection changes from image to image, and you need to adjust the position of the region of interest to match the new location of the object.

Curve Settings Tab

Modify the Extraction Mode, Edge Threshold, Edge Filter Size, Minimum Length, Row Search Step Size, and Column Search Step Size to improve edge detection, if necessary.

Shape Tab

- 1. Select the type of shape you want to detect.
- 2. Set the Descriptor values to indicate the size of the shapes to return.

Settings Tab

- 1. Specify the minimum score a detected shape can have to be considered a valid match. This value can range from 0 to 1000, where a score of 1000 indicates a perfect match.
- 2. Enable Search for Matches that are Rotated, Scaled, or Occluded to indicate that a match may be a rotated, scaled, or occluded version of the shape you want to detect. Specify an acceptable range for each parameter to restrict the amount of rotation, scale, or occlusion allowed in a valid shape.
- 3. Click **OK** to save this step to the script.

Shape Detection FAQs

What is the difference between the green region and red region?

The green region indicates the area of the image in which you want to search for shapes. The red region indicates a detected shape.

Edges in addition to the curves of my shape are detected in the image. Does this affect the accuracy of the function?

Detecting superfluous edges can negatively affect the accuracy of shape detection. Adjust the Curve Parameters so that the algorithm detects only the relevant curves.

What does the text overlay in the image indicate?

Each detected shape has a text overlay close to the first point of the shape. The text displays the shape number and score.

Golden Template Comparison

Compares an inspection image to a golden template and returns the areas that do not match up as defects. Refer to the *NI Vision Template Editor Help* for information about the Template Editor controls.

Main Tab

The following controls are available on the Main tab.

- **Step Name**—Name to give the step.
- **Template Image**—The image to use as the template.
- Template Size
 - Width—Width of the template in pixels.
 - Height—Height of the template in pixels.
- **New Template**—Launches the NI Vision Template Editor wizard, in which you can learn a template and save the result as a template image file.
- Edit Template—Launches the NI Vision Template Editor wizard, in which you can modify a template and save the result as a template image file.
- Load from File—Launches a dialog box in which you can browse to a template image file and specify that file as the search template.
- Note When you load a template from file, the template can be any valid NI Vision template, such as a Pattern Matching template. The Golden Template Comparison step prompts you to add golden template information to the template.
 - **Template Path**—Displays the location of the template image file.

Alignment Tab

The following controls are available on the Alignment tab.

- **Center X**—X-coordinate of the center point in the region of interest.
- **Center Y**—Y-coordinate of the center point in the region of interest.
- Angle (deg)—Rotation angle of the region of interest, in degrees.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.
- Scale (percentage)—Scale of the golden template in the inspection image expressed as a percentage.
- Alignment Correction—Specifies the algorithm to use to correct for slight misalignments between the golden template and inspection image. The following options are available:
 - **None**—No alignment correction.
 - **Perspective**—Adjusts the inspection image to correct for minor variations in alignment or perspective.
- **Display**—Specifies what is displayed in the Main window. The following options are available:
 - **Defects Only**—Displays only the bright and dark defects.
 - **Overlay Defects**—Displays the bright and dark defects as an overlay on the inspection image.

Settings Tab

The following controls are available on the Settings tab.

- Look For—Specifies the type of defects to search for in the image.
 - **All Defects**—Searches for areas in the image that are brighter and/or darker than the corresponding area in golden template.
 - **Bright Defects**—Searches for areas in the image that are brighter than the corresponding area in the golden template.
 - **Dark Defects**—Searches for areas in the image that are darker than the corresponding area in the golden template.
- **Intensity**—Specifies the algorithm used to resolve differences in the intensity of the inspection image compared to the intensity of the golden template.
 - **No Change**—Does not adjust the intensity of the golden template and the inspection image.
 - Histogram Matching Normalization—Adjusts the inspection image histogram to be similar to the histogram of the golden template.
 - Average Matching Normalization—Adjusts the inspection image so the mean pixel value of the inspection image equals the mean pixel value of the golden template.
- **Ignore Edges**—Specifies whether edges are ignored during the comparison process. If enabled, you can set the thickness of the edges to ignore using the **Edge Thickness** control.
 - **Edge Thickness**—Specifies the thickness of the edges to ignore.
- **Threshold Defect Image**—Specifies whether to threshold the defect image.
 - **Bright Level**—Threshold value for determining the minimum pixel intensity difference between the golden template and the inspection image used for determining bright defects.
 - **Dark Level**—Threshold value for determining the minimum pixel intensity difference between the golden template and the inspection image used for determining dark defects.
 - Bright Defects—Color used to display bright defects.

- Dark Defects—Color used to display dark defects.
- **Display**—Specifies what is displayed in the Main window. The following options are available:
 - **Defects Only**—Displays only the bright and dark defects.
 - **Overlay Defects**—Displays the bright and dark defects as an overlay on the inspection image.

Search for Defects Using Golden Template Comparison

Main Tab

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Define the golden template to compare to the inspection image using one of the following methods:
 - To create a new golden template, complete the following steps:
 - a. Click **New Template** to launch the NI Vision Template editor.
 - b. Complete the steps in the NI Vision Template Editor to create a golden template. Refer to the *NI Vision Template Editor Help* for specific instructions about how to define a golden template.
 - c. Click **Finish** to validate the new template.
 - d. In the Save Template As dialog box, browse to the location where you want to save the template file, enter a **File Name**, and click **OK**.
 - To use an existing image as the golden template, complete the following steps:
 - a. Click Load from File.
 - b. Browse to the image you want to use as the golden template.
 - c. Click Open.

If the image you selected is not a valid golden template file, complete the following steps to create a golden template based on the image you selected:

- a. Click **Yes** to launch the NI Vision Template Editor.
- b. Adjust the **Edge Threshold** value until only the edges you want to exclude during the golden template comparison remain.
- c. Click OK.
- d. In the Save Template As dialog box, browse to the location where you want to save the template file,

enter a File Name, and click OK.



Tip Click **Edit Template** to launch the NI Vision Template Editor and modify the currently selected golden template.

Alignment Tab

1. If necessary, adjust the position of the region of interest to correspond with the area of the image you want to search for defects.

For rough alignment of the region of interest within the inspection image, use the mouse to adjust the center of the position of the region of interest. For fine adjustments in the position of the region of interest, use the arrow keys or the **Center X**, **Center Y**, and **Angle** controls. The size of the region of interest cannot be adjusted because the size of the region of interest is based on the size of the specified golden template.

2. Verify that the **Reposition Region of Interest** checkbox is enabled if you want to link the region of interest specified in this step to a previously defined coordinate system.

Link the region of interest to a coordinate system if the position of the object under inspection changes from image to image, and you need to adjust the position of the region of interest to match the new location of the object.

- 3. Specify a **Scale** value to apply to the golden template if the area in the image you want to compare to the golden template is larger or smaller than the golden template image.
- 4. Select the type of **Alignment Correction** you want to use to when the golden template is applied to the image.

Settings Tab

- 1. Specify the type of defects to detect using the **Look For** control.
- 2. Use the **Intensity**, **Ignore Edges**, and **Edge Thickness** controls to adjust for variations in lighting and minor differences along the edges of the image that you want to ignore.
- 3. Use the **Threshold Defect Image**, **Bright Level**, and **Dark Level** controls to set the threshold limits for defects in the image.
- 4. Click **OK** to save this step to the script.
- **Tip** Use the **Display** button to show only the defects in the image or show the defects as an overlay on the original image. The green defects represent pixels in the inspection image that are brighter than the corresponding pixels in the golden template image. The red defects represent pixels in the inspection image that are darker than the corresponding pixels in the golden template image.

Golden Template Comparison FAQs

What is the difference between the green defects and red defects?

The green defects represent pixels in the inspection image that are brighter than corresponding pixels in the template image. The red defects represent pixels in the inspection image that are darker than the corresponding pixels in the template image.

Why is the image showing the defects not binary?

The defect image is computed by performing a difference between the pixel values in the template image and the corresponding pixel values in the inspection image. Vision Assistant displays this image with the Gradient palette. The algorithm does not threshold the result of the difference unless you instruct it to do so by enabling the **Threshold Defect Image** control.

Caliper

Computes measurements—such as distances, areas, and angles based on results returned from other machine vision and image processing functions. The following controls are available.

- Step Name—Name to give the step.
- **Geometric Feature**—Geometric feature you want to compute based on points you located during a previous step.
 - **Distance**—Computes the distance between two selected points.
 - Mid Point—Finds the center of a segment defined by two selected points.
 - **Perpendicular Projection**—Locates the perpendicular projection of the third point you selected onto a line specified by the first two points you selected.
 - Lines Intersection—Locates the intersection of the lines specified by the first two points you select and the last two points you select.
 - **Angle from Horizontal**—Finds the counterclockwise angle from the horizontal axis to a line specified by two points.
 - **Angle from Vertical**—Finds the counterclockwise angle from the vertical axis to a line specified by two points.
 - Angle Defined by 3 Points—Finds the counterclockwise angle between three points, where the second point is the vertex.
 - **Angle Defined by 4 Points**—Finds the counterclockwise angle between the lines specified by the first two points you select and the last two points you select.
 - **Bisecting Line**—Finds the line bisecting the counterclockwise angle formed by two lines, where the first two points you select create the first line and the second two points you select create the second line.
 - Mid Line—Finds a line midway between the line specified by the first two points you select and the third point you select. The new line is parallel to the line specified by the first two points you select.

- **Center of Mass**—Finds the center of mass of two or more points you select.
- **Area**—Computes the area of a polygon, where the vertices are points you select.
- Line Fit—Fits a straight line to a set of two or more points.
- Circle Fit—Fits a circle to a set of three or more points.
- Ellipse Fit—Fits an ellipse to a set of six or more points.
- Available Points—Points between which you want to find angles, lines, or mid points.

Use the Caliper Tool

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Select the type of geometric feature you want to compute.



- **Note** When you select a geometric feature, the step displays the minimum number of points you need to select to compute the feature.
- 3. Select the points that define the geometric feature using one of the following methods:
 - Click the points overlaid on the image.
 - Select the checkboxes in the Available Points list.
 - Double-click the point names in the Available Points list.

Tips

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- If a measurement creates a new point, the new point is available for new measurements when you close the caliper parameter window and re-open it.
- To save the data, click the **Send Data to Excel** button or the **Save Results** button.
- To deselect all points on the image, click **Reset**.

Related Topics

Find the angle made by three or four points

Find the angle made by two points

Find the area enclosed by three or more points

Find the center of mass using three or more points

Find the center of two points

Find the circular fit using three or more points

Find the distance between two points

Find the intersection of two lines

Find the perpendicular projection of a point on a line

Find the Distance Between Two Points

- Click Machine Vision»Caliper or select Caliper from the Machine Vision tab in the Processing Functions palette. Vision Assistant displays and numerically labels all points that you have located with the Edge Detector, Straight Edge (Rake), Circular Edge (Spoke), Centroid, Pattern Matching, Color Pattern Matching, Color Location, Shape Matching, Particle Analysis, or Circle Detection functions.
- 2. Select Distance.
- 3. Select two points on the image by clicking them.
- 4. Click Measure.
- 5. Click **OK** to add this step to the script.



Note You must have already located the position of objects in the image using one or more of the following functions: Edge Detector, Straight Edge (Rake), Circular Edge (Spoke), Centroid, Pattern Matching, Color Pattern Matching, Color Location, Shape Matching, Particle Analysis, or Circle Detection.



- Tips
 - You also can select points on the image by double-clicking them in the **Points** list. When a point is selected, Vision Assistant places a check mark to the left of the item.
 - To save the data, click the **Send Data to Excel** button or the **Save Results** button.

Related Topics

Find the angle made by three or four points

Find the angle made by two points

Find the area enclosed by three or more points

Find the center of mass using three or more points

Find the center of two points

Find the circular fit using three or more points

Find the intersection of two lines

Find the perpendicular projection of a point on a line

Find the Center of Two Points

- Click Machine Vision»Caliper or select Caliper from the Machine Vision tab in the Processing Functions palette. Vision Assistant displays and numerically labels all points that you have located with the Edge Detector, Straight Edge (Rake), Circular Edge (Spoke), Centroid, Pattern Matching, Color Pattern Matching, Color Location, Shape Matching, Particle Analysis, or Circle Detection functions.
- 2. Select Mid Point.
- 3. Select two points on the image by clicking them.
- 4. Click Measure.
- 5. Click **OK** to add this step to the script.



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Note You must have already located the position of objects in the image using one or more of the following functions: Edge Detector, Straight Edge (Rake), Circular Edge (Spoke), Centroid, Pattern Matching, Color Pattern Matching, Color Location, Shape Matching, Particle Analysis, or Circle Detection.

- Tips
 - You also can select points on the image by double-clicking them in the **Points** list. When a point is selected, Vision Assistant places a check mark to the left of the item.
 - The center point is available for new measurements when you close the caliper parameter window and re-open it.
 - To save the data, click the **Send Data to Excel** button or the **Save Results** button.

Related Topics

Find the angle made by three or four points Find the angle made by two points Find the area enclosed by three or more points Find the center of mass using three or more points Find the circular fit using three or more points Find the distance between two points Find the intersection of two lines Find the perpendicular projection of a point on a line

Find the Perpendicular Projection of a Point on a Line

- Click Machine Vision»Caliper or select Caliper from the Machine Vision tab in the Processing Functions palette. Vision Assistant displays and numerically labels all points that you located with the Edge Detector, Straight Edge (Rake), Circular Edge (Spoke), Centroid, Pattern Matching, Color Pattern Matching, Color Location, Shape Matching, Particle Analysis, or Circle Detection functions.
- 2. Select Perpendicular Projection in Geometric Feature.
- 3. Select three points (for example, points 1, 2, and 3) on the image by clicking them.
- 4. Click **Measure**. Vision Assistant computes the location of the perpendicular projection of point 3 on the line (point 1, point 2).
- 5. Click **OK** to add this step to the script.
- Note You must have already located the position of objects in the image using one of the following functions: Edge Detector, Straight Edge (Rake), Circular Edge (Spoke), Centroid, Pattern Matching, Color Pattern Matching, Color Location, Shape Matching, Particle Analysis, or Circle Detection.

💡 🛛 Tips

- You also can select points on the image by double-clicking them in the **Points** list. When a point is selected, Vision Assistant places a check mark to the left of the item.
- To save the data, click the **Send Data to Excel** button or the **Save Results** button.

Related Topics

Find the angle made by three or four points

Find the angle made by two points

Find the area enclosed by three or more points

Find the center of mass using three or more points

Find the center of two points

Find the circular fit using three or more points

Find the distance between two points Find the intersection of two lines

Find the Intersection of Two Lines

- Click Machine Vision»Caliper or select Caliper from the Machine Vision tab in the Processing Functions palette. Vision Assistant displays and numerically labels all points that you located with the Edge Detector, Straight Edge (Rake), Circular Edge (Spoke), Centroid, Pattern Matching, Color Pattern Matching, Color Location, Shape Matching, Particle Analysis, or Circle Detection functions.
- 2. Select Line Intersections in Geometric Feature.
- 3. Select four points (for example, points 1, 2, 3, and 4) on the image by clicking them.
- 4. Click **Measure**. Vision Assistant computes the location of the intersection of the lines represented by the lines (point 1, point 2) and (point 3, point 4).
- 5. Click **OK** to add this step to the script.
- Note You must have already located the position of objects in the image using one of the following functions: Edge Detector, Straight Edge (Rake), Circular Edge (Spoke), Centroid, Pattern Matching, Color Pattern Matching, Color Location, Shape Matching, Particle Analysis, or Circle Detection.

💡 🛛 Tips

- You also can select points on the image by double-clicking them in the **Points** list. When a point is selected, Vision Assistant places a check mark to the left of the item.
- To save the data, click the **Send Data to Excel** button or the **Save Results** button.

Related Topics

Find the angle made by three or four points

Find the angle made by two points

Find the area enclosed by three or more points

Find the center of mass using three or more points

Find the center of two points

Find the circular fit using three or more points

Find the distance between two points Find the perpendicular projection of a point on a line

Find the Angle Made by Two Points

- Click Machine Vision»Caliper or select Caliper from the Machine Vision tab in the Processing Functions palette. Vision Assistant displays and numerically labels all points that you have located with the Edge Detector, Straight Edge (Rake), Circular Edge (Spoke), Centroid, Pattern Matching, Color Pattern Matching, Color Location, Shape Matching, Particle Analysis, or Circle Detection functions.
- 2. Select either **Angle from Horizontal** or **Angle from Vertical**, depending on the type of angle you want.
- 3. Select two points on the image by clicking them.
- 4. Click Measure.
- 5. Click **OK** to add this step to the script.
- 🔊 Notes
 - You must have already located the position of objects in the image using one or more of the following functions: Edge Detector, Straight Edge (Rake), Circular Edge (Spoke), Centroid, Pattern Matching, Color Pattern Matching, Color Location, Shape Matching, Particle Analysis, or Circle Detection.
 - The angle is measured in degrees, counterclockwise.
- 💡 Tips
 - You also can select points on the image by double-clicking them in the **Points** list. When a point is selected, Vision Assistant places a check mark to the left of the item.
 - To save the data, click the **Send Data to Excel** button or the **Save Results** button.

Related Topics

Finding the angle made by three or four points Find the area enclosed by three or more points Find the center of mass using three or more points Find the center of two points Find the circular fit using three or more points Find the distance between two pointsFind the intersection of two linesFind the perpendicular projection of a point on a line

Find the Angle Made by Three or Four Points

- Click Machine Vision»Caliper or select Caliper from the Machine Vision tab in the Processing Functions palette. Vision Assistant displays and numerically labels all points that you have located with the Edge Detector, Straight Edge (Rake), Circular Edge (Spoke), Centroid, Pattern Matching, Color Pattern Matching, Color Location, Shape Matching, Particle Analysis, or Circle Detection functions.
- 2. Select Angle Defined by 3 Points or Angle Defined by 4 Points.
- 3. Select three or four points on the image by clicking them. If you select three points, the second point is used as the common vertex, and the angle is measured between (1,2) and (2,3). If you select four points, the angle is measured between (1,2) and (3,4).
- 4. Click Measure.
- 5. Click **OK** to add this step to the script.
- 🕅 Notes
 - You must have already located the position of objects in the image using one or more of the following functions: Edge Detector, Straight Edge (Rake), Circular Edge (Spoke), Centroid, Pattern Matching, Color Pattern Matching, Color Location, Shape Matching, Particle Analysis, or Circle Detection.
 - The angle is measured in degrees, counterclockwise.
- 💡 🛛 Tips
 - You also can select points on the image by double-clicking them in the **Points** list. When a point is selected, Vision Assistant places a check mark to the left of the item.
 - To save the data, click the **Send Data to Excel** button or the **Save Results** button.

Find the angle made by two points

Find the area enclosed by three or more points

Find the center of mass using three or more points

Find the center of two points

Find the circular fit using three or more points Find the distance between two points Find the intersection of two lines Find the perpendicular projection of a point on a line

Find the Center of Mass Using Three or More Points

- Click Machine Vision»Caliper or select Caliper from the Machine Vision tab in the Processing Functions palette. Vision Assistant displays and numerically labels all points that you have located with the Edge Detector, Straight Edge (Rake), Circular Edge (Spoke), Centroid, Pattern Matching, Color Pattern Matching, Color Location, Shape Matching, Particle Analysis, or Circle Detection functions.
- 2. Select Center of Mass.
- 3. Select three or more points on the image by clicking them.
- 4. Click Measure.
- 5. Click **OK** to add this step to the script.



Note You must have already located the position of objects in the image using one or more of the following functions: Edge Detector, Straight Edge (Rake), Circular Edge (Spoke), Centroid, Pattern Matching, Color Pattern Matching, Color Location, Shape Matching, Particle Analysis, or Circle Detection.

💡 Tips

- You also can select points on the image by double-clicking them in the **Points** list. When a point is selected, Vision Assistant places a check mark to the left of the item.
- The center point is available for new measurements when you close the caliper parameter window and re-open it.
- To save the data, click the **Send Data to Excel** button or the **Save Results** button.

Related Topics

Find the angle made by three or four pointsFind the angle made by two pointsFind the area enclosed by three or more pointsFind the center of two pointsFind the circular fit using three or more pointsFind the distance between two points
Find the intersection of two lines

Find the perpendicular projection of a point on a line

Find the Area Enclosed by Three or More Points

- 1. Click Machine Vision»Caliper or select Caliper from the Machine Vision tab in the Processing Functions palette. Vision Assistant displays and numerically labels all points that you have located with the Edge Detector, Straight Edge (Rake), Circular Edge (Spoke), Centroid, Pattern Matching, Color Pattern Matching, Color Location, Shape Matching, Particle Analysis, or Circle Detection functions.
- 2. Select Area.
- 3. Select three or more points on the image by clicking them.
- 4. Click Measure.
- 5. Click **OK** to add this step to the script.



Note You must have already located the position of objects in the image using one or more of the following functions: Edge Detector, Straight Edge (Rake), Circular Edge (Spoke), Centroid, Pattern Matching, Color Pattern Matching, Color Location, Shape Matching, Particle Analysis, or Circle Detection.



- Tips
 - You also can select points on the image by double-clicking them in the **Points** list. When a point is selected, Vision Assistant places a check mark to the left of the item.
 - To save the data, click the **Send Data to Excel** button or the **Save Results** button.

Related Topics

Find the angle made by three or four points

Find the angle made by two points

Find the center of mass using three or more points

Find the center of two points

Find the circular fit using three or more points

Find the distance between two points

Find the intersection of two lines

Find the perpendicular projection of a point on a line

Find the Circular Fit Using Three or More Points

- Click Machine Vision»Caliper or select Caliper from the Machine Vision tab in the Processing Functions palette. Vision Assistant displays and numerically labels all points that you have located with the Edge Detector, Straight Edge (Rake), Circular Edge (Spoke), Centroid, Pattern Matching, Color Pattern Matching, Color Location, Shape Matching, Particle Analysis, or Circle Detection functions.
- 2. Select Circle Fit.
- 3. Select three or more points on the image by clicking them.
- 4. Click Measure.
- 5. Click **OK** to add this step to the script.



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Note You must have already located the position of objects in the image using one or more of the following functions: Edge Detector, Straight Edge (Rake), Circular Edge (Spoke), Centroid, Pattern Matching, Color Pattern Matching, Color Location, Shape Matching, Particle Analysis, or Circle Detection.

Tips

- You also can select points on the image by double-clicking them in the **Points** list. When a point is selected, Vision Assistant places a check mark to the left of the item.
- The center of the circle is available for new measurements when you close the caliper parameter window and re-open it.
- To save the data, click the **Send Data to Excel** button or the **Save Results** button.

Related Topics

Find the angle made by three or four points

Find the angle made by two points

Find the area enclosed by three or more points

Find the center of mass using three or more points

Find the center of two points

Find the distance between two points

Find the intersection of two lines

Find the perpendicular projection of a point on a line

Caliper FAQs

Currently, there are no FAQs associated with this processing function.

Use Identification Functions

This palette groups visual inspection steps whose purposes are to read and verify printed characters, classify binary objects, and read 1D and 2D barcodes.

OCR/OCV

Use this function to read characters in a region of an image.

Classification

Use this function to classify samples in an image.

Barcode Reader

Use this function to read values encoded in 1D barcodes.

Data Matrix Reader

Use this function to read values encoded in a Data Matrix code.

PDF417 Code Reader

Use this function to read values encoded in a PDF417 code.

OCR/OCV

Refer to the *NI OCR Training Interface Help* for information about the NI OCR Training Interface controls.

Main Tab

The following controls are available on the Main tab.

- Step Name—Name to give the step.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.
- **Text Read**—Displays characters recognized in the region of interest (ROI).

Train Tab

The following controls are available on the Train tab.

- **Character Set Path**—Path of the character set you want to use to recognize the characters. A character set file contains a unique representation for each trained character, as well as its corresponding value.
- New Character Set File—Creates a new character set file or edits an existing one.
- Annulus Orientation—Becomes available when you select the Annulus ROI tool. Choose one of the following options:
 - **Baseline Inside**—Select this option when the imaginary line on which the bottoms of the letters align is closer to the center of the annulus.
 - **Baseline Outside**—Select this option when the imaginary line on which the bottoms of the letters align is closer to the outside of the annulus.
- **Text Read**—Displays characters recognized in the region of interest (ROI).

Threshold Tab

The following controls are available on the Threshold tab.

- **Mode**—Type of threshold you want to perform.
 - Fixed Range—Determines the threshold value for the ROI.
 - **Uniform**—Calculates a single threshold value for the ROI.
 - **Linear**—Divides the ROI into the number of blocks you specify, calculates a threshold value for the first and last blocks, and linearly interpolates values for the blocks between the first and last blocks.
 - **Nonlinear**—Divides the ROI into the number of blocks you specify and calculates a threshold value for each block.
- **Characters**—Specifies the relative intensity value of a character with respect to the background of the image. Use this control to specify if the character set includes light characters on a dark background or dark characters on a light background.
- Range Min—Minimum threshold value.
- Range Max—Maximum threshold value.
- **# of Blocks**—Number of blocks that the ROI is divided into when you use the Linear or Nonlinear Mode.
- **Ignore Objects Touching Region Borders**—When enabled, ignores objects that are touching the border of the ROI you drew.
- Remove Small Objects (# of Erosions)—Number of erosions you want to perform to remove small objects from the ROI.
- **Text Read**—Displays characters recognized in the region of interest (ROI).

Size Tab

The following controls are available on the Size tab.

- **Autosplit**—When enabled, the step is configured to read slanted characters.
- **Min Bounding Rect Width**—Minimum width limits, in pixels, for the character bounding rectangle.
- Max Bounding Rect Width—Maximum width limits, in pixels, for the character bounding rectangle.
- **Min Bounding Rect Height**—Minimum height limits, in pixels, for the character bounding rectangle.
- Max Bounding Rect Height—Maximum height limits, in pixels, for the character bounding rectangle.
- **Min Character Size**—Minimum size requirements, in pixels, for an object in an ROI to be considered a character that can be trained.
- Max Character Size—Maximum size requirements, in pixels, for an object in an ROI to be considered a character that can be trained.
- **Min Char Spacing**—Minimum amount of space, in pixels, that can be between characters in the ROI you specified. This value must be greater than Max Element Spacing.
- Max Horizontal Element Spacing—Maximum amount of space, in pixels, that can be between horizontally adjacent elements, such as in dot-matrix objects. This value must be less than Min Char Spacing.
- Max Vertical Element Spacing—Maximum amount of space, in pixels, that can be between vertically adjacent elements.

Read Options Tab

The following controls are available on the Read Options tab.

- **Read Strategy**—Specifies the criteria to determine if read characters match trained characters.
 - **Conservative**—The step uses extensive criteria to determine if read characters match trained characters.
 - Aggressive—The step uses fewer criteria to determine if read characters match trained characters. The Aggressive strategy processes images faster than the Conservative strategy.
- **Read Resolution**—Level of character detail the step uses to determine if an object matches a trained character.
- Acceptance Level—Value to indicate how closely an object must match a trained character to be a recognized character. The valid range of values is 0 to 1000. A value of 1000 indicates a perfect match between an object and a trained character.
- **Substitution Character**—Character you want to use for objects that are not yet trained and recognized.
- Aspect Ratio Dependent—Configures the step to read characters whose size is between a range. Specify how much larger or smaller, in percentages, the characters can be compared to the trained character. To maintain performance in the OCR process, limit the difference to ±50. Avoid creating character sets whose characters differ only in height and width. Consider separating the characters into different character sets, using valid characters to restrict trained characters, and enforcing the aspect ratio.
- Aspect Ratio—Specifies how much larger or smaller, in percentages, the characters can be compared to the trained character. To maintain performance in the OCR process, limit the difference to ±50. Avoid creating character sets whose characters differ only in height and width. Consider separating the characters into different character sets, using valid characters to restrict trained characters, and enforcing the aspect ratio.
- Use Text Pattern—Specifies whether you want to define a pattern of characters that you expect read strings to follow.
- Specify Text Pattern—Specifies that the text being read always

has the same pattern. You can then instruct the step that the first character expected is a letter, the second character a digit, and so on. Doing so increases the speed and accuracy of recognition.

• **Text Read**—Text that the step read.

Results

Displays the following information after reading the selected text:

- **Classification Score**—Indicates how closely a character matched its closest match in the character set. A high value indicates a close match, and a low value indicates a poor match.
- Identification Score—Indicates how closely a character matched the reference character of the class to which it is assigned. A high value indicates a close match, and a low value indicates a poor match.
- Left, Top—X- and y-coordinates of the bounding rectangle surrounding the character in the current ROI.
- Width, Height—Width and height of the character read in the current ROI.

Read and Verify Text in Images

Main Tab

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Verify that the **Reposition Region of Interest** option is enabled if you want to link the region of interest specified in this step to a previously defined coordinate system.

Link the region of interest to a coordinate system if the position of the object under inspection changes from image to image, and you need to adjust the position of the region of interest to match the new location of the object.

Train Tab

Follow these instructions to compare objects in an image to a trained set of characters and determine if the characters match a given string:

- 1. Click **Identification**»**OCR/OCV** or click **OCR/OCV** in the **Identification** tab of the Processing Functions palette.
- 2. Browse to the character set file you want to open, select the file, and click **Open**.

If necessary, click **New Character Set File** to train additional characters in the NI OCR Training Interface.

3. Draw a region of interest around the characters you want to read.

Vision Assistant segments objects in the region of interest by drawing character bounding rectangles around the objects according to the current settings in the **Threshold**, **Size**, and **Read Options** tabs.

Threshold Tab

- Note Configure options in the **Threshold** tab carefully. If you manually set the threshold values, and **OCR/OCV** cannot detect characters in the region you specified, the training process does not create the character set file correctly. For example, if you select **Fixed Range** from the **Mode** control, and you select a **Max** value that is too low, **OCR/OCV** cannot correctly detect the characters in the region of interest.
 - 1. Select a threshold type from the **Mode** control.

When you select **Linear** or **Nonlinear**, you must set **# of Blocks** to at least the number of objects in the region of interest. If you selected **Fixed Range** in **Type**, use **Min** and **Max** or the slider at the bottom of the histogram to determine the threshold value. If you selected **Computed**, **Linear**, or **Nonlinear** in **Type**, use **Characters** to indicate the character color in the image. **Light on Dark** indicates that the image contains light characters on a dark background. **Dark on Light** indicates that the image contains dark characters on a light background.

- 2. Enable the **Ignore Objects Touching Region Borders** control to ignore objects that touch the border of the region of interest.
- 3. In **Remove Small Objects (# of Erosions)**, select the number of erosions to remove small objects from the region of interest. The OCR Training Interface displays segmented objects in blue.

Size Tab

Use the controls to indicate the character size and spacing values required for character recognition. **OCR/OCV** recognizes only those characters in the region of inspection that meet the criteria in the **Size** tab.

Read Options

- 1. Select a **Read Strategy**.
- 2. Enable the **Aspect Ratio Invariant** control to read characters regardless of character size. Otherwise, select an **Aspect Ratio** value to indicate the allowable difference between the training and reading character sizes and height/width ratios.
- 3. Enter the **Substitution Character** you want to appear in the string to indicate objects that are not trained and recognized.
- 4. Select an **Acceptance Level** value to indicate how closely an object must match a trained character to be a recognized character.
- 5. Click **Specify Pattern** if you know that the text to read always has the same pattern. For example, you can specify that the first character should be a letter and the second character should be a digit. Specifying a pattern increases the speed and accuracy of recognition.
- 6. Click **OK** to add this step to the script and close the parameter window.

OCR/OCV FAQs

Why is the step not properly recognizing the text inside my region of interest?

Before the **OCR/OCV** step can read characters in a region of interest, you need to train the software to recognize the characters. If you have not trained for the characters, click **Edit Character Set File** on the **Main** tab to launch the NI OCR Training Interface and train for the characters.

Make sure you selected a **Character Set Path** from the **Main** tab that describes the characters you want to read.

Also, make sure that each character in the region of interest is tightly bounded by a character bounding rectangle. If each character is not bounded, adjust the parameters in the **Threshold** and **Size** tabs. In particular, enable the **Ignore Objects Touching Region Borders** control in the **Threshold** tab if artifacts touch the character bounding rectangle. Also, adjust the **Max Bounding Rect Width** in the **Size** tab if the characters are slanted and slightly overlap in the vertical direction causing one character bounding rectangle to surround all of the characters. Adjusting this parameter forces the width of the character bounding rectangle.

What is the difference between the Classification Score and Identification Score?

The Classification Score indicates the level of confidence that a character belongs to a specific class. The Identification Score indicates how similar a character is to the reference character specified for the class.

Classification

Classifies the sample or samples located in the given region of interest (ROI) based on their shape. Refer to the *NI Classification Training Interface Help* for information about the NI Classification Training Interface controls.

Main Tab

The following controls are available on the Main tab.

- Step Name—Name to give the step.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.
- **Samples**—Indicates the number of samples learned in the selected classifier file.

Train Tab

The following controls are available on the Train tab.

- **Classifier File Path**—Path of the classifier file you want to use to classify samples. A classifier file contains a representation for each trained sample as well as its corresponding label.
- New Classifier File—Allows you to create a new classifier file using the NI Classification Training Interface.
- **Sample to Classify**—Specifies whether to classify only the largest sample in the region or all of the samples in the region.
- **Training Required**—Indicates that you modified some parameters that require the classifier to be trained before classifying samples.
- **Samples**—Indicates the number of samples learned in the selected classifier file.

Threshold Tab

The following controls are available on the Threshold tab.

- Method—Specifies whether to perform a manual or automatic threshold. To perform a manual threshold, select Manual Threshold from the Method drop-down menu. To perform an automatic threshold, select one of the following options:
 - **Clustering**—Sorts the histogram of the image within a discrete number of classes corresponding to the number of phases perceived in an image. Clustering is the most frequently used automatic thresholding method.
 - **Entropy**—Detects samples that are present in minuscule proportions on the image.
 - **Metric**—Calculates a value for each threshold that is determined by the surfaces representing the initial gray scale.
 - Moments—Use for images that have poor contrast.
 - Inter Variance—Use for images in which classes are not too disproportionate. For satisfactory results, the smallest class must be at least 5% of the largest one.
- Look For—Specifies whether you want to classify bright, dark, or gray objects.
- **Range**—Cluster specifying the threshold range.
 - **Min**—Lower value of the threshold range when you perform a manual threshold. In automatic threshold mode, **Min** displays the value computed by the automatic threshold algorithm you selected.
 - Max—Upper value of the threshold range when you use a manual thresholding method. In automatic threshold mode, Max displays the value computed by the automatic threshold algorithm you selected.
 - **Lower Limit**—Lower limit of the thresholding range when you use an automatic thresholding method. The automatic thresholding algorithm you select cannot compute a threshold value lower than **Lower Limit**.
 - **Upper Limit**—Upper Limit of the thresholding range when

you use an automatic thresholding method. The automatic thresholding algorithm you select cannot compute a threshold value greater than **Upper Limit**.

- Ignore Objects Touching Region Borders—When enabled, ignores objects in the sample that are touching the border of the ROI.
- **Remove Small Objects (# of Erosions)**—Number of erosions you want the classification engine to perform to remove small objects in the sample from the ROI.
- **Training Required**—Indicates that you modified some parameters that require the classifier to be trained before classifying samples.
- **Samples**—Indicates the number of samples learned in the selected classifier file.

Options Tab

The following controls are available on the Options tab.

- **Method**—Method of classification.
 - Nearest Neighbor—Most direct approach to classification. In nearest neighbor classification, the distance of an input feature vector of unknown class to another class is defined as the distance to the closest samples that are used to represent that class.
 - K-Nearest Neighbor—More robust to noise compared with nearest neighbor classification. In K-nearest neighbor classification, an input feature vector is classified into a class based on a voting mechanism. The NI Classifier finds *K* nearest samples from all the classes. The input feature vector of unknown class is assigned to the class with majority of the votes in the *K* nearest samples.
 - **Minimum Mean Distance**—Most effective in applications that have little or no feature pattern variability or other corruptive influences. In minimum mean distance classification, an input feature vector of unknown class is classified based on its distance to each class center.
- **Metric**—Computes the distance between features in a classification application.
 - Maximum—Most sensitive to small variations between samples. Use Maximum when you need to classify samples with very small differences into different classes.
 - **Sum**—Metric used in most classification applications (also known as the Manhattan metric or Taxicab metric). This is the default value.
 - **Euclidean**—Least sensitive to small variations between samples. Use **Euclidean** when you need to classify samples with small differences into the same class.
- **K**—Sets the *K* value when using the K-Nearest Neighbor method of classification. The default is 3.
- **Training Required**—Indicates that you modified some parameters that require the classifier to be trained before classifying samples.
- Samples—Indicates the number of samples learned in the

selected classifier file.

Parameters Tab

The following controls are available on the Parameters tab.

Parameters define the dependence of the classification engine on shape, scale, and mirror symmetry. By default, when the **Scale Dependent** and **Mirror Dependent** options are disabled, the NI Classifier depends only on variations in shape to classify samples. When **Scale Dependent** and **Mirror Dependent** are enabled, the dependence on shape is calculated as follows: Shape Dependence = 1000 - (**Scale Factor** + **Mirror Factor**).

- **Scale Factor**—Determines the relative importance (between 0 and 1000) of scale when classifying samples. If the value is 0, the samples are classified independent of scale.
- **Mirror Factor**—Determines the relative importance (between 0 and 1000) of mirror symmetry when classifying samples. If the value is 0, the samples are classified independent of mirror symmetry. Examples of objects exhibiting mirror symmetry are a lowercase letter *p* and a lowercase letter *q*.
- **Training Required**—Indicates that you modified some parameters that require the classifier to be trained before classifying samples.
- **Samples**—Indicates the number of samples learned in the selected classifier file.

Classify Samples

Follow these instructions to classify a sample in a given region of interest (ROI):

Main Tab

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Verify that the **Reposition Region of Interest** option is enabled if you want to link the region of interest specified in this step to a previously defined coordinate system.

Link the region of interest to a coordinate system if the position of the object under inspection changes from image to image, and you need to adjust the position of the region of interest to match the new location of the object.

Train Tab

- 1. Browse to the classifier file you want to use, select the file, and click **Open**.
- 2. If you want to create a new classifier file, click **New Classifier File**. In the Save Classifier File As window, enter the file name for the file you want to create.
- 3. Click **OK** to open the NI Classification Training Interface.
 - **Tip** Refer to the *NI Classification Training Interface Help* for more information about how to train and classify samples in the Classification Training Interface.
 - Note If necessary, click Edit Classifier File to classify additional samples in the NI Classification Training Interface.
- 4. Draw an ROI around the sample you want to classify.

Vision Assistant segments samples in the ROI by drawing particle bounding rectangles around the samples according to the current settings in the **Main**, **Threshold**, **Engine Options**, and **Parameters** tabs.
Threshold Tab

- Note Configure options in the **Threshold** tab carefully. If you manually set the threshold values and the classification engine cannot detect samples in the region you specified, the training process does not create the classifier file correctly.
 - 1. Select a threshold type from the **Method** control. When you select **Manual Threshold**, you must set the threshold range with the Min and Max controls.
 - 2. Select the type of objects you want to classify in the sample from the Look For control. You can classify Bright Objects, Dark Objects, or Gray Objects.
 - 3. Enable the **Ignore Objects Touching Region Borders** control to ignore objects in the sample that touch the border of the ROI.
 - 4. In **Remove Small Objects (# of Erosions)**, select the number of erosions to remove small objects in the sample from the ROI.

The classification engine displays segmented objects in blue.

Options Tab

Use the controls to indicate the **Method** and **Metric** used by the classification engine for sample recognition.

Parameters Tab

- 1. Enable the **Scale Dependent** control to determine the relative importance of scale when classifying samples. Enter the numerical scale value (between 0 and 1000) in the **Scale Factor** control. If the value is 0, samples are classified independent of scale.
- 2. Enable the **Mirror Dependent** to determine the relative importance of mirror symmetry when classifying samples. Enter the numerical value of importance (between 0 and 1000) for the mirror symmetry in the **Mirror Factor** control. If the value is 0, samples are classified independent of mirror symmetry.

Classification FAQs

Why is the step not properly recognizing the sample inside my region of interest?

Before the **Classification** step can locate a sample in a region of interest (ROI), you need to train the software to recognize the sample. If you have not trained for the sample, click **Edit Classifier File** on the **Main** tab to launch the NI Classification Training Interface and train the samples.

Make sure you selected a **Classifier File Path** from the **Main** tab that describes the sample you want to classify.

Barcode Reader

Reads a one-dimensional barcode.

Main Tab

The following controls are available on the Main tab.

- **Step Name**—Name to give the step.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.

Read 1D Barcode Tab

The following controls are available on the Read 1D Barcode tab.

- Barcode Type—Type of barcode you want to read.
- Validate—When enabled, the step validates the barcode data. If the barcode type is Codabar, Code 39, or Interleaved 2 of 5, the error correction information built into the barcode is used to validate the results. For all other barcode types, either no validation is performed or the validation is performed automatically because the barcode type requires it.
- Add Special Character to Code Read—When enabled, this step adds the special characters to the encoded data. Only Codabar, Code 128, EAN 8, EAN 13, and UPCA barcodes contain special characters.
- Add Checksum to Code Read—When enabled, this step adds the checksum value read with the barcode to the encoded data. Refer to the following table for the layout of special characters, data, and checksum for each type of barcode.

Barcode Type	Special Characters	Layout
Codabar	Start character and stop character	<start char=""> <data> <checksum> <stop char=""></stop></checksum></data></start>
Code 39	None	<data> <checksum></checksum></data>
Code 93	None	<data> <checksum></checksum></data>
Code 128	FNC Number	<fnc> <data> <checksum></checksum></data></fnc>
EAN 8	Country character 1 and 2	<country char1=""> <country char2=""> <data> <checksum></checksum></data></country></country>
EAN 13	Country character 1 and 2	<country char1=""> <country char2=""> <data> <checksum></checksum></data></country></country>
Interleaved 2 of 5	None	<data> <checksum></checksum></data>

MSI	None	<data> <checksum></checksum></data>
UPCA	System char	<system char=""> <data> <checksum></checksum></data></system>
Pharmacode	None	<data char=""></data>
RSS Limited	None	<left guard=""> <left char="" data=""> <check char=""> <right char="" data=""> <right guard=""></right></right></check></left></left>

- **Region Profile**—Average intensity of the pixels in the region of interest (ROI).
- **Code Read**—Decoded barcode data.

Read Barcodes in Images

Use the Barcode Reader function to decode a 1D barcode.

Main Tab

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Verify that the **Reposition Region of Interest** option is enabled if you want to link the region of interest specified in this step to a previously defined coordinate system.

Link the region of interest to a coordinate system if the position of the object under inspection changes from image to image, and you need to adjust the position of the region of interest to match the new location of the object.

Read 1D Barcode Tab

- 1. Draw a region of interest (ROI) around the barcode. Make sure the ROI contains all of the bars.
- 2. Select the **Barcode Type** you want to read.

If the barcode type is Codabar, Code 39, or Interleaved 2 of 5, you can enable the **Validate** control to use the encoded error correction information to validate the results. If the validation fails, the step also fails.

If the barcode type is Codabar, Code 128, EAN 8, EAN 13, or UPCA, you can enable the **Add Special Character to Code** control to add the special characters of the code to the encoded data. You also can add the checksum to the encoded data by checking the **Add Checksum to Code** control.

Barcode Reader FAQs

Why is the Code Read control empty?

Make sure **Barcode Type** is set correctly and the region of interest (ROI) encloses all of the bars.

Can I adjust the parameters for finding the bars?

No. The algorithm that **Barcode Reader** uses is adaptive and can find the bars even when the image contains a slight light drift along the barcode.

The string returned by the algorithm does not match the code written below the barcode.

If the type of barcode is Codabar, Code 128, EAN 8, EAN 13, or UPCA, enable the **Add Special Characters to Code** control. You also can enable the **Add Checksum to Code** control.

Data Matrix Reader

Decodes a Data Matrix barcode.

Main Tab

The following controls are available on the Main tab.

- Step Name—Name to give the step.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.
- **Code Read**—Code that the step read.
- **Iterations**—Number of iterations the step took in attempting to locate the matrix. If this number is equal to Maximum Iterations and the step failed to locate the matrix, you may be able to locate the matrix by increasing the Maximum Iterations value.
- Elapsed Time—Amount of time the step took to read the code.
- **Suggest Values**—Allows the algorithm to detect the best values for parameters whose Suggest Value? checkboxes are enabled.

Basic Tab

The following controls are available on the Basic tab.

- **Suggest Value?**—When enabled, the step suggests a value for the associated control after the **Suggest Values** button is clicked.
- **ECC**—Specifies the <u>ECC</u> used for this Data Matrix.
 - **Auto-detect**—Sets the step to determine the ECC automatically.
 - ECC 000—Sets the step to read Data Matrix codes of ECC 000 only.
 - ECC 050—Sets the step to read Data Matrix codes of ECC 050 only.
 - ECC 080—Sets the step to read Data Matrix codes of ECC 080 only.
 - **ECC 100**—Sets the step to read Data Matrix codes of ECC 100 only.
 - **ECC 140**—Sets the step to read Data Matrix codes of ECC 140 only.
 - ECC 000–140—Sets the step to read Data Matrix codes of ECC 000, ECC 050, ECC 080, ECC 100, and ECC 140 only.
 - ECC 200—Sets the step to read Data Matrix codes of ECC 200 only.
- **Shape**—Specifies if the matrix is square or rectangular.
- Matrix Size—Size of the matrix to read.
- **Barcode Polarity**—Specifies the data-to-background contrast for the matrix.
 - **Auto-detect**—Sets the step to determine the matrix polarity automatically.
 - **Black On White**—Sets the step to read matrices with dark data on a bright background.
 - White On Black—Sets the step to read matrices with bright data on a dark background.
- Min. Barcode Size (pixels)—Specifies the minimum size, in pixels, of the matrix in the image. If you set this value to 0, the step never excludes a matrix candidate because it is too small.

- Max. Barcode Size (pixels)—Specifies the maximum size, in pixels, of the matrix in the image. If you set this value to 0, the step never excludes a matrix candidate because it is too large.
- **Min Border Integrity %**—Minimum percentage of the <u>finder</u> <u>pattern</u> that the step should expect in the Data Matrix. During the location phase, the step ignores possible matrix candidates that do not have at least this level of border integrity.
- Uncheck/Check All—Disables/Enables all Suggest Value checkboxes.
- **Code Read**—Code that the step read.
- **Iterations**—Number of iterations the step took in attempting to locate the matrix. If this number is equal to Maximum Iterations and the step failed to locate the matrix, you may be able to locate the matrix by increasing the Maximum Iterations value.
- **Elapsed Time**—Amount of time the step took to read the code.
- **Suggest Values**—Allows the algorithm to detect the best values for parameters whose Suggest Value? checkboxes are enabled.

Search Tab

The following controls are available on the Search tab.

- **Suggest Value?**—When enabled, the step suggests a value for the associated control after the **Suggest Values** button is clicked.
- **Quiet Zone Width**—Specifies the expected minimum size, in pixels, of the quiet zone. The step ignores Data Matrix candidates whose quiet zones are smaller than this value.
- Aspect Ratio—Ratio of the matrix width (in pixels) divided by the matrix height (in pixels). If you have rectangular matrices, and you set this value to 1, the step appropriately recalculates the aspect ratio. If you set this value to 0, the step automatically determines the aspect ratio.
- Rotation Mode—Specifies the amount of Data Matrix rotation to allow.
 - **Unlimited**—The step allows for unlimited rotation.
 - **0 Degrees**—The step allows for no rotation.
 - **90 Degrees**—The step allows for +/- 90 degrees of rotation.
 - 180 Degrees—The step allows for +/- 180 degrees of rotation.
 - 270 Degrees—The step allows for +/- 270 degrees of rotation.
- Skew Degrees Allowed—Amount of skew in the matrix to allow. The default is 5 degrees.
- **Maximum Iterations**—Maximum number of iterations the step makes before it stops looking for the matrix. The default is 150.
- Initial Search Vector Width—Number of pixels the step should average together to determine the location of an edge. You may need to increase this value when the Data Matrix has cells with a low fill percentage.
- Edge Threshold—Minimum contrast a pixel must have to be considered part of a matrix cell edge. The lower this value, the more potential edge candidates the step examines during the location phase. Setting this value too low decreases the performance of the step because the step examines too many potential edge candidates. Setting this value too high may also

decrease the performance of the step by removing valid edge candidates, making location more difficult. Setting this value too high may also cause the step to fail to identify the matrix because all edge candidates are eliminated.

- Uncheck/Check All—Disables/Enables all Suggest Value checkboxes.
- **Code Read**—Code that the step read.
- **Iterations**—Number of iterations the step took in attempting to locate the matrix. If this number is equal to Maximum Iterations and the step failed to locate the matrix, you may be able to locate the matrix by increasing the Maximum Iterations value.
- **Elapsed Time**—Amount of time the step took to read the code.
- **Suggest Values**—Allows the algorithm to detect the best values for parameters whose Suggest Value? checkboxes are enabled.

Cell Sampling Tab

The following controls are available on the Cell Sampling tab.

- **Suggest Value?**—When enabled, the step suggests a value for the associated control after the **Suggest Values** button is clicked.
- Cell Fill Percentage—Specifies the fill percentage for a cell that is in the On state.
 - **Auto-detect**—Sets the step to determine the matrix cell fill percentage automatically.
 - < 30%—Sets the step to read matrices with a cell fill percentage of less than 30%.</p>
 - >= 30%—Sets the step to read matrices with a cell fill percentage greater than or equal to 30%.
- **Demodulation Mode**—Mode that determines which cells are on and which cells are off in the Data Matrix.
 - **Auto-detect**—The step tries each demodulation mode and use the one which decodes the Data Matrix within the fewest iterations and utilizes the least amount of error correction.
 - **Histogram**—The step uses a histogram of all of the matrix cells to calculate a threshold. This threshold determines if a cell is on or off. This is the fastest method but requires images with consistent levels of contrast in the matrix.
 - Local Contrast—The step examines each neighbor of a cell to determine if the cell is on or off. This method is slower but works with images that have inconsistent levels of contrast in the matrix.
 - Combination—The step uses the histogram of the matrix to calculate a threshold. For cells with pixel values that are sufficiently below or above this threshold, the step uses the threshold to determine if the cell is on or off. If the cell pixel values are close to the threshold, the step uses the Local Contrast method to determine if the cell is on or off. This method is slower but works with images that have extremely low cell fill percentages or gross print growth errors.
 - **All**—The step tries Histogram first, then Local Contrast, and then Combination, stopping when one mode is successful.

- Cell Sample Size—Sample size, in pixels, to use to determine if each cell is on or off.
 - Auto-detect—The step tries each sample size and uses the one that decodes the Data Matrix in the fewest iterations using the least amount of error correction.
 - **1×1**—The step uses a 1×1 sized sample from each cell.
 - 2×2—The step uses a 2×2 sized sample from each cell.
 - **3×3**—The step uses a 3×3 sized sample from each cell.
 - **4×4**—The step uses a 4×4 sized sample from each cell.
 - **5×5**—The step uses a 5×5 sized sample from each cell.
 - **6×6**—The step uses a 6×6 sized sample from each cell.
 - 7×7—The step uses a 7×7 sized sample from each cell.
- **Cell Filter Mode**—Mode the step uses to determine the pixel value for each cell. Note that if Cell Sample Size is 1×1, the value of the single samples pixel always determines the pixel value for the cell.
 - **Auto-detect**—The step tries all filter modes and uses the one that decodes the Data Matrix within the fewest iterations and utilizing the least amount of error correction.
 - **Average**—The step sets the pixel value for the cell to the average of the sampled pixels.
 - **Median**—The step sets the pixel value for the cell to the median of the sampled pixels.
 - **Central Average**—The step sets the pixel value for the cell to the average of the pixels in the center of the cell sample.
 - **High Average**—The step sets the pixel value for the cell to the average value of the half of the sampled pixels with the highest pixel values.
 - Low Average—The step sets the pixel value for the cell to the average value of the half of the sampled pixels with the lowest pixel values.
 - Very High Average—The step sets the pixel value for the cell to the average value of the ninth of the sampled pixels with the highest pixel values.
 - Very Low Average—The step sets the pixel value for the cell to the average value of the ninth of the sampled pixels with the lowest pixel values.

- **All Filters**—The step tries each filter mode, starting with Average and ending with Very Low Average, stopping once a filter mode decodes correctly.
- **Mirror Mode**—Specifies if the matrix appears normally in the image or if the matrix appears mirrored in the image.
 - **Auto-detect**—Sets the step to determine if the matrix is mirrored automatically.
 - **Normal**—Sets the step to read matrices that appear normally in the image.
 - **Mirrored**—Sets the step to read matrices that appear mirrored in the image.
- Uncheck/Check All—Disables/Enables all Suggest Value checkboxes.
- **Code Read**—Code that the step read.
- **Iterations**—Number of iterations the step took in attempting to locate the matrix. If this number is equal to Maximum Iterations and the step failed to locate the matrix, you may be able to locate the matrix by increasing the Maximum Iterations value.
- **Elapsed Time**—Amount of time the step took to read the code.
- **Suggest Values**—Allows the algorithm to detect the best values for parameters whose Suggest Value? checkboxes are enabled.

Grading Tab

The following controls are available on the Grading tab.

- **Grading**—Specifies whether to enable matrix grading.
- **Overall Grade**—Overall letter grade, which is equal to the lowest of the other five letter grades.
- **Decoding Grade**—Letter grade assigned to a data matrix based on the step's success in decoding the data matrix. The step sets this grade to A if the step could decode the data matrix, otherwise the step sets this grade to F.
- **Symbol Contrast**—Raw score representing the percentage difference between the mean of the reflectance of the darkest 10% and lightest 10% of the matrix.
- **Print Growth**—Print growth raw score for the matrix, which is based on the extent to which dark or light markings appropriately fill their cell boundaries.
- Axial Nonuniformity Grade—Axial nonuniformity grade for the matrix.
- **Unused Error Correction Grade**—Unused error correction letter grade for the matrix.
- **Code Read**—Code that the step read.
- **Iterations**—Number of iterations the step took in attempting to locate the matrix. If this number is equal to Maximum Iterations and the step failed to locate the matrix, you may be able to locate the matrix by increasing the Maximum Iterations value.
- Elapsed Time—Amount of time the step took to read the code.
- **Suggest Values**—Allows the algorithm to detect the best values for parameters whose Suggest Value? checkboxes are enabled.

Read Data Matrix Codes in Images

Use the Data Matrix Reader step to decode a Data Matrix code.

Main Tab

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Verify that the **Reposition Region of Interest** option is enabled if you want to link the region of interest specified in this step to a previously defined coordinate system.

Link the region of interest to a coordinate system if the position of the object under inspection changes from image to image, and you need to adjust the position of the region of interest to match the new location of the object.

Basic Tab

Set the controls to specify the shape of the matrix and to improve the performance of the step. Enable the **Suggest Value?** checkbox if you want the step to suggest values for the controls when you click the **Suggest Values** button.

Search Tab

Set the controls on the **Search** tab. Enable the **Suggest Value?** checkbox if you want the step to suggest values for the controls when you click the **Suggest Values** button.

Cell Sampling Tab

Set the controls on the **Cell Sampling** tab if the step cannot consistently read the matrix because of variations in lighting or matrix quality. Otherwise, use the default values for the controls on this tab.

Grading Tab

Enable the **Grading** control if you want the step to return AIM grading metrics for your matrices. If you do not need grading information for your application, disable the **Grading** control to decrease the amount of time the step takes to complete.

The decoded characters read during the step are shown in the **Code Read** box.

Data Matrix Reader FAQs

What is the difference between the Suggest Value? checkboxes and the Auto-detect option available with some parameters?

When the **Suggest Value?** checkbox is enabled for a given parameter, and you click the **Suggest Values** button, the step suggests a value for that parameter based on the image currently loaded in the Processing window. The purpose of the **Suggest Value?** checkboxes is to recommend parameter values that may increase the reading speed of the step. However, if you expect the parameter values of the barcodes in your application to vary, select the **Auto-detect** option when available. When the **Auto-detect** option is selected for a given parameter, the Data Matrix Reader step automatically detects the value for that parameter during run time.

QR Code Reader

Decodes a QR code.

Main Tab

The following controls are available on the Main tab.

- **Step Name**—Name to give the step.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.
- **Code Read**—Specifies the code that the step read.
- **Elapsed Time**—Amount of time the step took to read the code.
- **Suggest Values**—Allows the algorithm to detect the best values for parameters whose Suggest Value? checkboxes are enabled.

Basic Tab

The following controls are available on the Basic tab.

- **Suggest Value?**—When enabled, the step suggests a value for the associated control after the **Suggest Values** button is clicked.
- **QR Model**—Specifies the QR code model to look for in the image.
 - **Auto-detect**—Sets the step to determine the QR code model automatically.
 - **Micro**—Sets the step to read Micro QR codes only. Micro QR codes have only a single target in the top left.
 - Model 1—Sets the step to read Model 1 QR codes only.
 Model 1 QR codes have targets in all corners except for the bottom right corner and have alignment patterns along the edges.
 - Model 2—Sets the step to read Model 2 QR codes only.
 Model 2 QR codes have targets in all corners except for the bottom right corner and have alignment patterns inside the data.
- Matrix Size—Sets the size of the QR code to read.
- **Barcode Polarity**—Specifies the data-to-background contrast for the QR code.
 - **Auto-detect**—Sets the step to determine the QR code polarity automatically.
 - **Black On White**—Sets the step to read QR codes with dark data on a bright background.
 - White On Black—Sets the step to read QR codes with bright data on a dark background.
- Min Cell Size (pixels)—Specifies the minimum size, in pixels, of the matrix in the image. If you set this value to 0, the step never excludes a matrix candidate because it is too small.
- Max Cell Size (pixels)—Specifies the maximum size, in pixels, of the matrix in the image. If you set this value to 0, the step never excludes a matrix candidate because it is too large.
- Uncheck/Check All—Disables/Enables all Suggest Value checkboxes.
- **Code Read**—Specifies the code that the step read.

- **Elapsed Time**—Amount of time the step took to read the code.
- **Suggest Values**—Allows the algorithm to detect the best values for parameters whose Suggest Value? checkboxes are enabled.

Advanced Search Tab

The following controls are available on the Advanced Search tab.

- **Suggest Value?**—When enabled, the step suggests a value for the associated control after the **Suggest Values** button is clicked.
- Rotation Mode—Specifies the amount of QR code rotation to allow.
 - Unlimited—The step allows for unlimited rotation.
 - **0 Degrees**—The step allows for no rotation.
 - **90 Degrees**—The step allows for +/- 90 degrees of rotation.
 - 180 Degrees—The step allows for +/- 180 degrees of rotation.
 - 270 Degrees—The step allows for +/- 270 degrees of rotation.
- Skew Degrees Allowed—Amount of skew in the QR code to allow. The default is 5 degrees.
- Edge Threshold—Specifies the minimum contrast a pixel must have to be considered part of a QR code cell edge. The lower this value, the more potential edge candidates the step examines during the location phase. Setting this value too low decreases the performance of the step because the step examines too many potential edge candidates. Setting this value too high may also decrease the performance of the step by removing valid edge candidates, making location more difficult. Setting this value too high may also cause the step to fail to identify the QR code because all edge candidates are eliminated.
- **Code Read**—Specifies the code that the step read.
- **Elapsed Time**—Amount of time the step took to read the code.
- **Suggest Value**—Allows the algorithm to detect the best values for parameters whose Suggest Value? checkboxes are enabled.

Cell Sampling Tab

The following controls are available on the Cell Sampling tab.

- **Suggest Value?**—When enabled, the step suggests a value for the associated control after the **Suggest Values** button is clicked.
- **Demodulation Mode**—Specifies the mode that the step uses to determine which cells are on and which cells are off in the QR code.
 - Auto-detect—The step tries each demodulation mode and use the one which decodes the QR code within the fewest iterations and utilizes the least amount of error correction.
 - **Histogram**—The step uses a histogram of all of the matrix cells to calculate a threshold. This threshold determines if a cell is on or off. This is the fastest method but requires images with consistent levels of contrast in the matrix.
 - Local Contrast—The step examines each neighbor of a cell to determine if the cell is on or off. This method is slower but works with images that have inconsistent levels of contrast in the matrix.
 - **Combination**—The step uses the histogram of the matrix to calculate a threshold. For cells with pixel values that are sufficiently below or above this threshold, the step uses the threshold to determine if the cell is on or off. If the cell pixel values are close to the threshold, the step uses the Local Contrast method to determine if the cell is on or off. This method is slower but works with images that have extremely low cell fill percentages or gross print growth errors.
 - **All**—The step tries Histogram first, then Local Contrast, and then Combination, stopping when one mode is successful.
- **Cell Sample Size**—Specifies the cell sample size, in pixels, to use to determine if each cell is on or off.
 - **Auto-detect**—The step tries each sample size and uses the one that decodes the QR code in the fewest iterations using the least amount of error correction.
 - **1×1** The step uses a 1×1 sized sample from each cell.
 - 2×2—The step uses a 2×2 sized sample from each cell.

- 3×3—The step uses a 3×3 sized sample from each cell.
- **4×4**—The step uses a 4×4 sized sample from each cell.
- 5×5—The step uses a 5×5 sized sample from each cell.
- 6×6—The step uses a 6×6 sized sample from each cell.
- **7×7**—The step uses a 7×7 sized sample from each cell.
- **Cell Filter Mode**—Specifies the mode the step uses to determine the pixel value for each cell. If Cell Sample Size is 1×1, the value of the single samples pixel always determines the pixel value for the cell.
 - **Auto-detect**—The step tries all filter modes and uses the one that decodes the QR code within the fewest iterations and utilizing the least amount of error correction.
 - **Average**—The step sets the pixel value for the cell to the average of the sampled pixels.
 - **Median**—The step sets the pixel value for the cell to the median of the sampled pixels.
 - **Central Average**—The step sets the pixel value for the cell to the average of the pixels in the center of the cell sample.
 - **High Average**—The step sets the pixel value for the cell to the average value of the half of the sampled pixels with the highest pixel values.
 - Low Average—The step sets the pixel value for the cell to the average value of the half of the sampled pixels with the lowest pixel values.
 - Very High Average—The step sets the pixel value for the cell to the average value of the ninth of the sampled pixels with the highest pixel values.
 - Very Low Average—The step sets the pixel value for the cell to the average value of the ninth of the sampled pixels with the lowest pixel values.
 - **All Filters**—The step tries each filter mode, starting with Average and ending with Very Low Average, stopping once a filter mode decodes correctly.
- **Mirror Mode**—Specifies if the QR code appears normally in the image or if the QR code appears mirrored in the image.
 - Auto-detect—Sets the step to determine if the QR code is
mirrored automatically.

- **Normal**—Sets the step to read QR codes that appear normally in the image.
- **Mirrored**—Sets the step to read QR codes that appear mirrored in the image.
- Uncheck/Check All—Disables/Enables all Suggest Value checkboxes.
- **Code Read**—Specifies the code that the step read.
- **Elapsed Time**—Amount of time the step took to read the code.
- **Suggest Values**—Allows the algorithm to detect the best values for parameters whose Suggest Value? checkboxes are enabled.

Read QR Codes in Images

Use the QR Code Reader step to decode a QR code.

Main Tab

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Verify that the **Reposition Region of Interest** option is enabled if you want to link the region of interest specified in this step to a previously defined coordinate system.

Link the region of interest to a coordinate system if the position of the object under inspection changes from image to image, and you need to adjust the position of the region of interest to match the new location of the object.

Basic Tab

Set the controls on the **Basic** tab to specify the shape of the QR code and to improve the performance of the step. Enable the **Suggest Value?** checkbox if you want the step to suggest values for the controls when you click the **Suggest Values** button.

Advanced Search Tab

Set the controls on the **Advanced Search** tab. Enable the **Suggest Value?** checkbox if you want the step to suggest values for the controls when you click the **Suggest Values** button.

Cell Sampling Tab

Set the controls on the **Cell Sampling** tab if the step cannot consistently read the matrix because of variations in lighting or matrix quality. Otherwise, use the default values for the controls on this tab.

The decoded characters read during the step are shown in the **Code Read** box.

Read QR Code FAQs

Currently, there are no FAQs associated with this processing function.

PDF417 Code Reader

Use the PDF417 Code Reader function to decode a PDF417 2D barcode.

- **Step Name**—Name to give the step.
- **Reposition Region of Interest**—When enabled, the step dynamically repositions the region of interest based on a coordinate system you built in a previous step.
- **Reference Coordinate System**—Coordinate system to which you want to link the region of interest.
- **Code Read**—Code that the step read.
- Errors Corrected—Number of errors that the barcode reading algorithm corrected.
- **Erasures Corrected**—Number of erasures that the barcode reading algorithm corrected.
- **Rows**—Number of rows in the barcode.
- **Columns**—Number of columns in the barcode.

Read PDF417 Codes in Images

- 1. In the **Step Name** control, enter a descriptive name for the step.
- 2. Draw a region of interest (ROI) around the barcode. Make sure the ROI contains all of the barcode.

The code read during the step is shown in the **Code Read** box.

PDF417 Code Reader FAQs

Currently, there are no FAQs associated with this processing function.

Vision Assistant Express VI Controls

Use the Vision Assistant Express VI to create, edit, and run vision applications in LabVIEW.

- Required Controls—The following controls are required and will always appear on the Express VI connector pane.
 - Image Src—Specifies a reference to the source image
 - **Image Dst**—Specifies a reference to the destination image.
 - error in (no error)—Describes error conditions that occur before this VI runs.
- User-Selected Controls—Displays the controls associated with the processing functions used on the image. The controls displayed depend on the processing functions you selected.
- Required Indicators
 - Image Dst Out—Specifies a reference to the destination image. If Image Dst is connected, Image Dst Out is the same as Image Dst. Otherwise, Image Dst Out refers to the image referenced by Image Src.
 - error out—Contains error information.
- User-Selected Indicators—Displays the indicators associated with the processing functions used on the image. The indicators displayed depend on the processing functions you selected.
- **Create Destination Image**—When enabled, the Express VI internally creates a destination image and outputs that image.
 - Note You are responsible for disposing of the images that are no longer needed in your application.
- **Process Images**—Navigates to the **Process Images** step of the Vision Assistant Express VI Wizard.
- Select Controls—Navigates to the Select Controls and Indicators step of the Vision Assistant Express VI Wizard.
- Finish—Click Finish to return to LabVIEW and update the Express VI.
- **Cancel**—Click Cancel to return to LabVIEW without modifying the existing Express VI.
- Image Caching—When Image caching is enabled, the Vision

Assistant Express VI automatically gets the last image used in LabVIEW. To disable/enable image caching, right-click the Vision Assistant Express VI in the block diagram and select **Disable Image Caching** or **Enable Image Caching**.

Use the Vision Assistant Express VI

Use the Vision Assistant Express VI to quickly create a vision application and to select the controls and indicators that you want to be able to programmatically change in LabVIEW.

Complete the following steps if you are using the Vision Assistant Express VI for the first time in your VI. If you are using the Vision Acquisition Express VI, skip this section and proceed to the <u>Using the</u> <u>Vision Acquisition Express VI with the Vision Assistant Express VI</u> section.

When the Vision Assistant Express VI is placed on the LabVIEW block diagram, Vision Assistant opens.

- Open an image to process from the Vision Assistant environment. Click Open Image or click File»Open Image. Browse to the image you want to open and click Open.
- 2. Develop your vision application using the Vision Assistant processing functions.
- 3. When you have finished developing your application, click **Select Controls**.
- 4. Select the controls and indicators that you want to be able to programmatically set in LabVIEW. The selected controls and indicators appear on the Express VI connector pane after you exit the configuration interface.
 - Note The Required Controls and Required Indicators appear on the Express VI connector pane by default.
- 5. When you are finished selecting controls and indicators, complete one of the following options:
 - Click **Finish** to return to LabVIEW and update the Express VI.
 - Click **Cancel** to return to LabVIEW without modifying the Express VI.
 - Click **Process Images** to modify your application.
- 6. To edit the Vision Assistant Express VI, double-click the Express VI on the block diagram.

Note Any changes you make in the Express VI dialog box

could result in broken wires on the block diagram.

Use the Vision Assistant Express VI with the Vision Acquisition Express VI



Note You must have NI Vision Acquisition Software installed to access the Vision Acquisition Express VI.

Use the Vision Acquisition Express VI to easily configure acquisitions from a camera or to simulate an acquisition. Use the Vision Assistant Express VI to process the image acquired with the Vision Acquisition Express VI.

- 1. Place the Vision Acquisition Express VI on the block diagram and configure your acquisition. Refer to the *NI Vision Acquisition Express VI Help* for more information.
 - Note You must click the **Test** button in the **Configure** Acquisition Settings step of the Vision Acquisition Express VI wizard to be able to use the acquired image in Vision Assistant.
- 2. Place the Vision Assistant Express VI on the block diagram. Vision Assistant will automatically open the image acquired from the **Configure Acquisition Settings** step of the Vision Acquisition Express VI wizard.
 - Note This feature only works when the Vision Assistant Express VI is placed on the block diagram. Otherwise, Vision Assistant follows the behavior described in <u>Vision</u> Assistant Express VI Image Caching.
- 3. Develop your vision application using the Vision Assistant processing functions.
- 4. When you have finished developing your application, click **Select Controls**.
- 5. Select the controls and indicators that you want to be able to programmatically set in LabVIEW. The selected controls and indicators appear on the Express VI connector pane after you exit the configuration interface.



Note The **Required Controls** and **Required Indicators** appear on the Express VI connector pane by default.

6. When you are finished selecting controls and indicators, complete

one of the following options:

- Click **Finish** to return to LabVIEW and update the Express VI.
- Click **Cancel** to return to LabVIEW without modifying the Express VI.
- Click **Process Images** to modify your application.
- 7. To edit the Vision Assistant Express VI, double-click the Express VI on the block diagram.
 - Note Any changes you make in the Express VI dialog box could result in broken wires on the block diagram.

Related Topics

Vision Assistant Express VI Image Caching

Use Coordinate Systems with Vision Assistant Express VIs

How can I prevent IMAQ ReadImageAndVisionInfo File not found, IMAQ ReadClassifier File not found, **and** IMAQ OCR Read File File not found **errors when running the Vision Assistant Express VI on a remote target?**

This error occurs when the Vision Assistant Express VI runs on a remote target and cannot locate the template file for a classification, pattern matching, geometric matching, or OCR step. To correct this error, you must manually copy the template file to the remote target, in a location that corresponds to the location you saved the template on the development computer. For example, if you saved template.png on your development computer at C:\images, you must copy template.png to the <root>\images directory on the remote target. Open the Vision Assistant step to see the file path where the template is saved.

Vision Assistant Express VI Image Caching

When image caching is enabled, the Vision Assistant Express VI automatically gets the last image used when the VI was run. To disable/enable image caching, right-click the Vision Assistant Express VI in the block diagram and select **Disable Image Caching** or **Enable Image Caching**. Image caching is enabled by default.

When you double-click the Vision Assistant Express VI to edit it, Vision Assistant opens the last image used when the VI was run. If you have not run the VI, the Vision Assistant Express VI will re-open the last image that was opened.

If you are using the Vision Assistant Express VI with the Vision Acquisition Express VI, the first time you place the Vision Assistant Express VI on the block diagram, Vision Assistant will automatically open the image acquired from the **Configure Acquisition Settings** step of the Vision Acquisition Express VI wizard.

Use Coordinate Systems with Vision Assistant Express VIs

You can create a coordinate system in one instance of a Vision Assistant Express VI and reference that coordinate system in a second instance of a Vision Assistant Express VI.

Complete the following steps to set up a reference coordinate system using the Vision Assistant Express VI.

- 1. Place the Vision Assistant Express VI on the LabVIEW block diagram.
- 2. Develop your vision application using the Vision Assistant processing functions.
- 3. Set up a coordinate system using the <u>Set Coordinate System</u> <u>step</u>. Coordinate system origins are based on feature locations. You can locate features using the following steps: Edge Detector, Straight Edge (Rake), Adv. Straight Edge, Circular Edge (Spoke), Detect Objects, Pattern Matching, Geometric Matching, Clamp, and Geometry.
- 4. When you have finished developing your application, click Select Controls.
- 5. Select the controls and indicators that you want to be able to programmatically set in LabVIEW. To use a reference coordinate system in another Express VI instance, you must select the **Coordinate System Out** control.
- 6. Click **Finish** to return to LabVIEW and update the Express VI.
- 7. Place a second instance of the Vision Assistant Express VI on the LabVIEW block diagram. If you configured a Set Coordinate System step in the first instance of the Vision Assistant Express VI, the **Select Coordinate System** dialog will open.
- 8. If you want to use the coordinate system defined in the first instance of the Vision Assistant Express VI as a reference coordinate system in the second instance of the Vision Assistant Express VI, select I want to use a coordinate system defined in the following VI in this Express VI.
- 9. Select the VI that creates the coordinate system from the dropdown listbox.

10. When the second instance of the Vision Assistant Express VI dialog opens, you will see a Set Coordinate System step in your script. You cannot edit the step in the second instance, but you can delete the step from the script. The Express VI will be created with a **Coordinate System in** input control. It is your responsibility to manually wire the **Coordinate System Out** from the first Express VI to the **Coordinate System in** of the second Express VI.

Considerations

- When you open an instance of the Vision Assistant Express VI that references a coordinate system from a previous instance of an Express VI, Vision Assistant opens with the last image used to configure the coordinate system. You cannot modify the image because the regions of interest you define in subsequent steps must be able to reference the image.
- The image used to define the coordinate system must be available when you edit the Express VI that references that coordinate system. This means you must edit or run the Express VI that defines the coordinate system before editing the Express VI that references the coordinate system.
- If you try to edit the Express VI when an image is not available, Vision Assistant prompts you to either run the VI that defines the coordinate system or disable the repositioning of regions of interest in the steps that reference that specific coordinate system.

Migrating to a development environment

Creating a LabVIEW VI

You can create a LabVIEW VI using Vision Assistant. Refer to <u>LabVIEW</u> <u>VI Creation (Tools»Create LabVIEW VI</u>) for more information about creating a LabVIEW VI.

Creating C Code

You can create C code using Vision Assistant. Refer to <u>C Code Creation</u> (Tools»Create C Code) for more information about creating C code.

Creating a Builder File

A Builder file is a tab-delimited ASCII text file that contains the processing functions and relevant parameters for a script that you created and saved in Vision Assistant. You can implement the algorithm defined by the Builder file in Visual Basic using the NI Vision machine vision and image processing libraries.

Complete the following steps to save a Builder file:

- 1. Select Tools»Builder File.
- 2. Browse to the location in which you want to save the Builder file.
- 3. Type a File name.
- 4. Click Save.

To view a Builder file, open it in a text editor, word processor, or spreadsheet.

Related Topics

Creating C Code Creating a LabVIEW VI Script Window Scripting

Create C Code

Creates C code using a wizard to implement the different steps of the script.



Note You must have a C compiler and the NI Vision 8.2.1 Development Module or later installed to use the Create C Code function.

- **Implementation File Name**—Name of the C file that implements the image processing algorithm you prototyped in the script.
- **Main File Name**—Name of the C file that implements a main function, which acquires an image from a source, then calls the image processing function created in the Implementation File.

Image Source

Select the source image from the following options:

- **Image File**—Creates the C code to open an image file from the hard drive.
- Acquisition from an NI Image Acquisition device—Creates the C code to acquire an image from a camera connected to an NI image acquisition device.
- Triggered Acquisition from an NI Image Acquisition device— Creates the C code to perform a triggered acquisition with an NI image acquisition device.
- Acquisition from an IEEE 1394 Camera—Creates the C code to acquire an image from an IEEE 1394 camera connected to an NI image acquisition device.
- **Note** Vision Assistant acquires images from interface img0. If you have more than one image acquisition device installed in the computer and want to use a different interface, you must modify the interface name within the created C Code.

Create C Code

- 1. Select Tools»Create C Code.
- 2. Enter the file name under which you want to save the C code in the Implementation File Name control.
- 3. If you would like the C Code Creation Wizard to generate a main function, which acquires an image from a source, enable the **Create Main Function** option. Enter the name of the main function file in the **Main File Name** control.
- 4. Select the **Image Source** for the C Code creation. The following image source options are available:
 - **Image File**—Creates the C code to open an image file from the hard drive.
 - Acquisition from an NI Image Acquisition device— Creates the C code to acquire an image from a camera connected to an NI image acquisition device.
 - **Triggered Acquisition from an NI Image Acquisition device**—Creates the C code that performs a triggered image acquisition with an NI image acquisition device.
 - Acquisition from an IEEE 1394 Camera—Creates the C code to acquire an image with NI-IMAQ for IEEE 1394 Cameras.
 - Note You must have NI-IMAQ for IEEE 1394 Cameras installed to create the code to acquire images from IEEE 1394 cameras.
- 5. Browse to the location to which you want to save the generated files.
- 6. If you would like to add the generated files to a LabWindows/CVI project, enable the Add Files to LabWindows/CVI project option. If you have a LabWindows/CVI Project open to which you want to add the generated files, enable the Use Currently Open Project option. Enable the Create New Project option to add the files to a new project.



Note This option is available only if LabWindows/CVI is installed on your computer.

Create LabVIEW VI

Creates a LabVIEW VI using a wizard to implement the different steps of the script.

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Note You must have LabVIEW 7.1 or later and the NI Vision 8.2.1 Development Module or later installed to use the Create LabVIEW VI function.

• Select the Vision Assistant script—Select the script from the following options:

CurrentCreates a diagram for the current Vision AssistantScriptscript.

Script File Creates a diagram according to a script file you have saved on the hard drive

Script File Path of the script file you want to use to create the VI. Path

• Select the image source—Select the source image from the following options:

Image Control	Creates an Image In control and Image Out
	indicator, allowing you to use the created VI
	as a sub-VI

- Image FileCreates the diagram to open an image file
from the hard drive.
- Image Acquisition Creates the diagram to acquire an image from a camera connected to an NI image acquisition device.

Image AcquisitionCreates the diagram to acquire an imagefrom an IEEE 1394from an IEEE 1394 camera.

Camera

Triggered Image Creates the diagram to perform a triggered acquisition with an NI image acquisition device.

Note Vision Assistant creates the VI to acquire images from the interface img0. If you have more than one image acquisition device installed in the computer and want to use a different interface, you

must modify the interface name in the created VI.

Create a LabVIEW VI

- 1. Select Tools»Create LabVIEW VI.
- 2. Select the version of LabVIEW that you want to use to create the VI.

If you have several versions of LabVIEW installed, the wizard displays a list of available LabVIEW versions that you can use to create the VI.

- 3. Browse to the location to which you want to save the VI.
- 4. Click Next.
- 5. Select the script you want to use to create the VI. **Current Script** creates the VI from the script that is currently loaded in Vision Assistant. **Script File** allows you to browse for a script file.
- 6. Click Next.
- 7. Select the image source for the VI.
 - Image Control—Creates an Image In control and Image Out indicator, allowing you to use the created VI as a sub-VI.
 - **Image File**—Creates the diagram to open an image file from the hard drive.
 - **Image Acquisition**—Creates the diagram to acquire an image from a camera connected to an NI image acquisition device.
 - **Triggered Image Acquisition**—Creates the diagram that performs a triggered image acquisition with an NI image acquisition device.
 - Image Acquisition from an IEEE 1394 Camera—Creates the diagram to acquire an image with an IEEE 1394 camera.



Note You must have NI-IMAQ for IEEE 1394 Cameras 1.5 or later installed to create the code to acquire images from IEEE 1394 cameras.

8. Click Finish.

Using the Solution Wizard

Use the Solution Wizard to view typical uses of NI Vision in imaging and machine vision applications.

- 1. Select Help»Solution Wizard.
- 2. Select an industry and an application from the list in the left window.
- 3. Look at the image representing the application and read the brief problem description.
- 4. Click **Load Solution** to load images and a solution script into Vision Assistant. When you load the solution into Vision Assistant, run the script on the Solution Wizard images or on the own images. You also can alter the script to experiment with different functions and parameters.

Related Topics

Getting help in Vision Assistant

Fusebox Inspection

M

Application TypeInspectionImage CharacteristicsColorMachine Vision Tool(s)Color Matching

The fusebox inspection determines if all the color-coded fuses are present and in the correct locations in the fuse box. The application uses color matching to compare the color information at each fuse socket in the image with the expected color for the fuse.

Color Matching—Compares the color information contained in the fuse labeled 20 with the color information in two predefined regions where you expect to find the fuse. In this application, it is assumed that the fuse boxes you are inspecting are always located at the same position in the image. The Color Matching function calls on the color information of the fuse, which has been learned and stored in the script. That color information is compared with the color information in the search regions. If the correct fuse is identified, the Color Matching function returns a match score greater than 750. If the correct fuse is not present in either of the search regions, the Color Matching function returns a lower score and the fuse box fails the inspection process.

Color Matching—Compares the color information contained in the fuse labeled 25 with the color information from two predefined regions in the image where you expect to find the fuse.

Note There are two types of colors associated with the fuse labeled 3, so color matching is performed twice (steps 3 and 4).

Color Matching—Compares the color information contained in the first type of fuse labeled 3 with the color information from two predefined regions in the image where you expect to find the fuse.

Color Matching—Compares the color information contained in the second type of fuse labeled 3 to same regions used in Step 3.

The fusebox passes inspection for the fuse labeled 3 if each of the two search regions passes at least one of the color matching tasks defined in Steps 3 and 4.

Color Matching—Compares the color information contained in the fuse labeled 10 to a predefined region in the image of the fusebox

where you expect to locate the fuse.

Sparkplug Inspection

Application Type	Inspection
Image Characteristics	Monochrome; Good Contrast; Very Little Image Noise
Machine Vision Tool(s)	Edge Detection; Caliper

The sparkplug inspection determines the width of the spark plug base and the gap between the electrodes using the Edge Detection and Caliper functions.

Edge Detection: All Edges (Simple Edge Detection)—Finds points on either end of the base of the spark plug. The edge detection process looks for edges (sharp transitions in pixel values) along a search path. The search path is defined as the line that is drawn across the base. The line is drawn long enough so that it always cuts through the base even if the spark plug moves from image to image.

The simple edge tool is used to detect the edges because the spark plug is well contrasted from the image and there is no noise in the image. Based on the line profile obtained along the search line, a threshold value of 128 is used to detect the edges.

Edge Detection: All Edges (Simple Edge Detection)—Finds points on the spark plug electrodes on either side of the gap. In this case, the search line is drawn so it cuts across the spark plug electrodes on either side of the gap.

Caliper—Measures the distance between the points found on the base to measure the width of the base. The distance between the points found on either side of the gap indicates the length of the gap.

Cell Analysis

Application TypeCounting; IdentificationImage CharacteristicsMonochrome; Good Contrast; NoisyImage Processing Tool(s)Filtering; Thresholding

The cell analysis example counts the number of cells and measures their areas using the Grayscale Filtering, Thresholding, and Binary Image Inversion functions.

Filters: Smoothing—Gaussian—Smoothes the image using a Gaussian filter.

Filters: Edge Detection—Laplacian—Highlights the edges in the image using a Laplacian filter. This operation finds edges in the filtered image and adds them to the original image. This operation helps increase the separation between the cells and the background.

Threshold: Auto Threshold—Metric—Separates the dark regions in the image from the rest of the image using an automatic threshold technique. In this case, the dark regions in the image correspond to the cells. The regions corresponding to the medium in which the cells are present appear as foreground in the resulting binary image.

Basic Morphology: Proper Close—Improves the shape of the particles in the binary image by smoothing the boundary of the particles, filling small holes in the particles, and closing small gaps along the perimeter of the particles.

Adv. Morphology: Fill Holes—Fills any size holes in a particle.

Particle Filter—Removes unwanted particles from the binary image using the particle filter. This application only analyzes particles that are mostly circular and larger than 10 pixels. Particles that have a Heywood Circularity Factor that falls outside of the 0 to 1.40 range or have a pixel area of less than 10 are removed.

Particle Analysis—Analyzes the properties of the remaining particles (cells) in the image. The particle measurement function can analyze up to 50 different properties of a particle.

Culture Analysis

Application Type	Segmentation; Counting
Image Characteristics	Monochrome; Good Contrast; Some Speckle Noise
Image Processing Tool(s)	Filtering; Thresholding; Advanced Morphology

The culture analysis example distinguishes the boundaries of each cell in a cluster of cells, separates the cluster into its individual cells, and overlays the cell boundaries over the original image.

Image Buffer: Add Copy (1)—Stores a copy of the original image into Buffer #1 of the image buffer for later use. The final results are overlaid on this image.

Filters: Smoothing—Median—Smoothes the image. The median filter removes any speckle noise that is present in the image. This prevents speckle noise from being highlighted as a detail in the next step.

Filters: Convolution—High Level Detail—Highlights details in the image. The convolution filter highlights regions in the image where there are sharp changes in pixel values. These regions correspond to the boundaries of the cells and other noisy pixels that may be present in the image.

Threshold: Auto-Threshold—Metric—Separates dark regions from the rest of the image. In this case, the dark regions in the image correspond to the cells. The regions corresponding to the medium in which the cells are present appear as background in the foreground binary image.

Adv. Morphology: Remove Small Particles—Removes noise particles in the binary image. Any particle removed by two iterations of the erosion operation is considered to be a noise particle and removed from the image. The rest of the particles are left untouched.

Adv. Morphology: Separate Objects—Separates touching particles in the image. This step helps to separate cells that may be touching each other at a few pixels along their boundaries. At the end of this step, the binary image contains particles corresponding to the cells that need to be counted.
Adv. Morphology: Label Objects—Labels each particle with a unique ID. When you display a labeled image with a binary palette, each particle appears as with a different color. Labeling helps you determine if the cells have been separated correctly.

Basic Morphology: Gradient Out—Finds the outer boundary of each particle in the image.

Operators: Multiply—Multiplies the image by 255 to extend the dynamic of the image from (0,1) to (0,255). Grayscale 255 is represented as white, which becomes the overlap color in the next step.

Operators: Add—Adds the processed image to the original image, which was stored in Buffer #1 of the image buffer. The addition process adds the particle boundary information to the original image, outlining the boundary of each cell.

Printed Circuit Board Inspection

Application TypeInspectionImage CharacteristicsMonochromeMachine Vision Tool(s)Pattern Matching

The printed circuit device inspection example uses the Pattern Matching function to determine if PCB components are present and in the correct location, and matches areas of inspection to a template of valid components. This application uses shift-invariant matching to inspect an oriented component (diode) and uses rotation-invariant matching to inspect a component (resistor) that may appear in multiple orientations.

Pattern Matching—Locates a specific diode component in the image of the PCB. The template used to locate the component is chosen so that it contains only the relevant parts of the component necessary for the location process. This avoids mismatches or positioning accuracy problems that may arise due to variations in the background of the component.

Because the orientation of the diode is important to the inspection process, shift-invariant pattern matching is used to locate the diode. The Pattern Matching function does not find the diode if it is present but incorrectly oriented, causing the inspection to fail.

Because you know the expected location of the diode before you begin the inspection process, you can specify a search region around the location of the diode, which speeds up the pattern matching process.

Pattern Matching—Locates a specific resistor component in the image of the PCB. The template used to locate the component is chosen such that it contains one of the relevant parts of the component needed to locate it. This avoids mismatches or positioning accuracy problems that may arise due to variations in the background of the component.

Because the orientation of the resistor is not important in the inspection process, rotation-invariant pattern matching is used to locate the resistor. The Pattern Matching function finds the resistor if it is present in the image at any orientation. Inspection fails only when the resistor is not present in the image.

Because you know the expected location of the resistor before you

begin the inspection process, you can specify a search region around the location, which speeds up the pattern matching process.

Pins Inspection

Application TypeInspection; GaugingImage CharacteristicsMonochrome; Good ContrastMachine Vision Tool(s)Edge Detection; Caliper

The pins inspection example examines if the connector pins on a Berg stick are vertical and straight. The inspection requires finding the edge of each pin at three different locations, and computing the angle formed by these points to determine the orientation of the pin.

Edge Detection (All Edges) Simple Edge Detection—Finds the edge points of the pins. The edge detection process looks for edges (sharp transitions in pixel values) along a search path. The search path is defined as the horizontal line drawn across the image close to the top of the pins.

The simple edge tool is used to detect the edges because the pins are well contrasted from the background in the image, and there is no noise in the image. Based on the line profile obtained along the search line, a threshold value of 100 is used to detect the edges.

The pixel coordinates of the left and right edges of each pin along the search line in the image are returned at the end of this step.

Edge Detection (All Edges) Simple Edge Detection—Finds edges on the pins along a horizontal search line that passes midway through each pin. The pixel coordinates of the left and right edges of each pin along the horizontal search line are returned at the end of this step.

Edge Detection (All Edges) Simple Edge Detection—Finds edges on the pins along a horizontal search line that passes close to the bottom of each pin. The pixel coordinates of the left and right edges of each pin along the horizontal search line are returned at the end of this step.

Caliper—Finds the angle of each pin. The right edge locations of each pin, obtained from the previous steps, are used to compute the angle of the pin.

Bordon Pressure Tube Calibration

Application TypeGaugingImage CharacteristicsMonochrome; Good ContrastMachine Vision Tool(s)Pattern Matching; Caliper

The Bordon pressure tube inspection example demonstrates calibrating a Bordon pressure tube by measuring the distance between the base and the tip of the tube.

As pressure is applied to the Bordon tube, the tip of the tube extends outward. The calibration process involves correlating the computed distance from the image to the pressure applied to the Bordon tube.

Pattern Matching—Finds the tip of the Bordon pressure tube. A region containing the hole at the tip of the tube is used as the template. Because the template is rotationally symmetric, shift-invariant pattern matching is used to locate the tip. The Pattern Matching function finds the location of the tip and returns the pixel coordinates of the location.

Pattern Matching—Finds the base of the Bordon pressure tube. A region containing the hole at the base of the tube is used as the template. Because the template is rotationally symmetric, shift-invariant pattern matching is used to locate the base. The Pattern Matching function finds the location of the base and returns the pixel coordinates of the location.

Caliper—Uses the caliper tool to measure the distance between the locations of the tip and the base of the Bordon tube.

Label Inspection

Application Type	Inspection
Image Characteristics	Monochrome; Good Contrast
Machine Vision Tool(s)	Pattern Matching; Golden Template Comparison; Particle Analysis

The label inspection example demonstrates finding defects such as double-prints, scratches, and lack of ink on a printed label. The defects are found by defining a golden template of a perfect label and comparing it to the inspection images. The particle analysis step at the end of the inspection characterizes the defects.

Pattern Matching—Finds the printed label in the image. A region containing the printed label is used as the template. Because the label can rotate slightly, rotation-invariant pattern matching is used to locate the label. The Pattern Matching function finds the location of the label and returns the pixel coordinates of the location.

Golden Template Comparison—Uses the same template from the pattern matching step as a golden template. This template represents a "perfect" label in the first image. The golden template comparison uses the coordinates returned by the pattern matching step to position the golden template in the image and compare the golden template with the corresponding pixels of the image. The difference image highlights the defects between the golden template and the image under inspection.

Particle Analysis—Analyzes the properties of the defects in the image. The particle measurement function can analyze up to 50 different properties of a particle.

LEGO Bricks Classification

Application Type Identification

Image Characteristics Color

Machine VisionRun LabVIEW VI; Custom Classification;Tool(s)Overlay

The LEGO bricks classification example demonstrates the use of the Run LabVIEW VI step. The Run LabVIEW VI step calls a custom classification algorithm written in LabVIEW to classify LEGO bricks based on the color and shape of the bricks. The Overlay step overlays the result onto the image.

Run LabVIEW VI—Calls a custom classification VI written in LabVIEW. The VI classifies the LEGO brick based on the specific features of the brick. The feature vector is made of an array containing the color spectrum of the part and a shape descriptor that recognizes the shape of the brick.

Overlay—Overlay the result of the classification onto the image without destroying the image data.

Color Pencil Inspection

Application Type Inspection

Image Characteristics Color

Machine Vision Tool(s) Color Matching; Pattern Matching

The color pencil inspection example determines if manufactured colored pencils meet specifications. This application compares the pencil lead color to the color of the pencil shaft using the Color Matching function, and uses the Pattern Matching function to ensure that the tip of the pencil is not broken.

Color Matching—Determines if the color of the pencil tip is the same color as the shaft.

Color Plane Extraction: HSL—Luminance—Extracts the luminance plane from the color image.

Pattern Matching—Verifies that the tip of the pencil is not broken.

Wood Inspection

Application Type	Inspection
Image Characteristics	Monochrome; Low Contrast
Image Processing Tool(s)	Lookup Table; Thresholding; Advanced Morphology; Particle Analysis

The wood inspection example checks the surface of wood planks for structural defects using a lookup table, an automatic threshold, binary image processing, advanced morphology, and particle analysis.

Lookup Table: Square Root—Enhances the appearance of the pixels in the image with low grayscale values. Structural defects on the wood surface appear as slightly darker regions in the image. A lookup table that applies a square root function to the image helps to enhance the difference between the defects and the surface of the wood.

Threshold: Auto-Threshold—Entropy—Separates the areas in the image that may be defects from the rest of the wood surface. An automatic thresholding technique is applied to create a binary image. An automatic threshold has the advantage of being independent of the imaging conditions.

Adv. Morphology: Remove Small Particles—Removes small noise particles from the binary image. Particles that are removed by an iteration of erosion are assumed to be noise particles.

Adv. Morphology: Remove Border Objects—Removes particles that touch the border of the image. Complete information about particles that touch the border of the image is not available, so the particles are removed from further analysis.

Particle Analysis—Determines characteristics of each particle (defect) in the image. You can compute up to 50 different properties of the structural defects.

Blister Pack Inspection

Application TypeInspectionImage CharacteristicsColor; Non-linear LightingMachine Vision Tool(s)Color Location

The blister pack inspection example determines if a blister pack has the correct number and type of pills using the Color Location function. The inspection determines the number of a specific color pill in the package.

Because the colors of the wrong pills (blue) are very distinct from the correct ones (green), a low sensitivity color representation is adequate for color location. Because you are interested only in counting the number of pills rather than finding the exact location of the pills, use a very aggressive search strategy.

Color Location—Determines the number of a specific color pill in the blister pack. To use color location, you first define a color template that represents the green part of a good pill. The Color Location function locates all instances of color information in an image that matches the template. You can use the number of matches (locations) to determine if the blister pack contains the correct number of pills.

Dental Floss Inspection

Application TypeInspectionImage CharacteristicsMonochrome; Good ContrastImage Processing
ToolsPattern Matching; Set Coordinate System;
Quantify

The dental floss inspection determines if dental floss holders contain toothpaste and a wire. The dental floss holders appear shifted and rotated from one image to another. To account for the different locations, this application uses the Set Coordinate System step to define a coordinate system relative to the feature found in the Pattern Matching step, the base of the dental floss holder.

Pattern Matching—Locates the dental floss base. The base is always in the field of view of the camera despite the different locations the dental floss holders may appear in from image to image. This feature is used to define the coordinate system.

Set Coordinate System—Defines a coordinate system based on the Pattern Matching step. Because the dental floss holders appear shifted and rotated from one image to another, the changes in the region of interest are accounted for using the **Horizontal**, **Vertical**, **and Angular Motion** mode. This mode adjusts the region of interest positions along the horizontal and vertical axes, and adjusts for rotational changes.

Quantify—Checks the dental floss holders for the presence of toothpaste and a wire. This step measures the pixel intensities of three regions of interest within the image—the wire, and the two toothpaste regions. This step uses the **Reposition Region of Interest** control to link the regions of interest specified in this step to the previously defined coordinate system. Vision Assistant can adjust the location and orientation of the regions of interest from image to image relative to the coordinate system.

Pills Inspection

Application Type	Inspection
Image Characteristics	Monochrome; Good Contrast
Machine Vision Tool(s)	<u>Threshold;</u> <u>Watershed Segmentation;</u> <u>Particle</u> <u>Analysis</u>

The pill inspection example uses the Watershed Segmentation algorithm to separate pills in an image and then perform particle analysis on the individual pills.

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. This example shows how to use the Watershed image to mask the original image and separate the objects. The particle analysis step then analyzes each individual pill.

Threshold: Auto Threshold—Clustering—Separates the bright regions in the image from the rest of the image using an automatic threshold technique.

Image Buffer: Add Copy (1)—Stores a copy of the thresholded image in Buffer #1 of the image buffer for later use.

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. This step is a preprocessing step before applying the Watershed Segmentation algorithm.

Watershed Segmentation—The Watershed Segmentation algorithm partitions an image based on the topographic surface of the image. The image is separated into non-overlapping segments, with each segment containing a unique particle. Each region is separated by a line of pixels with values of 0. This line is called the watershed line.

Image Buffer: Add Copy (2)—Stores a copy of the watershed image in Buffer #2 of the image buffer for later use.

Image Buffer: Retrieve Buffer—Retrieves the copy of the thresholded image.

Mask Buffer—Masks the thresholded image with the watershed image.

As a result, the pixels of the watershed lines (with values of 0) are set to 0 on the resulting image, therefore separating the particles.

Particle Analysis—Analyzes the properties of the remaining particles (pills) in the image. The particle measurement function can analyze up to 50 different properties of a particle.

Tablet Discoloration Inspection

Application TypeInspectionImage CharacteristicsColorImage Processing Tool(s)Color Thresholding; Particle Analysis

The tablet discoloration inspection example determines the presence and quantity of discolored areas on tablets. This application performs a color threshold in HSL mode to detect any discoloration and uses the Particle Analysis function to count the number of defects.

Color Threshold: Manual—Thresholds the color image to separate the colored pills from the background. A color threshold in the HSL color space is applied to the image. For thresholding, appropriate threshold ranges for the Hue, Saturation, and Luminance planes are chosen so that all the areas in the image containing the color of the pill appear in the resulting binary image. All other areas, such as the background and the defects on the pills, do not show up in the binary image.

Image Buffer: Add Copy (1)—Stores a copy of the binary image into the image buffer for later use. The copy is stored in Buffer #1 of the image buffer.

Adv. Morphology: Fill Holes—Fills any holes that are present in the particles corresponding to the pills in the binary image. These holes are caused by regions on the pills that do not have the same color information as the pills. The resulting binary image contains entire particles, without holes, that correspond to the pills.

Operators: Subtract—Subtracts the original binary image stored in Buffer #1 of the image buffer from the binary image that contains the pill particles in their entirety. The resulting image contains the regions corresponding to the defects on the pills, as well as other noise particles.

Adv. Morphology—Removes the noise particles from the image.

Particle Analysis—Analyzes the remaining particles in the binary image to determine if they are significant enough to classify a pill as defective. Particle measurements such as area, length, and orientation are parameters that determine if a defect is significant or not.

Foreign Tablet Inspection

Application Type	Sorting
Image Characteristics	Color
Image Processing	Color Thresholding; Operators; Particle
Tool(s)	<u>Analysis</u>

The foreign tablet inspection example determines if a sample of tablets contains any foreign tablets. This application performs a color threshold to distinguish all tablets from the background, performs another color threshold to isolate the correctly colored tablets in the sample, and then subtracts the first thresholded image from the second to find the foreign tablets.

Image Buffer: Add Copy (1)—Stores a copy of the original image into the image buffer for later use. The image is stored in Buffer #1.

Color Threshold: Manual—Thresholds the color image to separate all the tablets in the image from the background. A color threshold is applied to the image in the HSL color space. The resulting binary image contains all the tablets and some noise particles from the background.

Image Buffer: Add Copy (2)—Stores the binary image with all the pills into the image buffer. The image is stored in Buffer #2

Image Buffer: Retrieve Copy (1)—Retrieves the original color image from Buffer #1 in the image buffer.

Color Threshold: Manual—Thresholds the color image to separate all the correctly colored tablets from the rest of the image. A color threshold is applied to the thresholded image in the HSL color space. The hue values of the correctly colored tablets fall in a range from 230 – 255 (red). The resulting binary image contains all the correctly colored tablets and some noise particles from the background. The particles corresponding to the tablets may have holes in them.

Adv. Morphology: Fill Holes—Improves the binary image by filling holes in the particles corresponding to the correct tablets.

Image Buffer: Add Copy (3)—Stores the binary image with the correct tablet particles into the image buffer. The image is stored in Buffer #3.

Image Buffer: Retrieve Copy (2)—Retrieves the binary image with all the tablet particles for processing from Buffer #2 in the image buffer.

This image becomes the active image.

Operators: Subtract—Subtracts the binary image with the correct tablet particles from the binary image containing all the particles. The Subtract operator subtracts the image stored in Buffer #3 from the binary image you are processing. The resulting image contains particles that correspond to the foreign tablets and other noise particles in the background.

Basic Morphology: Erode Objects—Removes noise particles that are present in the image. All noise particles are removed within two erosion iterations. The resulting image contains particles corresponding to the foreign tablets in the image.

Adv. Morphology: Remove Small Particles—Uses the Particle Analysis function to determine the location of the foreign tablets. The center of mass coordinates of each particle are used to locate the particle in the image.

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Image Browser Controls

You can use the buttons in the Image Browser to navigate images you have opened in Vision Assistant. Refer to the following button descriptions for information about how to view images.

- **First Image**—In thumbnail view, navigates to the first page of thumbnail images. In full-size view, navigates to the first image you opened.
- **Scan Backward**—In thumbnail view, scans from the last page of thumbnail images to the first page of thumbnail images. In full-size, view scans from the last image to the first image.
- Previous Image—In thumbnail view, navigates to the previous page of thumbnail images. In full-size view, navigates to the previous image.
- Stop—In thumbnail view, stops continuous scanning of thumbnail image pages. In full-size view, stops the continuous scanning of images.
- **Next Image**—In thumbnail view, navigates to the next page of thumbnail images. In full-size view, navigates to the next image.
- Scan Forward—In thumbnail view, scans from the first page of thumbnail images to the last page of thumbnail images. In full-size view, scans from the first image to the last image.
- Last Image—In thumbnail view, navigates to the last page of thumbnail images. In full-size view, navigates to the last image you opened.
- **Solution** Continuous Scan—In thumbnail view, continuously scrolls through thumbnail image pages. In full-size, continuously scrolls through open images.
- **Thumbnail/Full-Size View Toggle**—Toggles between the thumbnail image view and full-size image view.
- **Open Image**—Add an image or images from file to the Image Browser.
- Close Selected Image(s)—Removes the selected image or images from the Image Browser.

Snapping an image (single image acquisition)

- 1. Click **File**»Acquire Image. Vision Assistant displays the Acquisition Functions palette.
- 2. Click the appropriate acquisition step. The Devices window displays all NI image acquisition devices and channels or ports available for the computer.
- 3. Select the device and channel or port you want to use to acquire an image.
- 4. Click Acquire Single Image to acquire a single image with the NI image acquisition device and display it. This operation is known as a snap.
- 5. Click Store Acquired Image in Browser to send the image to the Image Browser.
- 6. Click **Close** to add the acquisition step and close the setup window.
- 7. Process the image as you would any other image in Vision Assistant.
- $\overline{\mathbb{N}}$

Note Refer to the *NI Vision Acquisition Software Release Notes* for more information about configuring NI image acquisition devices.

Related Topics

Simulating image acquisitions

Acquiring a sequence of images

Acquiring images in color

Grabbing an image (continuous image acquisition)

Image Acquisition in Vision Assistant

Grabbing an image (continuous image acquisition)

- 1. Click **File**»**Acquire Image**. Vision Assistant displays the Acquire Images Processing Functions palette.
- 2. Click the appropriate acquisition step. The Devices window displays all NI image acquisition devices and channels or ports available for the computer.
- 3. Select the device and channel or port you want to use to acquire an image.
- 4. Click Acquire Continuous Images to acquire and display images in continuous mode at the maximum rate. This operation is known as a grab.
- 5. Click **Acquire Continuous Images** again to stop the acquisition and display the last acquired image.
- 6. Click Store Acquired Image in Browser to send the image to the Image Browser.
- 7. Process the image as you would any other image in Vision Assistant.

N

- **Note** Refer to the *NI Vision Acquisition Software Release Notes* for more information about configuring NI image acquisition devices.
- **Tip** You can select a region of interest from a full-size image during the acquisition. To reduce the image to the selected ROI, draw an ROI in the image while grabbing it. You can further refine the image by selecting another ROI. Return to the full-size image by clicking the image.

Related Topics

Acquiring a sequence of images

Acquiring images in color

Image Acquisition in Vision Assistant

Snapping an image (single image acquisition)

Acquiring a sequence of images

- 1. Click **File**»Acquire Image. Vision Assistant displays the Acquisition Interface window and acquisition property pages.
- 2. Click the appropriate acquisition step. The Devices window displays all NI image acquisition devices and channels or ports available for the computer.
- 3. Select the device and channel or port you want to use to acquire an image.
- 4. Click Sequence Acquisition to view the Sequence Acquisition Wizard.
- 5. Set the following properties in the Sequence Acquisition Wizard:
 - Number of Frames—Number of frames you want to acquire.
 - Skip Count—Number of frames you want to skip between acquisitions.
 - Action—Triggering action. Select Disabled, Trigger start of acquisition, or Trigger each image.
 - Line—Physical trigger line.
 - **Timeout**—Time, in milliseconds, within which the trigger must occur.
 - **Polarity**—Edge of the signal at which the trigger occurs.

For example, if you have a camera that acquires 30 frames per second (f/s) and you want to acquire an image every second until you acquire 10 images in the sequence, set **Number of Frames** to **10** and **Skip Count** to **29** (30 f/s–1 frame acquired in the sequence).

- 6. Click **Next**, **Next**, and **Finish** to complete the sequence acquisition. Vision Assistant sends acquired images to the Image Browser.
- 7. Process the images as you would any other image in Vision Assistant.
- Note Refer to the *NI Vision Acquisition Software Release Notes* for more information about configuring the NI image acquisition device.

Related Topics

Acquiring images in color Grabbing an image (continuous image acquisition) Image Acquisition in Vision Assistant Snapping an image (single image acquisition)

NI 17xx Light Configuration

Use the **Configure Light** dialog box to control your light. You must choose between **Select Light** and **Enter Light Protection Data** when configuring a light source.

Select **Select Light** to choose a lighting data file. Lighting data files exist in four levels of certification:

- Digitally Signed by National Instruments—The information contained within this file has been verified as correct and safe by National Instruments. Contact National Instruments for support regarding this lighting data file or the light to which it refers.
- Digitally Signed by a Third-party Company—The information contained within this file has been verified as correct and safe by the specified third-party company. Contact the third-party company for support regarding this lighting data file or the light to which it refers.
- Not Digitally Signed—The information contained within this file meets the requirements of Direct Drive lighting; however, it has not been verified that the information is safe to use with the specified light. Use this file at your own risk.
- Invalid—The information contained within this file is unusable because the digital signature is corrupt, the data describing the light is corrupt, the data describing the light is not in the proper syntax, or the data does not meet the requirements of Direct Drive lighting.

Select **Enter Lighting Protection Data** to manually enter control limits for your light. Before manually entering limits for your light, be aware of the manufacturer specified limitations. Exceeding the maximum current or timing limits specified by the manufacturer will damage the light. All lights support the following options:

- Maximum Continuous Current (mA) specifies the continuous current limit in milliamps and is the maximum current limit the light supports in continuous mode.
- Maximum Strobe Current (mA) specifies the strobe current limit in milliamps and is the maximum current the light supports when in

strobe mode.

- **Maximum Strobe Duration (ms)** specifies the strobe duration limit in milliseconds and is the maximum amount of time that the light remains on when being driven with the maximum strobe current.
- Maximum Strobe Duty Cycle (%) specifies the maximum duty cycle to allow for the strobe. The duty cycle is the ratio of the light strobe duration to the frame period.



Note If you violate either the strobe duration limit or the strobe duty cycle limit, then the settings will revert to the continuous current limit.

Refer to your light documentation for additional information about supported features and lighting limits.

Processing an Image



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



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

Related Topics

Adding a processed image to the Image Browser

Browsing images in the Image Browser

Magnifying an image

Opening images in Vision Assistant

Printing an image

Removing an image from the Image Browser

Saving an image

Batch Processing Controls

- Image Source
 - **Hard Disk**—Processes the images in the directory you specify.
 - Browser—Processes all images in the Image Browser.
 - Acquisition—Acquires images using the module you select in Acquisition Modules.
 - Acquisition Modules—Types of acquisition you can perform during batch processing.
 - **Iterations**—Number of times you want to acquire an image during batch processing.
 - **Period (s)**—Length of the delay, in seconds, between acquisitions.
- Script Steps
 - Analysis Mode
 - **Open Results Panel**—Displays the results panel for the selected analysis step for each image.
 - **Save Results**—Applies the script to each image and saves the analysis results to a text file.
 - **Save Options**—Displays the options you specified in the <u>Save Results Setup</u> dialog box.
 - Process Mode
 - **Open Process Interface**—Displays each image in the Processing window and displays the Parameter window for each step in the script. You can modify the step and save the changes before Vision Assistant processes the next image.
 - **Display Result Image**—Applies the script to each image and displays the resulting image.
 - Save Result Image—Applies the script to each image and allows you to save each processed image.
 - **Save Options**—Displays the options you specified in the <u>Save Results Image Setup</u> dialog box.

Save Results Setup

- **One file for all results**—Creates a single results file that contains the results information for each file in the batch process.
- Separate files for each image—Creates separate results files for each image in the batch process.
- Folder Path—Directory in which you want to save the results file
- File Prefix—Name of the individual results file when you select Separate files for each image, or the prefix associated with the index for each results file when you select Separate files for each image.
Save Results Image Setup

- File Format—Standard graphics format you want to save the processed image in.
- Folder Path—Location to which you want to save the processed images.
- File Prefix and Start Index—Text and browser position information you can use to distinguish the processed images. For example, you can type Bracket and 01 to indicate that the processed image is the processed result of the first bracket image in the browser.



- **Note** Values for **File Prefix** and **Start Index** are required to save results images.
- **Save Image Calibration**—Saves calibration information with the image, if applicable.
- Expand Dynamic of Binary Images—Replaces all pixels whose value is 1 with pixels whose value is 255 so that the image appears black and white when opened. If you are processing a binary image and you do not select this option, the image appears entirely black.
- **Compress**—When selected, specifies that BMP images should be compressed.
- **Image Quality**—Level of compression to apply to JPEG and PNG images. Valid values are 0 through 1000. A value of 0 completely compresses the image and produces a low-quality image. A value of 1000 compresses the image slightly and produces a high-quality image.
- **Lossless**—When selected, specifies that images should be compressed with <u>lossless compression</u>.
- **Ratio**—The degree to which to compress the JPEG2000 file when **Lossless** is not selected. For example, if **Ratio** is 50, the resulting file will be 50 times smaller than the size of the image in memory. This parameter is ignored if **Lossless** is True.
- Filter—Filter you want to use to compress AVI files.
- Frame Rate—Movie frame rate for AVI files.

Related Topic

Performing batch processing

Selecting a Region of Interest (ROI)

- 1. Select an ROI tool from the toolbar.
- 2. Using the mouse, click and drag 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



Numbers

- 1D One-dimensional.
- 2D Two-dimensional.
- 3D Three-dimensional.
- 3D view Displays the light intensity of an image in a threedimensional coordinate system, where the spatial coordinates of the image form two dimensions and the light intensity forms the third dimension.

Α

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

В

barycenter	The grayscale value representing the centroid of the range of an image's grayscale values in the image histogram.
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 Visual Basic processing functions and relevant parameters for an image processing algorithm that you created in Vision Assistant.

С

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. <i>See also</i> connectivity-4 <i>and</i> 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

connectivity- 8	part of two different objects if they are diagonally adjacent. 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	$3 \times 3, 5 \times 5, \text{ or } 7 \times 7 \text{ matrices (or templates) used to}$ 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.
coordinate system	A reference location (origin) and angle in an image that ROIs can relate to when positional and angular adjustments of the ROI are necessary. A coordinate system is depicted by two lines representing the orientation and direction of its two axes.

D

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.

Ε

ECC	Error Checking and Correcting. Type of algorithm used for error correction with Data Matrix codes.
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

A measurement from or attribute of a sample.
A 1D array in which each element represents a different feature of a sample.
Fast Fourier Transform. A method used to compute the Fourier transform of an image.
The perimeter of a Data Matrix barcode. The left and bottom sides of the finder pattern form a solid L shape. The right and bottom sides of the finder pattern are made of alternating light and dark cells.
The magnitude information of the Fourier transform of an image.
Transforms an image from the spatial domain to the frequency domain.
Counterparts of spatial filters in the frequency domain. For images, frequency information is in the form of spatial frequency.

G

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 NI 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.

Н

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 Degree of similarity between a sample and members of score 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.
- imageA user-defined region of pixels surrounding an image.borderFunctions that process pixels based on the value of pixel
neighbors require image borders.
- Image 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 The gradation of colors used to display an image on screen, usually defined by a color look-up table.
- image Encompasses various processes and analysis functions that you can apply to an image.
- image Original input image. If you start processing an image and source 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 Finds the inner boundary of objects.

gradient

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).
- JPEG2000 Joint Photographic Experts Group 2000. Image file format for storing 8-bit and color images with lossless compression (extension .jp2).

Κ

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

keying Color in an overlaid bitmap that becomes transparent, allowing

color pixels in the underlying image beneath the keying color to show through.

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.
linear filter	A special algorithm that calculates the value of a pixel based on its own pixel value as well as the pixel values of its neighbors. The sum of this calculation is divided by the sum of the elements in the matrix to obtain a new pixel value.
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.
lossless compression	Compression in which the decompressed image is identical to the original image.
lossy compression	Compression in which the decompressed image is visually similar but not identical to the original image.
lowpass	Applies a linear attenuation to the frequencies in an

attenuation	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.

Μ

- median 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- Uses an M-shaped structuring element in the skeleton skeleton function.

Ν

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 Replaces each pixel value with a nonlinear function of its filter surrounding pixels.

nonlinear A highpass edge-extraction filter that favors vertical edges. gradient

filter

nonlinear A highpass edge-extraction filter that favors horizontal and Prewitt vertical edges in an image.

filter

nonlinear A highpass edge-extraction filter that favors horizontal and Sobel vertical edges in an image.

filter

NthFilters 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 The number of arrays of pixels that compose the image. A of planes gray-level or pseudo-color image is composed of one plane, (in an while an RGB image is composed of three planes (one for the

image) red component, one for the blue, and one for the green).

0

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 smoothes 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 Finds the outer boundary of objects.

gradient

Ρ

- 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 A series of processing operations and analysis functions analysis that produce some information about the particles in an image.

pattern The process of locating a grayscale template in a grayscale matching image.

picture An element of a digital image. Also called pixel.

element pixel Picture element.

pixel Directly calibrating the physical dimensions of a pixel in an

calibration 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 Extracts the contours (edge detection) in gray-level values filter using a 3 × 3 filter kernel.

Processing 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.

- properclosing A finite combination of successive closing and opening operations that you can use to fill small holes and smooth the boundaries of objects.
- properopening 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 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 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 Inverts the pixel values in an image, producing a photometric function negative of the image.

- RGB Color image encoding using red, green, and blue colors.
- Roberts 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.

Т

- 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.

watershed Fully partitions an image based on the topographic surface of the image. The image is separated into non-overlapping zones with each zone containing a unique particle.

W

Saving a VI for Distribution

Complete the following steps to save a LabVIEW VI for distribution:

- 1. Launch LabVIEW.
- 2. Open the VI. If the VI is already open, save the VI.
- 3. Select File»New Project.
- 4. Add the VI and any dependencies to the project. If you want to run the VI on a remote target, you must first add the target to the project. Compete the following steps to add a remote target to the LabVIEW project:
 - a. In the Project Explorer window, right-click the project root and select **New**»**Targets and Devices**.
 - b. Select the target you want to add from the **Targets and Devices** section of the Add Targets and Devices dialog box.
 - c. Click **OK** to add the target to the project.
- 5. Save the project by selecting **File**»**Save Project**.
- 6. Right-click **Build Specifications** underneath the VI you added to the project and select **New**»**Source Distribution** from the shortcut menu to display the Source Distribution Properties dialog box.
- 7. Enter a Build Specification Name and Destination Directory.
- 8. Select the **Source Files** category.
- 9. In the Project Files list, select the top-level VI and any dependencies, and add the files to the **Always Included** list.
- 10. Select the **Destinations** category.
- 11. In the **Destination type** control, select **LLB**.
- 12. Select the **Source Files Settings** category.
- 13. In the Project Files list, click **Dependencies**.
- 14. Enable the **Apply prefix to all contained items** checkbox and enter a prefix.
- 15. Select the Additional Exclusions category.
- 16. Enable the **Disconnect type definitions**, **Remove unused polymorphic VI instances**, and **Remove unused members of project libraries** checkboxes. Do not enable the **Modify project**

library file after removing unused members checkbox.

- 17. Disable the Exclude files from vi.lib, Exclude files from instr.lib, and Exclude files from user.lib checkboxes.
- 18. Select the **Preview** category. Click **Generate Preview** to review the generated file hierarchy for the source distribution. To ensure the preview is accurate, save changes to VIs in memory before you create or edit a build specification.
- 19. Click **Build**. You can find the resulting source distribution in the directory specified in the **Destination directory** control in the **Information** category of the build specification.



Note Before you can use the new LLB on a remote target, you must first download the LLB to the target using FTP.

Particle Filter Measurements

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—Xand 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.

Detect Edges with the Simple Edge Tool

- 1. Select the **Simple Edge Tool** from the **Edge Detector** list.
- 2. In the image, click and drag to select a path along which to search for edges. Vision Assistant displays a line profile describing the path and lists the number of edges found along that path.
- 3. Select the option from **Look For** that specifies which edges you are looking for.
- 4. Set the **Level Type**. **Absolute Value** specifies the threshold level in pixel intensities, and **Relative Value** specifies the threshold level as a percentage of the intensity range found in the line of pixels.
- 5. Set the **Threshold Level** (intensity level that you expect to constitute an edge) or click and drag the cursor on the line profile to position the cursor at the appropriate threshold level.
- 6. Click **OK** to add this step to the script and close the Setup window.

P

Tip You can move the ROI using the arrow keys on the keyboard.

Detect Edges with the Advanced Edge Tool

- 1. Select the Advanced Edge Tool from the Edge Detector list.
- 2. In the image, click and drag to select a path along which to search for edges. Vision Assistant displays the strength of the edges along the ROI and lists the number of edges found along that path.
- 3. Select the option from **Look For** that specifies which edges you are looking for.
- 4. Set the Edge Polarity, Interpolation Type, Kernel Size, Width, and Min Edge Strength parameters to define which edges you are looking for.
- 5. Click **OK** to add this step to the script and close the Parameter window.
- $\mathbf{\widehat{v}}$ **Tip** You can move the ROI using the arrow keys on the keyboard.

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