

IMAQ™

IMAQ Vision for LabWindows/CVI Reference Manual

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The following conventions are used in this manual:



This icon denotes a note, which alerts you to important information.

bold

Bold text denotes items that you must select or click on in the software, such as menu items and dialog box options. Bold text also denotes parameter names.

italic

Italic text denotes variables, emphasis, a cross reference, 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, and code excerpts.

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Basic Concepts

This chapter explains the basic ideas underlying image processing with IMAQ Vision for LabWindows/CVI. For more information about images and image processing, see the *IMAQ Vision User Manual*.

Image Properties

An image is a two dimensional array of values representing light intensity. An image has the following properties: spatial resolution (size), definition (pixel depth), and number of planes. An image's pixel depth and number of planes combine to determine the type of image.

The IMAQ Vision library can manipulate three categories of images: grayscale, color, and complex images. The most common image type for the scientific and industrial fields is an 8-bit grayscale image. IMAQ Vision can also acquire and process 16-bit grayscale images, floating point images, complex images, and color images in Red, Green, and Blue (RGB) or Hue, Saturation, and Luminance (HSL) format.

In IMAQ Vision, you define an image type by using the `imaqCreateImage()` function to create the image object. IMAQ Vision uses the following enumerated values to represent the possible image types.

Table 1-1. IMAQ Vision for LabWindows/CVI Image Types

Value	Description
IMAQ_IMAGE_U8	8 bits per pixel—unsigned, standard monochrome
IMAQ_IMAGE_I16	16 bits per pixel—signed, monochrome
IMAQ_IMAGE_SGL	32 bits per pixel—floating point, monochrome
IMAQ_IMAGE_COMPLEX	2 × 32 bits per pixel—floating point, native format after a Fast Fourier Transform (FFT)
IMAQ_IMAGE_RGB	32 bits per pixel—standard color
IMAQ_IMAGE_HSL	32 bits per pixel—color

In addition to spatial resolution, definition, and number of planes, IMAQ Vision images have border and pixel calibration properties.

The image border attribute physically reserves additional space around the image. You must use borders when you perform a morphological transformation, a convolution, or a particle analysis. These calculations include operations that assign a new value to a pixel in relation to the value of its neighbors. By using image borders, IMAQ Vision can perform these calculations quickly.

The calibration attribute defines the physical horizontal and vertical dimensions of the pixels. With the ability to calibrate two axes independently, you can correct skew resulting from a camera sensor. Only calculations based on morphological transformations use this calibration information. Calibration has no effect on processing or operations between images.

Overview



Note You must install LabWindows/CVI 5.0.1 or higher before installing IMAQ Vision for LabWindows/CVI.

The IMAQ Vision installer adds three important files to your current LabWindows/CVI directory:

- `NIVision.h` contains all constants, enumerated types, structures, and prototypes related to IMAQ Vision.
- `NIVision.lfp` contains all function panels. These panels are similar to the other LabWindows/CVI function panels.
- `NIVision.lib` is an import library for the IMAQ Vision functions.

The IMAQ Vision installer also adds the following files to your system directory. These files contain function code for IMAQ Vision.

- `NIVision.dll`
- `NIVisSvc.dll`

The IMAQ Vision installer also adds the following files to your Program Files\National Instruments\IMAQ Vision directory. Use these files with Microsoft Visual C++ and Borland C++/C++ Builder.

- `NIVision.h` contains all constants, enumerated types, structures, and prototypes related to IMAQ Vision.
- `NIVision.lib` is an import library for the IMAQ Vision functions.

Application Development Environments

This release of IMAQ Vision for LabWindows/CVI supports the following Application Development Environments (ADEs) for Windows 2000/NT/9x.

- LabWindows/CVI version 5.0.1 and higher
- Borland C/C++ version 5.0 and higher
- Borland C++ Builder 3.0 and higher
- Microsoft Visual C/C++ version 6.0 and higher



Note Although IMAQ Vision has been tested and found to work with these ADEs, other ADEs may also work.

IMAQ Vision Function Tree

The IMAQ Vision function tree (`NIVision.lib`) contains separate classes corresponding to groups or types of functions. Table 1-2 lists the IMAQ Vision function types and gives a description of each type.

Table 1-2. IMAQ Vision for LabWindows/CVI Function Types

Function Type	Description
Image Management	Functions that create space in memory for images and perform basic image manipulation.
Memory Management	A function that returns memory you no longer need back to the operating system.
Error Management	Functions that set the current error, return the name of the function in which the last error occurred, return the error code of the last error, and clear any pending errors.
Acquisition	Functions that acquire images through an IMAQ hardware device.
Display	Functions that cover all aspects of image visualization and image window management.
Regions of Interest	Functions that create and manipulate regions of interest.
File I/O	Functions that read and write images to and from disk files.
Image Analysis	Functions that compute the centroid of an image, profile of a line of pixels, and the mean line profile. This type also includes functions that calculate the pixel distribution and statistical parameters of an image.

Table 1-2. IMAQ Vision for LabWindows/CVI Function Types (Continued)

Function Type	Description
Grayscale Processing	Functions for grayscale image processing and analysis.
Binary Processing	Functions for binary image processing and analysis.
Color Processing	Functions for color image processing and analysis.
Pattern Matching	Functions that learn patterns and search for patterns in images.
Caliper	Functions designed for gauging, measurement, and inspection applications.
Operators	Functions that perform arithmetic, logic, and comparison functions with two images or with an image and a constant value.
Analytic Geometry	Functions that perform basic geometric calculations on an image.
Frequency Domain Analysis	Functions for the extraction and manipulation of complex planes. Functions of this type perform FFTs, inverse FFTs, truncation, attenuation, addition, subtraction, multiplication, and division of complex images.
Barcode	A function that reads a barcode.
LCD	Functions that find and read seven-segment LCD characters.
Meter	Functions that return the arc information of a meter and read the meter.
Utilities	Functions that return structures, and a function that returns a pointer to predefined convolution matrices.

Using Images with IMAQ Vision for LabWindows/CVI

To create an image in IMAQ Vision for LabWindows/CVI, call `imaqCreateImage()`. This function returns an image reference you use when calling other IMAQ Vision functions. The only limitation to the size and number of images you can acquire and process is the amount of memory installed in your computer.

Source and Destination Images

All IMAQ Vision functions that modify the contents of an image have source image and destination image input parameters. The source image is the original image you want to process. The destination image is the result of the image processing. If you do not want the

contents of the original image to change, use separate source and destination images. If you want to replace the original image with the processed image, pass the image as both the source and destination. IMAQ Vision resizes the destination image to hold the result if the destination is not the appropriate size.

The following examples illustrate source and destination images with the `imaqTranspose()` function:

- `imaqTranspose(myImage, myImage);`
This function creates a transposed image using the same image for the source and destination. The contents of `myImage` change.
- `imaqTranspose(myTransposedImage, myImage);`
This function creates a transposed image and stores it in a destination different from the source. The `myImage` image remains unchanged, and `myTransposedImage` contains the result.

Some functions perform arithmetic or logical operations between two images. These functions require two source images of the same size. You can use either source image as your destination image, or you can supply a different image as your destination image.

The following examples show the possible combinations using the `imaqAdd()` function:

- `imaqAdd(myResultImage, myImageA, myImageB);`
This function adds two source images (`myImageA` and `myImageB`) and stores the result in a third image (`myResultImage`). Both source images remain intact after processing.
- `imaqAdd(myImageA, myImageA, myImageB);`
This function adds two source images and stores the result in the first source image.
- `imaqAdd(myImageA, myImageA, myImageB);`
This function adds two source images and stores the result in the second source image.

Image Masks

An image mask isolates parts of an image for further processing. If a function has a **mask** parameter, the function process or analysis depends on both the source image and the mask image. The image mask must be an 8-bit binary image.

Pixels in the source image are processed if corresponding pixels in the mask image have values other than zero. Figure 1-1 shows how a mask affects the output of `imaqInverse()`. Figure 1-1a shows the source image. Figure 1-1b shows the mask image. Figure 1-1c shows the inverse of the source image using the mask image. Figure 1-1d shows the inverse of the source image without the mask image.

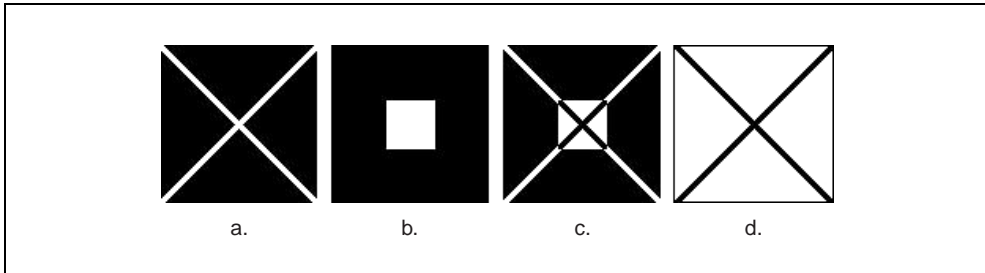


Figure 1-1. Image Masks

The following examples illustrate how to call a function with a mask parameter:

- `imaqInverse(myDest, myImage, myMask);`
This call performs an inverse computation using a mask image, as in Figure 1-1c.
- `imaqInverse(myDest, myImage, NULL);`
This call performs an inverse computation on the entire source image, as in Figure 1-1d.

Processing Options

When performing morphological functions, particle analysis, and filtering, you can specify certain processing options—connectivity and structuring elements. Connectivity controls the way IMAQ Vision determines which pixels belong to a particle. Structuring elements determine which pixels belong to a neighborhood.

Connectivity

In some functions, you can set the pixel connectivity, which specifies how IMAQ Vision determines whether two adjacent pixels are in the same particle. With connectivity-4, two pixels are part of the same particle if they are horizontally or vertically adjacent. With connectivity-8, two pixels are part of the same particle if they are horizontally, vertically, or diagonally adjacent. Figure 1-2 illustrates the two types of connectivity.

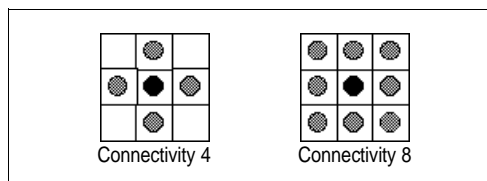


Figure 1-2. Connectivity Types

Figure 1-3 illustrates how connectivity-4 and connectivity-8 affect the way IMAQ Vision determines the number of particles in an image. In Figure 1-3a, IMAQ Vision considers the image as having two particles with connectivity-4. In Figure 1-3b, IMAQ Vision considers the same image as having one particle with connectivity-8. For more information about pixel connectivity in morphological operations and particle analysis, see the *IMAQ Vision User Manual*.

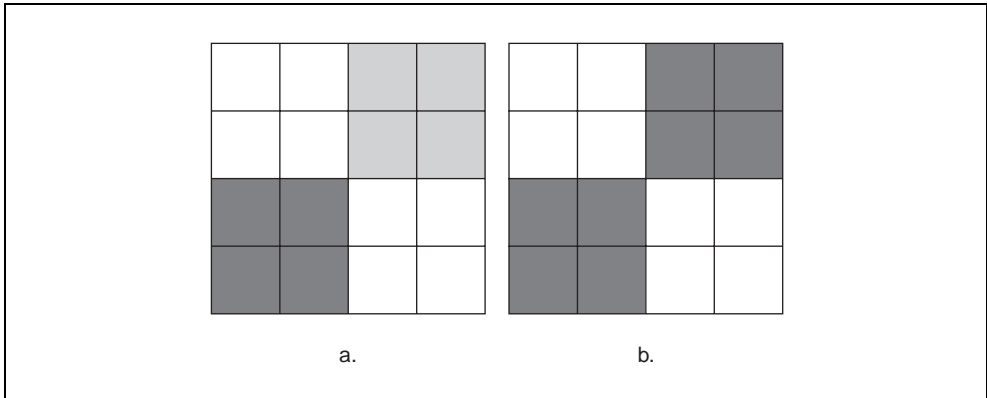


Figure 1-3. Example of Connectivity Processing

Structuring Element

A structuring element determines which pixels constitute a neighborhood. Structuring elements have three parts: structuring element size, pixel frame shape, and kernel values.

A structuring element descriptor is a specific IMAQ Vision structure defined as:

```
typedef struct StructuringElement_struct {
    int matrixCols;
    int matrixRows;
    int hexa;
    int* kernel;
} StructuringElement;
```

The first two fields set the size of the structuring element itself. The third field sets the pixel frame shape. The fourth field is a pointer to the structuring element values.

Structuring Element Size

Using structuring elements requires that the image has a border. The application of a 3×3 structuring element requires a minimum border size of 1. In the same way, structuring elements of 5×5 and 7×7 require a minimum border size of 2 and 3, respectively. Bigger structuring elements require corresponding increases in the image border size.

The coordinates of the central pixel (the pixel being processed) are determined as a function of the structuring element. In Figure 1-4 the coordinates of the processed pixels are (1,1), (2,2), and (3,3), respectively. The origin (0,0) is always the upper left-hand corner pixel.

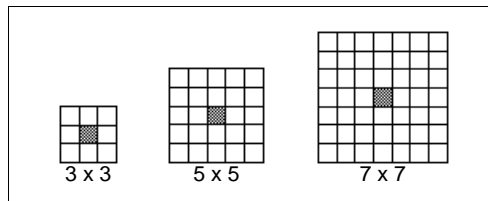


Figure 1-4. Structuring Element

Pixel Frames

A digital image is a two dimensional array of pixels arranged in a rectangular grid. In image processing, this grid can have two different pixel frames: square or hexagonal. As a result, the structuring element can have either a square or hexagonal frame. Your decision to use a square or hexagonal frame affects how IMAQ Vision analyzes the image when you process it with functions that use this frame concept. The chosen pixel frame directly affects the output from morphological measurements.

By default IMAQ Vision uses the square frame (`hexa` contains 0). Use a hexagonal frame to obtain highly precise morphological measurements. As shown below, with a hexagonal plane, the even lines shift half a pixel to the right. Therefore, the hexagonal frame places the pixels in a configuration similar to a true circle.

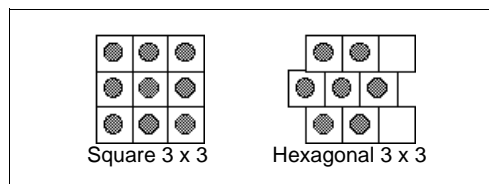


Figure 1-5. Square vs. Hexagonal Frames

The size of the structuring element directly determines the speed of the morphological transformation. Different results occur when you change the contents of the structuring element. You should possess a solid comprehension of morphology or spend some time learning how to use these elements before changing the standard structuring element (filled with 1s).

Kernel

The kernel specifies which pixels are in a neighborhood. The values contained in a structuring element are either 0 or 1. These values dictate which pixels to take into account during processing. If the value in a kernel is 1, the corresponding source image pixel is part of the neighborhood. If the value in the kernel is 0, the corresponding source pixel image is not part of the neighborhood.

Image Management

This chapter describes the Image Management functions in IMAQ Vision for LabWindows/CVI.

Image Management Function Panels

Table 2-1 lists the Image Management functions in a tree structure. The functions in the Image Management class are grouped according to the types of operations they perform. The first-level heading in the tree is the name of the class. The second-level headings are names of function subclasses. The third-level headings are names of individual function panels. Each image management function panel represents one function call.

Table 2-1. Image Management Function Tree

Class/Panel Name	Function Name
Image Management	
Create Image	imaqCreateImage
Pixel Manipulation	
Array To Complex Plane	imaqArrayToComplexPlane
Array To Image	imaqArrayToImage
Complex Plane To Array	imaqComplexPlaneToArray
Extract Color Planes	imaqExtractColorPlanes
Extract Complex Plane	imaqExtractComplexPlane
Fill Image	imaqFillImage
Get Line	imaqGetLine
Get Pixel	imaqGetPixel
Image To Array	imaqImageToArray
Replace Color Planes	imaqReplaceColorPlanes
Replace Complex Plane	imaqReplaceComplexPlane
Set Line	imaqSetLine
Set Pixel	imaqSetPixel
Image Manipulation	
Cast	imaqCast
Copy Rectangle	imaqCopyRect
Duplicate	imaqDuplicate
Flip	imaqFlip
Mask	imaqMask
Resample	imaqResample
Rotate	imaqRotate
Scale	imaqScale

Table 2-1. Image Management Function Tree (Continued)

Class/Panel Name	Function Name
Shift	imaqShift
Transpose	imaqTranspose
Image Information	
Get Bytes Per Pixel	imaqGetBytesPerPixel
Get Calibration Information	imaqGetCalibrationInfo
Get Image Information	imaqGetImageInfo
Get Image Size	imaqGetImageSize
Get Image Type	imaqGetImageType
Get Mask Offset	imaqGetMaskOffset
Get Pixel Address	imaqGetPixelAddress
Is Image Empty	imaqIsImageEmpty
Set Calibration Information	imaqSetCalibrationInfo
Set Image Size	imaqSetImageSize
Set Mask Offset	imaqSetMaskOffset
Drawing	
Draw Line On Image	imaqDrawLineOnImage
Draw Shape On Image	imaqDrawShapeOnImage
Draw Text On Image	imaqDrawTextOnImage
Clipboard	
Clipboard To Image	imaqClipboardToImage
Image To Clipboard	imaqImageToClipboard
Interlacing	
Interlace Combine	imaqInterlaceCombine
Interlace Separate	imaqInterlaceSeparate
Border	
Fill Border	imaqFillBorder
Get Border Size	imaqGetBorderSize
Set Border Size	imaqSetBorderSize

Subclass Descriptions

Image Management subclass descriptions are as follows:

- Pixel Manipulation functions allow you to manipulate images at the pixel level. You can use functions in the Pixel Manipulation subclass to extract image planes, replace image planes, set and return pixel values, and convert images to arrays and arrays to images.
- Image Manipulation functions allow you to manipulate images in their entirety. Functions in this subclass copy, scale, shift, and transpose images.
- Image Information functions allow you to gather information about pixels and images.
- Drawing functions allow you to draw lines, shapes, and text on images.
- Clipboard functions allow you to copy images to and from the clipboard.

- Interlacing functions allow you to combine two fields into one image frame or separate a frame into two fields.
- Border functions allow you to fill an image border with a set of values, get the size of an image border, and set the size of image border.

imaqArrayToComplexPlane

Usage

```
int = imaqArrayToComplexPlane(Image* dest, const Image* source, const float*
                               newPixels, ComplexPlane plane)
```

Purpose

Replaces a plane of a complex image with the given array of pixel values. The array must be the same size as the source image.

Image Type Supported

IMAQ_IMAGE_COMPLEX

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The source image.
newPixels	const float*	The two-dimensional array of pixel values. This array must be the same size as the source image.
plane	ComplexPlane	The plane to replace. Specify IMAQ_REAL to replace the real plane or IMAQ_IMAGINARY to replace the imaginary plane.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqArrayToImage

Usage

```
int = imaqArrayToImage(Image* image, const void* array, int numCols, int
                        numRows)
```

Purpose

Sets the pixels of an image to the values in a given array. This function resizes the image to the size of the source array.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description														
image	Image*	The image whose pixels the function sets to match the input array.														
array	const void*	The two-dimensional array of pixel values. The type of the array you provide depends on the image type. <table border="0" style="margin-left: 20px;"> <thead> <tr> <th>Image Type</th> <th>Array Type</th> </tr> </thead> <tbody> <tr> <td>IMAQ_IMAGE_U8</td> <td>unsigned char</td> </tr> <tr> <td>IMAQ_IMAGE_I16</td> <td>short</td> </tr> <tr> <td>IMAQ_IMAGE_SGL</td> <td>float</td> </tr> <tr> <td>IMAQ_IMAGE_COMPLEX</td> <td>Complex structures</td> </tr> <tr> <td>IMAQ_IMAGE_RGB</td> <td>RGBValue structures</td> </tr> <tr> <td>IMAQ_IMAGE_HSL</td> <td>HSLValue structures</td> </tr> </tbody> </table>	Image Type	Array Type	IMAQ_IMAGE_U8	unsigned char	IMAQ_IMAGE_I16	short	IMAQ_IMAGE_SGL	float	IMAQ_IMAGE_COMPLEX	Complex structures	IMAQ_IMAGE_RGB	RGBValue structures	IMAQ_IMAGE_HSL	HSLValue structures
Image Type	Array Type															
IMAQ_IMAGE_U8	unsigned char															
IMAQ_IMAGE_I16	short															
IMAQ_IMAGE_SGL	float															
IMAQ_IMAGE_COMPLEX	Complex structures															
IMAQ_IMAGE_RGB	RGBValue structures															
IMAQ_IMAGE_HSL	HSLValue structures															
numCols	int	The number of columns in the data array.														
numRows	int	The number of rows in the data array.														

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqCast

Usage

```
int = imaqCast(Image* dest, Image* source, ImageType type, float* lookup, int
              shift)
```

Purpose

Changes the type of an image. This function can perform the change directly on the source image, or it can leave the source image unchanged and instead copy the source image to a destination image and then convert the destination image. If **dest** is equal to **source**, the function changes the type of **source**. Otherwise, the function resizes **dest** to the size of **source** and then copies the pixels.

If the **source** type and the **type** parameter are the same, the function copies pixels unmodified. You can also use `imaqCopyRect()` to copy pixels without modifying them. If the **source** type and the **type** parameter are not the same, the function casts the pixel values to the new type, as Table 2-2 shows.

Table 2-2. Copying Source Pixels to a Destination Image

source Type	type Parameter	Result
IMAQ_IMAGE_U8	IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL	If you provide a lookup table, the destination pixel will have the lookup value of the source pixel. The lookup table must contain 256 elements. If you do not provide a lookup table, the function copies the source value to the destination unmodified.
IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL	IMAQ_IMAGE_RGB32	Each color component of the destination is set to the source value. If the source value is greater than 255, the function sets each color component to 255. If the source value is less than 0, the function sets each color component to 0.

Table 2-2. Copying Source Pixels to a Destination Image (Continued)

source Type	type Parameter	Result
IMAQ_IMAGE_U8 , IMAQ_IMAGE_I16 , IMAQ_IMAGE_SGL	IMAQ_IMAGE_HSL32	The function sets the luminance component of the destination to the source value. If the source value is greater than 255, the function sets the luminance to 255. If the source value is less than 0, the function sets the luminance to 0. The function sets hue and saturation to 0.
IMAQ_IMAGE_U8 , IMAQ_IMAGE_I16 , IMAQ_IMAGE_SGL	IMAQ_IMAGE_COMPLEX	The function sets the real component of the destination to the source value. The function sets the imaginary component of the destination to 0.
IMAQ_IMAGE_I16	IMAQ_IMAGE_U8	The function right-shifts the source value by the given shift value (divides each source pixel value by 2^{shift}) and stores the value in the destination. If the shifted value is greater than 255, the function sets the destination value to 255.
IMAQ_IMAGE_I16	IMAQ_IMAGE_SGL	If you provide a lookup table, the destination pixel will have the lookup value of the source pixel. The lookup table must contain 65,536 elements. If you do not provide a lookup table, the function copies the source value to the destination unmodified.
IMAQ_IMAGE_SGL	IMAQ_IMAGE_U8 , IMAQ_IMAGE_I16	The function sets the destination value to the source value. If the source value is out of the range of the destination, the function coerces the source to the range.
IMAQ_IMAGE_RGB	IMAQ_IMAGE_U8 , IMAQ_IMAGE_I16 , IMAQ_IMAGE_SGL	The function sets the destination value to the average of the three color components of the source.
IMAQ_IMAGE_RGB	IMAQ_IMAGE_HSL	The function converts each pixel from the RGB color space to the HSL color space.

Table 2-2. Copying Source Pixels to a Destination Image (Continued)

source Type	type Parameter	Result
IMAQ_IMAGE_RGB	IMAQ_IMAGE_COMPLEX	The function sets the real portion of the destination value to the average of the three color components of the source, and it sets the imaginary portion of the destination to 0.
IMAQ_IMAGE_HSL	IMAQ_IMAGE_U8 , IMAQ_IMAGE_I16 , IMAQ_IMAGE_SGL	The function sets the destination value to the luminance component of the source value.
IMAQ_IMAGE_HSL	IMAQ_IMAGE_RGB	The function converts each pixel from the HSL color space to the RGB color space.
IMAQ_IMAGE_HSL	IMAQ_IMAGE_COMPLEX	The function sets the real portion of the destination value to the value of the luminance component of the source, and it sets the imaginary portion of the destination to 0.
IMAQ_IMAGE_COMPLEX	IMAQ_IMAGE_U8 , IMAQ_IMAGE_I16 , IMAQ_IMAGE_SGL	The function sets the destination value to the magnitude of the source value.
IMAQ_IMAGE_COMPLEX	IMAQ_IMAGE_RGB	The function sets each color component of the destination value to the magnitude of the source value.
IMAQ_IMAGE_COMPLEX	IMAQ_IMAGE_HSL	The function sets the luminance component of the destination value to the magnitude of the source value, and it sets the hue and saturation components to 0.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The destination image. Set this parameter to source to change the source image directly.
source	Image*	The source image.
type	ImageType	The new type for the image.
lookup	float*	An optional lookup table. Set this parameter to NULL if you do not want to use a lookup table. See Table 2-2 for a description of how the function employs the lookup table.
shift	int	The shift value for converting 16-bit images to 8-bit images. The function ignores this value for all other conversions. See Table 2-2 for a description of how the function employs the shift value.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqClipboardToImage

Usage

```
int = imaqClipboardToImage(Image* dest, RGBValue* palette)
```

Purpose

Copies an image from the clipboard.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_RGB

Parameters

Name	Type	Description
dest	Image*	The image into which the function copies the clipboard image.
palette	RGBValue*	An array of 256 entries that receives the palette associated with the 8-bit clipboard image. If there is no palette associated with the image, the function will fill in a gray palette. Set this parameter to NULL if you do not need the palette.

Return Values

int—On success, this function returns 1 if there was an image on the clipboard or -1 if there was no image on the clipboard. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqComplexPlaneToArray

Usage

```
float* = imaqComplexPlaneToArray(const Image* image, ComplexPlane plane,
                                Rect rect, int* columns, int* rows)
```

Purpose

Extracts a plane from a complex image into a two-dimensional array.

Image Type Supported

IMAQ_IMAGE_COMPLEX

Parameters

Name	Type	Description
image	const Image*	The image whose plane of pixel values the function places into an array.
plane	ComplexPlane	The plane to extract. Set this parameter to IMAQ_REAL, IMAQ_IMAGINARY, IMAQ_MAGNITUDE, or IMAQ_PHASE.
rect	Rect	Specifies a rectangular region of the image to return. Set this parameter to IMAQ_NO_RECT to return the specified plane of the entire image.
columns	int*	On return, the number of columns in the returned array. Set this parameter to NULL if you do not need this information.
rows	int*	On return, the number of rows in the returned array. Set this parameter to NULL if you do not need this information.

Return Value

float*—On success, this function returns a two-dimensional array of values. These values are the pixel values of the extracted plane. On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`. When you are finished with the array, dispose of it by calling `imaqDispose()`.

imaqCopyRect

Usage

```
int = imaqCopyRect(Image* dest, const Image* source, Rect rect, Point dest)
```

Purpose

Copies an area of one image into another image. You can copy the source area to a new destination image or to another area in the source image. The source and destination images must be of the same type. If the source area is larger than the destination area, the source area will be clipped. The size of the destination image and pixels outside the destination area remain unchanged. To make a duplicate of an image, including border and calibration information, use `imaqDuplicate()`.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The source image.
rect	Rect	The area of the source to copy into the destination. Set this parameter to IMAQ_NO_RECT to copy the whole source image to the destination.
dest	Point	The coordinates of the top-left pixel in the destination image where the function copies the source area. This location can be anywhere on the image or on the border of the image.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqCreateImage

Usage

```
Image* = imaqCreateImage(ImageType type, int borderSize)
```

Purpose

Creates an image. The created image will be 0×0 pixels in size. To change the image size, use `imaqSetImageSize()`.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
type	ImageType	The type of image to create.
borderSize	int	The size of the image border. For more information about borders, see the <i>IMAQ Vision User Manual</i> .

Return Value

Image*—On success, this function returns the created image. On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`. When you are finished with the created image, dispose of it by calling `imaqDispose()`.

imaqDrawLineOnImage

Usage

```
int = imaqDrawLineOnImage(Image* dest, const Image* source, DrawMode mode,
                          Point start, Point end, float newPixelValue)
```

Purpose

Draws a line on an image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The source image.
mode	DrawMode	The method that the function uses to draw a line. Set this parameter to <code>IMAQ_DRAW_VALUE</code> to draw a line with the specified value or <code>IMAQ_DRAW_INVERT</code> to draw a line by inverting underlying pixel values.
start	Point	The coordinate location of the starting point of the line.
end	Point	The coordinate location of the ending point of the line.
newPixelValue	float	If you set mode to <code>IMAQ_DRAW_VALUE</code> , newPixelValue sets the pixel value in which the function draws the line. If you set mode to <code>IMAQ_DRAW_INVERT</code> , the function ignores this parameter.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqDrawShapeOnImage

Usage

```
int = imaqDrawShapeOnImage(Image* dest, const Image* source, Rect rect,
                           DrawMode mode, ShapeMode shape, float
                           newPixelValue)
```

Purpose

Draws a shape on an image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The source image.
rect	Rect	The bounding rectangle of the shape.
mode	DrawMode	The method that the function uses to draw the shape. The following options are valid: IMAQ_DRAW_VALUE—Draws the boundary of the shape with the specified pixel value. IMAQ_DRAW_INVERT—Inverts the pixel values of the boundary of the shape. IMAQ_PAINT_VALUE—Fills the shape with the given pixel value. IMAQ_PAINT_INVERT—Inverts the pixel values of the shape.
shape	ShapeMode	The shape to draw. The following options are valid: IMAQ_SHAPE_RECT—Draws a rectangle. IMAQ_SHAPE_OVAL—Draws an oval.
newPixelValue	float	If you set mode to IMAQ_DRAW_VALUE or IMAQ_PAINT_VALUE, newPixelValue sets the pixel value that the function uses to draw a shape

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqDrawTextOnImage

Usage

```
int = imaqDrawTextOnImage(Image* dest, const Image* source, Point coord,
                          const char* text, const DrawTextOptions* options,
                          int* fontNameUsed)
```

Purpose

Draws text on an image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_RGB

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The source image.
coord	Point	The coordinates of the text reference point.
text	const char*	The text that the function draws. This parameter is required and cannot be NULL.
options	const DrawTextOptions*	The method that the function uses to draw text.
fontNameUsed	int*	On return, this parameter equals TRUE if the function located and used <code>fontName</code> in options . This parameter equals FALSE if the function could not locate the <code>fontName</code> in options . When FALSE, the function uses the font Arial. Set this parameter to NULL if you do not need this information.

Parameter Discussion

options—A `DrawTextOptions` structure contains the following elements:

- `fontName`—The name of the font to use. This parameter is limited to 32 characters.
- `fontSize`—The size of the font.
- `bold`—Set this parameter to TRUE to bold the text.
- `italic`—Set this parameter to TRUE to italicize the text.
- `underline`—Set this parameter to TRUE to underline the text.

- `strikeout`—Set this parameter to TRUE to strikeout the text.
- `textAlignment`—Sets the alignment of the text. The following options are valid:
 - `IMAQ_LEFT`—Left aligns the text at the reference point.
 - `IMAQ_CENTER`—Centers the text around the reference point.
 - `IMAQ_RIGHT`—Right aligns the text at the reference point.
- `fontColor`—Sets the color of the font. The following options are valid:
 - `IMAQ_WHITE`—Draws text in white.
 - `IMAQ_BLACK`—Draws text in black.
 - `IMAQ_INVERT`—Inverts the text pixels.
 - `IMAQ_BLACK_ON_WHITE`—Draws text in black with a white background.
 - `IMAQ_WHITE_ON_BLACK`—Draws text in white with a black background.

Set the **options** parameter to NULL to use the default options, as follows:

- `fontName`—Arial
- `fontSize`—12
- `bold`—FALSE
- `italic`—FALSE
- `underline`—FALSE
- `strikeout`—FALSE
- `textAlignment`—`IMAQ_LEFT`
- `fontColor`—`IMAQ_WHITE`

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqDuplicate

Usage

```
int = imaqDuplicate(Image* dest, const Image* source)
```

Purpose

Copies the source image to the destination image, including the border size and calibration information. To copy an area of one image to an area of another image, use `imaqCopyRect()`.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The duplicated image.
source	const Image*	The image to copy.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqExtractColorPlanes

Usage

```
int = imaqExtractColorPlanes(const Image* image, ColorMode mode, Image*
                             plane1, Image* plane2, Image* plane3)
```

Purpose

Extracts the individual color planes from a color image. The plane you extract is independent from the type of the image. For example, you can extract the hue plane from an RGB image or the green plane from an HSL image.

Image Types Supported

IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description										
image	const Image*	The source image from which the function extracts the planes.										
mode	ColorMode	The color space from which the function extracts the planes. Valid options are IMAQ_RGB, IMAQ_HSL, IMAQ_HSV, and IMAQ_HSI. For more information about color spaces, see the <i>IMAQ Vision User Manual</i> .										
plane1	Image*	On return, the first extracted plane. The data contained in plane1 depends on the mode , as follows: <table border="1" data-bbox="530 1067 813 1232"> <thead> <tr> <th>Mode</th> <th>Plane</th> </tr> </thead> <tbody> <tr> <td>IMAQ_RGB</td> <td>Red</td> </tr> <tr> <td>IMAQ_HSL</td> <td>Hue</td> </tr> <tr> <td>IMAQ_HSV</td> <td>Hue</td> </tr> <tr> <td>IMAQ_HSI</td> <td>Hue</td> </tr> </tbody> </table> Set this parameter to NULL if you do not need this information.	Mode	Plane	IMAQ_RGB	Red	IMAQ_HSL	Hue	IMAQ_HSV	Hue	IMAQ_HSI	Hue
Mode	Plane											
IMAQ_RGB	Red											
IMAQ_HSL	Hue											
IMAQ_HSV	Hue											
IMAQ_HSI	Hue											

Name	Type	Description										
plane2	Image*	<p>On return, the second extracted plane. The data contained in plane2 depends on the mode, as follows:</p> <table data-bbox="556 302 874 461"> <thead> <tr> <th data-bbox="556 302 727 331">Mode</th> <th data-bbox="727 302 874 331">Plane</th> </tr> </thead> <tbody> <tr> <td data-bbox="556 340 727 369">IMAQ_RGB</td> <td data-bbox="727 340 874 369">Green</td> </tr> <tr> <td data-bbox="556 374 727 404">IMAQ_HSL</td> <td data-bbox="727 374 874 404">Saturation</td> </tr> <tr> <td data-bbox="556 409 727 439">IMAQ_HSV</td> <td data-bbox="727 409 874 439">Saturation</td> </tr> <tr> <td data-bbox="556 444 727 473">IMAQ_HSI</td> <td data-bbox="727 444 874 473">Saturation</td> </tr> </tbody> </table> <p>Set this parameter to NULL if you do not need this information.</p>	Mode	Plane	IMAQ_RGB	Green	IMAQ_HSL	Saturation	IMAQ_HSV	Saturation	IMAQ_HSI	Saturation
Mode	Plane											
IMAQ_RGB	Green											
IMAQ_HSL	Saturation											
IMAQ_HSV	Saturation											
IMAQ_HSI	Saturation											
plane3	Image*	<p>On return, the third plane. The data contained in plane3 depends on the mode, as follows:</p> <table data-bbox="556 644 911 803"> <thead> <tr> <th data-bbox="556 644 727 673">Mode</th> <th data-bbox="727 644 911 673">Plane</th> </tr> </thead> <tbody> <tr> <td data-bbox="556 682 727 711">IMAQ_RGB</td> <td data-bbox="727 682 911 711">Blue</td> </tr> <tr> <td data-bbox="556 716 727 746">IMAQ_HSL</td> <td data-bbox="727 716 911 746">Luminance</td> </tr> <tr> <td data-bbox="556 751 727 781">IMAQ_HSV</td> <td data-bbox="727 751 911 781">Value</td> </tr> <tr> <td data-bbox="556 786 727 815">IMAQ_HSI</td> <td data-bbox="727 786 911 815">Intensity</td> </tr> </tbody> </table> <p>Set this parameter to NULL if you do not need this information.</p>	Mode	Plane	IMAQ_RGB	Blue	IMAQ_HSL	Luminance	IMAQ_HSV	Value	IMAQ_HSI	Intensity
Mode	Plane											
IMAQ_RGB	Blue											
IMAQ_HSL	Luminance											
IMAQ_HSV	Value											
IMAQ_HSI	Intensity											

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqExtractComplexPlane

Usage

```
int = imaqExtractComplexPlane(Image* dest, const Image* source, ComplexPlane
                             plane)
```

Purpose

Extracts a plane from a complex image and places the plane into another image.

Image Type Supported

IMAQ_IMAGE_COMPLEX

Parameters

Name	Type	Description
dest	Image*	The destination image, which must be an IMAQ_IMAGE_SGL image.
source	const Image*	The image whose plane the function extracts.
plane	ComplexPlane	The plane to extract. Set this parameter to IMAQ_REAL to extract the real plane or IMAQ_IMAGINARY to extract the imaginary plane.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqFillBorder

Usage

```
int = imaqFillBorder(Image* image, BorderMethod method)
```

Purpose

Modifies the border of an image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
image	Image*	The image whose border the function modifies.
method	BorderMethod	The method by which the function modifies the border. The following options are valid: IMAQ_BORDER_MIRROR—Symmetrically copies pixel values from the image into the border. IMAQ_BORDER_COPY—Copies the value of the pixel closest to the edge of the image into the border. IMAQ_BORDER_CLEAR—Sets all pixels in the border to 0.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqFillImage

Usage

```
int = imaqFillImage(Image* image, PixelValue value, const Image* mask)
```

Purpose

Sets each pixel in an image to a specified value.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description														
image	Image*	The image whose pixel values the function overwrites with the given value.														
value	PixelValue	<p>The value with which the function fills the image pixels. The field of the PixelValue union you set depends on the image type, as follows:</p> <table border="0"> <thead> <tr> <th>Image Type</th> <th>PixelValue Field</th> </tr> </thead> <tbody> <tr> <td>IMAQ_IMAGE_U8</td> <td>grayscale</td> </tr> <tr> <td>IMAQ_IMAGE_I16</td> <td>grayscale</td> </tr> <tr> <td>IMAQ_IMAGE_SGL</td> <td>grayscale</td> </tr> <tr> <td>IMAQ_IMAGE_COMPLEX</td> <td>complex</td> </tr> <tr> <td>IMAQ_IMAGE_HSL</td> <td>hsl</td> </tr> <tr> <td>IMAQ_IMAGE_RGB</td> <td>rgb</td> </tr> </tbody> </table>	Image Type	PixelValue Field	IMAQ_IMAGE_U8	grayscale	IMAQ_IMAGE_I16	grayscale	IMAQ_IMAGE_SGL	grayscale	IMAQ_IMAGE_COMPLEX	complex	IMAQ_IMAGE_HSL	hsl	IMAQ_IMAGE_RGB	rgb
Image Type	PixelValue Field															
IMAQ_IMAGE_U8	grayscale															
IMAQ_IMAGE_I16	grayscale															
IMAQ_IMAGE_SGL	grayscale															
IMAQ_IMAGE_COMPLEX	complex															
IMAQ_IMAGE_HSL	hsl															
IMAQ_IMAGE_RGB	rgb															
mask	const Image*	A mask image. This image must be an IMAQ_IMAGE_U8 image. The function sets only those source pixels whose corresponding mask pixels are non-zero to the specified value. Set this parameter to NULL if you want the function to set every pixel in the source image to the specified value.														

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqFlip

Usage

```
int = imaqFlip(Image* dest, const Image* source, FlipAxis axis)
```

Purpose

Flips an image over an axis.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_RGB,
IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The image that the function flips over an axis.
axis	FlipAxis	<p>The axis to flip the image over. The following options are valid:</p> <p>IMAQ_HORIZONTAL_AXIS—Flips the image over the central horizontal axis.</p> <p>IMAQ_VERTICAL_AXIS—Flips the image over the central vertical axis.</p> <p>IMAQ_CENTER_AXIS—Flips the image over both the central vertical and horizontal axes.</p> <p>IMAQ_DIAG_L_TO_R_AXIS—Flips the image over an axis from the upper left corner to lower right corner.</p> <p>IMAQ_DIAG_R_TO_L_AXIS—Flips the image over an axis from the upper right corner to lower left corner.</p>

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetBorderSize

Usage

```
int = imaqGetBorderSize(const Image* image, int* borderSize)
```

Purpose

Returns the border size of the given image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
image	const Image*	The image whose border size the function queries.
borderSize	int*	On return, the border size of the image. This parameter is required and cannot be NULL.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetBytesPerPixel

Usage

```
int = imaqGetBytesPerPixel(const Image* image, int* byteCount)
```

Purpose

Returns the number of bytes that a single pixel occupies in the given image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
image	const Image*	The image whose bytes per pixel the function queries.
byteCount	int*	On return, the number of bytes per pixel. This parameter is required and cannot be NULL.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetCalibrationInfo

Usage

```
int = imaqGetCalibrationInfo(const Image* image, CalibrationUnit* unit,
                             float* xDistance, float* yDistance)
```

Purpose

Returns the calibration information of an image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
image	const Image*	The image whose calibration information the function queries.
unit	CalibrationUnit*	On return, the unit of measure that you specified in <code>imaqSetCalibrationInfo()</code> . Set this parameter to NULL if you do not need the unit information.
xDistance	float*	On return, the distance between two adjacent pixels in the <i>x</i> direction. This value is in the unit specified in unit . Set this parameter to NULL if you do not need the <i>x</i> distance information.
yDistance	float*	On return, the distance between two adjacent pixels in the <i>y</i> direction. This value is in the unit specified in unit . Set this parameter to NULL if you do not need the <i>y</i> distance information.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetImageInfo

Usage

```
int = imaqGetImageInfo(const Image* image, ImageInfo* info)
```

Purpose

Returns the size, border, type, calibration, and memory layout of an image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
image	const Image*	The image whose information the function returns.
info	ImageInfo*	On return, the information about the image.

Parameter Discussion

info—The `ImageInfo` structure consists of the following elements:

- `imageUnit`—If you set calibration information with `imaqSetCalibrationInfo()`, `imageUnit` is the calibration unit.
- `stepX`—If you set calibration information with `imaqSetCalibrationInfo()`, `stepX` is the distance, in the calibration unit, between two pixels in the *x* direction.
- `stepY`—If you set calibration information with `imaqSetCalibrationInfo()`, `stepY` is the distance, in the calibration unit, between two pixels in the *y* direction.
- `imageType`—The type of the image.
- `xRes`—The number of columns in the image.
- `yRes`—The number of rows in the image.
- `xOffset`—If you set mask offset information with `imaqSetMaskOffset()`, `xOffset` is the offset of the mask origin in the *x* direction.
- `yOffset`—If you set mask offset information with `imaqSetMaskOffset()`, `yOffset` is the offset of the mask origin in the *y* direction.
- `border`—The number of border pixels around the image.
- `pixelsPerLine`—The number of pixels stored for each line of the image. This value may be larger than `xRes`.
- `imageStart`—A pointer to pixel (0,0).

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetImageSize

Usage

```
int = imaqGetImageSize(const Image* image, int* width, int* height)
```

Purpose

Returns the size of a given image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
image	const Image*	The image whose size the function queries.
width	int*	On return, the width of the image. Set this parameter to NULL if you do not need this information.
height	int*	On return, the height of the image. Set this parameter to NULL if you do not need this information.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetImageType

Usage

```
int = imaqGetImageType(const Image* image, ImageType* type)
```

Purpose

Returns the type of the given image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
image	const Image*	The image whose type the function queries.
type	ImageType*	On return, the type of the image. This parameter is required and cannot be NULL.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetLine

Usage

```
void* = imaqGetLine(const Image* image, Point start, Point end, int*
                    numPoints)
```

Purpose

Returns the pixel values along a given line in an image. If the starting or ending point of the line is outside the image, the line clips at the last visible pixel.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_RGB,
IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
image	const Image*	The image containing a line whose pixels the function returns.
start	Point	The coordinate location of the starting point of the line.
end	Point	The coordinate location of the ending point of the line.
numPoints	int*	The number of elements in the returned array. Set this parameter to NULL if you do not need this information.

Return Value

void*—On success, this function returns the values of the pixels along the given line in the image. The type of array the function returns depends on the image type, as follows:

Image Type	Array Type
IMAQ_IMAGE_U8	unsigned char
IMAQ_IMAGE_I16	short
IMAQ_IMAGE_SGL	float
IMAQ_IMAGE_RGB	RGBValue structures
IMAQ_IMAGE_HSL	HSLValue structures

On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`. When you are finished with the array, dispose of it by calling `imaqDispose()`.

imaqGetMaskOffset

Usage

```
int = imaqGetMaskOffset(const Image* image, Point* offset)
```

Purpose

Retrieves the point in the source image at which the function places the (0,0) pixel of the mask image, as set by `imaqSetMaskOffset()`.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
image	const Image*	The mask image whose offset the function retrieves.
offset	Point*	On return, the coordinates where the function applies the mask. This parameter is required and cannot be NULL.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetPixel

Usage

```
int = imaqGetPixel(const Image* image, Point pixel, PixelValue* value)
```

Purpose

Returns the value of a pixel within an image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description														
image	const Image*	The image whose pixel value the function queries.														
pixel	Point	The coordinates of the pixel that the function queries.														
value	PixelValue*	On return, the value of the image pixel. The field of the PixelValue union that the function sets depends on the image type, as follows: <table border="1" data-bbox="534 916 1028 1142"> <thead> <tr> <th>Image Types</th> <th>PixelValue Field</th> </tr> </thead> <tbody> <tr> <td>IMAQ_IMAGE_U8</td> <td>grayscale</td> </tr> <tr> <td>IMAQ_IMAGE_I16</td> <td>grayscale</td> </tr> <tr> <td>IMAQ_IMAGE_SGL</td> <td>grayscale</td> </tr> <tr> <td>IMAQ_IMAGE_COMPLEX</td> <td>complex</td> </tr> <tr> <td>IMAQ_IMAGE_HSL</td> <td>hsl</td> </tr> <tr> <td>IMAQ_IMAGE_RGB</td> <td>rgb</td> </tr> </tbody> </table>	Image Types	PixelValue Field	IMAQ_IMAGE_U8	grayscale	IMAQ_IMAGE_I16	grayscale	IMAQ_IMAGE_SGL	grayscale	IMAQ_IMAGE_COMPLEX	complex	IMAQ_IMAGE_HSL	hsl	IMAQ_IMAGE_RGB	rgb
Image Types	PixelValue Field															
IMAQ_IMAGE_U8	grayscale															
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IMAQ_IMAGE_SGL	grayscale															
IMAQ_IMAGE_COMPLEX	complex															
IMAQ_IMAGE_HSL	hsl															
IMAQ_IMAGE_RGB	rgb															

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetPixelAddress

Usage

```
void* = imaqGetPixelAddress(const Image* image, Point pixel)
```

Purpose

Returns the address of a given pixel in an image. If the requested pixel location is outside of the image, the function fails and returns NULL.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
image	const Image*	The image containing the requested pixel.
pixel	Point	The coordinates of the pixel whose pointer the function retrieves.

Return Value

void*—On success, this function returns a pointer to the requested pixel in the image. The type of the pointer the function returns depends on the type of the image, as follows:

Image Type	Pointer Type
IMAQ_IMAGE_U8	unsigned char
IMAQ_IMAGE_I16	short
IMAQ_IMAGE_SGL	float
IMAQ_IMAGE_COMPLEX	Complex structures
IMAQ_IMAGE_RGB	RGBValue structures
IMAQ_IMAGE_HSL	HSLValue structures

On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`.

imaqImageToArray

Usage

```
void* = imaqImageToArray(const Image* image, Rect rect, int* columns, int*
                        rows)
```

Purpose

Creates a two-dimensional array from an image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
image	const Image*	The image from which the function makes the array.
rect	Rect	Specifies a rectangular region of the image to return. Set this parameter to IMAQ_NO_RECT if you want the function to return the whole image.
columns	int*	The number of columns in the returned array. Set this parameter to NULL if you do not need this information.
rows	int*	The number of rows in the returned array. Set this parameter to NULL if you do not need this information.

Return Value

void*—On success, this function returns a two-dimensional array. The type of the returned array depends on the image type, as follows:

Image Type	Pointer Type
IMAQ_IMAGE_U8	unsigned char
IMAQ_IMAGE_I16	short
IMAQ_IMAGE_SGL	float
IMAQ_IMAGE_COMPLEX	Complex structures
IMAQ_IMAGE_RGB	RGBValue structures
IMAQ_IMAGE_HSL	HSLValue structures

On failure, this function returns `NULL`. To get extended error information, call `imaqGetLastError()`. When you are finished with the array, dispose of it by calling `imaqDispose()`.

imaqImageToClipboard

Usage

```
int = imaqImageToClipboard(const Image* image, const RGBValue* palette)
```

Purpose

Copies an image onto the clipboard.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_RGB

Parameters

Name	Type	Description
image	const Image*	The image to copy onto the clipboard
palette	const RGBValue*	An optional palette to associate with 8-bit images. If this parameter is not NULL, it must point to an array of 256 colors, which represent the color palette that the function associates with the image. If this parameter is NULL, the function associates a grayscale palette with the image.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqInterlaceCombine

Usage

```
int = imaqInterlaceCombine(Image* frame, const Image* odd, const Image* even)
```

Purpose

Combines two field images to create a single frame image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
frame	Image*	On return, the combined image.
odd	const Image*	The odd field.
even	const Image*	The even field.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqInterlaceSeparate

Usage

```
int = imaqInterlaceSeparate(const Image* frame, Image* odd, Image* even)
```

Purpose

Separates a frame image into two field images.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
frame	const Image*	The frame image that the function separates into odd and even fields.
odd	Image*	The image into which the function places the odd field of the frame area. Set this parameter to NULL if you do not need the odd field.
even	Image*	The image into which the function places the even field of the frame area. Set this parameter to NULL if you do not need the even field.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqIsImageEmpty

Usage

```
int = imaqIsImageEmpty(const Image* image, int* empty)
```

Purpose

Tests to see if the supplied image is empty. An empty image is an image that only contains pixels with a value equal to zero. Use this function in conjunction with `imaqCompare()` and `imaqCompareConstant()` to see if the compare operation cleared all of the pixels in an image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
image	const Image*	The image that the function checks for emptiness.
empty	int*	On return, this parameter equals TRUE if the image is empty and FALSE if the image contains pixels with values other than 0. This parameter is required and cannot be NULL.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqMask

Usage

```
int = imaqMask(Image* dest, const Image* source, const Image* mask)
```

Purpose

Copies the source image to the destination image in the following manner: If a pixel in the mask has a value of 0, the function sets the corresponding source pixel to 0. Otherwise the function copies the corresponding source pixel to the destination image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The source image.
mask	const Image*	The mask image. This image must be an IMAQ_IMAGE_U8 image.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqReplaceColorPlanes

Usage

```
int = imaqReplaceColorPlanes(Image* dest, const Image* source, ColorMode
                             mode, const Image* plane1, const Image* plane2,
                             const Image* plane3)
```

Purpose

Replaces one or more of the color planes of a color image. The plane you replace is independent of the image type. For example, you can replace the hue plane of an RGB image or the green plane of an HSL image.

Image Types Supported

IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description										
dest	Image*	The destination image.										
source	const Image*	The source image.										
mode	ColorMode	The color space in which the function replaces planes. Valid options are IMAQ_RGB, IMAQ_HSL, IMAQ_HSV, and IMAQ_HSI. For more information on color spaces, see the <i>IMAQ Vision User Manual</i> .										
plane1	const Image*	The first plane of replacement data. Set this parameter to NULL if you do not want to change the first plane of the source image. The data contained here depends on mode , as follows: <table border="1" data-bbox="551 1180 873 1336"> <thead> <tr> <th>Mode</th> <th>Plane</th> </tr> </thead> <tbody> <tr> <td>IMAQ_RGB</td> <td>Red</td> </tr> <tr> <td>IMAQ_HSL</td> <td>Hue</td> </tr> <tr> <td>IMAQ_HSV</td> <td>Hue</td> </tr> <tr> <td>IMAQ_HSI</td> <td>Hue</td> </tr> </tbody> </table>	Mode	Plane	IMAQ_RGB	Red	IMAQ_HSL	Hue	IMAQ_HSV	Hue	IMAQ_HSI	Hue
Mode	Plane											
IMAQ_RGB	Red											
IMAQ_HSL	Hue											
IMAQ_HSV	Hue											
IMAQ_HSI	Hue											

Name	Type	Description										
plane2	const Image*	<p>The second plane of replacement data. Set this parameter to NULL if you do not want to change the second plane of the source image. The data contained here depends on mode, as follows:</p> <table border="0"> <thead> <tr> <th data-bbox="534 366 655 392">Mode</th> <th data-bbox="790 366 857 392">Plane</th> </tr> </thead> <tbody> <tr> <td data-bbox="534 401 655 427">IMAQ_RGB</td> <td data-bbox="790 401 857 427">Green</td> </tr> <tr> <td data-bbox="534 435 655 461">IMAQ_HSL</td> <td data-bbox="790 435 901 461">Saturation</td> </tr> <tr> <td data-bbox="534 470 655 496">IMAQ_HSV</td> <td data-bbox="790 470 901 496">Saturation</td> </tr> <tr> <td data-bbox="534 505 655 531">IMAQ_HSI</td> <td data-bbox="790 505 901 531">Saturation</td> </tr> </tbody> </table>	Mode	Plane	IMAQ_RGB	Green	IMAQ_HSL	Saturation	IMAQ_HSV	Saturation	IMAQ_HSI	Saturation
Mode	Plane											
IMAQ_RGB	Green											
IMAQ_HSL	Saturation											
IMAQ_HSV	Saturation											
IMAQ_HSI	Saturation											
plane3	const Image*	<p>The third plane of replacement data. Set this parameter to NULL if you do not want to change the third plane of the source image. The data contained here depends on mode, as follows:</p> <table border="0"> <thead> <tr> <th data-bbox="534 690 655 716">Mode</th> <th data-bbox="790 690 857 716">Plane</th> </tr> </thead> <tbody> <tr> <td data-bbox="534 725 655 751">IMAQ_RGB</td> <td data-bbox="790 725 844 751">Blue</td> </tr> <tr> <td data-bbox="534 760 655 786">IMAQ_HSL</td> <td data-bbox="790 760 911 786">Luminance</td> </tr> <tr> <td data-bbox="534 795 655 821">IMAQ_HSV</td> <td data-bbox="790 795 857 821">Value</td> </tr> <tr> <td data-bbox="534 829 655 855">IMAQ_HSI</td> <td data-bbox="790 829 884 855">Intensity</td> </tr> </tbody> </table>	Mode	Plane	IMAQ_RGB	Blue	IMAQ_HSL	Luminance	IMAQ_HSV	Value	IMAQ_HSI	Intensity
Mode	Plane											
IMAQ_RGB	Blue											
IMAQ_HSL	Luminance											
IMAQ_HSV	Value											
IMAQ_HSI	Intensity											

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqReplaceComplexPlane

Usage

```
int = imaqReplaceComplexPlane(Image* dest, const Image* source, const Image*
                             newValues, ComplexPlane plane)
```

Purpose

Replaces a plane of a complex image with the pixel values from a given image.

Image Type Supported

IMAQ_IMAGE_COMPLEX

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The image whose data the function modifies.
newValues	const Image*	The image containing the replacement values. This image may be IMAQ_IMAGE_U8, IMAQ_IMAGE_U16, or IMAQ_IMAGE_SGL.
plane	ComplexPlane	The complex image plane to replace. Set this value to IMAQ_REAL or IMAQ_IMAGINARY.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqResample

Usage

```
int = imaqResample(Image* dest, const Image* source, int newWidth, int
                    newHeight, InterpolationMethod method, Rect rect)
```

Purpose

Resizes an image to a given resolution. The source image and destination image must be the same image type. After execution, the size destination is **newWidth** × **newHeight**. For fast zero-order scaling, use `imaqScale()`.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_RGB,
IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The image into which the function places the resampled data. This may be the same as source.
source	const Image*	The image to resample.
newWidth	int	The width of the resampled area.
newHeight	int	The height of the resampled area.
method	InterpolationMethod	The method of interpolation. The following options are valid: IMAQ_ZERO_ORDER IMAQ_BILINEAR IMAQ_QUADRATIC IMAQ_CUBIC_SPLINE
rect	Rect	Specifies an area of the source image to resample. Set this parameter to IMAQ_NO_RECT to resample the entire image.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqRotate

Usage

```
int = imaqRotate(Image* dest, const Image* source, float angle, PixelValue
                fill, InterpolationMethod method)
```

Purpose

Rotates an image counterclockwise.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_RGB

Parameters

Name	Type	Description										
dest	Image*	The destination image.										
source	const Image*	The image to rotate.										
angle	float	The angle, in degrees, to rotate the image.										
fill	PixelValue	The value with which the function fills the image pixels not covered by the rotated image. The field of the PixelValue union you set depends on the image type, as follows: <table border="1" data-bbox="557 963 1055 1119"> <thead> <tr> <th>Image Types</th> <th>PixelValue Field</th> </tr> </thead> <tbody> <tr> <td>IMAQ_IMAGE_U8</td> <td>grayscale</td> </tr> <tr> <td>IMAQ_IMAGE_I16</td> <td>grayscale</td> </tr> <tr> <td>IMAQ_IMAGE_SGL</td> <td>grayscale</td> </tr> <tr> <td>IMAQ_IMAGE_RGB</td> <td>rgb</td> </tr> </tbody> </table>	Image Types	PixelValue Field	IMAQ_IMAGE_U8	grayscale	IMAQ_IMAGE_I16	grayscale	IMAQ_IMAGE_SGL	grayscale	IMAQ_IMAGE_RGB	rgb
Image Types	PixelValue Field											
IMAQ_IMAGE_U8	grayscale											
IMAQ_IMAGE_I16	grayscale											
IMAQ_IMAGE_SGL	grayscale											
IMAQ_IMAGE_RGB	rgb											
method	InterpolationMethod	The method of interpolation. The valid interpolation methods for rotation are IMAQ_ZERO_ORDER and IMAQ_BILINEAR.										

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqScale

Usage

```
int = imaqScale(Image* dest, const Image* source, int xScale, int yScale,
                ScalingMode scaleMode, Rect rect)
```

Purpose

Scales an image or area of an image. The source image and destination image must be the same image type. This function makes an image larger by duplicating pixels, and it makes an image smaller by subsampling pixels. For more sophisticated scaling techniques, use `imaqResample()`.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_RGB,
IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The source image to scale.
xScale	int	The scaling factor in the <i>x</i> direction. If you set scaleMode to IMAQ_SCALE_LARGER, xScale is a multiplicative factor, meaning the function duplicates each source pixel xScale times. If you set scaleMode to IMAQ_SCALE_SMALLER, xScale is a divisory factor, meaning the function takes one pixel for every xScale pixels.
yScale	int	The scaling factor in the <i>y</i> direction. If you set scaleMode to IMAQ_SCALE_LARGER, yScale is a multiplicative factor, meaning the function duplicates each source pixel yScale times. If you set scaleMode to IMAQ_SCALE_SMALLER, yScale is a divisory factor, meaning the function takes one pixel for every yScale pixels.
scaleMode	ScalingMode	The scaling mode. Set this parameter to IMAQ_SCALE_LARGER to duplicate pixels or IMAQ_SCALE_SMALLER to subsample pixels.
rect	Rect	Specifies the rectangular region of the source image to scale. Set this parameter to IMAQ_NO_RECT to scale the whole image.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSetBorderSize

Usage

```
int = imaqSetBorderSize(Image* image, int size)
```

Purpose

Sets the border size of an image. This operation preserves image pixels.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
image	Image*	The image whose border size the function sets.
size	int	The new border size. Valid border sizes range from 0–50.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSetCalibrationInfo

Usage

```
int = imaqSetCalibrationInfo(Image* image, CalibrationUnit unit, float
                             xDistance, float yDistance)
```

Purpose

Sets the physical calibration attributes of an image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
image	Image*	The image whose calibration information the function sets.
unit	CalibrationUnit	The unit of measure that the function uses to calibrate the image.
xDistance	float	The distance in the <i>x</i> direction between two adjacent pixels in units specified by unit .
yDistance	float	The distance in the <i>y</i> direction between to adjacent pixels in units specified by unit .

Parameter Discussion

unit—The following options are valid: IMAQ_UNDEFINED, IMAQ_ANGSTROM, IMAQ_MICROMETER, IMAQ_MILLIMETER, IMAQ_CENTIMETER, IMAQ_METER, IMAQ_KILOMETER, IMAQ_MICROINCH, IMAQ_INCH, IMAQ_FOOT, IMAQ_NAUTICMILE, IMAQ_GROUNDMILE.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSetImageSize

Usage

```
int = imaqSetImageSize(Image* image, int width, int height)
```

Purpose

Sets the size of an image. The original pixels are not transferred to the new image. To resize the image and retain the original information, use `imaqScale()` or `imaqResample()`.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
image	Image*	The image to resize.
width	int	The new width of the image.
height	int	The new height of the image.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSetLine

Usage

```
int = imaqSetLine(Image* image, const void* array, int arraySize, Point
                 start, Point end)
```

Purpose

Sets the pixel values along a line in an image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_RGB,
IMAQ_IMAGE_HSL

Parameters

Name	Type	Description												
image	Image*	The image whose line pixel values the function modifies.												
array	const void*	The one-dimensional array of pixel values that the function uses to replace the values in the line. The type of array you provide depends on the image type, as follows: <table border="0" style="margin-left: 20px;"> <thead> <tr> <th>Image Type</th> <th>Array Type</th> </tr> </thead> <tbody> <tr> <td>IMAQ_IMAGE_U8</td> <td>unsigned char</td> </tr> <tr> <td>IMAQ_IMAGE_I16</td> <td>short</td> </tr> <tr> <td>IMAQ_IMAGE_SGL</td> <td>float</td> </tr> <tr> <td>IMAQ_IMAGE_RGB</td> <td>RGBValue structures</td> </tr> <tr> <td>IMAQ_IMAGE_HSL</td> <td>HSLValue structures</td> </tr> </tbody> </table>	Image Type	Array Type	IMAQ_IMAGE_U8	unsigned char	IMAQ_IMAGE_I16	short	IMAQ_IMAGE_SGL	float	IMAQ_IMAGE_RGB	RGBValue structures	IMAQ_IMAGE_HSL	HSLValue structures
Image Type	Array Type													
IMAQ_IMAGE_U8	unsigned char													
IMAQ_IMAGE_I16	short													
IMAQ_IMAGE_SGL	float													
IMAQ_IMAGE_RGB	RGBValue structures													
IMAQ_IMAGE_HSL	HSLValue structures													
arraySize	int	The number of pixels in the array.												
start	Point	The coordinate location of the starting point of the line.												
end	Point	The coordinate location of the ending point of the line.												

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSetMaskOffset

Usage

```
int = imaqSetMaskOffset(Image* image, Point offset)
```

Purpose

When the given image is used as a mask, sets the location in the source image at which the function places the (0,0) pixel of the mask image.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
image	Image*	The mask image whose offset the function sets.
offset	Point	The coordinates where the function applies the mask.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSetPixel

Usage

```
int = imaqSetPixel(Image* image, Point coord, PixelValue value)
```

Purpose

Sets the value of a pixel within an image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description														
image	Image*	The image whose pixel value the function sets.														
coord	Point	The coordinates of the pixel the function sets.														
value	PixelValue	<p>The value to which the function sets the image pixel. The field of the PixelValue union you set depends on the image type, as follows:</p> <table border="1"> <thead> <tr> <th>Image Types</th> <th>PixelValue Field</th> </tr> </thead> <tbody> <tr> <td>IMAQ_IMAGE_U8</td> <td>grayscale</td> </tr> <tr> <td>IMAQ_IMAGE_I16</td> <td>grayscale</td> </tr> <tr> <td>IMAQ_IMAGE_SGL</td> <td>grayscale</td> </tr> <tr> <td>IMAQ_IMAGE_COMPLEX</td> <td>complex</td> </tr> <tr> <td>IMAQ_IMAGE_HSL</td> <td>hsl</td> </tr> <tr> <td>IMAQ_IMAGE_RGB</td> <td>rgb</td> </tr> </tbody> </table>	Image Types	PixelValue Field	IMAQ_IMAGE_U8	grayscale	IMAQ_IMAGE_I16	grayscale	IMAQ_IMAGE_SGL	grayscale	IMAQ_IMAGE_COMPLEX	complex	IMAQ_IMAGE_HSL	hsl	IMAQ_IMAGE_RGB	rgb
Image Types	PixelValue Field															
IMAQ_IMAGE_U8	grayscale															
IMAQ_IMAGE_I16	grayscale															
IMAQ_IMAGE_SGL	grayscale															
IMAQ_IMAGE_COMPLEX	complex															
IMAQ_IMAGE_HSL	hsl															
IMAQ_IMAGE_RGB	rgb															

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqShift

Usage

```
int = imaqShift(Image* dest, const Image* source, int shiftX, int shiftY,
                PixelValue fill)
```

Purpose

Shifts an image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_RGB,
IMAQ_IMAGE_HSL

Parameters

Name	Type	Description												
dest	Image*	The destination image.												
source	const Image*	The image to shift.												
shiftX	int	Specifies how many pixels to the right to shift the image.												
shiftY	int	Specifies how many pixels down to shift the image.												
fill	PixelValue	<p>The value with which the function fills the uncovered image pixels. The field of the PixelValue union you set depends on the image type, as follows:</p> <table border="0"> <thead> <tr> <th>Image Types</th> <th>PixelValue Field</th> </tr> </thead> <tbody> <tr> <td>IMAQ_IMAGE_U8</td> <td>grayscale</td> </tr> <tr> <td>IMAQ_IMAGE_I16</td> <td>grayscale</td> </tr> <tr> <td>IMAQ_IMAGE_SGL</td> <td>grayscale</td> </tr> <tr> <td>IMAQ_IMAGE_HSL</td> <td>hsl</td> </tr> <tr> <td>IMAQ_IMAGE_RGB</td> <td>rgb</td> </tr> </tbody> </table>	Image Types	PixelValue Field	IMAQ_IMAGE_U8	grayscale	IMAQ_IMAGE_I16	grayscale	IMAQ_IMAGE_SGL	grayscale	IMAQ_IMAGE_HSL	hsl	IMAQ_IMAGE_RGB	rgb
Image Types	PixelValue Field													
IMAQ_IMAGE_U8	grayscale													
IMAQ_IMAGE_I16	grayscale													
IMAQ_IMAGE_SGL	grayscale													
IMAQ_IMAGE_HSL	hsl													
IMAQ_IMAGE_RGB	rgb													

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqTranspose

Usage

```
int = imaqTranspose(Image* dest, const Image* source)
```

Purpose

Transposes an image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The image to transpose.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

Memory Management

This chapter describes the Memory Management function in IMAQ Vision for LabWindows/CVI. The Memory Management function, `imaqDispose()`, deletes images, ROIs, arrays, and reports and frees the space they occupied in memory.

Memory Management Function Panel

Table 3-1 lists the Memory Management function in a tree structure. The Memory Management function panel represents one function.

Table 3-1. Memory Management

Class/Panel Name	Function Name
Memory Management Dispose	<code>imaqDispose</code>

imaqDispose

Usage

```
int = imaqDispose(void* object)
```

Purpose

Cleans up resources associated with images, ROIs, arrays, and reports that you no longer need. After you dispose something, you can no longer use it.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
object	void*	The image, ROI, array, or report whose memory you want to free.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

Error Management

This chapter describes the Error Management functions in IMAQ Vision for LabWindows/CVI. Error Management functions clear pending errors, return the last error, return the function in which the last error occurred, and set the error.

Image Management Function Panels

Table 4-1 lists the Error Management functions in a tree structure. The first-level heading in the tree is the name of the class. The second-level headings are names of the individual function panels. Each error management function panel generates one function call.

Table 4-1. Error Management

Class/Panel Name	Function Name
Error Management	
Clear Error	imaqClearError
Get Error Text	imaqGetErrorText
Get Last Error	imaqGetLastError
Get Last Error Function	imaqGetLastErrorFunc
Set Error	imaqSetError

imaqClearError

Usage

```
int = imaqClearError()
```

Purpose

Sets the IMAQ Vision error status for the current thread to `ERR_SUCCESS`.

Return Value

int—This function returns a non-zero value.

imaqGetErrorText

Usage

```
char* = imaqGetErrorText(int errorCode)
```

Purpose

Returns the error text corresponding to an error code. The error text is a description of what the error code signifies.

Parameters

Name	Type	Description
errorCode	int	The error code whose error text the function returns. You can obtain this error code by calling <code>imaqGetLastError()</code> .

Return Value

char*—This function returns the error text corresponding to the error code input. This function returns `Unknown Error` if no error text corresponds to the error code you specified. When you are finished with this string, dispose of it by calling `imaqDispose()`.

imaqGetLastError

Usage

```
int = imaqGetLastError()
```

Purpose

Returns the error code of the last IMAQ Vision function executed in the calling thread. For a complete list of possible errors, see Appendix A, [Error Codes](#).

Return Value

int—This function returns the last error code. This function returns `ERR_SUCCESS` if there is no pending error.

imaqGetLastErrorFunc

Usage

```
const char* = imaqGetLastErrorFunc()
```

Purpose

Returns the name of the function in which the last error occurred.

Return Value

const char*—This function returns the name of the last function that failed. The function returns an empty string if there is no pending error. When you are finished with this information, dispose of the string by calling `imaqDispose()`.

imaqSetError

Usage

```
int = imaqSetError(int code, const char* function)
```

Purpose

Sets the current error.

Parameters

Name	Type	Description
code	int	The code of the error to set.
function	const char*	The name of the function in which the error occurred. Set this parameter to NULL to record no function.

Return Value

int—The error code set.

Acquisition

This chapter describes the Acquisition functions in IMAQ Vision for LabWindows/CVI. Functions in this chapter require NI-IMAQ 2.2 or higher. Acquisition functions let you perform common acquisition tasks, such as ring acquisitions, sequence acquisitions, and grabs, directly into an IMAQ Vision image. To perform more advanced acquisitions, such as triggered acquisitions, see the *NI-IMAQ Function Reference Manual*. You can use the Acquisition functions with the Signal I/O functions described in the *NI-IMAQ Function Reference Manual*.

Acquisition Function Panels

Table 5-1 lists the Acquisition functions in a tree structure. The first-level heading in the tree is the name of the class. The second-level headings are names of the individual function panels. Each acquisition function panel represents one function.

Table 5-1. Acquisition Function Tree

Class/Panel Name	Function Name
Acquisition	
Copy From Ring	imaqCopyFromRing
Easy Acquire	imaqEasyAcquire
Extract From Ring	imaqExtractFromRing
Grab	imaqGrab
Release Image	imaqReleaseImage
Setup Grab	imaqSetupGrab
Setup Ring	imaqSetupRing
Setup Sequence	imaqSetupSequence
Snap	imaqSnap
Start Acquisition	imaqStartAcquisition
Stop Acquisition	imaqStopAcquisition

imaqCopyFromRing

Usage

```
Image* = imaqCopyFromRing(SESSION_ID sessionID, Image* image, int
                           imageToCopy, int* imageNumber, Rect rect)
```

Purpose

Copies an area of a buffer to a user-specified image. This function is useful for ring acquisitions if you do not want to extract the buffer.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
sessionID	SESSION_ID	A valid session ID.
image	Image*	Receives the copied image. If you set this parameter to NULL, the function creates an image to receive the copy.
imageToCopy	int	The image to copy from the ring acquisition. The cumulative buffer index specifies the image to copy. If another image has overwritten imageToCopy , the function returns the next available image.
imageNumber	int*	The cumulative buffer index of the copied image. Set this parameter to NULL if you do not need this information.
rect	Rect	The rectangular area of the image in the ring that the function copies. If you set this parameter to IMAQ_NO_RECT, or if the area is larger than the image in the ring, the function copies the entire image.

Return Value

Image*—On success, this function returns the copied image. On failure, the function returns NULL. To get extended error information, call `imaqGetLastError()`. When you are finished with the image, dispose of it by calling `imaqDispose()`.

imaqEasyAcquire

Usage

```
Image* = imaqEasyAcquire(const char* interfaceName)
```

Purpose

Configures the IMAQ device specified by **interfaceName**, acquires one image, and returns the acquired image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
interfaceName	const char*	A null-terminated string that specifies the name of the interface to open. Examples of interfaces are <code>img0</code> and <code>img1</code> . For more information about interfaces, see the <i>NI-IMAQ User Manual</i> or the Measurement & Automation Explorer online help.

Return Value

Image*—On success, this function returns the acquired image. On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`. When you are finished with the image, dispose of it by calling `imaqDispose()`.

imaqExtractFromRing

Usage

```
Image* = imaqExtractFromRing(SESSION_ID sessionID, int imageToExtract, int*
                             imageNumber)
```

Purpose

Extracts an image from a live acquisition. This function lets you lock an image out of a continuous loop for processing during a ring acquisition. To unlock the image, call `imaqReleaseImage()`. The acquisition pauses when the continuous loop reaches the image you locked out.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
sessionID	SESSION_ID	A valid session ID.
imageToExtract	int	The cumulative buffer index of the image to extract. If another image has overwritten imageToExtract , the function returns the next available image.
imageNumber	int*	The cumulative buffer index of the extracted image. Set this parameter to NULL if you do not need this information.

Return Value

Image*—On success, this function returns a pointer to the extracted image. On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`. Because the return value is a pointer to an image that you provided to `imaqSetupRing()`, you should not dispose of the image until the acquisition is finished.

imaqGrab

Usage

```
Image* = imaqGrab(SESSION_ID sessionId, Image* image, int immediate)
```

Purpose

Returns a copy of the current image in the grab buffer. A grab performs an acquisition that loops continually on one buffer. Call this function only after calling `imaqGrabSetup()`.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
sessionId	SESSION_ID	A valid session ID.
image	Image*	A pointer to the acquired image. If image is NULL, <code>imaqGrab()</code> creates the image into which the function copies the grab buffer.
immediate	int	Determines the acquisition timing method. Set this parameter to FALSE if you want the grab operation to synchronize on the vertical blank. Set the parameter to TRUE if you want an immediate transfer. See the <i>NI-IMAQ Function Reference Manual</i> or the <i>NI-IMAQ User Manual</i> for more information about acquisition timing methods.

Return Value

Image*—On success, this function returns the acquired image. If you set **image** to NULL, the function returns a new image. Otherwise, the function returns a pointer to **image**.

On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`.

imaqReleaseImage

Usage

```
int = imaqReleaseImage(SESSION_ID sessionId)
```

Purpose

Releases an image that `imaqExtractFromRing()` previously extracted. After the function releases the image, the live acquisition continues if the acquisition had paused.

Parameters

Name	Type	Description
<code>sessionId</code>	SESSION_ID	A valid session ID.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSetupGrab

Usage

```
int = imaqSetupGrab(SESSION_ID sessionID, Rect rect)
```

Purpose

Configures and starts a grab acquisition. A grab performs an acquisition that loops continually on one buffer. Use `imaqGrab()` to copy an image out of the buffer. Use `imaqStopAcquisition()` to end the acquisition.

Parameters

Name	Type	Description
sessionID	SESSION_ID	A valid session ID.
rect	Rect	The area to acquire. If you set this parameter to <code>IMAQ_NO_RECT</code> , the function uses the entire acquisition window.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSetupRing

Usage

```
int = imaqSetupRing(SESSION_ID sessionId, Image** images, int numImages,
                   int skipCount, Rect rect)
```

Purpose

Configures a ring acquisition. A ring acquisition acquires images continuously and loops them into a buffer list. To start the acquisition, call `imaqStartAcquisition()`. To stop the acquisition, call `imaqStopAcquisition()`. To get an image from the ring, call `imaqExtractFromRing()` or `imaqCopyFromRing()`. Do not modify or dispose of the images in the ring until you end the acquisition with `imaqStopAcquisition()`.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
sessionId	SESSION_ID	A valid session ID.
images	Image**	An array of images. Each element in the array must be a pointer to a valid image.
numImages	int	The number of images in the images array.
skipCount	int	The number of frames to skip between each acquired image. A skipCount of 0 acquires images continuously without skipping frames between acquired images.
rect	Rect	The area to acquire. Set this parameter to IMAQ_NO_RECT to acquire the entire acquisition window.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSetupSequence

Usage

```
int = imaqSetupSequence(sessionID SESSION_ID, Image** images, int numImages,
                        int skipCount, Rect rect)
```

Purpose

Configures a sequence acquisition. A sequence acquisition acquires a full sequence of images into the image array. To start the acquisition, call `imaqStartAcquisition()`. The acquisition finishes upon reaching the end of the sequence or when you call `imaqStopAcquisition()`. Do not modify or dispose of the images in the sequence until the acquisition has finished.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
sessionID	SESSION_ID	A valid session ID.
images	Image**	An array of images. Each element in the array must be a pointer to a valid image.
numImages	int	The number of images in the images array.
skipCount	int	The number of frames to skip between each acquired image. A skipCount of 0 acquires images continuously without skipping frames between acquired images.
rect	Rect	The area to acquire. Set this parameter to IMAQ_NO_RECT to acquire the entire acquisition window.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSnap

Usage

```
Image* = imaqSnap(SESSION_ID sessionId, Image* image, Rect rect)
```

Purpose

Acquires a single image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
sessionId	SESSION_ID	A valid session ID.
image	Image*	The image into which to acquire. If image is NULL, <code>imaqSnap()</code> creates a new image.
rect	Rect	The area to acquire. Set this parameter to <code>IMAQ_NO_RECT</code> to acquire the entire acquisition window.

Return Value

Image*—On success, this function returns the acquired image. If you set **image** to NULL, the function returns a new image. Otherwise, the function returns a pointer to **image**. On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`.

imaqStartAcquisition

Usage

```
int = imaqStartAcquisition(SESSION_ID sessionID)
```

Purpose

Starts an acquisition identified by **sessionID**. Use this function with sequence and ring functions.

Parameters

Name	Type	Description
sessionID	SESSION_ID	A valid session ID.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqStopAcquisition

Usage

```
int = imaqStopAcquisition(SESSION_ID sessionID)
```

Purpose

Stops a session acquisition identified by **sessionID**. Use this function with grab, ring, and sequence functions.

Parameters

Name	Type	Description
sessionID	SESSION_ID	A valid session ID.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

Display

This chapter describes the Display functions in IMAQ Vision for LabWindows/CVI.

Display Function Panels

Table 6-1 lists the Display functions in a tree structure. The functions in the Display class are grouped according to the types of operations they perform. The first-level heading in the tree is the name of the class. The second-level headings are names of function subclasses. The third-level headings are names of individual function panels. Each Display function panel represents one function.

Table 6-1. Display Function Tree

Class/Panel Name	Function Name
Display	
Close Window	<code>imaqCloseWindow</code>
Display Image	<code>imaqDisplayImage</code>
Get Last Key	<code>imaqGetLastKey</code>
Get System Window Handle	<code>imaqGetSystemWindowHandle</code>
Show Window	<code>imaqShowWindow</code>
Window Management	
Are Scrollbars Visible	<code>imaqAreScrollbarsVisible</code>
Bring Window To Top	<code>imaqBringWindowToTop</code>
Get Mouse Position	<code>imaqGetMousePos</code>
Get Window Grid	<code>imaqGetWindowGrid</code>
Get Window Handle	<code>imaqGetWindowHandle</code>
Get Window Position	<code>imaqGetWindowPos</code>
Get Window Size	<code>imaqGetWindowSize</code>
Get Window Title	<code>imaqGetWindowTitle</code>
Get Window Zoom	<code>imaqGetWindowZoom</code>
Is Window Visible	<code>imaqIsWindowVisible</code>
Move Window	<code>imaqMoveWindow</code>
Set Window Grid	<code>imaqSetWindowGrid</code>
Set Window Palette	<code>imaqSetWindowPalette</code>
Set Window Size	<code>imaqSetWindowSize</code>
Set Window Thread Policy	<code>imaqSetWindowThreadPolicy</code>
Set Window Title	<code>imaqSetWindowTitle</code>
Setup Window	<code>imaqSetupWindow</code>
Show Scrollbars	<code>imaqShowScrollbars</code>
Zoom Window	<code>imaqZoomWindow</code>

Table 6-1. Display Function Tree (Continued)

Class/Panel Name	Function Name
Tool Window	
Close Tool Window	imaqCloseToolWindow
Get Current Tool	imaqGetCurrentTool
Get Last Event	imaqGetLastEvent
Get Tool Window Position	imaqGetToolWindowPos
Is Tool Window Visible	imaqIsToolWindowVisible
Move Tool Window	imaqMoveToolWindow
Set Current Tool	imaqSetCurrentTool
Set Event Callback	imaqSetEventCallback
Set Tool Color	imaqSetToolColor
Setup Tool Window	imaqSetupToolWindow
Show Tool Window	imaqShowToolWindow
Overlay	
Create Overlay From Metafile	imaqCreateOverlayFromMetafile
Create Overlay From ROI	imaqCreateOverlayFromROI
Set Window Overlay	imaqSetWindowOverlay

Subclass Descriptions

Display functions allow you to display images in image windows. Display subclass descriptions are as follows:

- Window Management functions allow you to configure, move, and resize image windows. You can control up to 16 image windows at a time.
- Tool Windows functions allow you to manage the tool palette, which you use to select areas of an image in an image window.
- Overlay functions allow you to create overlays and associate them with image windows.

Tool Window

The examples of the tool palette in Figure 6-1 have four icons per line. The tool palette on the left automatically transforms to the palette on the right when you manipulate a region tool in an image window.

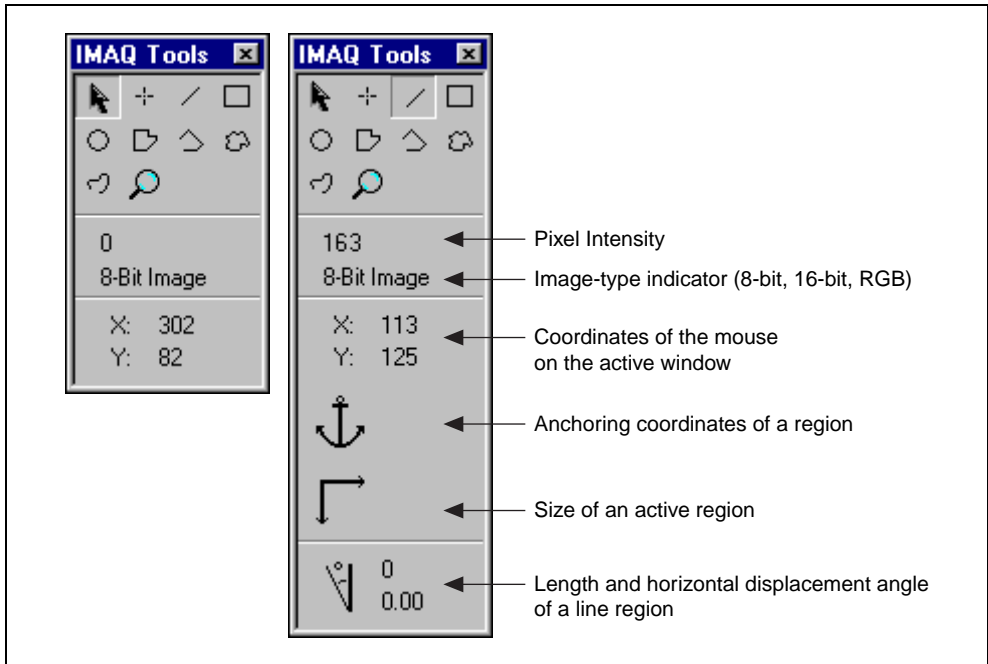


Figure 6-1. Tool Palette Transformation

Tips for Using the Tool Window

The following are tips you can apply when using the tool window:

- Use `imaqGetLastEvent()` or register a callback with `imaqSetEventCallback()` to retrieve the draw events on a window and find the coordinates of a selected region.
- Alter the functionality of region tools by pressing certain keyboard keys while using the tool:
 - To constrain the x and y dimensions of an ROI, press `<Shift>` while drawing. This forces rectangles into squares, ellipses into circles, and line segments into horizontal or vertical segments.

- To add an ROI without erasing the previous ROI elements, press <Control> when you click. The previous elements are erased if you do not use <Control> when starting a new element.
- To produce the last point of a polygon or broken line, double-click while drawing.
- Use the selection tool to select an existing ROI by clicking its border. Once you select and ROI, you can manipulate it in the following ways:
 - To erase an ROI in an image window, select it and press <Delete>.
 - To resize a rectangle or ellipse, click in a grab handle and drag it to a new location.
 - To reposition a vertex in a broken line, polygon, or line, click in a grab handle and move it to a new location.
 - To reposition a rectangle or ellipse, click in the interior and drag it to a new location.
 - To reposition a point, click on it and drag it to a new location.
 - To reposition lines, broken lines, and polygons, click on any segment and drag it to a new location.
 - To reposition freehand lines and closed freehand lines, click anywhere on the line and drag it to a new location.

imaqAreScrollbarsVisible

Usage

```
int = imaqAreScrollbarsVisible(int windowNumber, int* visible)
```

Purpose

Retrieves whether the scrollbars of the given image window are visible.

Parameters

Name	Type	Description
windowNumber	int	The window number of the image window.
visible	int*	On return, this parameter is TRUE if the scrollbars are visible and FALSE if the scrollbars are hidden. This parameter is required and cannot be NULL.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqBringWindowToTop

Usage

```
int = imaqBringWindowToTop(int windowNumber)
```

Purpose

Makes the given image window active. This function has no effect on Windows 2000 if your application is not the active application in the system.

Parameters

Name	Type	Description
windowNumber	int	The window number of the window you want to be active.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqCloseToolWindow

Usage

```
int = imaqCloseToolWindow()
```

Purpose

Closes the tool window and frees all associated resources.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqCloseWindow

Usage

```
int = imaqCloseWindow(int windowNumber)
```

Purpose

Closes an image window and frees all associated resources.

Parameters

Name	Type	Description
windowNumber	int	The window number of the image window to close. Set this parameter to <code>IMAQ_ALL_WINDOWS</code> to close all of the image windows.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqCreateOverlayFromMetafile

Usage

```
Overlay* = imaqCreateOverlayFromMetafile(const void* metafile)
```

Purpose

Creates a window overlay from a Windows metafile or enhanced metafile.

Parameters

Name	Type	Description
metafile	const void*	The Windows handle to the metafile that you want to convert into an overlay. The handle may be either an HMETAFILE or HENHMETAFILE.

Return Value

Overlay*—On success, this function returns an overlay. On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`. When you are finished with the overlay, dispose of it by calling `imaqDispose()`.

imaqCreateOverlayFromROI

Usage

```
Overlay* = imaqCreateOverlayFromROI(const ROI* roi)
```

Purpose

Creates a window overlay from a region of interest.

Parameters

Name	Type	Description
roi	const ROI*	The region of interest to convert into an overlay.

Return Value

Overlay*—On success, this function returns an overlay. On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`. When you are finished with the overlay, dispose of it by calling `imaqDispose()`.

imaqDisplayImage

Usage

```
int = imaqDisplayImage(const Image* image, int windowNumber, int resize)
```

Purpose

Displays an image in an image window. The window becomes visible when you call the function. The window is associated with the image until you close the window, dispose of the image, or call this function again with the same window number.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
image	const Image*	The image to display in the window.
windowNumber	int	The window number of the window in which to display the image. There are 16 image windows, which have window numbers 0–15. To obtain a window number not in use, call <code>imaqGetWindowHandle()</code> .
resize	int	If you set this parameter to TRUE, the window resizes to the size of the image. If you set this parameter to FALSE, the window size does not change.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetCurrentTool

Usage

```
int = imaqGetCurrentTool(Tool* currentTool)
```

Purpose

Returns the currently selected tool from the tool window.

Parameters

Name	Type	Description
currentTool	Tool*	On return, contains the currently selected tool. This parameter is required and cannot be NULL.

Parameter Discussion

currentTool—The following options are valid:

- **IMAQ_NO_TOOL**—No tool is in the selected state.
- **IMAQ_SELECTION_TOOL**—The selection tool selects an existing ROI in an image.
- **IMAQ_POINT_TOOL**—The point tool draws a point on the image.
- **IMAQ_LINE_TOOL**—The line tool draws a line on the image.
- **IMAQ_RECTANGLE_TOOL**—The rectangle tool draws a rectangle on the image.
- **IMAQ_OVAL_TOOL**—The oval tool draws an oval on the image.
- **IMAQ_POLYGON_TOOL**—The polygon tool draws a polygon on the image.
- **IMAQ_CLOSED_FREEHAND_TOOL**—The closed freehand tool draws closed freehand shapes on the image.
- **IMAQ_ZOOM_TOOL**—The zoom tool controls the zoom of an image.
- **IMAQ_POLYLINE_TOOL**—The polyline tool draws a series of connected straight lines on the image.
- **IMAQ_FREEHAND_TOOL**—The freehand tool draws freehand lines on the image.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetLastEvent

Usage

```
int = imaqGetLastEvent(WindowEventType* type, int* windowNumber, Tool* tool,
                       Rect* rect)
```

Purpose

Returns the last event that the user performed on an image window. Do not use this function if you have registered an event callback with `imaqSetEventCallback()`.

Parameters

Name	Type	Description
type	WindowEventType*	On return, the last event that occurred.
windowNumber	int*	On return, the window number of the window in which the last event occurred. Set this parameter to NULL if you do not need this information.
tool	Tool*	If the event was <code>IMAQ_DRAW_EVENT</code> , tool is the ROI tool with which the user drew. If the event was not <code>IMAQ_DRAW_EVENT</code> , the function ignores this parameter. Set this parameter to NULL if you do not need this information.
rect	Rect*	A rectangle describing the location of the event. Set this parameter to NULL if you do not need this information.

Parameter Discussion

For **type**, the last event can be one of the following:

- `IMAQ_NO_EVENT`—No event occurred since the last call to `imaqGetLastEvent()`.
- `IMAQ_CLICK_EVENT`—The user clicked on a window.
- `IMAQ_DRAW_EVENT`—The user drew an ROI in a window.
- `IMAQ_MOVE_EVENT`—The user moved a window.
- `IMAQ_SIZE_EVENT`—The user sized a window.
- `IMAQ_SCROLL_EVENT`—The user scrolled a window.
- `IMAQ_ACTIVATE_EVENT`—The user activated a window.
- `IMAQ_CLOSE_EVENT`—The user closed a window.
- `IMAQ_DOUBLE_CLICK_EVENT`—The user double-clicked in a window.

For **rect**, the contents of the rectangle depend on **type**, as follows:

- `IMAQ_CLICK_EVENT`—The top left corner of the rectangle is the location of the click. The width and height of the rectangle are 0.
- `IMAQ_SCROLL_EVENT`—The top left of the rectangle is the center of the displayed image. The width and height of the rectangle are 0.
- `IMAQ_DRAW_EVENT`—The rectangle is the bounding rectangle of the drawn shape.
- `IMAQ_MOVE_EVENT` or `IMAQ_SIZE_EVENT`—The rectangle is the new location of the window on the screen.

For all other events, the function ignores the rectangle.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetLastKey

Usage

```
int = imaqGetLastKey(char* keyPressed, int* windowNumber, int* modifiers)
```

Purpose

Returns the last key pressed in an active image window.

Parameters

Name	Type	Description
keyPressed	char*	On return, contains the last key pressed. Returns -1 if there was no new key press to retrieve. Set this parameter to NULL if you do not need this information.
windowNumber	int*	On return, contains the window number of the window in which the key press was caught. Returns -1 if there was no new key press to retrieve. Set this parameter to NULL if you do not need this information.
modifiers	int*	On return, will contain a bit-shifted value indicating what modifiers, if any, the function applied to the key press. The following are possible modifiers: IMAQ_SHIFT IMAQ_ALT IMAQ_CTRL IMAQ_CAPS_LOCK Set this parameter to NULL if you do not need this information.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetMousePos

Usage

```
int = imaqGetMousePos(Point* position, int* windowNumber)
```

Purpose

Returns the mouse cursor coordinates and window number of the most recent instance that the mouse cursor was located over an active window.

Parameters

Name	Type	Description
position	Point*	Upon return, the coordinates of the mouse in the active image window. Set this parameter to NULL if you do not need this information.
windowNumber	int*	Upon return, contains the window number of the active window. Set this parameter to NULL if you do not need this information.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetSystemWindowHandle

Usage

```
void* = imaqGetSystemWindowHandle(int windowNumber)
```

Purpose

Returns the Windows HWND for a given IMAQ Vision image window.

Parameters

Name	Type	Description
windowNumber	int	The window number of the window whose HWND to retrieve.

Return Value

void*—On success, this function returns the Windows HWND for the window. On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`.

imaqGetToolWindowPos

Usage

```
int = imaqGetToolWindowPos(Point* position)
```

Purpose

Retrieves the current location of the tool window. The function behaves in the same manner as `imaqGetWindowPos()`.

Parameters

Name	Type	Description
position	Point*	Upon return, the position of the upper left corner of the tool window.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetWindowGrid

Usage

```
int = imaqGetWindowGrid(int windowNumber, int* xResolution, int*
                        yResolution)
```

Purpose

Retrieves the grid resolution of the image window. Grid resolution is the number of pixels between grid lines. IMAQ Vision uses the grid resolution when drawing regions of interest on the window using tools in the tool window. You can use the grid to trace a region of interest accurately.

Parameters

Name	Type	Description
windowNumber	int	The window number of the image window.
xResolution	int*	On return, the number of pixels between grid lines in the <i>x</i> direction. Set this parameter to NULL if you do not need this information.
yResolution	int*	On return, the number of pixels between grid lines in the <i>y</i> direction. Set this parameter to NULL if you do not need this information.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetWindowHandle

Usage

```
int = imaqGetWindowHandle(int* handle)
```

Purpose

Returns an unused window number. You can use the window number in conjunction with functions such as `imaqDisplayImage()`. This function does not reserve the window number until you call a function that uses the window number.

Parameters

Name	Type	Description
handle	int*	On return, an unused window number. If no unused window numbers are available, the function sets this parameter to -1.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetWindowPos

Usage

```
int = imaqGetWindowPos(int windowNumber, Point* position)
```

Purpose

Retrieves the current location of the given image window.

Parameters

Name	Type	Description
windowNumber	int	The window number of the image window.
position	Point*	On return, the position of the upper left corner of the given image window. This parameter is required and cannot be NULL.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetWindowSize

Usage

```
int = imaqGetWindowSize(int windowNumber, int* width, int* height)
```

Purpose

Retrieves the size of a given image window.

Parameters

Name	Type	Description
windowNumber	int	The window number of the image window.
width	int*	On return, the width of the window. Set this parameter to NULL if you do not need this information.
height	int*	On return, the height of the window. Set this parameter to NULL if you do not need this information.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetWindowTitle

Usage

```
char* = imaqGetWindowTitle(int windowNumber)
```

Purpose

Retrieves the current title of an image window.

Parameters

Name	Type	Description
windowNumber	int	The window number of the image window.

Return Value

char*—On success, this function returns the title of the given window. On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`. When you are finished with the title, dispose of it by calling `imaqDispose()`.

imaqGetWindowZoom

Usage

```
int = imaqGetWindowZoom(int windowNumber, int* xZoom, int* yZoom)
```

Purpose

Retrieves the current zoom factors for a given image window. The zoom factor indicates an increase or decrease in the magnification of an image. A positive number indicates a magnification by the amount specified. For example, a zoom factor of 3 indicates that the image is displayed at three times its actual size (3:1). A negative number indicates that the image is decreased in magnification by the specified amount. For example, a zoom factor of -5 indicates that the image is displayed at one-fifth its actual size (1:5).

Parameters

Name	Type	Description
windowNumber	int	The window number of the image window.
xZoom	int*	On return, the current zoom factor in the <i>x</i> direction for the window.
yZoom	int*	On return, the current zoom factor in the <i>y</i> direction for the window.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqIsToolWindowVisible

Usage

```
int = imaqIsToolWindowVisible(int* visible)
```

Purpose

Retrieves whether the tool window is visible. This function behaves in the same manner as `imaqIsWindowVisible()`.

Parameters

Name	Type	Description
visible	int*	On return, this parameter is TRUE if the tool window is visible and FALSE if the tool window is hidden. This parameter is required and cannot be NULL.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqIsWindowVisible

Usage

```
int = imaqIsWindowVisible(int windowNumber, int* visible)
```

Purpose

Retrieves whether the given window is visible.

Parameters

Name	Type	Description
windowNumber	int	The window number of the image window.
visible	int*	On return, this parameter is TRUE if the given window is visible and FALSE if the window is hidden. This parameter is required and cannot be NULL.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqMoveToolWindow

Usage

```
int = imaqMoveToolWindow(Point position)
```

Purpose

Moves the tool window.

Parameters

Name	Type	Description
position	Point	The new position, in screen coordinates, of the upper left corner of the tool window.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqMoveWindow

Usage

```
int = imaqMoveWindow(int windowNumber, Point position)
```

Purpose

Moves an image window.

Parameters

Name	Type	Description
windowNumber	int	The window number of the image window.
position	Point	The new position, in screen coordinates, of the upper left corner of the window.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSetCurrentTool

Usage

```
int = imaqSetCurrentTool(Tool currentTool)
```

Purpose

Sets the currently selected tool in the tool window.

Parameters

Name	Type	Description
currentTool	Tool	The tool to make the selected region tool.

Parameter Discussion

currentTool—The following options are valid:

- **IMAQ_NO_TOOL**—Sets all tools to the unselected state.
- **IMAQ_SELECTION_TOOL**—The selection tool selects an existing ROI in an image.
- **IMAQ_POINT_TOOL**—The point tool draws a point on the image.
- **IMAQ_LINE_TOOL**—The line tool draws a line on the image.
- **IMAQ_RECTANGLE_TOOL**—The rectangle tool draws a rectangle on the image.
- **IMAQ_OVAL_TOOL**—The oval tool draws an oval on the image.
- **IMAQ_POLYGON_TOOL**—The polygon tool draws a polygon on the image.
- **IMAQ_CLOSED_FREEHAND_TOOL**—The closed freehand tool draws closed freehand shapes on the image.
- **IMAQ_ZOOM_TOOL**—The zoom tool controls the zoom of an image.
- **IMAQ_POLYLINE_TOOL**—The polyline tool draws a series of connected straight lines on the image.
- **IMAQ_FREEHAND_TOOL**—The freehand tool draws freehand lines on the image.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSetEventCallback

Usage

```
int = imaqSetEventCallback(EventCallback callback, int synchronous)
```

Purpose

Sets a callback function that IMAQ Vision calls when an event occurs in a window. When a user generates an event, IMAQ Vision calls the callback function using the following parameters: event, window number, tool, and location of the event. For a full description of these parameters, see `imaqGetLastEvent()`.

Parameters

Name	Type	Description
callback	EventCallback	The function to call. Set this parameter to NULL if you want to disable event processing using a callback. If you disable callbacks, you can process events using <code>imaqGetLastEvent()</code> .
synchronous	int	Set this parameter to TRUE to call the callback function in the thread that calls <code>imaqSetEventCallback()</code> . Set this parameter to FALSE to call the callback function asynchronously in a separate thread. To process callbacks synchronously, your application must have a message pump. In LabWindows/CVI, calling <code>RunUserInterface()</code> starts a message pump. The function ignores this parameter if callback is NULL.

Parameter Discussion

callback—The callback should have the following prototype:

```
void IMAQ_CALLBACK MyCallback(WindowEventType, int windowNumber,
                               Tool tool, Rect rect);
```

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSetToolColor

Usage

```
int = imaqSetToolColor(const RGBValue* color)
```

Purpose

Sets the color in which the tools from the tool window draw.

Parameters

Name	Type	Description
color	const RGBValue*	The tool drawing color. This parameter is required and cannot be NULL.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSetupToolWindow

Usage

```
int = imaqSetupToolWindow(int showCoordinates, int maxIconsPerLine, const
                          ToolWindowOptions* options)
```

Purpose

Configures the appearance and availability of the tools in the tool window.

Parameters

Name	Type	Description
showCoordinates	int	Determines whether active pixel coordinates are visible. Set this parameter to TRUE to display the active pixel coordinates. Set this parameter to FALSE if you do not want the coordinates to show.
maxIconsPerLine	int	The maximum number of tool icons to show on each line. The tool window uses the minimum number of lines needed to display all of the tools based on this parameter and distributes the tools as evenly as possible.
options	const ToolWindowOptions*	Determines the availability of tools in the tool window.

Parameter Discussion

Set **options** to NULL to display all the tools. A `ToolWindowOptions` structure has the following elements:

- `showSelectionTool`—If TRUE, the selection tool becomes visible. The selection tool selects an existing ROI in an image.
- `showZoomTool`—If TRUE, the zoom tool becomes visible. The zoom tool controls the magnification of an image.
- `showPointTool`—If TRUE, the point tool becomes visible. The point tool draws a point on the image.
- `showLineTool`—If TRUE, the line tool becomes visible. The line tool draws a line on the image.
- `showRectangleTool`—If TRUE, the rectangle tool becomes visible. The rectangle tool draws a rectangle on the image.

- `showOvalTool`—If TRUE, the oval tool becomes visible. The oval tool draws an oval on the image.
- `showPolygonTool`—If TRUE, the polygon tool becomes visible. The polygon tool draws a polygon on the image.
- `showClosedFreehandTool`—If TRUE, the closed freehand tool becomes visible. The closed freehand tool draws closed freehand shapes on the image.
- `showPolyLineTool`—If TRUE, the polyline tool becomes visible. The polyline tool draws a series of connected straight lines on the image.
- `showFreehandTool`—If TRUE, the freehand tool becomes visible. The freehand tool draws freehand lines on the image.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSetupWindow

Usage

```
int = imaqSetupWindow(int windowNumber, int configuration)
```

Purpose

Sets the properties of an image window.

Parameters

Name	Type	Description
windowNumber	int	The window number of the image window.
configuration	int	Any of the following flags combined together: IMAQ_WIND_RESIZABLE—When present, the user may resize the window interactively. When absent, you can only resize the window programmatically. IMAQ_WIND_TITLEBAR—When present, the title bar on the window is visible. When absent, the title bar on the window is not visible. IMAQ_WIND_CLOSABLE—When present, the close box is available. When absent, the close box is removed. The title bar must be present for this flag to have effect. IMAQ_WIND_TOPMOST—When present, the window is always on top. When absent, the window is on top only when active.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSetWindowGrid

Usage

```
int = imaqSetWindowGrid(int windowNumber, int xResolution, int yResolution)
```

Purpose

Sets the grid resolution of the image window. Grid resolution is the number of pixels between grid lines. IMAQ Vision uses the grid resolution when drawing regions of interest on the window using tools in the tool window. You can use the grid to trace a region of interest accurately.

Parameters

Name	Type	Description
windowNumber	int	The window number of the image window.
xResolution	int	The <i>x</i> resolution of the grid.
yResolution	int	The <i>y</i> resolution of the grid.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSetWindowOverlay

Usage

```
int = imaqSetWindowOverlay(int windowNumber, const Overlay* overlay)
```

Purpose

Sets or removes the overlay from a window.

Parameters

Name	Type	Description
windowNumber	int	The window number of the image window.
overlay	const Overlay*	The overlay. Set this parameter to NULL to remove any existing overlay from the given window.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSetWindowPalette

Usage

```
int = imaqSetWindowPalette(int windowNumber, PaletteType type, const
                           RGBValue* palette, int numColors)
```

Purpose

Sets the color palette to use when displaying a monochrome image in an image window.

Parameters

Name	Type	Description
windowNumber	int	The window number of the image window.
type	PaletteType	The palette type to use. The following values are valid: IMAQ_PALETTE_GRAY IMAQ_PALETTE_BINARY IMAQ_PALETTE_GRADIENT IMAQ_PALETTE_RAINBOW IMAQ_PALETTE_TEMPERATURE IMAQ_PALETTE_USER
palette	const RGBValue*	If type is IMAQ_PALETTE_USER, this array is the palette of colors to use with the window. If type is not IMAQ_PALETTE_USER, the function ignores this parameter, and you may set it to NULL. The maximum number of colors in a palette is 256. palette[n] maps to pixel value n. If there are less than 256 elements in palette , the function maps all pixel values past the last element in palette to black.
numColors	int	If type is IMAQ_PALETTE_USER, this parameter is the number of colors in the palette array. If type is not IMAQ_PALETTE_USER, the function ignores this parameter.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSetWindowSize

Usage

```
int = imaqSetWindowSize(int windowNumber, int width, int height)
```

Purpose

Sets the size of an image window.

Parameters

Name	Type	Description
windowNumber	int	The window number of the image window.
width	int	The new width of the window.
height	int	The new height of the window.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSetWindowThreadPolicy

Usage

```
int = imaqSetWindowThreadPolicy(WindowThreadPolicy policy)
```

Purpose

Determines the thread in which IMAQ Vision creates windows. By default, IMAQ Vision uses `IMAQ_CALLING_THREAD`. This policy creates windows in the thread that makes the first display function call for a given window number. If that thread does not process messages, set the window thread policy to `IMAQ_SEPARATE_THREAD`. Using this policy, IMAQ Vision creates windows in a separate thread and processes messages for the windows automatically.

Parameters

Name	Type	Description
policy	WindowThreadPolicy	The thread policy. Valid options are <code>IMAQ_CALLING_THREAD</code> and <code>IMAQ_SEPARATE_THREAD</code> .

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSetWindowTitle

Usage

```
int = imaqSetWindowTitle(int windowNumber, const char* title)
```

Purpose

Sets the title of an image window.

Parameters

Name	Type	Description
windowNumber	int	The window number of the image window.
title	const char*	The new title of the window. This parameter is required and cannot be NULL.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqShowScrollbars

Usage

```
int = imaqShowScrollbars(int windowNumber, int visible)
```

Purpose

Shows or hides the scrollbars on an image window.

Parameters

Name	Type	Description
windowNumber	int	The window number of the image window.
visible	int	If TRUE, the scrollbars of the window are visible. If FALSE, the scrollbars of the window are hidden.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqShowToolWindow

Usage

```
int = imaqShowToolWindow(int visible)
```

Purpose

This function shows or hides the tool window.

Parameters

Name	Type	Description
visible	int	If TRUE, the tool window becomes visible. If FALSE, the tool window becomes hidden.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqShowWindow

Usage

```
int = imaqShowWindow(int windowNumber, int visible)
```

Purpose

Shows or hides an image window.

Parameters

Name	Type	Description
windowNumber	int	The window number of the image window.
visible	int	If TRUE, the given window is visible. If FALSE, the given window is hidden.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqZoomWindow

Usage

```
int = imaqZoomWindow(int windowNumber, int xZoom, int yZoom, Point center)
```

Purpose

Sets the current zoom factors for a given image window. The zoom factor indicates an increase or decrease in the magnification of an image. A positive number indicates a magnification by the amount specified. For example, a zoom factor of 3 indicates that the image is displayed at three times its actual size (3:1). A negative number indicates that the image is decreased in magnification by the specified amount. For example, a zoom factor of -5 indicates that the image is displayed at one-fifth its actual size (1:5).

Parameters

Name	Type	Description
windowNumber	int	The window number of the image window.
xZoom	int	The zoom factor for the x direction.
yZoom	int	The zoom factor for the y direction.
center	Point	The center point around which to zoom. Set this parameter to <code>IMAQ_NO_POINT</code> to maintain the current center point.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

Regions of Interest

This chapter describes the Regions of Interest (ROI) functions in IMAQ Vision for LabWindows/CVI.

Regions of Interest Function Panels

Table 7-1 lists the Regions of Interest functions in a tree structure. The functions in the Regions of Interest class are grouped according to the types of operations they perform. The first-level heading in the tree is the name of the class. The second-level headings are names of function subclasses. The third-level headings are names of individual function panels. Each Regions of Interest function panel represents one function.

Table 7-1. Regions of Interest Function Tree

Class/Panel Name	Function Name
Regions of Interest	
Create ROI	<code>imaqCreateROI</code>
Get ROI Bounding Box	<code>imaqGetROIBoundingBox</code>
Get ROI Color	<code>imaqGetROIColor</code>
Get Window ROI	<code>imaqGetWindowROI</code>
Mask To ROI	<code>imaqMaskToROI</code>
ROI Profile	<code>imaqROIProfile</code>
ROI To Mask	<code>imaqROIToMask</code>
Set ROI Color	<code>imaqSetROIColor</code>
Set Window ROI	<code>imaqSetWindowROI</code>
Transform ROI	<code>imaqTransformROI</code>
Contours	
Add Closed Contour	<code>imaqAddClosedContour</code>
Add Line Contour	<code>imaqAddLineContour</code>
Add Open Contour	<code>imaqAddOpenContour</code>
Add Oval Contour	<code>imaqAddOvalContour</code>
Add Point Contour	<code>imaqAddPointContour</code>
Add Rect Contour	<code>imaqAddRectContour</code>
Copy Contour	<code>imaqCopyContour</code>
Get Contour	<code>imaqGetContour</code>
Get Contour Color	<code>imaqGetContourColor</code>
Get Contour Count	<code>imaqGetContourCount</code>
Get Contour Information	<code>imaqGetContourInfo</code>
Remove Contour	<code>imaqRemoveContour</code>
Set Contour Color	<code>imaqSetContourColor</code>

Subclass Description

Regions of Interest functions allow you to create, modify, and extract information about regions of interest. The Regions of Interest subclass description is as follows:

- Contour functions allow you to create and modify individual contours of a region of interest.

imaqAddClosedContour

Usage

```
ContourID = imaqAddClosedContour(ROI* roi, const Point* points,
                                  int numPoints)
```

Purpose

Creates a new ROI contour based on the provided array of points. To make the contour, the function connects each point in the array to the next point in the array, and it connects the last point in the array to the first point in the array. The function adds the contour to the provided ROI.

Parameters

Name	Type	Description
roi	ROI*	The ROI to contain the new contour.
points	const Point*	An array of points describing the location and shape of the contour. This parameter is required and cannot be NULL.
numPoints	int	The number of points in the array.

Return Value

ContourID—On success, this function returns a ContourID for the added contour. You can use the ContourID to reference the contour within the containing ROI. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqAddLineContour

Usage

```
ContourID = imaqAddLineContour(ROI* roi, Point start, Point end)
```

Purpose

Creates a new line ROI contour and adds the line to the provided ROI.

Parameters

Name	Type	Description
roi	ROI*	The ROI to contain the new contour.
start	Point	The pixel location of the start of the line.
end	Point	The pixel location of the end of the line.

Return Value

ContourID—On success, this function returns a ContourID for the contour. You can use the ContourID to reference the contour within the containing ROI. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqAddOpenContour

Usage

```
ContourID = imaqAddOpenContour(ROI* roi, const Point* points, int numPoints)
```

Purpose

Creates a new ROI contour based on the provided array of points. To make the contour, the function connects each point in the array to the next point in the array. The function does not connect the last point in the array to the first point in the array. The function adds the contour to the provided ROI.

Parameters

Name	Type	Description
roi	ROI*	The ROI to contain the new contour.
points	const Point*	An array of points describing the location and shape of the contour. This parameter is required and cannot be NULL.
numPoints	int	The number of points in the array.

Return Value

ContourID—On success, this function returns a ContourID for the contour. You can use the ContourID to reference the contour within the containing ROI. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqAddOvalContour

Usage

```
ContourID = imaqAddOvalContour(ROI* roi, Rect boundingBox)
```

Purpose

Creates a new oval ROI contour and adds the oval to the provided ROI.

Parameters

Name	Type	Description
roi	ROI*	The ROI to contain the new contour.
boundingBox	Rect	The pixel location of the bounding box of the oval.

Return Value

ContourID—On success, this function returns a ContourID for the contour. You can use the ContourID to reference the contour within the containing ROI. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqAddPointContour

Usage

```
ContourID = imaqAddPointContour(ROI* roi, Point point)
```

Purpose

Creates a new single-point ROI contour and adds the point to the provided ROI.

Parameters

Name	Type	Description
roi	ROI*	The ROI to contain the new contour.
point	Point	The pixel location of the point.

Return Value

ContourID—On success, this function returns a ContourID for the contour. You can use the ContourID to reference the contour within the containing ROI. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqAddRectContour

Usage

```
ContourID = imaqAddRectContour(ROI* roi, Rect rect)
```

Purpose

Creates a new rectangle ROI contour and adds the rectangle to the provided ROI.

Parameters

Name	Type	Description
roi	ROI*	The ROI to contain the new contour.
rect	Rect	The pixel location of the rectangle.

Return Value

ContourID—On success, this function returns a ContourID for the contour. You can use the ContourID to reference the contour within the containing ROI. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqCopyContour

Usage

```
ContourID = imaqCopyContour(ROI* destRoi, const ROI* sourceRoi, ContourID id)
```

Purpose

Copies a contour existing in one ROI to another ROI. Copying the contour does not affect the original contour or the source ROI.

Parameters

Name	Type	Description
destRoi	ROI*	The ROI to which the function adds the contour.
sourceRoi	const ROI*	The ROI that contains the contour to copy.
id	ContourID	The contour to add to the ROI.

Return Value

ContourID—On success, this function returns the ContourID of the contour in the destination ROI. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqCreateROI

Usage

```
ROI* = imaqCreateROI()
```

Purpose

Creates a new, empty region of interest (ROI).

Return Value

ROI*—On success, this function returns a pointer to a new, empty ROI. On failure, this function returns `NULL`. To get extended error information, call `imaqGetLastError()`. When you are finished with the ROI, dispose of the pointer by calling `imaqDispose()`.

imaqGetContour

Usage

```
ContourID = imaqGetContour(const ROI* roi, unsigned int index)
```

Purpose

Returns the ContourID of the contour at the specified index location within an ROI.

Parameters

Name	Type	Description
roi	const ROI*	The ROI containing the desired contour.
index	unsigned int	The zero-offset index of the contour to get.

Return Value

ContourID—On success, this function returns the ContourID of the requested contour.

On failure, this function returns 0. To get extended error information, call

```
imaqGetLastError().
```

imaqGetContourColor

Usage

```
int = imaqGetContourColor(const ROI* roi, ContourID id, RGBValue*  
                        contourColor)
```

Purpose

Returns the color of a contour.

Parameters

Name	Type	Description
roi	const ROI*	The ROI containing the contour from which the function gets color information.
id	ContourID	The ContourID of the contour from which the function gets color information.
contourColor	RGBValue*	On return, the color of the contour.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetContourCount

Usage

```
int = imaqGetContourCount(const ROI* roi)
```

Purpose

Returns the number of contours in an ROI.

Parameters

Name	Type	Description
roi	const ROI*	The ROI from which the function gets the contour count.

Return Value

int—On success, this function returns the number of contours in the ROI. On failure, this function returns `-1`. To get extended error information, call `imaqGetLastError()`.

imaqGetContourInfo

Usage

```
ContourInfo* = imaqGetContourInfo(const ROI* roi, ContourID id)
```

Purpose

Returns information about a particular contour. The structure that the function returns contains a copy of the data from the contour. Modifications to the information in the structure do not affect the contour.

Parameters

Name	Type	Description
roi	const ROI*	The ROI containing the contour from which the function gets the information.
id	ContourID	The ContourID of the contour about which the function gets information.

Return Value

ContourInfo*—On success, this function returns a pointer to the structure containing information about the requested contour. The structure contains the following information:

- **type**—The type of the contour. The following options are valid:
 IMAQ_EMPTY_CONTOUR
 IMAQ_POINT
 IMAQ_LINE
 IMAQ_RECT
 IMAQ_OVAL
 IMAQ_CLOSED_CONTOUR
 IMAQ_OPEN_CONTOUR
- **numPoints**—The number of points that make up the contour.
- **points**—The points describing the contour.
- **contourColor**—The color of the contour.

On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`. When you are finished with this structure, dispose of the pointer by calling `imaqDispose()`.

imaqGetROIBoundingBox

Usage

```
int = imaqGetROIBoundingBox(const ROI* roi, Rect* boundingBox)
```

Purpose

Returns the bounding box for the ROI. The bounding box is the smallest rectangle that contains all of the contours that comprise the ROI.

Parameters

Name	Type	Description
roi	const ROI*	The ROI from which the function gets the bounding box information.
boundingBox	Rect*	On return, the bounding box. This parameter is required and cannot be NULL.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetROIColor

Usage

```
int = imaqGetROIColor(const ROI* roi, RGBValue* roiColor)
```

Purpose

Returns the color of an ROI.

Parameters

Name	Type	Description
roi	const ROI*	The ROI from which the function gets color information.
roiColor	RGBValue*	On return, the color of the ROI. This parameter is required and cannot be NULL.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetWindowROI

Usage

```
ROI* = imaqGetWindowROI(int windowNumber)
```

Purpose

Retrieves a copy of the ROI associated with a given image window.

Parameters

Name	Type	Description
windowNumber	int	The window number of the image window.

Return Value

ROI*—On success, this function returns a copy of the ROI associated with the given window. On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`. When you are finished with the ROI, dispose of it by calling `imaqDispose()`.

imaqMaskToROI

Usage

```
ROI* = imaqMaskToROI(const Image* mask, int* withinLimit)
```

Purpose

Transforms a mask image into a region of interest descriptor. The number of points that define the ROI cannot exceed 2,500.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
mask	const Image*	The mask image that the function transforms into a ROI. This image must be an IMAQ_IMAGE_U8 image.
withinLimit	int*	On return, this parameter indicates whether the ROI is a true representation of the mask. If TRUE, the number of points is within the 2,500 point limit. If FALSE, the number of points exceeds the 2,500 limit, and the ROI may not represent the mask completely. Set this parameter to NULL if you do not need this information.

Return Value

ROI*—On success, this function returns a pointer to the ROI descriptor. On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`. When you are finished with this descriptor, dispose of the pointer by calling `imaqDispose()`.

imaqRemoveContour

Usage

```
int = imaqRemoveContour(ROI* roi, ContourID id)
```

Purpose

Deletes the specified contour from the specified ROI, freeing all allocated memory associated with the contour.

Parameters

Name	Type	Description
roi	ROI*	The ROI containing the contour to remove.
id	ContourID	The ContourID of the contour to remove. After this operation, the ContourID no longer correlates to a valid contour. Set this parameter to <code>IMAQ_ALL_CONTOURS</code> to remove all contours.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqROIProfile

Usage

```
ROIProfile* = imaqROIProfile(const Image* image, const ROI* roi)
```

Purpose

Calculates the profile of the pixels along the edge of each contour in an ROI.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
image	const Image*	The image from which the function gets the profile.
roi	const ROI*	The ROI describing the pixels about which the function gets information.

Return Value

ROIProfile*—On success, this function returns a pointer to information about the points along the edge of each contour in the ROI. The `ROIProfile` structure consists of the following elements:

- `report`—A `LineProfile` structure quantifying information about the points along the edge of each contour in the ROI. The `LineProfile` structure consists of the following elements:
 - `profileData`—An array of the pixel values along the edge of each contour in the ROI. This array has `dataCount` elements.
 - `boundingBox`—The bounding rectangle of the ROI.
 - `min`—The minimum pixel value along the edge of each contour in the ROI.
 - `max`—The maximum pixel value along the edge of each contour in the ROI.
 - `mean`—The mean of the pixel values along the edge of each contour in the ROI.
 - `stdDev`—The standard deviation of the pixel values along the edge of each contour in the ROI.
 - `dataCount`—The number of points along the edge of each contour in the ROI.
- `pixels`—An array of the points along the edge of each contour in the ROI. This array has a number of `Point` structures equal to the `dataCount` in `report`.

On failure, this function returns `NULL`. To get extended error information, call `imaqGetLastError()`. When you are finished with this information, dispose of it by calling `imaqDispose()`.

imaqROIToMask

Usage

```
int = imaqROIToMask(Image* mask, const ROI* roi, int fillValue, const Image*
                    imageModel, int* inSpace)
```

Purpose

Transforms an ROI into a mask image.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
mask	Image*	The resulting mask image.
roi	const ROI*	The descriptor defining the ROI.
fillValue	int	The pixel value of the mask. All pixels inside the ROI receive this value.
imageModel	const Image*	An optional template for the destination mask image. This parameter can be any image type that IMAQ Vision supports. If you supply an imageModel , the mask image is the size of the model. If you set imageModel to NULL, the size of mask is equal to the size of the bounding box of the ROI, which reduces the amount of memory used. The function sets the offset of the mask image to reflect the real position of the ROI.
inSpace	int*	If you used imageModel , this parameter indicates on return whether the mask is a true representation of the ROI. If TRUE, the ROI data is completely within imageModel . If FALSE, some of the ROI data fell outside the space associated with imageModel . Set this parameter to NULL if you do not need this information, or if you did not use imageModel .

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSetContourColor

Usage

```
int = imaqSetContourColor(ROI* roi, ContourID id, const RGBValue* color)
```

Purpose

Sets the color of a contour.

Parameters

Name	Type	Description
roi	ROI*	The ROI containing the contour whose color the function sets.
id	ContourID	The ContourID of the contour whose color the function sets.
color	const RGBValue*	The color to which the function sets the contour.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSetROIColor

Usage

```
int = imaqSetROIColor(ROI* roi, const RGBValue* color)
```

Purpose

Sets the color of all the contours currently in an ROI. All contours you add to the ROI become this color after you call this function. Use `imaqSetContourColor()` to change the color of individual contours within the ROI.

Parameters

Name	Type	Description
roi	ROI*	The ROI whose color the function sets.
color	const RGBValue*	The color to which the function sets the ROI.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSetWindowROI

Usage

```
int = imaqSetWindowROI(int windowNumber, const ROI* roi)
```

Purpose

Sets the ROI associated with a given window.

Parameters

Name	Type	Description
windowNumber	int	The window number of the image window.
roi	const ROI*	The ROI to associate with the window. Set this parameter to NULL to remove any ROIs from the window.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqTransformROI

Usage

```
int = imaqTransformROI(ROI* roi, Point originStart, float angleStart, Point
                      originFinal, float angleFinal)
```

Purpose

Rotates and translates an ROI from one coordinate system to another coordinate system within an image.

Parameters

Name	Type	Description
roi	ROI*	The ROI to transform.
originStart	Point	The origin of the starting coordinate system.
angleStart	float	The angle, in degrees, of the x-axis of the starting coordinate system relative to the x-axis of the image.
originFinal	Point	The origin of the new coordinate system.
angleFinal	float	The angle, in degrees, of the x-axis of the new coordinate system relative to the x-axis of the image.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

File I/O

This chapter describes the File I/O functions in IMAQ Vision for LabWindows/CVI. File I/O functions allow you to read images from a hard drive or disk, write images to a hard drive or disk, and get information about images stored on a hard drive or disk.

File I/O Function Panels

Table 8-1 lists the File I/O functions in a tree structure. The functions in the File I/O class are grouped in alphabetical order according to Class/Panel Name. The first-level heading in the tree is the name of the class. The second-level headings are names of individual function panels. Each File I/O function panel represents one function.

Table 8-1. Image Management Function Tree

Class/Panel Name	Function Name
File I/O	
Get File Information	imaqGetFileInfo
Read File	imaqReadFile
Write BMP File	imaqWriteBMPFile
Write File	imaqWriteFile
Write JPEG File	imaqWriteJPEGFile
Write PNG File	imaqWritePNGFile
Write TIFF File	imaqWriteTIFFFile

imaqGetFileInfo

Usage

```
int = imaqGetFileInfo(const char* filePath, CalibrationUnit*
                    calibrationUnit, float* calibrationX, float*
                    calibrationY, int* width, int* height, ImageType*
                    imageType)
```

Purpose

Returns information regarding the contents of an image file. You can retrieve information from the following image file formats only: PNG, JPEG, TIFF, AIPD, and BMP.

Parameters

Name	Type	Description
filePath	const char*	The name of the file from which the function gets information. This parameter is required and cannot be NULL.
calibrationUnit	CalibrationUnit*	On return, the calibration unit of the image. If the file does not have calibration information, the function sets calibrationUnit to <code>IMAQ_UNDEFINED</code> . Set this parameter to NULL if you do not need this information.
calibrationX	float*	On return, the interpixel distance in the <i>x</i> direction. If the file does not have calibration information, the function sets calibrationX to 1. Set this parameter to NULL if you do not need this information.
calibrationY	float*	On return, the interpixel distance in the <i>y</i> direction. If the file does not have calibration information, the function sets calibrationY to 1. Set this parameter to NULL if you do not need this information.
width	int*	On return, the width of the image. Set this parameter to NULL if you do not need this information.
height	int*	On return, the height of the image. Set this parameter to NULL if you do not need this information.
imageType	ImageType*	On return, the type of the image. Set this parameter to NULL if you do not need this information.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqReadFile

Usage

```
int = imaqReadFile(Image* image, const char* fileName, RGBValue* colorTable,
                  int* numColors)
```

Purpose

Creates an IMAQ Vision image from the information in a file. The file can be in one of the following formats: PNG, JPEG, TIFF, AIPD, or BMP.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
image	Image*	The image in which the function stores data it reads from the file.
fileName	const char*	The name of the file to read. This parameter is required and cannot be NULL.
colorTable	RGBValue*	An optional array of up to 256 elements. If the file has a color table, the function fills this parameter with the color table values. If the file does not contain a color table, the function returns an empty array. Set this parameter to NULL if you do not want the function to load the color table.
numColors	int*	If colorTable is not NULL, the function fills this parameter with the number of colors in the color table. If colorTable is NULL, the function ignores this parameter. Set this parameter to NULL if you do not need this information.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqWriteBMPFile

Usage

```
int = imaqWriteBMPFile(const Image* image, const char* fileName, int
                      compress, const RGBValue* colorTable)
```

Purpose

Writes an image to a BMP file. The function also stores a `CalibrationUnit` of `IMAQ_METER` only. If you pass an image to this function that has a `CalibrationUnit` other than `IMAQ_METER`, the function converts `xStep` and `yStep` from the supplied unit into meters.

Image Types Supported

`IMAQ_IMAGE_U8`, `IMAQ_IMAGE_RGB`

Parameters

Name	Type	Description
image	<code>const Image*</code>	The image to write to a file.
fileName	<code>const char*</code>	The name of the file to write. This parameter is required and cannot be NULL.
compress	<code>int</code>	Set this parameter to <code>TRUE</code> to compress the BMP. Set this parameter to <code>FALSE</code> to write an uncompressed BMP.
colorTable	<code>const RGBValue*</code>	An optional color table to associate with 8-bit images. If you want to provide a color table, the table must have 256 elements. Set this parameter to <code>NULL</code> to write a grayscale palette to the file.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqWriteFile

Usage

```
int = imaqWriteFile(const Image* image, const char* fileName, const RGBValue*
                    colorTable)
```

Purpose

This function writes an image to a file. In addition to writing pixel information, the function writes calibration information if the file format supports calibration information. The following list details file formats that support calibration information.

- **AIPD Files**—Stores any type of `CalibrationUnit` but stores only one step size. The function stores the `xStep` from the supplied image as the step size.
- **BMP Files**—Stores a `CalibrationUnit` of `IMAQ_METER` only. If you pass an image to this function that has a `CalibrationUnit` other than `IMAQ_METER`, the function converts `xStep` and `yStep` from the supplied unit into meters.
- **JPEG and TIFF Files**—Stores a `CalibrationUnit` of `IMAQ_CENTIMETER` or `IMAQ_INCH` only. If you pass an image to this function that has a metric `CalibrationUnit` other than `IMAQ_CENTIMETER`, the function converts `xStep` and `yStep` from the supplied unit into centimeters. If you pass an image to this function that has an English `CalibrationUnit` other than `IMAQ_INCH`, the function converts `xStep` and `yStep` from the supplied unit into inches.
- **PNG Files**—Stores any type of `CalibrationUnit`.

To write specific file types with more flexibility, use `imaqWriteJPEGFile()`, `imaqWriteBMPFile()`, `imaqWriteTIFFFile()`, or `imaqWritePNGFile()`.

Image Types Supported

`IMAQ_IMAGE_U8`, `IMAQ_IMAGE_I16`, `IMAQ_IMAGE_SGL`, `IMAQ_IMAGE_COMPLEX`,
`IMAQ_IMAGE_RGB`, `IMAQ_IMAGE_HSL`

Parameters

Name	Type	Description												
image	const Image*	<p>The image to write to a file. The function cannot write all image types to all file types. The following are the supported image types for each file type:</p> <table> <thead> <tr> <th>Image Types</th> <th>File Types</th> </tr> </thead> <tbody> <tr> <td>AIPD</td> <td>all image types</td> </tr> <tr> <td>BMP, JPEG, TIFF</td> <td>8-bit, RGB</td> </tr> <tr> <td>PNG</td> <td>8-bit, 16-bit, RGB</td> </tr> </tbody> </table>	Image Types	File Types	AIPD	all image types	BMP, JPEG, TIFF	8-bit, RGB	PNG	8-bit, 16-bit, RGB				
Image Types	File Types													
AIPD	all image types													
BMP, JPEG, TIFF	8-bit, RGB													
PNG	8-bit, 16-bit, RGB													
fileName	const char*	<p>The name of the file. The file type is determined by the extension, as follows:</p> <table> <thead> <tr> <th>Extension</th> <th>File Type</th> </tr> </thead> <tbody> <tr> <td>.aipd or .apd</td> <td>AIPD</td> </tr> <tr> <td>.bmp</td> <td>BMP</td> </tr> <tr> <td>.jpg or .jpeg</td> <td>JPEG</td> </tr> <tr> <td>.png</td> <td>PNG</td> </tr> <tr> <td>.tif or .tiff</td> <td>TIFF</td> </tr> </tbody> </table> <p>This parameter is required and cannot be NULL.</p>	Extension	File Type	.aipd or .apd	AIPD	.bmp	BMP	.jpg or .jpeg	JPEG	.png	PNG	.tif or .tiff	TIFF
Extension	File Type													
.aipd or .apd	AIPD													
.bmp	BMP													
.jpg or .jpeg	JPEG													
.png	PNG													
.tif or .tiff	TIFF													
colorTable	const RGBValue*	<p>An optional color table to associate with 8-bit images. If you provide a color table, the table must have 256 elements. Set this parameter to NULL to write a grayscale palette to the image.</p>												

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqWriteJPEGFile

Usage

```
int = imaqWriteJPEGFile(const Image* image, const char* fileName, unsigned
                        int quality, const RGBValue* colorTable)
```

Purpose

Writes an image to a JPEG file. The function also stores a `CalibrationUnit` of `IMAQ_CENTIMETER` or `IMAQ_INCH` only. If you pass an image to this function that has a metric `CalibrationUnit` other than `IMAQ_CENTIMETER`, the function converts `xStep` and `yStep` from the supplied unit into centimeters. If you pass an image to this function that has an English `CalibrationUnit` other than `IMAQ_INCH`, the function converts `xStep` and `yStep` from the supplied unit into inches.

Image Types Supported

`IMAQ_IMAGE_U8`, `IMAQ_IMAGE_RGB`

Parameters

Name	Type	Description
image	<code>const Image*</code>	The image to write to a file.
fileName	<code>const char*</code>	The name of the file to write. This parameter is required and cannot be NULL.
quality	<code>unsigned int</code>	Represents the quality of the image. As quality increases, the function uses less lossy compression. Acceptable values range from 0 to 1,000 with 750 as the default. Note: This function uses lossy compression even if you set the quality to 1,000.
colorTable	<code>const RGBValue*</code>	An optional color table to associate with 8-bit images. If you provide a color table, the table must have 256 elements. Set this parameter to NULL to write a grayscale palette to the image.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqWritePNGFile

Usage

```
int = imaqWritePNGFile(const Image* image, const char* fileName, unsigned int
                      compressionSpeed, const RGBValue* colorTable)
```

Purpose

Writes an image to a PNG file. This function stores any type of `CalibrationUnit` in a format that IMAQ Vision can read. This function also converts calibration information into meters, which any PNG file reader can interpret.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_RGB

Parameters

Name	Type	Description
image	const Image*	The image to write to a file.
fileName	const char*	The name of the file to write. This parameter is required and cannot be NULL.
compressionSpeed	unsigned int	Represents the relative speed of the compression algorithm. As this value increases, the function spends less time compressing the image. Acceptable values range from 0 to 1,000 with 750 as the default. PNG format always stores images in a lossless fashion.
colorTable	const RGBValue*	An optional color table to associate with 8-bit images. If you provide a color table, the table must have 256 elements. Set this parameter to NULL to write a grayscale palette to the image.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqWriteTIFFFile

Usage

```
int = imaqWriteTIFFFile(const Image* image, const char* fileName, const
                        TIFFFileOptions* options, const RGBValue*
                        colorTable)
```

Purpose

Writes an image to a TIFF file. This function stores a `CalibrationUnit` of `IMAQ_CENTIMETER` or `IMAQ_INCH` only. If you pass an image to this function that has a metric `CalibrationUnit` other than `IMAQ_CENTIMETER`, the function converts `xStep` and `yStep` from the supplied unit into centimeters. If you pass an image to this function that has an English `CalibrationUnit` other than `IMAQ_INCH`, the function converts `xStep` and `yStep` from the supplied unit into inches.

Image Types Supported

`IMAQ_IMAGE_U8`, `IMAQ_IMAGE_RGB`

Parameters

Name	Type	Description
image	<code>const Image*</code>	The image to write to a file.
fileName	<code>const char*</code>	The name of the file to write. This parameter is required and cannot be NULL.
options	<code>const TIFFFileOptions*</code>	A structure defining the specific options to use while writing the TIFF file.
colorTable	<code>const RGBValue*</code>	An optional color table to associate with 8-bit images. If you provide a color table, the table must have 256 elements. Set this parameter to NULL to write a grayscale palette to the image.

Parameter Discussion

options—The `TIFFFileOptions` structure contains three fields:

- `rowsPerStrip`—Indicates the number of rows that the function writes per strip.
- `photoInterp`—Designates which photometric interpretation to use. The following options are valid:

`IMAQ_WHITE_IS_ZERO`

`IMAQ_BLACK_IS_ZERO`

- `compressionType`—Indicates the type of compression to use on the TIFF. The following options are valid:

`IMAQ_NO_COMPRESSION`

`IMAQ_JPEG`

`IMAQ_RUN_LENGTH`

`IMAQ_ZIP`

Set the **options** parameter to `NULL` to use the default options, as follows:

- `rowsPerStrip`—0, which writes all data in one strip
- `photoInterp`—`IMAQ_BLACK_IS_ZERO`
- `compressionType`—`IMAQ_NO_COMPRESSION`

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

Image Analysis

This chapter describes the Image Analysis functions in IMAQ Vision for LabWindows/CVI. Image Analysis functions allow you to calculate various statistics about the pixels of an image.

Image Analysis Function Panels

Table 9-1 lists the Image Analysis functions in a tree structure. The functions in the Image Analysis class are grouped in alphabetical order according to Class/Panel Name. The first-level heading in the tree is the name of the class. The second-level headings are names of individual function panels. Each Image Analysis function panel represents one function.

Table 9-1. Image Analysis Function Tree

Class/Panel Name	Function Name
Image Analysis	
Centroid	imaqCentroid
Histogram	imaqHistogram
Linear Averages	imaqLinearAverages
Line Profile	imaqLineProfile
Quantify	imaqQuantify

imaqCentroid

Usage

```
int = imaqCentroid(const Image* image, PointFloat* centroid, const Image*
                  mask)
```

Purpose

Computes the centroid of an image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
image	const Image*	The image whose centroid the function calculates.
centroid	PointFloat*	On return, the x and y coordinates of the centroid. This parameter is required, and may not be NULL.
mask	const Image*	An optional mask image. This image must be an IMAQ_IMAGE_U8 image. In the calculation, the function uses only those source pixels whose corresponding mask pixels are non-zero. Set this parameter to NULL if you want the function to use the whole image in the centroid calculation.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqHistogram

Usage

```
HistogramReport* = imaqHistogram(const Image* image, int numClasses, float
                                min, float max, const Image* mask)
```

Purpose

Calculates the histogram, or pixel value distribution, of an image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
image	const Image*	The image whose histogram the function calculates.
numClasses	int	The number of classes into which the function separates the pixels.
min	float	The minimum pixel value to consider for the histogram. The function does not count pixels with values less than min .
max	float	The maximum pixel value to consider for the histogram. The function does not count pixels with values greater than max .
mask	const Image*	An optional mask image. This image must be an IMAQ_IMAGE_U8 image. When calculating the histogram, the function considers only those pixels in image whose corresponding pixels in mask are non-zero. Set this parameter to NULL if you want the function to perform a histogram on the whole image.

Return Value

HistogramReport*—On success, this function returns a report describing the pixel value classification. The `HistogramReport` structure contains the following elements:

- `histogram`—An array describing the number of pixels that fell into each class.
- `histogramCount`—The number of elements in the `histogram` array. The number of elements equals the value you provided in **numClasses**.
- `min`—The smallest pixel value that the function classified.
- `max`—The largest pixel value that the function classified.
- `start`—The smallest pixel value that fell into the first class.

- `width`—The size of each class.
- `mean`—The mean value of the pixels that the function classified.
- `stdDev`—The standard deviation of the pixels that the function classified.
- `numPixels`—The number of pixels that the function classified. The **mask** and the given **min** and **max** influence this element.

On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`. When you are finished with the report, dispose of it by calling `imaqDispose()`.

imaqLinearAverages

Usage

```
LinearAverages* = imaqLinearAverages(const Image* image, Rect rect)
```

Purpose

Computes the mean line profile of an image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
image	const Image*	The image on which the function calculates pixel value averages.
rect	Rect	Sets the rectangular area in which the function calculates the averages. Set this parameter to <code>IMAQ_NO_RECT</code> to calculate the averages on the whole image.

Return Value

LinearAverages*—On success, this function returns a structure containing the linear averages of the image. The `LinearAverages` structure has the following elements:

- `columnAverages`—An array containing the mean pixel value of each column.
- `columnCount`—The number of elements in the `columnAverages` array.
- `rowAverages`—An array containing the mean pixel value of each row.
- `rowCount`—The number of elements in the `rowAverages` array.
- `risingDiagAverages`—An array containing the mean pixel value of each diagonal running from the lower left to the upper right of the area you set in `rect`.
- `risingDiagCount`—The number of elements in the `risingDiagAverages` array.
- `fallingDiagAverages`—An array containing the mean pixel value of each diagonal running from the upper left to the lower right of the area you set in `rect`.
- `fallingDiagCount`—The number of elements in the `fallingDiagAverages` array.

On failure, this function returns `NULL`. To get extended error information, call `imaqGetLastError()`. When you are finished with this information, dispose of the pointer by calling `imaqDispose()`.

imaqLineProfile

Usage

```
LineProfile* = imaqLineProfile(const Image* image, Point start, Point end)
```

Purpose

Computes the profile of a line of pixels.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
image	const Image*	The image containing a line whose profile the function computes.
start	Point	The first point of the line.
end	Point	The last point of the line.

Return Value

LineProfile*—On success, this function returns a report containing information about the line. The `LineProfile` structure contains the following elements:

- `profileData`—An array containing the value of each pixel in the line.
- `boundingRect`—The bounding rectangle of the line.
- `min`—The smallest pixel value in the line profile.
- `max`—The largest pixel value in the line profile.
- `mean`—The mean value of the pixels in the line profile.
- `stdDev`—The standard deviation of the line profile.
- `dataCount`—The size of the `profileData` array.

On failure, this function returns `NULL`. To get extended error information, call `imaqGetLastError()`. When you are finished with the line profile, dispose of it by calling `imaqDispose()`.

imaqQuantify

Usage

```
QuantifyReport* = imaqQuantify(const Image* image, const Image* mask)
```

Purpose

Calculates statistical parameters on an image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
image	const Image*	The image to quantify.
mask	const Image*	If provided, a labeled version of the source image specifying the regions to quantify. This image must be an IMAQ_IMAGE_U8 image. Set this parameter to NULL if you want the function to quantify the whole image as one region.

Return Value

QuantifyReport*—On success, this function returns a pointer to a report describing the statistical parameters of the image. The `QuantifyReport` structure consists of the following parameters:

- `global`—A `QuantifyData` structure containing statistical data of the whole image.
- `regions`—An array of `QuantifyData` structures containing statistical data of each region of the image. See the **mask** parameter for more information on the regions.
- `regionCount`—The number of regions.

The elements `global` and `regions` are `QuantifyData` structures. A `QuantifyData` structure consists of the following elements:

- `mean`—The mean value of the pixel values.
- `stdDev`—The standard deviation of the pixel values.
- `min`—The smallest pixel value.
- `max`—The largest pixel value.
- `calibratedArea`—The area, calibrated to the calibration information of the image.
- `pixelArea`—The area, in number of pixels.

- `relativeSize`—The proportion, expressed as a percentage, of the associated region relative to the whole image.

On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`. When you are finished with this information, dispose of the pointer by calling `imaqDispose()`.

Grayscale Processing

This chapter describes the Grayscale Processing functions in IMAQ Vision for LabWindows/CVI.

Grayscale Processing Function Panels

Table 10-1 lists the Grayscale Processing functions in a tree structure. The functions in the Grayscale Processing class are grouped according to the types of operations they perform. The first-level heading in the tree is the name of the class. The second-level headings are names of function subclasses. The third-level headings are names of individual function panels. Each Grayscale Processing function panel represents one function.

Table 10-1. Grayscale Processing Function Tree

Class/Panel Name	Function Name
Grayscale Processing	
Threshold	
Automatic Threshold	imaqAutoThreshold
Magic Wand	imaqMagicWand
Multithreshold	imaqMultithreshold
Threshold	imaqThreshold
Transform	
BCG Transform	imaqBCGTransform
Equalize	imaqEqualize
Inverse	imaqInverse
Lookup	imaqLookup
Math Transform	imaqMathTransform
Spatial Filters	
Canny Edge Filter	imaqCannyEdgeFilter
Convolve	imaqConvolve
Correlate	imaqCorrelate
Edge Filter	imaqEdgeFilter
Lowpass	imaqLowpass
Median Filter	imaqMedianFilter
Nth Order Filter	imaqNthOrderFilter
Morphology	
Gray Morphology	imaqGrayMorphology

Subclass Descriptions

Grayscale Processing functions enhance grayscale images for viewing or further processing. These functions usually modify the pixel values of the images they enhance. Grayscale Processing subclass descriptions are as follows:

- Threshold functions allow you to convert a grayscale image to a binary image.
- Transform functions allow you to replace each pixel in an image using a transfer function.
- Spatial Filter functions allow you to modify an image using neighborhood functions.
- Morphology functions allow you to apply standard morphological transformations, such as dilations and erosions.

imaqAutoThreshold

Usage

```
ThresholdData* = imaqAutoThreshold(Image* dest, Image* source, int
                                   numClasses, ThresholdMethod method)
```

Purpose

Automatically thresholds an image into multiple classes.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	Image*	The image to threshold.
numClasses	int	The number of classes into which to threshold the image. Valid values range from 2 to 256.
method	ThresholdMethod	<p>The method for binary thresholding. If numClasses is 2 (a binary threshold), method specifies how to calculate the classes, as follows:</p> <p>IMAQ_THRESH_CLUSTERING IMAQ_THRESH_ENTROPY IMAQ_THRESH_METRIC IMAQ_THRESH_MOMENTS IMAQ_THRESH_INTERCLASS</p> <p>If numClasses is not 2, the function ignores this parameter. For a description of how each method works, see the <i>IMAQ Vision User Manual</i>.</p>

Return Value

ThresholdData*—On success, this function returns an array of structures providing information about the threshold ranges that the function applied. The array contains a number of **ThresholdData** structures equal to **numClasses**. Each **ThresholdData** element in the array contains the following fields:

- **rangeMin**—The lower boundary of the range to keep.
- **rangeMax**—The upper boundary of the range to keep.

- `useNewValue`—If TRUE, the function sets pixel values within `[rangeMin, rangeMax]` to the value specified in `newValue`.
- `newValue`—The replacement value for pixels within the range.

On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`. When you are finished with the array, dispose of it by calling `imaqDispose()`.

imaqBCGTransform

Usage

```
int = imaqBCGTransform(Image* dest, const Image* source, const BCGOptions*
                      options, const Image* mask)
```

Purpose

Applies brightness, contrast, and gamma correction to an image by computing and applying a lookup table. The function computes the lookup table based on the values in BCGOptions.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The image to transform.
options	const BCGOptions*	The parameters to use in the transform. This parameter is required and cannot be NULL.
mask	const Image*	An optional mask image. This image must be an IMAQ_IMAGE_U8 image. The function applies the transform to only those source pixels whose corresponding mask pixels are non-zero. All other pixel remain unchanged. Set this parameter to NULL to apply the transform to the whole source image.

Parameter Description

options—A BCGOptions structure contains the following elements:

- **brightness**—Adjusts the brightness of the image. A value of 128 leaves the brightness unchanged. Values below 128 darken the image, and values above 128 brighten the image.
- **contrast**—Adjusts the contrast of the image. A value of 45 leaves the contrast unchanged. Values below 45 decrease the contrast, and values above 45 increase the contrast.
- **gamma**—Performs gamma correction. A value of 1.0 leaves the image unchanged. Values below 1.0 enhance contrast for darker pixel at the expense of the brighter pixels. Values above 1.0 enhance contrast for brighter pixels at the expense of darker pixels.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqCannyEdgeFilter

Usage

```
int = imaqCannyEdgeFilter(Image* dest, const Image* source, const
                          CannyOptions* options)
```

Purpose

Outlines edges in an image using the Canny algorithm, which is well-suited to images with poor signal-to-noise ratios.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The image whose edges the function outlines.
options	const CannyOptions*	A description of filter parameters to use in the algorithm.

Parameter Discussion

options—A `CannyOptions` structure contains the following elements:

- `sigma`—The sigma of the Gaussian smoothing filter that the function applies to the image before edge detection.
- `upperThreshold`—The upper fraction of pixel values in the image from which the function chooses a seed or starting point of an edge segment. This value must be between 0 and 1.
- `lowerThreshold`—The function multiplies this value by `upperThreshold` to determine the lower threshold for all the pixels in an edge segment.
- `windowSize`—The window size of the Gaussian filter that the function applies to the image. This value must be odd.

Set the **options** parameter to `NULL` to use the default options, as follows:

- `sigma`—1.00
- `upperThreshold`—0.70
- `lowerThreshold`—0.20
- `windowSize`—9

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqConvolve

Usage

```
int = imaqConvolve(Image* dest, Image* source, const float* kernel, int
                  matrixRows, int matrixCols, float normalize,
                  const Image* mask)
```

Purpose

Applies a linear filter to an image by convolving the image with a filtering kernel. The convolution kernel must have an odd width and height.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	Image*	The image to filter. This function modifies the border of the source image. The border must be at least half as large as the larger dimension of the kernel.
kernel	const float*	The matrix representing the linear filter. This parameter is required and cannot be NULL.
matrixRows	int	The number of rows in the kernel matrix. This number must be odd.
matrixCols	int	The number of columns in the kernel matrix. This number must be odd.
normalize	float	The normalization factor. After performing the convolution, the function divides each pixel value by this value. Set this parameter to 0 to divide by the sum of the elements of the kernel.
mask	const Image*	An optional mask image. This image must be an IMAQ_IMAGE_U8 image. The function filters only those pixels in the source image whose corresponding pixels in the mask are non-zero. Set this parameter to NULL to filter the entire image.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqCorrelate

Usage

```
int = imaqCorrelate(Image* dest, Image* source, const Image* templateImage,
                   Rect rect)
```

Purpose

Computes the normalized cross-correlation between a source image and a template image. This operation is time-intensive. To reduce the correlation time, use a small template, reduce the search area by using the area rectangle, and make the template image width a multiple of 4.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	Image*	The source image. The correlation modifies the border of the source image. The border must be at least half as large as the larger dimension of the template image.
templateImage	const Image*	The template image to correlate against the source.
rect	Rect	The area of the source image on which to perform the correlation. Set this parameter to IMAQ_NO_RECT to perform the correlation on the whole source image.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqEdgeFilter

Usage

```
int = imaqEdgeFilter(Image* dest, Image* source, OutlineMethod method, const
                    Image* mask)
```

Purpose

Applies a nonlinear filter to highlight edges.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	Image*	The image of which the function highlights edges. The convolution modifies the border of the source image. The border must be at least one pixel wide.
method	OutlineMethod	Method to use when outlining the edges. The following options are valid: IMAQ_EDGE_DIFFERENCE IMAQ_EDGE_GRADIENT IMAQ_EDGE_PREWITT IMAQ_EDGE_ROBERTS IMAQ_EDGE_SIGMA IMAQ_EDGE_SOBEL For more information about filtering, see the <i>IMAQ Vision User Manual</i> .
mask	const Image*	An optional mask image. This image must be an IMAQ_IMAGE_U8 image. The function filters only those pixels in the source image whose corresponding pixels in the mask are non-zero. Set this parameter to NULL to filter the whole source image.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqEqualize

Usage

```
int = imaqEqualize(Image* dest, const Image* source, float min, float max,
                  const Image* mask)
```

Purpose

Calculates the histogram of an image and redistributes pixel values across the desired range to maintain the same pixel value distribution. Pixels whose values are the same before the redistribution also have common pixel values after the redistribution.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The source image.
min	float	The minimum value of the range to which the function equalizes the image.
max	float	The maximum value of the range to which the function equalizes the image.
mask	const Image*	An optional mask image. This image must be an IMAQ_IMAGE_U8 image. The function equalizes only those pixels in the source image whose corresponding pixels in the mask are non-zero. Set this parameter to NULL to equalize the whole image.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGrayMorphology

Usage

```
int = imaqGrayMorphology(Image* dest, Image* source, MorphologyMethod
                        method, const StructuringElement*
                        structuringElement)
```

Purpose

Applies morphological transformations to gray level images.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	Image*	The image on which the function performs the morphological operation. The calculation modifies the border of the source image. The border must be at least half as large as the larger of the dimensions of the structuring element.
method	MorphologyMethod	The morphological transformation to apply. For more information about morphological transformations, see the <i>IMAQ Vision User Manual</i> .
structuringElement	const StructuringElement*	The structuring element that the function uses in the operation. Set this parameter to NULL if you do not want a custom structuring element. For more information about structuring elements, see Chapter 1, <i>Basic Concepts</i> , or see the <i>IMAQ Vision User Manual</i> .

Parameter Discussion

method—The following options are valid: IMAQ_AUTOM, IMAQ_CLOSE, IMAQ_DILATE, IMAQ_ERODE, IMAQ_GRADIENT, IMAQ_GRADIENTOUT, IMAQ_GRADIENTIN, IMAQ_HITMISS, IMAQ_OPEN, IMAQ_PCLOSE, IMAQ_POPEN, IMAQ_THICK, IMAQ_THIN.

structuringElement—The following fields are valid:

- `matrixCols`—Number of columns in the matrix.
- `matrixRows`—Number of rows in the matrix.
- `hexa`—Set this field to TRUE if you specify a hexagonal structuring element in `kernel`. Set this field to FALSE if you specify a square structuring element in `kernel`.
- `kernel`—The values of the structuring element. Specify these values in order from the top-left of the kernel to the bottom-right of the kernel. For example, to set up the 3×3 kernel.

-1	0	1
-1	0	1
-1	0	1

called `myStructuringElement`, use the following syntax:

```
myStructuringElement.matrixCols = 3
myStructuringElement.matrixRows = 3
myStructuringElement.hexa = FALSE
myStructuringElement.kernel = malloc(9 * sizeof(int))
myStructuringElement.kernel[0] = -1
myStructuringElement.kernel[1] = 0
myStructuringElement.kernel[2] = 1
myStructuringElement.kernel[3] = -1
myStructuringElement.kernel[4] = 0
myStructuringElement.kernel[5] = 1
myStructuringElement.kernel[6] = -1
myStructuringElement.kernel[7] = 0
myStructuringElement.kernel[8] = 1
```

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imgaGetLastError()`.

imaqInverse

Usage

```
int = imaqInverse(Image* dest, const Image* source, const Image* mask)
```

Purpose

Inverts the pixel intensities of an image using the following equation:

$$f(p) = \text{dynamicMax} - p + \text{dynamicMin}$$

where p represents the value of a pixel.

dynamicMin represents 0 (8-bit images) or the smallest pixel value in the source image (16-bit and floating point images).

dynamicMax represents 255 (8-bit images) or the largest pixel value in the source image (16-bit and floating point images).

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The image to invert.
mask	const Image*	An optional mask image. This image must be an IMAQ_IMAGE_U8 image. The function inverts only those pixels in the source image whose corresponding pixels in the mask are non-zero. Set this parameter to NULL to invert the pixel intensities of the entire source image.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqLookup

Usage

```
int = imaqLookup(Image* dest, const Image* source, const short* table, const
                Image* mask)
```

Purpose

Performs a transformation on an image by replacing each pixel value with the lookup table entry corresponding to that value.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The source image.
table	const short*	The lookup table. For 8-bit images, the lookup table must contain 256 elements. The function replaces each pixel value <i>v</i> with <code>table[v]</code> . For 16-bit images, the lookup table must contain 65,536 elements. The function replaces each non-negative pixel value <i>v</i> with <code>table[v]</code> and replaces each negative pixel value <i>v</i> with <code>table[65536+v]</code> .
mask	const Image*	An optional mask image. This image must be an IMAQ_IMAGE_U8 image. The function applies the lookup only to those source pixels whose corresponding mask pixels are non-zero. All other pixels remain unchanged. Set this parameter to NULL to apply the lookup to the entire source image.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqLowpass

Usage

```
int = imaqLowpass(Image* dest, Image* source, int width, int height, float
                 tolerance, const Image* mask)
```

Purpose

Filters an image using a non-linear filter. For each pixel, the algorithm considers the neighborhood specified by the given filter sizes. If the current pixel value varies from the value of its neighbors more than the specified tolerance, the function sets the pixel value to the average value of its neighborhood. If the current pixel value varies from the value of its neighbors less than the specified tolerance, the function does not change the value of the pixel.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	Image*	The image to filter. The filter modifies the border of the source image. The border must be at least half as large as the larger of the neighborhood dimensions.
width	int	The width of the rectangular neighborhood around the pixel on which the function operates. This number must be odd.
height	int	The height of the rectangular neighborhood around the pixel on which the function operates. This number must be odd.
tolerance	float	The maximum allowable variance.
mask	const Image*	An optional mask image. This image must be an IMAQ_IMAGE_U8 image. The function filters only those pixels in the source image whose corresponding pixels in the mask are non-zero. Set this parameter to NULL to apply the filter to the entire source image.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqMagicWand

Usage

```
int = imaqMagicWand(Image* dest, const Image* source, Point coord, float
                    tolerance, int connectivity8, float replaceValue)
```

Purpose

Creates a mask of a particle in an image by selecting a particle at the given location and setting all the pixels of that particle to a specified value. The function sets all other pixel values to 0.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
dest	Image*	On return, the mask image. This image must be an IMAQ_IMAGE_U8 image.
source	const Image*	The source image containing the particle to mask.
coord	Point	The coordinates of the reference point in the particle to mask.
tolerance	float	Specifies the pixel value tolerance that the function uses to determine whether neighbors of the reference point are part of the particle.
connectivity8	int	Set this parameter to TRUE to use connectivity-8 to determine whether pixels are part of the same particle. Set this parameter to FALSE to use connectivity-4 to determine whether pixels are part of the same particle. For more information about connectivity, see Chapter 1, <i>Basic Concepts</i> , or see the <i>IMAQ Vision User Manual</i> .
replaceValue	float	The value to which the function sets pixels in the selected particle. The function sets pixels not in the particle to 0.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqMathTransform

Usage

```
int = imaqMathTransform(Image* dest, const Image* source,
                        MathTransformMethod method, float rangeMin, float
                        rangeMax, float power, const Image* mask)
```

Purpose

Transforms an image by applying a transfer function to the value of each pixel. The function applies the transform $T(x)$ over a specified input range [rangeMin, rangeMax] in the following manner:

$$T(x) = \begin{cases} \text{dynamicMin} & \text{if } x \leq \text{rangeMin} \\ f(x) & \text{if } \text{rangeMin} < x \leq \text{rangeMax} \\ \text{dynamicMax} & \text{if } x > \text{rangeMax} \end{cases}$$

where dynamicMin = 0 (8-bit images) or the smallest initial pixel value (16-bit and floating point images)

dynamicMax = 255 (8-bit images) or the largest initial pixel value (16-bit and floating point images)

dynamicRange = dynamicMax – dynamicMin

The function scales $f(x)$ so that $f(\text{rangeMin}) = \text{dynamicMin}$ and $f(\text{rangeMax}) = \text{dynamicMax}$. $f(x)$ behaves on (rangeMin, rangeMax) according to the method you select.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The source image.
method	MathTransformMethod	The transform function to use.
rangeMin	float	The smallest pixel value on which the function applies the transform.

Name	Type	Description
rangeMax	float	The largest pixel value on which the function applies the transform.
power	float	If you set method to <code>IMAQ_TRANSFORM_POWX</code> or <code>IMAQ_TRANSFORM_POW1X</code> , power specifies the power to which the function raises the value.
mask	const Image*	An optional mask. This image must be an <code>IMAQ_IMAGE_U8</code> image. The function transforms only those source pixels whose corresponding mask pixels are non-zero. All other pixels remain unchanged. Set this parameter to <code>NULL</code> to apply the transform to the entire source image.

Parameter Discussion

method—The following options are valid:

- `IMAQ_TRANSFORM_LINEAR`—Linear remapping.
- `IMAQ_TRANSFORM_LOG`—Logarithmic remapping. Enhances contrast for small pixel values and reduces contrast for large pixel values.
- `IMAQ_TRANSFORM_EXP`—Exponential remapping. Enhances contrast for large pixel values and reduces contrast for small pixel values.
- `IMAQ_TRANSFORM_SQR`—Square remapping. Similar to exponential remapping but with a more gradual effect.
- `IMAQ_TRANSFORM_SQRT`—Square root remapping. Similar to logarithmic remapping but with a more gradual effect.
- `IMAQ_TRANSFORM_POWX`—Power X remapping. Causes variable effect depending on `power`.
- `IMAQ_TRANSFORM_POW1X`—Power 1/X remapping. Causes variable effect depending on `power`.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqMedianFilter

Usage

```
int = imaqMedianFilter(Image* dest, Image* source, int width, int height,
                      const Image* mask)
```

Purpose

Filters an image using a non-linear filter. For each pixel, the algorithm takes the neighborhood specified by the given filter sizes and replaces the pixel with the median value of the neighborhood.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	Image*	The image to filter. The filter modifies the border of the source image. The border must be at least half as large as the larger of the neighborhood dimensions.
width	int	The width of the rectangular neighborhood around the pixel on which the function operates. This number must be odd.
height	int	The height of the rectangular neighborhood around the pixel on which the function operates. This number must be odd.
mask	const Image*	An optional mask. This image must be an IMAQ_IMAGE_U8 image. The function filters only those source pixels whose corresponding mask pixels are non-zero. Set this parameter to NULL to apply the filter to the entire source image.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqMultithreshold

Usage

```
int = imaqMultithreshold(Image* dest, const Image* source, const
                        ThresholdData* ranges, int numRanges)
```

Purpose

Thresholds an image into multiple classes. The function classifies each pixel into the first threshold range of which it is a member. If a pixel is not a member of any of the given ranges, the function sets it to 0. For example, given two threshold ranges:

rangeMin	rangeMax	useNewValue	newValue
80	150	TRUE	10
120	200	FALSE	<ignored>

The function operates as follows:

- The function replaces pixel values below 80 with 0.
- The function replaces pixel values from 80 to 150 with 10.
- The function does not change pixel values from 151 to 200.
- The function replaces pixel values above 200 with 0.

For more information on thresholding, see `imaqThreshold()`.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The source image.
ranges	const ThresholdData*	An array of threshold data. This array is required and cannot be NULL.
numRanges	int	The number of elements in the <code>ranges</code> array.

Parameter Discussion

ranges—Each element in the **ranges** array is a structure with the following fields:

- **rangeMin**—The lower boundary of the range of pixel values to keep.
- **rangeMax**—The upper boundary of the range of pixel values to keep.
- **useNewValue**—Set this field to **TRUE** to set the pixel values within `[rangeMin, rangeMax]` to the value specified in **newValue**. Set this field to **FALSE** to leave the pixel values unchanged.
- **newValue**—If you set **useNewValue** to **TRUE**, **newValue** is the replacement value for pixels within the range. If you set **useNewField** to **FALSE**, the function ignores this field.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqNthOrderFilter

Usage

```
int = imaqNthOrderFilter(Image* dest, Image* source, int width, int height,
                        int n, const Image* mask)
```

Purpose

Filters an image using a non-linear filter. For each pixel, the algorithm takes the neighborhood specified by the given filter sizes and replaces the pixel with the *n*th smallest value in the neighborhood.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	Image*	The image to filter. The filter modifies the border of the source image. The border must be at least half as large as the larger of the neighborhood dimensions.
width	int	The width of the rectangular neighborhood around the pixel on which the function operates. This number must be odd.
height	int	The height of the rectangular neighborhood around the pixel on which the function operates. This number must be odd.
n	int	Specifies which value in the neighborhood to place in the destination. Set n to 0 to select the smallest value in the neighborhood, set n to 1 to select the next smallest value, and so on.
mask	const Image*	An optional image mask. This image must be an IMAQ_IMAGE_U8 image. The function filters only those pixels in the source image whose corresponding pixels in the mask are non-zero. Set this parameter to NULL to filter the entire source image.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqThreshold

Usage

```
int = imaqThreshold(Image* dest, const Image* source, float rangeMin, float
                    rangeMax, int useNewValue, float newValue)
```

Purpose

Thresholds an image. The function sets pixels values outside of the given range to 0. The function sets pixel values within the range to a given value or leaves the values unchanged.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The source image.
rangeMin	float	The lower boundary of the range of pixel values to keep.
rangeMax	float	The upper boundary of the range of pixel values to keep.
useNewValue	int	Set this parameter to TRUE to set the pixel values within [rangeMin , rangeMax] to the value specified in newValue . Set this field to FALSE to leave the pixel values unchanged.
newValue	float	If you set useNewValue to TRUE, newValue is the replacement value for pixels within the range. If you set useNewValue to FALSE, the function ignores this parameter.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

Binary Processing

This chapter describes the Binary Processing functions in IMAQ Vision for LabWindows/CVI. Use Binary Processing functions on binary and labeled images for applications in which the size, number, or shape of the objects in the image are important. Binary images have only two pixel values, unless you label the image.



Note Apply a threshold to a grayscale image to make an image binary. For more information about thresholding an image, see `imaqThreshold()` in Chapter 10, *Grayscale Processing*.

Binary Processing Function Panels

Table 11-1 lists the Binary Processing functions in a tree structure. The functions in the Binary Processing class are grouped according to the types of operations they perform. The first-level heading in the tree is the name of the class. The second-level headings are names of function subclasses. The third-level headings are names of individual function panels. Each Binary Processing function panel represents one function.

Table 11-1. Binary Processing Function Tree

Class/Panel Name	Function Name
Binary Processing	
Morphology	
Circles	<code>imaqCircles</code>
Convex	<code>imaqConvex</code>
Danielsson Distance	<code>imaqDanielssonDistance</code>
Fill Holes	<code>imaqFillHoles</code>
Label	<code>imaqLabel</code>
Morphology	<code>imaqMorphology</code>
Reject Border	<code>imaqRejectBorder</code>
Segmentation	<code>imaqSegmentation</code>
Separation	<code>imaqSeparation</code>
Simple Distance	<code>imaqSimpleDistance</code>
Size Filter	<code>imaqSizeFilter</code>
Skeleton	<code>imaqSkeleton</code>
Shape Matching	
Match Shape	<code>imaqMatchShape</code>

Table 11-1. Binary Processing Function Tree (Continued)

Blob Analysis	
Calculate Coefficient	<code>imaqCalcCoeff</code>
Get Particle Information	<code>imaqGetParticleInfo</code>
Particle Filter	<code>imaqParticleFilter</code>
Select Particles	<code>imaqSelectParticles</code>

Subclass Descriptions

Binary Processing subclass descriptions are as follows:

- Morphology functions allow you to apply standard morphological transformations. For a description of many of these transformations, see the *IMAQ Vision User Manual*.
- Shape Matching functions allow you to find shapes in an image.
- Blob Analysis functions allow you to calculate information about particles (or blobs) in an image and select particles using the information.

imaqCalcCoeff

Usage

```
int = imaqCalcCoeff(const Image* image, const ParticleReport* report,
                   MeasurementValue parameter, float* coefficient)
```

Purpose

Returns a coefficient associated with a particle. Call `imaqGetParticleInfo()` before calling `imaqCalcCoeff()` to get the particle reports you need to pass to this function.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
image	const Image*	The image containing the particle.
report	const ParticleReport*	The particle report you want to use to calculate the coefficient. You must generate this report using <code>imaqGetParticleInfo()</code> with the mode parameter set to <code>IMAQ_ALL_INFO</code> . This parameter is required and cannot be NULL.
parameter	MeasurementValue	The coefficient to calculate.
coefficient	float*	On return, the coefficient you request. This parameter is required and cannot be NULL.

Parameter Discussion

parameter—The following options are valid:

- `IMAQ_AREA`—Surface area of the particle in pixels.
- `IMAQ_AREA_CALIBRATED`—Surface area of the particle in calibrated units.
- `IMAQ_NUM_HOLES`—Number of holes in the particle.
- `IMAQ_AREA_OF_HOLES`—Surface area of the holes in calibrated units.
- `IMAQ_TOTAL_AREA`—Total surface area (holes and particle) in calibrated units.
- `IMAQ_IMAGE_AREA`—Surface area of the entire image in calibrated units.
- `IMAQ_TOTAL_TO_IMAGE`—Ratio, expressed as a percent, of the total surface area (holes and particle) in relation to the image.

- `IMAQ_PARTICLE_TO_IMAGE`—Ratio, expressed as a percent, of the surface area of a particle in relation to the image area.
- `IMAQ_CENTER_MASS_X`—X-coordinate of the center of gravity.
- `IMAQ_CENTER_MASS_Y`—Y-coordinate of the center of gravity.
- `IMAQ_LEFT_COLUMN`—Left edge of the bounding rectangle.
- `IMAQ_TOP_ROW`—Top edge of the bounding rectangle.
- `IMAQ_RIGHT_COLUMN`—Right edge of the bounding rectangle.
- `IMAQ_BOTTOM_ROW`—Bottom edge of the bounding rectangle.
- `IMAQ_WIDTH`—Width of bounding rectangle in calibrated units.
- `IMAQ_HEIGHT`—Height of bounding rectangle in calibrated units.
- `IMAQ_MAX_SEGMENT_LENGTH`—Length of longest horizontal line segment.
- `IMAQ_MAX_SEGMENT_LEFT_COLUMN`—Leftmost x-coordinate of longest horizontal line segment.
- `IMAQ_MAX_SEGMENT_TOP_ROW`—Y-coordinate of longest horizontal line segment.
- `IMAQ_PERIMETER`—Outer perimeter of the particle.
- `IMAQ_PERIMETER_OF_HOLES`—Perimeter of all holes within the particle.
- `IMAQ_SIGMA_X`—Sum of the particle pixels on the x-axis.
- `IMAQ_SIGMA_Y`—Sum of the particle pixels on the y-axis.
- `IMAQ_SIGMA_XX`—Sum of the particle pixels on the x-axis squared.
- `IMAQ_SIGMA_YY`—Sum of the particle pixels on the y-axis squared.
- `IMAQ_SIGMA_XY`—Sum of the particle pixels on the x-axis and y-axis.
- `IMAQ_PROJ_X`—Projection corrected in X.
- `IMAQ_PROJ_Y`—Projection corrected in Y.
- `IMAQ_INERTIA_XX`—Inertia matrix coefficient in XX.
- `IMAQ_INERTIA_YY`—Inertia matrix coefficient in YY.
- `IMAQ_INERTIA_XY`—Inertia matrix coefficient in XY.
- `IMAQ_MEAN_H`—Mean length of horizontal segments.
- `IMAQ_MEAN_V`—Mean length of vertical segments.
- `IMAQ_MAX_INTERCEPT`—Length of longest segment of the convex hull.
- `IMAQ_MEAN_INTERCEPT`—Mean length of the chords in a particle perpendicular to its max intercept.
- `IMAQ_ORIENTATION`—Direction of the longest segment.
- `IMAQ_EQUIV_ELLIPSE_MINOR`—Total length of the axis of the ellipse having the same area as the particle and a major axis equal to half the max intercept.

- `IMAQ_ELLIPSE_MAJOR`—Total length of the major axis having the same area and perimeter as the particle in calibrated units.
- `IMAQ_ELLIPSE_MINOR`—Total length of the minor axis having the same area and perimeter as the particle in calibrated units.
- `IMAQ_ELLIPSE_RATIO`—Fraction of the major axis to the minor axis.
- `IMAQ_RECT_LONG_SIDE`—Length of the long side of a rectangle having the same area and perimeter as the particle in calibrated units.
- `IMAQ_RECT_SHORT_SIDE`—Length of the short side of a rectangle having the same area and perimeter as the particle in calibrated units.
- `IMAQ_RECT_RATIO`—Ratio of rectangle long side to rectangle short side.
- `IMAQ_ELONGATION`—Max intercept/mean perpendicular intercept.
- `IMAQ_COMPACTNESS`—Particle area/(height × width).
- `IMAQ_HEYWOOD`—Particle perimeter/perimeter of the circle having the same area as the particle.
- `IMAQ_TYPE_FACTOR`—A complex factor relating the surface area to the moment of inertia.
- `IMAQ_HYDRAULIC`—Particle area/particle perimeter.
- `IMAQ_WADDLE_DISK`—Diameter of the disk having the same area as the particle in user units.
- `IMAQ_DIAGONAL`—Diagonal of an equivalent rectangle in user units.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqCircles

Usage

```
CircleReport* = imaqCircles(Image* dest, const Image* source, float
                           minRadius, float maxRadius, int* numCircles)
```

Purpose

Separates overlapping circular objects and classifies them depending on their radii. This function also draws the detected circles into the destination image.

Image Types Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
dest	Image*	On return, an image containing circles that the function located.
source	const Image*	The image in which the function finds circles.
minRadius	float	The smallest radius (in pixels) to be detected. Circles with radii smaller than this value do not appear in the destination image. These circles are in the returned report array, but the function reports their radii as negative.
maxRadius	float	The largest radius (in pixels) to be detected. Circles with radii larger than this value do not appear in the destination image. These circles are in the returned report array, but the function reports their radii as negative.
numCircles	int*	On return, the number of circles that the function detected in the image. If any circles fall outside the radius range, numCircles will be greater than the number of circles that the function draws in the destination image. Set this parameter to NULL if you do not need this information.

Return Value

CircleReport*—On success, this function returns an array of structures containing information about each of the found circles. Each `CircleReport` structure consists of the following elements:

- `center`—The coordinate point of the center of the circle.
- `radius`—The radius of the circle, in pixels. If the radius of the circle is not within the given range, this value is negative.
- `area`—The area of the circle, in pixels.

On failure, this function returns `NULL`. To get extended error information, call `imaqGetLastError()`. When you are finished with the array, dispose of it by calling `imaqDispose()`.

imaqConvex

Usage

```
int = imaqConvex(Image* dest, const Image* source)
```

Purpose

Computes the convex envelope for each labeled particle in the source image. If the source image contains more than one particle, you must label each particle with `imaqLabel()` before calling this function.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The image containing the labeled particles whose convex envelopes the function calculates.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqDanielssonDistance

Usage

```
int = imaqDanielssonDistance(Image* dest, Image* source)
```

Purpose

Creates a very accurate distance map based on the Danielsson distance algorithm. The function encodes the pixel value of a particle as a function of the distance of the pixel from the particle perimeter. For a faster but less precise algorithm, use `imaqSimpleDistance()`.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	Image*	The image that the function uses to compute the distance map. The function modifies the border of the source image. The border must be at least one pixel wide.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqFillHoles

Usage

```
int = imaqFillHoles(Image* dest, const Image* source, int connectivity8)
```

Purpose

Fills holes in particles. The function fills the holes with a pixel value of 1. The function does not fill areas touching the edge of the image that appear to be holes because these areas could be either holes or areas of concavity.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The image containing particles with holes.
connectivity8	int	Set this parameter to TRUE to use connectivity-8 to determine whether particles are touching. Set this parameter to FALSE to use connectivity-4 to determine whether particles are touching. For more information about connectivity, see Chapter 1, <i>Basic Concepts</i> , or see the <i>IMAQ Vision User Manual</i> .

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetParticleInfo

Usage

```
ParticleReport* = imaqGetParticleInfo(Image* image, int connectivity8,
                                     ParticleInfoMode mode, int* reportCount)
```

Purpose

Calculates various measurements of particles in a binary image.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
image	Image*	The binary image containing particles on which the function gets particle information. The calculation modifies the border of the image.
connectivity8	int	Set this parameter to TRUE to use connectivity-8 to determine whether particles are touching. Set this parameter to FALSE to use connectivity-4 to determine whether particles are touching. For more information about connectivity, see Chapter 1, <i>Basic Concepts</i> , or see the <i>IMAQ Vision User Manual</i> .
mode	ParticleInfoMode	Controls the extent of particle information that the function returns. Set this parameter to IMAQ_ALL_INFO to return all the information about each particle. Set this parameter to IMAQ_BASIC_INFO to get faster results by filling in only the following elements of each report: area, calibratedArea, boundingRect.
reportCount	int*	On return, filled with the number of reports in the array returned by the function. Set this parameter to NULL if you do not need this information.

Return Value

ParticleReport*—On success, this function returns a pointer to an array of reports about the particles in the image. Each report consists of the following elements:

- `area`—The number of pixels in the particle.
- `calibratedArea`—The size of the particle, calibrated to the calibration information of the image.
- `perimeter`—The length of the perimeter, calibrated to the calibration information of the image.
- `numHoles`—The number of holes in the particle.
- `areaOfHoles`—The total surface area, in pixels, of all the holes in a particle.
- `perimeterOfHoles`—The length of the perimeter of all the holes in the particle calibrated to the calibration information of the image.
- `boundingRect`—The smallest rectangle that encloses the particle.
- `sigmaX`—The sum of the particle pixels on the x-axis.
- `sigmaY`—The sum of the particle pixels on the y-axis.
- `sigmaXX`—The sum of the particle pixels on the x-axis squared.
- `sigmaYY`—The sum of the particle pixels on the y-axis squared.
- `sigmaXY`—The sum of the particle pixels on the x-axis and y-axis.
- `longestLength`—The length, in pixels, of the longest segment in the convex hull of the particle.
- `longestPoint`—The location of the leftmost pixel of the longest segment in the particle.
- `projectionX`—Equals half of the sum of the horizontal segments in a particle that do not overlap another adjacent horizontal segment.
- `projectionY`—Equals half of the sum of the vertical segments in a particle that do not overlap another adjacent vertical segment.

On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`. When you are finished with this data, dispose of the array by calling `imaqDispose()`.

imaqLabel

Usage

```
int = imaqLabel(Image* dest, Image* source, int connectivity8, int*
                particleCount)
```

Purpose

Labels the particles in a binary image by applying a unique value to all pixels within a particle. This value is encoded in 8 or 16 bits, depending on the image type. The function can label 255 particles in an 8-bit image and 65,535 particles in a 16-bit image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	Image*	The source image. The labeling process modifies the border of the source image. The border must be at least one pixel wide if you use connectivity-4 or two pixels wide if you use connectivity-8.
connectivity8	int	Set this parameter to TRUE to use connectivity-8 to determine whether particles are touching. Set this parameter to FALSE to use connectivity-4 to determine whether particles are touching. For more information about connectivity, see Chapter 1, <i>Basic Concepts</i> , or see the <i>IMAQ Vision User Manual</i> .
particleCount	int*	On return, the number of particles that the function found. Set this parameter to NULL if you do not need this information.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqMatchShape

Usage

```
ShapeReport* = imaqMatchShape(Image* dest, const Image* source, const Image*
                             templateImage, int scaleInvariant, int
                             connectivity8, double tolerance, int* numMatches)
```

Purpose

Finds a shape in an image. In most cases, use `imaqMatchPattern()` instead of this function. For information about when to use this function, see the *IMAQ Vision User Manual*.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
dest	Image*	On return, the objects in the source image that match the object in the template image.
source	const Image*	The image in which the function searches for shapes.
templateImage	const Image*	The image containing the shape to find.
scaleInvariant	int	Set this parameter to TRUE to search for shapes regardless of size. Set this parameter to FALSE to search for shapes that are $\pm 10\%$ the same size as the template shape.
connectivity8	int	Set this parameter to TRUE to use connectivity-8 to determine whether particles are touching. Set this parameter to FALSE to use connectivity-4 to determine whether particles are touching. For more information about connectivity, see Chapter 1, <i>Basic Concepts</i> , or see the <i>IMAQ Vision User Manual</i> .
tolerance	double	Indicates the allowable difference between the template shape and similar shapes in the image. The difference is expressed as a value from 0 to 1.
numMatches	int*	On return, the number of matches to the template image. Set this parameter to NULL if you do not need this information.

Return Value

ShapeReport*—On success, this function returns an array of reports describing the matches to the given template shape. `ShapeReport` contains the following elements:

- `coordinates`—A `Rect` that contains the bounding rectangle of the object.
- `centroid`—A `Point` containing the coordinate location of the centroid of the object.
- `size`—The size (in pixels) of the object.
- `score`—A value ranging between 1 and 1,000 that specifies how similar the object in the image is to the template. A score of 1,000 indicates a perfect match.

On failure, this function returns `NULL`. To get extended error information, call `imaqGetLastError()`. When you are finished with the array, dispose of it by calling `imaqDispose()`.

imaqMorphology

Usage

```
int = imaqMorphology(Image* dest, Image* source, MorphologyMethod method,
                    const StructuringElement* structuringElement)
```

Purpose

Applies morphological transformations to binary images.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	Image*	The image on which the function performs the morphological operations. The calculation modifies the border of the source image. The border must be at least half as large as the larger dimension of the structuring element.
method	MorphologyMethod	The morphological transform to apply. For a description of the morphological transformations, see the <i>IMAQ Vision User Manual</i> .
structuringElement	const StructuringElement*	The structuring element used in the operation. Set this parameter to NULL if you do not want a custom structuring element. For more information on structuring elements, see Chapter 1, <i>Basic Concepts</i> , or see the <i>IMAQ Vision User Manual</i> .

Parameter Discussion

method—The following operations are valid: IMAQ_AUTOM, IMAQ_CLOSE, IMAQ_DILATE, IMAQ_ERODE, IMAQ_GRADIENT, IMAQ_GRADIENTOUT, IMAQ_GRADIENTIN, IMAQ_HITMISS, IMAQ_OPEN, IMAQ_PCLOSE, IMAQ_POPEN, IMAQ_THICK, IMAQ_THIN.

structuringElement—A `StructuringElement` consists of the following elements:

- `matrixCols`—Number of columns in the matrix.
- `matrixRows`—Number of rows in the matrix.
- `hexa`—Set this field to `TRUE` if you specify a hexagonal structuring element in `kernel`. Set this field to `FALSE` if you specify a square structuring element in `kernel`.
- `kernel`—The values of the structuring element. Specify these values in order from the top-left of the kernel to the bottom-right of the kernel. For example, to set up the 3×3 kernel.

-1	0	1
-1	0	1
-1	0	1

called `myStructuringElement`, use the following syntax:

```
myStructuringElement.matrixCols = 3
myStructuringElement.matrixRows = 3
myStructuringElement.hexa = FALSE
myStructuringElement.kernel = malloc(9 * sizeof(int))
myStructuringElement.kernel[0] = -1
myStructuringElement.kernel[1] = 0
myStructuringElement.kernel[2] = 1
myStructuringElement.kernel[3] = -1
myStructuringElement.kernel[4] = 0
myStructuringElement.kernel[5] = 1
myStructuringElement.kernel[6] = -1
myStructuringElement.kernel[7] = 0
myStructuringElement.kernel[8] = 1
```

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqParticleFilter

Usage

```
int = imaqParticleFilter(Image* dest, Image* source, const
                        ParticleFilterCriteria* criteria, int
                        criteriaCount, int keepMatches, int
                        connectivity8)
```

Purpose

Filters particles based on their morphological measurements.

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	Image*	The image on which to perform the particle filter. The calculation modifies the border of the source image. The border must be at least one pixel wide if you use connectivity-4 or two pixels wide if you use connectivity-8.
criteria	const ParticleFilterCriteria*	The array of criteria for the filter. This parameter is required and cannot be NULL.
criteriaCount	int	Specifies the number of entries in the criteria array.
keepMatches	int	Set this parameter to TRUE to transfer only those particles that meet all the criteria to the destination. Set this parameter to FALSE to transfer only those particles that do not meet all the criteria.
connectivity8	int	Set this parameter to TRUE to use connectivity-8 to determine whether particles are touching. Set this parameter to FALSE to use connectivity-4 to determine whether particles are touching. For more information about connectivity, see Chapter 1, <i>Basic Concepts</i> , or see the <i>IMAQ Vision User Manual</i> .

Parameter Discussion

criteria—Each element in a `criteria` array consists of the following:

- `parameter`—The morphological measurement that the function uses for filtering. The following measurements are valid:
 - `IMAQ_AREA`—Surface area of the particle in pixels.
 - `IMAQ_AREA_CALIBRATED`—Surface area of the particle in calibrated units.
 - `IMAQ_NUM_HOLES`—Number of holes in the particle.
 - `IMAQ_AREA_OF_HOLES`—Surface area of the holes in calibrated units.
 - `IMAQ_TOTAL_AREA`—Total surface area (holes and particle) in calibrated units.
 - `IMAQ_IMAGE_AREA`—Surface area of the entire image in calibrated units.
 - `IMAQ_TOTAL_TO_IMAGE`—Ratio, expressed as a percent, of the total surface area (holes and particle) in relation to the image area.
 - `IMAQ_PARTICLE_TO_IMAGE`—Ratio, expressed as a percent, of the surface area of a particle in relation to the image area.
 - `IMAQ_CENTER_MASS_X`—X-coordinate of the center of gravity.
 - `IMAQ_CENTER_MASS_Y`—Y-coordinate of the center of gravity.
 - `IMAQ_LEFT_COLUMN`—Left edge of the bounding rectangle.
 - `IMAQ_TOP_ROW`—Top edge of the bounding rectangle.
 - `IMAQ_RIGHT_COLUMN`—Right edge of the bounding rectangle.
 - `IMAQ_BOTTOM_ROW`—Bottom edge of bounding rectangle.
 - `IMAQ_WIDTH`—Width of bounding rectangle in calibrated units.
 - `IMAQ_HEIGHT`—Height of bounding rectangle in calibrated units.
 - `IMAQ_MAX_SEGMENT_LENGTH`—Length of longest horizontal line segment.
 - `IMAQ_MAX_SEGMENT_LEFT_COLUMN`—Leftmost x-coordinate of longest horizontal line segment.
 - `IMAQ_MAX_SEGMENT_TOP_ROW`—Y-coordinate of longest horizontal line segment.
 - `IMAQ_PERIMETER`—Outer perimeter of the particle.
 - `IMAQ_PERIMETER_OF_HOLES`—Perimeter of all holes within the particle.
 - `IMAQ_SIGMA_X`—Sum of the particle pixels on the x-axis.
 - `IMAQ_SIGMA_Y`—Sum of the particle pixels on the y-axis.
 - `IMAQ_SIGMA_XX`—Sum of the particle pixels on the x-axis squared.
 - `IMAQ_SIGMA_YY`—Sum of the particle pixels on the y-axis squared.
 - `IMAQ_SIGMA_XY`—Sum of the particle pixels on the x-axis and y-axis.
 - `IMAQ_PROJ_X`—Projection corrected in X.

- IMAQ_PROJ_Y—Projection corrected in Y.
- IMAQ_INERTIA_XX—Inertia matrix coefficient in XX.
- IMAQ_INERTIA_YY—Inertia matrix coefficient in YY.
- IMAQ_INERTIA_XY—Inertia matrix coefficient in XY.
- IMAQ_MEAN_H—Mean length of horizontal segments.
- IMAQ_MEAN_V—Mean length of vertical segments.
- IMAQ_MAX_INTERCEPT—Length of longest segment of the convex hull.
- IMAQ_MEAN_INTERCEPT—Mean length of the chords in an object perpendicular to its max intercept.
- IMAQ_ORIENTATION—Direction of the longest segment.
- IMAQ_EQUIV_ELLIPSE_MINOR—Total length of the axis of the ellipse having the same area as the particle and a major axis equal to half the max intercept.
- IMAQ_ELLIPSE_MAJOR—Total length of major axis having the same area and perimeter as the particle in calibrated units.
- IMAQ_ELLIPSE_MINOR—Total length of minor axis having the same area and perimeter as the particle in calibrated units.
- IMAQ_ELLIPSE_RATIO—Fraction of major axis to minor axis.
- IMAQ_RECT_LONG_SIDE—Length of the long side of a rectangle having the same area and perimeter as the particle in calibrated units.
- IMAQ_RECT_SHORT_SIDE—Length of the short side of a rectangle having the same area and perimeter as the particle in calibrated units.
- IMAQ_RECT_RATIO—Ratio of rectangle long side to rectangle short side.
- IMAQ_ELONGATION—Max intercept / mean perpendicular intercept.
- IMAQ_COMPACTNESS—Particle area / (height × width).
- IMAQ_HEYWOOD—Particle perimeter / perimeter of the circle having the same area as the particle.
- IMAQ_TYPE_FACTOR—A complex factor relating the surface area to the moment of inertia.
- IMAQ_HYDRAULIC—Particle area / particle perimeter.
- IMAQ_WADDLE_DISK—Diameter of the disk having the same area as the particle in user units.
- IMAQ_DIAGONAL—Diagonal of an equivalent rectangle in user units.
- lower—The lower bound of the criteria range.
- upper—The upper bound of the criteria range.

- `exclude`—Set this element to `TRUE` to indicate that a match occurs when the value is outside the criteria range. Set this element to `FALSE` to indicate that a match occurs when the value is inside the criteria range.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqRejectBorder

Usage

```
int = imaqRejectBorder(Image* dest, Image* source, int connectivity8)
```

Purpose

Eliminates particles touching the border of the image.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	Image*	The source image. If the image has a border, the function sets all border pixel values to 0.
connectivity8	int	Set this parameter to TRUE to use connectivity-8 to determine whether particles are touching. Set this parameter to FALSE to use connectivity-4 to determine whether particles are touching. For more information about connectivity, see Chapter 1, <i>Basic Concepts</i> , or see the <i>IMAQ Vision User Manual</i> .

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSegmentation

Usage

```
int = imaqSegmentation(Image* dest, Image* source)
```

Purpose

Calculates zones of influence around particles in a labeled image. The function finds the nearest particle of each pixel in the source image and sets the pixel value to the labeled value of that particle. Before calling `imaqSegmentation()`, you must label the particles with `imaqLabel()`.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	Image*	The image to segment. The segmentation modifies the border of the source image. The border must be at least one pixel wide.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSelectParticles

Usage

```
ParticleReport* = imaqSelectParticles(const Image* image, const
                                     ParticleReport* reports, int* reportCount, int
                                     rejectBorder, const SelectParticleCriteria*
                                     criteria, int* criteriaCount)
```

Purpose

Filters an array of particle reports based on criteria ranges. Call `imaqGetParticleInfo()` before calling `imaqSelectParticle()`.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
image	const Image*	The image from which <code>imaqGetParticleInfo()</code> generated the particle reports.
reports	const ParticleReport*	The array of reports that <code>imaqGetParticleInfo()</code> returned. The function makes a copy of the reports that match the criteria.
reportCount	int	The number of reports in the input reports array.
rejectBorder	int	Set this parameter to TRUE to filter out particles touching the border of the image. Set this parameter to FALSE to process all particles.
criteria	const SelectParticleCriteria*	The array of criteria for the filter. This parameter is required and cannot be NULL.
criteriaCount	int	The number of criteria in the criteria array.
selectedCount	int*	On return, the number of reports that matched the criteria. Set this parameter to NULL if you do not need this information.

Parameter Discussion

criteria—Each `SelectParticleCriteria` structure consists of the following elements:

- **parameter**—The morphological measurement that the function uses for filtering. The following measurements are valid. If you set the mode of `imaqGetParticleInfo()` to `IMAQ_BASIC_INFO`, the `criteria` array must contain only the values denoted as *basic*.
 - `IMAQ_AREA`—Surface area of the particle in pixels (basic).
 - `IMAQ_AREA_CALIBRATED`—Surface area of the particle in calibrated units (basic).
 - `IMAQ_NUM_HOLES`—Number of holes in the particle.
 - `IMAQ_AREA_OF_HOLES`—Surface area of the holes in calibrated units.
 - `IMAQ_LEFT_COLUMN`—Left edge of the bounding rectangle (basic).
 - `IMAQ_TOP_ROW`—Top edge of the bounding rectangle (basic).
 - `IMAQ_RIGHT_COLUMN`—Right edge of the bounding rectangle (basic).
 - `IMAQ_BOTTOM_ROW`—Bottom edge of the bounding rectangle (basic).
 - `IMAQ_MAX_SEGMENT_LENGTH`—Length of longest horizontal line segment.
 - `IMAQ_MAX_SEGMENT_LEFT_COLUMN`—Leftmost x-coordinate of longest horizontal line segment.
 - `IMAQ_MAX_SEGMENT_TOP_ROW`—Y-coordinate of longest horizontal line segment.
 - `IMAQ_PERIMETER`—Outer perimeter of the particle.
 - `IMAQ_PERIMETER_OF_HOLES`—Perimeter of all holes.
 - `IMAQ_SIGMA_X`—Sum of the particle pixels on the x-axis.
 - `IMAQ_SIGMA_Y`—Sum of the particle pixels on the y-axis.
 - `IMAQ_SIGMA_XX`—Sum of the particle pixels on the x-axis squared.
 - `IMAQ_SIGMA_YY`—Sum of the particle pixels on the y-axis squared.
 - `IMAQ_SIGMA_XY`—Sum of the particle pixels on the x-axis and y-axis.
 - `IMAQ_PROJ_X`—Projection corrected in x.
 - `IMAQ_PROJ_Y`—Projection corrected in y.
- **lower**—The lower boundary of the criteria range
- **upper**—The upper boundary of the criteria range.

Return Value

ParticleReport*—On success, this function returns an array of the input reports that match the filtration criteria. On failure, this function returns `NULL`. To get extended error information, call `imaqGetLastError()`. When you are finished with this information, dispose of it by calling `imaqDispose()`. For more information on the `ParticleReport` structure, see `imaqGetParticleInfo()`.

imaqSeparation

Usage

```
int = imaqSeparation(Image* dest, Image* source, int erosions, const
                    StructuringElement* structuringElement)
```

Purpose

Separates touching particles by eroding the image to remove small isthmuses between the particles. After performing the erosion, the algorithm reconstructs the image.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	Image*	The image containing particles to separate. The separation modifies the border of the source image. The border must be at least half as large as the larger dimension of the structuring element.
erosions	int	The number of erosions to perform.
structuringElement	const StructuringElement*	The structuring element used in the operation. Set this parameter to NULL if you do not want a custom structuring element. For more information on structuring elements, see Chapter 1, <i>Basic Concepts</i> , or see the <i>IMAQ Vision User Manual</i> .

Parameter Discussion

structuringElement—A `StructuringElement` consists of the following elements:

- `matrixCols`—Number of columns in the matrix.
- `matrixRows`—Number of rows in the matrix.
- `hexa`—Set this field to TRUE if you specify a hexagonal structuring element in `kernel`. Set this field to FALSE if you specify a square structuring element in `kernel`.

- `kernel`—The values of the structuring element. Specify these values in order from the top-left of the kernel to the bottom-right of the kernel. For example, to set up the 3×3 kernel.

-1	0	1
-1	0	1
-1	0	1

called `myStructuringElement`, use the following syntax:

```
myStructuringElement.matrixCols = 3
myStructuringElement.matrixRows = 3
myStructuringElement.hexa = FALSE
myStructuringElement.kernel = malloc(9 * sizeof(int))
myStructuringElement.kernel[0] = -1
myStructuringElement.kernel[1] = 0
myStructuringElement.kernel[2] = 1
myStructuringElement.kernel[3] = -1
myStructuringElement.kernel[4] = 0
myStructuringElement.kernel[5] = 1
myStructuringElement.kernel[6] = -1
myStructuringElement.kernel[7] = 0
myStructuringElement.kernel[8] = 1
```

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSimpleDistance

Usage

```
int = imaqSimpleDistance(Image* dest, Image* source, const
                        StructuringElement* structuringElement)
```

Purpose

Creates a distance map. The function encodes the pixel value of a particle as a function of the distance of the pixel from the particle border. For a more precise but slower algorithm, use `imaqDanielssonDistance()`.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	Image*	The image that the function uses to compute the distance map. The function modifies the border of the source image. The border must be at least half as large as the larger of the structuring element dimensions.
structuringElement	const StructuringElement*	The structuring element used in the operation. Set this parameter to NULL if you do not want a custom structuring element. For more information on structuring elements, see Chapter 1, <i>Basic Concepts</i> , or see the <i>IMAQ Vision User Manual</i> .

Parameter Discussion

structuringElement—A `StructuringElement` consists of the following elements:

- `matrixCols`—Number of columns in the matrix.
- `matrixRows`—Number of rows in the matrix.
- `hexa`—Set this field to TRUE if you specify a hexagonal structuring element in `kernel`. Set this field to FALSE if you specify a square structuring element in `kernel`.

- `kernel`—The values of the structuring element. Specify these values in order from the top-left of the kernel to the bottom-right of the kernel. For example, to set up the 3×3 kernel.

-1	0	1
-1	0	1
-1	0	1

called `myStructuringElement`, use the following syntax:

```
myStructuringElement.matrixCols = 3
myStructuringElement.matrixRows = 3
myStructuringElement.hexa = FALSE
myStructuringElement.kernel = malloc(9 * sizeof(int))
myStructuringElement.kernel[0] = -1
myStructuringElement.kernel[1] = 0
myStructuringElement.kernel[2] = 1
myStructuringElement.kernel[3] = -1
myStructuringElement.kernel[4] = 0
myStructuringElement.kernel[5] = 1
myStructuringElement.kernel[6] = -1
myStructuringElement.kernel[7] = 0
myStructuringElement.kernel[8] = 1
```

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSizeFilter

Usage

```
int = imaqSizeFilter(Image* dest, Image* source, int connectivity8, int
                    erosions, SizeType keepSize, const
                    StructuringElement* structuringElement)
```

Purpose

Filters particles based on their size. The algorithm erodes the image a specified number of times and either keeps or discards the particles from the original image that remain in the eroded image.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	Image*	The image on which the function applies the filter. The calculation modifies the border of the source image. The border must be at least half as large as the larger of the structuring element dimensions.
connectivity8	int	Set this parameter to TRUE to use connectivity-8 to determine whether particles are touching. Set this parameter to FALSE to use connectivity-4 to determine whether particles are touching. For more information about connectivity, see Chapter 1, <i>Basic Concepts</i> , or see the <i>IMAQ Vision User Manual</i> .
erosions	int	The number of erosions to perform.
keepSize	SizeType	Set this parameter to IMAQ_KEEP_LARGE to keep the particles remaining after the erosion. Set this parameter to IMAQ_KEEP_SMALL to keep the particles eliminated by the erosion.
structuringElement	const StructuringElement*	The structuring element used in the operation. Set this parameter to NULL if you do not want a custom structuring element. For more information on structuring elements, see Chapter 1, <i>Basic Concepts</i> , or see the <i>IMAQ Vision User Manual</i> .

Parameter Discussion

structuringElement—A `StructuringElement` consists of the following elements:

- `matrixCols`—Number of columns in the matrix.
- `matrixRows`—Number of rows in the matrix.
- `hexa`—Set this field to `TRUE` if you specify a hexagonal structuring element in `kernel`. Set this field to `FALSE` if you specify a square structuring element in `kernel`.
- `kernel`—The values of the structuring element. Specify these values in order from the top-left of the kernel to the bottom-right of the kernel. For example, to set up the 3×3 kernel.

-1	0	1
-1	0	1
-1	0	1

called `myStructuringElement`, use the following syntax:

```
myStructuringElement.matrixCols = 3
myStructuringElement.matrixRows = 3
myStructuringElement.hexa = FALSE
myStructuringElement.kernel = malloc(9 * sizeof(int))
myStructuringElement.kernel[0] = -1
myStructuringElement.kernel[1] = 0
myStructuringElement.kernel[2] = 1
myStructuringElement.kernel[3] = -1
myStructuringElement.kernel[4] = 0
myStructuringElement.kernel[5] = 1
myStructuringElement.kernel[6] = -1
myStructuringElement.kernel[7] = 0
myStructuringElement.kernel[8] = 1
```

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSkeleton

Usage

```
int = imaqSkeleton(Image* dest, Image* source, SkeletonMethod method)
```

Purpose

Calculates the skeleton of the particles inside the image. The skeleton is made up of lines separating the zones of influence in the image.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	Image*	The image whose skeleton the function derives. The calculation modifies the border of the source image. The border must be at least one pixel wide.
method	SkeletonMethod	The method that the function uses to calculate the skeleton. The following options are valid: IMAQ_SKELETON_L IMAQ_SKELETON_M IMAQ_SKELETON_INVERSE For more information about skeleton functions, see the <i>IMAQ Vision User Manual</i> .

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

Color Processing

This chapter describes the Color Processing functions in IMAQ Vision for LabWindows/CVI. Color Processing functions allow you to analyze and process color images in different color spaces. Use Color Processing functions with applications in which color information is important. These functions work with color images in the Red, Green, Blue (RGB) domain and the Hue, Saturation, and Luminance (HSL) domain. For more information about color domains, see the *IMAQ Vision User Manual*.

Color Processing Function Panels

Table 12-1 lists the Color Processing functions in a tree structure. The functions in the Color Processing class are grouped according to the types of operations they perform. The first-level heading in the tree is the name of the class. The second-level headings are names of function subclasses. The third-level headings are names of individual function panels. Each Color Processing function panel represents one function.

Table 12-1. Color Processing Function Tree

Class/Panel Name	Function Name
Color Processing	
Change Color Space	<code>imaqChangeColorSpace</code>
Color BCG Transform	<code>imaqColorBCGTransform</code>
Color Equalize	<code>imaqColorEqualize</code>
Color Histogram	<code>imaqColorHistogram</code>
Color Lookup	<code>imaqColorLookup</code>
Color Threshold	<code>imaqColorThreshold</code>
Color Matching	
Learn Color	<code>imaqLearnColor</code>
Match Color	<code>imaqMatchColor</code>

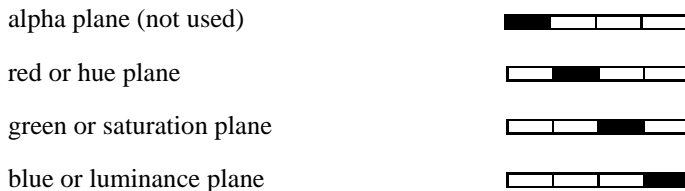
Subclass Description

The Color Processing subclass description is as follows:

- Color Matching functions allow you to learn information about the colors in a template image and compare that information with the colors in other images.

Color Spaces

An RGB or HSL image is a color image coded in three parts. For RGB, these parts are red, green, and blue. For HSL, these parts are hue, saturation, and luminance. A pixel encoded in 32 bits is actually four planes:



A color image is encoded in memory in either the form RGB or HSL. However, there are a number of other color spaces, such as HSI and HSV. The HSI model is composed as hue, saturation, and intensity. The HSV model is composed as hue, saturation, and value.

To determine the values for hue, saturation, luminance, intensity, or value, a measurement is made from the red, green, and blue components. These extractions are approximate. In effect, a color converted between two of the different color spaces (for instance, RGB to HSL) and then reconverted back to the original color space, does not have exactly the same values as the original image. This difference results from the 8-bit encoding of the image planes, which causes some loss of data.

The following formulas illustrate converting an RGB color value to an HSL color value:

$$H = \frac{256 \tan^{-1} \left(\frac{\sqrt{3}(G - B)}{2R - G - B} \right)}{2\pi}$$

$$S = 256 \left(1 - \frac{3 \min(R, G, B)}{R + G + B} \right)$$

$$L = 0.299R + 0.587G + 0.114B$$

In the HSV and HSI modes, H and S are computed as approximations to the model shown above. V and I are computed as follows:

$$V = \frac{\max(R, G, B) - \min(R, G, B)}{2}$$

$$I = \max(R, G, B)$$

imaqChangeColorSpace

Usage

```
Color = imaqChangeColorSpace(const Color* sourceColor, ColorMode
                             sourceSpace, ColorMode destSpace)
```

Purpose

Maps the value of a color in one color space into the value of the same color in another color space.

Parameters

Name	Type	Description
sourceColor	const Color*	The color in the source color space. This parameter is required and cannot be NULL.
sourceSpace	ColorMode	The source color space. Valid options are <code>IMAQ_RGB</code> , <code>IMAQ_HSL</code> , <code>IMAQ_HSV</code> , and <code>IMAQ_HSI</code> . For more information about color spaces, see the <i>IMAQ Vision User Manual</i> .
destSpace	ColorMode	The destination color space. Valid options are <code>IMAQ_RGB</code> , <code>IMAQ_HSL</code> , <code>IMAQ_HSV</code> , and <code>IMAQ_HSI</code> . For more information about color spaces, see the <i>IMAQ Vision User Manual</i> .

Return Value

Color—On success, this function returns the value of the color in the destination color space. On failure, this function returns black. To get extended error information, call `imaqGetLastError()`.

imaqColorBCGTransform

Usage

```
int = imaqColorBCGTransform(Image* dest, const Image* source, const
                             BCGOptions* redOptions, const BCGOptions*
                             greenOptions, const BCGOptions* blueOptions,
                             const Image* mask)
```

Purpose

Applies brightness, contrast, and gamma correction to each plane of a color image.

Image Type Supported

IMAQ_IMAGE_RGB

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The image to transform.
redOptions	const BCGOptions*	The parameters to use in the transform of the red plane. Set this parameter to NULL to leave the red plane unchanged.
greenOptions	const BCGOptions*	The parameters to use in the transform of the green plane. Set this parameter to NULL to leave the green plane unchanged.
blueOptions	const BCGOptions*	The parameters to use in the transform of the blue plane. Set this parameter to NULL to leave the blue plane unchanged.
mask	const Image*	An optional mask image. This image must be an IMAQ_IMAGE_U8 image. The function transforms only those pixel in the source image whose corresponding pixels in the mask image are non-zero. Set this parameter to NULL to transform the whole image.

Parameter Discussion

redOptions, greenOptions, blueOptions—A BCGOptions structure has the following elements:

- **brightness**—Adjusts the brightness of the image. A value of 128 leaves the brightness unchanged. Values below 128 darken the image, and values above 128 brighten the image.

- `contrast`—Adjusts the contrast of the image. A value of 45 leaves the contrast unchanged. Values below 45 decrease the contrast, and values above 45 increase the contrast.
- `gamma`—Performs gamma correction. A value of 1.0 leaves the image unchanged. Values below 1.0 enhance contrast for darker pixel at the expense of the brighter pixels. Values above 1.0 enhance contrast for brighter pixels at the expense of darker pixels.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqColorEqualize

Usage

```
int = imaqColorEqualize(Image* dest, const Image* source, int
                        colorEqualization)
```

Purpose

Calculates the histogram of each plane of a color image and redistributes pixel values across the desired range while maintaining pixel value groupings.

Image Types Supported

IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The image to equalize.
colorEqualization	int	Set this parameter to TRUE to equalize all three planes of the image. Set this parameter to FALSE to equalize only the luminance plane.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqColorHistogram

Usage

```
ColorHistogramReport* = imaqColorHistogram(Image* image, int numClasses,
                                           ColorMode mode, const Image* mask)
```

Purpose

Calculates the histogram, or pixel distribution, of a color image.

Image Types Supported

IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
image	Image*	The image whose histogram the function calculates.
numClasses	int	The number of classes into which the function separates the pixels.
mode	ColorMode	The color space in which to perform the histogram. Valid options are IMAQ_RGB, IMAQ_HSL, IMAQ_HSV, and IMAQ_HSI. For more information about color spaces, see the <i>IMAQ Vision User Manual</i> .
mask	const Image*	An optional mask image. This image must be an IMAQ_IMAGE_U8 image. The function calculates the histogram using only those pixels in the image whose corresponding pixels in the mask are non-zero. Set this parameter to NULL to calculate the histogram of the entire image.

Return Value

ColorHistogramReport*—On success, this function returns a report describing the classification of each plane in a *ColorHistogramReport*. The *ColorHistogramReport* structure contains the following elements:

- `plane1`—The histogram report of the first color plane.
- `plane2`—The histogram report of the second plane.
- `plane3`—The histogram report of the third plane.

The data of each plane depends on the **mode** parameter, as follows:

- `IMAQ_RGB`—`plane1` is the red plane, `plane2` is the green plane, `plane3` is the blue plane.
- `IMAQ_HSL`—`plane1` is the hue plane, `plane2` is the saturation plane, `plane3` is the luminance plane.
- `IMAQ_HSV`—`plane1` is the hue plane, `plane2` is the saturation plane, `plane3` is the value plane.
- `IMAQ_HSI`—`plane1` is the hue plane, `plane2` is the saturation plane, `plane3` is the intensity plane.

Each `HistogramReport` structure contains the following elements:

- `histogram`—An array describing the number of pixels that fell into each class.
- `histogramCount`—The number of elements in the `histogram` array. The number of elements equals the value you provided in **numClasses**.
- `min`—The smallest pixel value that the function classified.
- `max`—The largest pixel value that the function classified.
- `start`—The smallest pixel value that fell into the first class. The smallest pixel value may be smaller than **min**.
- `width`—The size of each class.
- `mean`—The mean value of the pixels that the function classified.
- `stdDev`—The standard deviation of the pixels that the function classified.
- `numPixels`—The number of pixels that the function classified. The **mask** and the given **min** and **max** influence this element.

On failure, this function returns `NULL`. To get extended error information, call `imaqGetLastError()`. When you are finished with the report, dispose of it by calling `imaqDispose()`.

imaqColorLookup

Usage

```
int = imaqColorLookup(Image* dest, const Image* source, ColorMode mode, const
                    Image* mask, const short* plane1, const short*
                    plane2, const short* plane3)
```

Purpose

Performs a transformation on an image by replacing each pixel value in a given color plane with the lookup table entry corresponding to that value.

Image Types Supported

IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The image on which to apply the lookup.
mode	ColorMode	The color space in which to apply the lookup. Valid options are IMAQ_RGB, IMAQ_HSL, IMAQ_HSV, and IMAQ_HSI. If the image is not in the color space you specify, the function converts the pixels into the specified color space, performs the lookup, and converts the pixels back to their original color space. For more information on color spaces, see the <i>IMAQ Vision User Manual</i> .
mask	const Image*	An optional mask image. This image must be an IMAQ_IMAGE_U8 image. The function applies the lookup to only those pixels in the source image whose corresponding pixels in the mask image are non-zero. Set this parameter to NULL to apply the lookup to the whole image.
plane1	const short*	The lookup table for the first plane of the image. If you set this parameter, the table must contain 256 values. Set this parameter to NULL to leave the first plane unchanged. The color plane depends on mode, as follows: IMAQ_RGB—red plane IMAQ_HSL—hue plane IMAQ_HSV—hue plane IMAQ_HSI—hue plane

Name	Type	Description
plane2	const short*	<p>The lookup table for the second plane of the image. If you set this parameter, the table must contain 256 values. Set this parameter to NULL to leave the second plane unchanged. The color plane depends on mode, as follows:</p> <p>IMAQ_RGB—green plane IMAQ_HSL—saturation plane IMAQ_HSV—saturation plane IMAQ_HSI—saturation plane</p>
plane3	const short*	<p>The lookup table for the third plane of the image. If you set this parameter, the table must contain 256 values. Set this parameter to NULL to leave the third plane unchanged. The color plane depends on mode, as follows:</p> <p>IMAQ_RGB—blue plane IMAQ_HSL—luminance plane IMAQ_HSV—value plane IMAQ_HSI—intensity plane</p>

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqColorThreshold

Usage

```
int = imaqColorThreshold(Image* dest, const Image* source, int replaceValue,
                        ColorMode mode, const Range* plane1Range, const
                        Range* plane2Range, const Range* plane3Range)
```

Purpose

Thresholds a color image. The function selects a pixel if all three color components fall within the specified range. The function replaces the value of selected pixels with the given replacement value and sets the value of unselected pixels to 0.

Image Types Supported

IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The destination image. This image must be an IMAQ_IMAGE_U8 image.
source	const Image*	The image to threshold.
replaceValue	int	The value to which the function sets selected pixels.
mode	ColorMode	The color space in which to perform the threshold. Valid options are IMAQ_RGB, IMAQ_HSL, IMAQ_HSV, and IMAQ_HSI. For more information about color spaces, see the <i>IMAQ Vision User Manual</i> .
plane1Range	const Range*	The selection range for the first plane of the image. Set this parameter to NULL to use a selection range from 0 to 255.
plane2Range	const Range*	The selection range for the second plane of the image. Set this parameter to NULL to use a selection range from 0 to 255.
plane3Range	const Range*	The selection range for the third plane of the image. Set this parameter to NULL to use a selection range from 0 to 255.

Parameter Discussion

plane1Range—The color plane depends on the **mode**, as follows:

- IMAQ_RGB—red plane
- IMAQ_HSL—hue plane

- `IMAQ_HSV`—hue plane
- `IMAQ_HSI`—hue plane

plane2Range—The color plane depends on the **mode**, as follows:

- `IMAQ_RGB`—green plane
- `IMAQ_HSL`—saturation plane
- `IMAQ_HSV`—saturation plane
- `IMAQ_HSI`—saturation plane

plane3Range—The color plane depends on the **mode**, as follows:

- `IMAQ_RGB`—blue plane
- `IMAQ_HSL`—luminance plane
- `IMAQ_HSV`—value plane
- `IMAQ_HSI`—intensity plane

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqLearnColor

Usage

```
ColorInformation* = imaqLearnColor(const Image* image, const ROI* roi,
                                   ColorComplexity complexity, int saturation)
```

Purpose

Extracts the color features of an image. Use these features for color matching with `imaqMatchColor()`.

Image Types Supported

IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
image	const Image*	The image containing the color information to learn.
roi	const ROI*	The region about which the function learns the color information. Set this parameter to NULL to learn color information about the whole image.
complexity	ColorComplexity	Specifies the complexity the color information in the image. The following options are valid: IMAQ_COMPLEXITY_LOW IMAQ_COMPLEXITY_MED IMAQ_COMPLEXITY_HIGH In most cases, set this parameter to IMAQ_COMPLEXITY_LOW. However, set this parameter to IMAQ_COMPLEXITY_HIGH to learn more information and better distinguish colors in highly complex images.
saturation	int	Sets a threshold value which the function uses to separate colors with similar hues. The function classifies colors below the given saturation value separately from colors above the given saturation value.

Return Value

ColorInformation*—On success, this function returns a color information structure which you can pass into `imaqMatchColor()`. On failure, this function returns `NULL`. To get extended error information, call `imaqGetLastError()`. When you are finished with this structure, dispose of it by calling `imaqDispose()`.

imaqMatchColor

Usage

```
int* = imaqMatchColor(const Image* image, const ColorInformation* info, const
                    ROI* roi, int* numScores)
```

Purpose

Determines how closely colors in an image match colors in the given color information.

Image Types Supported

IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
image	const Image*	The image containing colors you want to compare with the given color information.
info	const ColorInformation*	The color information. Call <code>imaqLearnColor()</code> to get the color information. This parameter is required and cannot be NULL.
roi	const ROI*	The region of the image in which to compare the colors. Set this parameter to NULL to compare colors in the entire image.
numScores	int*	On return, contains the number of values in the score array. Set this parameter to NULL if you do not need this information.

Return Value

int*—On success, this function returns an array filled with scores describing the closeness of a match between each contour in the ROI and the color information. A score of 1,000 indicates a perfect match. On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`. When you are finished with this array, dispose of it by calling `imaqDispose()`.

Pattern Matching

This chapter describes the Pattern Matching functions in IMAQ Vision for LabWindows/CVI. Pattern Matching functions allow you to search for templates in an image.

Pattern Matching Function Panels

Table 13-1 lists the Pattern Matching functions in a tree structure. The functions in the Pattern Matching class are grouped according to the types of operations they perform. The first-level heading in the tree is the name of the class. The second-level headings are names of individual function panels. Each Pattern Matching function panel represents one function.

Table 13-1. Pattern Matching Function Tree

Class/Panel Name	Function Name
Pattern Matching	
Learn Pattern	<code>imaqLearnPattern</code>
Load Pattern	<code>imaqLoadPattern</code>
Match Pattern	<code>imaqMatchPattern</code>
Save Pattern	<code>imaqSavePattern</code>

imaqLearnPattern

Usage

```
int = imaqLearnPattern(Image* image, LearningMode learningMode)
```

Purpose

Prepares an image for use as a pattern for `imaqMatchPattern()`. If you change the pattern image after calling this function, you must call the function again to learn the modified image.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
image	Image*	The image about which the function learns pattern matching information. The function appends the pattern matching information to the image.
learningMode	LearningMode	The mode in which the function learns the pattern image. The following options are valid: IMAQ_LEARN_ALL—Learns information about the image that <code>imaqMatchPattern()</code> requires for shift-invariant and rotation-invariant pattern matching. IMAQ_LEARN_SHIFTINVARIANT—Learns information about the image that <code>imaqMatchPattern()</code> requires for shift-invariant pattern matching. IMAQ_LEARN_ROTATIONINVARIANT—Learns information about the image that <code>imaqMatchPattern()</code> requires for rotation-invariant pattern matching.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqLoadPattern

Usage

```
int = imaqLoadPattern(Image* pattern, const char* fileName)
```

Purpose

Loads a pattern image previously saved with the `imaqSavePattern()` function.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
pattern	Image*	The pattern image.
fileName	const char*	The name of the image file to load.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqMatchPattern

Usage

```
PatternMatch* = imaqMatchPattern(const Image* image, Image* pattern, const
                                MatchPatternOptions* options, Rect searchRect,
                                int* numMatches)
```

Purpose

Searches for areas in an image that match a given pattern image.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
image	const Image*	The image in which the function finds matches to the pattern image.
pattern	Image*	The pattern image to find in the image. IMAQ Vision must learn this pattern image in <code>imaqLearnPattern()</code> before using it in this function.
options	const MatchPatternOptions*	Describes how to search for the pattern image.
searchRect	Rect	Specifies a rectangle in the image in which to search for the pattern image. Set this parameter to <code>IMAQ_NO_RECT</code> to search for the pattern image in the entire image.
numMatches	int*	On return, the number of matches to the pattern image that the function found. Set this parameter to <code>NULL</code> if you do not need this information.

Parameter Discussion

options—The following options are valid:

- **mode**—Specifies the method to use when looking for the pattern in the image. The following modes are valid:
 - `IMAQ_MATCH_SHIFT_INVARIANT`—Searches for occurrences of the pattern image anywhere in the `searchRect`, assuming that the pattern is not rotated more than $\pm 4^\circ$.

- `IMAQ_MATCH_ROTATION_INVARIANT`—Searches for occurrences of the pattern in the image with no restriction on the rotation of the pattern.
- `minContrast`—Specifies the minimum contrast expected in the image.
- `subpixelAccuracy`—Set this parameter to `TRUE` to return areas in the image that match the pattern area with subpixel accuracy.
- `angleRanges`—An array of angle ranges, in degrees, where each range specifies how much you expect the pattern to be rotated in the image. To decrease the search time, limit the degrees of rotation in which you expect to find the pattern image.
- `numRanges`—Number of angle ranges in the `angleRanges` array.
- `numMatchesRequested`—Number of valid matches expected.
- `matchFactor`—Controls the number of potential matches that the function examines. Acceptable values range from 0 to 1,000. For most applications, set `matchFactor` to 0, which optimizes the speed of the algorithm. If you are not getting all of the `numMatchesRequested`, increasing this factor may increase the number of matches you receive but decreases the speed of the algorithm. Normally, increasing `matchFactor` is necessary only when looking for more than 200 matches per image.
- `minMatchScore`—The minimum score a match can have for the function to consider the match valid.

Set the **options** parameter to `NULL` to use the default options, as follows:

- `mode`—`IMAQ_MATCH_SHIFT_INVARIANT`
- `minContrast`—10
- `subpixelAccuracy`—`FALSE`
- `angleRanges`—`NULL` (all angles allowed)
- `numRanges`—0
- `numMatchesRequested`—1
- `matchFactor`—0
- `minMatchScore`—800

Return Value

PatternMatch*—On success, this function returns an array of information about each match found. Each `PatternMatch` structure contains the following information:

- `position`—The location of the center of the match.
- `rotation`—The rotation of the match relative to the pattern image, in degrees.
- `scale`—The ratio of the size of the match relative to the pattern image.

- `score`—The accuracy of the match. A 1,000 indicates a perfect match, and a 0 indicates no match.
- `corner`—An array of four points describing the rectangle surrounding the pattern image.

On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`. When you are finished with this information, dispose of the pointer by calling `imaqDispose()`.

imaqSavePattern

Usage

```
int = imaqSavePattern(const Image* pattern, const char* filename)
```

Purpose

Saves a pattern image to disk in PNG format. If you alter the contents of this file, IMAQ Vision may not be able to use the file as a pattern image.

Image Type Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
pattern	const Image*	The pattern image to save.
filename	const char*	The name in which the function saves the pattern image.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

Caliper

This chapter describes the Caliper functions in IMAQ Vision for LabWindows/CVI. Caliper functions allow you to detect and measure features, such as edges and angles, along a path in an image.

Caliper Function Panels

Table 14-1 lists the Caliper functions in a tree structure. The functions in the Caliper class are grouped according to the types of operations they perform. The first-level heading in the tree is the name of the class. The second-level headings are names of individual function panels. Each Caliper function panel represents one function.

Table 14-1. Caliper Function Tree

Class/Panel Name	Function Name
Caliper	
Caliper Tool	imaqCaliperTool
Detect Rotation	imaqDetectRotation
Edge Tool	imaqEdgeTool
Line Gauge Tool	imaqLineGaugeTool
Simple Edge	imaqSimpleEdge

imaqCaliperTool

Usage

```
CaliperReport* = imaqCaliperTool(const Image* image, const Point* points, int
                                numPoints, const EdgeOptions* edgeOptions, const
                                CaliperOptions* caliperOptions, int*
                                numEdgePairs)
```

Purpose

Finds edges along a path in an image, chooses pairs of the edges, and measures the distance between them.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
image	const Image*	The image in which the function finds edges.
points	const Point*	The path along which the function detects edges. This parameter is required and cannot be NULL.
numPoints	int	The number of points in the points array.
edgeOptions	const EdgeOptions*	Describes how you want the function to find an edge. This parameter is required and cannot be NULL.
caliperOptions	const CaliperOptions*	Describes how you want the function to choose edge pairs. This parameter is required and cannot be NULL.
numEdgePairs	int*	On return, the number of edge pairs that the function found. Set this parameter to NULL if you do not need this information.

Parameter Discussion

edgeOptions—The `EdgeOptions` structure consists of the following entries:

- **threshold**—Specifies the threshold for the contrast of the edge. The function identifies only edges with a contrast greater than this value in the detection process.
- **width**—The number of pixels that the function averages to find the contrast at either side of the edge.

- `steepness`—The span, in pixels, of the slope of the edge projected along the path specified by the input points.
- `subpixelType`—The method for interpolating. Valid options are `IMAQ_ZERO_ORDER`, `IMAQ_QUADRATIC`, and `IMAQ_CUBIC_SPLINE`.
- `subpixelDivisions`—The number of samples the function obtains from a pixel. For example, set `subpixelDivisions` to 4 to split each pixel into four subpixels. The maximum number of subpixel divisions is 12.

caliperOptions—The `CaliperOptions` structure consists of the following entries:

- `polarity`—Specifies the edge polarity of the edge pairs. The following options are valid:
 - `IMAQ_NONE`—The function ignores the polarity of the edges.
 - `IMAQ_RISING_FALLING`—The polarity of the first edge is rising (dark to light) and the polarity of the second edge is falling (light to dark).
 - `IMAQ_RISING_RISING`—The polarity of the first edge is rising (dark to light) and the polarity of the second edge is rising (dark to light).
 - `IMAQ_FALLING_FALLING`—The polarity of the first edge is falling (light to dark) and the polarity of the second edge is falling (light to dark).
 - `IMAQ_FALLING_RISING`—The polarity of the first edge is falling (light to dark) and the polarity of the second edge is rising (dark to light).
- `separation`—The distance between edge pairs. If the edge pair has a separation greater than this value \pm the `separationDeviation`, the function ignores the edge pair. Set this parameter to 0 to find all edge pairs.
- `separationDeviation`—Sets the range around the separation value. If you set `separation` to 0, the function ignores `separationDeviation`.

Return Value

CaliperReport*—On success, this function returns an array of information about each edge. This structure consists of the following values:

- `edge1Contrast`—The contrast of the first edge.
- `edge1Coord`—The coordinates of the first edge.
- `edge2Contrast`—The contrast of the second edge.
- `edge2Coord`—The coordinates of the second edge.
- `separation`—The distance between the two edges.

On failure, this function returns `NULL`. To get extended error information, call `imaqGetLastError()`. When you are finished with this information, dispose of this function by calling `imaqDispose()`.

imaqDetectRotation

Usage

```
int = imaqDetectRotation(const Image* referenceImage, const Image*
                        testImage, PointFloat referenceCenter, PointFloat
                        testCenter, int radius, float precision, double*
                        angle)
```

Purpose

Detects the rotational shift between two images, usually a reference image containing a part at a known orientation and another image containing the part in an unknown position. This function extracts pixel values around a circular region in the reference image and compares these values to the same region in the test image. The algorithm looks for the rotational shift between those two samples.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
referenceImage	const Image*	The reference image.
testImage	const Image*	The test image.
referenceCenter	PointFLoat	The center point of the circular region in the reference image.
testCenter	PointFLoat	The center point of the circular region in the test image.
radius	int	The radius of the circles used to detect rotation.
precision	float	The sampling period, in degrees, of the pixel values that the function extracts from the circular region. The sampling period directly affects the speed of the function. If the sampling period is high (the number of samples along the circular region are few), the processing speed of the function increases at the cost of reduced accuracy in the computed rotational shift. In many cases, you do not need a precision higher than 5 degrees to position the regions of inspection of a part. If the sampling period is less than or equal to 0, the function returns an error.
angle	double*	On return, the angle, in degrees, between the two images.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqEdgeTool

Usage

```
EdgeReport* = imaqEdgeTool(const Image* image, const Point* points, int
                           numPoints, const EdgeOptions* options, int*
                           numEdges)
```

Purpose

Finds edges along a path in an image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
image	const Image*	The image in which to find edges.
points	const Point*	The path along which the function detects edges. This parameter is required and cannot be NULL.
numPoints	int	The number of points in the points array.
options	const EdgeOptions*	Describes how you want the function to find edges. This parameter is required and cannot be NULL.
numEdges	int*	On return, the number of edges that the function found. Set this parameter to NULL if you do not need this information.

Parameter Discussion

options—The `EdgeOptions` structure consists of the following entries:

- **threshold**—Specifies the threshold for the contrast of the edge. The function identifies only edges with a contrast greater than this value in the detection process.
- **width**—The number of pixels that the function averages to find the contrast at either side of the edge.
- **steepness**—The span, in pixels, of the slope of the edge projected along the path specified by the input points.
- **subpixelType**—The method for interpolating. Valid options include `IMAQ_QUADRATIC` and `IMAQ_CUBIC_SPLINE`.

- `subpixelDivisions`—The number of samples the function obtains from a pixel. For example, set `subpixelDivisions` to 4 to split each pixel into four subpixels. The maximum number of subpixels is 12.

Return Value

EdgeReport*—On success, this function returns an array of information about each edge. This structure consists of the following values:

- `position`—The position of the edge from the first point in the `points` array. This is a subpixel interpolated distance.
- `contrast`—The contrast at the edge.
- `polarity`—The polarity of the edge. The following values are valid:
 - `IMAQ_EDGE_RISING`—Indicates a rising edge (dark to light).
 - `IMAQ_EDGE_FALLING`—Indicates a falling edge (light to dark).
- `coordinates`—The coordinates of the edge.

On failure, this function returns `NULL`. To get extended error information, call `imaqGetLastError()`. When you are finished with this information, dispose of this function by calling `imaqDispose()`.

imaqLineGaugeTool

Usage

```
int = imaqLineGaugeTool(const Image* image, Point start, Point end,
                        LineGaugeType method, const EdgeOptions*
                        edgeOptions, const CoordinateTransform*
                        reference, float* distance)
```

Purpose

Measures the distance between selected edges of a line with high-precision subpixel accuracy. This function has the ability to work on a rotated or translated particle. If you supply coordinate transform information, the function transforms the line information you pass from the coordinate system of the particle to the coordinate system of the image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
image	const Image*	The image in which the function measures the distance between edges.
start	Point	The starting point of the line.
end	Point	The ending point of the line.
method	LineGaugeMethod	The measurement method.
edgeOptions	const EdgeOptions*	Describes how you want the function to find edges. If you set method to IMAQ_POINT_TO_POINT, the function ignores edgeOptions. If you set method to anything other than IMAQ_POINT_TO_POINT, this parameter is required and cannot be NULL.
reference	const CoordinateTransform*	The transform between the coordinate system of the particle and the image. See the purpose for a discussion of using a transform. Set this parameter to NULL if you do not want to apply a transform.
distance	float*	On return, the distance between edges and/or points.

Parameter Discussion

method—The following options are valid:

- `IMAQ_EDGE_TO_EDGE`—Measures from the first edge on the line to the last edge on the line.
- `IMAQ_EDGE_TO_POINT`—Measures from the first edge on the line to the end point of the line.
- `IMAQ_POINT_TO_EDGE`—Measures from the start point of the line to the first edge on the line.
- `IMAQ_POINT_TO_POINT`—Measures from the start point of the line to the end point of the line.

edgeOptions—The `EdgeOptions` structure consists of the following entries:

- `threshold`—Specifies the threshold value for the contrast of the edge. The function identifies only edges with a contrast greater than this value in the detection process.
- `width`—The number of pixels that the function averages to find the contrast at either side of the edge.
- `steepness`—The span, in pixels, of the slope of the edge projected along the path specified by the input points.
- `subpixelType`—The method for interpolating. Valid options include `IMAQ_QUADRATIC` and `IMAQ_CUBIC_SPLINE`.
- `subpixelDivisions`—The number of samples the function obtains from a pixel. For example, set `subpixelDivisions` to 4 to split each pixel into four subpixels. The maximum number of subpixel divisions is 12.

reference—The `CoordinateTransform` structure contains the following elements:

- `initialOrigin`—The origin of the initial coordinate system.
- `initialAngle`—The angle, in degrees, of the initial coordinate system.
- `finalOrigin`—The origin of the final coordinate system.
- `finalAngle`—The angle, in degrees, of the final coordinate system.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSimpleEdge

Usage

```
PointFloat* = imaqSimpleEdge(const Image* image, const Point* points, int
                             numPoints, const SimpleEdgeOptions* options, int*
                             numEdges)
```

Purpose

Finds prominent edges along an array of pixel coordinates. This function can return the first edge, both the first and the last edges, or all the edges.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
image	const Image*	The image in which to find edges.
points	const Point*	The path along which the function detects edges. This parameter is required and cannot be NULL.
numPoints	int	The number of points in the points array.
options	const SimpleEdgeOptions*	Describes how you want the function to find edges. This parameter is required and cannot be NULL.
numEdges	int*	On return, the number of edges that the function found. Set this parameter to NULL if you do not need this information.

Parameter Discussion

options—The SimpleEdgeOptions structure consists of the following entries:

- **type**—Set this parameter to IMAQ_ABSOLUTE to make the values in **threshold** and **hysteresis** absolute values. Set this parameter to IMAQ_RELATIVE to make the values in **threshold** and **hysteresis** relative to the dynamic range of the given path.
- **threshold**—The pixel value at which an edge occurs.
- **hysteresis**—A value that helps determine edges in noisy images. If a pixel value crosses the given **threshold** value but does not exceed the value by the **hysteresis** value, the function does not consider the pixel to be part of an edge.
- **process**—Defines which edges to find. Valid options include the IMAQ_FIRST, IMAQ_FIRST_AND_LAST, or IMAQ_ALL.

- `subpixel`—Set this parameter to TRUE to find edges with subpixel accuracy by interpolating between points to find the crossing of the given threshold. Set this parameter to FALSE to report an edge as the point nearest the threshold crossing.

Return Value

PointF*—On success, this function returns an array of points indicating the location of the edges. On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`. When you are finished with this information, dispose of the array by calling `imaqDispose()`.

Operators

This chapter describes the Operator functions in IMAQ Vision for LabWindows/CVI.

Operator Function Panels

Table 15-1 lists the Operator functions in a tree structure. The functions in the Operator class are grouped according to the types of operations they perform. The first-level heading in the tree is the name of the class. The second-level headings are names of function subclasses. The third-level headings are names of individual function panels. Each Operator function panel represents one function.

Table 15-1. Operator Function Tree

Class/Panel Name	Function Name
Operators	
Arithmetic	
Add	imaqAdd
Add Constant	imaqAddConstant
Average	imaqAverage
Average Constant	imaqAverageConstant
Divide	imaqDivide
Divide Constant	imaqDivideConstant
Max	imaqMax
Max Constant	imaqMaxConstant
Min	imaqMin
Min Constant	imaqMinConstant
Modulo	imaqModulo
Modulo Constant	imaqModuloConstant
Multiply Divide	imaqMulDiv
Multiply	imaqMultiply
Multiply Constant	imaqMultiplyConstant
Subtract	imaqSubtract
Subtract Constant	imaqSubtractConstant
Logical	
And	imaqAnd
And Constant	imaqAndConstant
Compare	imaqCompare
Compare Constant	imaqCompareConstant
Logical Difference	imaqLogicalDifference
Logical Difference Constant	imaqLogicalDifferenceConstant

Table 15-1. Operator Function Tree (Continued)

Class/Panel Name	Function Name
Nand	imaqNand
Nand Constant	imaqNandConstant
Nor	imaqNor
Nor Constant	imaqNorConstant
Or	imaqOr
Or Constant	imaqOrConstant
Xnor	imaqXnor
Xnor Constant	imaqXnorConstant
Xor	imaqXor
Xor Constant	imaqXorConstant

Subclass Descriptions

Operator subclass descriptions are as follows:

- Arithmetic functions allow you to perform arithmetic operations between two images or between an image and a constant.
- Logical functions allow you to perform logic operations between two images or between an image and a constant.

imaqAdd

Usage

```
int = imaqAdd(Image* dest, const Image* sourceA, const Image* sourceB)
```

Purpose

Adds two images.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB

Parameters

Name	Type	Description
dest	Image*	The destination image.
sourceA	const Image*	The first image to add.
sourceB	const Image*	<p>The second image to add. The image type of sourceB depends on the image type of sourceA, as follows:</p> <p>If sourceA is IMAQ_IMAGE_U8, sourceB must be IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX, or IMAQ_IMAGE_RGB.</p> <p>If sourceA is IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, or IMAQ_IMAGE_COMPLEX, sourceB must be IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, or IMAQ_IMAGE_COMPLEX.</p> <p>If sourceA is IMAQ_IMAGE_RGB, sourceB must be IMAQ_IMAGE_RGB or IMAQ_IMAGE_U8.</p>

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqAddConstant

Usage

```
int = imaqAddConstant(Image* dest, const Image* source, PixelValue value)
```

Purpose

Adds a constant value to each pixel in an image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The image to which the function adds a scalar constant.
value	PixelValue	The value to add to the source image. value must correspond to the image type, as follows: If the image is IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, or IMAQ_IMAGE_SGL, use the <code>grayscale</code> value of the PixelValue union. If the image is IMAQ_IMAGE_COMPLEX, use the <code>complex</code> value of the PixelValue union. If the image is IMAQ_IMAGE_RGB, use the <code>rgb</code> value of the PixelValue union.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqAnd

Usage

```
int = imaqAnd(Image* dest, const Image* sourceA, const Image* sourceB)
```

Purpose

Computes a bitwise AND between two images.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The destination image.
sourceA	const Image*	The first source image.
sourceB	const Image*	The second source image, which must be the same type of image as sourceA .

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqAndConstant

Usage

```
int = imaqAndConstant(Image* dest, const Image* source, PixelValue value)
```

Purpose

Performs a bitwise AND between an image and a constant.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The source image.
value	PixelValue	The value to AND to the source image. value must correspond to the image type, as follows: If the image is IMAQ_IMAGE_U8 or IMAQ_IMAGE_I16, use the <code>grayscale</code> value of the PixelValue union. If the image is IMAQ_IMAGE_HSL, use the <code>hsl</code> value of the PixelValue union. If the image is IMAQ_IMAGE_RGB, use the <code>rgb</code> value of the PixelValue union.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqAverage

Usage

```
int = imaqAverage(Image* dest, const Image* sourceA, const Image* sourceB)
```

Purpose

Computes the average of two source images and places the result in the destination image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
dest	Image*	The destination image.
sourceA	const Image*	The first source image.
sourceB	const Image*	The second source image, which must be the same type of image as sourceA .

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqAverageConstant

Usage

```
int = imaqAverageConstant(Image* dest, const Image* source, PixelValue value)
```

Purpose

Computes the average of a source image and a constant and places the result into a destination image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The source image.
value	PixelValue	The value to average with the source image. Use the grayscale value of the PixelValue union.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqCompare

Usage

```
int = imaqCompare(Image* dest, const Image* source, const Image*  
                 compareImage, ComparisonFunction compare)
```

Purpose

Copies the source image to the destination image in the following manner: If the given comparison between the source pixel value and its corresponding comparison image pixel value is true, the function sets the destination pixel value to 0. If the comparison is false, the function copies the source pixel value to the destination pixel.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The source image.
compareImage	const Image*	The image to which the function compares the source image. This image must be the same type of image as source .
compare	ComparisonFunction	<p>The method in which the function compares images. The following options are valid:</p> <p>IMAQ_CLEAR_LESS—The comparison is true if the source pixel value is less than the comparison image pixel value.</p> <p>IMAQ_CLEAR_LESS_OR_EQUAL—The comparison is true if the source pixel value is less than or equal to the comparison image pixel value.</p> <p>IMAQ_CLEAR_EQUAL—The comparison is true if the source pixel value is equal to the comparison image pixel value.</p> <p>IMAQ_CLEAR_GREATER_OR_EQUAL—The comparison is true if the source pixel value is greater than or equal to the comparison image pixel value.</p> <p>IMAQ_CLEAR_GREATER—The comparison is true if the source pixel value is greater than the comparison image pixel value.</p>

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqCompareConstant

Usage

```
int = imaqCompareConstant(Image* dest, const Image* source, PixelValue value,  
                          ComparisonFunction compare)
```

Purpose

Copies the source image to the destination image in the following manner: If the given comparison between the source pixel value and the given constant is true, the function sets the destination pixel value to 0. If the comparison is false, the function copies the source pixel value to the destination.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The source image.
value	PixelValue	The value to compare to the source image. Use the grayscale value of the PixelValue union.
compare	ComparisonFunction	<p>The method in which the function compares images. The following options are valid:</p> <p><code>IMAQ_CLEAR_LESS</code>—The comparison is true if the source pixel value is less than the comparison image pixel value.</p> <p><code>IMAQ_CLEAR_LESS_OR_EQUAL</code>—The comparison is true if the source pixel value is less than or equal to the comparison image pixel value.</p> <p><code>IMAQ_CLEAR_EQUAL</code>—The comparison is true if the source pixel value is equal to the comparison image pixel value.</p> <p><code>IMAQ_CLEAR_GREATER_OR_EQUAL</code>—The comparison is true if the source pixel value is greater than or equal to the comparison image pixel value.</p> <p><code>IMAQ_CLEAR_GREATER</code>—The comparison is true if the source pixel value is greater than the comparison image pixel value.</p>

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqDivide

Usage

```
int = imaqDivide(Image* dest, const Image* sourceA, const Image* sourceB)
```

Purpose

Divides two images.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB

Parameters

Name	Type	Description
dest	Image*	The destination image.
sourceA	const Image*	The first image to divide.
sourceB	const Image*	<p>The second image to divide. The image type of sourceB depends on the image type of sourceA, as follows:</p> <p>If sourceA is IMAQ_IMAGE_I16, sourceB must be IMAQ_IMAGE_I16 or IMAQ_IMAGE_U8.</p> <p>If sourceA is IMAQ_IMAGE_SGL, sourceB must be IMAQ_IMAGE_SGL, IMAQ_IMAGE_16, or IMAQ_IMAGE_U8.</p> <p>If sourceA is IMAQ_IMAGE_COMPLEX, sourceB must be IMAQ_IMAGE_COMPLEX, IMAQ_IMAGE_SGL, IMAQ_IMAGE_16, or IMAQ_IMAGE_U8.</p> <p>If sourceA is IMAQ_IMAGE_RGB, sourceB must be IMAQ_IMAGE_RGB or IMAQ_IMAGE_U8.</p> <p>Otherwise sourceB must be the same type as sourceA.</p>

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqDivideConstant

Usage

```
int = imaqDivideConstant(Image* dest, const Image* source, PixelValue value)
```

Purpose

Divides each pixel in an image by a constant.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The image by which the function divides a scalar constant.
value	PixelValue	<p>The value by which the function divides the source image. value must correspond to the image type, as follows:</p> <p>If the image is IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, or IMAQ_IMAGE_SGL, use the <code>grayscale</code> value of the PixelValue union.</p> <p>If the image is IMAQ_IMAGE_COMPLEX, use the <code>complex</code> value of the PixelValue union.</p> <p>If the image is IMAQ_IMAGE_RGB, use the <code>rgb</code> value of the PixelValue union.</p>

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqLogicalDifference

Usage

```
int = imaqLogicalDifference(Image* dest, const Image* sourceA, const Image*
                           sourceB)
```

Purpose

Computes a bitwise logical difference (A AND NOT B) between two images.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The destination image.
sourceA	const Image*	The first source image.
sourceB	const Image*	The second source image, which must be the same type of image as sourceA .

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqLogicalDifferenceConstant

Usage

```
int = imaqLogicalDifferenceConstant(Image* dest, const Image* source,
                                   PixelValue value)
```

Purpose

Performs a bitwise logical difference (A AND NOT B) between an image and a constant.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The source image.
value	PixelValue	The value to AND NOT to the source image. value must correspond to the image type, as follows: If the image is IMAQ_IMAGE_U8 or IMAQ_IMAGE_I16, use the grayscale value of the PixelValue union. If the image is IMAQ_IMAGE_HSL, use the hsl value of the PixelValue union. If the image is IMAQ_IMAGE_RGB, use the rgb value of the PixelValue union.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqMax

Usage

```
int = imaqMax(Image* dest, const Image* sourceA, const Image* sourceB)
```

Purpose

Copies the larger pixel value of the two sources into the destination for each pixel.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
dest	Image*	The destination image.
sourceA	const Image*	The first source image.
sourceB	const Image*	The second source image, which must be the same type of image as sourceA .

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqMaxConstant

Usage

```
int = imaqMaxConstant(Image* dest, const Image* source, PixelValue value)
```

Purpose

Copies the source image to the destination in the following manner: If the source image pixel value is greater than the given constant, the function copies the source pixel to the destination. Otherwise the function copies the constant to the destination.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The first source image
value	PixelValue	The value to use in the computation. Use the <code>grayscale</code> value of the <code>PixelValue</code> union.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqMin

Usage

```
int = imaqMin(Image* dest, const Image* sourceA, const Image* sourceB)
```

Purpose

Copies the smaller pixel value of the two source pixels into the destination for each pixel.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
dest	Image*	The destination image.
sourceA	const Image*	The first source image.
sourceB	const Image*	The second source image, which must be the same type of image as sourceA .

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqMinConstant

Usage

```
int = imaqMinConstant(Image* dest, const Image* source, PixelValue value)
```

Purpose

Copies the source image to the destination in the following manner: If the source image pixel value is less than the given constant, the function copies the source pixel to the destination. Otherwise the function copies the constant to the destination.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The first source image
value	PixelValue	The value to use in the computation. Use the <code>grayscale</code> value of the PixelValue union.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqModulo

Usage

```
int = imaqModulo(Image* dest, const Image* sourceA, const Image* sourceB)
```

Purpose

Modulo divides two images.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_RGB

Parameters

Name	Type	Description
dest	Image*	The destination image.
sourceA	const Image*	The first image to modulo divide.
sourceB	const Image*	<p>The second image to modulo divide. The image type of sourceB depends on the image type of sourceA, as follows:</p> <p>If sourceA is IMAQ_IMAGE_I16, sourceB must be IMAQ_IMAGE_I16 or IMAQ_IMAGE_U8.</p> <p>If sourceA is IMAQ_IMAGE_SGL, sourceB must be IMAQ_IMAGE_SGL, IMAQ_IMAGE_16, or IMAQ_IMAGE_U8.</p> <p>If sourceA is IMAQ_IMAGE_RGB, sourceB must be IMAQ_IMAGE_RGB or IMAQ_IMAGE_U8.</p> <p>Otherwise sourceB must be the same type as sourceA.</p>

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqModuloConstant

Usage

```
int = imaqModuloConstant(Image* dest, const Image* source, PixelValue value)
```

Purpose

Performs a modulo division operation with each pixel in an image by a constant.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_RGB

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The image to be modulo divided by the scalar constant.
value	PixelValue	The value to use as the divisor in the operation. value must correspond to the image type, as follows: If the image is IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, or IMAQ_IMAGE_SGL, use the <code>grayscale</code> value of the <code>PixelValue</code> union. If the image is IMAQ_IMAGE_RGB, use the <code>rgb</code> value of the <code>PixelValue</code> union.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqMulDiv

Usage

```
int = imaqMulDiv(Image* dest, const Image* sourceA, const Image* sourceB,
                 float value)
```

Purpose

Computes a ratio between the two source images. You find the ratio by multiplying each pixel value in the first source image by the constant value you supply. This result is divided by the corresponding pixel in the second source, and the final result is stored in the destination image. You can use this function to correct a background if the background is lighter than the image. In a background correction, the first source image is the acquired image and the second source image is the background image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_RGB

Parameters

Name	Type	Description
dest	Image*	The destination image.
sourceA	const Image*	The first source image.
sourceB	const Image*	The second source image, which must be the same type of image as sourceA .
value	float	The value by which the function multiplies the first image.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqMultiply

Usage

```
int = imaqMultiply(Image* dest, const Image* sourceA, const Image* sourceB)
```

Purpose

Multiplies two images.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX,
IMAQ_IMAGE_RGB

Parameters

Name	Type	Description
dest	Image*	The destination image.
sourceA	const Image*	The first image to multiply.
sourceB	const Image*	<p>The second image to multiply. The image type of sourceB depends on the image type of sourceA, as follows:</p> <p>If sourceA is IMAQ_IMAGE_U8, sourceB must be IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX, or IMAQ_IMAGE_RGB.</p> <p>If sourceA is IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, or IMAQ_IMAGE_COMPLEX, sourceB must be IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, or IMAQ_IMAGE_COMPLEX.</p> <p>If sourceA is IMAQ_IMAGE_RGB, sourceB must be IMAQ_IMAGE_RGB or IMAQ_IMAGE_U8.</p>

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqMultiplyConstant

Usage

```
int = imaqMultiplyConstant(Image* dest, const Image* source, PixelValue
                           value)
```

Purpose

Multiplies each pixel in an image by a constant.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_RGB,
IMAQ_IMAGE_COMPLEX

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The image by which the function multiplies a scalar constant.
value	PixelValue	The value by which to multiply. value must correspond to the image type, as follows: If the image is IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, or IMAQ_IMAGE_SGL, use the grayscale value of the PixelValue union. If the image is IMAQ_IMAGE_COMPLEX, use the complex value of the PixelValue union. If the image is IMAQ_IMAGE_RGB, use the rgb value of the PixelValue union.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqNand

Usage

```
int = imaqNand(Image* dest, const Image* sourceA, const Image* sourceB)
```

Purpose

Computes a bitwise NAND between two images.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The destination image.
sourceA	const Image*	The first source image.
sourceB	const Image*	The second source image, which must be the same type of image as sourceA .

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqNandConstant

Usage

```
int = imaqNandConstant(Image* dest, const Image* source, PixelValue value)
```

Purpose

Performs a bitwise NAND between an image and a constant.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The source image.
value	PixelValue	<p>The value to NAND with the source image. value must correspond to the image type, as follows:</p> <p>If the image is IMAQ_IMAGE_U8 or IMAQ_IMAGE_I16, use the <code>grayscale</code> value of the <code>PixelValue</code> union.</p> <p>If the image is IMAQ_IMAGE_HSL, use the <code>hsl</code> value of the <code>PixelValue</code> union.</p> <p>If the image is IMAQ_IMAGE_RGB, use the <code>rgb</code> value of the <code>PixelValue</code> union.</p>

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqNor

Usage

```
int = imaqNor(Image* dest, const Image* sourceA, const Image* sourceB)
```

Purpose

Computes a bitwise NOR between two images.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The destination image.
sourceA	const Image*	The first source image.
sourceB	const Image*	The second source image, which must be the same type of image as sourceA .

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqNorConstant

Usage

```
int = imaqNorConstant(Image* dest, const Image* source, PixelValue value)
```

Purpose

Performs a bitwise NOR between an image and a constant.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The source image.
value	PixelValue	<p>The value to NOR with the source image. value must correspond to the image type, as follows:</p> <p>If the image is IMAQ_IMAGE_U8 or IMAQ_IMAGE_I16, use the <code>grayscale</code> value of the <code>PixelValue</code> union.</p> <p>If the image is IMAQ_IMAGE_HSL, use the <code>hsl</code> value of the <code>PixelValue</code> union.</p> <p>If the image is IMAQ_IMAGE_RGB, use the <code>rgb</code> value of the <code>PixelValue</code> union.</p>

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqOr

Usage

```
int = imaqOr(Image* dest, const Image* sourceA, const Image* sourceB)
```

Purpose

Computes a bitwise OR between two images.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The destination image.
sourceA	const Image*	The first source image.
sourceB	const Image*	The second source image, which must be the same type of image as sourceA .

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqOrConstant

Usage

```
int = imaqOrConstant(Image* dest, const Image* source, PixelValue value)
```

Purpose

Performs a bitwise OR between an image and a constant.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The source image.
value	PixelValue	<p>The value to OR to the source image. value must correspond to the image type, as follows:</p> <p>If the image is IMAQ_IMAGE_U8 or IMAQ_IMAGE_I16, use the <code>grayscale</code> value of the PixelValue union.</p> <p>If the image is IMAQ_IMAGE_HSL, use the <code>hsl</code> value of the PixelValue union.</p> <p>If the image is IMAQ_IMAGE_RGB, use the <code>rgb</code> value of the PixelValue union.</p>

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSubtract

Usage

```
int = imaqSubtract(Image* dest, const Image* sourceA, const Image* sourceB)
```

Purpose

Subtracts two images.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_RGB,
IMAQ_IMAGE_COMPLEX

Parameters

Name	Type	Description
dest	Image*	The destination image.
sourceA	const Image*	The first image to subtract.
sourceB	const Image*	<p>The second image to subtract. The type of the sourceB image depends on the type of the sourceA, as follows:</p> <p>If sourceA is IMAQ_IMAGE_I16, sourceB must be IMAQ_IMAGE_I16 or IMAQ_IMAGE_U8.</p> <p>If sourceA is IMAQ_IMAGE_SGL, sourceB must be IMAQ_IMAGE_SGL, IMAQ_IMAGE_16, or IMAQ_IMAGE_U8.</p> <p>If sourceA is IMAQ_IMAGE_RGB, sourceB must be IMAQ_IMAGE_RGB or IMAQ_IMAGE_U8.</p> <p>If sourceA is IMAQ_IMAGE_COMPLEX, sourceB must be IMAQ_IMAGE_COMPLEX, IMAQ_IMAGE_SGL, IMAQ_IMAGE_I16, or IMAQ_IMAGE_U8.</p> <p>Otherwise sourceB must be the same type as sourceA.</p>

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqSubtractConstant

Usage

```
int = imaqSubtractConstant(Image* dest, const Image* source, PixelValue
                           value)
```

Purpose

Subtracts each pixel in an image by a constant.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_RGB,
IMAQ_IMAGE_COMPLEX

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The image from which the function subtracts a scalar constant.
value	PixelValue	The value to subtract from the source image pixels. value must correspond to the image type, as follows: If the image is IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, or IMAQ_IMAGE_SGL, use the grayscale value of the PixelValue union. If the image is IMAQ_IMAGE_COMPLEX, use the complex value of the PixelValue union. If the image is IMAQ_IMAGE_RGB, use the rgb value of the PixelValue union.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqXnor

Usage

```
int = imaqXnor(Image* dest, const Image* sourceA, const Image* sourceB)
```

Purpose

Computes a bitwise XNOR between two images.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The destination image.
sourceA	const Image*	The first source image.
sourceB	const Image*	The second source image, which must be the same type of image as sourceA .

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqXnorConstant

Usage

```
int = imaqXnorConstant(Image* dest, const Image* source, PixelValue value)
```

Purpose

Performs a bitwise XNOR between an image and a constant.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The source image.
value	PixelValue	<p>The value to XNOR with the source image. value must correspond to the image type, as follows:</p> <p>If the image is IMAQ_IMAGE_U8 or IMAQ_IMAGE_I16, use the <code>grayscale</code> value of the PixelValue union.</p> <p>If the image is IMAQ_IMAGE_HSL, use the <code>hsl</code> value of the PixelValue union.</p> <p>If the image is IMAQ_IMAGE_RGB, use the <code>rgb</code> value of the PixelValue union.</p>

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqXor

Usage

```
int = imaqXor(Image* dest, const Image* sourceA, const Image* sourceB)
```

Purpose

Computes a bitwise XOR between two images.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The destination image.
sourceA	const Image*	The first source image.
sourceB	const Image*	The second source image, which must be the same type of image as sourceA .

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqXorConstant

Usage

```
int = imaqXorConstant(Image* dest, const Image* source, PixelValue value)
```

Purpose

Performs a bitwise XOR between an image and a constant.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_RGB, IMAQ_IMAGE_HSL

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The source image.
value	PixelValue	<p>The value to XOR with the source image. value must correspond to the image type, as follows:</p> <p>If the image is IMAQ_IMAGE_U8 or IMAQ_IMAGE_I16, use the <code>grayscale</code> value of the PixelValue union.</p> <p>If the image is IMAQ_IMAGE_HSL, use the <code>hsl</code> value of the PixelValue union.</p> <p>If the image is IMAQ_IMAGE_RGB, use the <code>rgb</code> value of the PixelValue union.</p>

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

Analytic Geometry

This chapter describes the Analytic Geometry functions in IMAQ Vision for LabWindows/CVI. Analytic Geometry functions allow you to perform analytical geometry operations, such as obtaining points on a contour within an image or obtaining the angle between two lines.

Analytic Geometry Function Panels

Table 16-1 lists the Analytic Geometry functions in a tree structure. The functions in the Analytic Geometry class are grouped according to the types of operations they perform. The first-level heading in the tree is the name of the class. The second-level headings are names of individual function panels. Each Analytic Geometry function panel represents one function.

Table 16-1. Analytic Geometry Function Tree

Class/Panel Name	Function Name
Analytic Geometry	
Best Circle	imaqBestCircle
Coordinate Reference	imaqCoordinateReference
Get Angle	imaqGetAngle
Get Points On Contour	imaqGetPointsOnContour
Get Points On Line	imaqGetPointsOnLine
Interpolate Points	imaqInterpolatePoints

imaqBestCircle

Usage

```
int = imaqBestCircle(const PointFloat* points, int numPoints, PointFloat*
                    center, double* radius)
```

Purpose

Returns the circle that best fits the given points.

Parameters

Name	Type	Description
points	const PointFloat*	The array of points to fit to the edge of the circle.
numPoints	int	The number of points in the supplied array. You must supply at least three points.
center	PointFloat*	On return, filled with the coordinates of the center of the circle. Set this parameter to NULL if you do not need this information.
radius	double*	On return, filled with the radius of the center of the circle. Set this parameter to NULL if you do not need this information.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqCoordinateReference

Usage

```
int = imaqCoordinateReference(const Point* points, ReferenceMode mode,
                             Point* origin, float* angle)
```

Purpose

Builds a reference for any arbitrary coordinate system with respect to the image plane. The reference of the coordinate system is specified as the position of the origin of the coordinate system and the orientation of its x-axis with respect to that of the image plane. Figure 16-1 illustrates how the function determines the reference of a coordinate system.



Note The y-axis of an image is inverted relative to the Cartesian coordinate system.

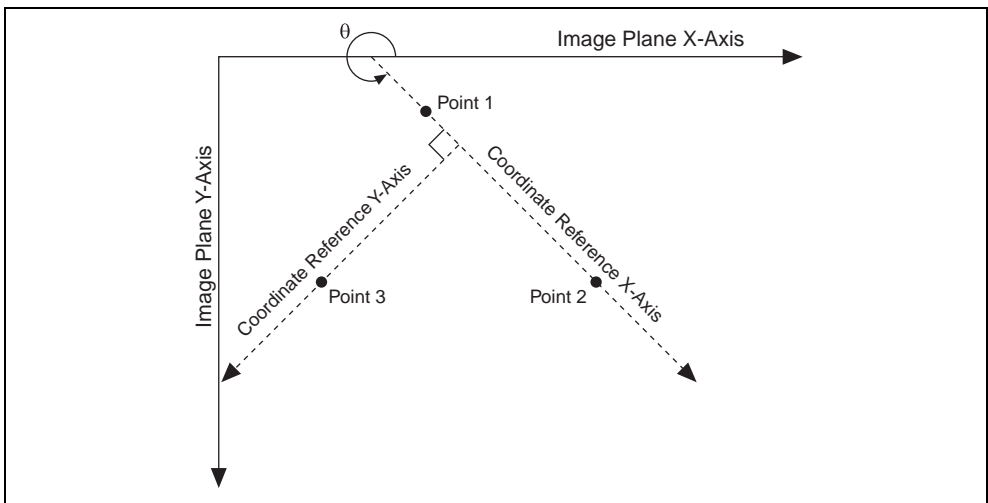


Figure 16-1. Reference of a Coordinate System

Parameters

Name	Type	Description
points	const Point*	An array of points defining the coordinate reference. If mode is <code>IMAQ_COORD_X_Y</code> , the points array must have three points. If mode is <code>IMAQ_COORD_ORIGIN_X</code> , the points array must have two points.
mode	ReferenceMode	Specifies the method that the function uses to calculate the coordinate reference. Set this parameter to <code>IMAQ_COORD_X_Y</code> to require three elements in the points array. The first two points are on the x-axis of the coordinate reference, and the third point is on the y-axis. Set this parameter to <code>IMAQ_COORD_ORIGIN_X</code> to require two elements in the points array. The first point is the origin of the coordinate reference, and the second point is on the x-axis.
origin	Point*	On return, the origin of the coordinate system. Set this parameter to <code>NULL</code> if you do not need this information.
angle	float*	On return, the angle, in degrees, of the x-axis of the coordinate system relative to the x-axis of an image. Set this parameter to <code>NULL</code> if you do not need this information.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetAngle

Usage

```
int = imaqGetAngle(PointFloat start1, PointFloat end1, PointFloat start2,
                   PointFloat end2, float* angle)
```

Purpose

Returns the angle, in degrees, between two lines. The returned angle represents the rotation around **start1** required so the line from **start1** to **end1** is parallel with the line from **start2** to **end2**. Figure 16-2 illustrates how the function calculates the angle between two lines.

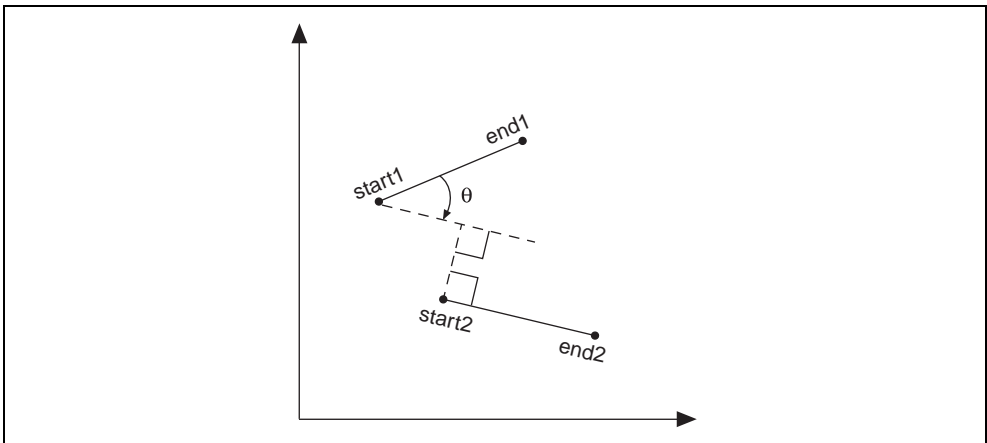


Figure 16-2. Calculating the Angle Between Two Lines

Parameters

Name	Type	Description
start1	PointFloat	The start point of the first line.
end1	PointFloat	The end point of the first line.
start2	PointFloat	The start point of the second line.
end2	PointFloat	The end point of the second line.
angle	float*	On return, the angle, in degrees, between the lines.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqGetPointsOnContour

Usage

```
SegmentInfo* = imaqGetPointsOnContour(const Image* image, int* numSegments)
```

Purpose

Finds the number of edge segments in an image with outlined edges and returns the points of each segment.

Image Types Supported

IMAQ_IMAGE_U8

Parameters

Name	Type	Description
image	const Image*	The image in which to find the segments.
numSegments	int*	On return, the number of segments found. Set this parameter to NULL if you do not need this information.

Return Value

SegmentInfo*—On success, this function returns an array of information about the segments. The **SegmentInfo** structure contains the following elements:

- **numberOfPoints**—The number of points in the segment.
- **isOpen**—If **TRUE**, the contour is open. If **FALSE**, the contour is closed.
- **weight**—The significance of the edge in terms of the gray values that constitute the edge.
- **points**—The points of the segment. This is a **ContourPoint**.

The **ContourPoint** structure contains the following information:

- **x**—The x-coordinate value in the image.
- **y**—The y-coordinate value in the image.
- **curvature**—The change in slope at this edge point of the segment.
- **xDisplacement**—The x displacement of the current edge pixel from a cubic spline fit of the current edge segment.
- **yDisplacement**—The y displacement of the current edge pixel from a cubic spline fit of the current edge segment.

On failure, this function returns `NULL`. To get extended error information, call `imaqGetLastError()`. When you are finished with the information, dispose of it by calling `imaqDispose()`.

imaqGetPointsOnLine

Usage

```
Point* = imaqGetPointsOnLine(Point start, Point end, int* numPoints)
```

Purpose

Given the endpoints of a line, this function returns all the points comprising the line.

Parameters

Name	Type	Description
start	Point	The first point of the line.
end	Point	The last point of the line.
numPoints	int*	On return, the number of points put into the returned array. Set this parameter to NULL if you do not need this information.

Return Value

Point*—On success, this function returns an array of the points on the line. On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`. When you are finished with this array, dispose of it by calling `imaqDispose()`.

imaqInterpolatePoints

Usage

```
float* = imaqInterpolatePoints(const Image* image, const Point* points, int
                               numPoints, InterpolationMethod method, int
                               subpixel, int* interpCount)
```

Purpose

Interpolates the pixel values of an image over specified points.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
image	const Image*	The image containing the values to interpolate.
points	const Point*	The points over which to interpolate. All the points in this array must be within the image. This parameter is required and cannot be NULL.
numPoints	int	The number of points in the input points array.
method	InterpolationMethod	Specifies the method for the interpolation. The following options are valid: IMAQ_BILINEAR IMAQ_QUADRATIC IMAQ_CUBIC_SPLINE
subpixel	int	The number of subdivisions into which to interpolate. For example, a value of 0 causes the function to return only the pixel values at the given points, whereas a value of 1 returns the pixel values at the given points and at the midpoint of each pair.
interpCount	int*	On return, the number of interpolated values in the array returned by the function. Set this parameter to NULL if you do not need this information.

Return Value

float*—On success, this function returns an array of the interpolated values. On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`. When you are finished with this array, dispose of it by calling `imaqDispose()`.

Frequency Domain Analysis

This chapter describes the Frequency Domain Analysis functions in IMAQ Vision for LabWindows/CVI. Frequency Domain Analysis functions allow you to convert images between the spatial and frequency domains and to analyze images in the frequency domain.

Frequency Domain Analysis Function Panels

Table 17-1 lists the Frequency Domain Analysis functions in a tree structure. The functions in the Frequency Domain Analysis class are grouped according to the types of operations they perform. The first-level heading in the tree is the name of the class. The second-level headings are names of individual function panels. Each Frequency Domain Analysis function panel represents one function.

Table 17-1. Frequency Domain Analysis Function Tree

Class/Panel Name	Function Name
Frequency Domain Analysis	
Attenuate	imaqAttenuate
Conjugate	imaqConjugate
FFT	imaqFFT
Flip Frequencies	imaqFlipFrequencies
Inverse FFT	imaqInverseFFT
Truncate	imaqTruncate

imaqAttenuate

Usage

```
int = imaqAttenuate(Image* dest, const Image* source, AttenuateMode highlow)
```

Purpose

Attenuates the frequencies of a complex image.

Image Type Supported

IMAQ_IMAGE_COMPLEX

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The image to attenuate.
highlow	AttenuateMode	The frequencies to attenuate. Set this parameter to IMAQ_ATTENUATE_LOW to attenuate low frequencies. Set this parameter to IMAQ_ATTENUATE_HIGH to attenuate high frequencies.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqConjugate

Usage

```
int = imaqConjugate(Image* dest, const Image* source)
```

Purpose

Computes the conjugate of a complex image.

Image Type Supported

IMAQ_IMAGE_COMPLEX

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The source image whose conjugate the function calculates.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqFFT

Usage

```
int = imaqFFT(Image* dest, const Image* source)
```

Purpose

Computes the Fourier transform of an image. The image can be any size, but the function works faster if the image dimensions are powers of 2. The destination image must be different than the source image to perform this operation.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, IMAQ_IMAGE_COMPLEX

Parameters

Name	Type	Description
dest	Image*	The destination image. The destination image must be a complex image and must be different than source image.
source	const Image*	The image whose Fourier transform the function computes.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqFlipFrequencies

Usage

```
int = imaqFlipFrequencies(Image* dest, const Image* source)
```

Purpose

Transposes the high and low frequencies of a complex image.

Image Type Supported

IMAQ_IMAGE_COMPLEX

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The complex image whose frequencies the function flips.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqInverseFFT

Usage

```
int = imaqInverseFFT(Image* dest, const Image* source)
```

Purpose

Takes the inverse Fourier transform of an image. The destination image must be different than the source image to perform this operation.

Image Type Supported

IMAQ_IMAGE_COMPLEX

Parameters

Name	Type	Description
dest	Image*	The destination image. Valid image types are IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL, or IMAQ_IMAGE_COMPLEX. The destination image must be different from the source image.
source	const Image*	The image whose inverse Fourier transform the function takes.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqTruncate

Usage

```
int = imaqTruncate(Image* dest, const Image* source, TruncateMode highlow,
                  float ratioToKeep)
```

Purpose

Truncates the frequencies of a complex image.

Image Type Supported

IMAQ_IMAGE_COMPLEX

Parameters

Name	Type	Description
dest	Image*	The destination image.
source	const Image*	The image whose frequencies the function truncates.
highlow	TruncateMode	Set this parameter to IMAQ_TRUNCATE_LOW to truncate low frequencies. Set this parameter to IMAQ_TRUNCATE_HIGH to truncate high frequencies.
ratioToKeep	float	Specifies the ratio of frequencies that the function retains. For example, set this parameter to 0.1 to retain 10% of the frequencies and attenuate 90% of the frequencies.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

Barcode

This chapter describes the Barcode function in IMAQ Vision for LabWindows/CVI. The Barcode function, `imaqReadBarcode`, allows you to read a barcode from an image.

Barcode Function Panels

Table 18-1 lists the Barcode function in a tree structure. The Barcode function panel represents one function.

Table 18-1. Barcode Function Tree

Class/Panel Name	Function Name
Barcode I/O	
Read Barcode	<code>imaqReadBarcode</code>

imaqReadBarcode

Usage

```
BarcodeInfo* = imaqReadBarcode(const Image* image, BarcodeType type,
                               const ROI* roi, int validate)
```

Purpose

This function reads a barcode from an image.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
image	const Image*	The image containing the barcode to read.
type	BarcodeType	The type of the barcode to read, as follows: IMAQ_I2_OF_5 IMAQ_EAN8 IMAQ_CODE39 IMAQ_EAN13 IMAQ_CODE93 IMAQ_CODABAR IMAQ_CODE128 IMAQ_MSI IMAQ_UPCA
roi	const ROI*	An ROI specifying the location of the barcode in the image. Set this parameter to NULL to use the entire image.
validate	int	If type is IMAQ_I2_OF_5, IMAQ_CODE39, or IMAQ_CODABAR, set validate to TRUE to use the error correction information of the barcode to validate the data. If type is not IMAQ_I2_OF_5, IMAQ_CODE39, or IMAQ_CODABAR, or if you set validate to FALSE, no validation occurs.

Return Value

BarcodeInfo*—On success, this function returns a pointer to a `BarcodeInfo` structure. This structure contains the following elements:

- `outputString`—A string containing the decoded barcode data.
- `outputChar1`—The contents of this character depend on the barcode type, as follows:
 - IMAQ_CODABAR—The start character.
 - IMAQ_CODE128—The FNC value.
 - IMAQ_EAN8 and IMAQ_EAN13—The first country code.

For all other barcode types, the function sets `outputChar1` to 0.

- `outputChar2`—The contents of this character depend on the barcode type, as follows:
 - `IMAQ_CODABAR`—The stop character.
 - `IMAQ_EAN8` and `IMAQ_EAN13`—The second country code.
 - `IMAQ_UPCA`—The system number.

For all other barcode types, the function sets `outputChar2` to 0.

- `confidenceLevel`—A quality measure of the decoded barcode ranging from 0 to 100, with 100 being the best. This value weighs the error in the widths of the bars and spaces with the size of the character in the barcode. In general, a confidence level of less than 80 means the decoded string is suspect.



Note The **confidenceLevel** is particularly useful in decoding `IMAQ_EAN13` barcodes because twelve of the thirteen data values are encoded as characters in the barcode, and the thirteenth value is encoded by the parity of the first 12 encoded characters.

- `type`—The type of barcode.

On failure, this function returns `NULL`. To get extended error information, call `imaqGetLastError()`. When you are finished with this structure, dispose of it by calling `imaqDispose()`.

LCD

This chapter describes the LCD functions in IMAQ Vision for LabWindows/CVI. LCD functions allow you to isolate and read the value of a seven-segment LCD.

LCD Function Panels

Table 19-1 lists the LCD functions in a tree structure. The functions in the LCD class are grouped according to the types of operations they perform. The first-level heading in the tree is the name of the class. The second-level headings are names of individual function panels. Each LCD function panel represents one function.

Table 19-1. LCD Function Tree

Class/Panel Name	Function Name
LCD	
Find LCD Segments	<code>imaqFindLCDSegments</code>
Read LCD	<code>imaqReadLCD</code>

imaqFindLCDSegments

Usage

```
int = imaqFindLCDSegments(ROI* roi, const Image* image, const
                          LCDOptions* options)
```

Purpose

Takes an ROI around a seven-segment LCD and transforms the ROI to be a set of rectangles around each LCD digit. You can then process this modified ROI with the `imaqReadLCD()` function.



Note All segments of the LCD must be on for this function to properly find the digits.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
roi	ROI*	The region of interest to transform.
image	const Image*	The image containing the LCD. All segments of the LCD must be lit.
options	const LCDOptions*	Controls how the function performs the search.

Parameter Discussion

options—The `LCDOptions` structure contains the following elements:

- `litSegments`—Set this parameter to `TRUE` if the segments are brighter than the background. Set this parameter to `FALSE` if the segments are darker than the background.
- `threshold`—Determines whether a segment is ON or OFF. A segment is ON if the standard deviation of the pixels along a line profile across the segment is greater than this threshold. Increase the threshold value when using images with high contrast. Decrease the threshold value when using images with low contrast.
- `sign`—Indicates whether the function must read the sign of the indicator. Set this parameter to `TRUE` to search for the sign. Set this parameter to `FALSE` to not search for the sign.
- `decimalPoint`—Determines whether to look for a decimal separator after each digit. Set this parameter to `TRUE` to search for the separator. Set this parameter to `FALSE` to not search for the separator.

Set the **options** parameter to `NULL` to use the default options, as follows:

- `litSegments`—`FALSE`
- `threshold`—`8`
- `sign`—`FALSE`
- `decimalPoint`—`FALSE`

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

imaqReadLCD

Usage

```
LCDReport* = imaqReadLCD(const Image* image, const ROI* roi, const
                        LCDOptions* options)
```

Purpose

Reads the numeric value of a seven-segment LCD.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
image	const Image*	The image containing the LCD to read.
roi	const ROI*	An ROI consisting of rectangles around each of the digits of the LCD. Generate this ROI by calling <code>imaqFindLCDSegments()</code> .
options	const LCDOptions*	Controls how the LCD is read.

Parameter Discussion

options—The `LCDOptions` structure contains the following elements:

- `litSegments`—Set this parameter to `TRUE` if the segments are brighter than the background. Set this parameter to `FALSE` if the segments are darker than the background.
- `threshold`—Determines whether a segment is ON or OFF. A segment is ON if the standard deviation of the pixels along a line profile across the segment is greater than this threshold. Increase the threshold value when using images with high contrast. Decrease the threshold value when using images with low contrast.
- `sign`—Indicates whether the function must read the sign of the indicator. Set this parameter to `TRUE` to search for the sign. Set this parameter to `FALSE` to not search for the sign.
- `decimalPoint`—Determines whether to look for a decimal separator after each digit. Set this parameter to `TRUE` to search for the separator. Set this parameter to `FALSE` to not search for the separator.

Set the **options** parameter to `NULL` to use the default options, as follows:

- `litSegments`—`FALSE`
- `threshold`—8

- `sign`—FALSE
- `decimalPoint`—FALSE

Return Value

`LCDReport*`—On success, this function returns a structure describing the state of the LCD. The `LCDReport` structure consists of the following elements:

- `text`—A string of the characters of the LCD.
- `segmentInfo`—An array of `LCDSegment` structures describing which segments of each digit are on.
- `numCharacters`—The number of characters that the function read. This describes the number of elements in the `segmentInfo` array.

The `LCDSegment` structure consists of the following elements. See Figure 19-1 for more information.

- `a`—True if the **a** segment is on.
- `b`—True if the **b** segment is on.
- `c`—True if the **c** segment is on.
- `d`—True if the **d** segment is on.
- `e`—True if the **e** segment is on.
- `f`—True if the **f** segment is on.
- `g`—True if the **g** segment is on.

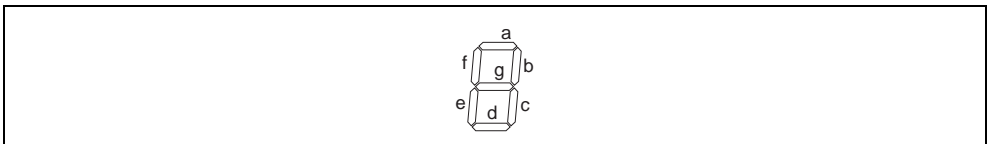


Figure 19-1. Segments of an LCD

On failure, this function returns `NULL`. To get extended error information, call `imaqGetLastError()`.

Meter

This chapter describes the Meter functions in IMAQ Vision for LabWindows/CVI. Meter functions allow you to identify the arc information of and then read a meter.

Meter Function Panels

Table 20-1 lists the Meter functions in a tree structure. The functions in the Meter class are grouped according to the types of operations they perform. The first-level heading in the tree is the name of the class. The second-level headings are names of individual function panels. Each Meter function panel represents one function.

Table 20-1. Meter Function Tree

Class/Panel Name	Function Name
Meter	
Get Meter Arc	imaqGetMeterArc
Read Meter	imaqReadMeter

imaqGetMeterArc

Usage

```
MeterArc* = imaqGetMeterArc(int lightNeedle, MeterArcMode mode, const ROI*
                             roi, PointFloat base, PointFloat start,
                             PointFloat end)
```

Purpose

Returns the arc information of a meter. The `imaqReadMeter()` function uses this information to read a meter.

Parameters

Name	Type	Description
lightNeedle	int	Set this parameter to TRUE to find a light-colored needle on a dark background. Set this parameter to FALSE to find a dark-colored needle on a light background.
mode	MeterArcMode	Describes how to determine the arc. Set this parameter to <code>IMAQ_METER_ARC_ROI</code> to use the roi parameter and ignore the base , start , and end parameters. Set this parameter to <code>IMAQ_METER_ARC_POINTS</code> to use the base , start , and end parameters and ignore the roi parameter.
roi	const ROI*	Consist of two lines, each drawn from the tip of the needle to its base. The first line represents the minimum position of the needle, and the second line represents the maximum position of the needle. If mode is <code>IMAQ_METER_ARC_ROI</code> , roi is required and cannot be NULL. If mode is <code>IMAQ_METER_ARC_POINTS</code> , the function ignores roi , and the parameter can be NULL.
base	PointFloat	The location of the base of the needle. If mode is <code>IMAQ_METER_ARC_POINTS</code> , base is required and cannot be NULL. If mode is <code>IMAQ_METER_ARC_ROI</code> , the function ignores base .
start	PointFloat	The location of the tip of the needle when the needle is at the minimum sweep position. If mode is <code>IMAQ_METER_ARC_POINTS</code> , start is required and cannot be NULL. If mode is <code>IMAQ_METER_ARC_ROI</code> , the function ignores start .

Name	Type	Description
end	PointFloat	The location of the tip of the needle when the needle is at the maximum sweep position. If mode is <code>IMAQ_METER_ARC_POINTS</code> , end is required. If mode is <code>IMAQ_METER_ARC_ROI</code> , the function ignores end .

Return Value

MeterArc*—On success, this function returns a structure describing the arc across which a meter sweeps. On failure, this function returns `NULL`. To get extended error information, call `imaqGetLastError()`. When you are finished with this information, dispose of it by calling `imaqDispose()`.

imaqReadMeter

Usage

```
int = imaqReadMeter(const Image* image, const MeterArc* arcInfo, double*
                    percentage, PointF* endOfNeedle)
```

Purpose

Reads a meter. You must have already determined the arc information with `imaqGetMeterArc()`.

Image Types Supported

IMAQ_IMAGE_U8, IMAQ_IMAGE_I16, IMAQ_IMAGE_SGL

Parameters

Name	Type	Description
image	const Image*	The image of the meter to read.
arcInfo	const MeterArc*	Information about the meter's arc. This information is returned by <code>imaqGetMeterArc()</code> .
percentage	double*	Returns the current sweep position of the needle in comparison to the maximum sweep position, expressed as a percentage. For example, a value of 100 indicates the needle is at the maximum sweep position. Set this parameter to NULL if you do not need this information.
endOfNeedle	PointF*	Returns the location of the endpoint of the needle. Set this parameter to NULL if you do not need this information.

Return Value

int—On success, this function returns a non-zero value. On failure, this function returns 0. To get extended error information, call `imaqGetLastError()`.

Utilities

This chapter describes the Utilities functions in IMAQ Vision for LabWindows/CVI. Utilities functions allow you to set up structures that you can embed in other functions to eliminate the need to declare certain types of variables such as `Point`, `PointFLoat`, and `Rect`.

Utilities Function Panels

Table 21-1 lists the Utilities functions in a tree structure. The functions in the Utilities class are grouped according to the types of operations they perform. The first-level heading in the tree is the name of the class. The second-level headings are names of individual function panels. Each Utilities function panel represents one function.

Table 21-1. Utilities Function Tree

Class/Panel Name	Function Name
Utilities	
Get Kernel	<code>imaqGetKernel</code>
Make Point	<code>imaqMakePoint</code>
Make Point Float	<code>imaqMakePointFLoat</code>
Make Rect	<code>imaqMakeRect</code>

imaqGetKernel

Usage

```
const float* = imaqGetKernel(KernelFamily family, int size, int number)
```

Purpose

Returns a pointer to a predefined convolution matrix. You can use the returned pointer in conjunction with `imaqConvolve()`. You cannot dispose of or alter the returned pointer because it is a reference to static memory. If you need to alter the kernel, copy the data from the supplied kernel to the memory space you have allocated yourself. For information about the predefined kernels, see Appendix B, *Kernels*.

Parameters

Name	Type	Description
family	KernelFamily	The family of the kernel matrix. The following options are valid: IMAQ_GRADIENT_FAMILY IMAQ_LAPLACIAN_FAMILY IMAQ_SMOOTHING_FAMILY IMAQ_GAUSSIAN_FAMILY
size	int	The horizontal and vertical matrix size. Valid values are 3, 5, and 7, corresponding to the convolution matrix sizes of 3×3 , 5×5 , and 7×7 .
number	int	References the particular desired matrix among the predefined matrices that are available for each family and size.

Return Value

const float*—On success, this function returns a pointer to the requested matrix. This pointer points to constant data in memory that you should not alter. On failure, this function returns NULL. To get extended error information, call `imaqGetLastError()`. You do not need to call `imaqDispose()` on the pointer.

imaqMakePoint

Usage

```
Point = imaqMakePoint(int xCoordinate, int yCoordinate)
```

Purpose

Returns a `Point` structure with the values you specify. The `Point` structure defines the location of a point. You can embed a call to `imaqMakePoint()` in calls to other IMAQ functions that require `Point` structures as input parameters, thereby eliminating the need to declare a `Point` variable.



Note LabWindows/CVI users: This function duplicates the functionality of the LabWindows/CVI function `MakePoint()`.

Parameters

Name	Type	Description
<code>xCoordinate</code>	<code>int</code>	Horizontal location of the point.
<code>yCoordinate</code>	<code>int</code>	Vertical location of the point.

Return Value

Point—This function returns a `Point` structure containing the coordinate values you specify.

imaqMakePointFloat

Usage

```
PointFloat = imaqMakePointFloat(float xCoordinate, float yCoordinate)
```

Purpose

Returns a `PointFloat` structure with the values you specify. The `PointFloat` structure defines the location of a point. You can embed a call to `imaqMakePointFloat()` in calls to other IMAQ functions that require `PointFloat` structures as input parameters, thereby eliminating the need to declare a `PointFloat` variable.

Parameters

Name	Type	Description
xCoordinate	float	Horizontal location of the point.
yCoordinate	float	Vertical location of the point.

Return Value

PointFloat—This function returns a `PointFloat` structure containing the coordinate values you specify.

imaqMakeRect

Usage

```
Rect = imaqMakeRect(int top, int left, int height, int width)
```

Purpose

Returns a `Rect` structure with the values you specify. The `Rect` structure defines the location and size of a rectangle. You can embed a call to `imaqMakeRect()` in calls to other IMAQ functions that require `Rect` structures as input parameters, thereby eliminating the need to declare a `Rect` variable.



Note LabWindows/CVI users: This function duplicates the functionality of the LabWindows/CVI function `MakeRect()`.

Parameters

Name	Type	Description
top	int	Location of the top edge of the rectangle.
left	int	Location of the left edge of the rectangle.
height	int	Height of the rectangle.
width	int	Width of the rectangle.

Return Value

Rect—This function returns a `Rect` structure containing the coordinate values you specify.



Error Codes

Table A-1 lists the IMAQ Vision for LabWindows/CVI function error codes.

Table A-1. IMAQ Vision for LabWindows/CVI Error Codes

Error Code	Error Name	Description
0	ERR_SUCCESS	No error.
-1074396160	ERR_SYSTEM_ERROR	System error.
-1074396159	ERR_OUT_OF_MEMORY	Not enough memory for requested operation.
-1074396158	ERR_MEMORY_ERROR	Memory error.
-1074396157	ERR_UNREGISTERED	Unlicensed IMAQ Vision.
-1074396156	ERR_NEED_FULL_VERSION	The function requires an IMAQ Vision 5.0 Advanced license.
-1074396155	ERR_UNINIT	IMAQ Vision did not initialize properly.
-1074396154	ERR_IMAGE_TOO_SMALL	The image is not large enough for the operation.
-1074396153	ERR_BARCODE_CODABAR	The barcode is not a valid Codabar barcode.
-1074396152	ERR_BARCODE_CODE39	The barcode is not a valid Code 3 of 9 barcode.
-1074396151	ERR_BARCODE_CODE93	The barcode is not a valid Code93 barcode.
-1074396150	ERR_BARCODE_CODE128	The barcode is not a valid Code128 barcode.
-1074396149	ERR_BARCODE_EAN8	The barcode is not a valid EAN8 barcode.
-1074396148	ERR_BARCODE_EAN13	The barcode is not a valid EAN13 barcode.
-1074396147	ERR_BARCODE_I25	The barcode is not a valid Interleaved 2 of 5 barcode.
-1074396146	ERR_BARCODE_MSI	The barcode is not a valid MSI barcode.
-1074396145	ERR_BARCODE_UPCA	The barcode is not a valid UPCA barcode.
-1074396144	ERR_BARCODE_CODE93_SHIFT	The Code93 barcode contains an invalid shift encoding.
-1074396143	ERR_BARCODE_TYPE	The barcode type is invalid.
-1074396142	ERR_BARCODE_INVALID	The image does not represent a valid linear barcode.
-1074396141	ERR_BARCODE_CODE128_FNC	The FNC value in the Code128 barcode is not before the first data value.

Table A-1. IMAQ Vision for LabWindows/CVI Error Codes (Continued)

Error Code	Error Name	Description
-1074396140	ERR_BARCODE_CODE128_SET	The starting code set in the Code128 barcode is not valid.
-1074396120	ERR_NOT_IMAGE	Not an image.
-1074396117	ERR_MATRIX_SIZE	Invalid matrix size in the structuring element.
-1074396080	ERR_INVALID_IMAGE_TYPE	Invalid image type.
-1074396079	ERR_INVALID_METAFILE_HANDLE	Invalid metafile handle.
-1074396077	ERR_INCOMP_TYPE	Incompatible image type.
-1074396074	ERR_INCOMP_SIZE	Incompatible image size.
-1074396072	ERR_INVALID_BORDER	Invalid image border.
-1074396070	ERR_INVALID_FUNCTION	Unsupported function.
-1074396069	ERR_INVALID_COLOR_MODE	IMAQ Vision does not support the color mode you specified.
-1074396068	ERR_INVALID_ACTION	The function does not support the requested action.
-1074396067	ERR_IMAGES_NOT_DIFF	Source and destination images must be different.
-1074396040	ERR_DRIVER	Cannot access NI-IMAQ driver.
-1074396039	ERR_IO_ERROR	I/O error.
-1074396037	ERR_TIMEOUT	Trigger timeout.
-1074396000	ERR_FILE_FILE_HEADER	Invalid file header.
-1074395999	ERR_FILE_FILE_TYPE	Invalid file type.
-1074395998	ERR_FILE_COLOR_TABLE	Invalid color table.
-1074395997	ERR_FILE_ARGERR	Invalid parameter.
-1074395996	ERR_FILE_OPEN	File is already open for writing.
-1074395995	ERR_FILE_NOT_FOUND	File not found.
-1074395994	ERR_FILE_TOO_MANY_OPEN	Too many files open.
-1074395993	ERR_FILE_IO_ERR	File I/O error.
-1074395992	ERR_FILE_PERMISSION	File access denied.
-1074395991	ERR_FILE_INVALID_TYPE	IMAQ Vision does not support the file type you specified.
-1074395990	ERR_FILE_GET_INFO	Unable to get file information.
-1074395989	ERR_FILE_READ	Unable to read data.
-1074395988	ERR_FILE_WRITE	Unable to write data.

Table A-1. IMAQ Vision for LabWindows/CVI Error Codes (Continued)

Error Code	Error Name	Description
-1074395987	ERR_FILE_EOF	Premature end of file.
-1074395986	ERR_FILE_FORMAT	Invalid file format.
-1074395985	ERR_FILE_OPERATION	Invalid file operation.
-1074395984	ERR_FILE_INVALID_DATA_TYPE	IMAQ Vision does not support the file data type you specified.
-1074395983	ERR_FILE_NO_SPACE	Disk full.
-1074395960	ERR_INIT	Initialization error.
-1074395959	ERR_CREATE_WINDOW	Unable to create window.
-1074395958	ERR_WINDOW_ID	Invalid window ID.
-1074395957	ERR_ARRAY_SIZE_MISMATCH	The array sizes are not compatible.
-1074395920	ERR_NUMBER_CLASS	Invalid number of classes.
-1074395880	ERR_PARTICLE	Invalid particle.
-1074395879	ERR_BAD_MEASURE	Invalid measure number.
-1074395840	ERR_BAD_INDEX	Invalid handle table index.
-1074395800	ERR_PROTECTION	Protection error.
-1074395799	ERR_INTERNAL	Internal error.
-1074395760	ERR_BOARD_NOT_FOUND	Board not found.
-1074395758	ERR_BOARD_NOT_OPEN	Board not opened.
-1074395757	ERR_DLL_NOT_FOUND	DLL not found.
-1074395756	ERR_DLL_FUNCTION_NOT_FOUND	DLL function not found.
-1074395754	ERR_TRIG_TIMEOUT	Trigger timeout.
-1074395720	ERR_BAD_ROI	Invalid ROI.
-1074395719	ERR_BAD_ROI_BOX	Invalid ROI global rectangle.
-1074395718	ERR_LAB_VERSION	The version of LabVIEW or BridgeVIEW you are running does not support this operation.
-1074395600	ERR_INFO_NOT_FOUND	You did not provide information about the subimage within the browser.
-1074395401	ERR_INVALID_MATCHFACTOR	The function does not support the matchFactor that you specified.
-1074395397	ERR_COMPLEX_IMAGE_REQUIRED	Complex image required.

Table A-1. IMAQ Vision for LabWindows/CVI Error Codes (Continued)

Error Code	Error Name	Description
-1074395360	ERR_COMPLEX_PLANE	Invalid complex plane.
-1074395349	ERR_INVALID_SKELETONMETHOD	IMAQ Vision does not support the SkeletonMethod value you supplied.
-1074395348	ERR_INVALID_3DPLANE	IMAQ Vision does not support the 3DPlane value you supplied.
-1074395347	ERR_INVALID_3DDIRECTION	IMAQ Vision does not support the 3DDirection value you supplied.
-1074395346	ERR_INVALID_INTERPOLATIONMETHOD_FOR_ROTATE	imaqRotate does not support the InterpolationMethod value you supplied.
-1074395345	ERR_INVALID_FLIPAXIS	IMAQ Vision does not support the FlipAxis value you supplied.
-1074395343	ERR_FILE_FILENAME_NULL	You must pass a valid file name. Do not pass in NULL.
-1074395340	ERR_INVALID_SIZETYPE	IMAQ Vision does not support the SizeType value you supplied.
-1074395332	ERR_INVALID_COMPAREFUNCTION	IMAQ Vision does not support the ComparisonFunction value you supplied.
-1074395331	ERR_INVALID_BORDERMETHOD	IMAQ Vision does not support the BorderMethod value you supplied.
-1074395330	ERR_INVALID_BORDER_SIZE	The border size is not within the valid range (0-50).
-1074395329	ERR_INVALID_OUTLINEMETHOD	IMAQ Vision does not support the OutlineMethod value you supplied.
-1074395328	ERR_INVALID_INTERPOLATIONMETHOD	IMAQ Vision does not support the InterpolationMethod value you supplied.
-1074395327	ERR_INVALID_SCALINGMODE	IMAQ Vision does not support the ScalingMode value you supplied.
-1074395326	ERR_INVALID_DRAWMODE_FOR_LINE	imaqDrawLineOnImage does not support the DrawMode value you supplied.
-1074395325	ERR_INVALID_DRAWMODE	IMAQ Vision does not support the DrawMode value you supplied.
-1074395324	ERR_INVALID_SHAPEMODE	IMAQ Vision does not support the ShapeMode value you supplied.
-1074395323	ERR_INVALID_FONTCOLOR	IMAQ Vision does not support the FontColor value you supplied.
-1074395322	ERR_INVALID_TEXTALIGNMENT	IMAQ Vision does not support the TextAlignment value you supplied.

Table A-1. IMAQ Vision for LabWindows/CVI Error Codes (Continued)

Error Code	Error Name	Description
-1074395321	ERR_INVALID_MORPHOLOGYMETHOD	IMAQ Vision does not support the MorphologyMethod value you supplied.
-1074395320	ERR_TEMPLATE_EMPTY	The template image is empty.
-1074395319	ERR_INVALID_SUBPIX_TYPE	IMAQ Vision does not support the interpolation type you supplied.
-1074395318	ERR_INSF_POINTS	Insufficient points in array.
-1074395317	ERR_UNDEF_POINT	Invalid point defined.
-1074395316	ERR_INVALID_KERNEL_CODE	Invalid kernel code.
-1074395310	ERR_INVALID_PALETTE_TYPE	IMAQ Vision does not support the PaletteType value you supplied.
-1074395309	ERR_INVALID_WINDOW_THREAD_POLICY	IMAQ Vision does not support the WindowThreadPolicy value you supplied.
-1074395308	ERR_INVALID_COLORCOMPLEXITY	IMAQ Vision does not support the ColorComplexity value you supplied.
-1074395307	ERR_PRECISION_NOT_GTR_THAN_0	The percision parameter must be greater than 0.
-1074395306	ERR_INVALID_TOOL	IMAQ Vision does not support the Tool value you supplied.
-1074395305	ERR_INVALID_REFERENCEMODE	IMAQ Vision does not support the ReferenceMode value you supplied.
-1074395304	ERR_INVALID_MATHTRANSFORMMETHOD	IMAQ Vision does not support the MathTransformMethod value you supplied.
-1074395303	ERR_INVALID_NUM_OF_CLASSES	The number of classes for imaqAutoThreshold is not within the valid range (2-256).
-1074395302	ERR_INVALID_THRESHOLDMETHOD	IMAQ Vision does not support the ThresholdMethod value you supplied.
-1074395301	ERR_ROI_NOT_2_LINES	The ROI you passed into imaqGetMeterArc must consist of two lines.
-1074395300	ERR_INVALID_METERARCMODE	IMAQ Vision does not support the MeterArcMode value you supplied.
-1074395299	ERR_INVALID_COMPLEXPLANE	IMAQ Vision does not support the ComplexPlane value you supplied.
-1074395298	ERR_COMPLEXPLANE_NOT_REAL_OR_IMAGINARY	You can perform this operation on a real or an imaginary ComplexPlane only.
-1074395297	ERR_INVALID_PARTICLEINFOMODE	IMAQ Vision does not support the ParticleInfoMode value you supplied.

Table A-1. IMAQ Vision for LabWindows/CVI Error Codes (Continued)

Error Code	Error Name	Description
-1074395296	ERR_INVALID_BARCODETYPE	IMAQ Vision does not support the BarcodeType value you supplied.
-1074395295	ERR_INVALID_INTERPOLATIONMETHOD_INTERPOLATEPOINTS	imaqInterpolatePoints does not support the InterpolationMethod value you supplied.
-1074395294	ERR_CONTOUR_INDEX_OUT_OF_RANGE	The contour index you supplied is larger than the number of contours in the ROI.
-1074395293	ERR_CONTOURID_NOT_FOUND	The supplied ContourID did not correlate to a contour inside the ROI.
-1074395280	ERR_ROI_NOT_RECT	ROI is not a rectangle.
-1074395279	ERR_ROI_NOT_POLYGON	ROI is not a polygon.
-1074395278	ERR_LCD_NOT_NUMERIC	LCD image is not a number.
-1074395277	ERR_BARCODE_CHECKSUM	The decoded barcode information did not pass the checksum test.
-1074395276	ERR_LINES_PARALLEL	You specified parallel lines for the meter ROI.
-1074395275	ERR_INVALID_BROWSER_IMAGE	Invalid browser image.
-1074395270	ERR_DIV_BY_ZERO	Cannot divide by zero.
-1074395269	ERR_NULL_POINTER	Null pointer.
-1074395268	ERR_LINEAR_COEFF	The linear equations are not independent.
-1074395267	ERR_COMPLEX_ROOT	The roots of the equation are complex.
-1074395265	ERR_BARCODE	The barcode does not match the type you specified.
-1074395263	ERR_LCD_NO_SEGMENTS	No lit segment.
-1074395262	ERR_LCD_BAD_MATCH	The LCD does not form a known digit.
-1074395261	ERR_GIP_RANGE	An internal error occurred while attempting to access an invalid coordinate on an image.
-1074395260	ERR_HEAP_TRASHED	An internal memory error occurred.
-1074395258	ERR_BAD_FILTER_WIDTH	The filter width must be odd for the Canny operator.
-1074395257	ERR_INVALID_EDGE_DIR	You supplied an invalid edge direction in the Canny operator.
-1074395256	ERR_EVEN_WINDOW_SIZE	The window size must be odd for the Canny operator.
-1074395253	ERR_LEARN_MODE	Invalid learn mode.
-1074395252	ERR_LEARN_SETUP_DATA	Invalid learn setup data.

Table A-1. IMAQ Vision for LabWindows/CVI Error Codes (Continued)

Error Code	Error Name	Description
-1074395251	ERR_MATCH_MODE	Invalid match mode.
-1074395250	ERR_MATCH_SETUP_DATA	Invalid match setup data.
-1074395249	ERR_ROTATION_ANGLE_RANGE_TOO_LARGE	At least one range in the array of rotation angle ranges exceeds 360 degrees.
-1074395248	ERR_TOO_MANY_ROTATION_ANGLE_RANGES	The array of rotation angle ranges contains too many ranges.
-1074395247	ERR_TEMPLATE_DESCRIPTOR	Invalid template descriptor.
-1074395246	ERR_TEMPLATE_DESCRIPTOR_IMAGE_INFO	Invalid template descriptor.
-1074395245	ERR_TEMPLATE_DESCRIPTOR_LEARN_MODE	Invalid template descriptor.
-1074395244	ERR_TEMPLATE_DESCRIPTOR_VERSION	Invalid template descriptor.
-1074395243	ERR_TEMPLATE_DESCRIPTOR_MATCH_VERSION	The template descriptor was created in a newer version of IMAQ Vision. Upgrade to a higher version of IMAQ Vision to use this template.
-1074395242	ERR_TEMPLATE_DESCRIPTOR_ROTATION	Invalid template descriptor.
-1074395241	ERR_TEMPLATE_DESCRIPTOR_ROTATION_EMPTY	The template descriptor does not contain data that <code>imaqMatchPattern</code> requires for rotation-invariant matching.
-1074395240	ERR_TEMPLATE_DESCRIPTOR_ROTATION_FINALSTAGE	Invalid template descriptor.
-1074395239	ERR_TEMPLATE_DESCRIPTOR_SHIFT	Invalid template descriptor.
-1074395238	ERR_TEMPLATE_DESCRIPTOR_SHIFT_EMPTY	The template descriptor does not contain data that <code>imaqMatchPattern</code> requires for shift-invariant matching.
-1074395237	ERR_TEMPLATE_DESCRIPTOR_SHIFT_FINALSTAGE	Invalid template descriptor.
-1074395235	ERR_TEMPLATE_IMAGE_CONTRAST_TOO_LOW	The template image does not contain enough contrast.
-1074395234	ERR_TEMPLATE_IMAGE_TOO_SMALL	The template image is too small.
-1074395233	ERR_TEMPLATE_IMAGE_TOO_LARGE	The template image is too large.

Kernels

Appendix B shows the available predefined convolution matrices. You can access these matrices by calling `imaqGetKernel()`.

Table B-1. Gradient 3 x 3

matrix # & Content	matrix # & Content	matrix # & Content	matrix # & Content
#0 -1 0 1 -1 0 1 -1 0 1	#1 -1 0 1 -1 1 1 -1 0 1	#2 0 1 1 -1 0 1 -1 -1 0	#3 0 1 1 -1 1 1 -1 -1 0
#4 1 1 1 0 0 0 -1 -1 -1	#5 1 1 1 0 1 0 -1 -1 -1	#6 1 1 0 1 0 -1 0 -1 -1	#7 1 1 0 1 1 -1 -0 -1 -1
#8 1 0 -1 1 0 -1 1 0 -1	#9 1 0 -1 1 1 -1 1 0 -1	#10 0 -1 -1 1 0 -1 1 1 0	#11 0 -1 -1 1 1 -1 1 1 0
#12 -1 -1 -1 0 0 0 1 1 1	#13 -1 -1 -1 0 1 0 1 1 1	#14 -1 -1 0 -1 0 1 0 1 1	#15 -1 -1 0 -1 1 1 0 1 1
#16 -1 0 1 -2 0 2 -1 0 1	#17 -1 0 1 -2 1 2 -1 0 1	#18 0 1 2 -1 0 1 -2 -1 0	#19 0 1 2 -1 1 1 -2 -1 0

Table B-1. Gradient 3 x 3 (Continued)

matrix # & Content	matrix # & Content	matrix # & Content	matrix # & Content
#20 1 2 1 0 0 0 -1 -2 -1	#21 1 2 1 0 1 0 -1 -2 -1	#22 2 1 0 1 0 -1 0 -1 -2	#23 2 1 0 1 1 -1 0 -1 -2
#24 1 0 -1 2 0 -2 1 0 -1	#25 1 0 -1 2 1 -2 1 0 -1	#26 0 -1 -2 1 0 -1 2 1 0	#27 0 -1 -2 1 1 -1 2 1 0
#28 -1 -2 -1 0 0 0 1 2 1	#29 -1 -2 -1 0 1 0 1 2 1	#30 -2 -1 0 -1 0 1 0 1 2	#31 -2 -1 0 -1 1 1 0 1 2

Table B-2. Gradient 5 x 5

matrix # & Content	matrix # & Content	matrix # & Content	matrix # & Content
#0 0 -1 0 1 0 -1 -2 0 2 1 -1 -2 0 2 1 -1 -2 0 2 1 0 -1 0 1 0	#1 0 -1 0 1 0 -1 -2 0 2 1 -1 -2 1 2 1 -1 -2 0 2 1 0 -1 0 1 0	#2 0 0 1 1 1 0 0 2 2 1 -1 -2 0 2 1 -1 -2 -2 0 0 -1 -1 -1 0 0	#3 0 0 1 1 1 0 0 2 2 1 -1 -2 1 2 1 -1 -2 -2 0 0 -1 -1 -1 0 0
#4 0 1 1 1 0 1 2 2 2 1 0 0 0 0 0 -1 -2 -2 -2 -1 0 -1 -1 -1 0	#5 0 1 1 1 0 1 2 2 2 1 0 0 1 0 0 -1 -2 -2 -2 -1 0 -1 -1 -1 0	#6 1 1 1 0 0 1 2 2 0 0 1 2 0 -2 -1 0 0 -2 -2 -1 0 0 -1 -1 -1	#7 1 1 1 0 0 1 2 2 0 0 1 2 1 -2 -1 0 0 -2 -2 -1 0 0 -1 -1 -1

Table B-2. Gradient 5 x 5 (Continued)

matrix # & Content	matrix # & Content	matrix # & Content	matrix # & Content
#8	#9	#10	#11
0 1 0 -1 0	0 1 0 -1 0	0 0 -1 -1 -1	0 0 -1 -1 -1
1 2 0 -2 -1	1 2 0 -2 -1	0 0 -2 -2 -1	0 0 -2 -2 -1
1 2 0 -2 -1	1 2 1 -2 -1	1 2 0 -2 -1	1 2 1 -2 -1
1 2 0 -2 -1	1 2 0 -2 -1	1 2 2 0 0	1 2 2 0 0
0 1 0 -1 0	0 1 0 -1 0	1 1 1 0 0	1 1 1 0 0
#12	#13	#14	#15
0 -1 -1 -1 0	0 -1 -1 -1 0	-1 -1 -1 0 0	-1 -1 -1 0 0
-1 -2 -2 -2 -1	-1 -2 -2 -2 -1	-1 -2 -2 0 0	-1 -2 -2 0 0
0 0 0 0 0	0 0 1 0 0	-1 -2 0 2 1	-1 -2 1 2 1
1 2 2 2 1	1 2 2 2 1	0 0 2 2 1	0 0 2 2 1
0 1 1 1 0	0 1 1 1 0	0 0 1 1 1	0 0 1 1 1

Table B-3. Gradient 7 x 7

matrix # & Content	matrix # & Content	matrix # & Content	matrix # & Content
#0 0 -1 -1 0 1 1 0 -1 -2 -2 0 2 2 1 -1 -2 -3 0 3 2 1 -1 -2 -3 0 3 2 1 -1 -2 -3 0 3 2 1 -1 -2 -2 0 2 2 1 0 -1 -1 0 1 1 0	#1 0 -1 -1 0 1 1 0 -1 -2 -2 0 2 2 1 -1 -2 -3 0 3 2 1 -1 -2 -3 1 3 2 1 -1 -2 -3 0 3 2 1 -1 -2 -2 0 2 2 1 0 -1 -1 0 1 1 0	#2 0 1 1 1 1 1 0 1 2 2 2 2 2 1 1 2 3 3 3 2 1 0 0 0 0 0 0 0 -1 -2 -3 -3 -3 -2 -1 -1 -2 -2 -2 -2 -2 -1 0 -1 -1 -1 -1 -1 0	#3 0 1 1 1 1 1 0 1 2 2 2 2 2 1 1 2 3 3 3 2 1 0 0 0 1 0 0 0 -1 -2 -3 -3 -3 -2 -1 -1 -2 -2 -2 -2 -2 -1 0 -1 -1 -1 -1 -1 0
#4 0 1 1 0 -1 -1 0 1 2 2 0 -2 -2 -1 1 2 3 0 -3 -2 -1 1 2 3 0 -3 -2 -1 1 2 3 0 -3 -2 -1 1 2 2 0 -2 -2 -1 0 1 1 0 -1 -1 0	#5 0 1 1 0 -1 -1 0 1 2 2 0 -2 -2 -1 1 2 3 0 -3 -2 -1 1 2 3 1 -3 -2 -1 1 2 3 0 -3 -2 -1 1 2 2 0 -2 -2 -1 0 1 1 0 -1 -1 0	#6 0 -1 -1 -1 -1 -1 0 -1 -2 -2 -2 -2 -2 -1 -1 -2 -3 -3 -3 -2 -1 0 0 0 0 0 0 0 1 2 3 3 3 2 1 1 2 2 2 2 2 1 0 1 1 1 1 1 0	#7 0 -1 -1 -1 -1 -1 0 -1 -2 -2 -2 -2 -2 -1 -1 -2 -3 -3 -3 -2 -1 0 0 0 1 0 0 0 1 2 3 3 3 2 1 1 2 2 2 2 2 1 0 1 1 1 1 1 0

Table B-4. Laplacian 3 x 3

matrix # & Content	matrix # & Content	matrix # & Content	matrix # & Content
#0 0 -1 0 -1 4 -1 0 -1 0	#1 0 -1 0 -1 5 -1 0 -1 0	#2 0 -1 0 -1 6 -1 0 -1 0	#3 -1 -1 -1 -1 8 -1 -1 -1 -1
#4 -1 -1 -1 -1 9 -1 -1 -1 -1	#5 -1 -1 -1 -1 10 -1 -1 -1 -1	#6 -1 -2 -1 -2 12 -2 -1 -2 -1	#7 -1 -2 -1 -2 13 -2 -1 -2 -1

Table B-5. Laplacian 5 x 5

matrix # & Content	matrix # & Content
#0	#1
-1 -1 -1 -1 -1	-1 -1 -1 -1 -1
-1 -1 -1 -1 -1	-1 -1 -1 -1 -1
-1 -1 24 -1 -1	-1 -1 25 -1 -1
-1 -1 -1 -1 -1	-1 -1 -1 -1 -1
-1 -1 -1 -1 -1	-1 -1 -1 -1 -1

Table B-6. Laplacian 7 x 7

matrix # & Content	matrix # & Content
#0	#1
-1 -1 -1 -1 -1 -1 -1	-1 -1 -1 -1 -1 -1 -1
-1 -1 -1 -1 -1 -1 -1	-1 -1 -1 -1 -1 -1 -1
-1 -1 -1 -1 -1 -1 -1	-1 -1 -1 -1 -1 -1 -1
-1 -1 -1 48 -1 -1 -1	-1 -1 -1 49 -1 -1 -1
-1 -1 -1 -1 -1 -1 -1	-1 -1 -1 -1 -1 -1 -1
-1 -1 -1 -1 -1 -1 -1	-1 -1 -1 -1 -1 -1 -1
-1 -1 -1 -1 -1 -1 -1	-1 -1 -1 -1 -1 -1 -1

Table B-7. Smoothing 3 x 3

matrix # & Content	matrix # & Content	matrix # & Content	matrix # & Content
#0	#1	#2	#3
0 1 0	0 1 0	0 2 0	0 4 0
1 0 1	1 1 1	2 1 2	4 1 4
0 1 0	0 1 0	0 2 0	0 4 0
#4	#5	#6	#7
1 1 1	1 1 1	2 2 2	4 4 4
1 0 1	1 1 1	2 1 2	4 1 4
1 1 1	1 1 1	2 2 2	4 4 4

Table B-8. Smoothing 5 x 5

matrix # & Content	matrix # & Content
#0	#1
1 1 1 1 1	1 1 1 1 1
1 1 1 1 1	1 1 1 1 1
1 1 0 1 1	1 1 1 1 1
1 1 1 1 1	1 1 1 1 1
1 1 1 1 1	1 1 1 1 1

Table B-9. Smoothing 7 x 7

matrix # & Content	matrix # & Content
#0	#1
1 1 1 1 1 1 1	1 1 1 1 1 1 1
1 1 1 1 1 1 1	1 1 1 1 1 1 1
1 1 1 1 1 1 1	1 1 1 1 1 1 1
1 1 1 0 1 1 1	1 1 1 1 1 1 1
1 1 1 1 1 1 1	1 1 1 1 1 1 1
1 1 1 1 1 1 1	1 1 1 1 1 1 1
1 1 1 1 1 1 1	1 1 1 1 1 1 1

Table B-10. Gaussian 3 x 3

matrix # & Content	matrix # & Content	matrix # & Content
#0	#1	#2
0 1 0	0 1 0	1 1 1
1 2 1	1 4 1	1 2 1
0 1 0	0 1 0	1 1 1
#3	#4	#5
1 1 1	1 2 1	1 4 1
1 4 1	2 4 2	4 16 4
1 1 1	1 2 1	1 4 1

Table B-11. Gaussian 5 x 5

matrix # & Content
#0
1 2 4 2 1
2 4 8 4 2
4 8 16 8 4
2 4 8 4 2
1 2 4 2 1

Table B-12. Gaussian 7 x 7

matrix # & Content
#0
1 1 2 2 2 1 1
1 2 2 4 2 2 1
2 2 4 8 4 2 2
2 4 8 16 8 4 2
2 2 4 8 4 2 2
1 2 2 4 2 2 1
1 1 2 2 2 1 1



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- **KnowledgeBase**—A searchable database containing thousands of frequently asked questions (FAQs) and their corresponding answers or solutions, including special sections devoted to our newest products. The database is updated daily in response to new customer experiences and feedback.
- **Troubleshooting Wizards**—Step-by-step guides lead you through common problems and answer questions about our entire product line. Wizards include screen shots that illustrate the steps being described and provide detailed information ranging from simple getting started instructions to advanced topics.
- **Product Manuals**—A comprehensive, searchable library of the latest editions of National Instruments hardware and software product manuals.
- **Hardware Reference Database**—A searchable database containing brief hardware descriptions, mechanical drawings, and helpful images of jumper settings and connector pinouts.
- **Application Notes**—A library with more than 100 short papers addressing specific topics such as creating and calling DLLs, developing your own instrument driver software, and porting applications between platforms and operating systems.

Software-Related Resources

- **Instrument Driver Network**—A library with hundreds of instrument drivers for control of standalone instruments via GPIB, VXI, or serial interfaces. You also can submit a request for a particular instrument driver if it does not already appear in the library.
- **Example Programs Database**—A database with numerous, non-shipping example programs for National Instruments programming environments. You can use them to complement the example programs that are already included with National Instruments products.
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Netherlands 0348 433466, New Zealand 09 914 0488,
Norway 32 27 73 00, Poland 0 22 528 94 06, Portugal 351 1 726 9011,
Singapore 2265886, Spain 91 640 0085, Sweden 08 587 895 00,
Switzerland 056 200 51 51, Taiwan 02 2528 7227,
United Kingdom 01635 523545

Glossary

Prefix	Meaning	Value
p-	pico-	10^{-12}
n-	nano-	10^{-9}
μ -	micro-	10^{-6}
m-	milli-	10^{-3}
k-	kilo-	10^3
M-	mega-	10^6
G-	giga-	10^9
t-	tera-	10^{12}

Numbers/Symbols

1D One-dimensional.

2D Two-dimensional.

3D Three-dimensional.

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

A

address Value that identifies a specific location (or series of locations) in memory.

AIPD National Instruments internal image file format used for saving complex images and calibration information associated with an image (extension APD).

aliasing	The effect created by sampling a signal that contains frequency components higher than one-half the sampling frequency. Aliasing causes high frequency information to appear as low frequency information, which can make small repetitive features look large and, in horizontally sampled images, can produce jagged lines.
alignment	The process by which a machine vision application determines the location, orientation, and scale of a part being inspected.
alpha channel	Channel used to code extra information, such as gamma correction, about a color image. The alpha channel is stored as the first byte in the four-byte representation of an RGB pixel.
ANSI	American National Standards Institute.
API	Application programming interface.
area	A rectangular portion of an acquisition window or frame that is controlled and defined by software.
area threshold	Detects objects based on their size, which can fall within a user-specified range.
arithmetic operators	The image operations multiply, divide, add, subtract, and remainder.
array	Ordered, indexed set of data elements of the same type.
aspect ratio	The ratio of a picture or image's width to its height.
asynchronous	Property of a function or operation that begins an operation and returns control to the program before the completion or termination of the operation.
auto-median function	A function that uses dual combinations of opening and closing operations to smooth the boundaries of objects.
B	
b	Bit. One binary digit, either 0 or 1.
B	Byte. Eight related bits of data, an eight-bit binary number. Also denotes the amount of memory required to store one byte of data.

barycenter	The grayscale value representing the centroid of the range of an image's grayscale values in the image histogram.
binary image	An image in which the objects usually have a pixel intensity of 1 (or 255) and the background has a pixel intensity of 0.
binary morphology	Functions that perform morphological operations on a binary image.
binary threshold	Separation of an image into objects of interest (assigned a pixel value of 1) and background (assigned pixel values of 0) based on the intensities of the image pixels.
bit depth	The number of bits (n) used to encode the value 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 $32,767$.
blob	Binary large object. A connected region or grouping of pixels in an image in which all pixels have the same intensity level.
blob analysis	A series of processing operations and analysis functions that produce some information about the blobs in an image.
blurring	Reduces the amount of detail in an image. Blurring commonly occurs because the camera is out of focus. You can blur an image intentionally by applying a lowpass frequency filter.
BMP	Bitmap. Image file format commonly used for 8-bit and color images (extension BMP).
border function	Removes objects (or particles) in a binary image that touch the image border.
brightness	(1) A constant added to the red, green, and blue components of a color pixel during the color decoding process. (2) The perception by which white objects are distinguished from gray and light objects from dark objects.
buffer	Temporary storage for acquired data.

C

C	Celsius.
caliper	(1) A function in IMAQ Vision Builder that calculates distances, angles, circular fits, and the center of mass based on positions given by edge detection, particle analysis, centroid, and search functions. (2) A measurement function that finds edge pairs along a specified path in the image. This function performs an edge extraction and then finds edge pairs based on specified criteria such as the distance between the leading and trailing edges, edge contrasts, and so forth.
callback function	A user-defined function that receives a message.
center of mass	The point on an object where all the mass of the object could be concentrated without changing the first moment of the object about any axis
character recognition	The ability of a machine to read human-readable text.
chroma	The color information in a video signal.
chrominance	<i>See</i> chroma.
circle function	Detects circular objects in a binary image.
closing	A dilation followed by an erosion. A closing fills small holes in objects and smooths 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 and a barycenter are 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.
color space	The mathematical representation for a color. For example, color can be described in terms of red, green, and blue; hue, saturation, and luma; or hue, saturation, and intensity.
compiler	A software utility that converts a source program in a high-level programming language, such as Basic, C, or Pascal, into an object or compiled program in machine language. Compiled programs run 10 to 1,000 times faster than interpreted programs. <i>See also</i> interpreter.

complex image	Stores 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.
connectivity-4	Only pixels adjacent in the horizontal and vertical directions are considered neighbors.
connectivity-8	All adjacent pixels are considered neighbors.
contrast	A constant multiplication factor applied to the luma and chroma components of a color pixel in the color decoding process.
convex function	Computes the convex regions of objects in a binary image.
convolution	<i>See</i> linear filter.
convolution kernel	Simple 3×3 , 5×5 , or 7×7 matrices (or templates) used to represent the filter in the filtering process. The contents of these kernels are a discrete two-dimensional representation of the impulse response of the filter that they represent.
cross correlation	The most common way to perform pattern matching.

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.
densitometry	Determination of optical or photographic density.
density function	For each gray level in a linear histogram, the function gives the number of pixels in the image that have the same gray level.
differentiation filter	Extracts the contours (edge detection) in gray level.
digital image	An image $f(x, y)$ that has been converted into a discrete number of pixels. Both spatial coordinates and brightness are specified.

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.
DLL	Dynamic link library. A software module in Microsoft Windows containing executable code and data that can be called or used by Windows applications or other DLLs; functions and data in a DLL are loaded and linked at run time when they are referenced by a Windows application or other DLLs.
E	
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 detection	Any of several techniques to identify the edges of objects in an image.
edge hysteresis	The difference in threshold level between a rising and a falling edge.
edge steepness	The number of pixels that corresponds to the slope or transition area of an edge.
energy center	The center of mass of a grayscale image. <i>See</i> center of mass.
entropy	A measure of the randomness in an image. An image with high entropy contains more pixel value variation than an image with low entropy.
equalize function	<i>See</i> histogram equalization.
erosion	Reduces the size of an object along its boundary and eliminates isolated points in the image.
Euclidean distance	The shortest distance between two points in a Cartesian system.

event	Object-generated response to some action or change in state, such as a mouse click or x number of points being acquired. The event calls an event handler (callback function), which processes the event. Events are defined as part of an ActiveX control object.
event handler	<i>See</i> callback function <i>and</i> event.
exception	Error message generated by a control and sent directly to the application or programming environment containing the control.
exponential and gamma corrections	Expand the high gray-level information in an image while suppressing low gray-level information.
exponential function	Decreases brightness and increases contrast in bright regions of an image, and decreases contrast in dark regions of an image.

F

falling edge	The digital signal transition from the low state to the high state.
FFT	Fast Fourier Transform. A method used to compute the Fourier transform of an image.
fiducial	A reference pattern on a part that helps a machine vision application find the part's location and orientation in an image.
field	For an interlaced video signal, a field is half the number of horizontal lines needed to represent a frame of video. The first field of a frame contains all the odd-numbered lines, the second field contains all of the even-numbered lines.
Fourier spectrum	The magnitude information of the Fourier transform of an image.
Fourier transform	Transforms an image from the spatial domain to the frequency domain.
frame	A complete image. In interlaced formats, a frame is composed of two fields.
frequency filters	Counterparts of spatial filters in the frequency domain. For images, frequency information is in the form of spatial frequency.
ft	Feet.
function	A set of software instructions executed by a single line of code that may have input and/or output parameters and returns a value when executed.

G

gamma	The nonlinear change in the difference between the video signal's brightness level and the voltage level needed to produce that brightness.
gauging	Measurement of an object or distances between objects.
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 IMAQ device.
gradient convolution filter	<i>See</i> 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 point (pixel) in an image.
gray-level dilation	Increases the brightness of pixels in an image that are surrounded by other pixels with a higher intensity.
gray-level erosion	Reduces the brightness of pixels in an image that are surrounded by other pixels with a lower intensity.
gray-level images	Images with monochrome information.
gray-level morphology	Functions that perform morphological operations on a gray-level image.
grayscale	The range of shades of black in an image.
GUI	Graphical user interface. An intuitive, easy-to-use means of communicating information to and from a computer program by means of graphical screen displays. GUIs can resemble the front panels of instruments or other objects associated with a computer program.

H

h	Hour.
hardware	The physical components of a computer system, such as the circuit boards, plug-in boards, chassis, enclosures, peripherals, and cables.
highpass attenuation	Inverse of lowpass attenuation.
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	Inverse of lowpass truncations.
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.
histogram inversion	Finds the photometric negative of an image. The histogram of a reversed image is equal to the original histogram flipped horizontally around the center of the histogram.
histograph	In LabVIEW, a histogram that can be wired directly into a graph.
hit-miss function	Locates objects in the image similar to the pattern defined in the structuring element.
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 using Hue, Saturation, and Luma information where each image in the pixel is encoded using 32 bits: 8 bits for hue, 8 bits for saturation, 8 bits for luma, and 8 unused bits.

HSV	Color encoding scheme in Hue, Saturation, and Value.
hue	Represents the dominant color of a pixel. The hue function is a continuous function that covers all the possible colors generated using the R, G, and B primaries. <i>See also</i> RGB.
hue offset angle	The value added to all hue values so that the discontinuity occurs outside the values of interest during analysis.
Hz	Hertz. Frequency in units of 1/second.
I	
I/O	Input/output. The transfer of data to/from a computer system involving communications channels, operator interface devices, and/or data acquisition and control interfaces.
image	A two-dimensional light intensity function $f(x, y)$ where x and y denote spatial coordinates and the value f at any point (x, y) is proportional to the brightness at that point.
image buffer	Memory location used to store images.
image definition	<i>See</i> pixel depth.
image enhancement	The process of improving the quality of an image that you acquire from a sensor in terms of signal-to-noise ratio, image contrast, edge definition, and so on.
image file	A file containing image information and data.
image format	Defines how an image is stored in a file. Usually composed of a header followed by the pixel data.
image palette	The gradation of colors used to display an image on screen, usually defined by a color look-up table.
image processing	Encompasses various processes and analysis functions that you can apply to an image.
image source	Original input image.
image understanding	A technique that interprets the content of the image at a symbolic level rather than a pixel level.

image visualization	The presentation (display) of an image (image data) to the user.
imaging	Any process of acquiring and displaying images and analyzing image data.
in.	Inches.
inner gradient	Finds the inner boundary of objects.
inspection	The process by which parts are tested for simple defects such as missing parts or cracks on part surfaces.
inspection function	Analyzes groups of pixels within an image and returns information about the size, shape, position, and pixel connectivity. Typical applications include quality of parts, analyzing defects, locating objects, and sorting objects.
intensity	The sum of the Red, Green, and Blue primary colors divided by three. $(\text{Red} + \text{Green} + \text{Blue}) / 3$
intensity calibration	Assigning user-defined quantities such as optical densities or concentrations to the gray-level values in an image.
intensity profile	The gray-level distribution of the pixels along an ROI in an image.
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.
interpolation	The technique used to find values in between known values when resampling an image or array of pixels.
interpreter	A software utility that executes source code from a high-level language such as Basic, C or Pascal, by reading one line at a time and executing the specified operation. <i>See also</i> compiler.

J

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

k	Kilo. The standard metric prefix for 1,000, or 10^3 , used with units of measure such as volts, hertz, and meters.
K	Kilo. The prefix for 1,024, or 2^{10} , used with B in quantifying data or computer memory.
kbytes/s	A unit for data transfer that means 1,000 or 10^3 bytes/s.
kernel	Structure that represents a pixel and its relationship to its neighbors. The relationship is specified by weighted coefficients of each neighbor.
Kword	1,024 words of memory.

L

L-skeleton function	Uses an L-shaped structuring element in the skeleton function.
labeling	The process by which each object in a binary image is assigned a unique value. This process is useful for identifying the number of objects in the image and giving each object a unique identity.
LabVIEW	Laboratory Virtual Instrument Engineering Workbench. Program development environment application based on the programming language G 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.
library	A file containing compiled object modules, each comprised of one or more functions, that can be linked to other object modules that make use of these functions.
line count	The total number of horizontal lines in the picture.
line gauge	Measures the distance between selected edges with high-precision subpixel accuracy along a line in an image. For example, this function can be used to measure distances between points and edges. This function also can step and repeat its measurements across the image.
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 and inverse gamma corrections	Expand low gray-level information in an image while compressing information from the high gray-level ranges.
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.
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 attenuation	Applies a linear attenuation to the frequencies in an image, with no attenuation at the lowest frequency and full attenuation at the highest frequency.
lowpass FFT filter	Removes or attenuates high frequencies present in the FFT domain of an image.
lowpass filter	Attenuates intensity variations in an image. You can use these filters to smooth an image by eliminating fine details and blurring edges.
lowpass frequency filter	Attenuates high frequencies present in the frequency domain of the image. A lowpass frequency filter suppresses information related to fast variations of light intensities in the spatial image.
lowpass truncation	Removes all frequency information above a certain frequency.
LSB	Least significant bit.
luma	The brightness information in the video picture. The luma signal amplitude varies in proportion to the brightness of the video signal and corresponds exactly to the monochrome picture.
luminance	<i>See</i> luma.

LUT	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.
M	
m	Meters.
M	(1) Mega, the standard metric prefix for 1 million or 10^6 , when used with units of measure such as volts and hertz (2) Mega, the prefix for 1,048,576, or 2^{20} , when used with B to quantify data or computer memory.
M-skeleton function	Uses an M-shaped structuring element in the skeleton function.
machine vision	An automated application that performs a set of visual inspection tasks.
mask	Isolates parts of an image for further processing.
mask FFT filter	Removes frequencies contained in a mask (range) specified by the user.
mask image	An image containing a value of 1 and values of 0. Pixels in the source image with a corresponding mask image value of 1 are processed, while the others are left unchanged.
match score	A number ranging from 0 to 1000 that indicates how closely an acquired image matches the template image. A match score of 1000 indicates a perfect match. A match score of 0 indicates no match.
MB	Megabyte of memory.
Mbytes/s	A unit for data transfer that means 1 million or 10^6 bytes/s.
median filter	A lowpass filter that assigns to each pixel the median value of its neighbors. This filter effectively removes isolated pixels without blurring the contours of objects.
memory buffer	<i>See</i> buffer.
memory window	Continuous blocks of memory that can be accessed quickly by changing addresses on the local processor.
method	Function that performs a specific action on or with an object. The operation of the method often depends on the values of the object properties.

mile	An Imperial unit of length equal to 5,280 feet or 1,609.344 meters. Also known as a <i>statute mile</i> to discern from a nautical mile. <i>See also</i> nautical mile.
MMX	Multimedia Extensions. Intel chip-based technology that allows parallel operations on integers, which results in accelerated processing of 8-bit images.
morphological transformations	Extract and alter the structure of objects in an image. You can use these transformations for expanding (dilating) or reducing (eroding) objects, filling holes, closing inclusions, or smoothing borders. They are used primarily to delineate objects and prepare them for quantitative inspection analysis.
MSB	Most significant bit.
N	
nautical mile	International unit of length used for sea and air navigation equal to 6,076.115 feet or 1,852 meters. <i>See also</i> mile.
neighbor	A pixel whose value affects the values of nearby pixels when an image is processed. The neighbors of a pixel are usually defined by a kernel.
neighborhood operations	Operations on a point in an image that take into consideration the values of the pixels neighboring that point.
NI-IMAQ	Driver software for National Instruments IMAQ hardware.
nonlinear filter	Replaces each pixel value with a nonlinear function of its surrounding pixels.
nonlinear gradient filter	A highpass edge-extraction filter that favors vertical edges.
nonlinear Prewitt filter	A highpass, edge-extraction filter based on two-dimensional gradient information.
nonlinear Sobel filter	A highpass, edge-extraction filter based on two-dimensional gradient information. The filter has a smoothing effect that reduces noise enhancements caused by gradient operators.
<i>N</i> th order filter	Filters an image using a nonlinear filter. This filter orders (or classifies) the pixel values surrounding the pixel being processed. The pixel being processed is set to the <i>N</i> th pixel value, where <i>N</i> is the order of the filter.

number of planes (in an image) The number of arrays of pixels that compose the image. A gray-level or pseudo-color image is composed of one plane, while an RGB image is composed of three planes (one for the red component, one for the blue, and one for the green).

O

opening An erosion followed by a dilation. An opening removes small objects and smoothes boundaries of objects in the image.

operating system Base-level software that controls a computer, runs programs, interacts with users, and communicates with installed hardware or peripheral devices.

operators Allow masking, combination, and comparison of images. You can use arithmetic and logic operators in IMAQ Vision.

optical character verification A machine vision application that inspects the quality of printed characters.

optical representation Contains the low-frequency information at the center and the high-frequency information at the corners of an FFT-transformed image.

outer gradient Finds the outer boundary of objects.

P

palette The gradation of colors used to display an image on screen, usually defined by a color look-up table.

pattern matching The technique used to locate quickly a grayscale template within a grayscale image

picture element An element of a digital image. Also called *pixel*.

pixel Picture element. The smallest division that makes up the video scan line. For display on a computer monitor, a pixel's optimum dimension is square (aspect ratio of 1:1, or the width equal to the height).

pixel depth The number of bits used to represent the gray level of a pixel.

PNG Portable Network Graphic. Image file format for storing 8-bit, 16-bit, and color images with lossless compression (extension PNG).

power 1/Y function	Similar to a logarithmic function but with a weaker effect.
power Y function	<i>See</i> exponential function.
Prewitt filter	Extracts the contours (edge detection) in gray-level values using a 3×3 filter kernel.
probability function	Defines the probability that a pixel in an image has a certain gray-level value.
proper-closing	A finite combination of successive closing and opening operations that you can use to fill small holes and smooth the boundaries of objects.
proper-opening	A finite combination of successive opening and closing operations that you can use to remove small particles and smooth the boundaries of objects.
property	Attribute that controls the appearance or behavior of an object. The property can be a specific value or another object with its own properties and methods. For example, a value property is the color (property) of a plot (object), while an object property is a specific Y axis (property) on a graph (object). The Y axis itself is another object with properties, such as minimum and maximum values.
pts	Points.
pyramidal matching	A technique used to increase the speed of a pattern matching algorithm by matching subsampled versions of the image and the reference pattern.

Q

quantitative analysis Obtaining various measurements of objects in an image.

R

RAM Random-access memory.

real time A property of an event or system in which data is processed as it is acquired instead of being accumulated and processed at a later time.

resolution	(1) 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. (2) The smallest signal increment that can be detected by a measurement system. Resolution can be expressed in bits, proportions, or a percentage of full scale. For example, a system has 12-bit resolution, one part in 4,096 resolution, and 0.0244 percent of full scale.
reverse function	Inverts the pixel values in an image, producing a photometric negative of the image.
RGB	Color encoding scheme using red, green, and blue (RGB) color information where each pixel in the color image is encoded using 32 bits: 8 bits for red, 8 bits for green, 8 bits for blue, and 8 bits for the alpha value (unused).
rising edge	The digital signal transition from the high state to the low state.
Roberts filter	Extracts the contours (edge detection) in gray level, favoring diagonal edges.
ROI	Region of interest. (1) An area of the image that is graphically selected from a window displaying the image. This area can be used focus further processing. (2) A hardware-programmable rectangular portion of the acquisition window.
ROI tools	Collection of tools from the Lab VIEW Tools palette 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.
rotational shift	The amount by which one image is rotated with respect to a reference image. This rotation is computed with respect to the center of the image.
rotation-invariant matching	A pattern matching technique in which the reference pattern can be located at any orientation in the test image as well as rotated at any degree.
S	
s	Seconds.
saturation	The amount of white added to a pure color. Saturation relates to the richness of a color. A saturation of zero corresponds to a pure color with no white added. Pink is a red with low saturation.

scale-invariant matching	A pattern matching technique in which the reference pattern can be any size in the test image.
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.
shape matching	Finds objects in an image whose shape matches the shape of the object specified by a shape template. The matching process is invariant to rotation and can be set to be invariant to the scale of the objects.
shift-invariant matching	A pattern matching technique in which the reference pattern can be located anywhere in the test image but cannot be rotated or scaled.
Sigma filter	A highpass filter that outlines edges.
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.
spatial filters	Alter the intensity of a pixel with respect to variations in intensities of its neighboring pixels. You can use these filters for edge detection, image enhancement, noise reduction, smoothing, and so forth.
spatial resolution	The number of pixels in an image, in terms of the number of rows and columns in the image.
square function	<i>See</i> exponential function.
square root function	<i>See</i> logarithmic function.

standard representation	Contains the low-frequency information at the corners and high-frequency information at the center of an FFT-transformed image.
statute mile	<i>See mile.</i>
structuring element	A binary mask used in most morphological operations. A structuring element is used to determine which neighboring pixels contribute in the operation.
sub-pixel analysis	Finds the location of the edge coordinates in terms of fractions of a pixel.
synchronous	Property or operation that begins an operation and returns control to the program only when the operation is complete.
syntax	Set of rules to which statements must conform in a particular programming language.

T

template	Color, shape, or pattern that you are trying to match in an image using the color matching, shape matching, or pattern 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.
threshold interval	Two parameters, the lower threshold gray-level value and the upper threshold gray-level value.
TIFF	Tagged Image File Format. Image format commonly used for encoding 8-bit, 16-bit, and color images (extension TIF).

Tools palette Collection of tools that enable you to select regions of interest, zoom in and out, and change the image palette.

truth table A table associated with a logic operator that describes the rules used for that operation.

U

UV plane *See* YUV.

V

V Volts.

value The grayscale intensity of a color pixel computed as the average of the maximum and minimum red, green, and blue values of that pixel.

VI Virtual Instrument. (1) A combination of hardware and/or software elements, typically used with a PC, that has the functionality of a classic stand-alone instrument (2) A LabVIEW software module (VI), which consists of a front panel user interface and a block diagram program.

W

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

Y

YUV A representation of a color image used for the coding of NTSC or PAL video signals. The luma information is called Y, while the chroma information is represented by two components, U and V representing the coordinates in a color plane.

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