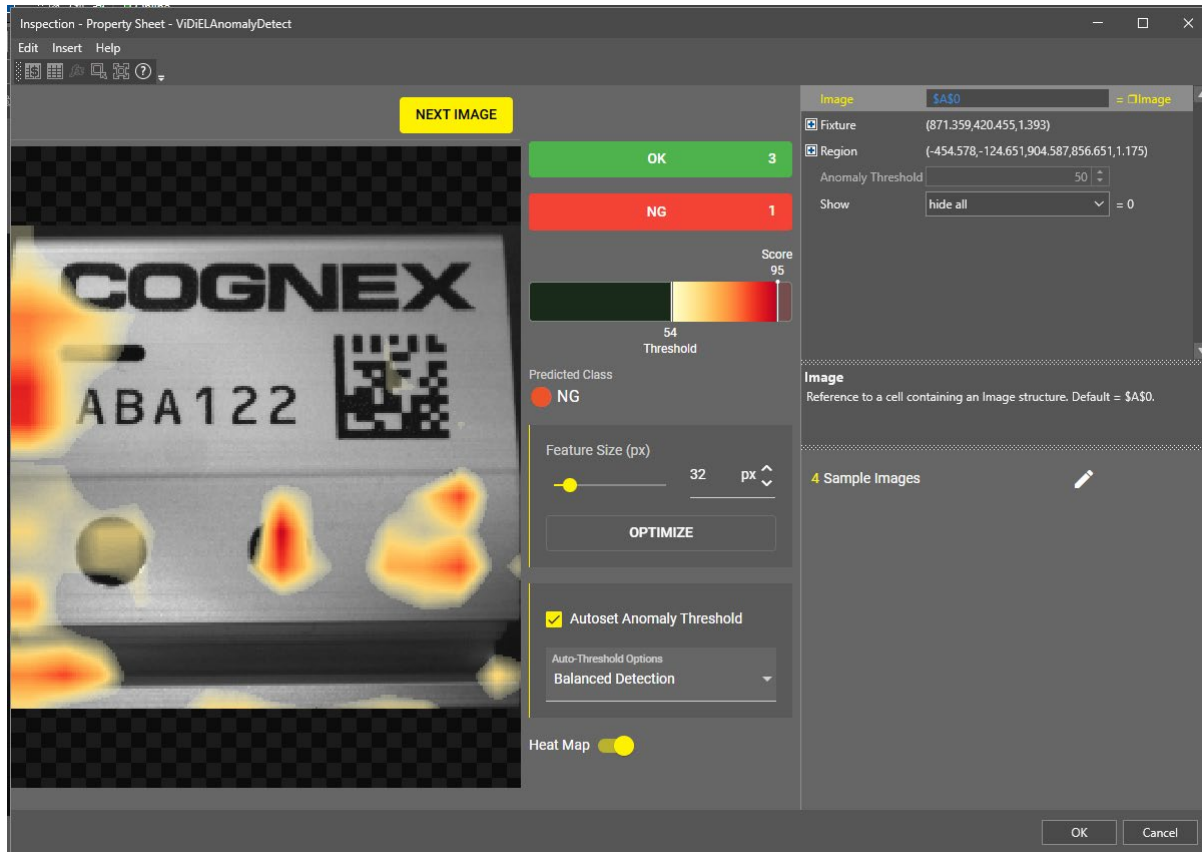


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EL Anomaly Detect Overview

The ViDiELAnomalyDetect function automatically recognizes defects, debris, and other faults, allowing you to identify unknown or unanticipated defects on your inspected parts. This tool requires initial training on a sample image set, with manual classification of the images as **OK** or **NG**. Based on this training, the tool inspects new acquisitions to determine deviations from the OK training set and predicts the acquisitions accordingly.



Application Candidates

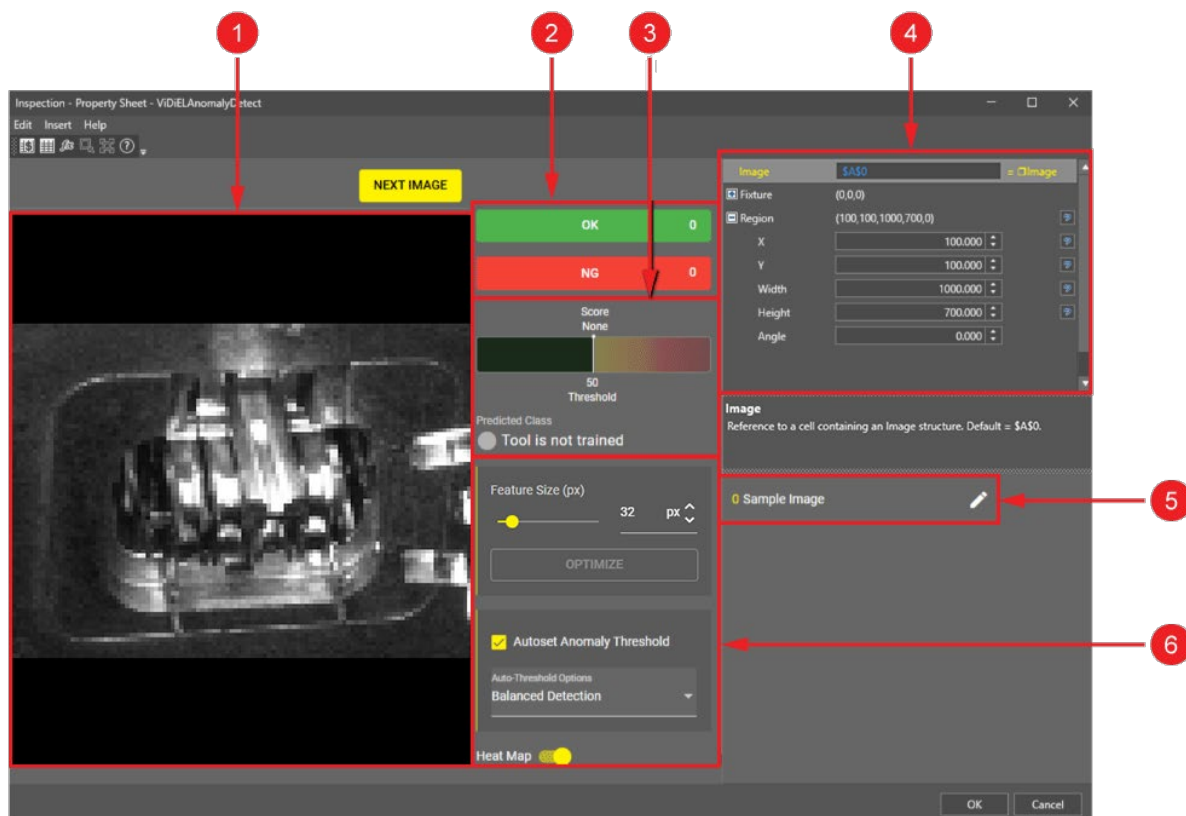
This tool can be used as an image collector so other tools can be configured for long-term deployment.

The highest potential use cases (not exhaustive) are as follows:

- Medical, High-Speed Presentation
 - Products where it is difficult to get a sample of known defects presented to the camera
 - If you can't introduce defective parts into the production process, or the defects aren't reproduceable, and samples must be destroyed
 - Canning, Printing, and the like where the introduction of defects into process is not feasible and machine downtime cannot be allocated
- Injection Modeling, Stamping, Machining.
 - Machinery that has fixed locational tolerance and the need for leftover material detection
 - Leftover material after the process, and gross defects could be detected while still in the mold

- Foreign material detection; Bulk Conveying, Extrusion, Continuous Web
 - With bulk conveying, you would want the product to be consistent to overcome the inherent noise of the product being randomly oriented (e.g., cheese on a conveyor, kibble, cut potatoes, etc.). Malformed products might also be detected.
 - Extrusion looking for dye lines or carbon contamination. Opacity should be considered, as it makes the application more challenging.
 - Consistence of triggering is critical for continuous web where there is print, and the pattern is repeated. In a web without a pattern (i.e., no pattern, not a nonrepeating pattern) getting the trigger to ensure 100% coverage is more important than the timing.

1. Spreadsheet



Element	Description
1	Image display
2	Sample labeling controls
3	Tool predictions
4	Function property list
5	Sample images labeled for training
6	Tool settings

1.1 Image Display

Shows current image, including the heat map. If there is a defect and the Heat Map is enabled, the heat map will be overlayed.

1.2 Sample Labeling Control



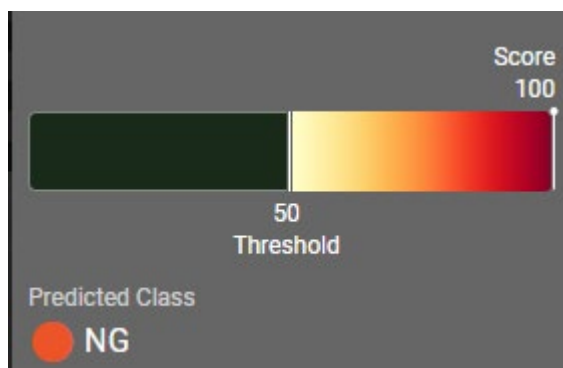
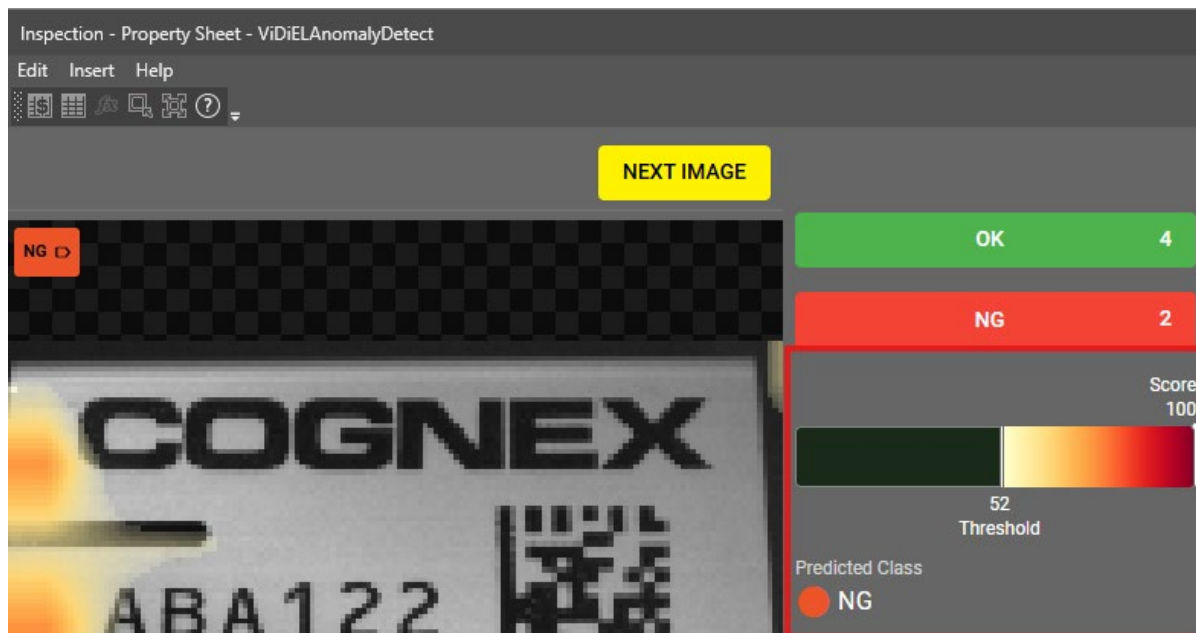
Clicking **OK** will label the current image as **OK**.



Clicking **NG** will label the current image as **NG**.

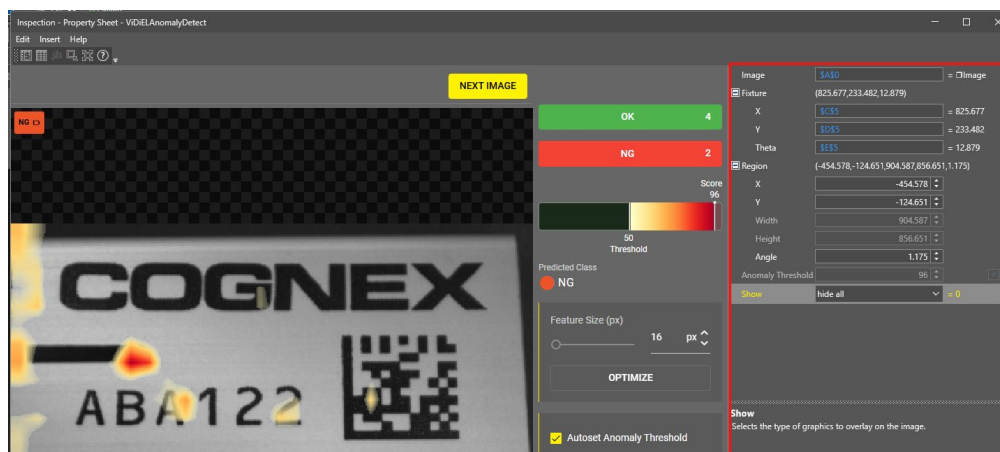


1.3 Tool Prediction



Shows the score of the current image and the set threshold. The score is on a scale of 0 to 100 and indicates the presence of a defect. A score of 0 would be an ideal **OK** image. Anything that is below the threshold is an **OK** image. At or above the threshold, the image will be marked as **NG**.

1.4 Function Property List



The screenshot shows the configuration panel for the ViDiEL Anomaly Detect tool. It includes the following fields:

- Image:** Set to `$A$0`, with a reference icon and `= Image`.
- Fixture:** A checkbox is checked. The coordinates are `(825.677, 233.482, 12.879)`.
 - X:** `$C$5` = 825.677
 - Y:** `$D$5` = 233.482
 - Theta:** `$E$5` = 12.879
- Region:** A checkbox is checked. The coordinates are `(-454.578, -124.651, 904.587, 856.651, 1.175)`.
 - X:** `-454.578`
 - Y:** `-124.651`
 - Width:** `904.587`
 - Height:** `856.651`
 - Angle:** `1.175`
- Anomaly Threshold:** `96`
- Show:** `hide all` = 0

- **Image**
 - Reference A0 for the raw image from the camera or it can be pointed at the output of a separate filtering tool.
- **Fixture**
 - Establish the point and rotation about which the region will be established.
- **Region**
 - Defines the Rectangle that is the ROI relative to the fixture. The Height and Width of the tool **cannot** be changed once an image has been labeled **NG** or **OK**.
 - Ensure that the region that is defined is within the area of the image. If the ROI of the tool falls outside of the Image, then the tool will **#ERR**.
 - When working with a filter, we advise using the EditRegion function so that the filter and tool can share the region.
- **Anomaly Threshold**
 - Editable and referenceable when the tool is not set to **Autoset Anomaly Threshold**.
 - If to be set manually, you will need to review the scores of the trained images and test images to find a functional threshold.
- **Show**
 - Allows you to control the display output of the tool.

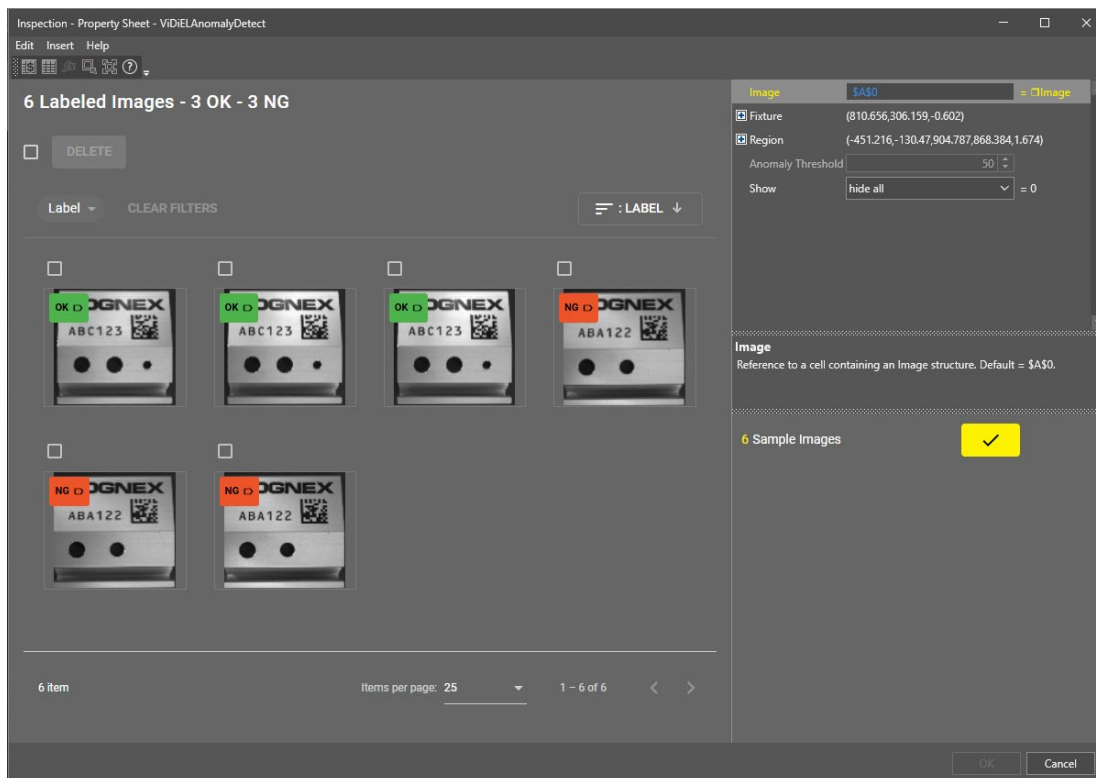
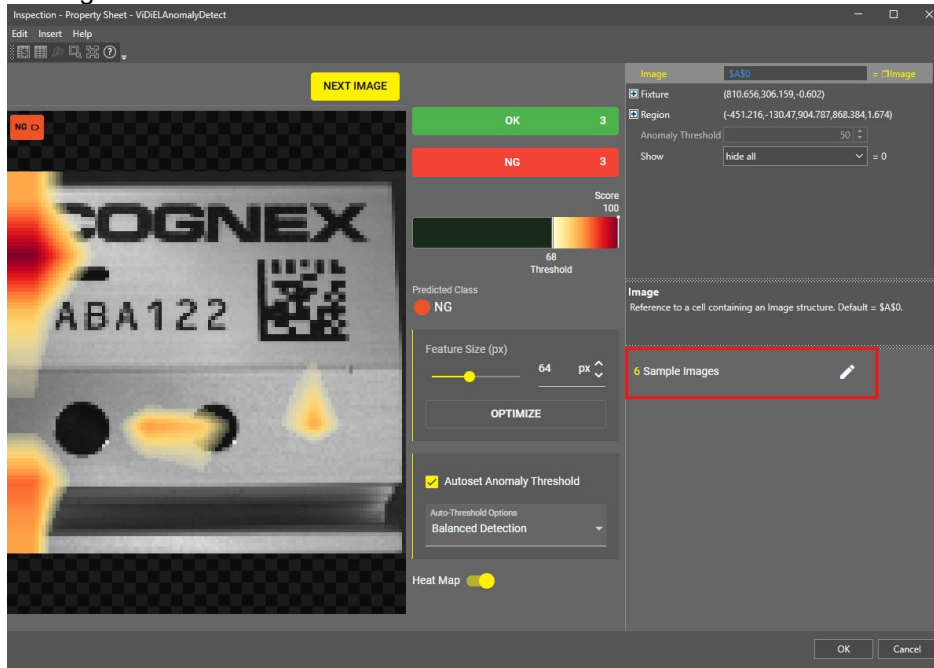
The screenshot shows the **Show** dropdown menu with the following options:

- `hide all` (selected)
- `result graphics only`
- `input and result graphics`

The reference icon and `= 0` are also visible.

1.5 Sample Image Labeled for Training

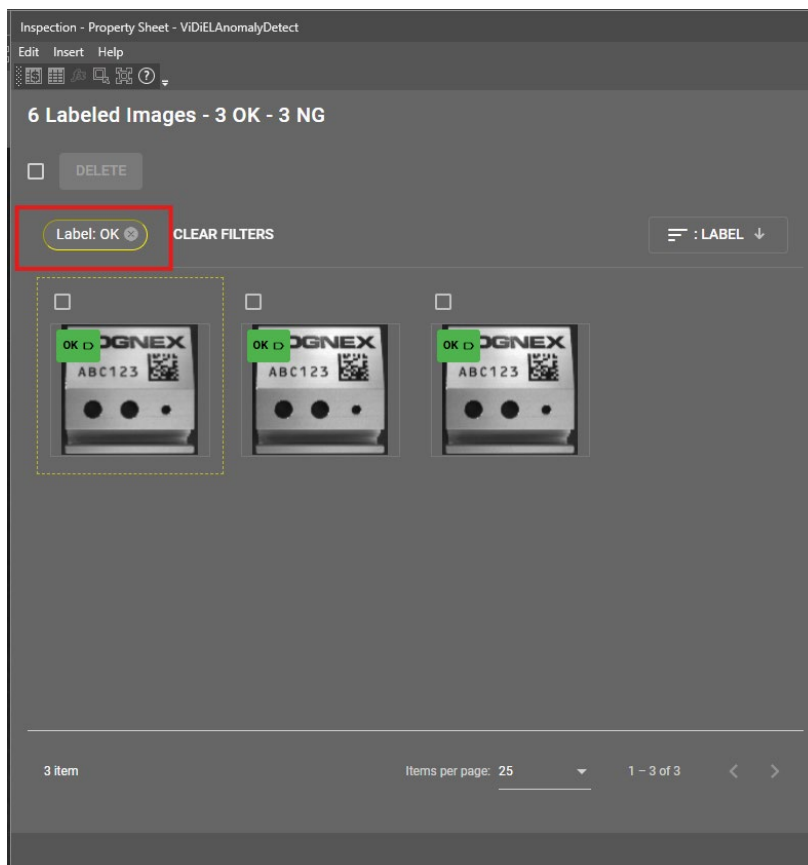
To review your training images, click **Edit** next to **Sample Image** in the bottom right section of the property sheet. The sample image view allows you to delete or relabel any images you added to the training set.



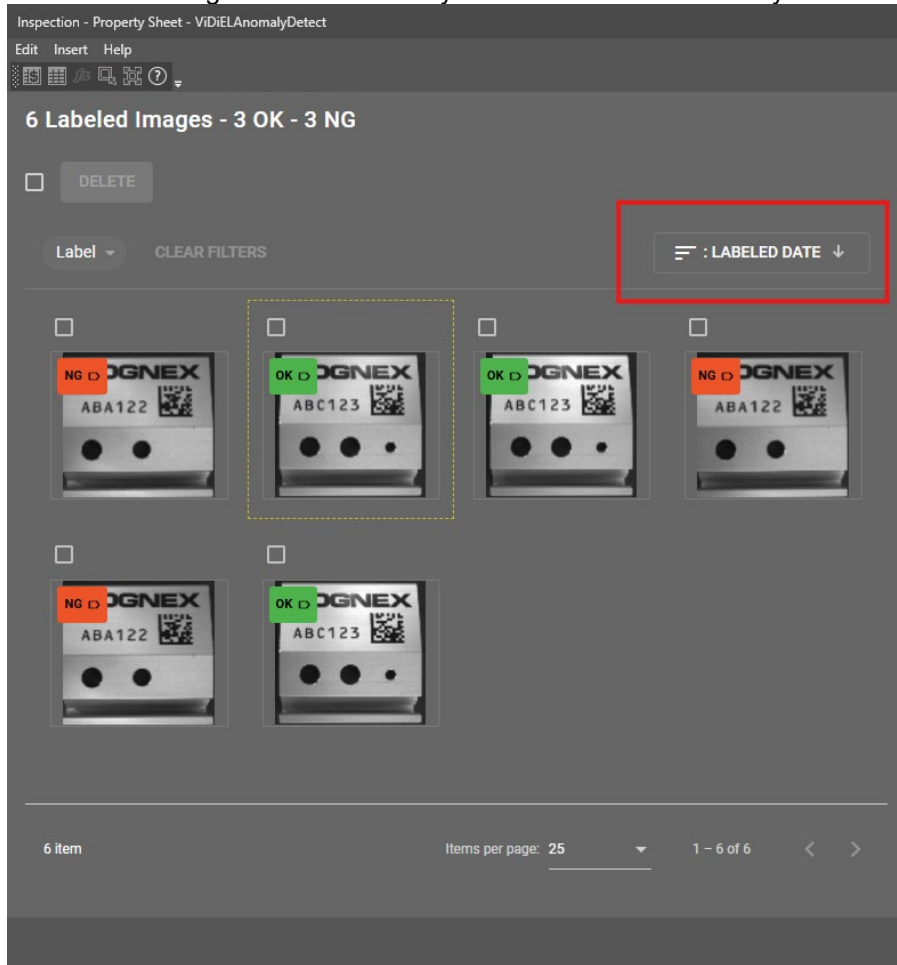
All the images in the training set can be selected at once by checking the box at the top left.



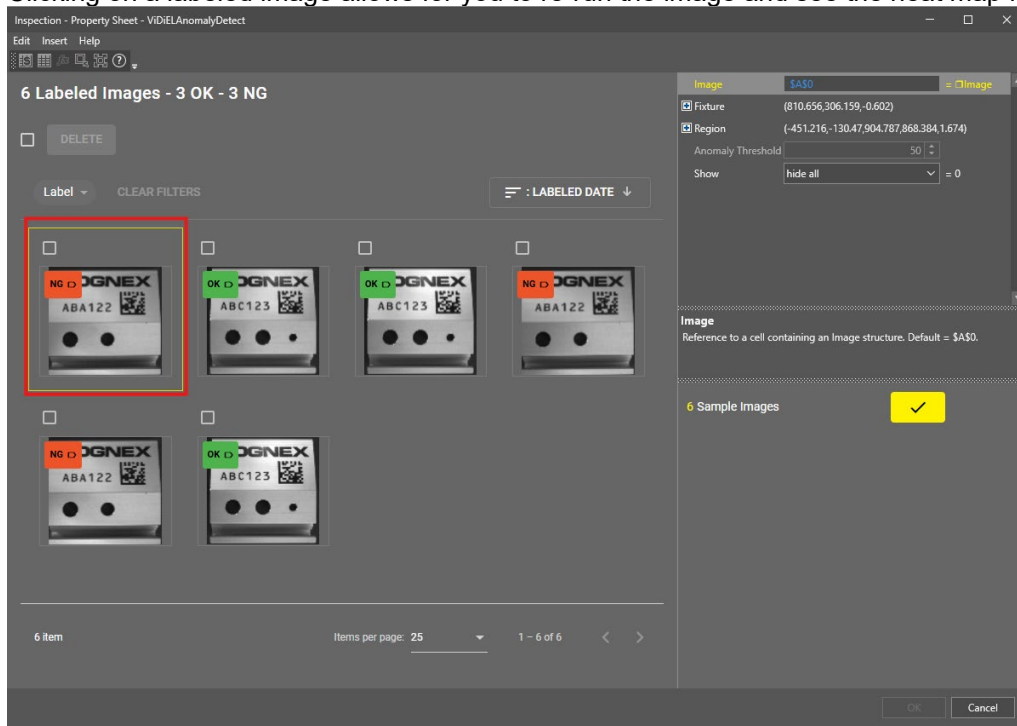
The images can be sorted by the current Label.



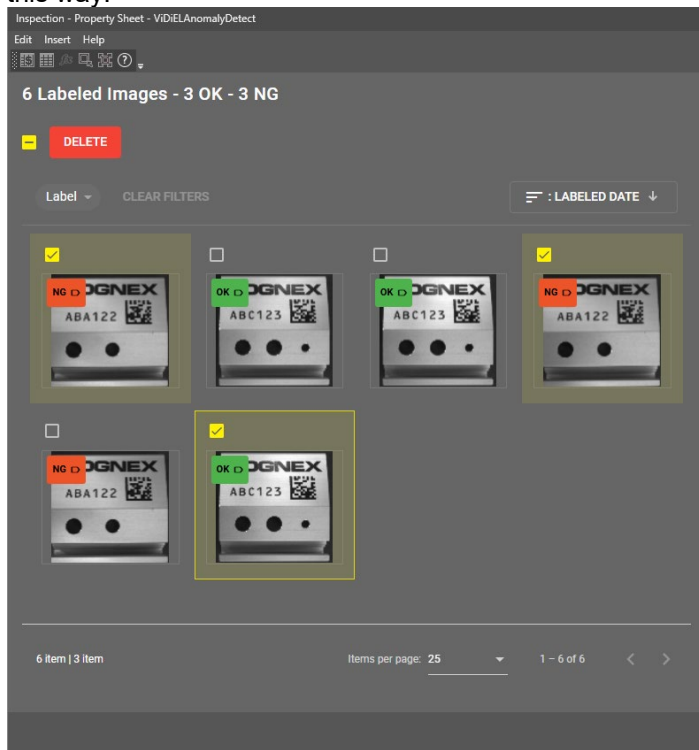
The Labeled images can be sorted by the label and the order they were entered.



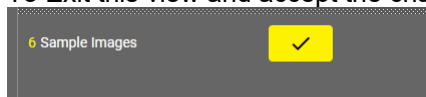
Clicking on a labeled image allows for you to re-run the image and see the heat map for that image.



Multiple images can be selected and removed at once by CTRL or SHIFT clicking the checkbox on the image. This only for deleting multiple images at once; you cannot change the label of the image this way.



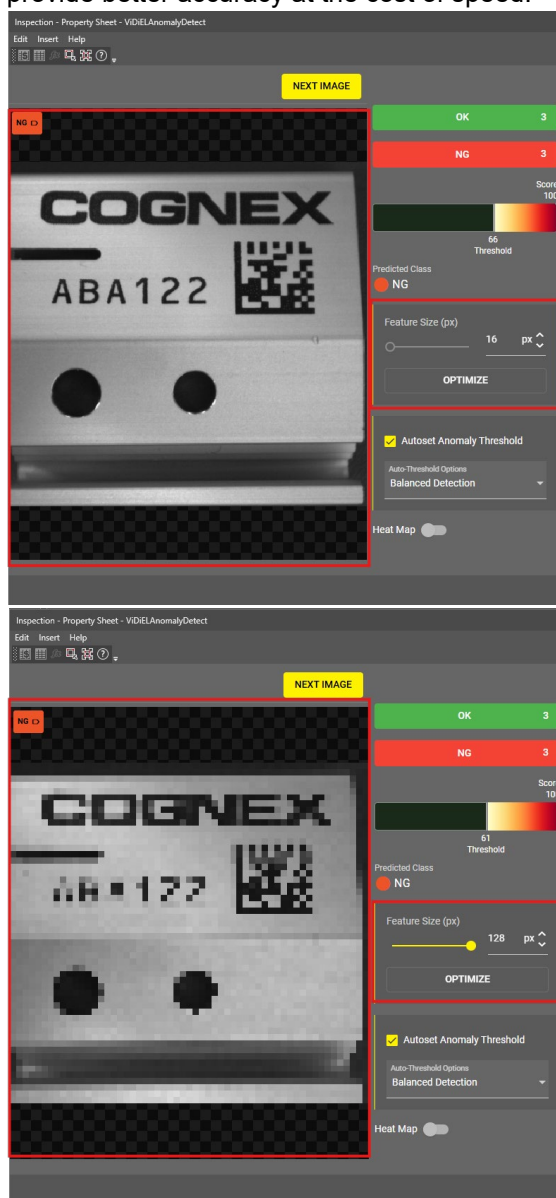
To Exit this view and accept the changes made click the checkmark.



1.6 Tool Settings

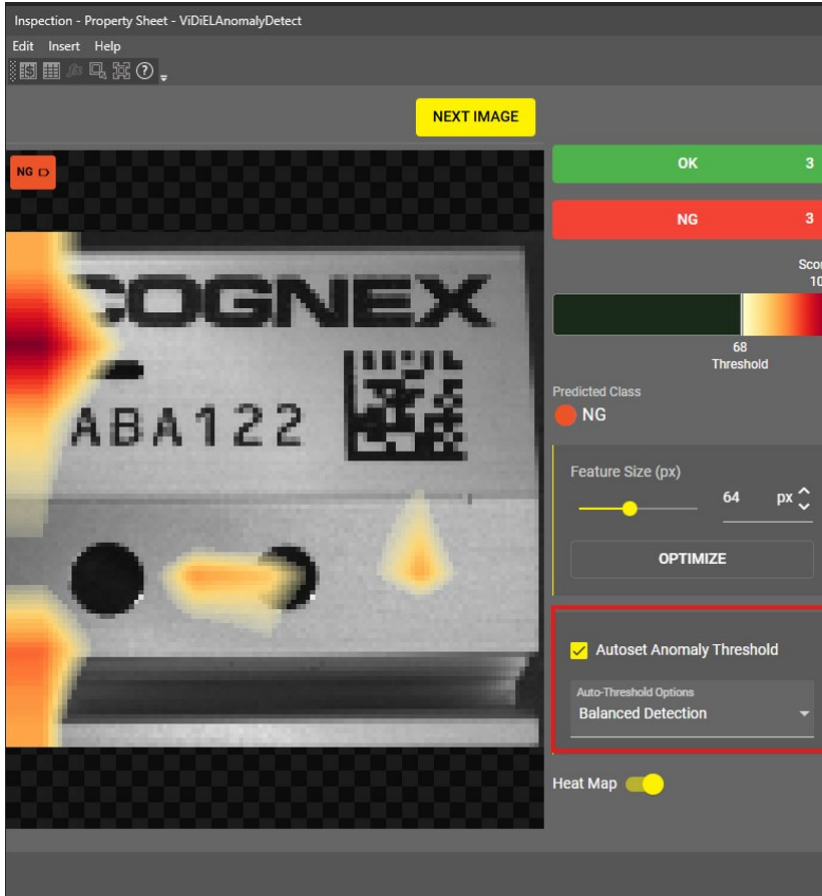
1.6.1 Feature Size

- Depending on the size of the anomalies you want the tool to find, you can also adjust the feature size and anomaly threshold.
- You can adjust the feature size using the **Feature Size (px)** slider in the tool settings next to the image display or click **Optimize** for automatic feature size settings.
- You can see the effect of the feature size in the example below. Larger feature size settings decrease the resolution of the image for faster processing, and smaller feature size settings provide better accuracy at the cost of speed.

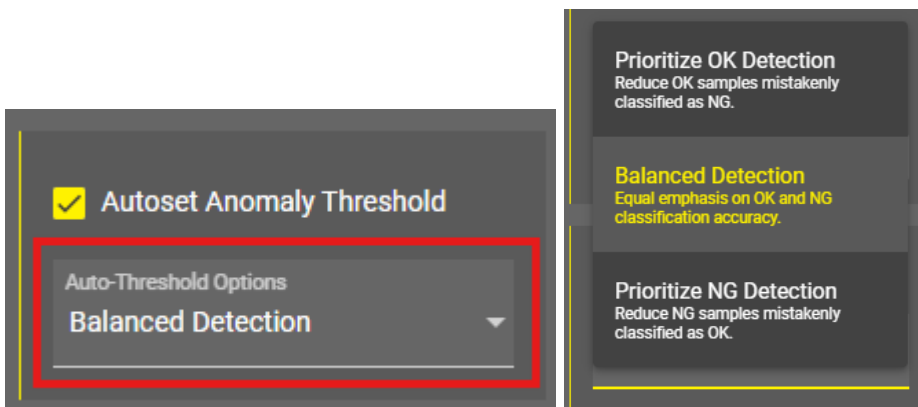


1.6.2 Threshold

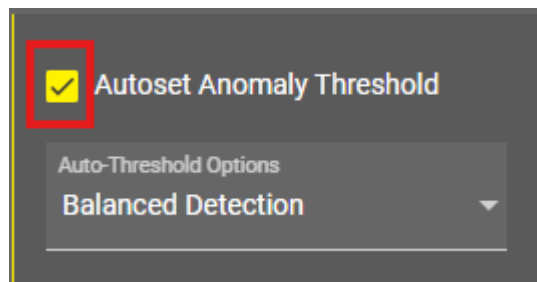
By default, the tool automatically sets the anomaly threshold based on the detection settings. The **Auto-Threshold Options** drop down in the tool settings next to the image display allows you to set the automatic anomaly threshold to the following options.



- **Prioritize OK Detection** sets the automatic anomaly threshold to reduce the number of OK results that are falsely classified as **NG**.
- **Balanced Detection** sets the automatic anomaly threshold to minimize undetected anomalies while avoiding false positives.
- **Prioritize NG Detection** sets the automatic anomaly threshold to reduce the number of NG results that are falsely classified as **OK**.

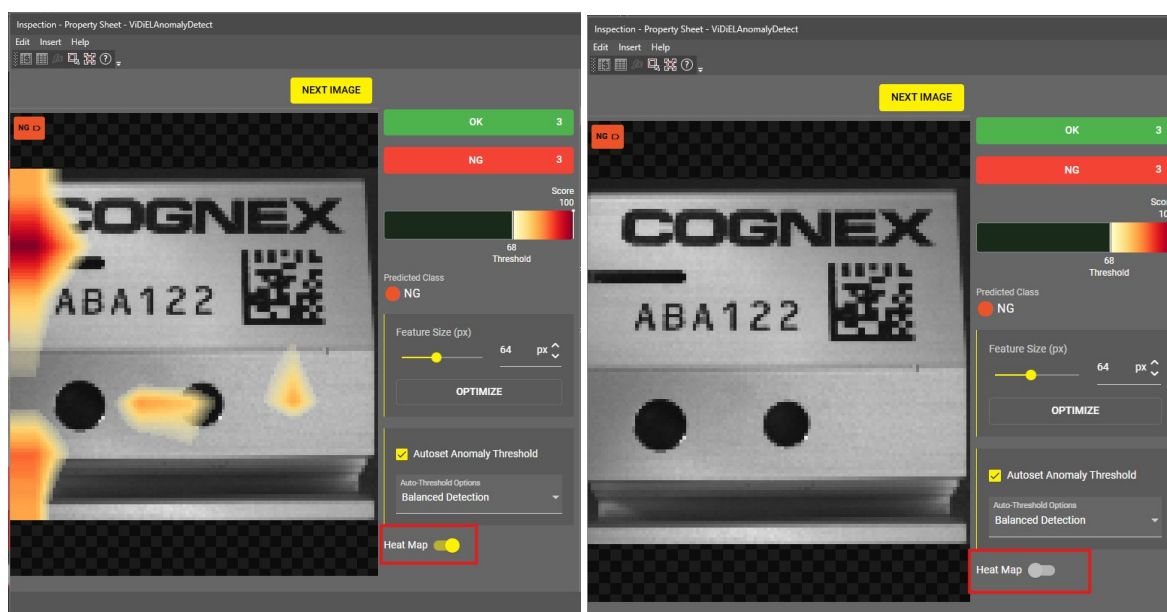


Alternatively, you can disable the **Autoset Anomaly Threshold** setting in the tool settings next to the image display, which enables the Anomaly Threshold property in the property list. The Anomaly Threshold property allows you to manually specify the anomaly score above which an inspection produces a **NG** result.



1.6.3 Heat Map

You can also enable or disable a heat map overlay using the **Heat Map** toggle in the tool settings next to the image display. This does not affect the output of the OutputMask and is used to see what is happening in the tool in the dialog. It is not a persistent option and will be Enabled the next time that you enter the tool.



Tips and Tricks:

- Rectangular ROI
 - The ROI must be rectangular and therefore can result in situations where the background impacts the performance of the tool.
 - An optional output of the tool is a heatmap image structure. This image can then be chained into additional tools to help false defects in the background.
- Fixturing is fundamental to successful deployment.
 - Perform all inspections using the same perspective.
 - While the tool may be able to detect major defects without consistent perspective, it will be significantly more difficult to configure the Feature Sizer and Threshold to get consistent performance.
 - The part rotating 180 degrees can be observed as a defect. When it is added to the **OK** labeled images, you intrinsically lower the sensitivity of the tool.
- Noise in region of interest.
 - Noise in the region of interest can be misinterpreted as a defect; consistency is key to achieving stability in the tool.
 - Take a repeating pattern such as patterned cloth in a continuous web, unless the triggering is strictly controlled the movement of the pattern in the FOV can require that the threshold be set such that minor defect will be difficult to detect.
 - Use the heat map to see what the tools are seeing. Keep an eye on where the **NG** images are failing. Make sure that a feature in the background isn't correctly labeling a failure of the foreground.
- Relationship between feature size and ROI size.
 - The larger the ROI and the smaller the feature size the higher the processing times.
 - A smaller feature size is not always the answer to increased sensitivity.
 - Often, you will see with small feature sizes the tool does not highlight the full area of the defect but only the transition from good to bad.
- **OK** images are used for training. **NG** images are used for configuring the Feature Size and threshold.
 - There is a limit of 36 images that can be added to the tool.
 - Watch for confirmation bias in adding tools. If an image is already scoring 0 or 100 there is no value in adding it to the image set.
 - **OK** images should be prioritized over **NG** images.
 - The tool will function once there are two **OK** Images. Model Health will be unavailable until there are **NG** samples in the data set.
- GetModelHealth is a valid function for ViDiELAnomalyDetect.
 - Returns the health of a model between 0 and 100.
 - As you approach 100, you should see most images score 0 or 100, and images that fall in the middle are good candidates to be recorded for further development of the model.