Title Gocator HexSight Integration
Revision 1.2

Purpose This application note demonstrates how to interface a Gocator sensor to HexSight

Equipment Any Gocator 2000 or 2300 family sensor
HexSight 4.3.0.70 or above

Table of Contents

1 Overview

This application note demonstrates how to interface a Gocator sensor to HexSight, which is a comprehensive software library of machine vision tools, available as ActiveX controls, C++ DLL libraries, or a .NET DLL assembly. Besides the API, HexSight also comes with a number of demo applications which allow the user to explore the tools without writing any software.

HexSight includes a powerful Locator tool, which provides accurate and robust object recognition through geometric object location. The Locator finds the contours of parts in the image, and quickly identifies each part's position and orientation. HexSight's other Inspection tools can be model-based to leverage the Locator's results by automatically transposing tools on parts regardless of their scale or rotation

The example application presented in this note is using HexSight in this fashion to measure how deeply a rubber plug is seated in one of the holes in the part pictured in Figure 1. Although the Gocator's Whole Part Mode can detect and scan the part, there are no built-in measurement tools with the ability to locate a particular area within the part for a local measurement.

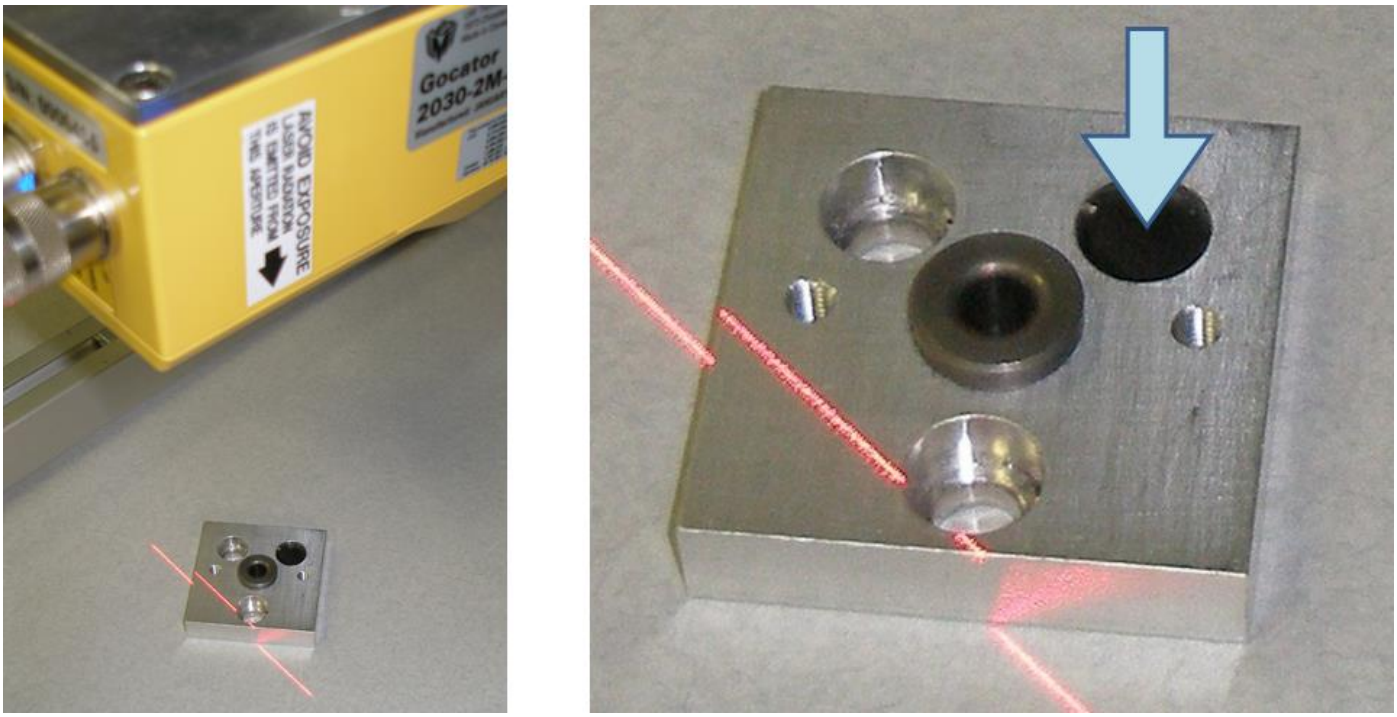


Figure 1: Gocator scanning a part with a rubber plug seated in one hole.

This document assumes that HexSight is installed on a PC, with a dongle enabling the Locator, and that the user is already familiar with the Gocator Whole Part Mode.

2 HexSight – Gocator Support

2.1 Overview

HexSight can directly import the data captured by the Gocator, and use its vision capacities to locate 3D objects. The entry point into HexSight is done just like any other camera or sensor device, through the AcquisitionDevice, by simply providing the IP address of the system to use. The height maps created by the Gocator are supported in HexSight and are imported in their native 16 bit format. While the X-Y calibration is transferred in the process from the Gocator to HexSight, the Z information has no real meaning in HexSight. The images are, hence, kept as 16 bit intensity images internally.

2.2 Integration Scope

The Locator and the Histogram tool natively support the 16 bit images generated by the Gocator. Several tools only support 8 bit images, but the ImageProcessing tool can convert the Gocator images to 8 bit images, allowing the full suite of HexSight tools to be used. Refer to Appendix B for a detailed outline of the 8-bit/16-bit support of each tool.

Initial performance testing of the Locator shows that the 16 bit Gocator height map images are handled as well as regular 8 bit images, with slight to no loss of performance. This is due to the nature of the tool, which is using detection based relative differences between intensity levels.

HexSight only starts and stops the Gocator. The user must use the Gocator web-interface, or an application using the Gocator SDK, to correctly configure the Gocator first. We highly recommend users test their configuration with the web-interface first as there are no error messages reported in HexSight if the configuration is wrong.

HexSight can capture in four modes and the Gocator must be setup in the same mode before acquiring:

- Whole Part Mode [default]
- Profile Mode
- Whole Part and/or Intensity
- Profile and/or Intensity

Like with any other device in HexSight, all settings in the AcquisitonDevice can be configured programmatically with functions in the API.

The example in this document is for the default Whole Part Mode, but the other modes would be handled the same way.

3 Configuring the Gocator

This note is focusing on the Gocator delivering Whole Part data, as that is the natural operation mode for part inspection. The user should first configure the sensor using the Gocator web-interface. For Whole Part operation this typically includes:

- Set the operation mode to Whole Part. Enable 'acquire intensity' if intensity data is required.

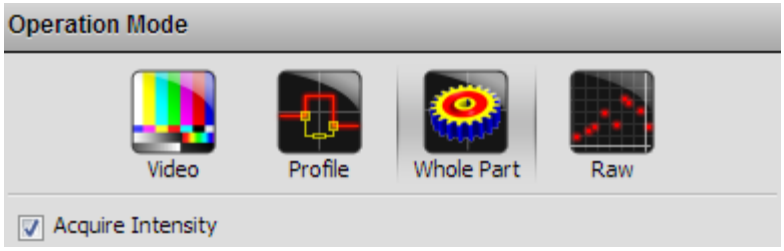


Figure 2. Select Operation Mode

- Tune exposure time to get good profile data across the part to be scanned.
- Perform Alignment calibration, or Travel calibration if encoder trigger is used.
- Configure Detection setting to properly detect the part to be scanned.
- Verify that the part scans in Whole Part Mode as desired.
- In the Output panel, *must* enable the data to be sent over Ethernet.

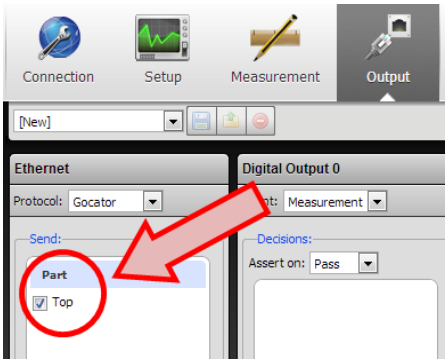


Figure 3: Part data *must* be enabled to be sent over Ethernet.

The part used in this example is scanned in Whole Part Mode as shown in Figure 4. The rubber plug is the green hole. There are a few data points missing off the rubber surface, as the material is dark. The exposure time cannot be increased too much due to reflection issues around the other holes. This compromise scenario is typical in many scanning applications.

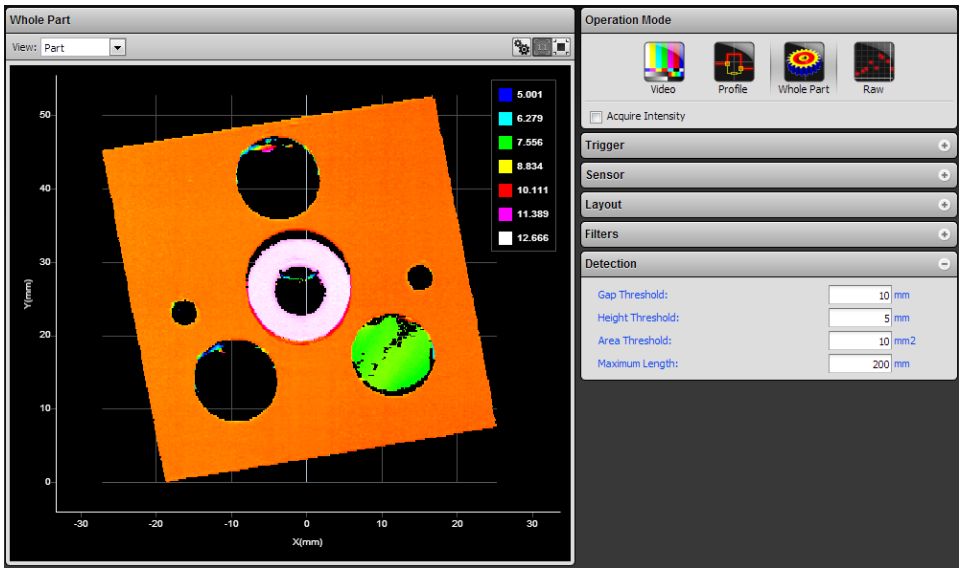


Figure 4: Whole Part scan of example part. Rubber plug is the green hole.

3.1 Configure Scheduling Gocator Digital Outputs from HexSight

HexSight can control the Gocator digital outputs using the *HSOutputTool*. To use this functionality, set the Gocator into scheduled output mode.

- In the Output Page, set the Measurement Event of Digital Output to Software

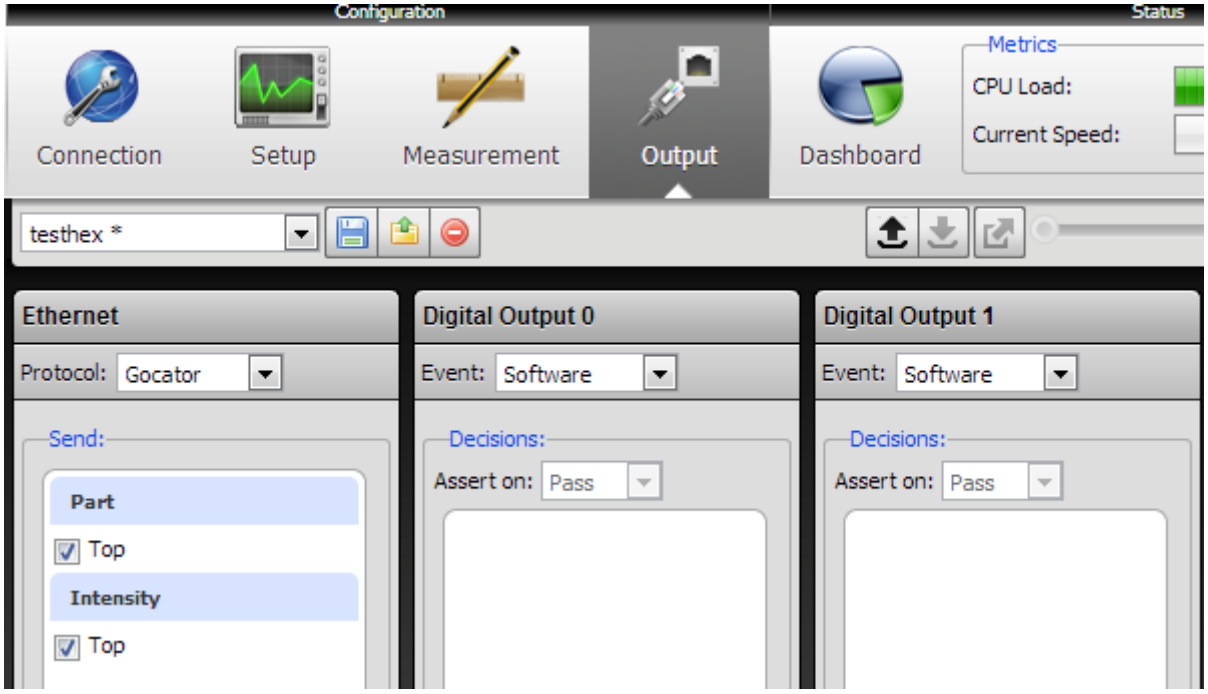


Figure 5. Setup Digital Output Event

- Set the desired pulse width.
- Enable scheduling if the output needs to be triggered at a fixed time or position offset from when the part is captured. If scheduling is not enabled, the sensor is triggered immediately after the command is received from HexSight.

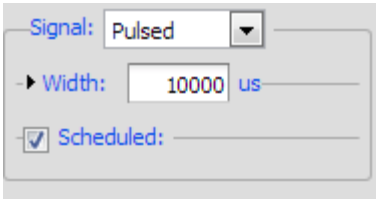


Figure 6. Output Pulse Width and Enable Schedule

4 Gocator Demo – Introduction

HexSight is a toolbox, not a stand-alone application. For the purpose of this document, the Gocator Demo will be used to show how the example part can be measured. The Gocator Demo is an example application provided in the installation package of HexSight.

4.1 Installing the Go2.dll

The Go2.dll is needed to interface to the HexSight. The Go2.dll is included in the Gocator SDK package (*14400-x.x.x.x_SOFTWARE_Go2_SDK*) of each Gocator firmware release. Before running HexSight, copy the Go2.dll from the bin\win32 directory into Controls directory in the HexSight installed directory (e.g. *C:\Program Files\HexSight 4.3\Controls*).

4.2 Starting the Gocator Demo

Once HexSight 4.3.0.70+ has been installed, the Gocator Demo shortcut will be located in the HexSight 4.3 folder under Example when using the Windows Start button.

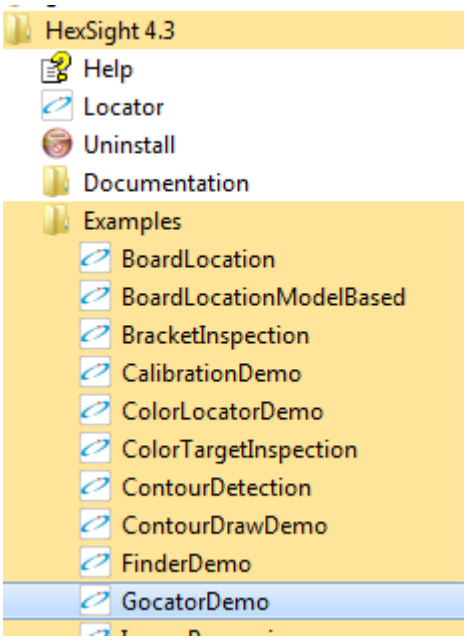


Figure 7: Starting the Gocator Demo Application

4.3 Exploring the Gocator Demo Application

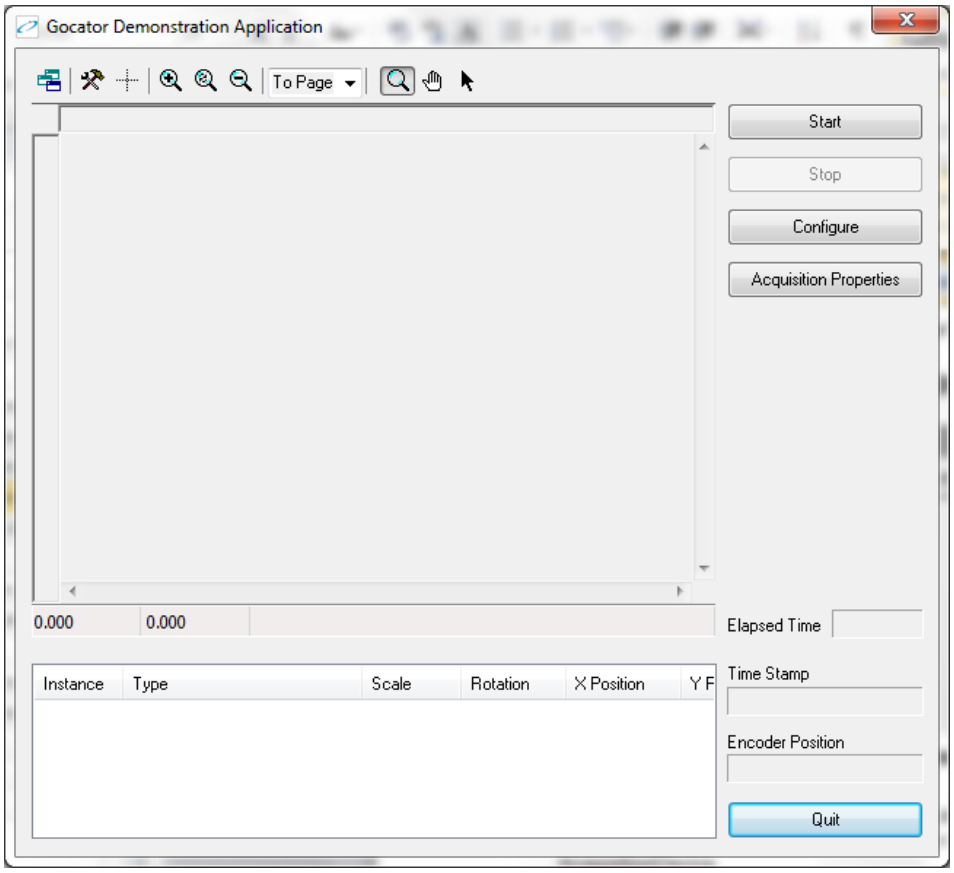


Figure 8. Gocator Demo Application

- The **Start** button starts the Gocator scan collection.
- The **Acquisition Properties** button from the main application opens the property pages to configure the AcquisitionDevice.
- The **Configure** button shows the HSApplication control, which contains the HSProcessManager and the HSExplorer.
    - Within the HSProcessManager, the left-side panel displays the sequence of the tools: an AcquisitionDevice, followed by a Locator.
    - The right-side panel shows all the available tools to customize the sequence of tools to perform a specific application.

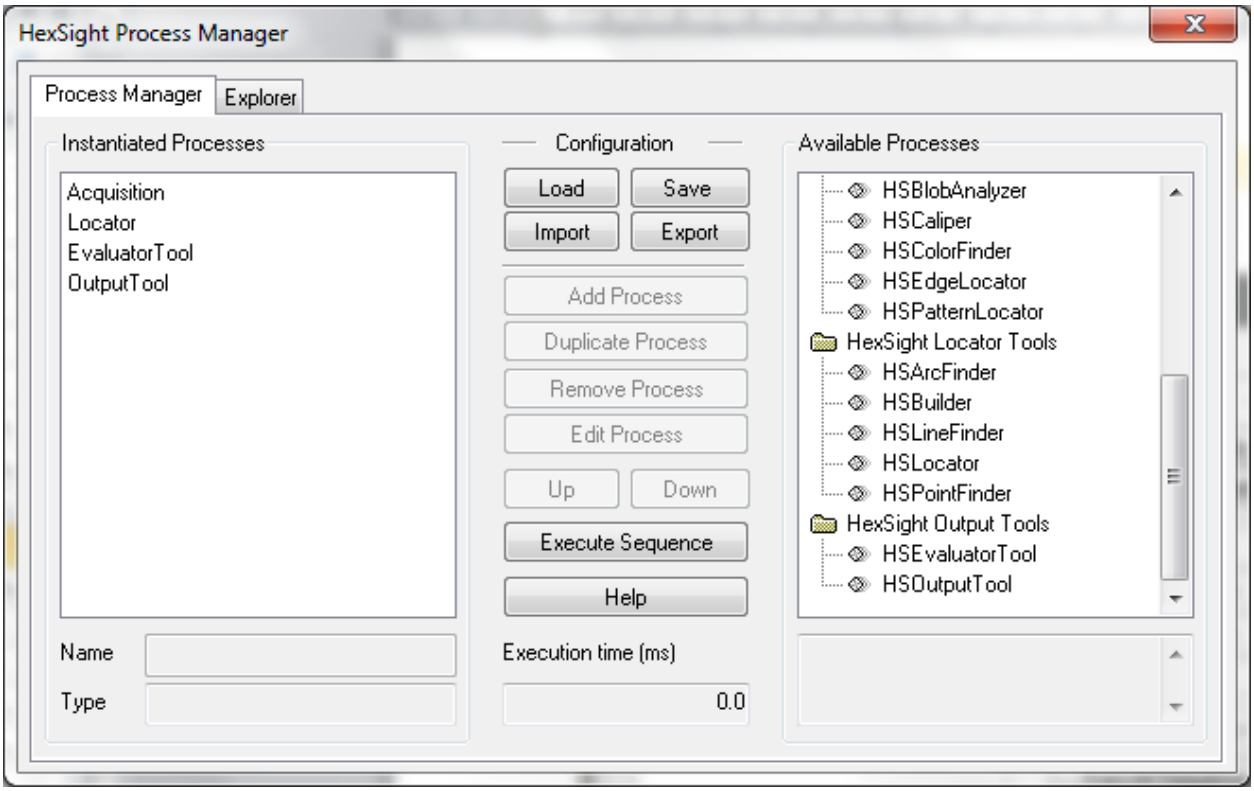


Figure 9. HSApplication control, with HSProcessManager

5 Adding the Gocator as a Device

In the Configuration tab of the AcquisitionDevice, a Gocator would be automatically listed under the Input tab if it is networked to the PC running HexSight.

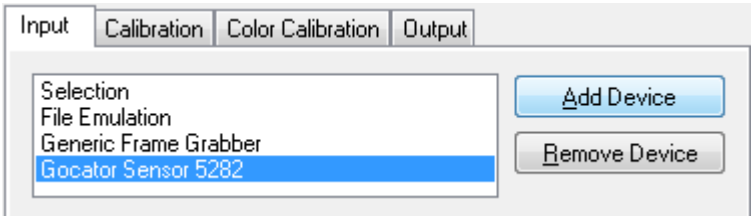


Figure 10. Gocator Detected as Input Device

If the Gocator is not detected, user can add the device by clicking on **Add Device**. This brings a dialog with a list of available devices to the left and a list of possible devices in the **Model** to the right. **LMI Gocator Sensor** should be selected before clicking OK.

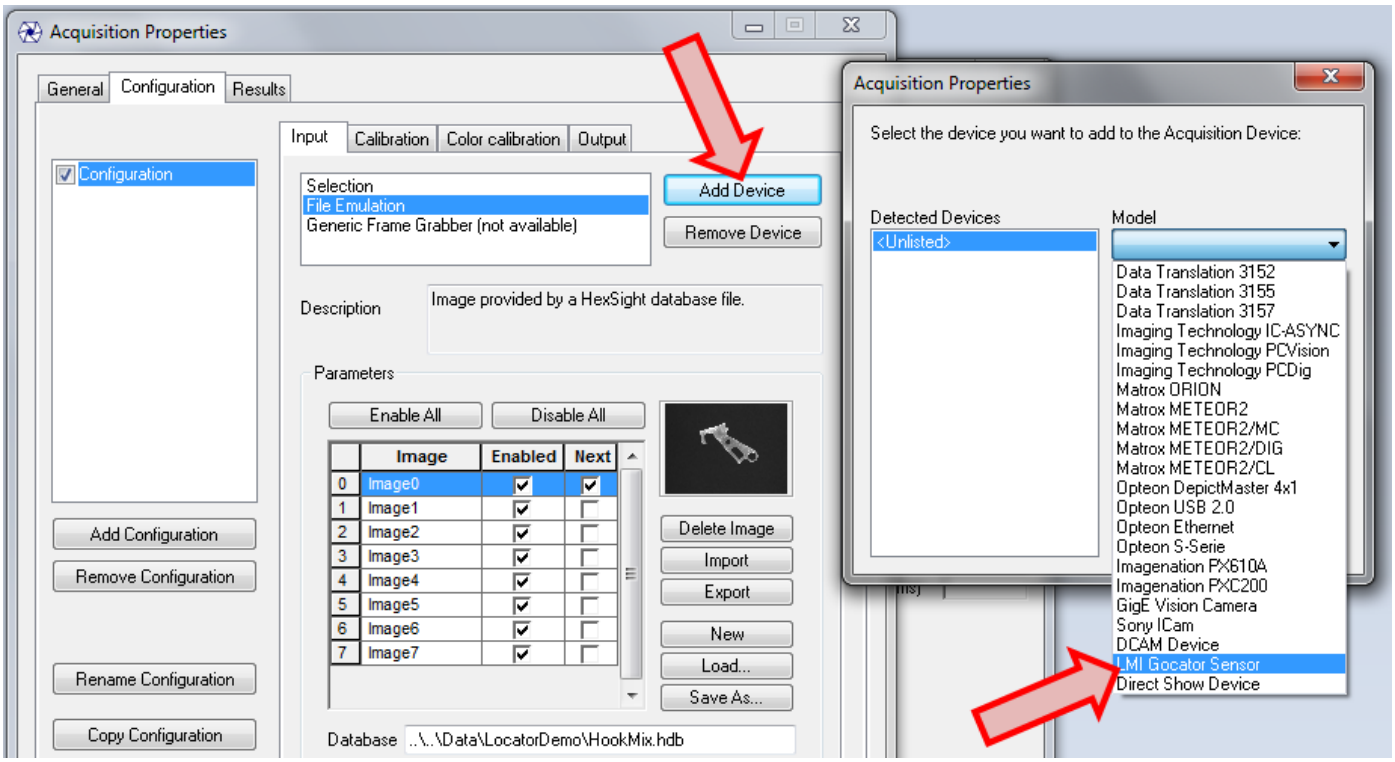


Figure 11: Adding a Gocator Sensor

In the attributes tab in the centre of the AcquisitionDevice, there should be the IP address field required to connect to the Gocator device.

Enter the correct IP address and the proper Data type in which it is currently configured. Click **OK**.

To get the same image orientation as in the Gocator's display from the web-interface, the image coordinate system should be set to Left-Handed

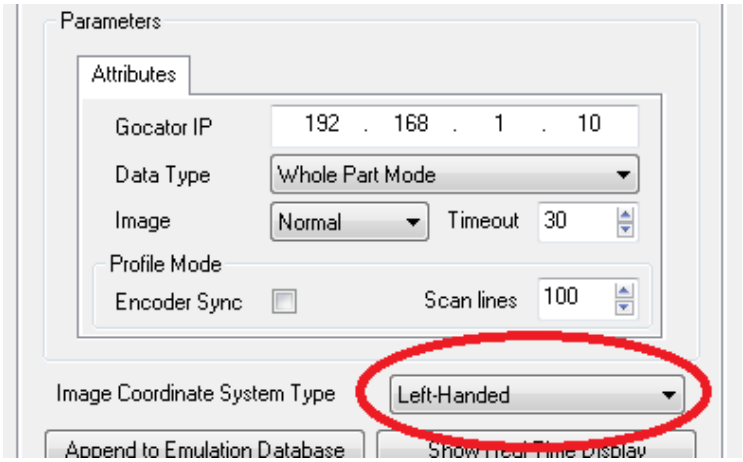


Figure 12. Gocator Parameters

5.1 Testing Acquisition

If the Gocator and HexSight are both configured correctly, clicking **Start** should start and stop the Gocator's acquisition and display the captured height map image in the application's Display.

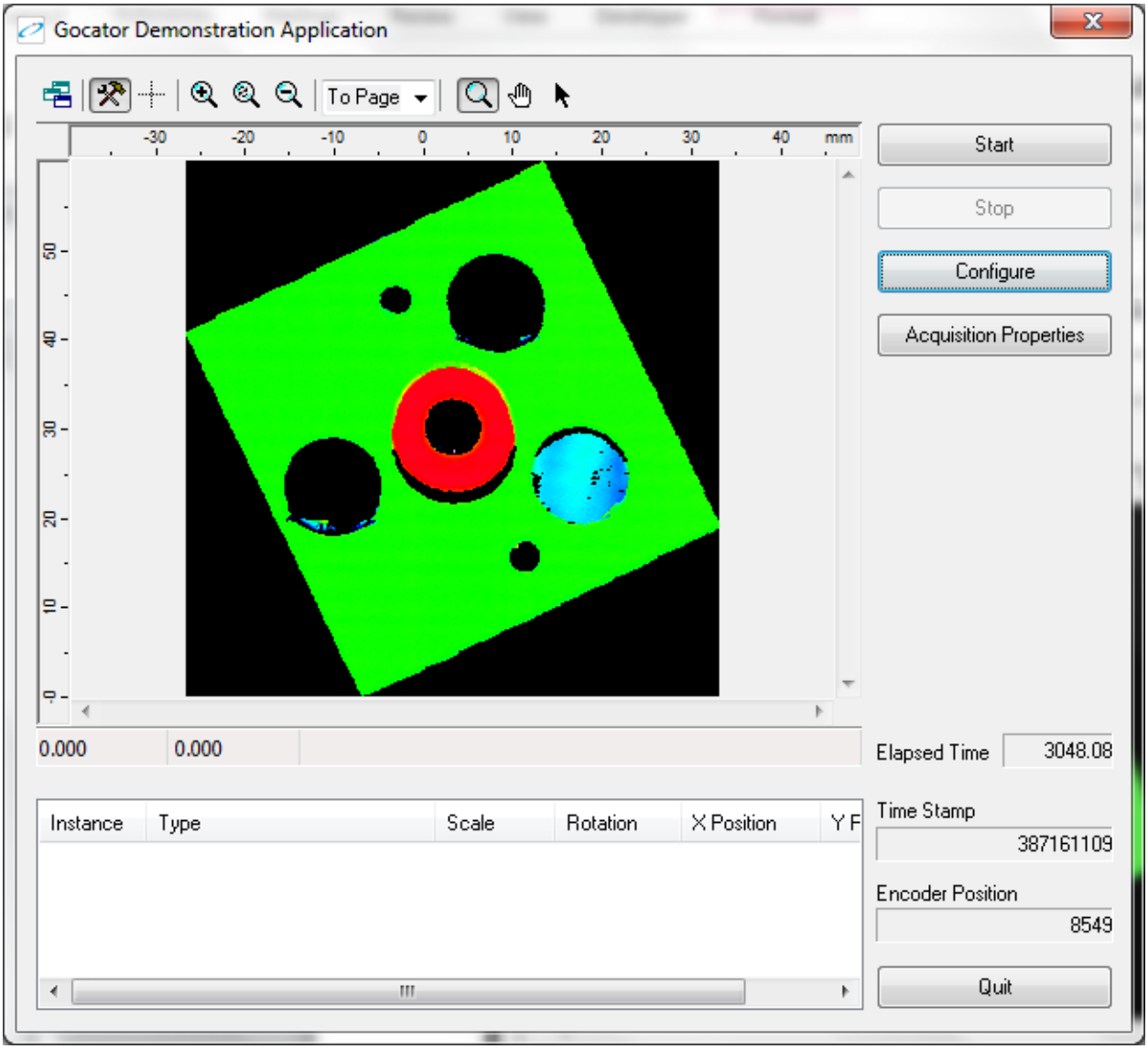
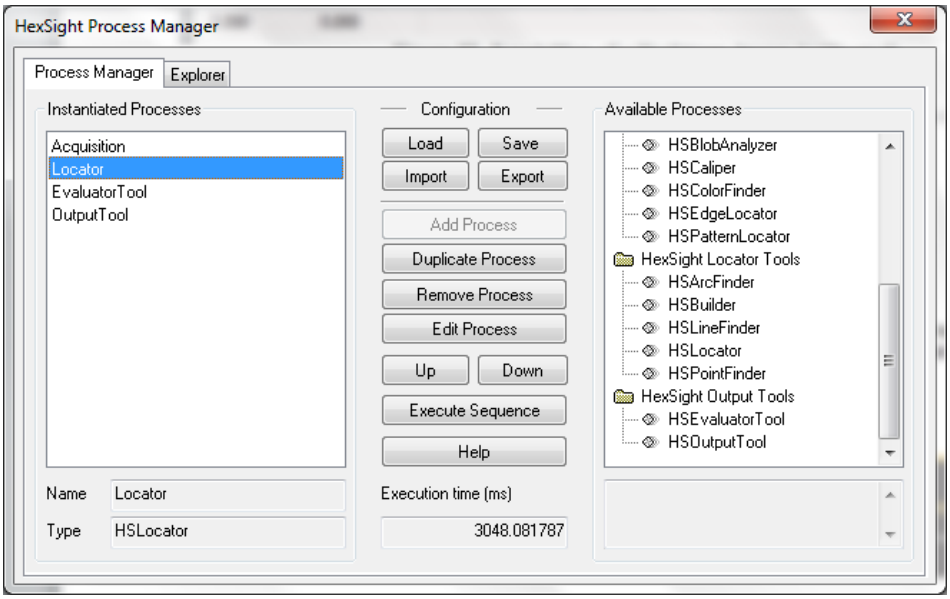


Figure 13. Acquisition of a Heghtmap Image (Calibrated)

- The **hammer and wrench button** ( ) in the toolbar allows the user to display a calibrated view of the image. Otherwise the image may appear distorted.
- Press the **Stop** button to stop the acquisition.

6 Adding a Model

The Locator property pages can be shown by clicking the Locator in the Process Manager.



The Locator needs to be trained to look for a certain object before getting a successful location.

- In the Model tab, clicking **New** will clear the current Model Database, allowing the creation of a new model. Click **Add** to create a model from the current captured image (Heightmap).

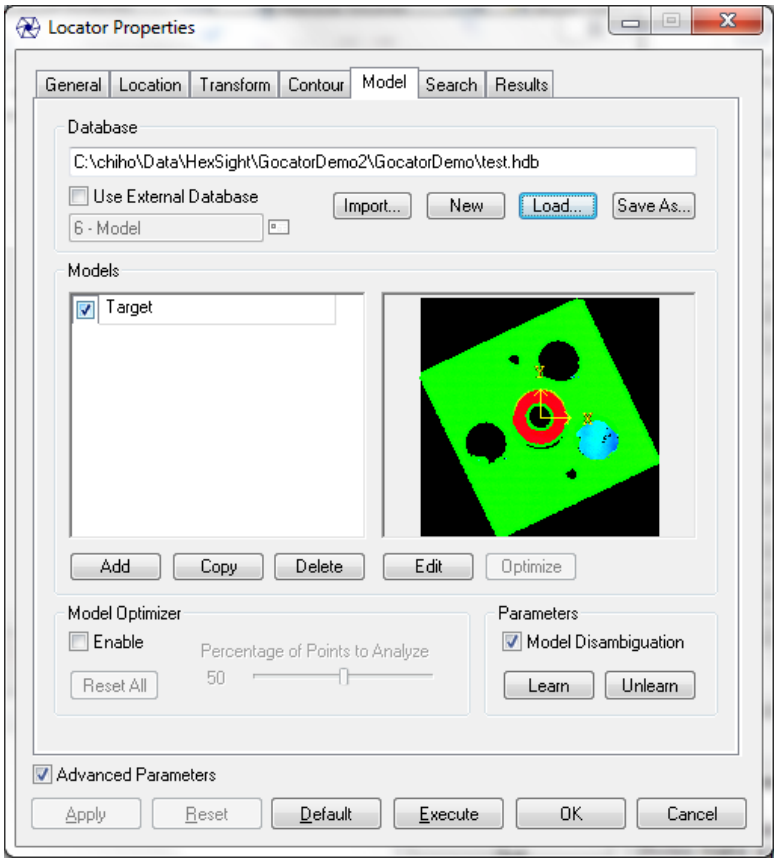


Figure 14. Model tab of the Locator

- Click **Edit** to bring up the model edit dialog box. Refer to the HexSight user manual on how to setup the model. Once it has been set properly, clicking **Build Model** will create a geometric representation of the object.

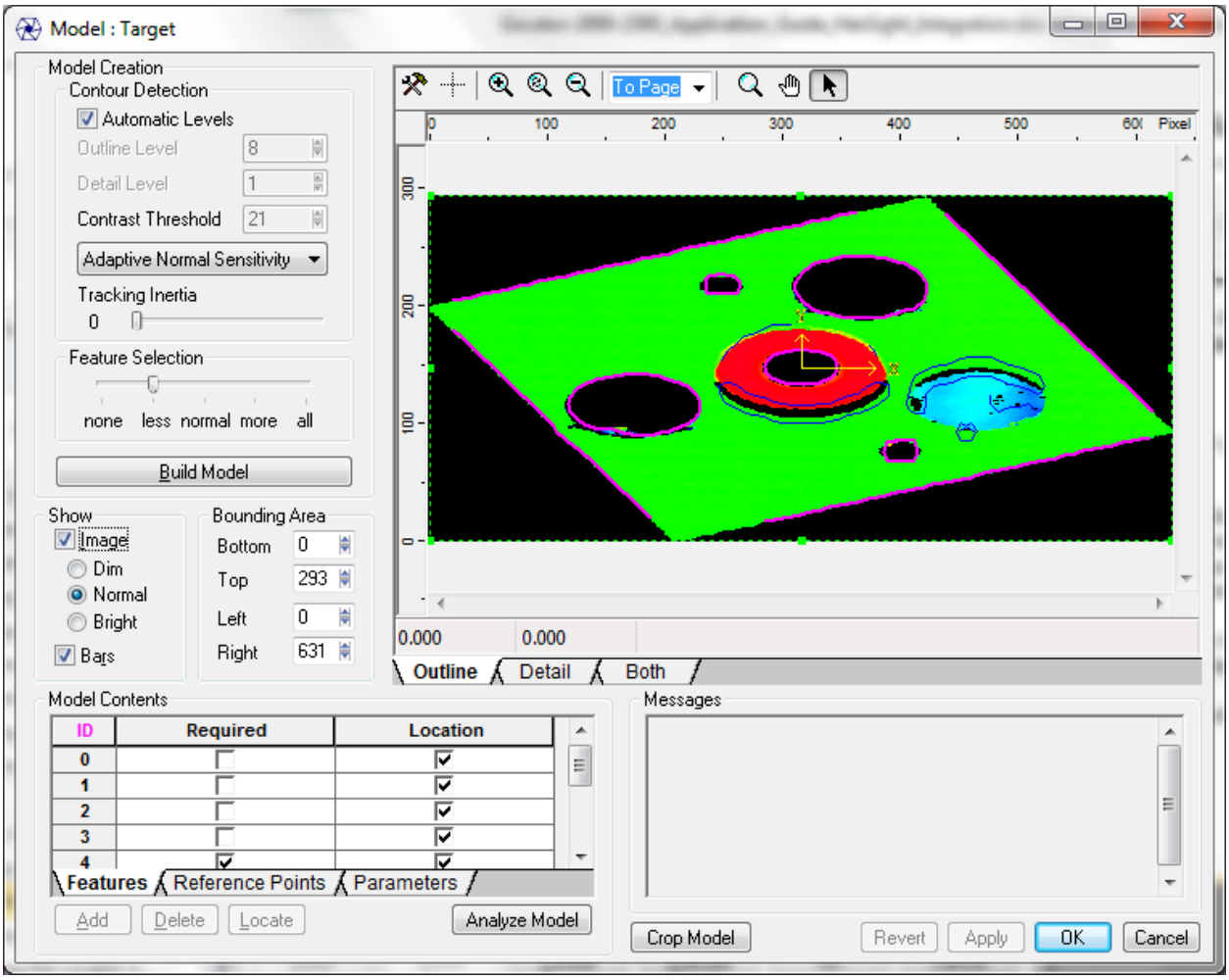


Figure 15. Model Edit Dialog

- For a complicated part, like the one used in this example, it's unlikely that HexSight will automatically generate a suitable model. From the Model Content table in the bottom left corner, it is possible to **Add** and **Delete** contours to be used in the model. It is important to select non-symmetrical features in the model, otherwise the Locator cannot determine the unique rotation of the part.

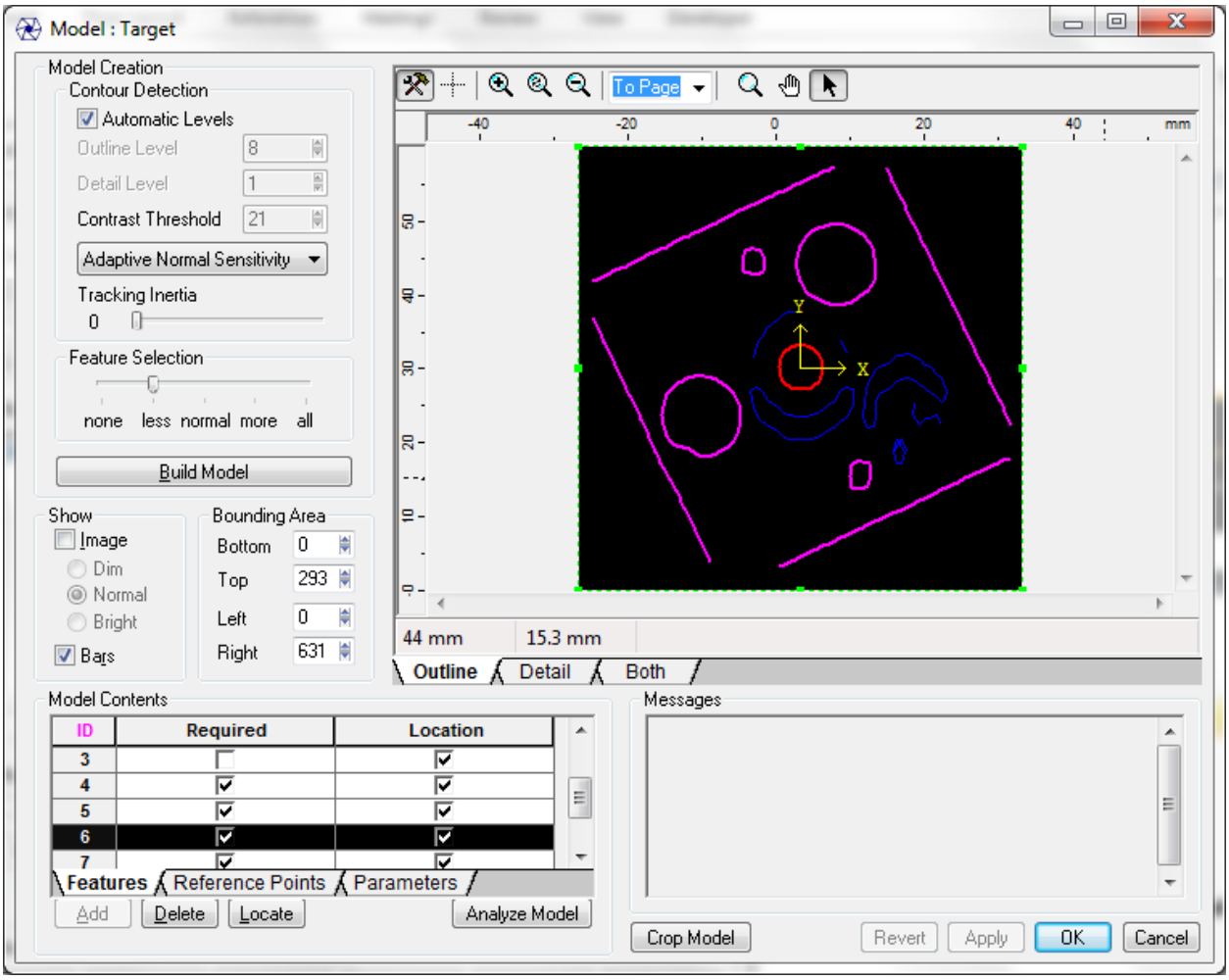


Figure 16. Select Contour to Use In the Model

- **OK** will accept the current model edition, keeping the new defined model as a new model in the database.

6.1 Running the Locator on the Model Itself

To first validate that the model has been trained properly, a simple search on the current image should return the single instance that was just trained. This is done by clicking **Execute** at the bottom of the Locator property pages.

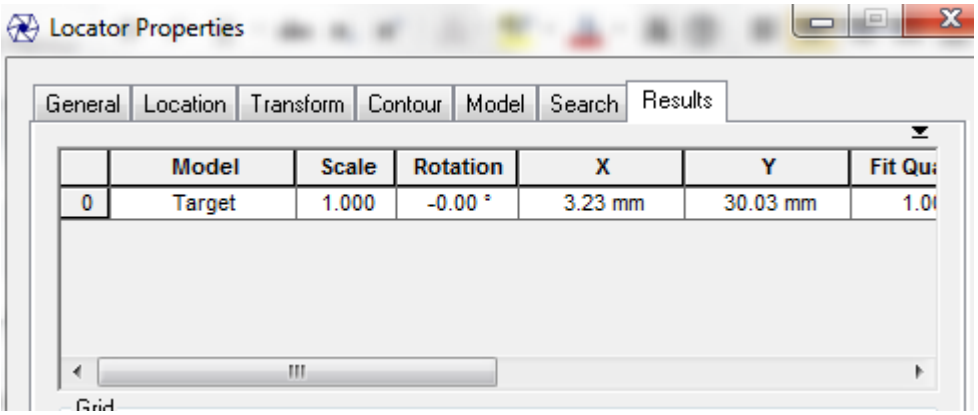


Figure 17. Result tab of the Locator

In the top grid, instance 0 is the result of the search. There should be at least 1 instance detected with a rotation of 0 degrees.

6.2 Running the Locator on other Acquired Images

Leaving the Locator property pages opened at the result page will give an up-to-date report of the found instances.

Back in the main application, hitting the **Start** button will execute the whole sequence, starting with the capture of a new Heightmap image from the Gocator, and run a search on the new image as well. If the test is going well, the presence of the object should be detected every time it is in the field of view of the Gocator.

The Result tab will show the position and rotation angle of the part and the image display will also indicate this information.

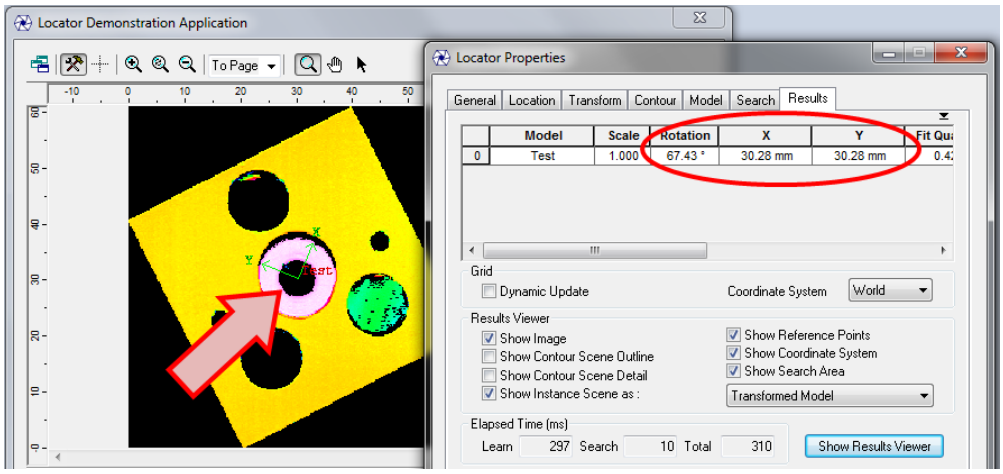


Figure 18. Main application showing the detected instance in a new image

7 Histogram Tool

The Histogram Tool can be used to measure average or median height in a specific local area, in this example the rubber plug. To add the tool into the processing chain, go back to the main Locator Demo window and press the **Configure** button. This will open the Application Control with the Process Manager.

- Select the histogram in the list of available processes on the right, then press the **Add Process** button.

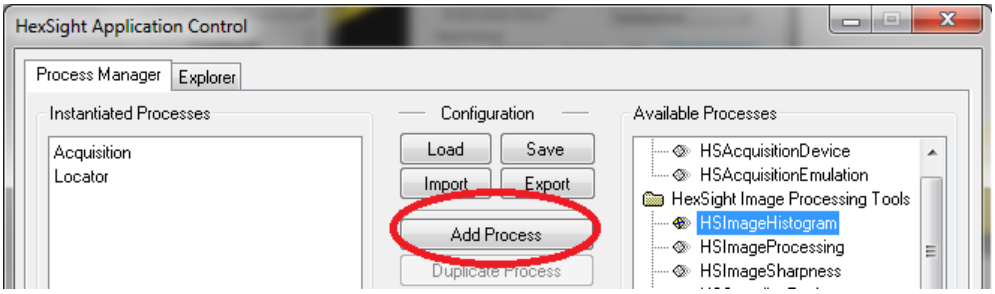


Figure 19: Add Histogram Tool to processing chain.

- Add the **Input Image** from the Acquisition Device.

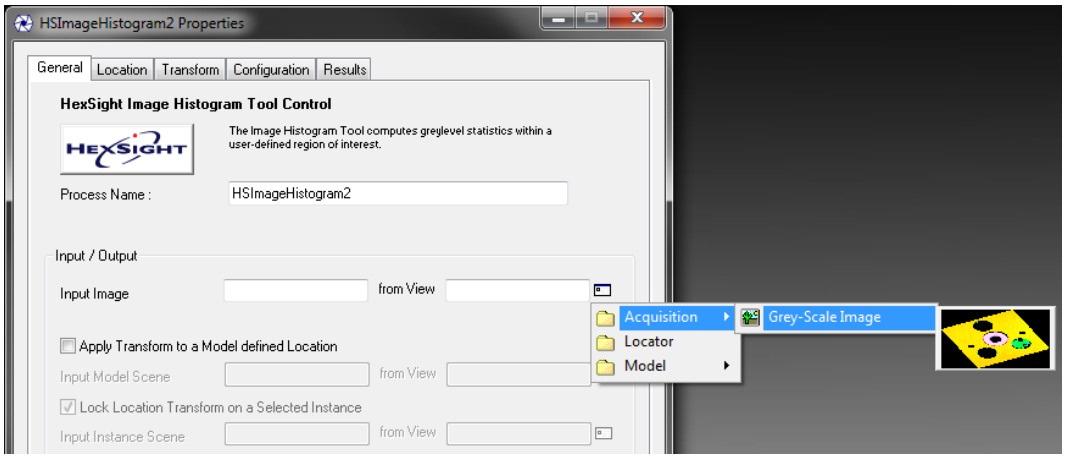


Figure 20: Add Input Image to histogram.

- Add the **Input Model Scene** from the Model.

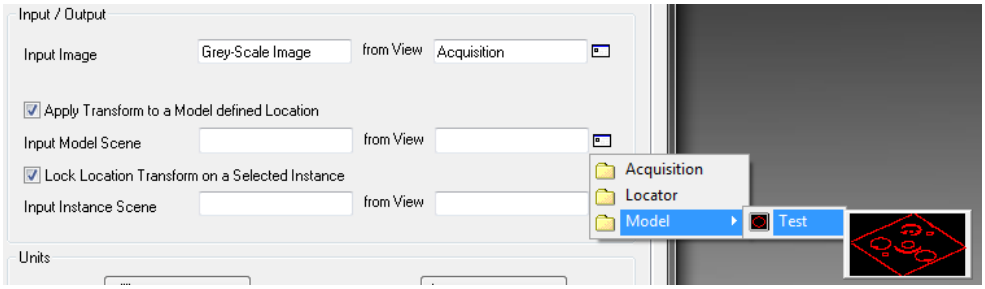


Figure 21: Add Input Model Scene to histogram.

- Add the **Input Instance Scene** from the Locator. Then press the **Apply** button.

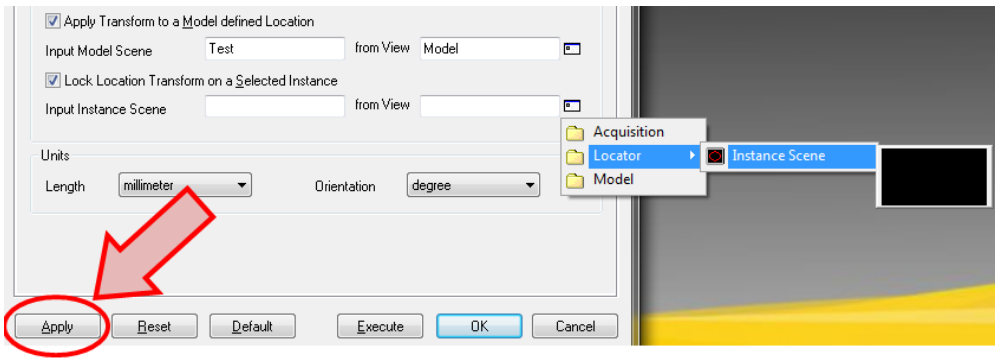


Figure 22: Add Input Instance Scene to histogram

The Region of Interest (ROI) in which the histogram will operate is configured under the **Location** tab. The ROI is show as a green rectangle overlay on the image. First centre the position the ROI by setting Position X and Y

to 0, then use the mouse to fine tune the exact size and position. In the rubber plug example, the ROI is positioned over the plug with a 5x5 mm ROI.

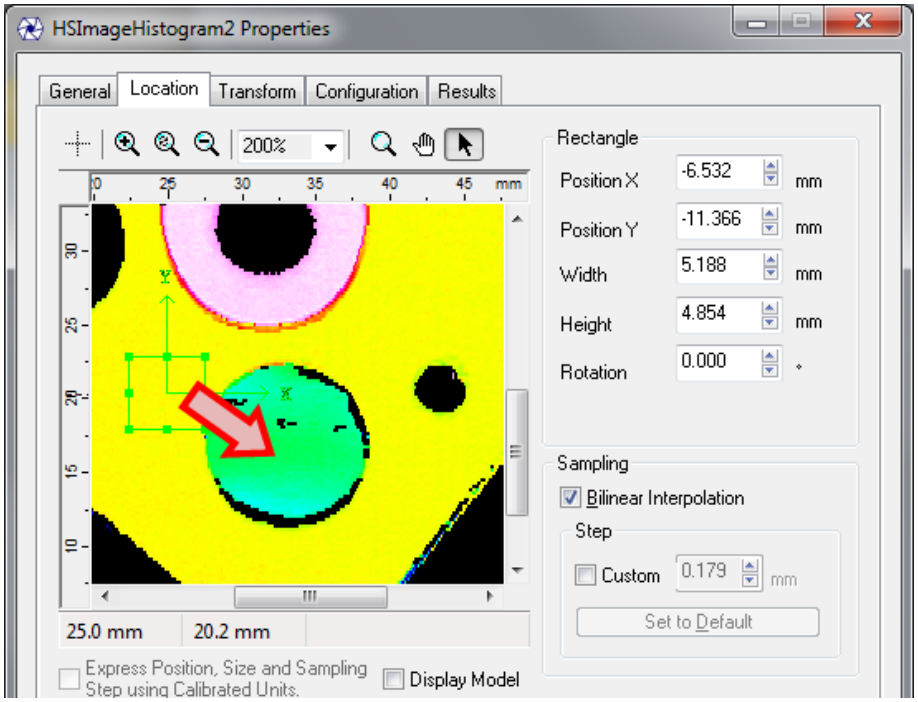


Figure 23: Configuring ROI for histogram.

To verify the histogram is configured as expected, press **Execute** to process the current image and then go to the **Result** tab. In the case of the rubber plug example, the Median value should be used, because there is some missing data on the plug which significantly skews the Mean.

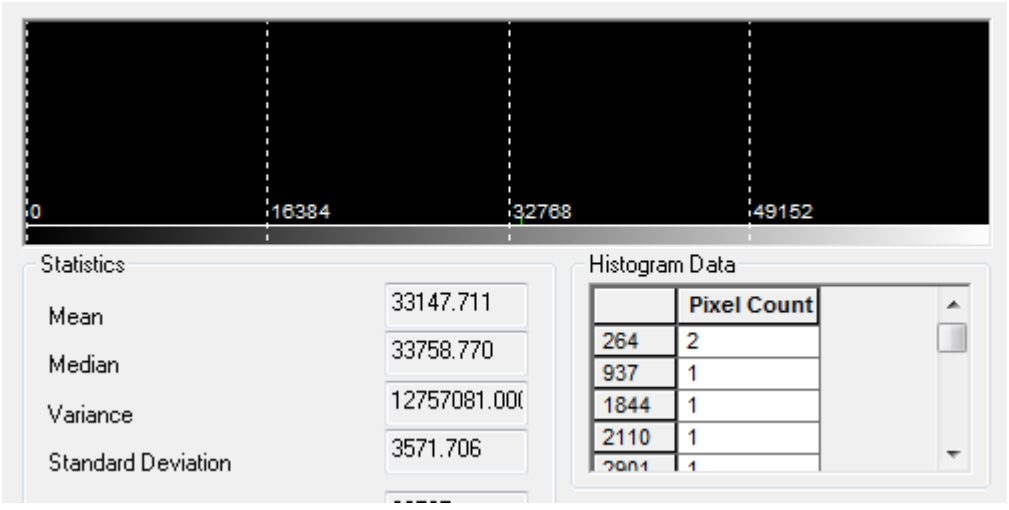


Figure 24: Histogram results.

Finally, to convert the 16 bit pixel value back to real-world engineering units in mm, the following calculation is used:

*mm_median = ZOffset + pixel_median * ZResolution*

The image calibration parameters are located under the Acquisition Device in the Configuration tab under the Calibration tab. The height of the rubber plug is -262.144 + 33758.8 * 0.008 = 7.92 mm.

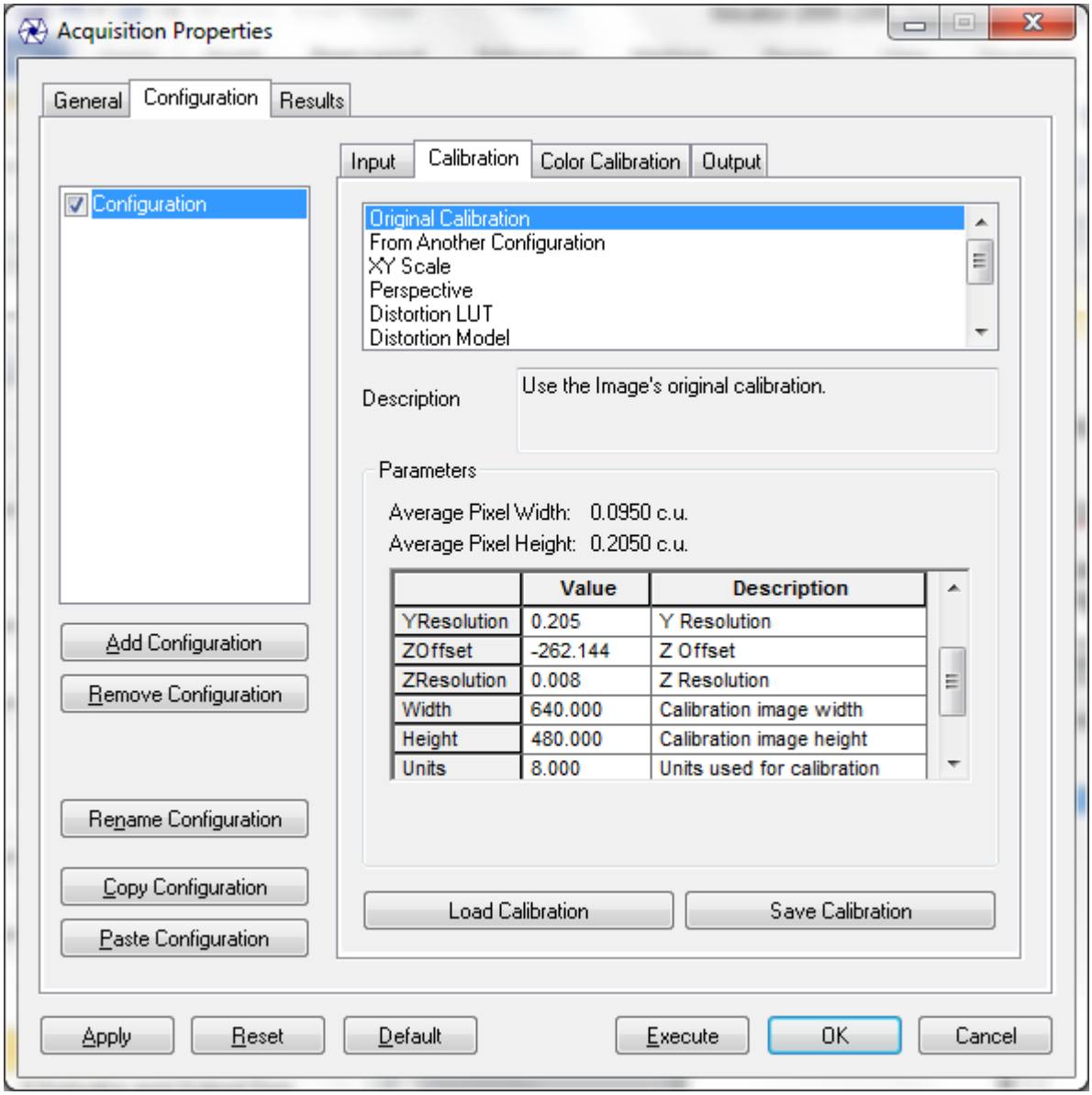


Figure 25: ZOffset and ZResolution parameters in the Calibration tab.

This example application is now completely configured. Pressing the **Locate** button in the main Locator Demo window will execute the full process chain. The part can be scanned in any rotation and the histogram will always measure the height of the plug in the correct location.

8 Evaluator and Output Tool

The Evaluator Tool and the Output tool can be used to pulse the Gocator digital output based on the results of a measurement or histogram tool. To add the tool into the processing chain, go back to the main Gocator Demo Application window and press the **Configure** button. This will open the Application Control with the Process Manager.

- Select the HSEvaluatorTool in the list of available processes on the right, then press the **Add Process** button.

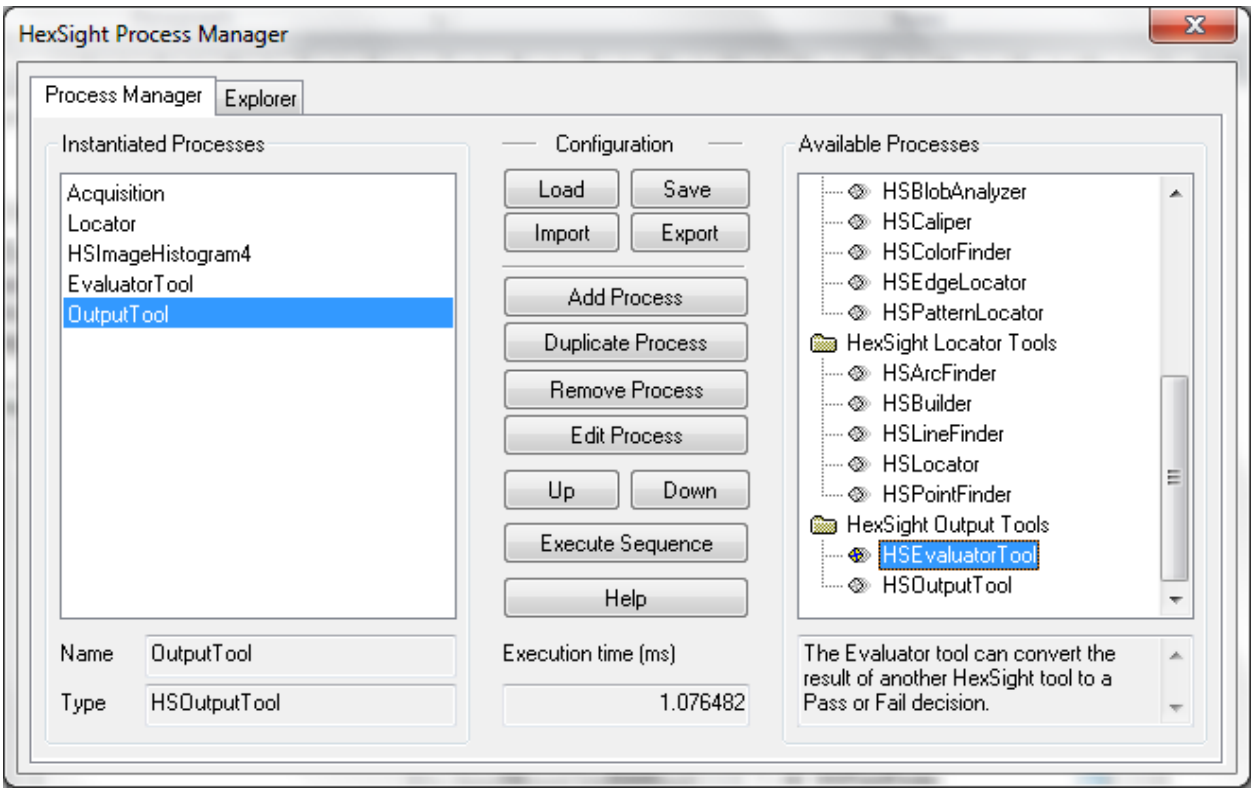
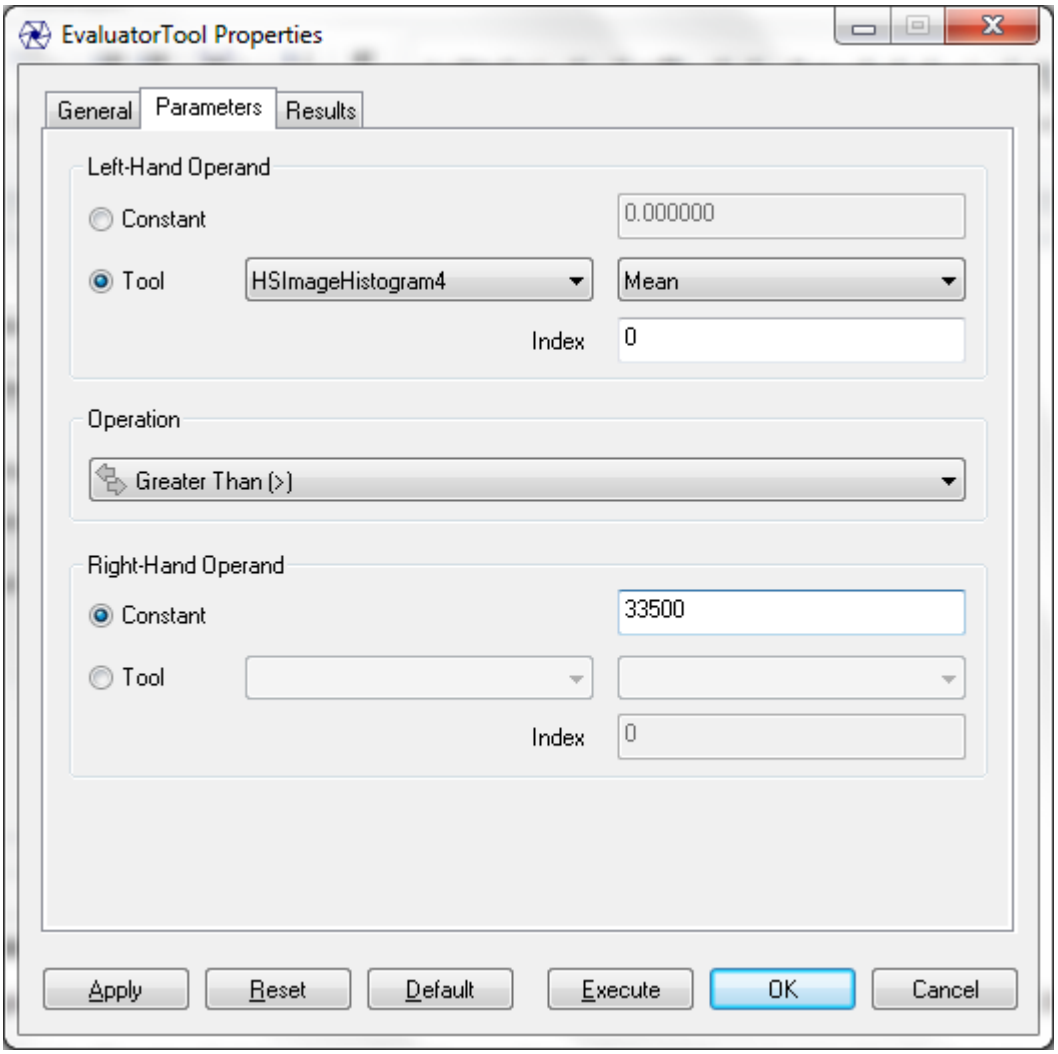


Figure 26: Add Histogram Tool to processing chain.

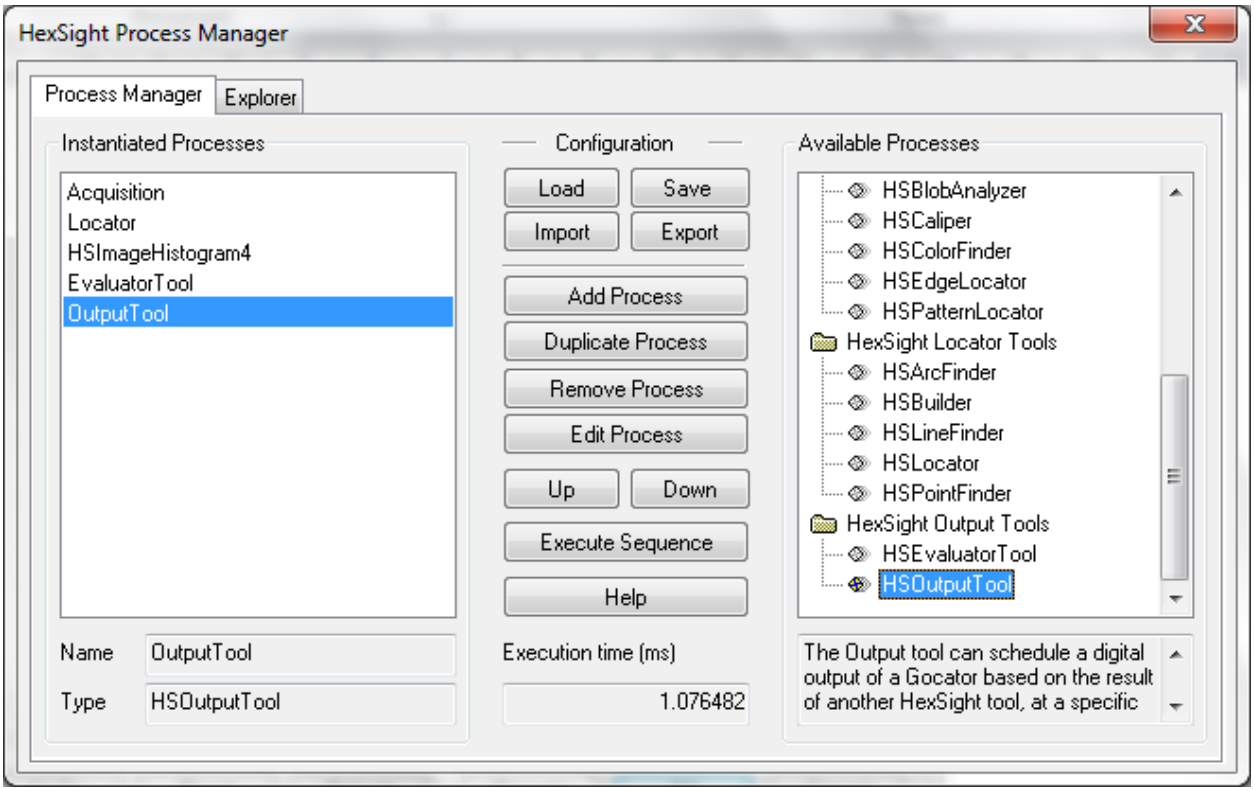
- Configure the evaluation criteria.



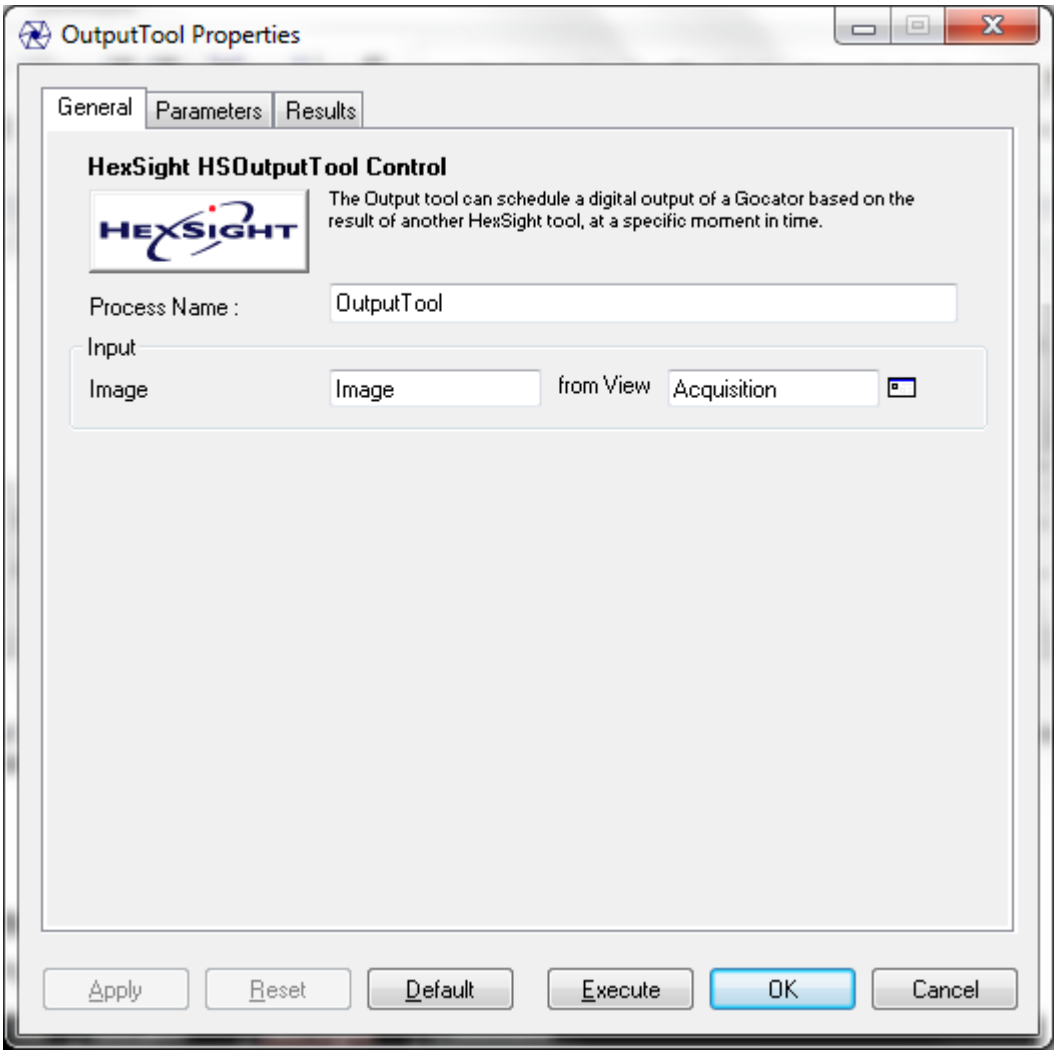
In the example above the inspection is successful if the height is greater than 33500, equivalent to 5.8mm.

Finally, to pulse the Gocator digital output when the result is valid, add the Output Tool to the last step of the process.

- Select the HSOutputTool in the list of available processes on the right, then press the **Add Process** button.



- Set the input image to the output from the acquisition device. The output tool extracts the time or position at which the data was captured and add an offset as the target schedule time or position.



- Configure the Schedule Condition. The Schedule Condition should be linked to the result of an earlier tool (e.g. the evaluator tool)

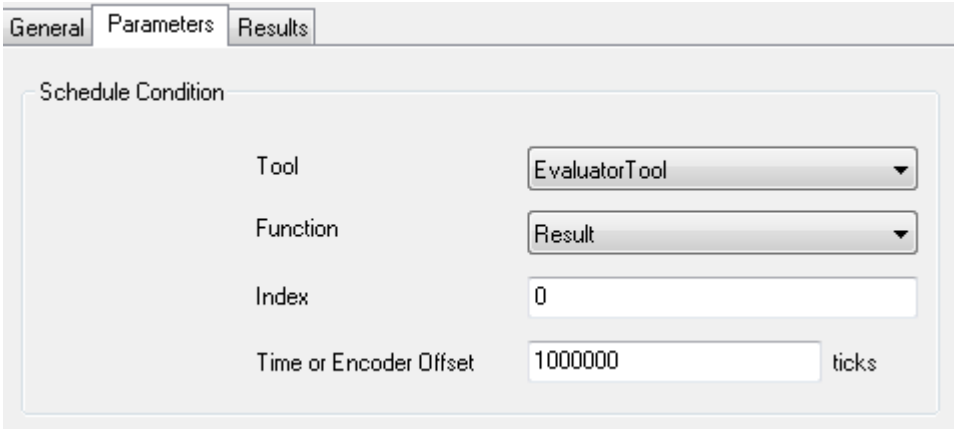
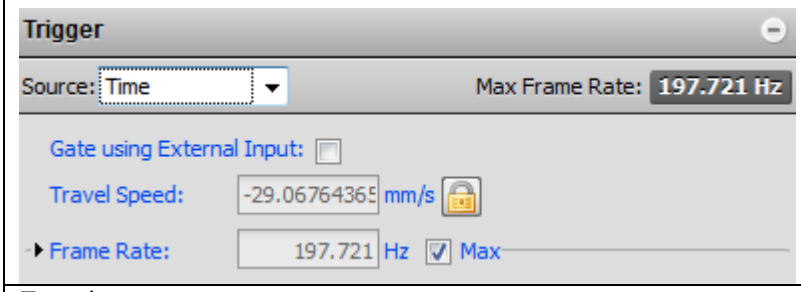
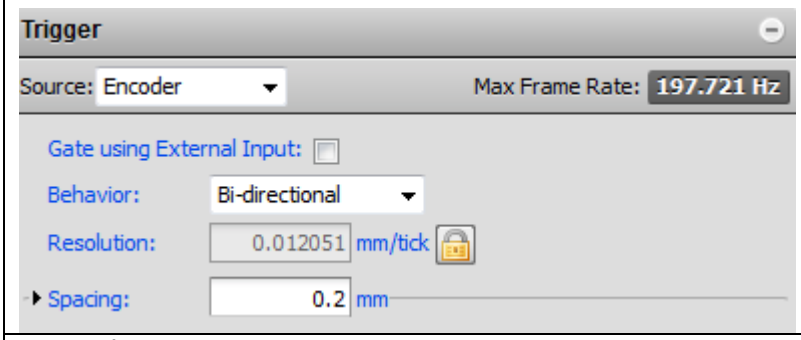
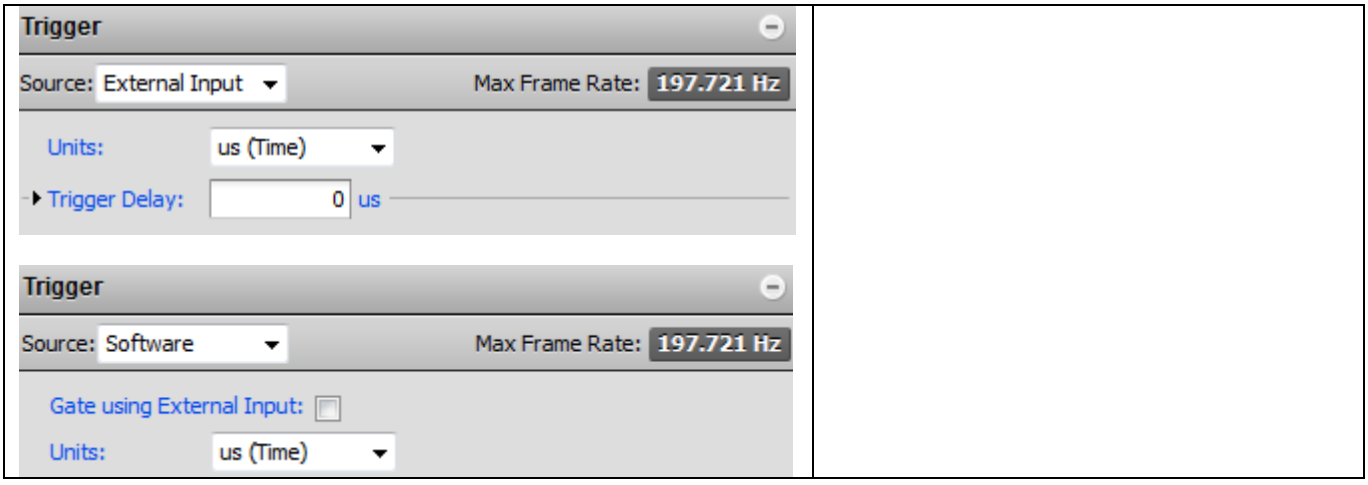


Figure 27. Output Tool Schedule Condition

The offset is in time (us) depends on the trigger source and domain setting as follows

Trigger Source	Offset unit
Time 	Time (us)
Encoder 	Position (tick)
Input Trigger	Depends on the unit selection.



- Finally, selects the Gocator and the digital output channel that the result should be output on.

Figure 28. Gocator Digital Output Channel Selection

9 Appendix A

The following tables outline the processing capabilities of all HexSight tools.

Locator Tools	Capability
Locator	16-bit/8-bit
Arc Finder	16-bit/8-bit
Line Finder	16-bit/8-bit
Point Finder	16-bit/8-bit
Builder	16-bit/8-bit

Image Processing Tools	Capability
Image Processing	16-bit/8-bit
Image Sharpness	8-bit
Image Histogram	16-bit/8-bit
Sampling	16-bit (no calibration)/8-bit (full support)
Builder	(In Locator Tools:16-bit/8-bit)

Inspection Tools	Capability
Edge Locator	8-bit
Arc Edge Locator	8-bit
Caliper	8-bit
Arc Caliper	8-bit
Blob Analyzer	8-bit
Color Finder	8-bit
Pattern Locator	8-bit

Symbology Tools	Capability
Barcode Reader	8-bit
Date Matrix Reader	8-bit
OCR Fixed Font	8-bit