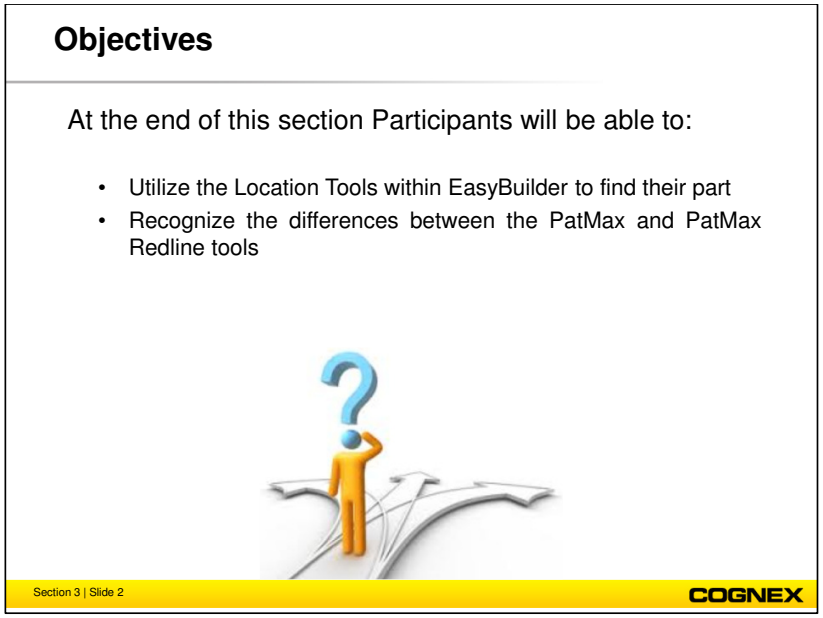
The third section of the In-Sight EasyBuilder Standard training will focus on **Location Tools.**

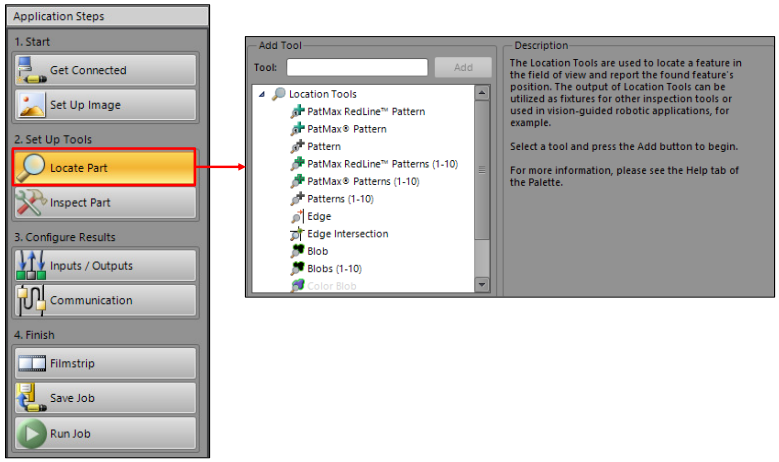
Location Tools are used to define a feature in the image that provides positional data. The Location Tools create a Fixture, which is used to locate a part in the image quickly and reliably, even if the part being inspected rotates or appears in different locations in the image.



At the end of this section of training, Participants will be able to:

- Utilize the Location Tools within EasyBuilder to find their part
- Recognize the differences between the PatMax and PatMax Redline tools

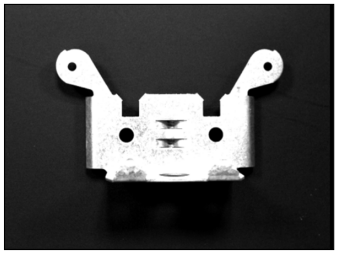
Locate Part – Set up Tools



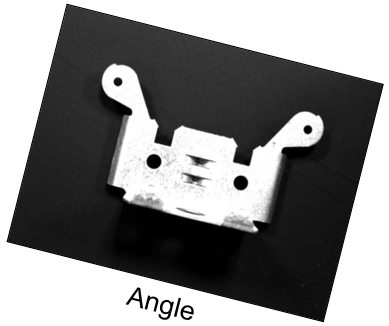
The **Location Tools** are used to define a feature in the image that provides positional data. The Location Tools create a fixture, which is used to locate a part in the image quickly and reliability, even if the part being inspected rotates or appears in different locations in the image.

NOTE: *EasyBuilder does not provide an 'auto-save' feature; pressing <Ctrl+S> to regularly save your job during development is recommended.*

Locate Part – Positional



(x, y)



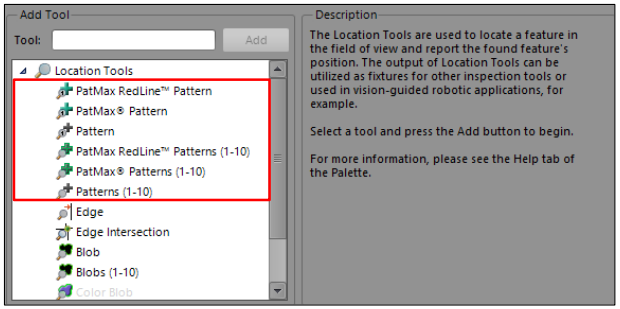
When a part moves in the Field of View (FOV), the tools that inspect a certain area on the part must also move, this is done by Fixturing.

To fully account for movement of a part, three parameters are needed:

- Determine (x, y) part location
- Determine orientation

A pattern tool returns all three of these values.

Locating Parts – Pattern Matching Tools



Pattern tools provide x, y, and angle

The **Pattern Match** tools include the following functions:

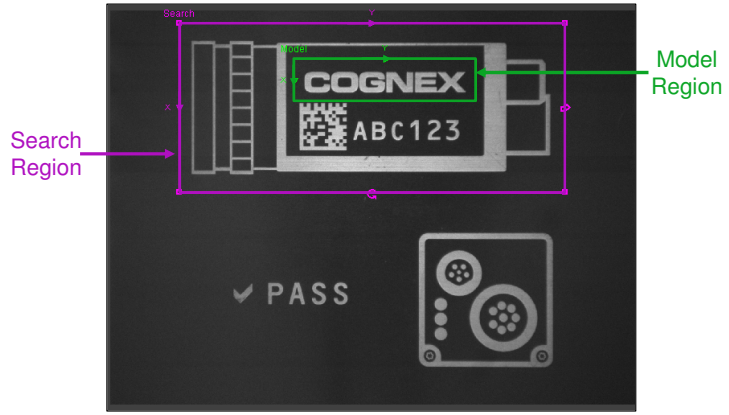
- **PatMax Pattern** – Locates one pattern feature, using PatMax algorithms; reports the X, Y coordinates, angle and score of the found pattern. It is commonly used as a fixture to orient other vision tools.
- **PatMax Redline Pattern** – Locates a single instance of the trained pattern in the image, using PatMax RedLine® algorithms; reports the X, Y coordinates, angle, and score of the found pattern. Outputs a Tool Fixture that can be referenced by other tools.
- **Pattern** – Locates a single pattern feature; reports the X, Y coordinates,, angle, and score of the found pattern. Outputs a Tool Fixture that can be referenced by other tools.

To select a tool to your job, select the appropriate tool from the **Add Tool** group and press the **Add** button, or double click on the tool. You will then be prompted to define the feature in the image, either through EasyBuilder Smart Feature selections, adjusting region graphics in the image or positioning geometric reference graphics.

To **Delete** a tool from your job, simply do one of the following:

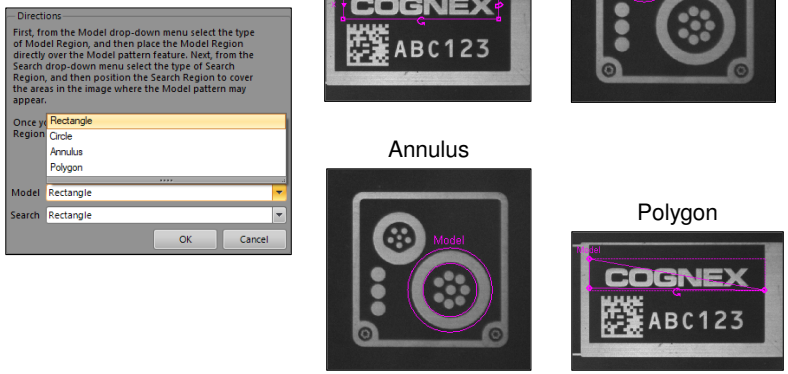
- Select the tool in the Results table (located in the Results tab of the Palette) and press the <Delete> key on your keyboard.
- Select the tool in the Results table and press the Delete icon in the Standard toolbar.
- Right-click on the tool in the Results table and select the Delete option from the menu.

Pattern Tools – Setting Regions



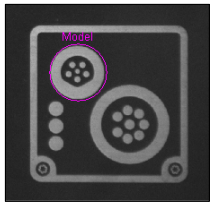
Regions define the area of the image where the Location or Inspection Tool will perform its operation and are also referred to as the Region of Interest (ROI).

PatMax – Setting Regions



Rectangle

Circle



Annulus

Polygon

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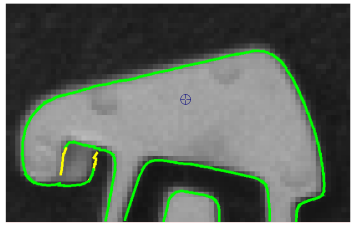
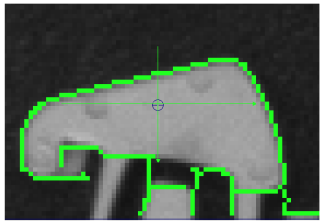
There are several different types of regions used by the Location Tools in EasyBuilder, depending upon the type of tool being used.

The **Regions** used by EasyBuilder are the following:

- **Rectangle** – rectangular regions are the most common means of defining an inspection. They can be resized into arc segments or annular regions, to better meet the needs of your particular application.
- **Circle** – circle regions are used to define circular features. The circle region captures everything inside the circle.
- **Annulus** – annulus regions are used to define circular edge features. The annular region has an inner and outer radius, allowing you to define a circular edge feature while ignoring the center of the circle.
- **Polygon** – polygon regions are used to define irregular features by constructing a shape out of line segments. You must configure the polygon region into your desired shape.

What is PatMax?





PatMax: Feature-based

FindPatterns: Pixel grid-based

- PatMax is a pattern-based search technology.
- The models in PatMax use geometric (feature based) representation; FindPatterns is pixel grid-based. *Feature based is more accurate.*

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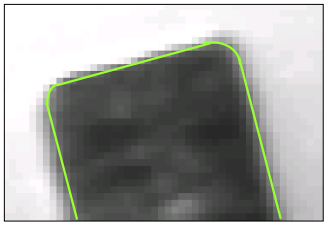
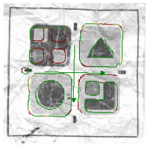
A **PatMax** pattern is a collection of geometric features where each feature is a point on the boundary between two regions of dissimilar pixel values. PatMax calculates geometric representations of curves. This makes it more accurate than FindPatterns, which approximates curves with line segments that follow the pixel grid.

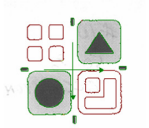
PatMax: Locating Degraded Features



Trained Pattern



Degraded Image



Missing Features

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A **PatMax** pattern is a collection of geometric features where each feature is a point on the boundary between two regions of dissimilar pixel values. PatMax differs from other pattern-location technologies in that it is not based on pixel grid representation that cannot be efficiently and accurately rotated or scaled. Instead, PatMax uses a feature-based representation that can be transformed quickly and accurately for pattern matching.

PatMax offers three key features that distinguish it from other pattern-location technologies in machine vision:

- High-speed location of objects whose appearance is rotated, scaled and/or stretched
- Location technology that is based on object shape, not greyscale values
- Very high accuracy

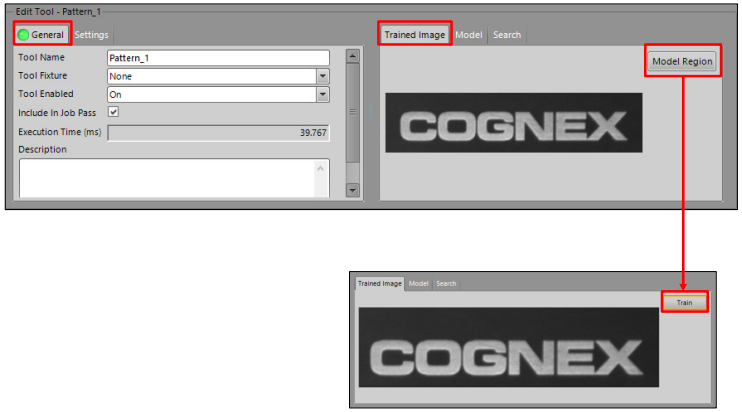
Situations that require the accuracy and reliability of the **PatMax Patterns** Tool:

- When variations in lighting and reflections are difficult to control. For example, metal parts can reflect light in random directions.
- When the pattern being inspected is similarly shaped or shaded in comparison to something in the background, or the pattern is being overlapped or partially hidden by other objects in the image.
- When you want to accurately recognize one type of pattern from other, similar, patterns.
- When the conditions of your deployment environment are too demanding for the *Patterns Location Tool* to consistently and reliably.

PatMax Redline is currently available on the In-Sight 5705, 5705C and the In-Sight Micro 8405. The PatMax Redline Pattern Tool can be found in the In-Sight Spreadsheet view.

PatMax Pattern

General Tab – Trained Image Tab



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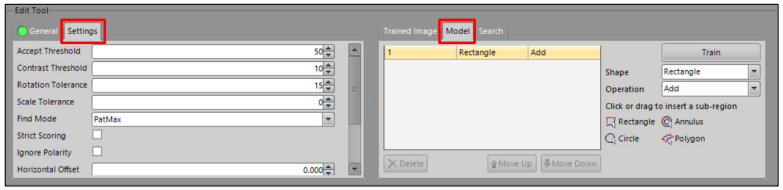
The **General** tab is generic for all inspection tools. Some of the parameters include tool name, fixture tool to use, execution time (ms) and a description.

The image displayed in the Trained Image tab is a thumb nail of the Model Pattern. Click the Model Region button to resize or move the Model region, and then click the Train button to retrain the Model pattern

The section on the right will change depending on the tool selected. For PatMax and Patterns, it allows you to view the current model or retrain it by clicking the **Model Region** button.

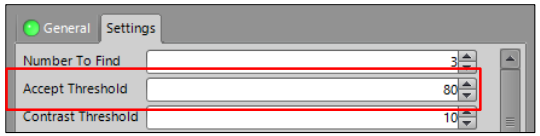
PatMax Pattern

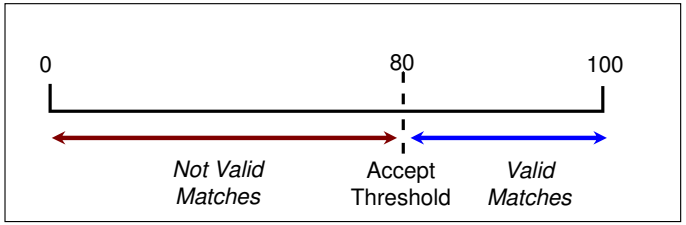
Settings Tab – Model Tab



The Model and Search tabs are used to configure the composite region for the Model and Search regions of the PatMax Pattern tool. Composite regions are a collection of sub-regions (Rectangle, Annulus, Circle, or Polygon) that either Add to the region (the region will be included in the image analysis) or Subtract from the region (the region will be excluded from the image analysis, also known as masking).

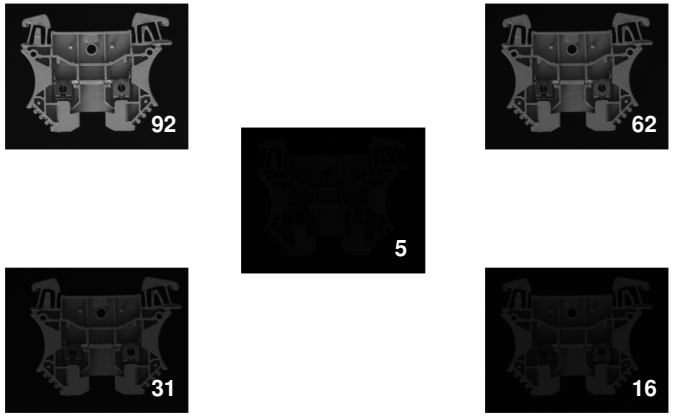
PatMax: Accept Threshold





Accept Threshold defines the degree of similarity that must exist between the model pattern and the found pattern. The minimum acceptable score will vary depending upon the Location Tool selected. Increasing the Accept value *reduces* the time required for the search.

PatMax: Contrast Threshold



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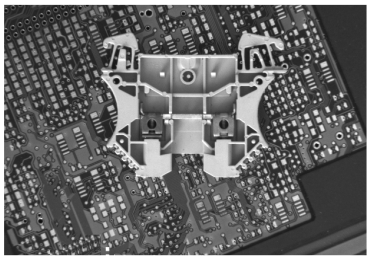
Contrast Threshold defines the minimum acceptable contrast that must be present in the found pattern; the contrast for a found pattern must be greater than the Contrast Threshold value to be considered a valid instance. A low Contrast Threshold value is used for low-contrast images, while a high Contrast Threshold value is used for high-contrast images.

Contrast threshold sets the minimum contrast required in order to consider a change in grayscale a potential boundary point. For a boundary point to be detected its feature contrast must exceed this value.

PatMax: Strict Scoring



Strict Scoring ☑ Score: 68 Strict Scoring ☐ Score: 94

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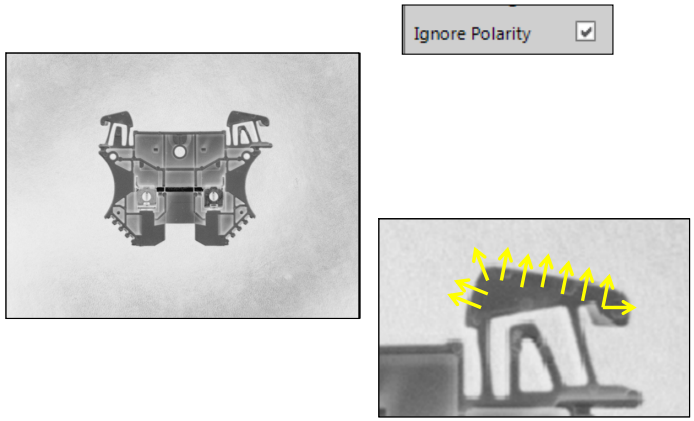
Strict Scoring defines whether or not missing or blocked features of the found pattern will affect the score (default = Off, unchecked). When Strict Scoring is applied (On, checked), if features of the pattern are absent or blocked, the score of the found pattern will be lowered.

PatMax: Ignore Polarity



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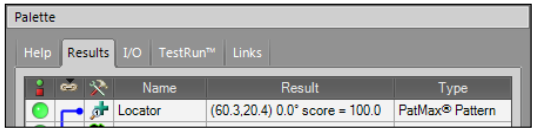
The **Ignore Polarity** defines whether or not found patterns can contain color-inverted match features, in respect to the Model pattern (default = Off, unchecked). When Ignore Polarity is applied (On, Checked), detected patterns with color inverted features, such as black/white vs. white/black in the Model pattern, for example, will be classified as matching the Model pattern.

Ignore Polarity instructs PatMax to check for original polarity identified at training and opposite polarity as well. This may increase execution time for PatMax.

Results

Locate Part step:



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The image will display the model features and a green cross to show the center of the model.

The **Results** tab displays the results generated by the tool; notice the values reported for X, Y, Angle, Score, and Time. The Results table displays information about each tool in the active job, allowing you to monitor or troubleshoot the tools as the job runs. For each tool, the Results Table displays its pass/fail status, tool icon, name, result, pass total and fail total as well as the amount of time, in milliseconds, needed to run the tools.

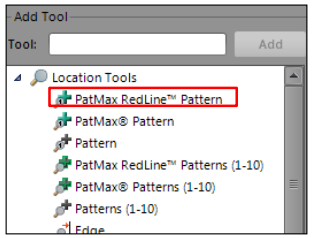
In addition, when a tool is selected in the table the dependent relationships among the selected tool (highlighted in orange) and other tools in the job are displayed, allowing you to determine if a tool failure is related to the failure of another tool. A dependency exists when a tool references another tool. Each dependency consists or two parts: a precedent and a dependent, which are connected by a line.

- The **Precedent** refers to the source of the data (the tool providing the input) and is represented by a circle.
- The **Dependent** is the destination of the data (the tool receiving the output) and is represented by an arrow.

Blue dependency graphics indicate that the selected tool is the destination; green indicates that the selected tool is the source.

PatMax RedLine

- A complete reinvention of pattern matching
- An option available on newer models
- Generally 4-7 times faster than PatMax
- Provides both speed and accuracy



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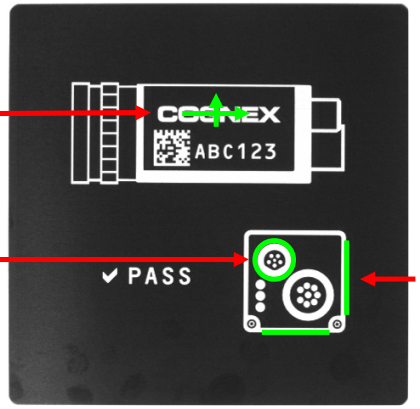
PatMax Redline has been designed from the ground up to be optimized for speed on the newer In-Sight 5 megapixel models. It is *not* based on PatMax. PatMax Redline is typically 4 – 7X faster than PatMax, and is sometimes even faster. It allows for both speed in pattern matching and high resolution (accuracy).

Ways to Locate a Part

Track location of part based on a model (COGNEX logo)

Track location of part based on circles (connectors)



Track location based on sides of a part

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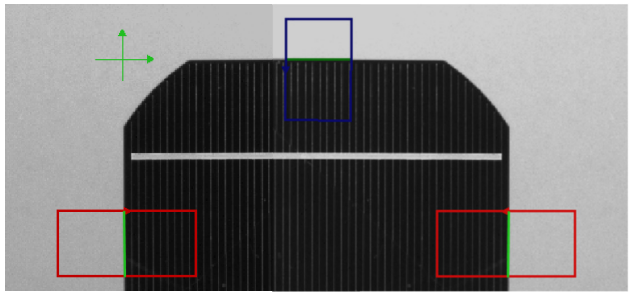
What else can you find using your Location Tools on this part?

- Track the part based on a model, for example the COGNEX logo – What tool would you use?
- Track the location of the part based on the circles – What tools would you use to complete this operation? How does this compare to using a pattern tool?
- Track the location of the part based on the sides of the part. How does this compare to using a pattern tool?

Locating Parts – Edge Tool



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The **Edge Tool** functions detect edges by examining a region of interest (ROI) for discontinuities in pixel polarity, i.e. an area in the image where there is an abrupt change between light and dark (or vice versa) pixels. An edge might only span two or three pixels, or several.

The Edge Tools should be used in the following circumstances:

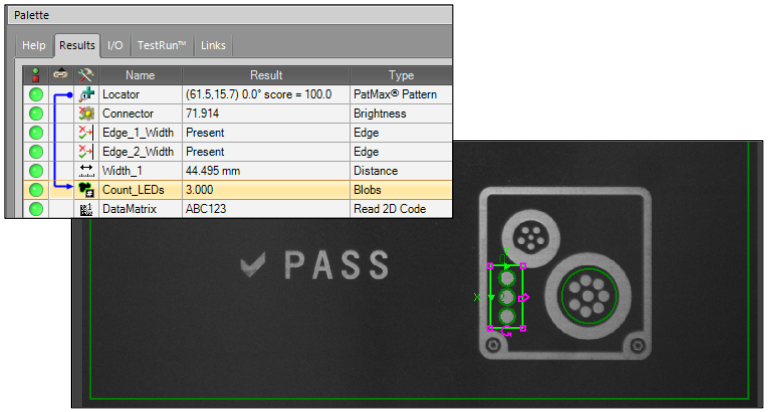
- The edge has a high contrast between light and dark pixels.
- The application requires quick detection of features. The Edge Tools are among the fastest In-Sight Vision Tools, providing the ability to detect edge features faster than patterns, for example.

NOTE: *The In-Sight Edge Tools only analyze greyscale images; all color images are automatically converted to a greyscale value.*

Edge Detection and Data Extrapolation can be extremely useful in applications such as the following:

- Gauging applications, such as measuring the radius of circular features on parts such as gaskets or measuring the length of circuits on a circuit board.
- Locating features on parts, such as circular features or the straight ends of parts, to use as fixture inputs for other In-Sight Vision Tools.
- Presence / absence applications, where the Edge Tools are used to determine whether or not an edge feature is present or absent.
- Counting and sorting applications, where the Edge Tools are used to count, and sort edges based on their established parameters.

Locating Parts – Blob Tool



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In machine vision terminology, any two-dimensional, variably shaped and similarly shaded group of connected pixels can be referred to as a blob. The process of extracting these blobs from an image, finding them in a region of interest (ROI) and sorting them based on specific criteria is called blob analysis. During this process, the pixels in the ROI are divided into two categories, Blob and Background, based upon the greyscale threshold value. This threshold value separates the pixels so that those pixels below the threshold are categorized as Black, and those values over the threshold are categorized as White.

The **Blob Tool** should be used in the following circumstances:

- The image is of a two-dimensional object.
- The image provides high contrast between light and dark pixels.

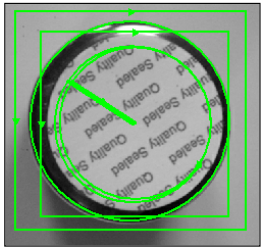
NOTE: *The In-Sight Blob Tool only analyzes greyscale images; all color images are automatically converted to a greyscale value.*

Blob Analysis can be extremely useful in the following applications:

- Course gauging applications, such as measuring diameters or dimensions of squares to determine a part's width in a particular orientation.
- First-pass positioning applications, where the Blob Tools are used to quickly locate and place a rough fixture for another tool.
- Presence / absence applications where the Blob Tools are used to determine whether or not a blob is present or absent in the image.
- Counting applications, where the Blob Tools can be set up to count and sort blobs based upon characteristics such as their area or perimeter.

Locating Parts – Circle

Circle
Location Tool



X and Y

The **Circle Location Tool** is used to locate a circular feature that falls within the specified parameters. The tools reports the found circle's X, Y coordinates (its center) and diameter. After the tool's region has been set and accepted, you can begin customizing and fine-tuning the tool for your application.

NOTE: *The tool reports X, Y coordinates in pixels, unless the image was calibrated to real-world units in Set up Image.*

The Circle Location Tool is one of the faster tools, these tools are also useful as fixtures for other vision tools, when you are inspecting circular objects or a part of object that does not rotate.

Summary

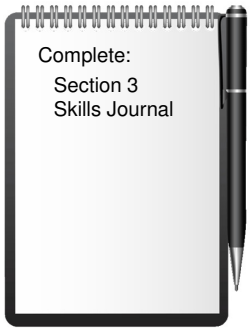
- Location tools can be used to find a part's position.
  - They are often used for fixturing
- Three parameters are needed to account for full movement of a part: X, Y, and Angle
- PatMax tools provide all three parameters
  - X, Y and Angle
- Other tools may be used, when there is no pattern or higher speed is needed

In this section we covered the following topics:

- Location Tools can be used to find the part position or to be used as a fixture
- Three parameters are needed to account for full movement of a part: x, y, and angle
- Pattern tools provide all three parameters
- Other tools may be used, if there is no pattern, or higher speed is needed

Skills Journal

Lab Exercise



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COGNEX

Complete:

Skills Journal (image designed by pngtree)

Lab Exercise