Section 7: HeightCalculator Tool

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Objectives

HeightCalculator Tool

- Learn about the 3D HeightCalculator Tool
- Pass a BasePlane across tool blocks
- Display 3D measurement results on the HMI

❖ Lab: Use the HeighCalculatorTool to get measurements from part

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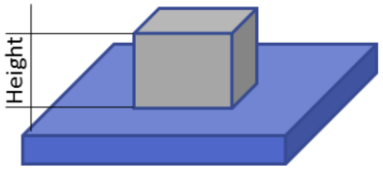
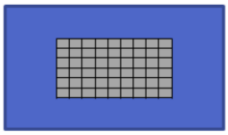
Measuring Height

- **What is Height?**
  - **Distance between two known locations**
  - **In this case, the base plane and the top of the object**



Base Plane



Top View

- **Result are in mm**

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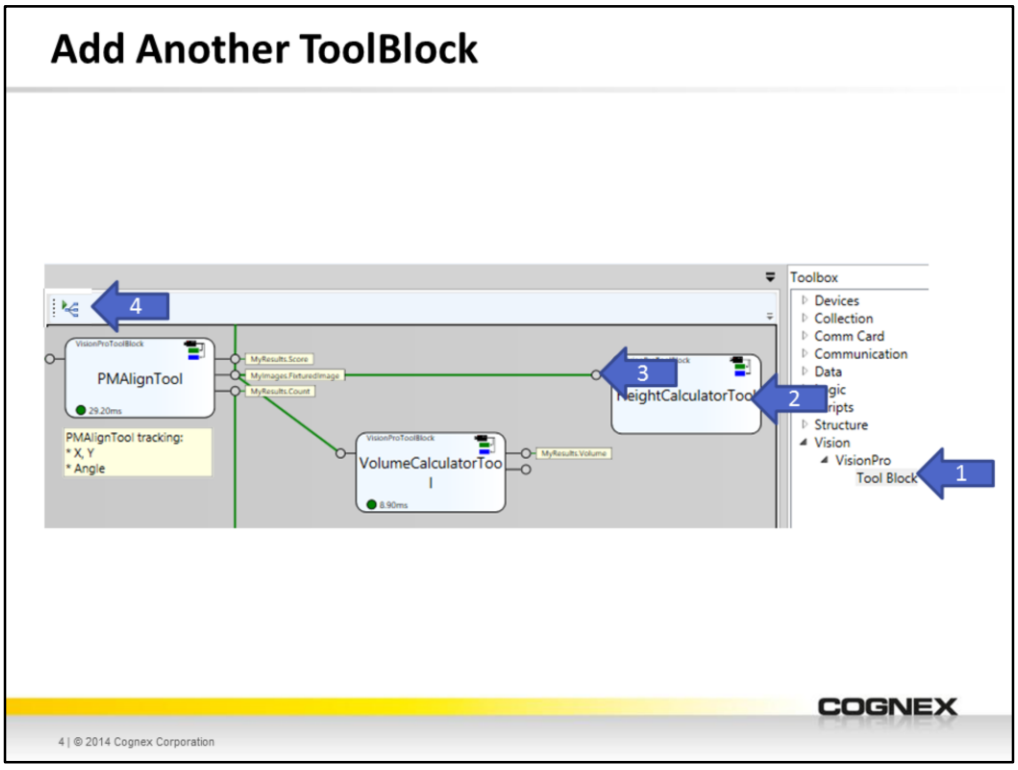
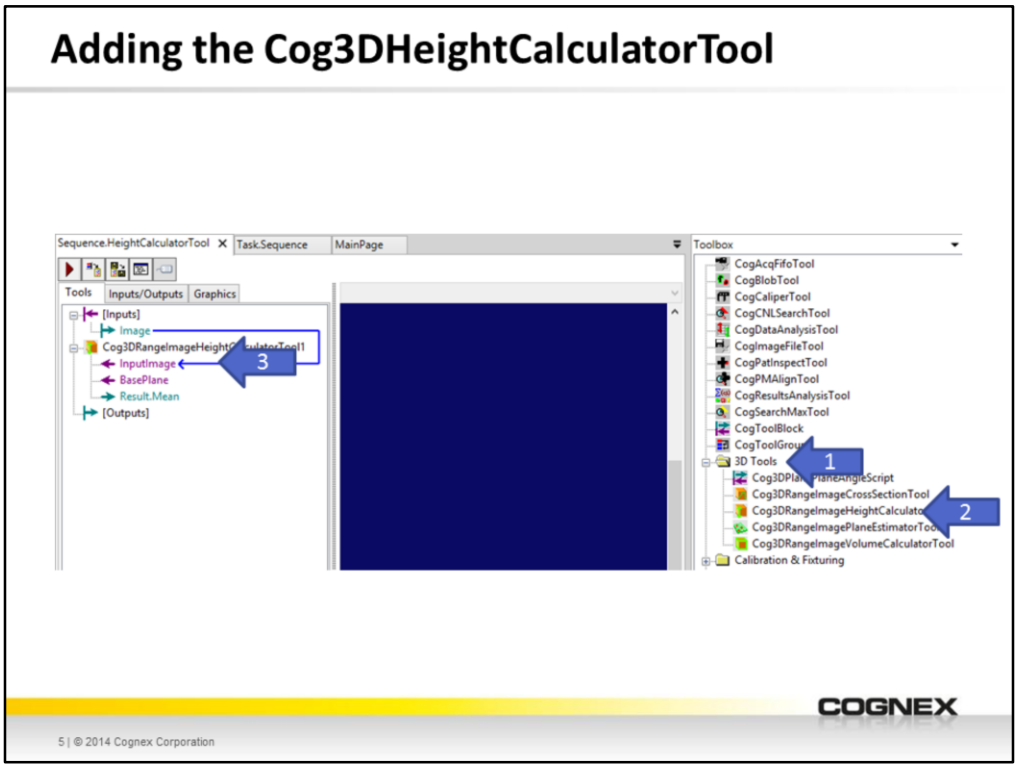
Only pixels that are visible and not masked are used to compute the height of an object.

- Height is in respect to base plane



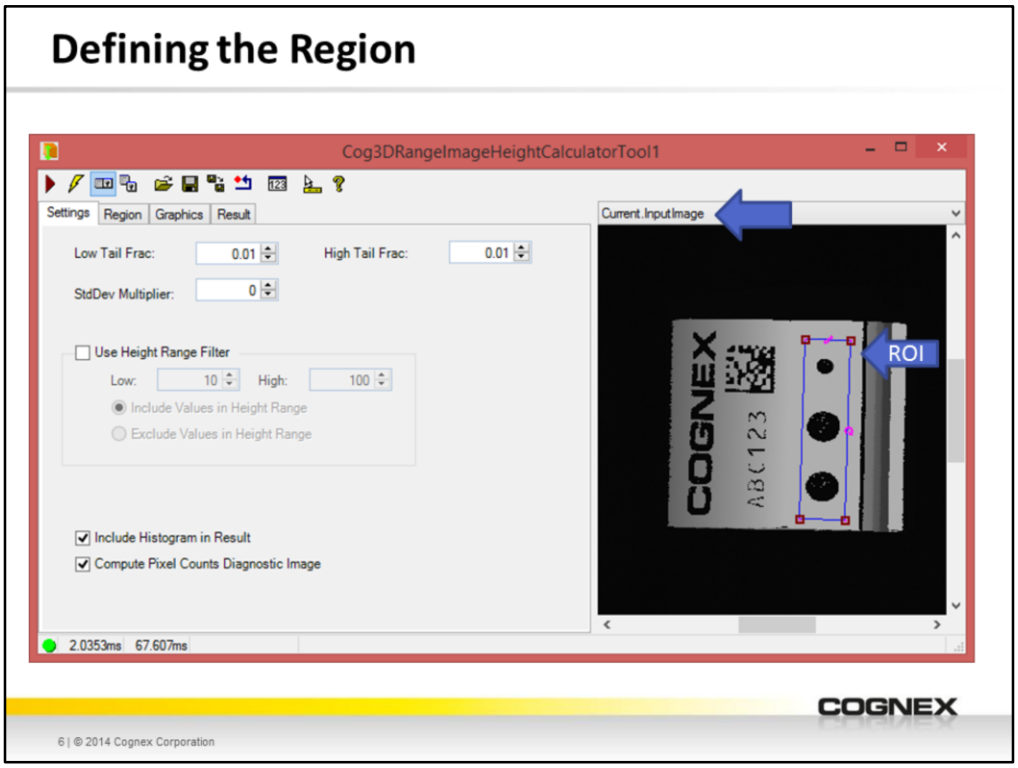
To implement a Cog3DRangeImageVolumeCalculatorTool:

1) Add a new vision tool block to your sequence
2) Rename it “HeightCalculatorTool”
3) Connect the output image from the PMAlignTool block
4) Run the sequence once

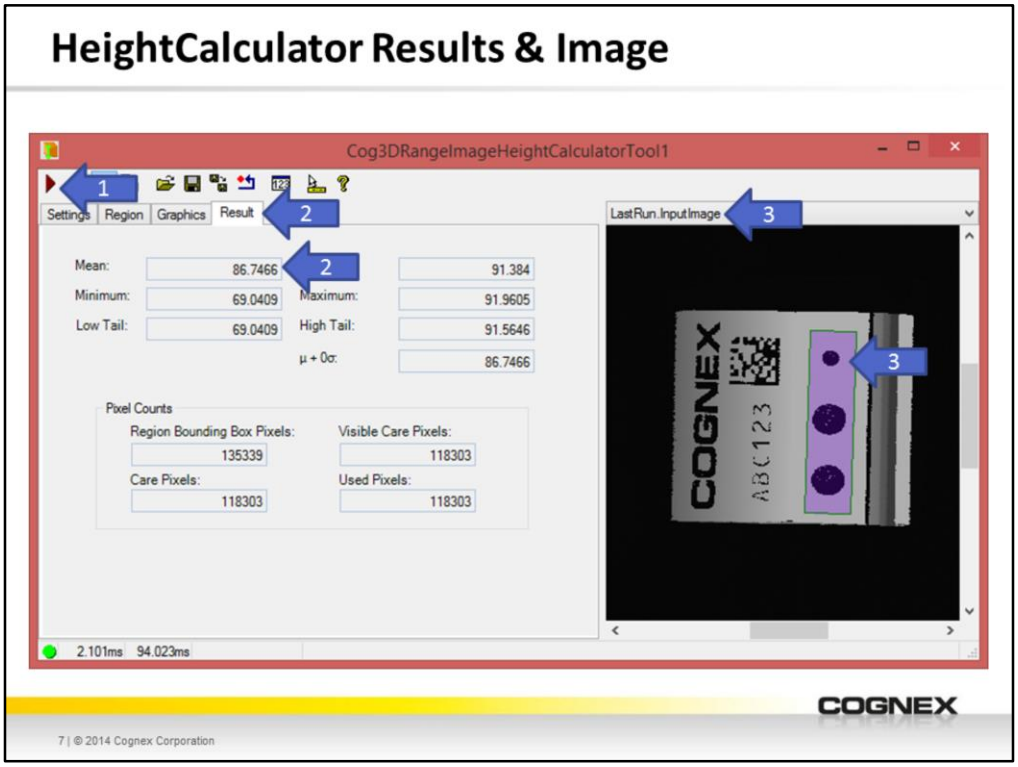


Once our Tool Block is in place and connected to the right image, open it.

1) Expand the “3D Tools” category
2) Drag a Cog3DRangeImageCrossSectionTool into the tool block listing
3) Drag the Image into the newly added Cog3DRangeImageCrossSectionTool1’s InputImage input terminal

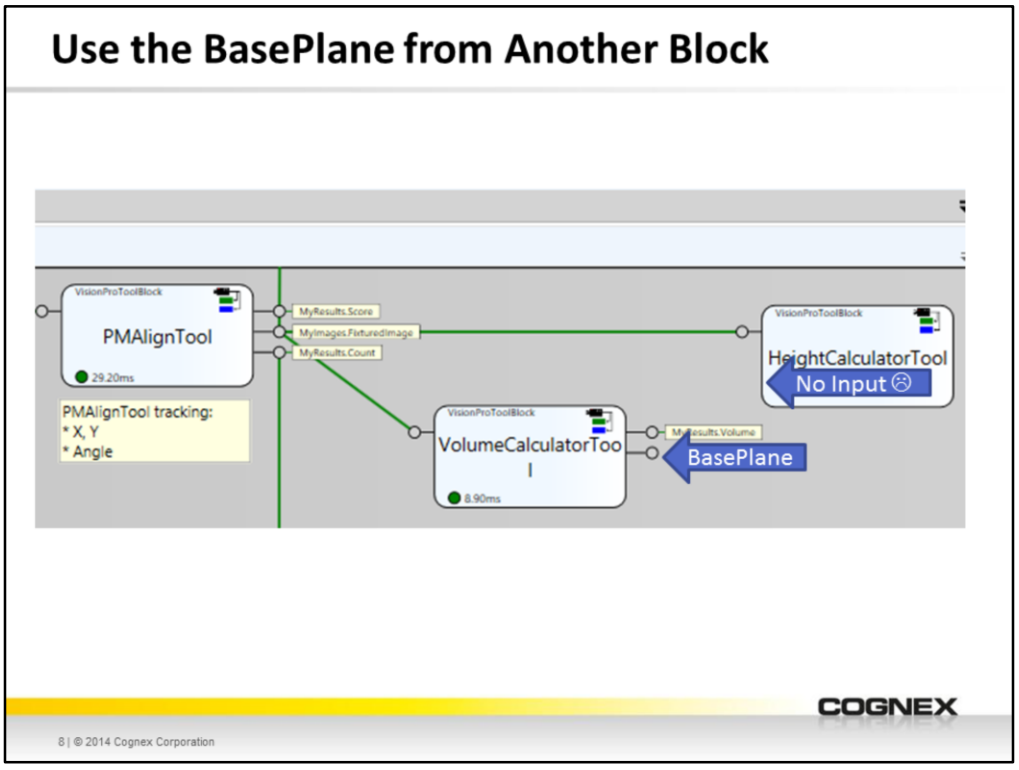


Setting the region allows you to choose what portions of the part you will use to calculate the height.
For the sample part imaged here we have selected the flat area with the 3 holes as the Region of Interest (ROI).
Make sure you are on the Current.InputImage to place the region.



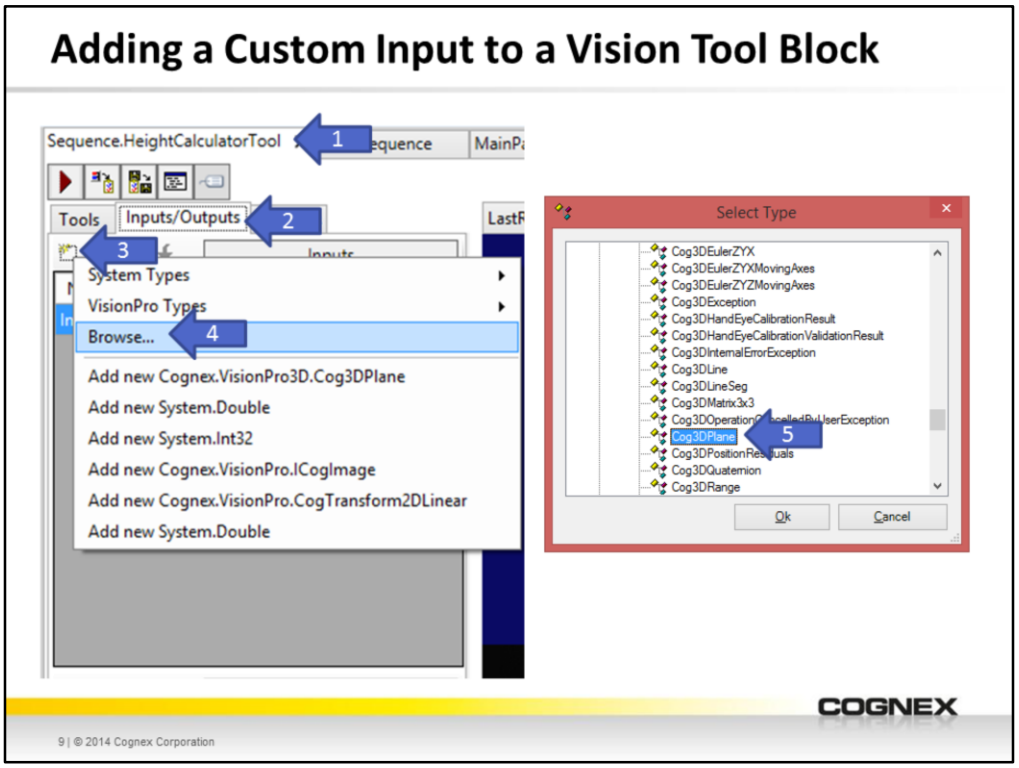
1) Run the tool
2) Click the Result tab to display the results of the tool.
   The Mean value is hovering around 86.7mm.
   This should be your first indication that this height measurement isn't quite right.
3) Select the LastRun.InputImage image from the image pull-down menu.
   You can see which portions of the image were used to calculate the volume of the object in purple.

Why is the height being reported higher than the object?



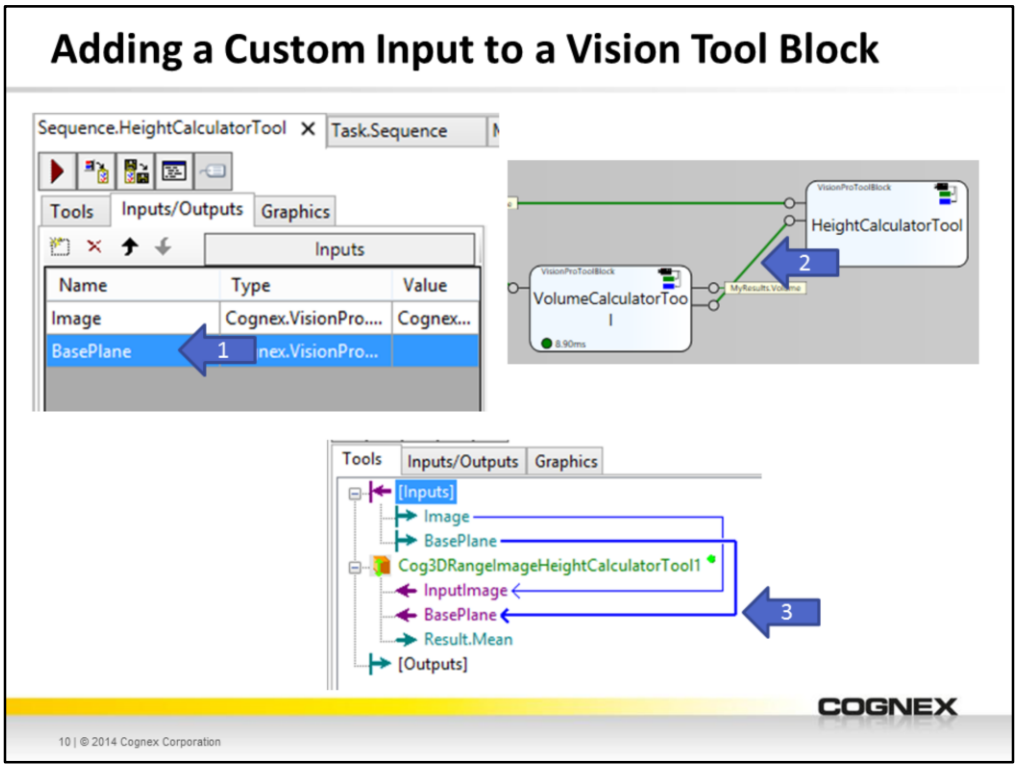
You *could* create a whole other PlaneEstimator tool.
It is better to use the PlaneEstimator we have already created as it does what we need (establish the table top base plane).
This will save processor and overall execution time.

We need to connect the BasePlane result from the VolumeCalculatorTool to the HeightCalculatorTool.
Problem: The HeightCalculatorTool does not have an input that accepts the BasePlane result.



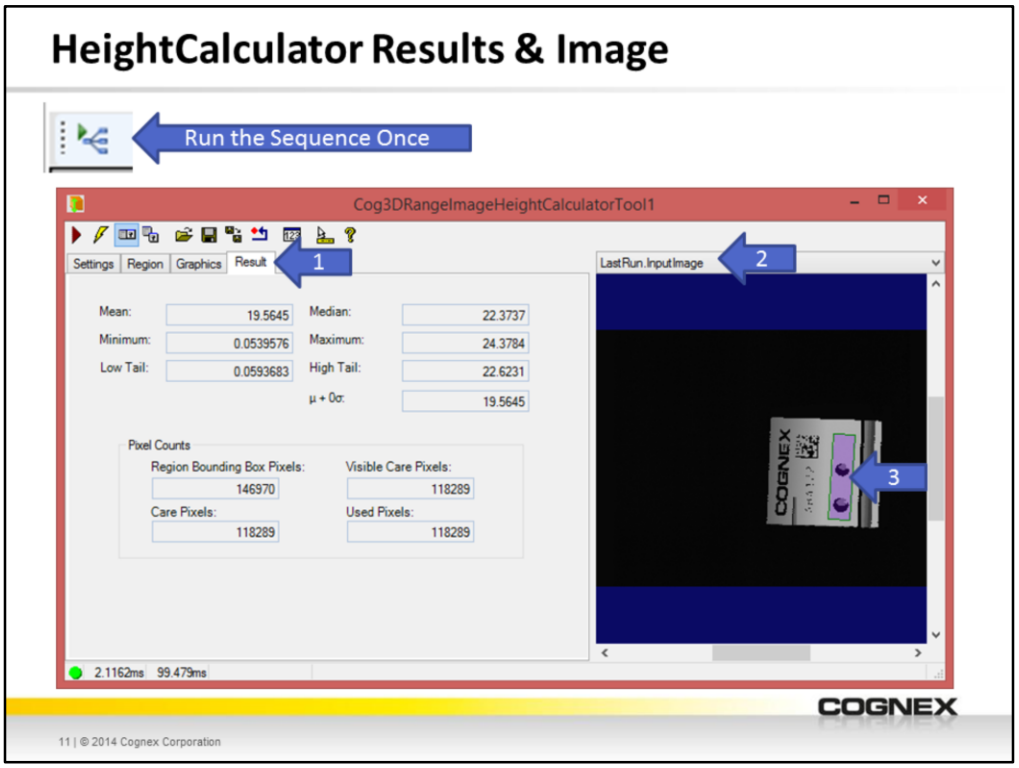
To add a custom input to the HeightCalculatorTool:

1) Open the HeightCalculatorTool
2) Select the Inputs/Outputs tab.
3) Click the “Add New” button in the inputs section.
4) Click Browse… to access all available input types.
5) Navigate to and select (hold your breath because we’re going deep) VisionPro→Cognex.VisionPro3D.Core.dll→Cognex.VisionPro3D→Cog3DPlane.



This allows you to:

1) Use an additional input from other blocks into your HeightCalculatorTool block.
2) Back in the sequence, connect the outgoing BasePlane from the VolumeCalculatorTool to the HeightCalculatorTool.
3) Back in the tool block, connect the incoming BasePlane to the Cog3DRangeIMageHeightCalculatorTool1's BasePlane input terminal.

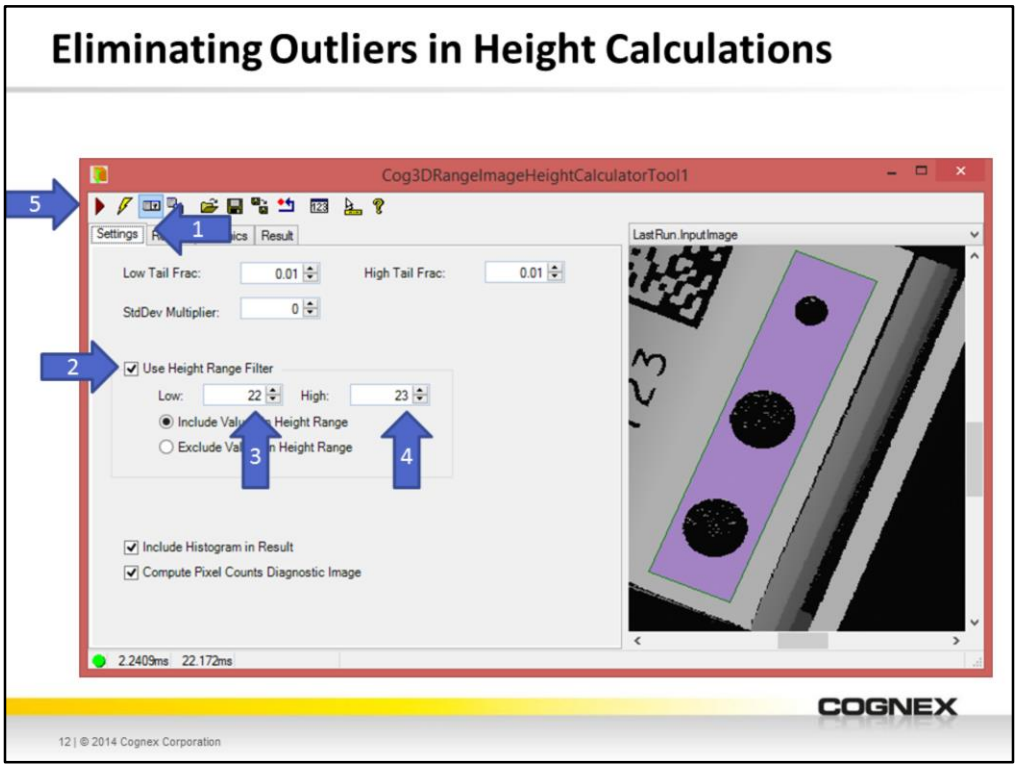


To check if this PlaneEstimator tool has helped:
Run your sequence once.
You must run the sequence because you have to execute both the VolumeCalculatorTool and the HeightCalculatorTool.

Then:

1) Open the HeightCalculator tool and click the Result tab to display the results of the tool.
   The result is hovering around 19.5 mm.
   This should be your first indication that this height measurement is closer to the mark.
2) Select the LastRun.InputImage image from the image pull-down menu.
   You can see which portions of the image were used to calculate the height of the object in purple.
   There are still portions on the object being used to calculate the height that do not belong.

Q1> Does it make sense that we are seeing a minimum height value of 0.05 and also a maximum of 24.4?
Q2> What portion of the image are these outliers coming come?



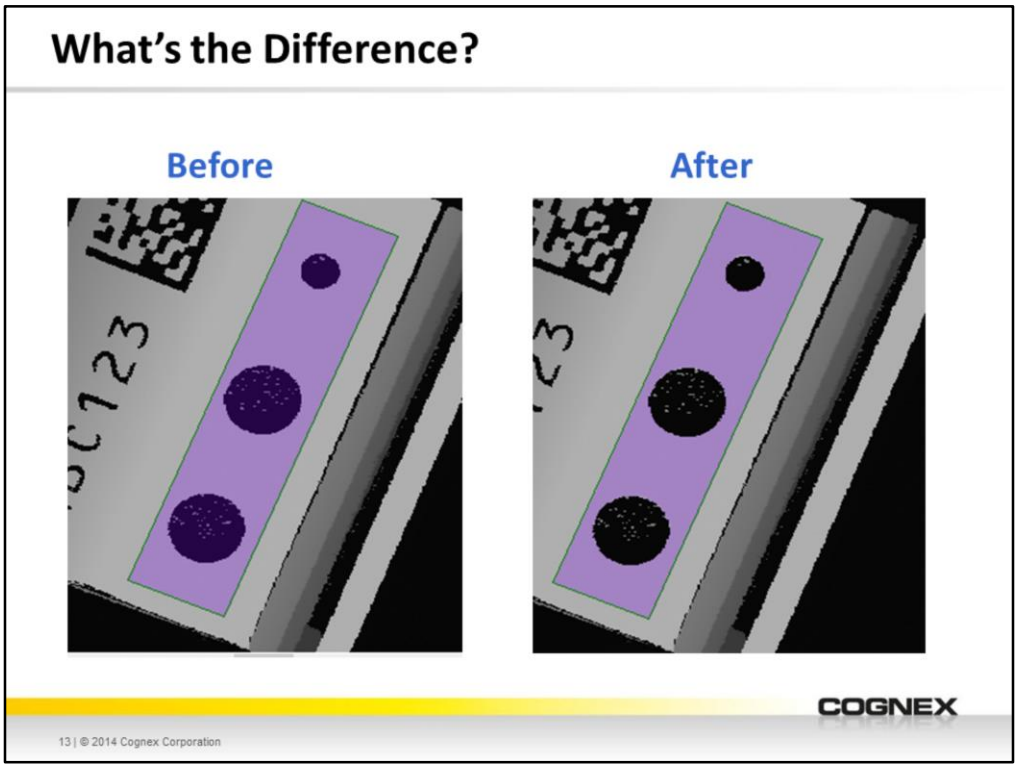
To eliminate outliers in the HeightCalculator tool:

1) Click the Setting tab.
2) Enable “Use Height Range Filter”.
3) Set the Low to 22.
4) Set the High to 23.
5) Run the tool.

Why 22mm and 23mm?

We already know the tool’s height from the CrossSectionTool block.
The height was hovering around 22.2mm.
We are using this value as a starting guideline.

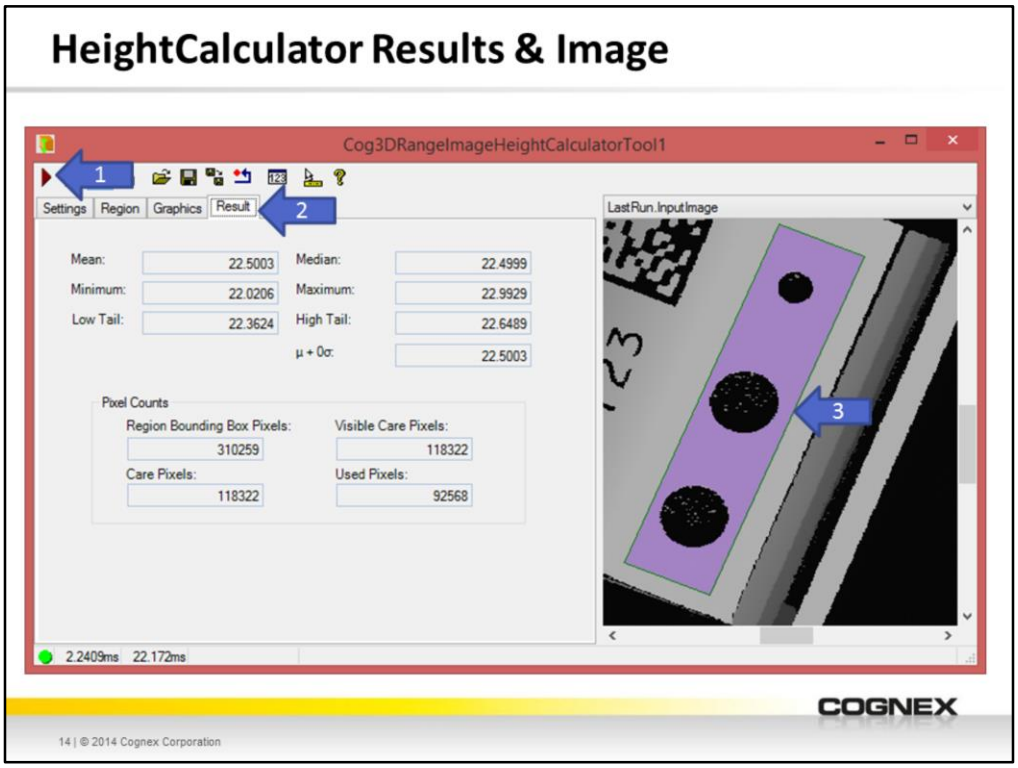
Alternatively:
You could also physically measure the actual height and use that as the starting guideline for the range filter.



Before using the Height Range Filter: we were using all height ranges.
This is illustrated by all holes having the purple coloring.

After using the Height Range Filter: we are only using those height values between 22mm and 23mm.

Pro tip: Zoom in and look closely. It might be tough to detect purple graphics over the dark pixels when zoomed out.



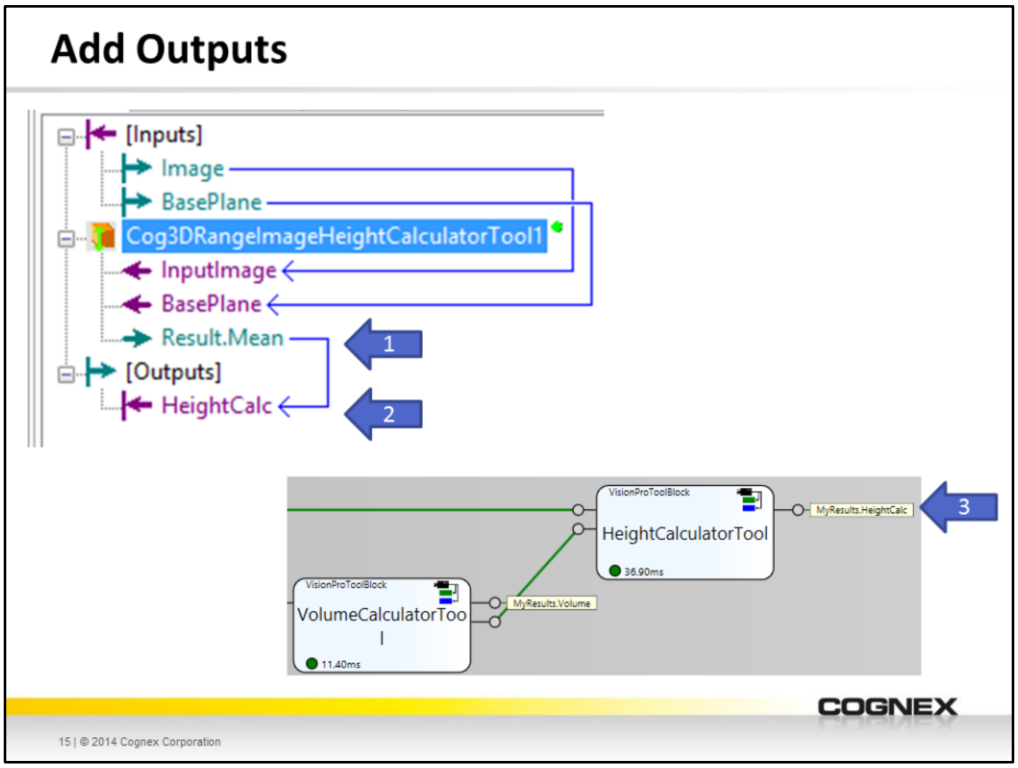
To check if these Height Range Filter settings have helped:

1) Run the Cog3DRangeImageHeightCalulatorTool1 once more.
2) Click the Result tab to display the results of the tool. You can see a mean result hovering around 22.5 mm. This should be your first indication that this height measurement is closer to the mark.
3) Select the LastRun.InputImage image from the image pull-down menu. Look closely. You can see which portions of the image were used to calculate the height of the object in purple. Those pixels in the holes are no longer being used.

Does it make sense that we are seeing a minimum height value of 22.02mm and also a maximum of 22.9mm?

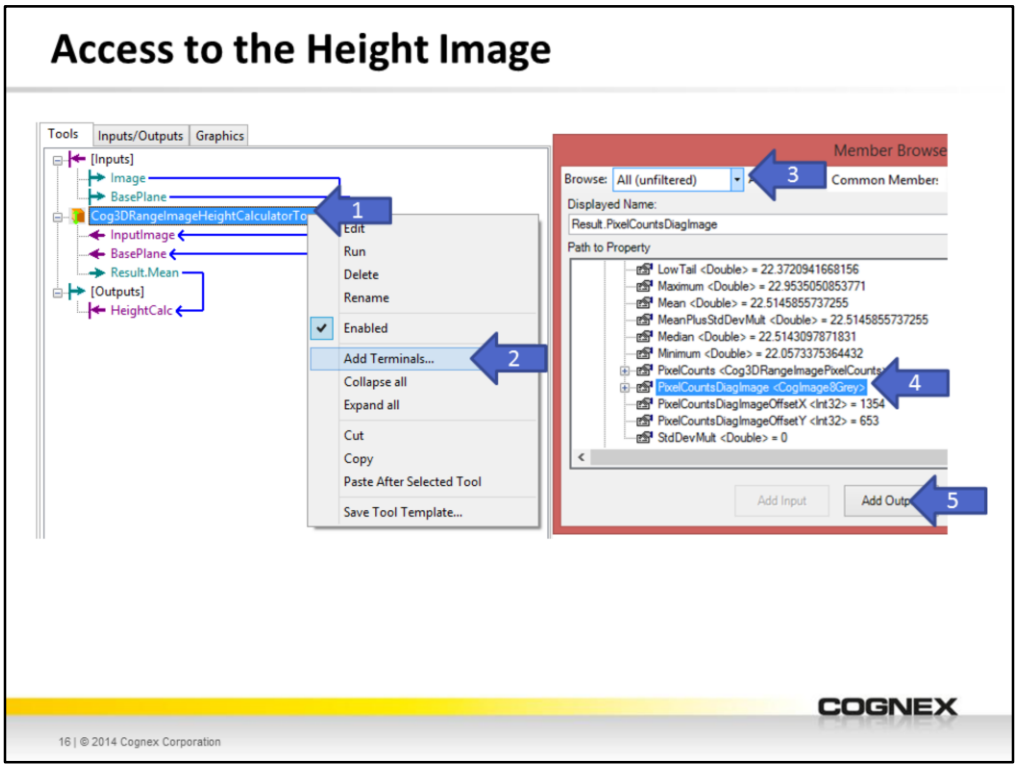
Can you explain the 0.9mm range?

What portion of the image are these outliers coming come?



Now add the Result.Mean output terminal to the Outputs of this block.

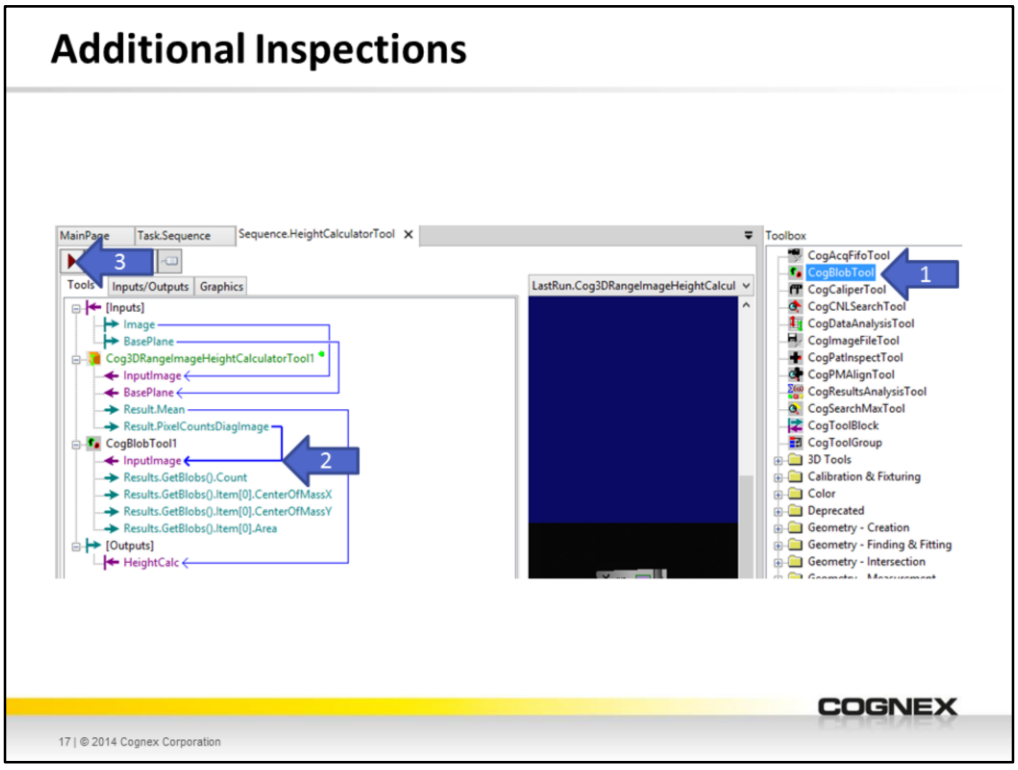
1) Drag output terminals Result.Mean to the [Outputs] collection.
2) Rename it to HeightCalc.
3) Verify you now have additional outputs visible at the sequence level and assign it to a new tag:
    - MyResults.HeightCalc



You can access the resulting image whose gray values were used to determine the height measurement.

For this example, that would look like a rectangular region with 3 holes.

1) Right-click on the HeightCalculator tool.
2) Select Add Terminals…
3) Set Browse to All (unfiltered).
4) Navigate to and select Result→PixelCountsDiagImage.
5) Click Add Output.



Now you can pass that PixelCountsDiagImage to other vision tools and perform additional inspections.
To perform a hole count:

1) Add a CogBlobTool AFTER the Cog3DRangeImageHeightCalculatorTool1 tool.
2) Connect the PixelsCountsDiagImage to the InputImage of the Blob tool.
3) Run the tool block once.

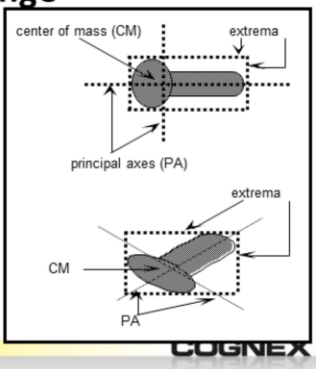
Blob Overview

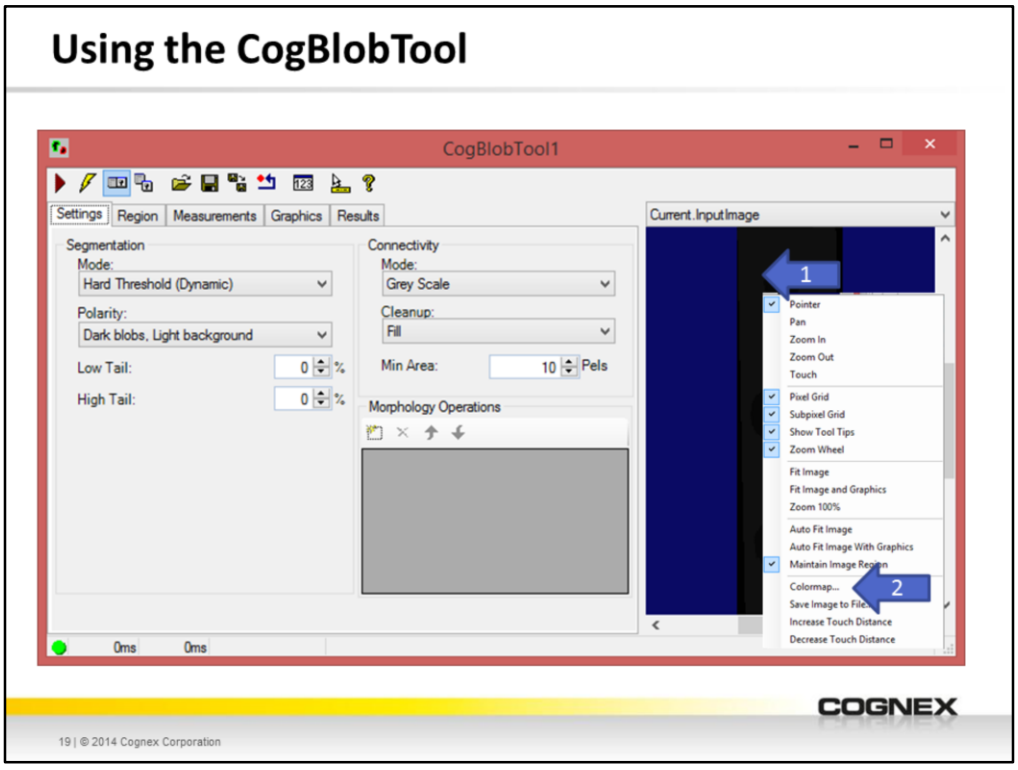
Blob analysis **is the detection and analysis of two-dimensional shapes within an image**

Blob finds objects by identifying groups of pixels that fall into a user-defined grey-scale range

Blob reports many properties:

- **Number Found**
- **Area**
- **Center of Mass**
- **Perimeter**
- **Principal Axes**

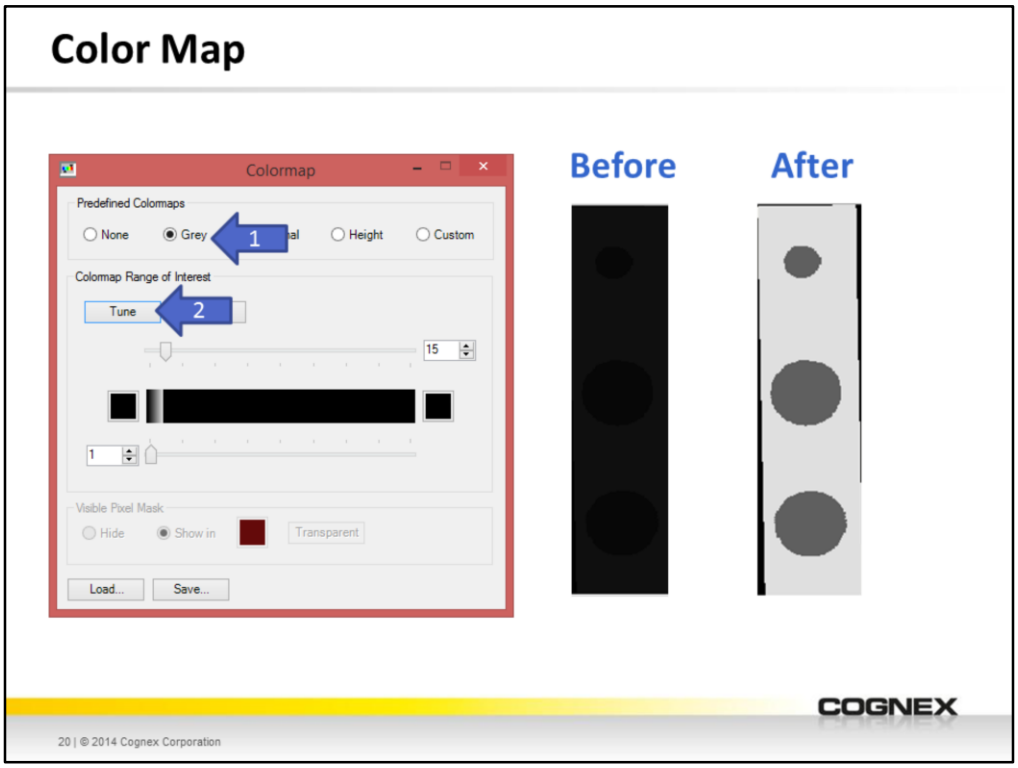




At first glance, the PixelCountsDiag image looks all black and useless.

Let's enable Color Mapping to help us see what's really in there.

1) Right click the image.
2) Select Color Map.

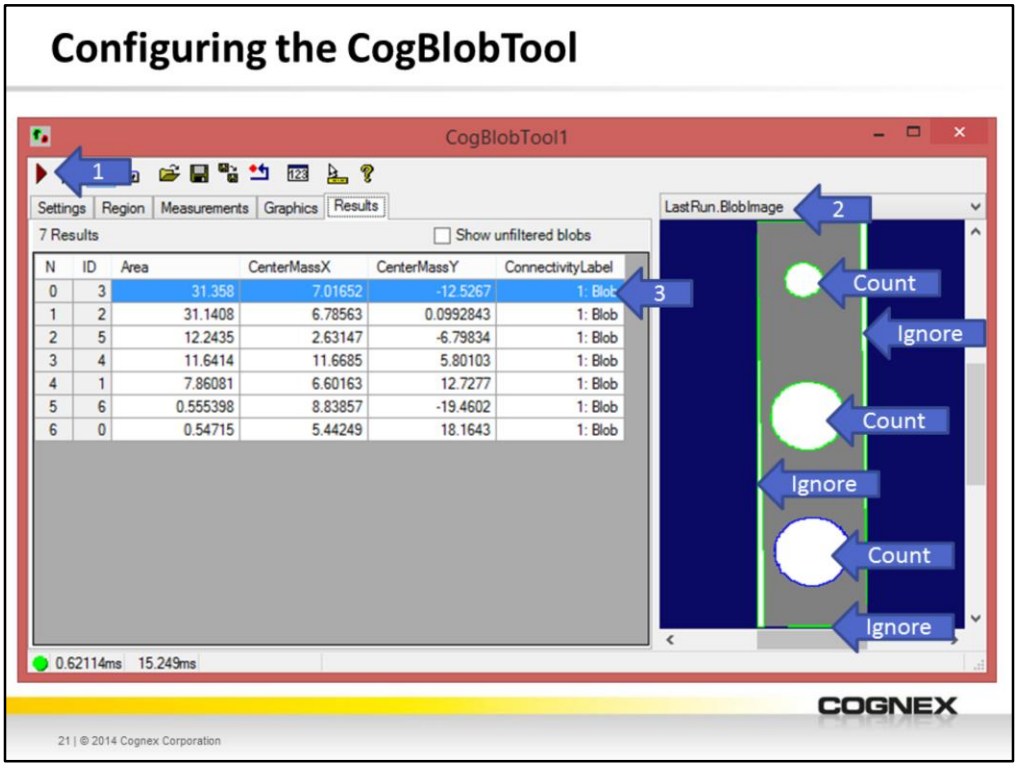


To make the color map show better contrast in the image:

1) Select Grey
2) Click Tune

Now we have an image that shows better contrast. This is only visual, we have not changed the actual data in the image, it was just tough to see because of low contrast.

Now we get to see what the Blob tool can see.

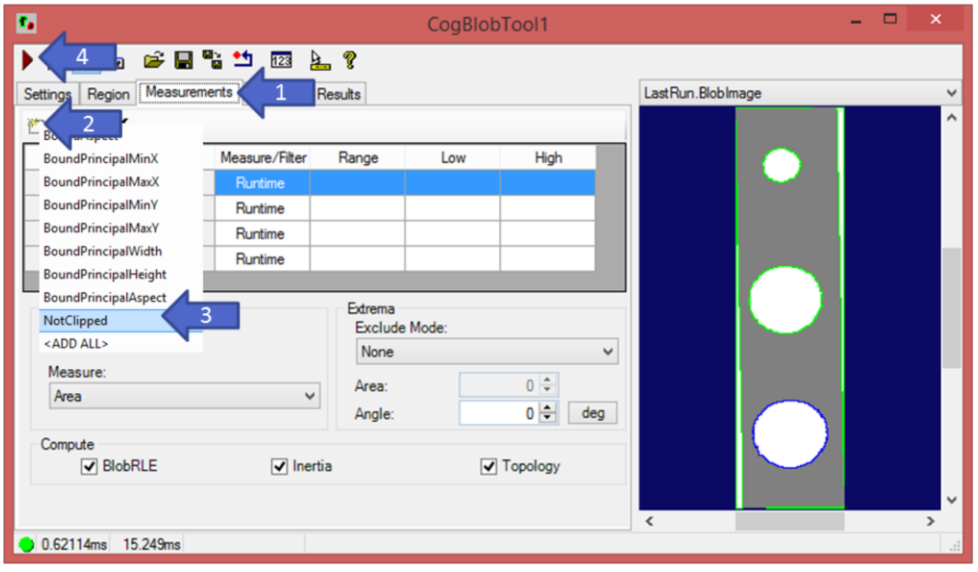


Let's focus on what you need to know about the Blob tool. The default settings should take care of what we need for now.

1) Run the tool once.
2) Select the LastRun.BlobImage. This shows you all the blobs the tool has found so far without filtering them.
3) Select the Results tab and try clicking through all the results to see what blob corresponds to each result. You might have anywhere from 2-7 results. Maybe even more.

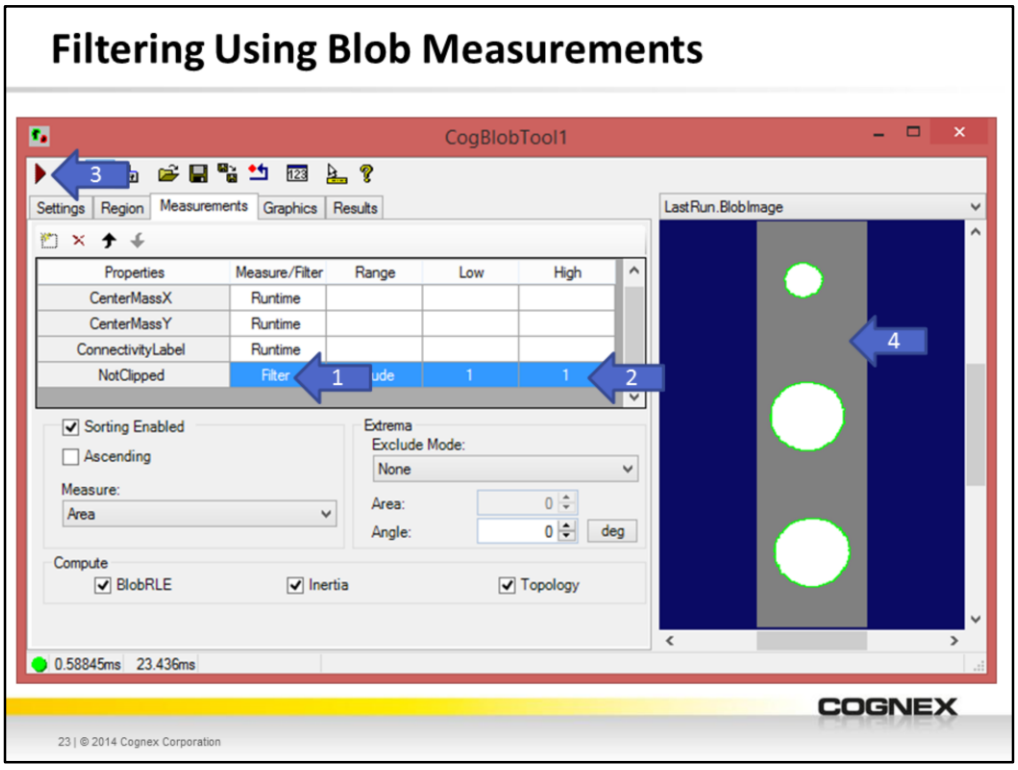
We want to focus on just the holes. In particular we was to find those that are not cut off or clipped by the edges of the image region.

Adding Blob Measurements



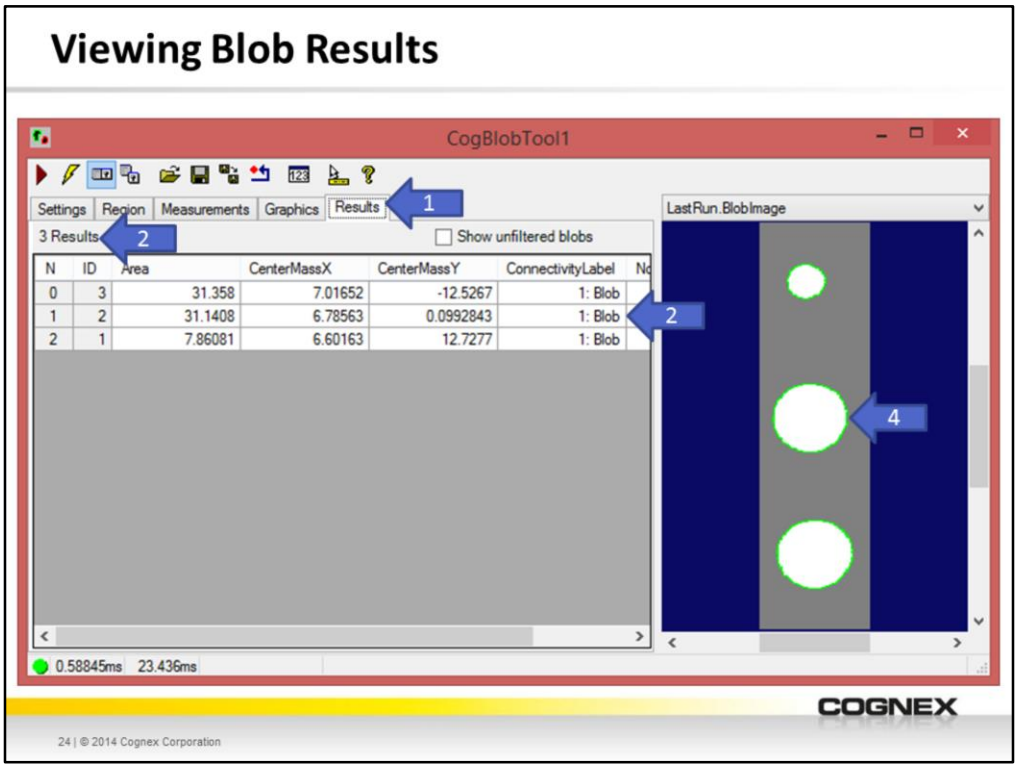
To filter blobs, add the criteria you want to use as a filter.

1) Click the Measurements tab.
2) Click the Add New measurement button.
3) Select “NotClipped”. This means the tool will now check if a blob tool is “not clipped” or not touching the boundary of the region of interest.
4) Run the tool once.



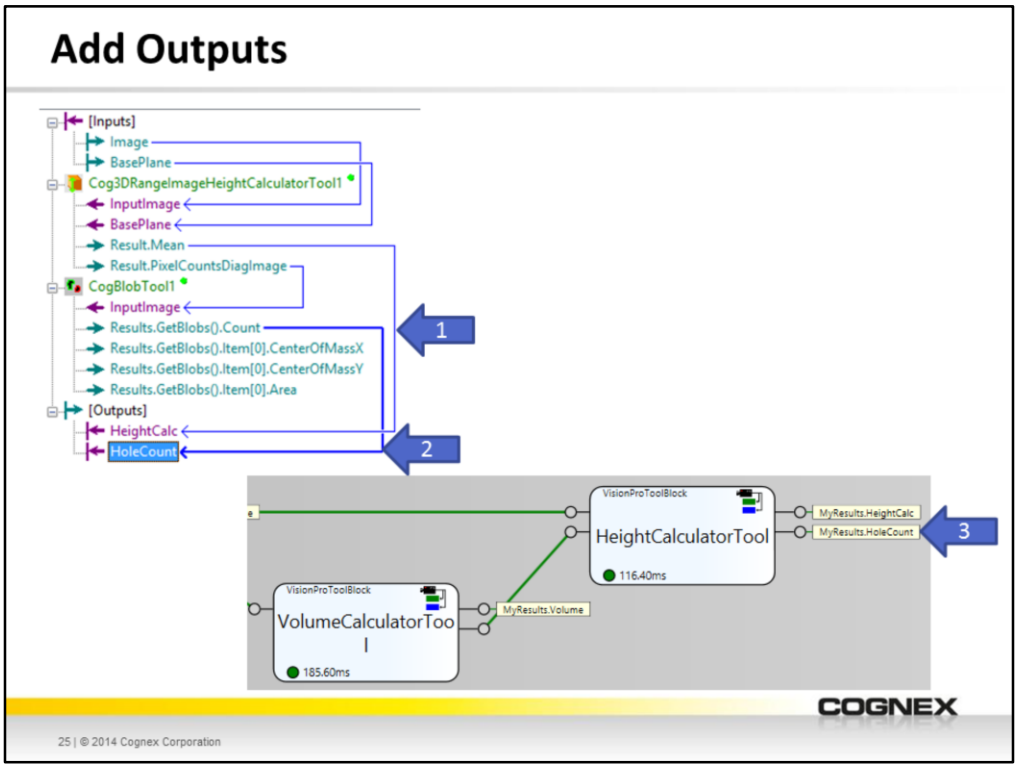
To filter based on the new criterion:

1) Set the Measure/Filter option to Filter.
2) Range: Include
    - Low: 1
    - High: 1
3) Run the tool once more.
4) Notice that only the holes are now being reported.



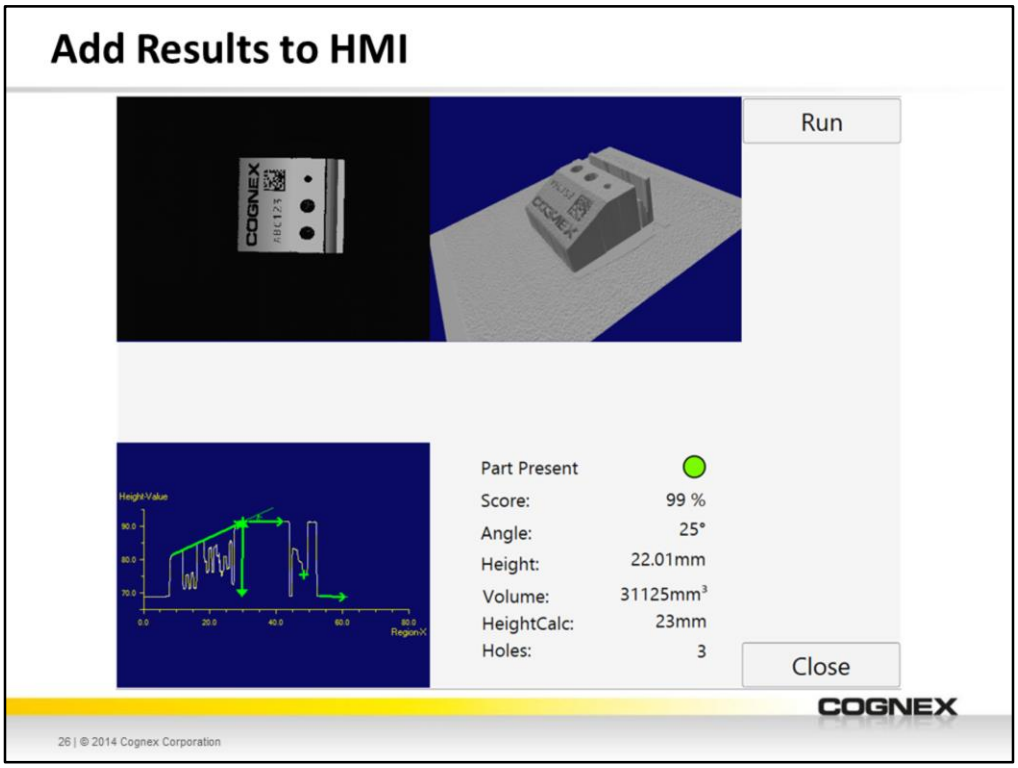
Check the Results tab again.

1) Click the Results tab.
2) Review the number found.
3) Review the blob results.
4) Click on them to match them with their result counterparts.



Now add the Results.GetBlobs().Count output terminal to the Outputs of this block.

1) Drag output terminals Results.GetBlobs().Count to the [Outputs] collection.
2) Rename it to HoleCount.
3) Verify you now have additional outputs visible at the sequence level and assign it to a new tag:
    - MyResults.HoleCount



Use your HMI to add the following results:

- HeightCalc in mm
- Number of Holes

Summary

Cog3DRangeImageHeightCalculatorTool

- Explored how the Plane Estimator works
- Implemented the 3D Height Tool & modified settings
- Extracted a PixelCountsDiagImage for additional analysis
- Displayed formatted results on the HMI

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