HADI - BGA DOCUMENT

VERSION	AUTHOR	DATE
V2.7	Xin Chen	2016.04.14
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3D INDUSTRIAL IMAGING

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1 Introduction

1.1 Introduction

HADI - BGA is a Template-based inspection 11 software.

User can deploy HADI - BGA as an Automated BGA Detection 56 and Automated Void Inspection 61 software.

It supports following inspection features:

	Inspection Functions	Support
1	Template Management	YES
2	Automated BGA Detection	YES
3	Automated Void Inspection	YES
4	Inline Void Inspection	NO
5	Inline PCB Inspection	NO
6	Batch Processing Simulation	NO

Check more detail products comparison 6.

1.2 Basic Features

- Support various image formats loading and saving.(gif, bmp, jpg, tif, tiff, png, etc.)
- Support image/scene 49 loading and saving.
- Support 16bit image I/O and Window/Level adjust 25.
- Support image calibration.
- Support image histogram and profile.
- Support multiple languages. (English, Korean, Japanese, Chinese)
- Support up to 21 measurement tools.
- Support up to 14 images filters 26.
- Support command line invoke with various parameters.
- Advanced template management. 71
- Full featured reporting and printing functions.
- Support windows explorer integration.

1.3 HADI Products Comparison

Functions	HADI - Inspection	HADI - BGA	HADI - Inspection Pro	HADI - iBoard	HADI - iBoard Pro
Image Import / Export	√	√	√	√	√
Scene Import / Export	√	√	√	√	√
Print Images	√	√	√	√	√
Image / Screen Capture	√	√	√	√	√
Multiple Language Support	√	√	√	√	√
Measurement Tools (21)	√	√	√	√	√
Image Filters (14)	√	√	√	√	√
Image Calibration	√	√	√	√	√
Histogram and Profile	√	√	√	√	√
Multiple Image Display	√	√	√	√	√
16 bit image support	√	√	√	√	√
Image Conversion	√	√	√	√	√
Image Alignment	√	√	√	√	√
Command Line Support	√	√	√	√	√
Void Inspection	√	√	√		√
BGA Detection		√	√	√	√
Batch Processing Simulation			√	√	√
UDP Communication Support			√	√	√
PCB Inspection				√	√

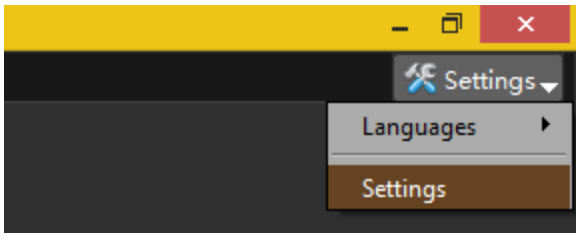
1.4 System-Requirements

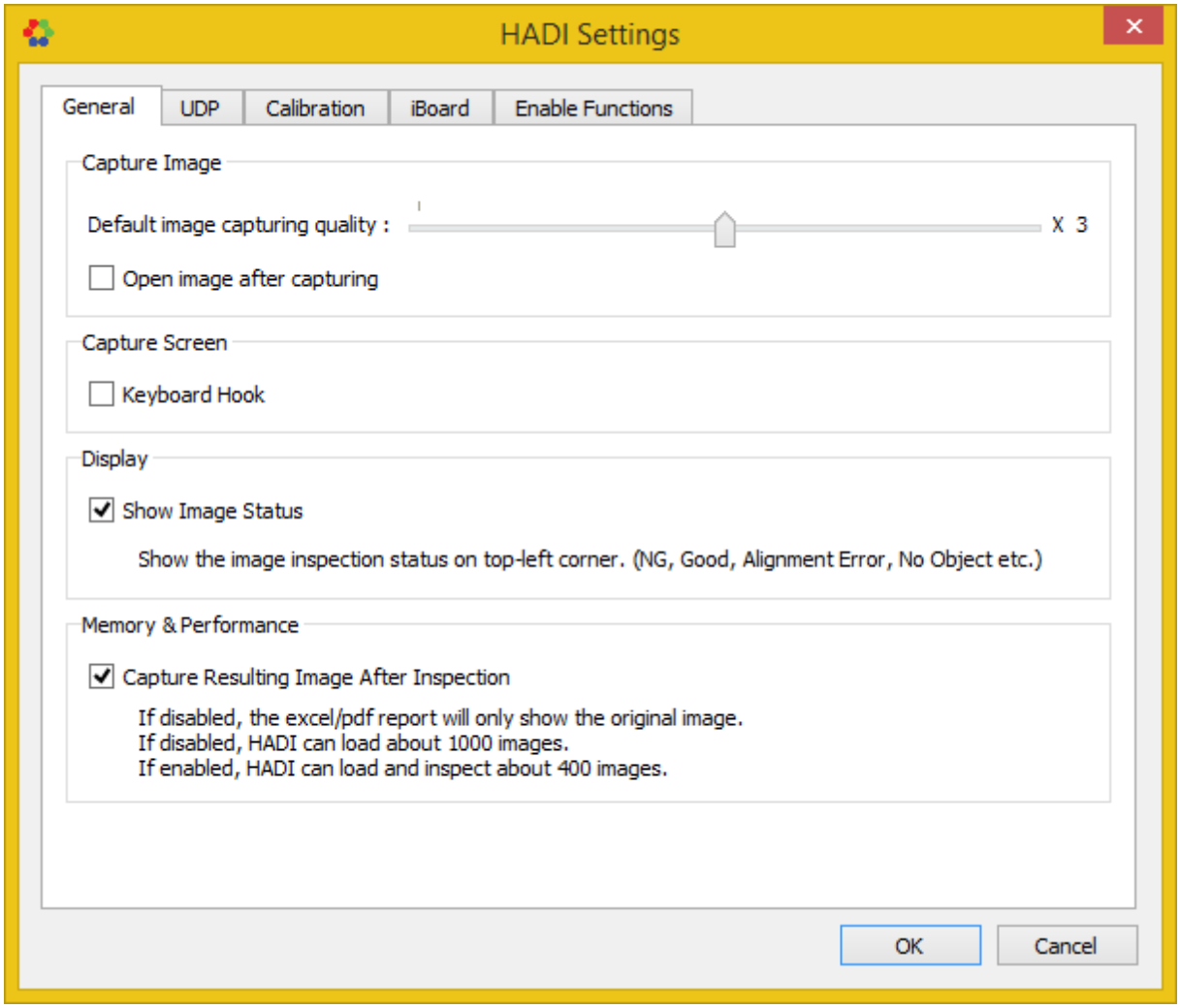
	Minimum	Recommended	Inline Inspection
OS	Windows 7	Windows 7	Windows 7 64bit
HDD	20GB	200GB	500GB or Higher
SSD	None	128G	128GB or Higher
CPU	Intel i5	Intel i7	Intel i7 3.40 GHz or Higher
RAM	2G	4G	8G
GPU	None	Individual Graphic Cards	Individual Graphic Cards
Display Resolution	1920 x 1080	1920 x 1080	1920 x 1080
Additional Apps	None	Microsoft Office PDF Reader	Microsoft Office PDF Reader
Network	Required	Required	Required

2 HADI Settings

2.1 Global Settings - General

Click on top right menu "Settings" -> "Settings" -> "General".





Capture Image

Default image capturing quality

Set the image capturing quality. "X3" means the captured image resolution is 3 x 3 = 9 times of original resolution.

Higher quality image capturing takes more time.

Open Image After Capturing

Open the image after capturing.

Show Image Status

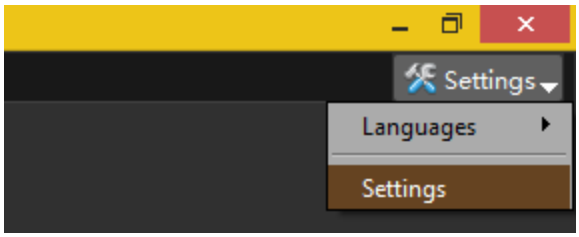
Show/Hide the Image status appeared in Top Left corner of main view.

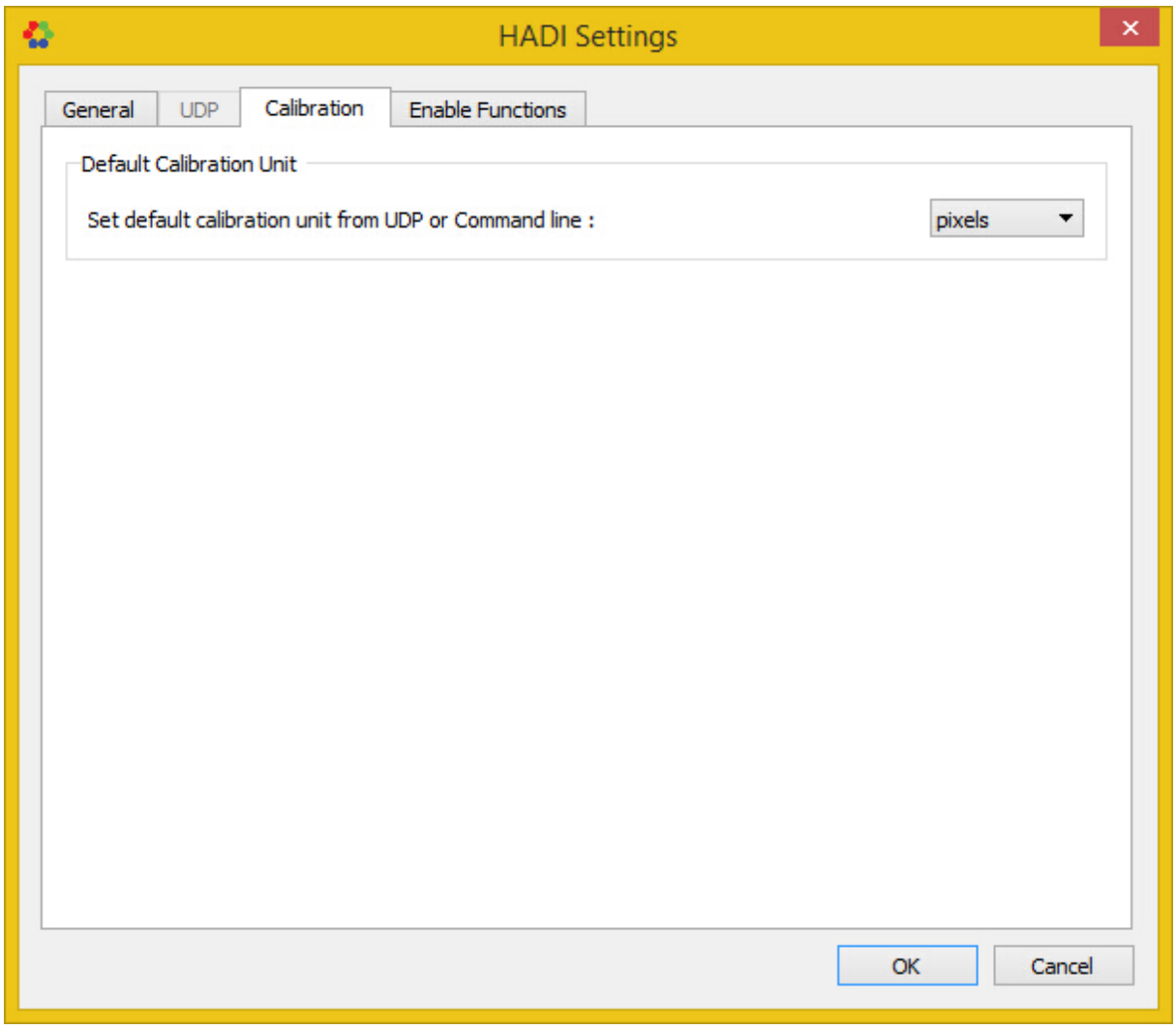
Capture Resulting Image After Inspection

Set that whether to capture the resulting image or not.
See the discussion in "Improve Performance 55".

2.2 Global Settings - Calibration

Click on top right menu "Settings" -> "Settings" -> "Calibration".





Default Calibration Unit

In UDP mode, if user sends the calibration command, the default unit is millimeter. This option will convert the displaying calibration info to target unit.

For example

User send "image_name; 1.5" to HADI by calibration command.

1.5 means: 1 pixel = 1.5 millimeter.

When the default calibration unit set to centimeter, the displaying calibration info will be set to 1 pixel = 0.15 centimeter.

2.3 Template-based Inspection

All HADI products support Template-based inspection.

Template Saves

The purpose that using Template is to

- Save all parameters in Image or in Measurement Tools.
- Save the image alignment information.
- Apply all saved parameters and Measurement Tools to a new image (to do inspection).

Template Auto Saving

In a Template, every editing will be automatically saved, including,

- Measurement Tool moves, changes.
- Window/Level changes for 16bit image.
- Void Inspection parameter changes.
- BGA Detection parameter changes.
- PCB Inspection parameter changes.

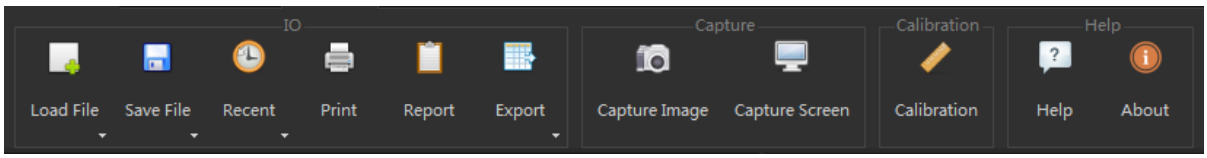
See also:

- How to create a Template? 63
- Teach a Template 64

3 Toolbars

3.1 Toolbar - FILE

Click on Toolbar "FILE", the following toolbar will be shown



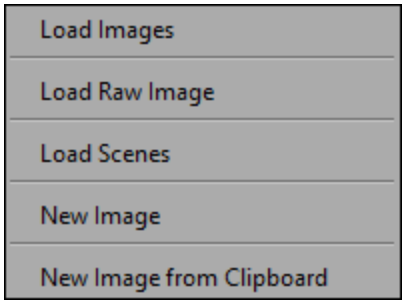
IO

Load File

Users can load image files into HADI using various approaches.

HADI can remember last used directory, and the last used directory for Images and Scenes are memorized separately.

See "How to load image into HADI".



- **Load Images**

  load general images from disk.

- **Load Raw Image:**

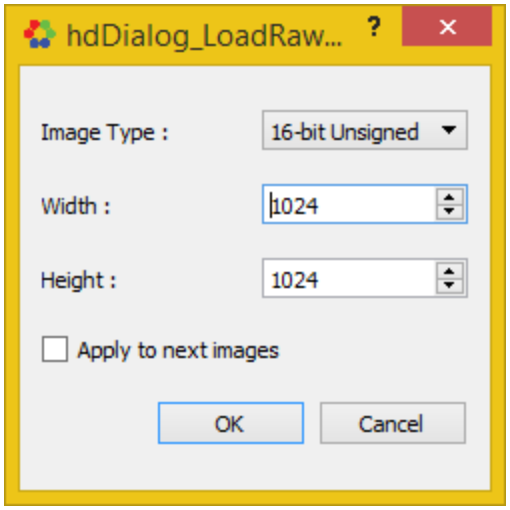
  HADI supports RAW Images.

  Image Type: specify image types.

Width: specify image width.

Height: specify image height.

Apply to next images: all above parameters will be applied to next images when loading multiple raw images.

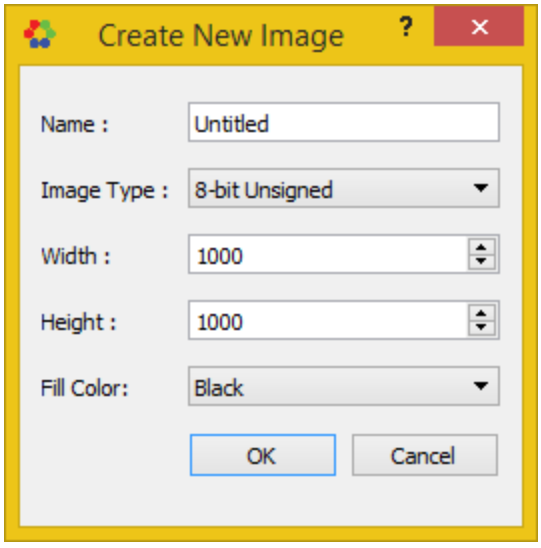


- **Load Scenes:**

  All the working scene 49 can be saved as XML file, and user can load multiple scenes into HADI.

- **New Image**

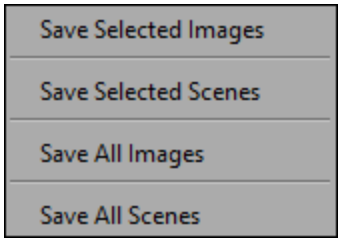
  Create a new image by specified parameters.



- **New Image from Clipboard**
  Create a new image from Clipboard.

Save File

User can save images and scenes to disk.



- **Save Selected Images**
  Save selected images in dock panel "Images 74" as images to disk.

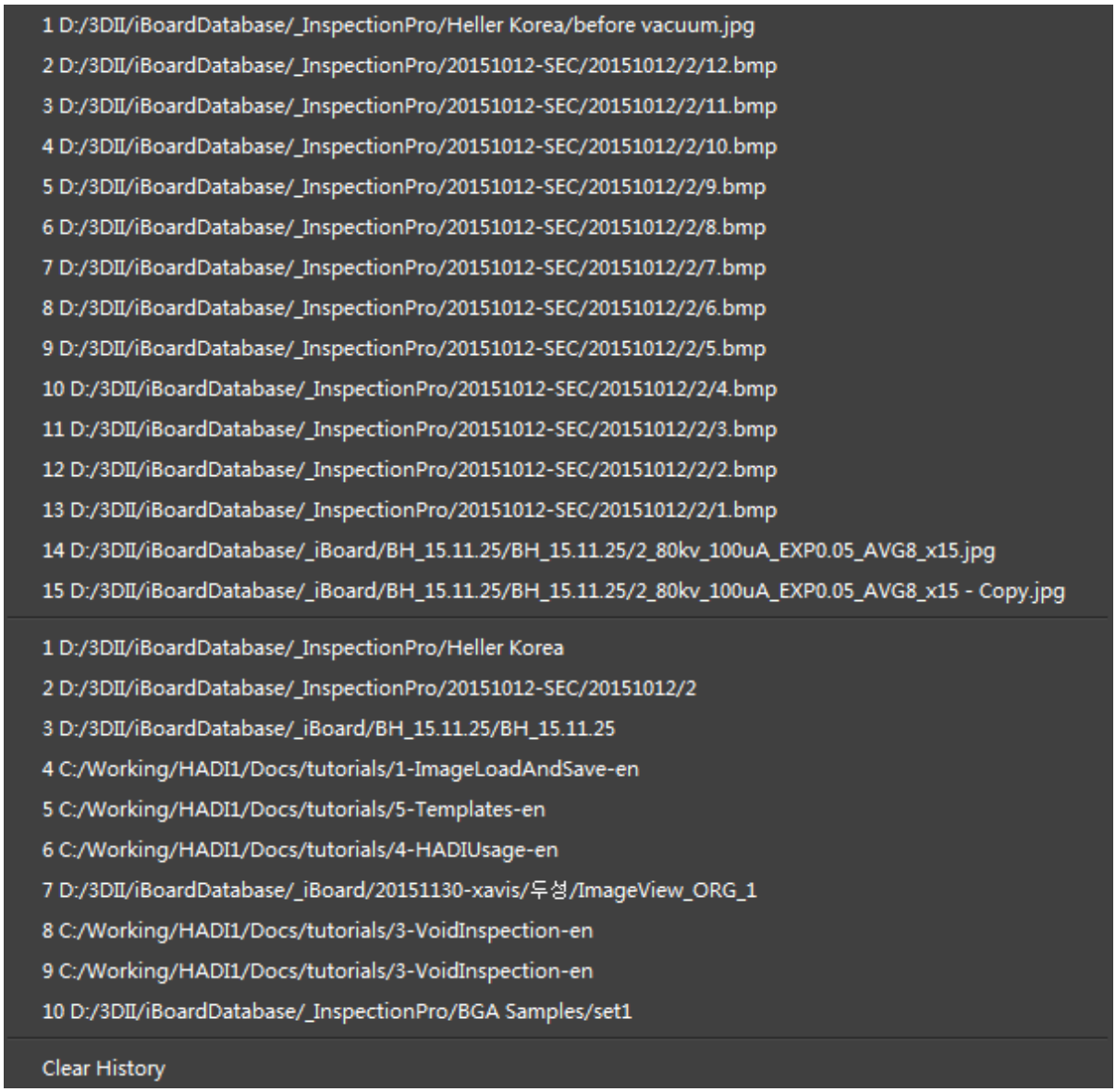
- **Save Selected Scenes**
  Save selected images in dock panel "Images 74" as working scenes 49 to disk.

- **Save All Images**
  Save all images in dock panel "Images 74" as images to disk.

- **Save All Scenes**
  Save selected images in dock panel "Images 74" as working scenes 49 to disk.

Recent

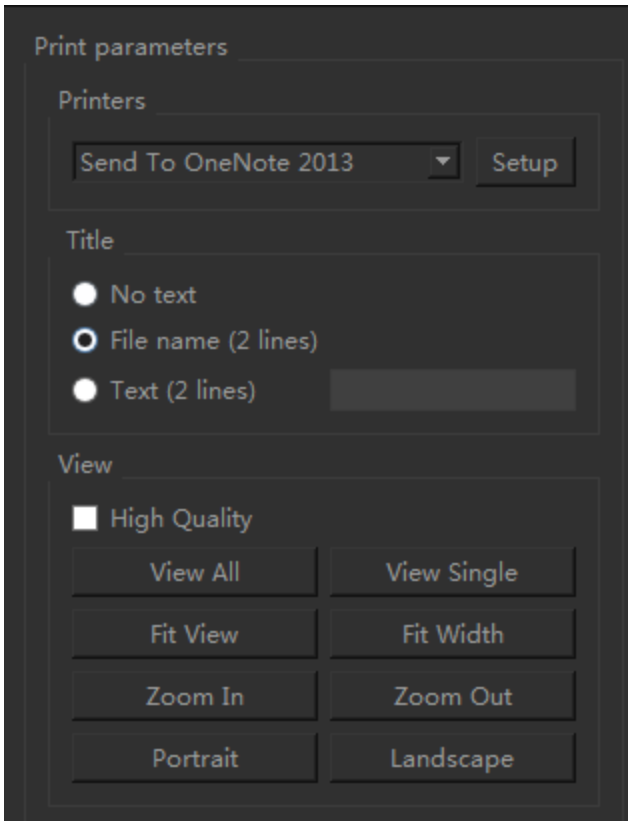
Shows the recently used images and directories.



Print

Print selected images.

User can set title for each image, or print with high quality.

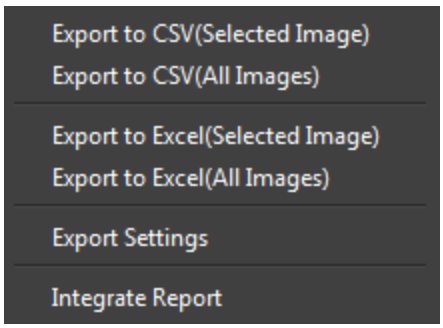


Report

Generate general report for selected images.

Now, most modules have their specific file format, please find out the related Toolbar to get more information.

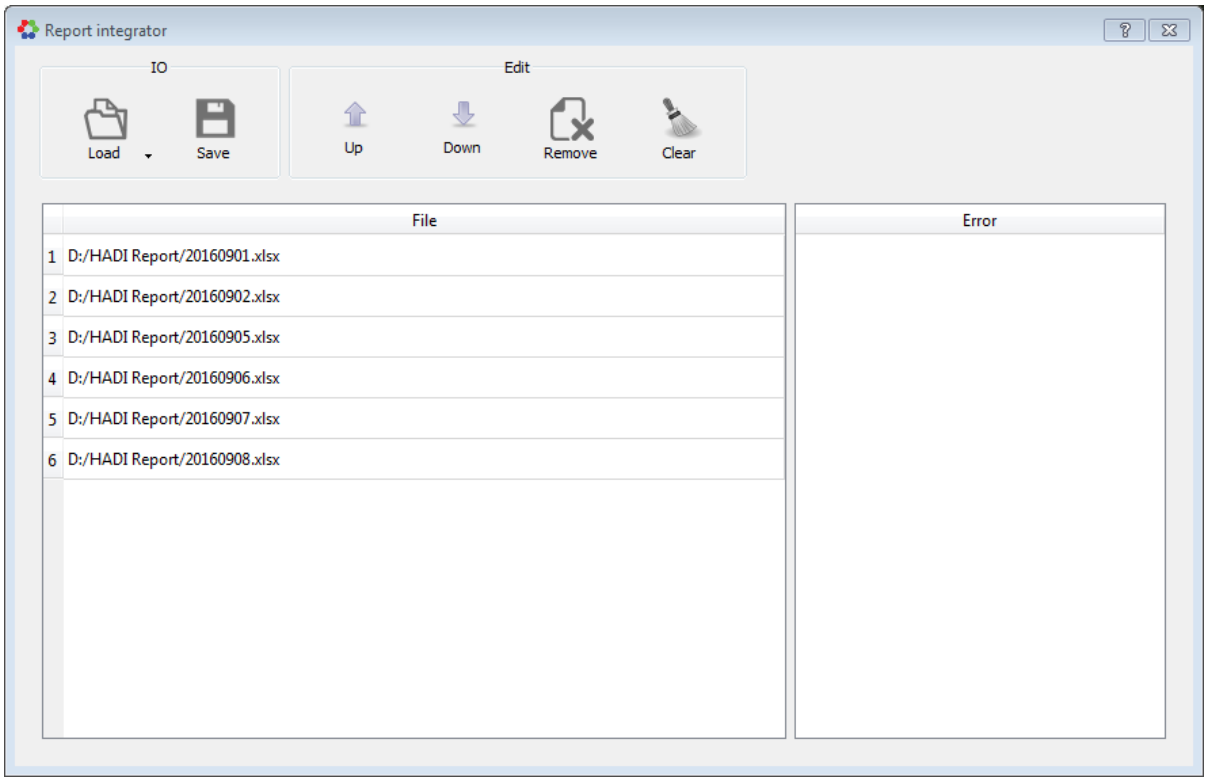
If user needs customized report format, please contact with 3DII (xin.chen@3dii.kr)



- **Export to CSV(Selected Image)**
- **Export to CSV(All Images)**
- **Export to Excel(Selected Image)**
- **Export to Excel(All Images)**
- **Export Settings**

  See "Export Settings 78" in dock "MT Info 77".
- **Integrate Report**

  Show the Report integrator Dialog.



Load

Load the files to be integrated.

Save

Integrate the loaded files into one file.

Up

Move up selected rows in File list.

Down

Move down selected rows in File list.

Remove

Remove selected files.

Clear

Remove all files.

Capture

Capture Image

User can capture the current displaying image by

- Clicking "Capture Image" in Capture panel,
- Clicking the camera icon on the top left corner of any view 50.

User can also capture high quality images.
Go to "Settings" -> "General" -> "Capture Image" 8, to adjust default image quality.

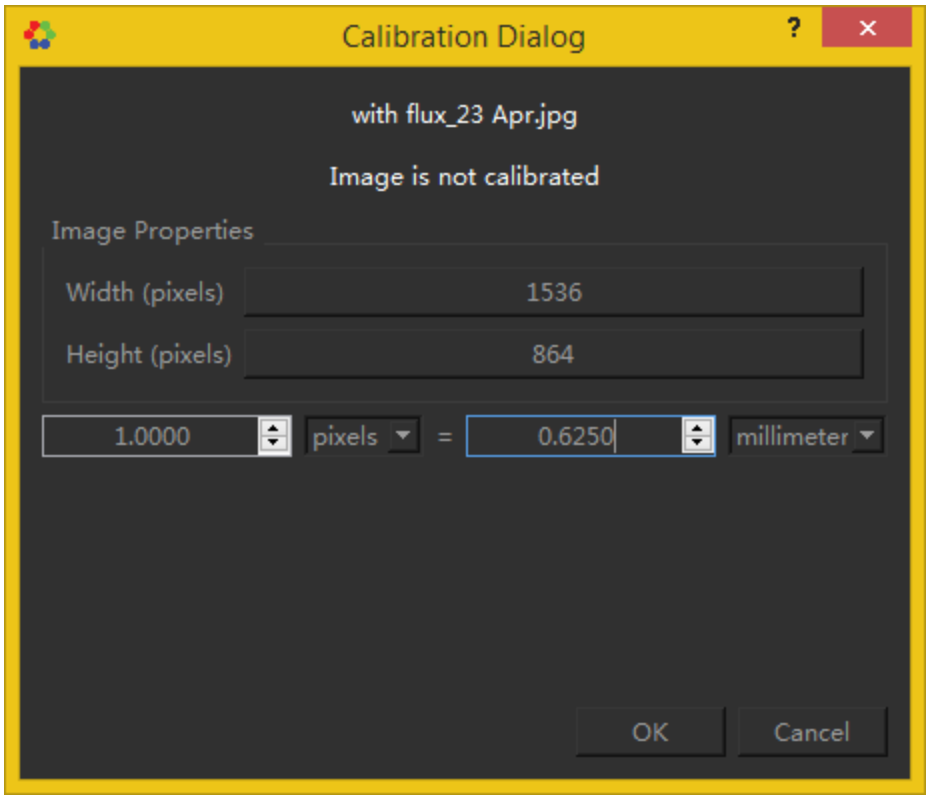
Capture Screen

User can capture the whole desktop by clicking "Capture Screen" or using "Ctrl + 1".

Go to "Settings" -> "General" -> "Capture Screen" 8 to see more options.

Calibration

For current displaying image, make a connection between Pixel Size and Real World Size.
See "Image Calibration 65".



Help

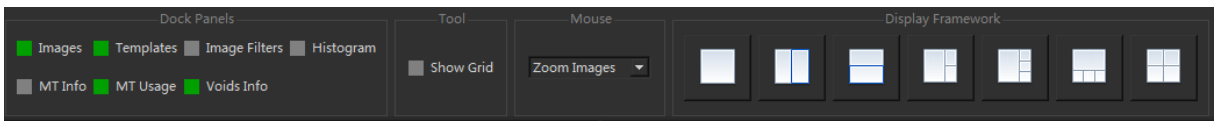
Show this document.

About

Show about information.

3.2 Toolbar - VIEW

Click on Toolbar "VIEW", the following toolbar will be shown



Dock Panels

Images

Show/hide Images dock panel 74.

Templates

Show/hide Templates dock panel 71.

Image Filters

Show/hide Image Filters dock panel 26.

Histogram

Show/hide Histogram dock panel 82.

MT Info

Show/hide MT Info dock panel 77.

MT Usage

Show/hide MT Usage dock panel 79.

Voids Info

Show/hide Void Info dock panel 83.

Tool

Show Grid

Show guiding grid in image.

Mouse

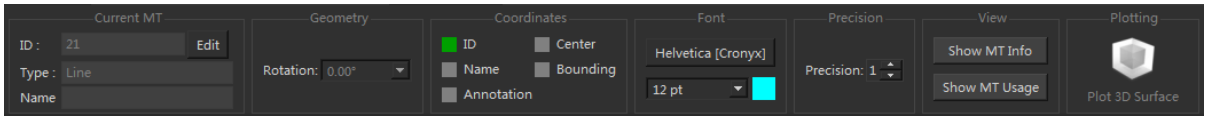
Choose left mouse behavior to "Zoom Images" or "Switch Images".

Display Framework

Set the display framework of main workspace.

3.3 Toolbar - MEASURE

Click on Toolbar "MEASURE", the following toolbar will be shown



Note: All the parameters are acting on selected Measurement Tools

Current MT

ID

Shows the ID of the selected Measurement Tool.

Edit

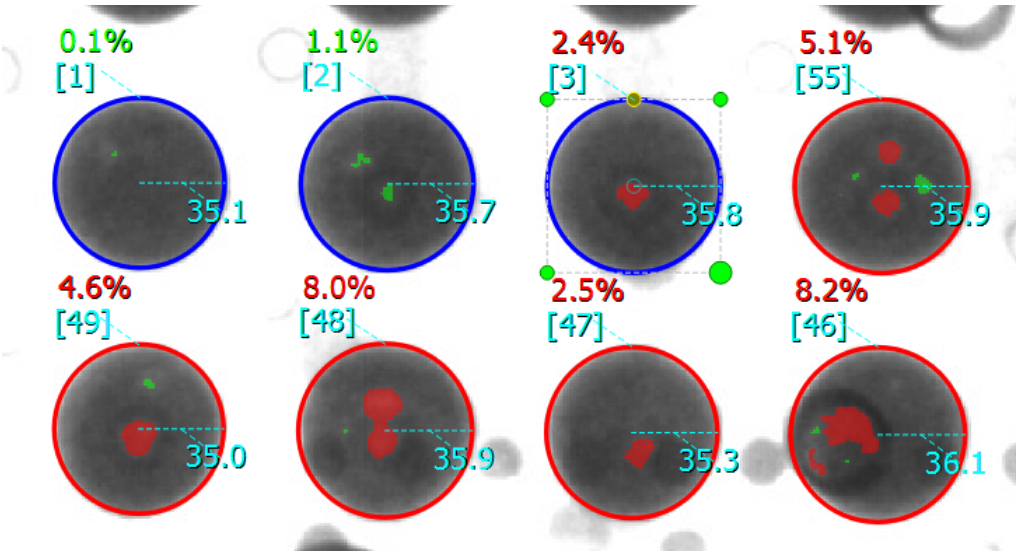
User can change the ID of Measurement Tools.

1. Select Measurement Tools in active view 50.

2. Click "Edit", the MT color will change to red color.

3. Click each MT in order, the ID will be reassign from 1, new ID assigned MT will become blue color as shown in following pictures.

4. If all MTs have been clicked, the editing will be finished automatically. Or user can click "Edit" again to finish editing.



Type

Shows the Type of the selected Measurement Tool, such as Line, Rectangle, Circle, Polygon and so on.

Name

Shows the Name of the selected Measurement Tool(s).

There's no Name by default, user can input name and press "Enter" to let MT remember it.

Geometry

Rotation

Set the rotation angle of the selected Measurement Tool(s).

User can operate multiple Measurement Tools at a time.

Rotation angle starts from -180°(Counterclockwise Rotation) to 180°(Clockwise Rotation).

Coordinates

Shows the coordinate information and label information of the selected Measurement Tool(s).

ID

Shows the ID of the selected Measurement Tool.

Name

Shows the Name that edited by user in Current MT of the selected Measurement Tool.

Annotation

Shows default annotation of the selected Measurement Tool.

Center

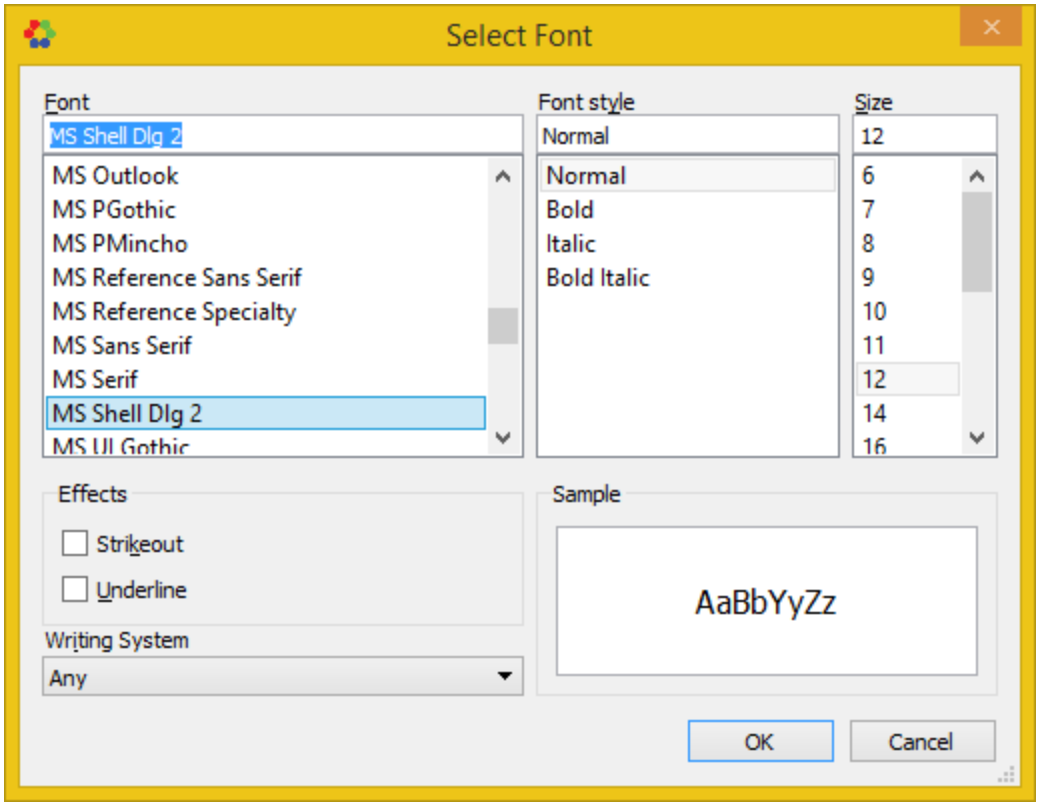
Shows the center coordinates of the selected Measurement Tool.

Bounding

Shows the vertex coordinates of the selected Measurement Tool.

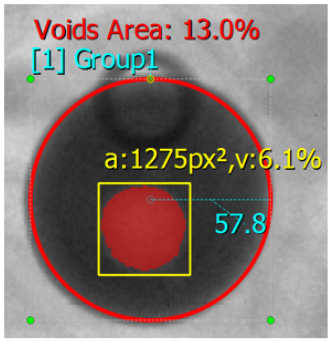
Font

User can change the font and font size of the selected MTs.

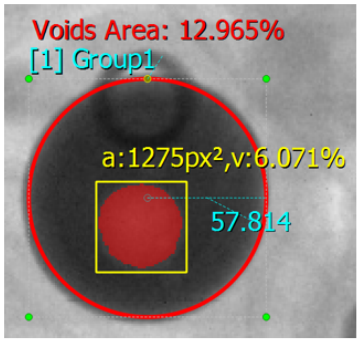


Precision

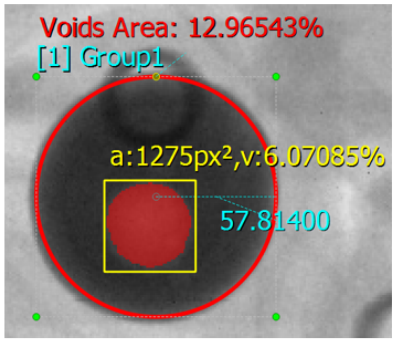
User can change the precision of the selected MTs.



Precision = 1



Precision = 3



Precision = 5

View

Show MT Info

Show Measurement Tool Info dock panel 77.

Show MT Usage

Show Measurement Tool Usage dock panel 79.

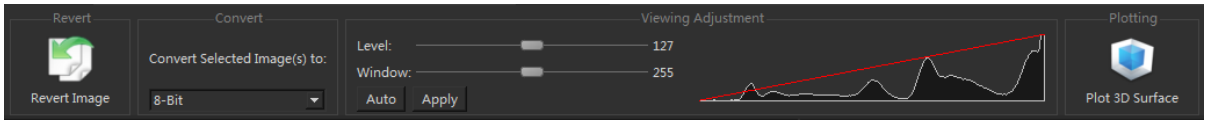
Plotting

Plot 3D Surface

Plot 3D surface of selected closed-shape 88 Measurement Tools 87

3.4 Toolbar - IMAGE

Click on Toolbar "IMAGE", the following toolbar will be shown



Revert

Revert Image

Reload the image from disk again, all changes will be abandoned.

Convert

User can convert the displaying image format among 8-Bit, RGB Color and 16-Bit.

Viewing Adjustment

Level

Adjust the viewing level of current image.

Window

Adjust the viewing window of current image.

Auto

Auto adjust the viewing of current image.

Apply

Apply current viewing effect to current image.

Histogram

Show the histogram of current image.

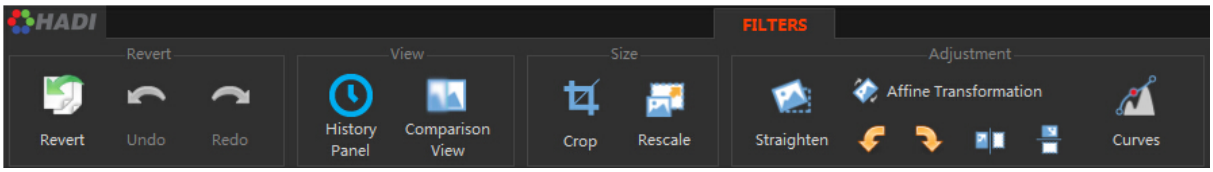
Plotting

Plot 3D Surface

Plot 3D Surface of current image.

3.5 Toolbar - FILTERS

Click on Toolbar "FILTERS", the following toolbar will be shown



Revert

Revert

Restore the current image as original image, and lost all undo/redo history at the same time.

Undo

Reverse the last operation user performed.

Redo

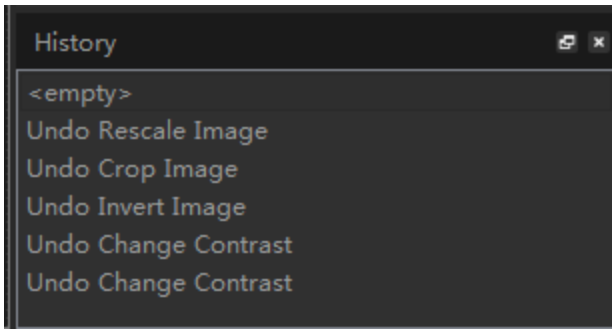
Perform the last undo operation again.

View

History Panel

Display the sequence of HADI states recorded during image filters, and its main purpose is to let user manage and access the history states recorded by HADI.

Click the desired history state to activate a previous state.



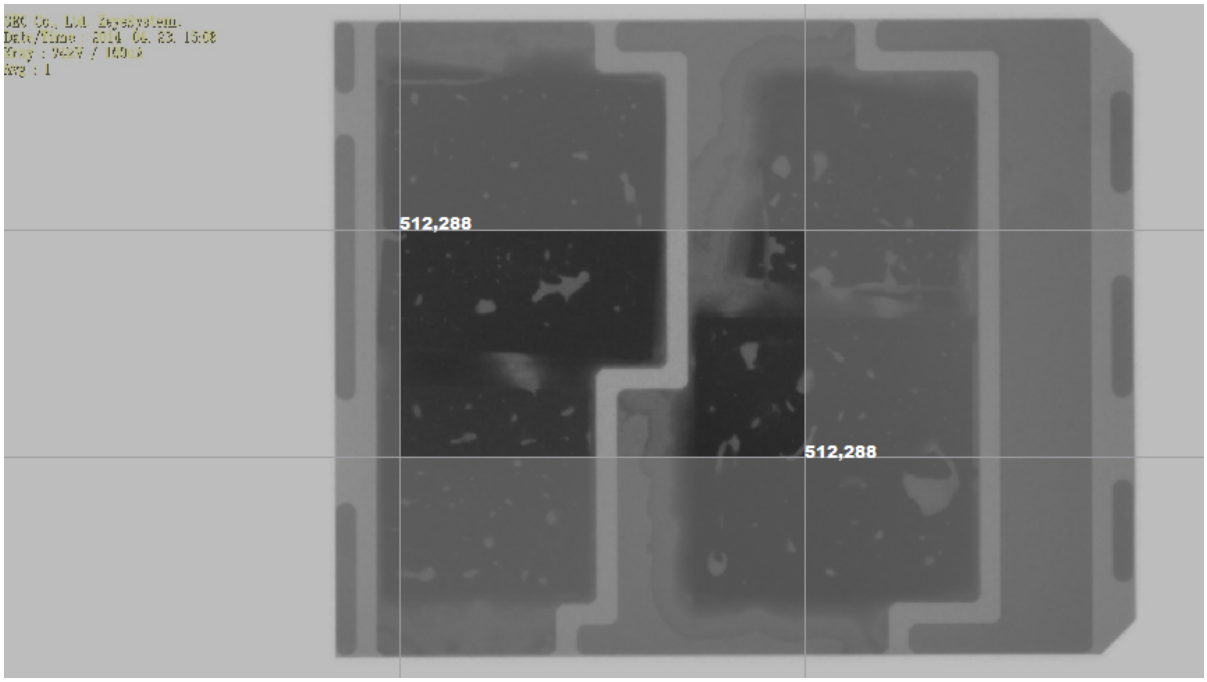
Comparison View

Compare the current image after processing with filters with the original image.

Size

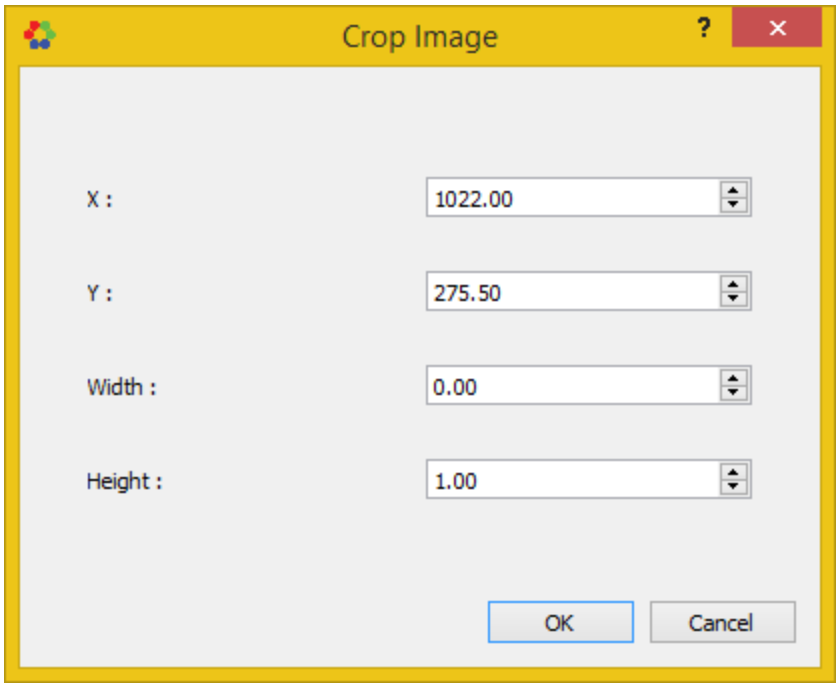
Crop

Click on Crop Button. The main view shows



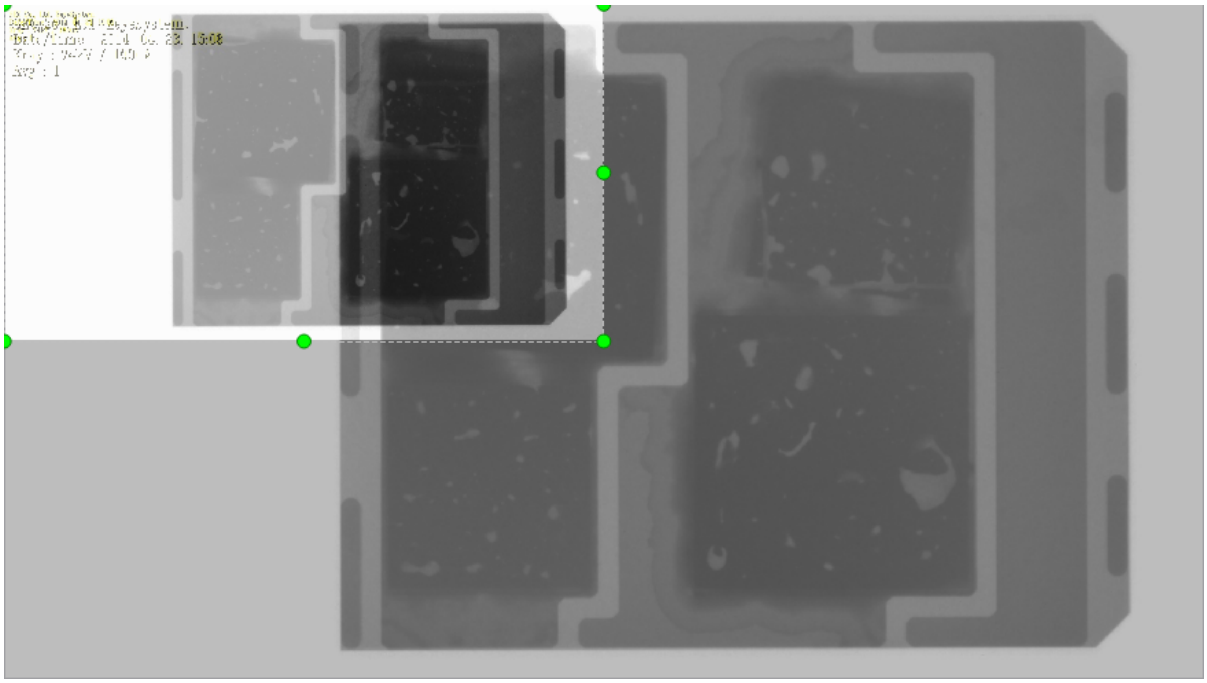
The center area show the preview of cropped image.

- User can set top-left position by clicking near to current top-left position.
- User can set bottom-right position by clicking near to current bottom-right position.
- User can also set the exact X,Y,Width,Height in the parameter panel as shown in below figure.



Rescale

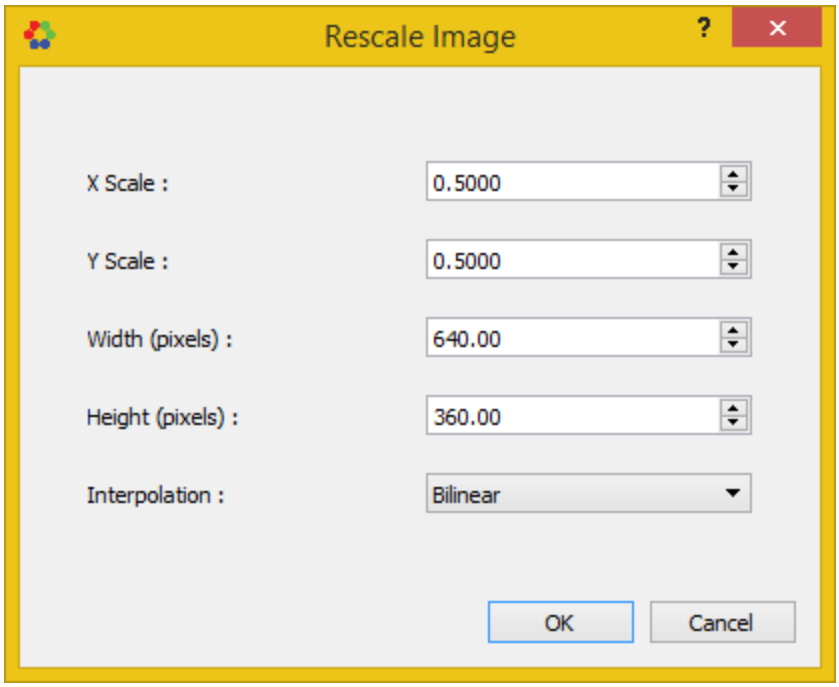
Click on Rescale Button. The main view shows



The ROI area shows the preview of rescaled image.

- User can drag the eight hover points to see the result.

- User can set exact X Scale, Y Scale, Width, Height, Interpolation Algorithm in the parameter panel as shown in following picture.

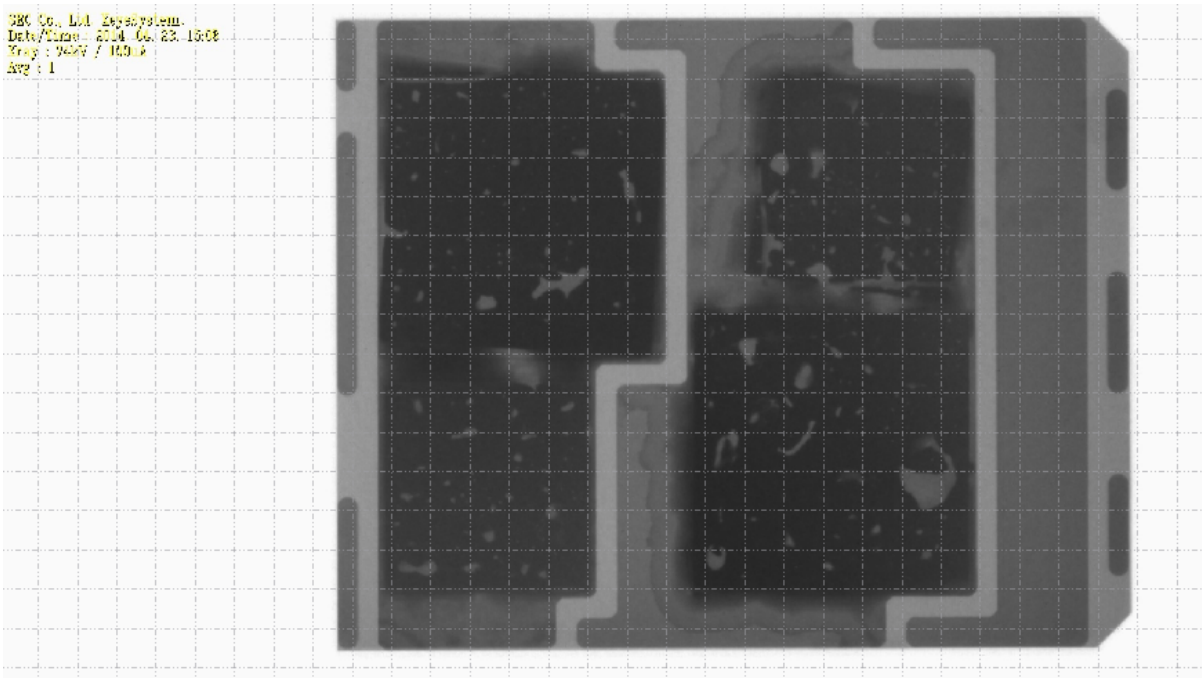


Adjustment

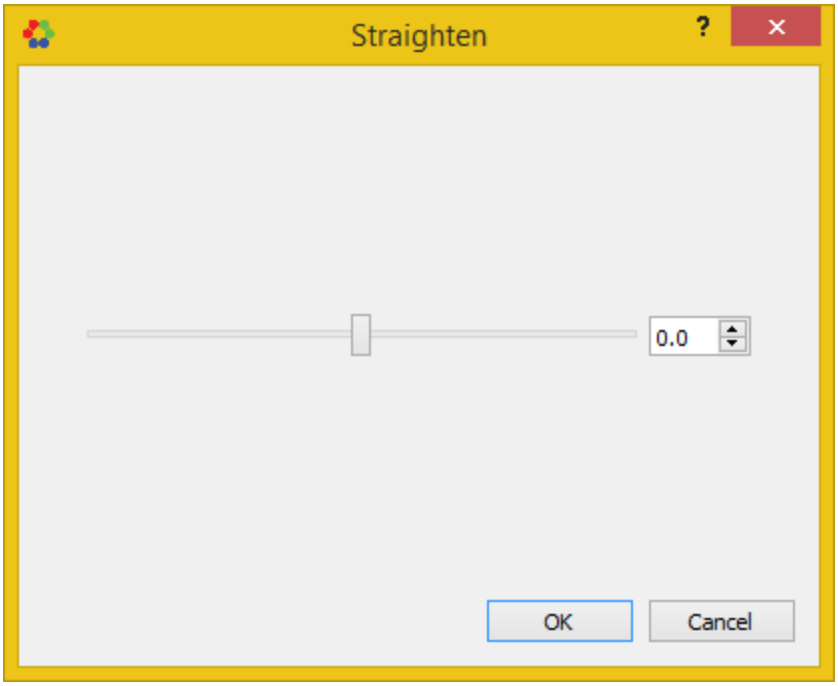
Straighten: slightly change rotation and scale

Click on Straighten Button. The main view show grid line to help straighten,

The difference between Rotation and Straighten is that Straighten will has slightly rescale to avoid black border.



- User can use Straighten parameter panel to tune the straighten weight.

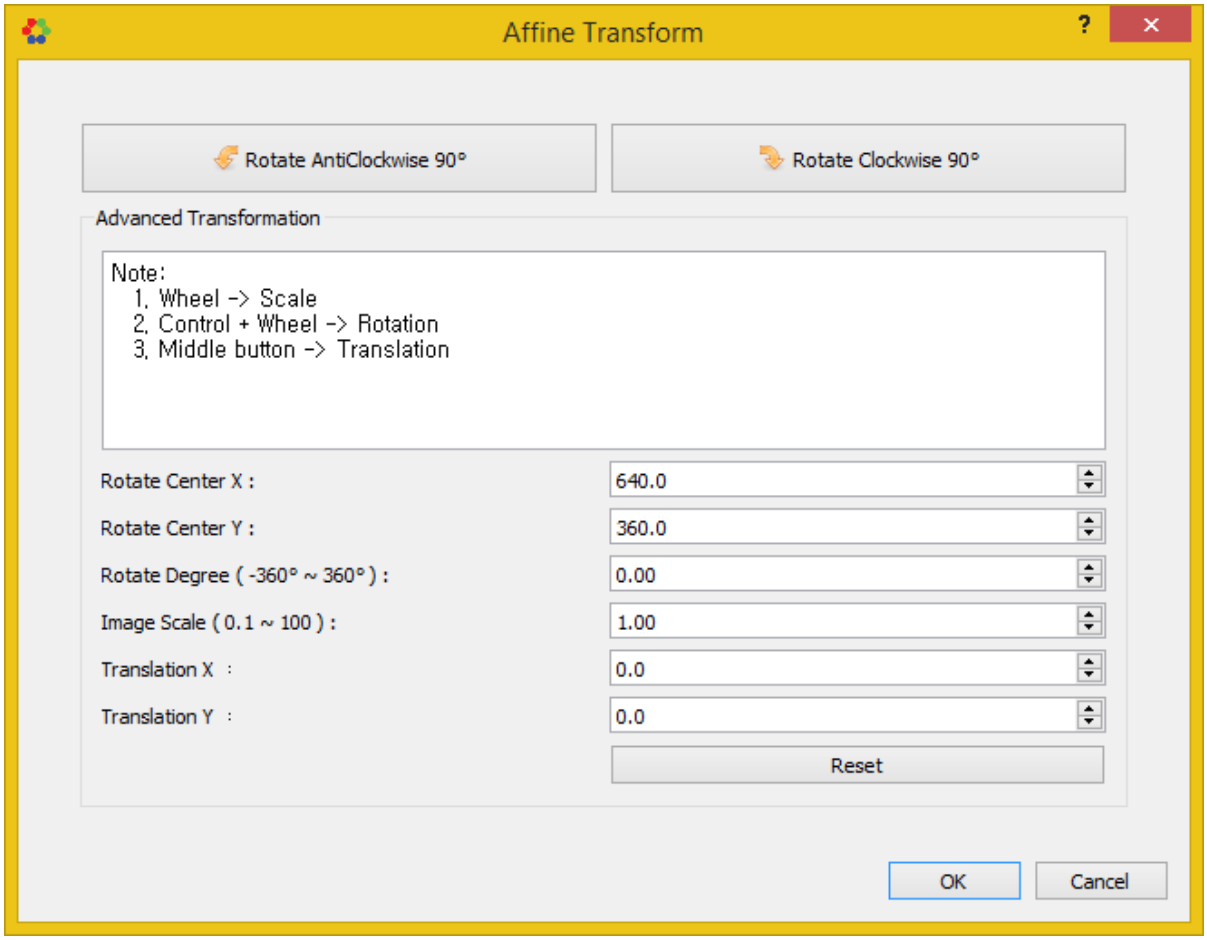


Affine Transformation

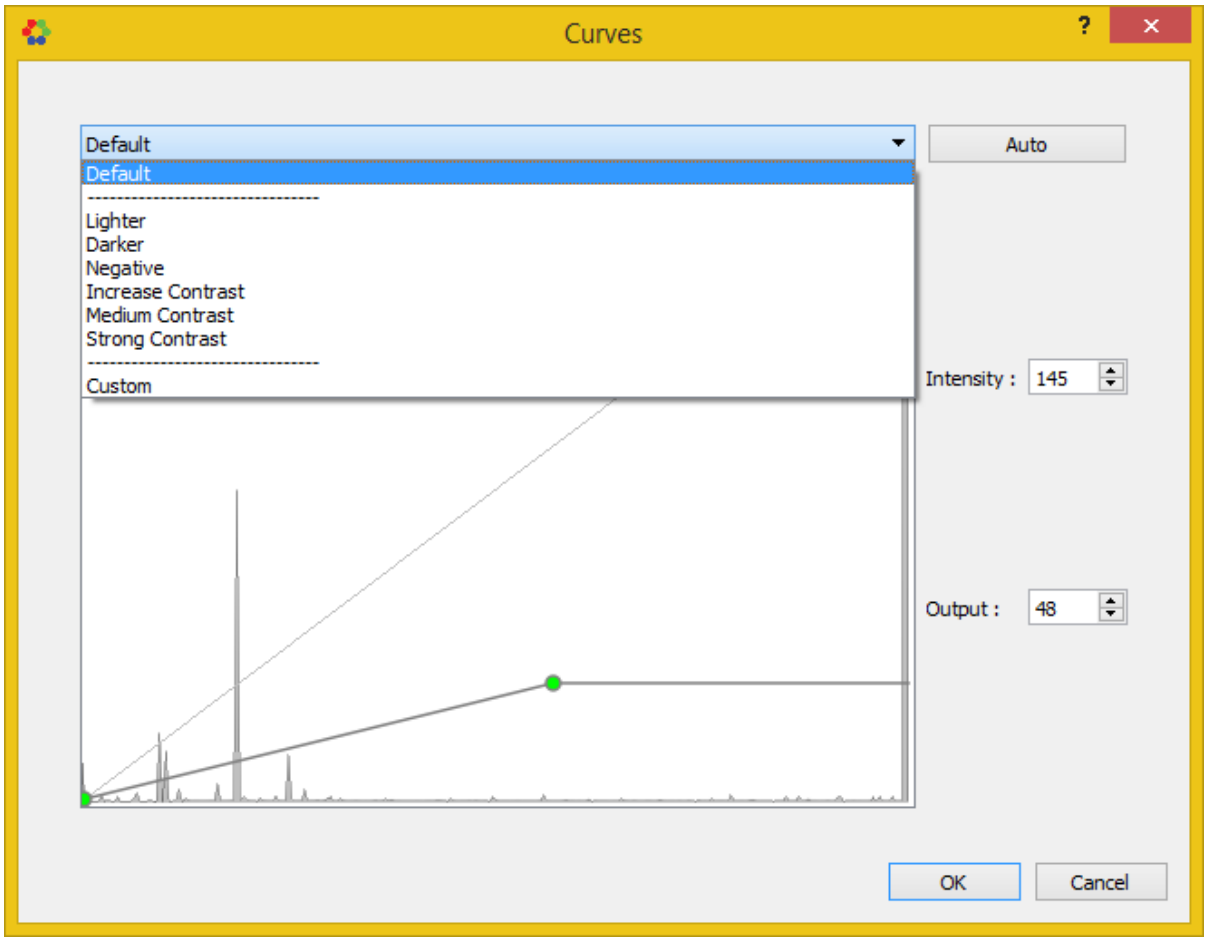
Click on Affine Transformation Button. The parameter panel is shown as following picture.

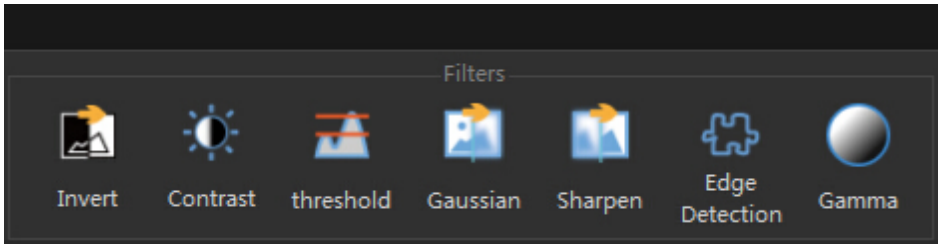
- User can rotate the image clockwise or anticlockwise by 90°.

- User can define the rotate center by adjusting Rotate Center X and Rotate Center Y.
- User can rotate the image for a defined degree by editing Rotate Degree.
- User can zoom in and zoom out the image by adjusting Image Scale.
- User can shift an image by a specified number of pixels in either the *x* or *y* direction, or both by adjusting Translation X and Translation Y.



Curves





Filters

Invert

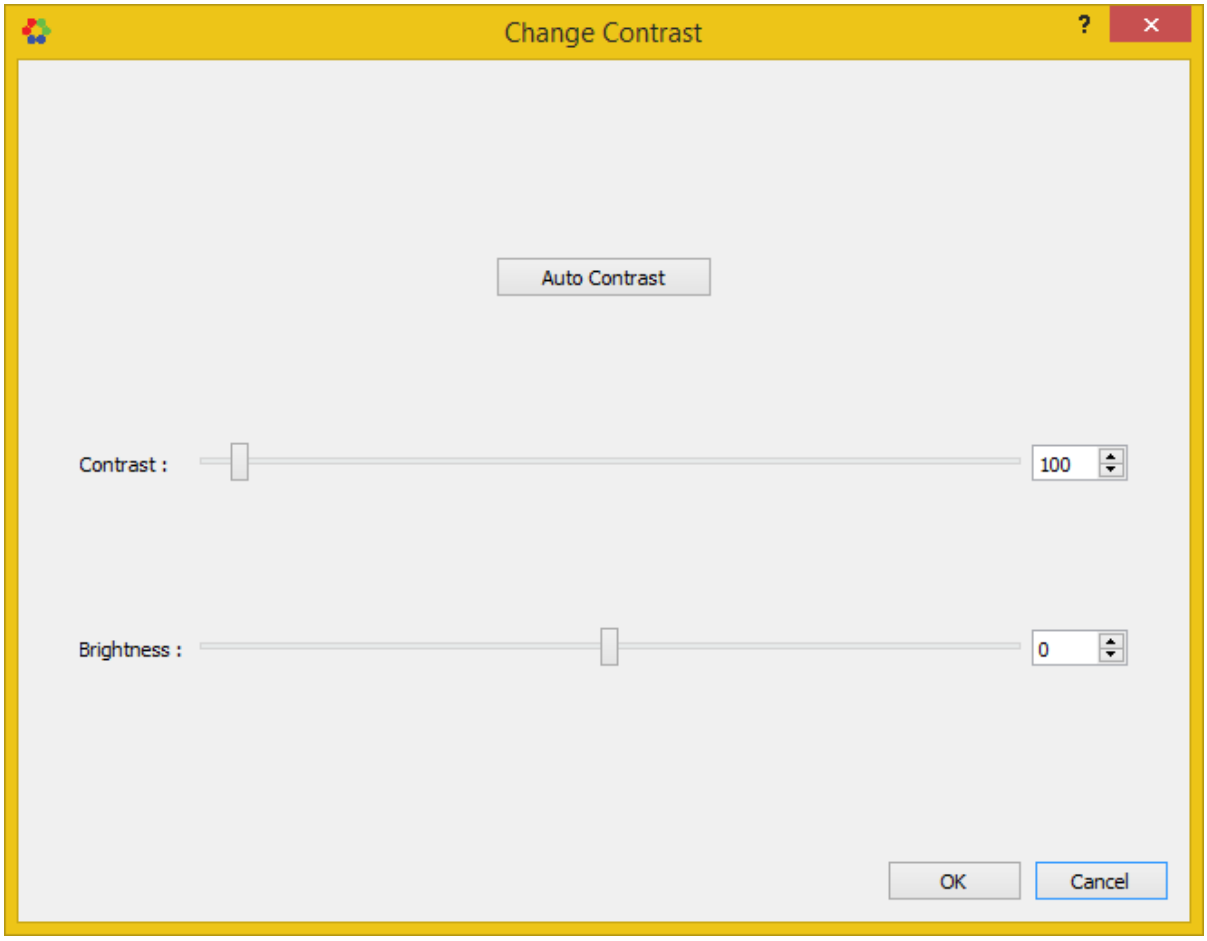
Invert the current image.

Contrast

Auto Contrast: Automatically adjust contrast and brightness of the current image.

Contrast: Adjust contrast and brightness of the current image.

Brightness:



Threshold

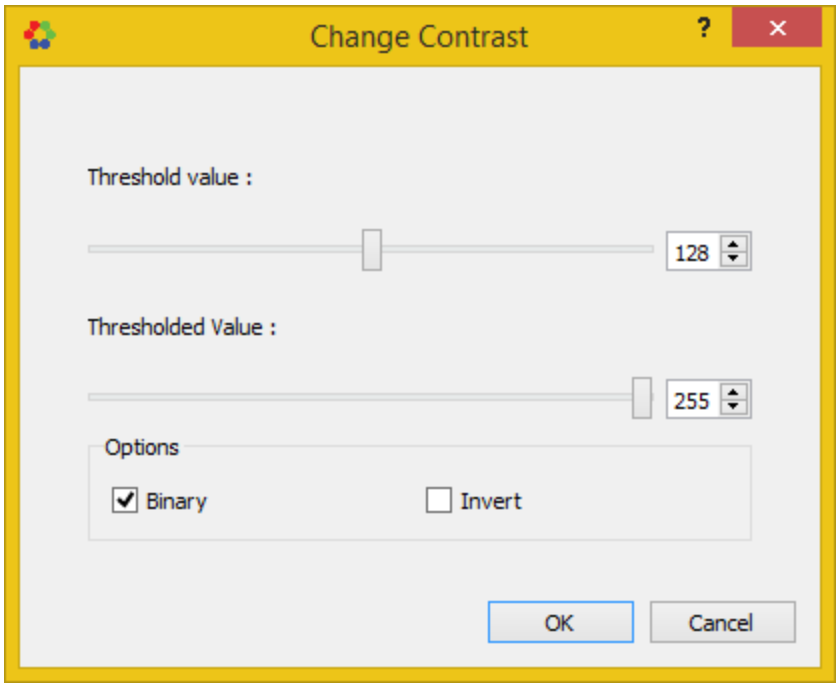
Do Thresholding on the current image.

"Threshold value" adjusts images by converting all colors and shades of grey to either black or white. use the adjustment to create stark, high-contrast images.

"Thresholded value" decides a value that if

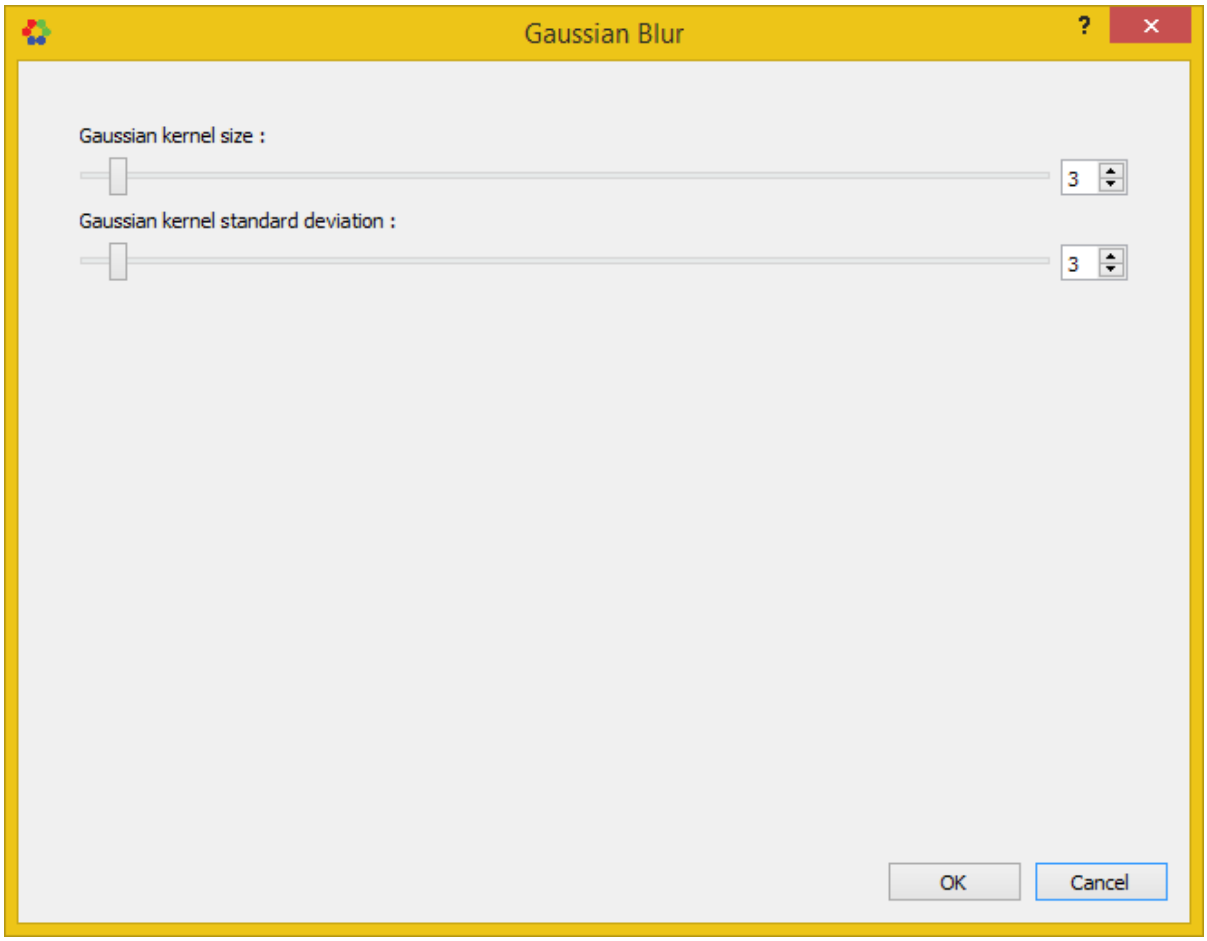
- "Threshold value" is smaller than it, the pixel value will be assigned to 0 (black).
- "Threshold value" is larger than it, the pixel value will be assigned to 255 (white).

Choosing "Binary" to make current image as binary image (black and white); "Invert" is used to invert the current image.



Gaussian

Blur the current image using a Gaussian filter.

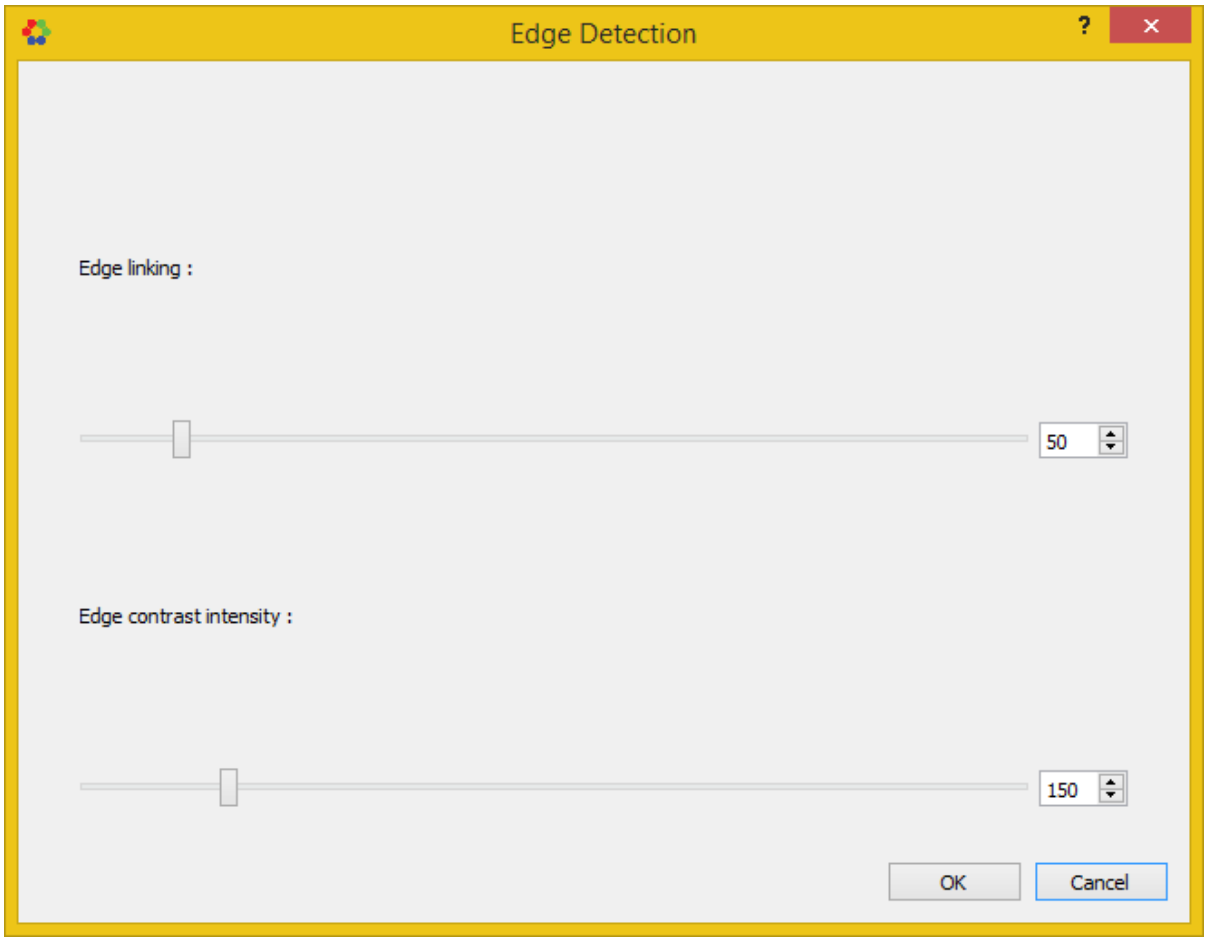


Sharpen

Sharpen the current image.

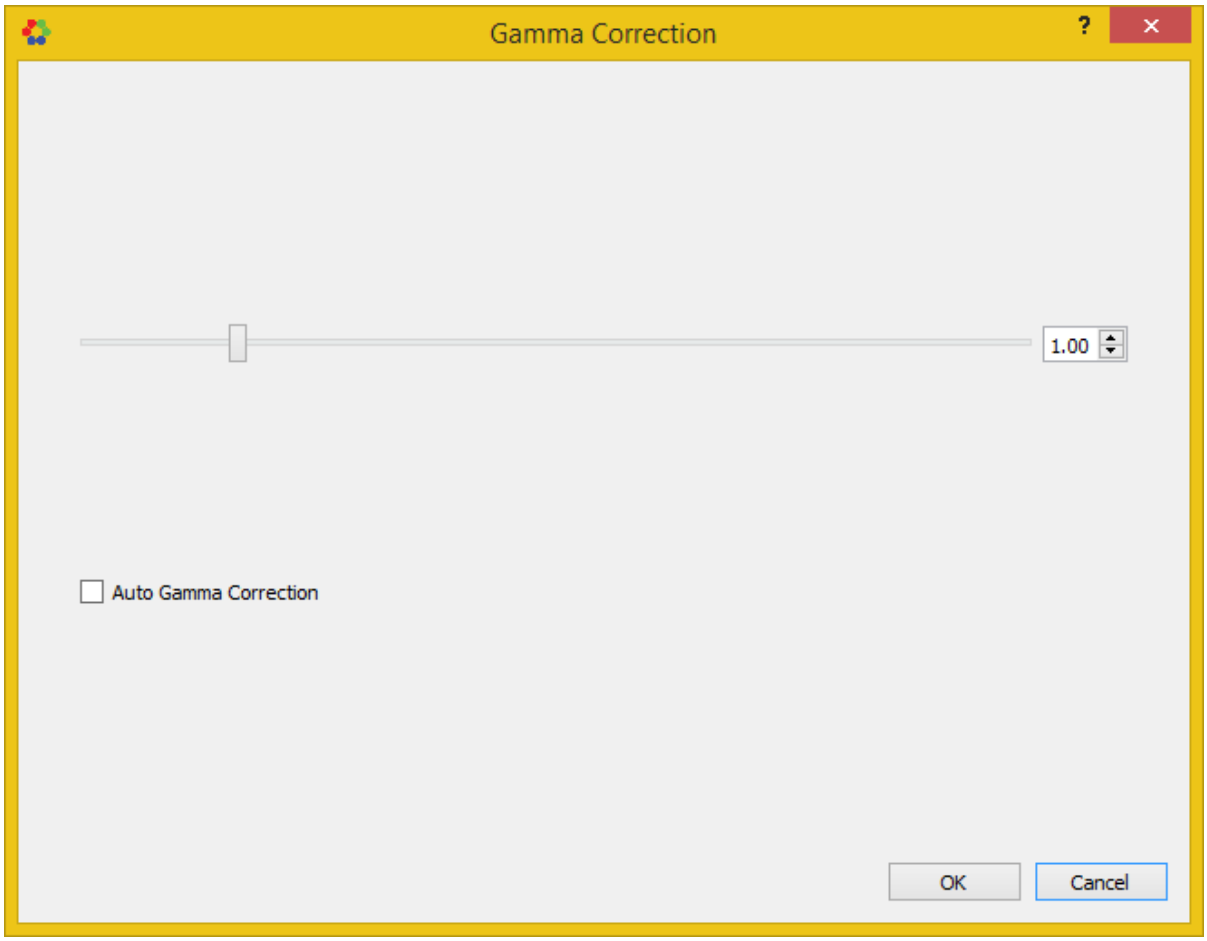
Edge Detection

Find edges in the current image using Canny edge detection algorithm.



Gamma

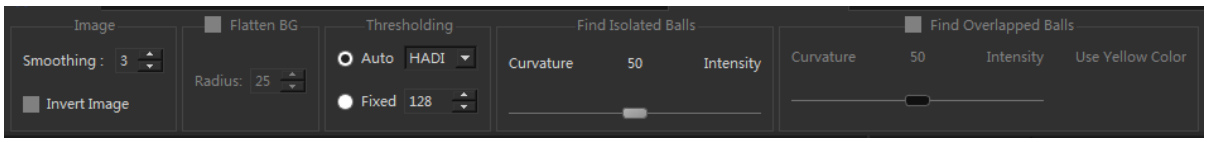
Gamma Correction enables user to adjust how an image is displayed on the monitor. Gamma correction only adjusts the dark tones.


Gamma Correction
1.00
Auto Gamma Correction
OK
Cancel

4 Inspection

4.1 BGA DETECTION

Click on Toolbar "BGA DETECTION", the following toolbar will be shown



BGA DETECTION Toolbar (1/2)

Image

Smoothing

Defines the Gaussian smoothing iterations. Default value is 3.

Invert Image

HADI default will try to find out Black Balls on White Background. In case user has white balls on black image, user needs to check this option.

Flatten BG

If the background is inhomogeneous, please check this option.

Radius

The radius is usually set as twice as the Ball diameter.

Thresholding

Auto

Default Option is “HADI”, Which is an adaptive Thresholding algorithm developed by HADI team. It can cover most cases.

User can also try to use “OSTU” adaptive Thresholding in some case.

Fixed

In the very noise image, auto(Adaptive Thresholding) may not work.

User can give a Fixed Thresholding value to do segmentation.

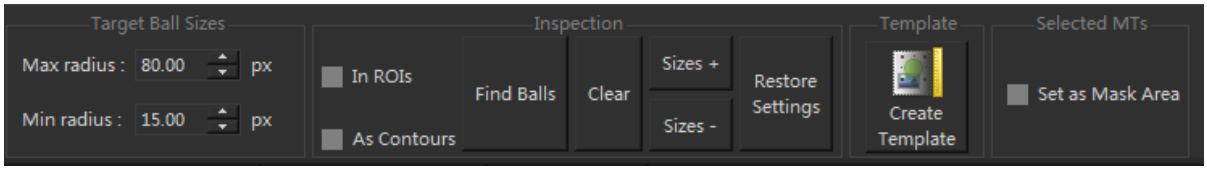
When adjust this parameter, the image will have an overlay to show the segmentation area. If the segmentation roughly OK, click "Find Balls" to find BGA.

Find Isolated Balls & Find Overlapped Balls

The two slider bars in "Find Isolated Ball" and "Find Overlapped Ball"are designed for finding balls as contour. it defines the balance between ball curvature and intensity.

User doesn't need to change them, and that make sure the value to be 50 is OK.

Please see tutorial "BGA Detection" to get more information.



BGA DETECTION Toolbar (2/2)

Target Ball Sizes

Set the ball minimum size and maximum size.

Roughly setting the range will bring more accurate result, so setting ball radius limitation is very important.

Default value of Minimum radius and Maximum radius of a ball are 15 pixels and 80 pixels, respectively.

- If ball size is larger than 80, user needs to change "Max Radius" to a proper value.
- User can use Line Tools 91 to measure a Ball size

Inspection

In ROIs

- Check "In ROIs"
- Put one or more rectangle, and set it as "Tool3 (BGA Detection) 81"

Then algorithm will only find balls inside the ROIs.

As Contours

- Check this option, all the balls will be displayed as Polygon 90 (Contour).
- Uncheck this option, all the balls will be displayed as Circle 88.

Find Balls

Click this button to find Balls.

It will first remove all the detected balls, then find out balls with current parameters.

Clear

Remove all the detected balls by clicking "Clear" button.

Size+

Increase radius of all the selected balls with value 1.

Size-

Decrease radius of all the selected balls with value 1.

Restore Settings

Restore all the parameter settings as default.

Template

User can create a Template 63 with current displaying parameters.

Click any Template will apply the parameters inside Template to UI.

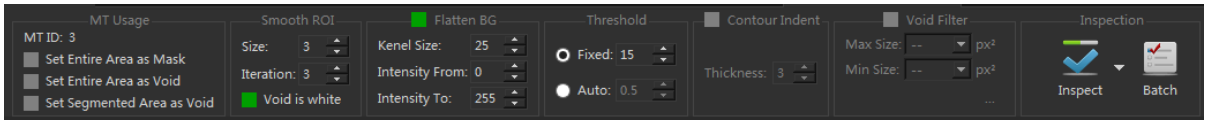
See tutorial "Template" to get more information.

Selected MTs

Check "Set as Mask Area", HADI will set all selected ROIs (Rectangle, Polygon, and Circle) as Mask, which means the balls inside the Mask area will be removed automatically.

4.2 VOID INSPECTION

Click on Toolbar "MEASURE", the following toolbar will be shown



VOID INSPECTION Toolbar 1/2

Note: All above parameters are acting on **selected** closed-shape 88 Measurement Tools 87 with usage "Void Inspection" 81

MT Usage

Set the usage of selected Measurement Tool.
NOTE: HADI supports MT Usage 79 definition that assign each MT a explicit usage.

To do Void Inspection, the usage for a MT should be Void Inspection Usage 81.
By default, any closed-shape MT is assigned as Void Inspection Usage.

MT ID

Show ID of selected Measurement Tools.

Set Entire Area as Mask

Set entire area as No Void Area

Set Entire Area as Void

Set entire area as Void Area

Set Segmented Area as Void

Set segmented area as Void Area

Smooth ROI

Smooth the ROI with Gaussian smoothing algorithm

Size and Iteration:

Defines the Gaussian kernel size and smoothing iteration.

Void is white

By default, HADI tries to find out Void (air) that is brighter than the background (object).

Uncheck this option If user wants to find out dark object.

Flatten BG

Flatten Background that helps the foreground segmentation on Inhomogeneous background.
See "Background Processing for Void Inspection"

Kernel Size

Defines the maximum Void object radius.

Intensity From

Defines an the intensity value that background flatten start from.

HADI usually ignore the surrounding pixels that intensity value < Intensity From.

Intensity To

Defines an intensity value that background flatten end to.

HADI usually ignore the surrounding pixels that intensity value > Intensity To.

Threshold

Do the foreground segmentation.

Fixed

Use fixed Thresholding value to do segmentation.

- If "Flatten BG" is checked. Thresholding will be applied to background processed image.

  The Thresholding value is quite different from original image.

  After background processing, the background pixels become 0, the foreground pixels starts from 1.

It means user should set value start from 1.

In general, user can set the Thresholding value to 5 ~15 to do the foreground segmentation.

- If "Flatten BG" is not checked. Thresholding will be applied to smoothed image.

  The Thresholding value is almost exactly same with the original intensity value.

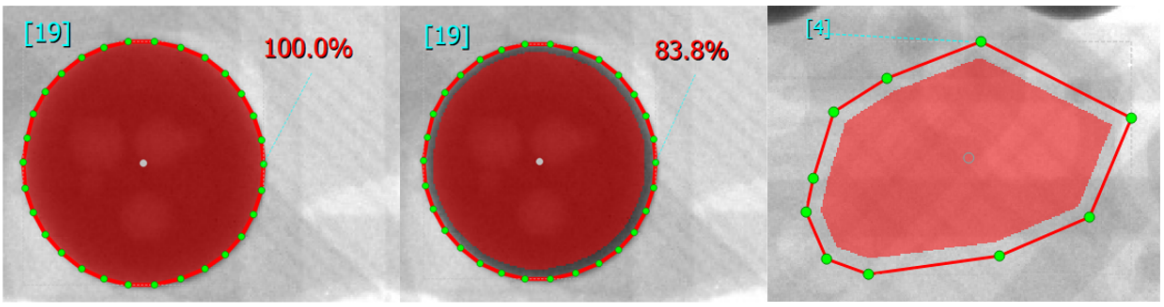
Auto

Use auto Thresholding value to do segmentation.
User can use the “Offset” value slightly tuning the Thresholding results.

Contour Indent

Remove the Void pixels that adhere to the inner Measurement Tool shape.

The “Thickness” define that how many pixels from the border should be removed.



Thickness = 0 Thickness = 6 Thickness = 10

Void Filter

If enabled, HADI will only keep the Voids that the area size located in range Min to Max.

Max Size

defines the maximum void size in the selected MT. If a Void area size larger than this value, it will be removed.

Min Size

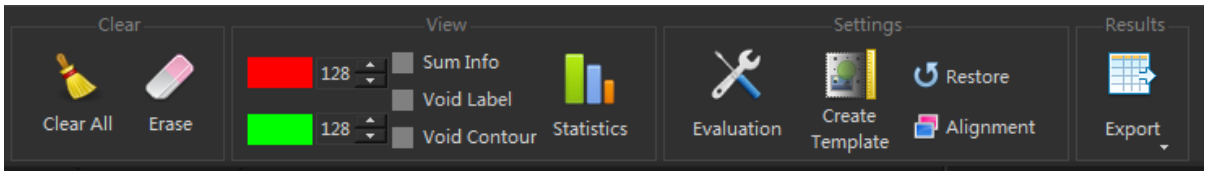
defines the minimum void size in the selected MT. If a Void area size smaller than this value, it will be removed.

Inspection

Inspect current displaying image.

Batch

Invoke the Batch Processing Tool 67. It is a simulation tool for inline inspection.



VOID INSPECTION Toolbar 2/2

Clear

Clear All

Clear all Voids in the current displaying image.

Erase

Click this button, the mouse cursor will be changed to "Cross". Click on any Void to remove it.

Click this button again to exist erasing status.

View

Voids can be evaluated as Defect and Non-Defects according to the Evaluation Settings. .

Defects Color

Define the Defect color for current image.

Non-Defects Color

Defines the Non-Defect color for current image.

Sum Info

Show summary info in the Main window. (will be abandoned)

Void Contour

Show the Voids as contours.

Note: This option is a global option that applied to all displaying Voids.

Statistics

Show Void Statistics Plotting 86 dock panel.

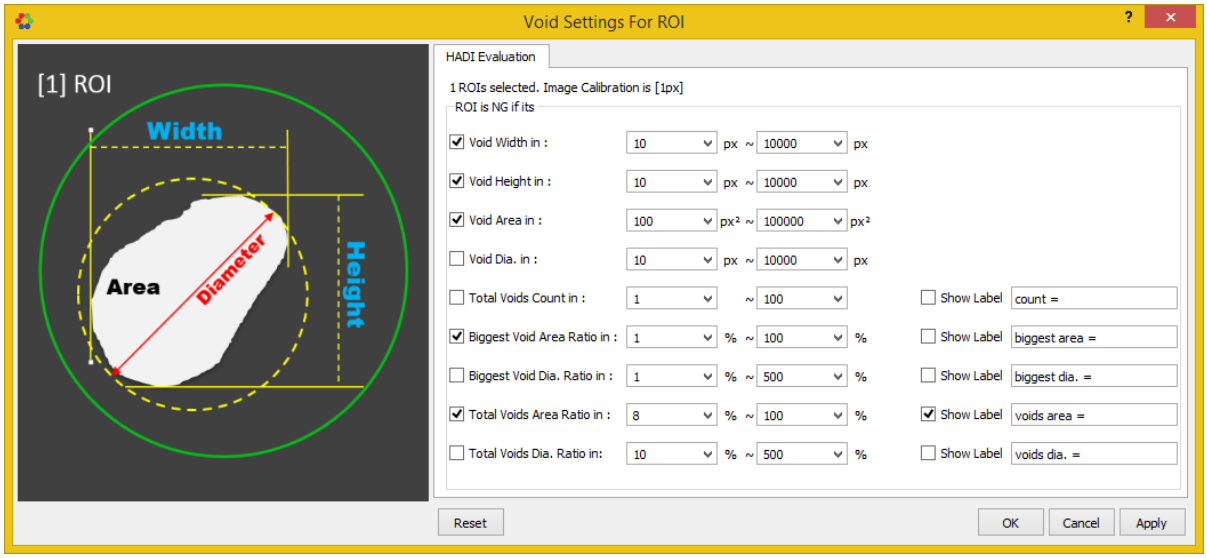
Settings

Evaluation

Show the Void Evaluation Settings Dialog.

- The settings will apply to all selected Measurement Tools
- When creating a new Void Inspection Tool 81, the last Void Evaluation Settings will be applied to it.

All the settings are defining NG conditions for selected Void Inspection Tool 81.



Void Width in

If the width of a Void is in the defined range,

- The Image is NG.
- The Void Inspection Tool is NG.
- The Void is marked as Defect Color 44.
- The Tool border is marked as Defect Color 44.

Void height in

If the height of a Void is in the defined range,

- The Image is NG.
- The Void Inspection Tool is NG.
- The Void is marked as Defect Color 44.
- The Tool border is marked as Defect Color 44.

Void Area in

If the area of a Void is in the defined range,

- The Image is NG.
- The Void Inspection Tool is NG.
- The Void is marked as Defect Color 44.
- The Tool border is marked as Defect Color 44.

Void Dia. in

If the diameter of a Void is in the defined range,

- The Image is NG.
- The Void Inspection Tool is NG.
- The Void is marked as Defect Color 44.
- The Tool border is marked as Defect Color 44.

Total Voids Count in

If the total Voids count in selected ROI is in the defined range,

- The Image is NG.
- The Void Inspection Tool is NG.
- The Tool border is marked as Defect Color 44.

Biggest Void Area Ratio in

If the area ratio of the biggest Void of the Void Inspection Tool is in the defined range,

- The Image is NG.
- The Void Inspection Tool is NG.
- The biggest Void is marked as Defect Color 44.
- The Tool border is marked as Defect Color 44.

Biggest Void Dia. Ration in

If the diameter ratio of the biggest Void of the Void Inspection Tool is in the defined range,

- The Image is NG.
- The Void Inspection Tool is NG.
- The biggest Void is marked as Defect Color 44.
- The Tool border is marked as Defect Color 44.

Total Voids Area ratio in

If the area ratio of the total Voids of the Void Inspection Tool is in the defined range,

- The Image is NG.
- The Void Inspection Tool is NG.
- The Tool border is marked as Defect Color 44.

Total Voids Dia. ratio in

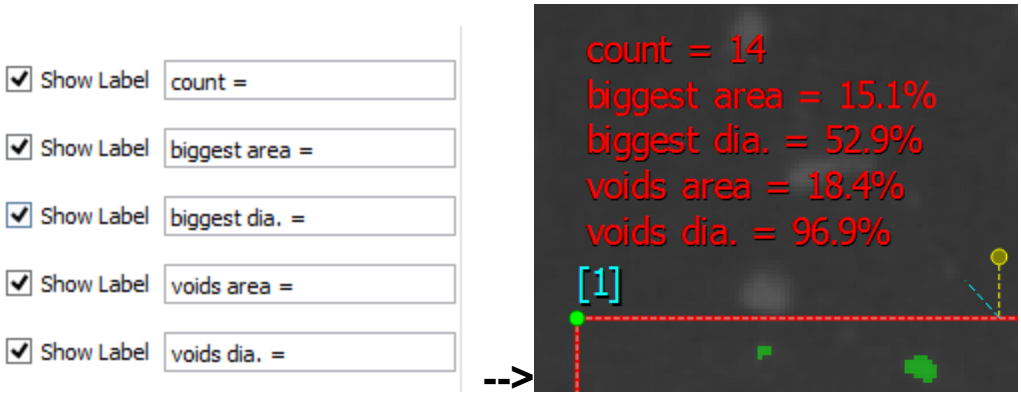
If the diameter ratio of the total Voids of the Void Inspection Tool is in the defined range,

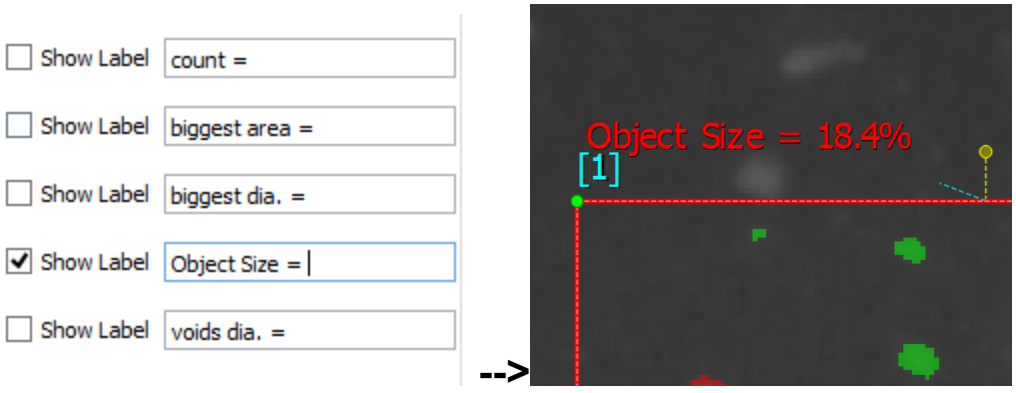
- The Image is NG.
- The Void Inspection Tool is NG.
- The Tool border is marked as Defect Color 44.

Show Label

Show the annotation prefix on MT's annotation area.

For example .





Create Template

Create a Template 63 with current displaying image.

Alignment

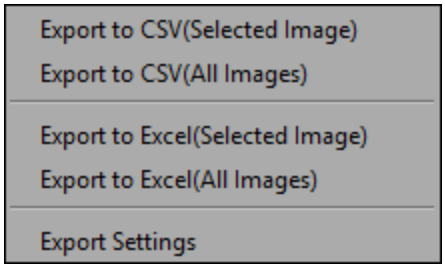
Show "Image Alignment" dialog. It only shows the Alignment settings for selected Template(s).

Restore Parameters

Restore Void inspection parameters of selected Measurement Tools as default.

Results

Export



- Export to CSV format (Selected Image)
  - will be abandoned
- Export to CSV format (All Images)
  - will be abandoned
- Export to Excel (Selected Image)
- Export to Excel (All Images)
- Export Settings
  - See "Export Settings 78" in dock "MT Info 77".

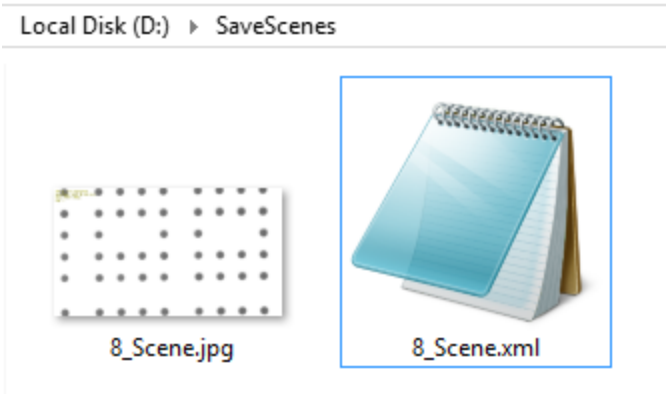
5 Get Start

5.1 General

5.1.1 Work-With Scenes

When user editing an image in HADI.

The current working scene can be saved as XML file. and the image also saved in the same name.

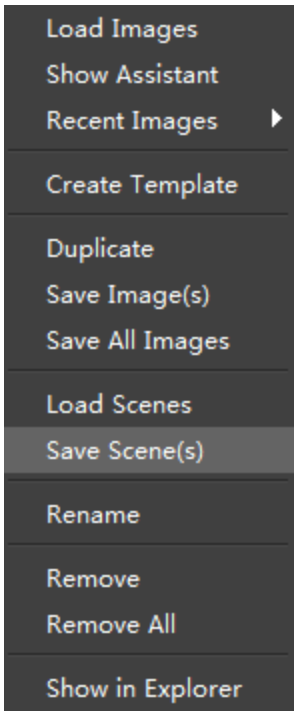


The XML file contains,

- Measurement Tools (position, color, pen etc.).
- All Parameters belong to the Measurement Tool.
- All Parameters belong to the Image.

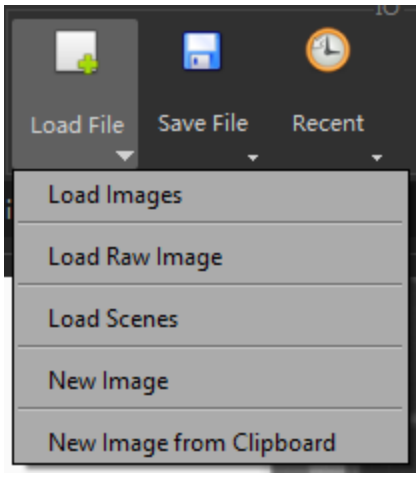
Save Scenes

- Click "FILE" -> "Save File" -> "Save Selected Scenes" or
- Click "FILE" -> "Save File" -> "Save All Scenes" or
- Right Click dock panel "Images" -> "Save Scene(s)"



Load Scenes

- Click "FILE" -> "Load File" -> "Load Selected Scenes" or
- Click "FILE" -> "Load File" -> "Load All Scenes" or
- Right Click dock panel "Images" -> "Load Scenes"

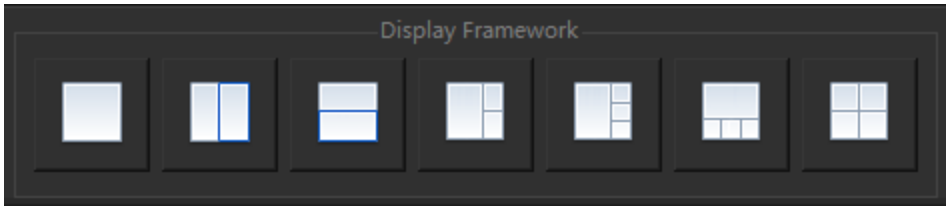


5.1.2 Multi-View Display

HADI support multiple view display, user can see two or more images at the same time.

By default, HADI shows only one view to display image.

Goto toolbar "VIEW" -> "Display Framework" to set the display framework to multiple view display.



 shows one view

 shows two vertical views

 shows two horizontal views

 shows one main view and two small views

 shows one main view and three small views vertically

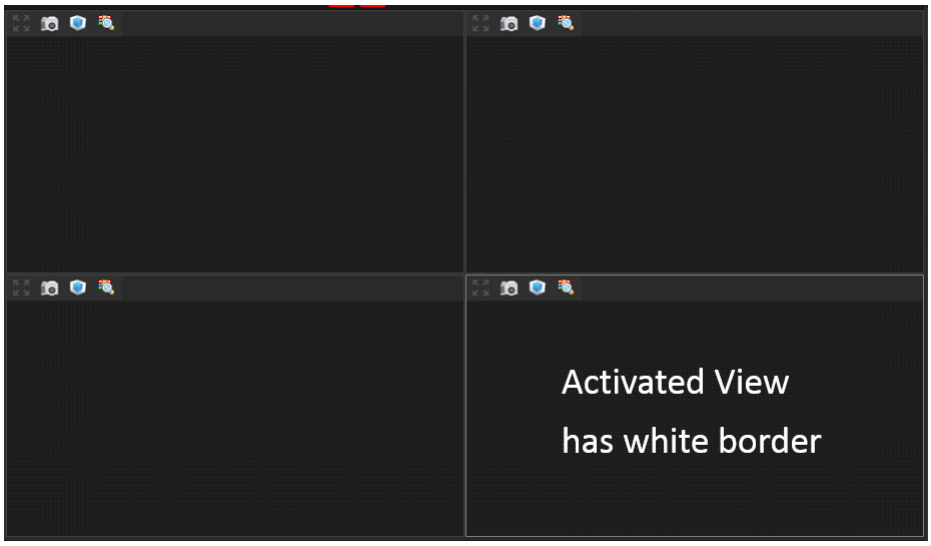
 shows one main view and three small views horizontally

 shows 4 views

Activated View

The activated view has a white border that different with other views.

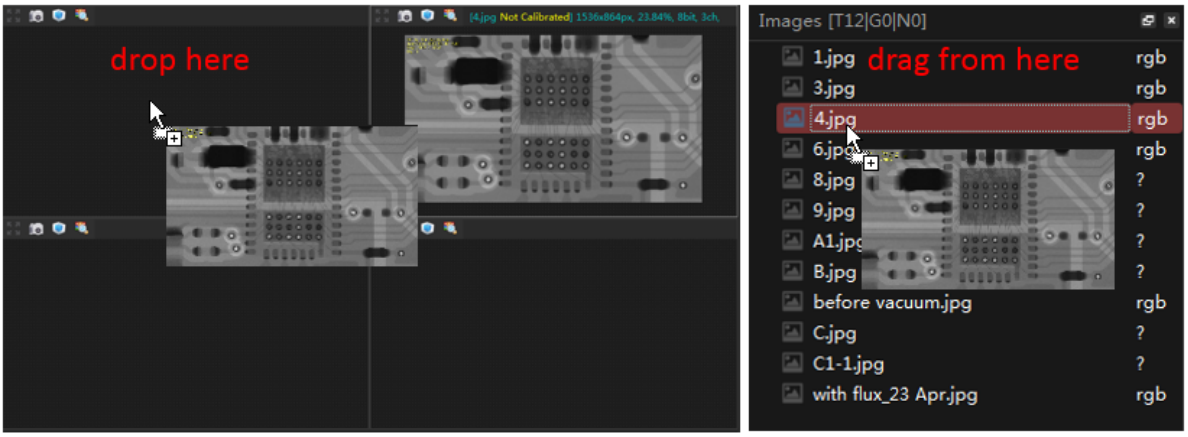
User can click on the view to active it.



How to show images in multiple view

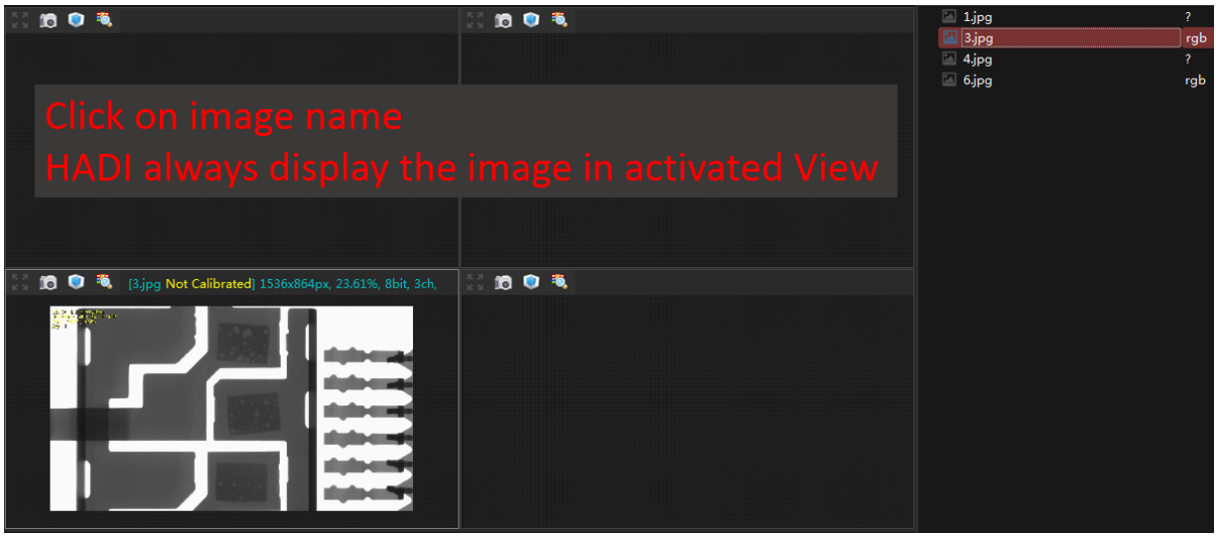
Method 1

- User can use Alt + Left Mouse to Drag image from dock panel "Images 74" into a view.



Method 2

- Active a view by click on the view first , then click on Image name, the image will be displayed to the activated view.

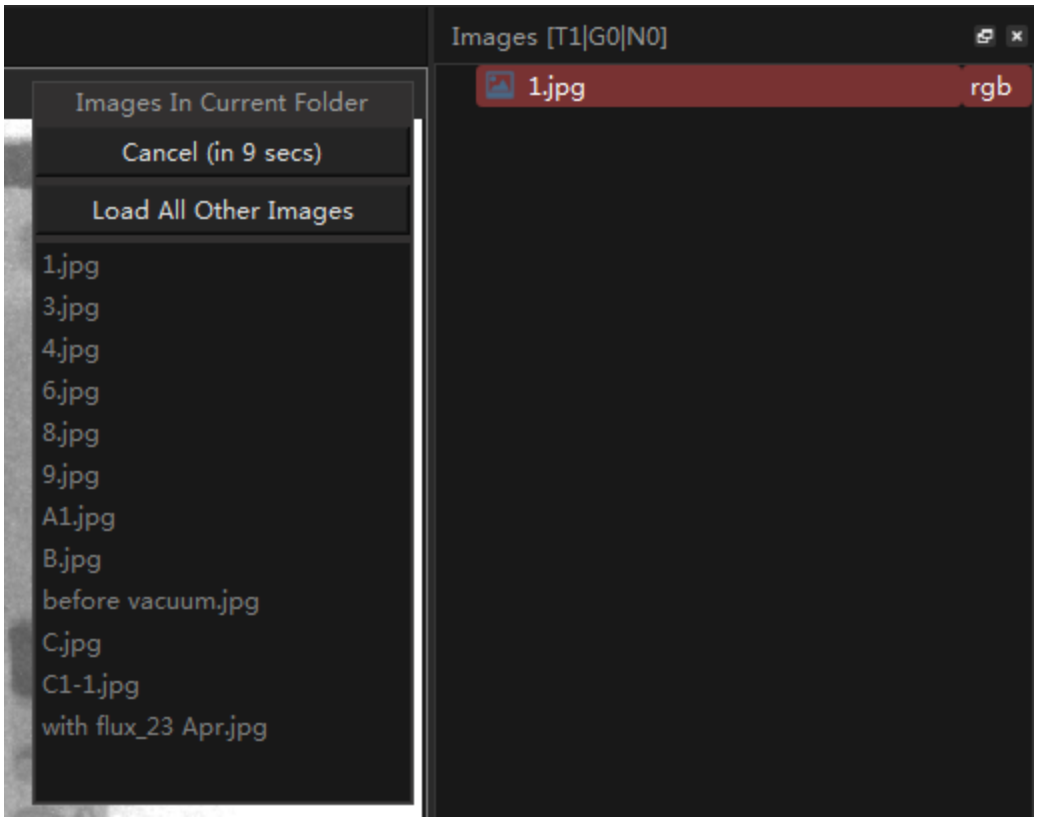


5.1.3 Image Loading Assist

When user load images into HADI, an Image Loading Assistant window pop-up.

It shows all image files in that directory, user can

- Cancel : ignore it.
- Load All Other Images : Load all image files in that directory to HADI, no duplicate loading.
- Click on an image name to load image: this loading is duplicate loading.



5.1.4 Exporting

HADI has following functions

- Save Images 14
- Save Working Scenes 14
- Capture Image 18
- Capture Screen 18
- Print Images 15
- Export Inspection Results as PDF 16
- Export Inspection Results as CSV/Excel 48

5.1.5 Supported File Form

- HADI supports loading PNG, XPM, JPG, BMP GIF, TIFF formats.
- The TIFF file can be 16-bit. 25
- HADI also support loading RAW files.
- HADI saves the working scene 49 as XML file. So user can also load XML scene files 49.

5.1.6 HADI Terminology

Name	Description
NG	Not Good, used in inspection and evaluation
GOOD	Good, used in inspection and evaluation
Void Inspection Tool	A Measurement Tool that the usage is Void Inspection 81.
Measurement Tool	HADI provided all tools are Measurement Tool, user can assign different usage 79 for MTs.
Closed-Shape MT	Tools like Circle, Rectangle, Polygon are closed-shape MTs 88.
Non-Closed-Shape MT	Tools like Angle, Line, Distance are non-closed-shape MTs 91.
Image Alignment	Alignment incoming image with specified Template. See "Image Alignment"

5.1.7 Improve Performance

User is able improve performance by settings.

Improve Image Alignment Speed

In "Alignment Settings 48" -> "General" -> "Set Alignment Speed".
Choose X4 means the image alignment speed is 4 times faster than original.
Choose X16 means the image alignment speed is 16 times faster than original.

In general, X4 is reasonable. Alignment two 1000x1000 image will take about 200 ms in i7 CPU.
If user choose X16, the alignment probably lose some accuracy.

Improve Inspection Speed

- Turn off the "Capture Resulting Image After Inspection" will improve inspection speed. (see below "Improve Memory Usage").
- Choose X16 for the image alignment. (see above "Improve Image Alignment Speed").

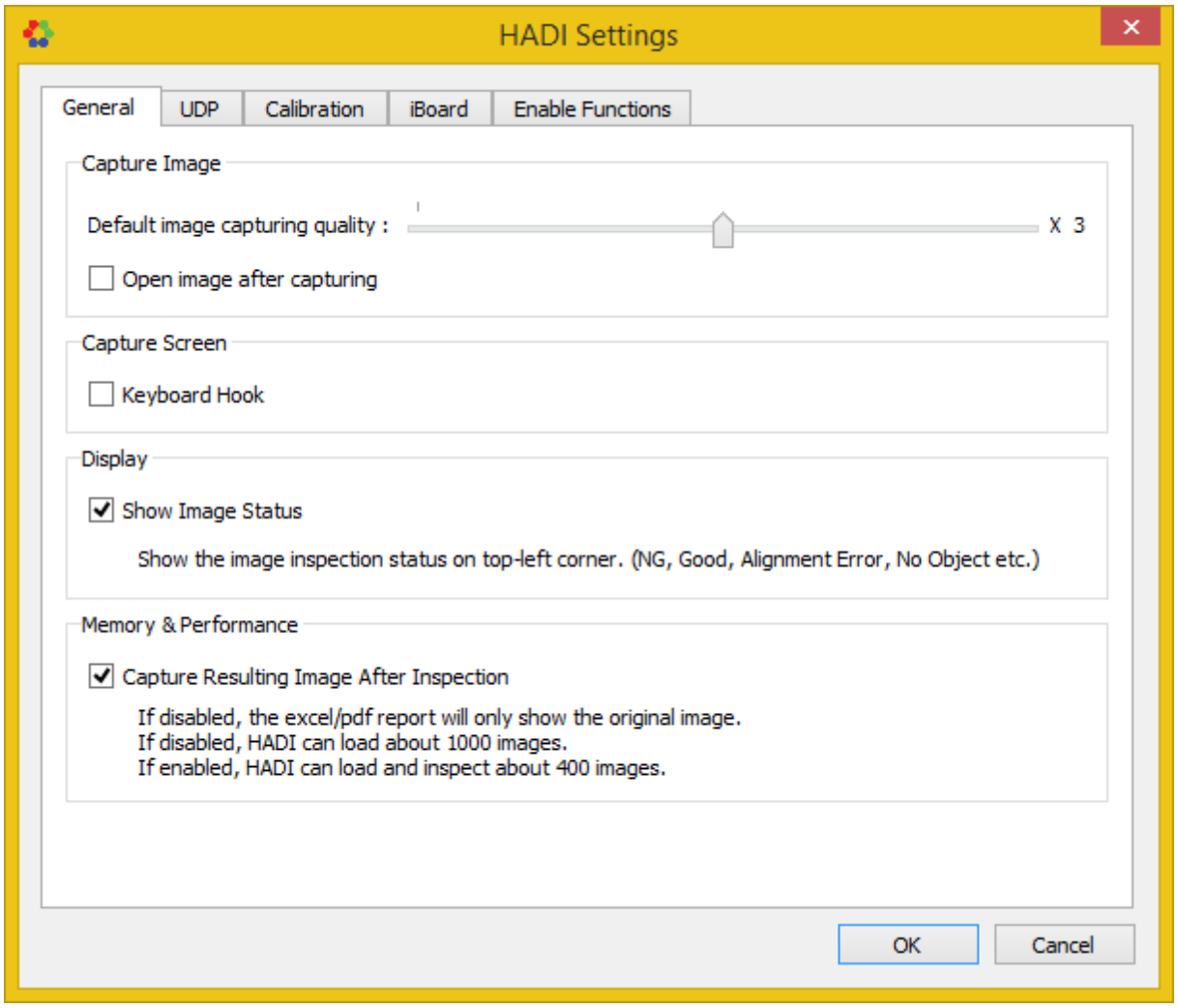
Improve Memory Usage

To generate report with inspected images. HADI keeps inspected image after inspection.

The image is 3 channel RGB image, so it takes huge memory.

User can turn it off by unchecking "Global Settings" -> "General" -> "Memory & Performance".

But, the reporting will no have inspected image, instead, the original image is contained. (This issue will be improved soon).



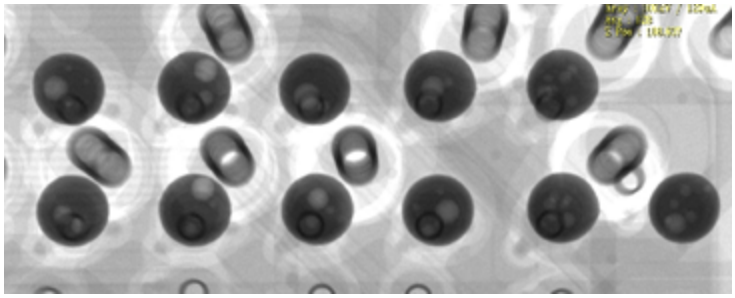
5.2 Automated and Template based Inspection

5.2.1 Automated BGA Inspection

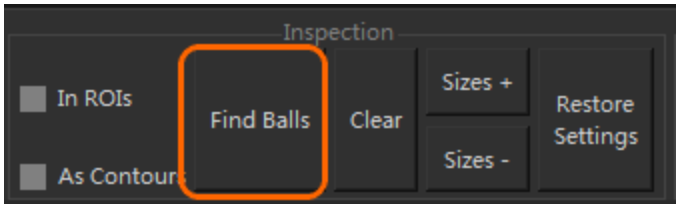
To find out BGA in a Image, user need to switch to toolbar "BGA DETECTION 38".

General BGA Detection Procedure

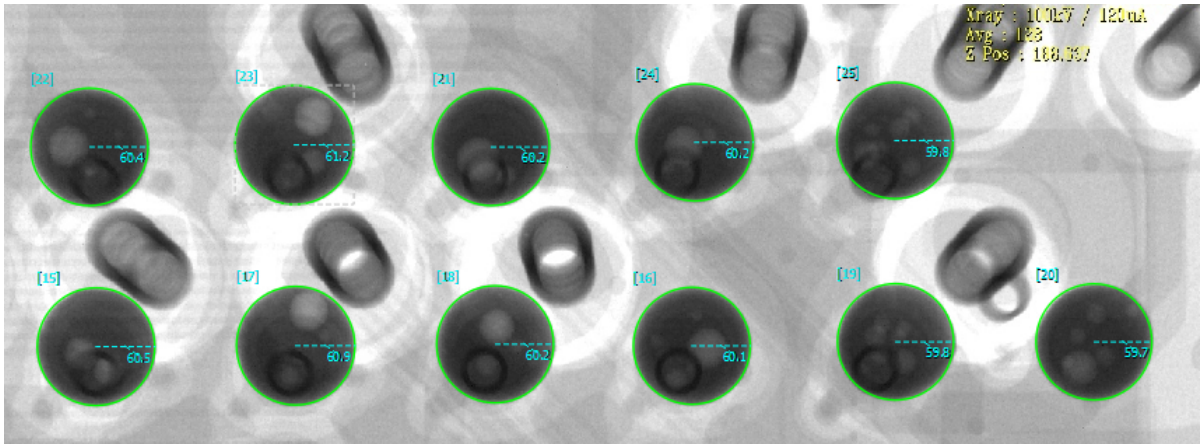
1. Load a BGA Image.



2. Click on "Find Balls" button.



In general, BGAs in the image will be detected and shows like following image.
Balls are shown as Circle MT 88, the ball radius is shown as a label.



If Failed...

Try following methods.

- **Reset Parameter**

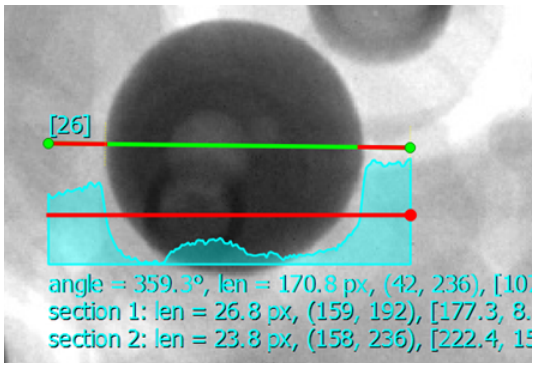
  Reset the BGA detection parameters, click "Restore Settings", and then "Find Balls" again.

- **Change Target Ball Sizes**

  If the Ball sizes are not located in the defined default range (15px ~ 80px), HADI will ignore the Ball.

  So defining a suitable Ball radius is very important.

User can measure the Ball radius by Line Tools 91



- **If the Ball is White**

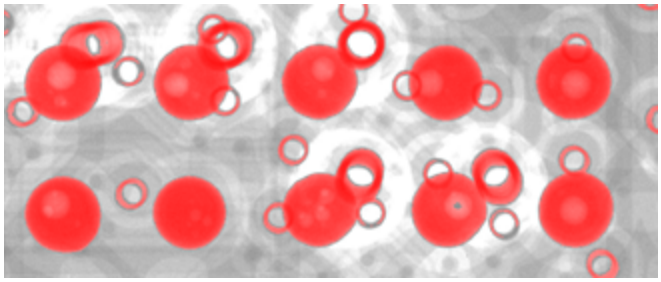
  HADI tries to find out dark Balls by default, in some cases, the Balls is white.
  User needs to check the "Invert Image" option is the ball is white

- **Use Fixed Threshold**

  HADI uses auto (adaptive) Thresholding segmentation to segment the Balls by default.
  If the background is very complex, the auto Thresholding probably doesn't work.

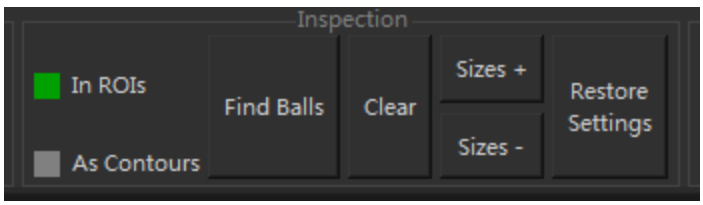
  User need to adjust the fixed Thresholding value to show the segmentation overlay to make sure the segmentation is correct.

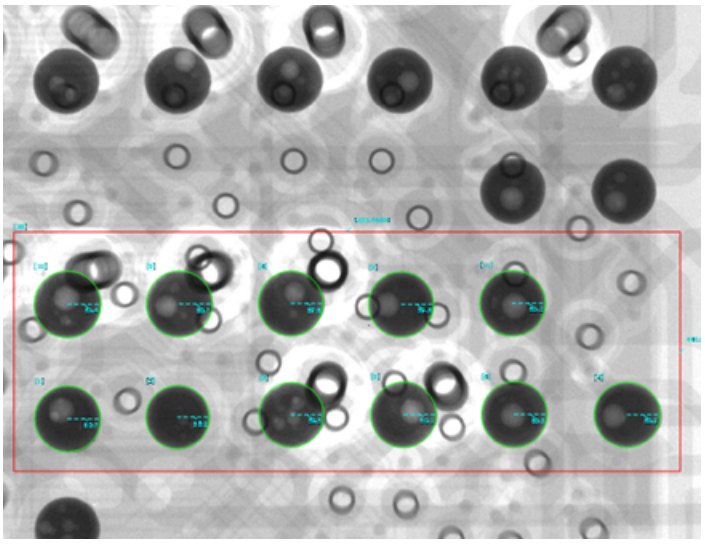
  When tuning the Thresholding value, HADI shows the segmentation overlay.



- **Try find Balls in ROIs**

  Put a Rectangle Tool, and set the usage as "Tool3 (BGA Detection) 81".
  HADI will find out Balls only inside the ROI.
  User can put more ROIs to find Balls.

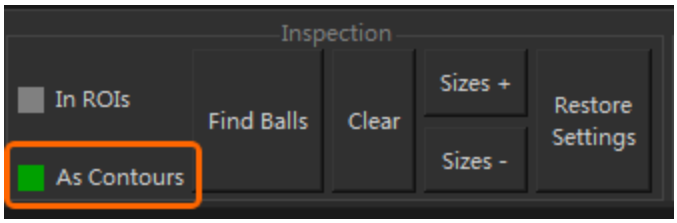


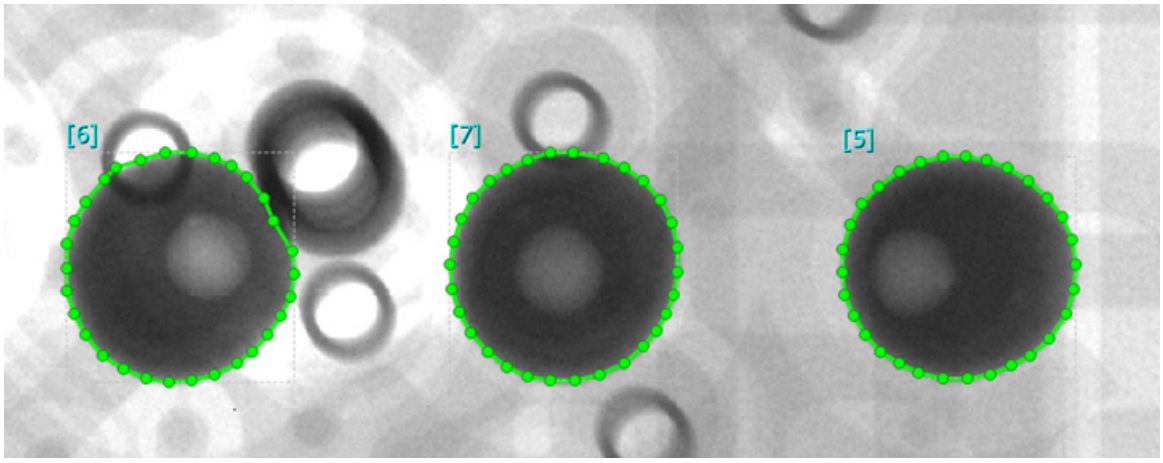


Ball Representations

HADI can display Balls by Circle Tool or by Polygon Tool.

If "As Contours" is checked. HADI will shows the Balls by Polygon Tool.

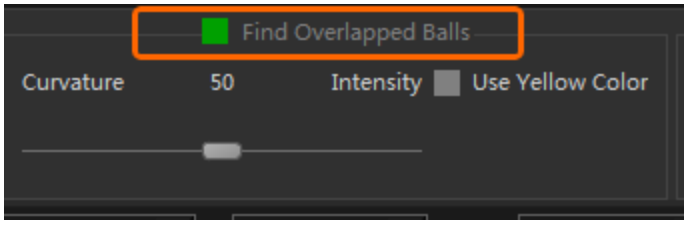


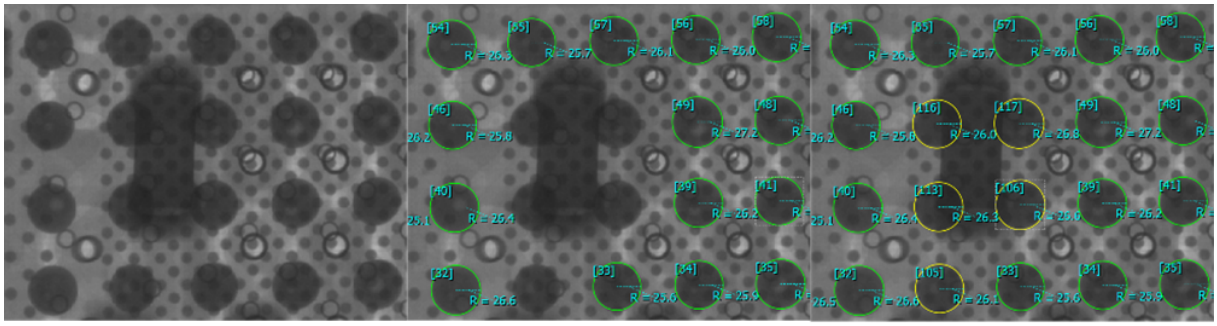


Advanced BGA Detection

Find Overlapped Balls

Check the option "Find Overlapped Balls", HADI will try to find overlapped Balls.

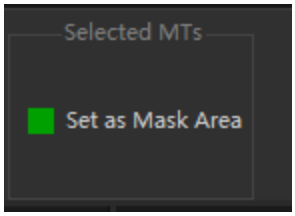


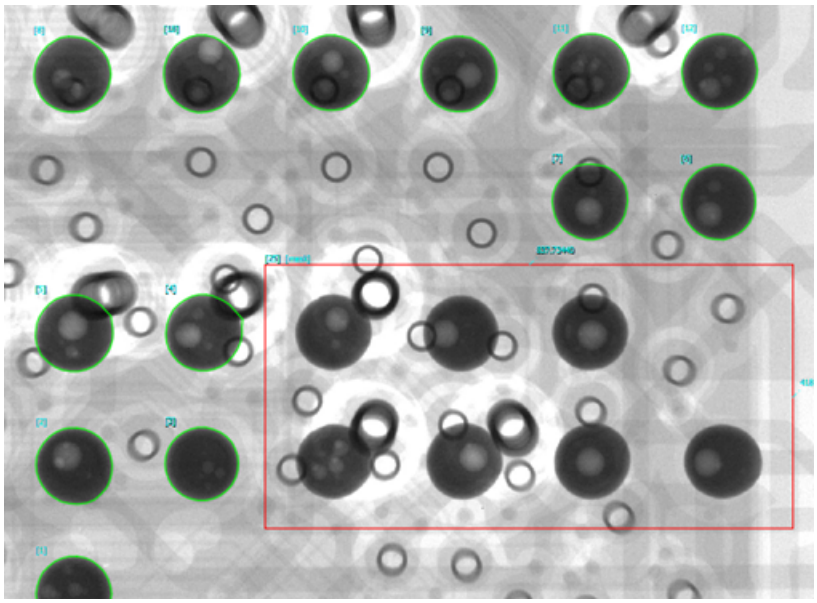


1. Original Image 2. Find Isolated Balls 3. Find Isolated and Overlapped Balls

Set Mask Area

Put a Rectangle tool and set as Mask Area.
HADI will not find Balls inside the mask area.



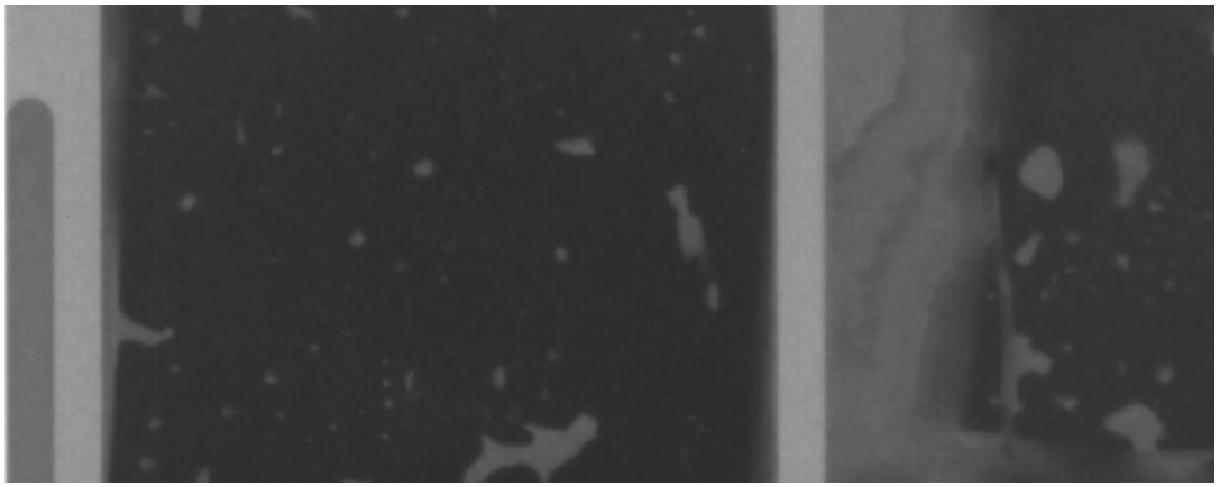


5.2.2 Automated Void Inspection

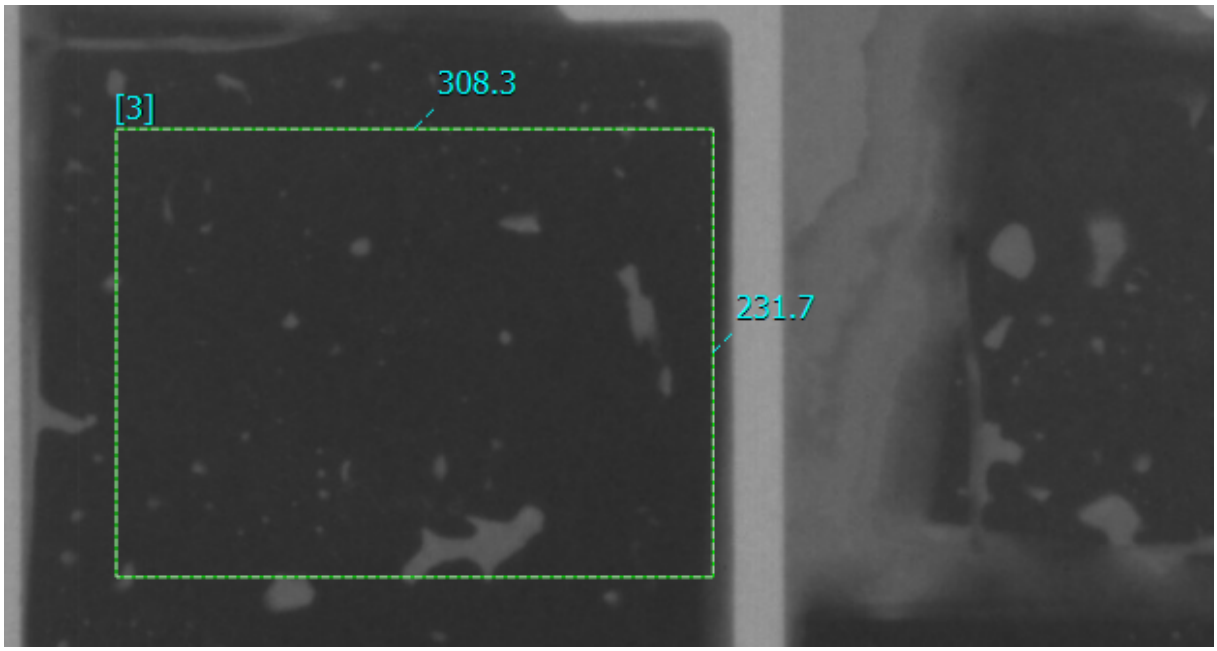
To do Void Inspection in a image, user needs to switch to "VOID INSPECTION 41"

General Void Inspection Procedure

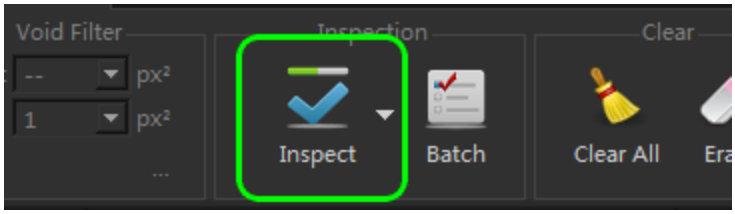
1. Load an Image



2. Put a closed-shape 88 MT on the Image



3. Click button Inspection



If Failed...

First, make sure you are adjusting parameters with **SELECTED** Measurement Tools.

1. Check the tool is closed-shape 88 or non-closed shape 91.
   HADI can only do Void Inspection in closed-shape MTs.

2. Check the tool's usage in dock panel "MT Usage 79"
   HADI can only do Void Inspection in tool with usage "Tool2 (Void Inspection) 81"

3. Check the Void Color
   If the Voids are white color comparing to background, make sure "Void is white" is checked.
   If the Voids are dark color comparing to background, make sure "Void is white" is unchecked.

4. Check the "Flatten BG 42" parameters.
   See "Background Processing" to know more about Flatten BG.

5. Check the "Thresholding 42" parameters.

6. Check the "Void Filter"

Void filters are calibration 18 enabled. So if the image is calibrated, make sure the Void filter doesn't remove everything.

Show Voids as Contour

Check the "Void Contour 44" option.

Void Evaluation

To decide a Void is defect or not, user needs to set the Evaluation parameters.

Click on "Evaluation 45" to show the evaluation settings for selected MTs.

Create a Template with Current Image

If all the inspection works well, the current image is ready to make a Template.

User can create a Template 63 by click on "Create Template 47".

Export Results

User can
1. Export PDF results by click "Report 16" button on toolbar "FILE 12".
2. Export Excel results by click "Export 48" menu on toolbar "VOID INSPECTION 41"

5.2.3 Create Template

Create a Template from an Image File

Method 1. Goto toolbar "VOID INSPECTION" -> "Create Template"
Method 2. Goto toolbar "PCB INSPECTION" -> "Create Template"
Method 3. Goto dock panel "Templates" -> right click to pop-up menu -> "New Template(s)"

Create a Template from Current Displaying Image

Method 1. Goto toolbar "PCB INSPECTION" -> "Create Template" menu -> "From Current Image"
Method 2. Goto dock panel "Templates" -> right click to pop-up menu -> "New Template(s) From Current"

5.2.4 Teach a Template

- **Show a Template**
- **Edit a Template**
- **Teaching Experience**
  - BGA Teaching
  - Void Inspection Tool Teaching

Show a Template

Double click on a Template item in dock panel "Templates 71" will show that Template.

Edit a Template

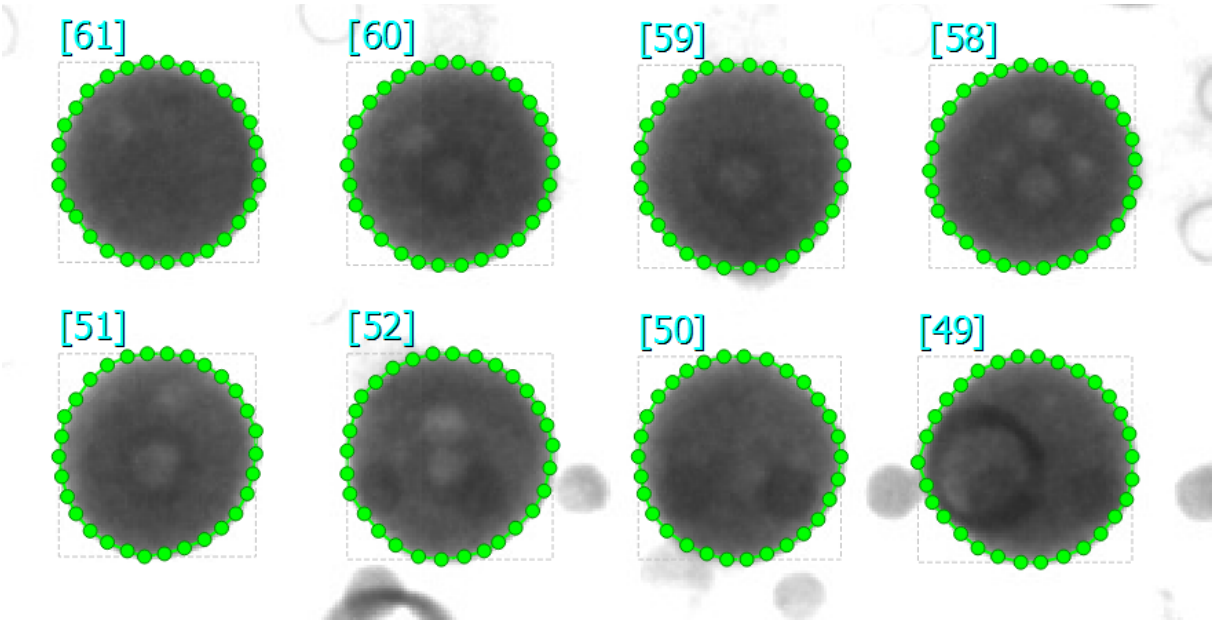
User can put Measurement Tools and tuning parameters directly on the Template.

Each action on the Template will be automatically saved.

Teaching Experience

BGA Teaching

Circles or Polygons should be exatly match the Ball



Void Inspection Tool Teaching

Free teaching

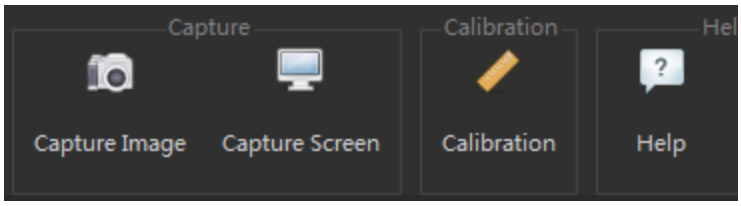
5.2.5 Image Calibration

Image Calibration is trying to make connection between Pixel Size and Real World Size.

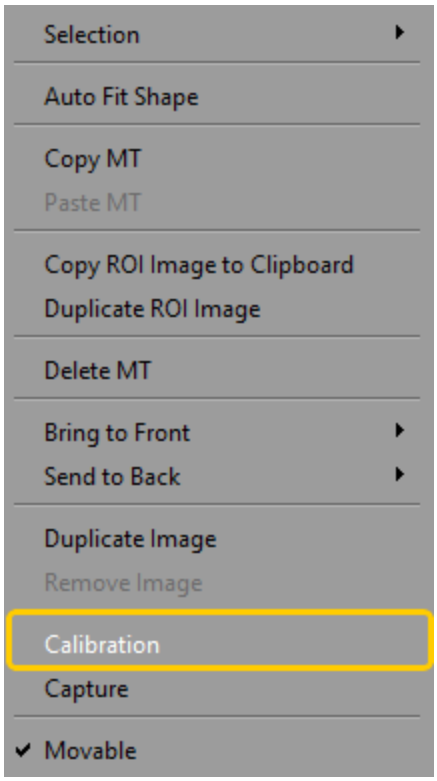
Open Calibration Window

To do calibration for a loaded image user can

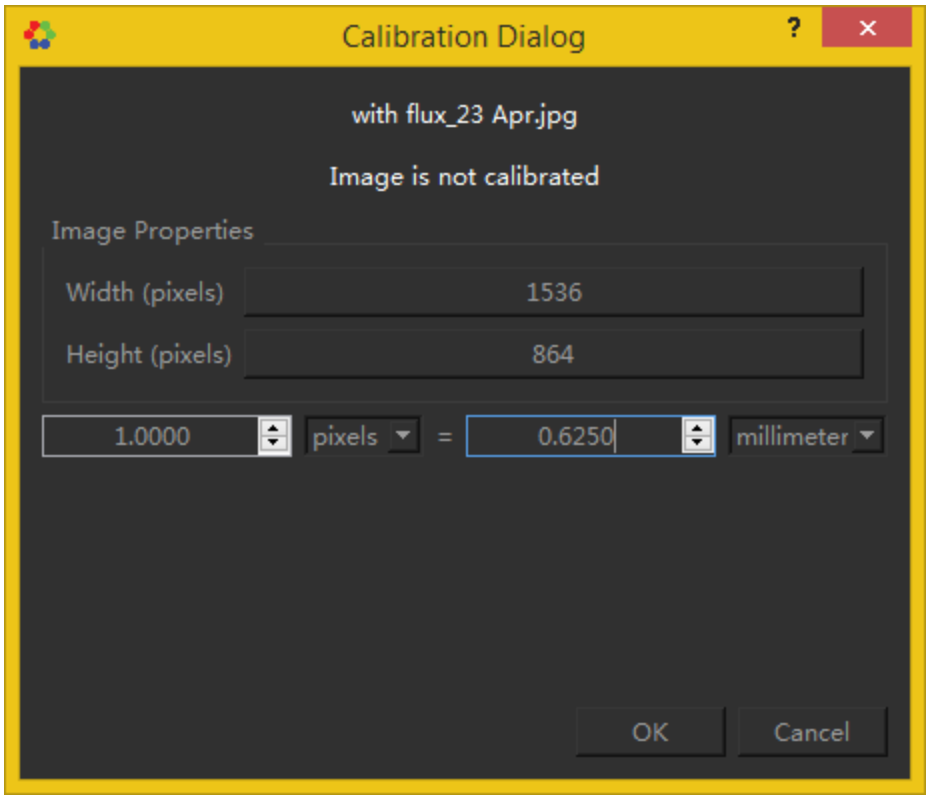
- Click "Calibration" button on toolbar "FILE"



- Click "Calibration" item on right menu of View.



the calibration window will be pop-up.



- If user right click on Image, the calibration window shows the image properties.
- If user right click on Measurement Tool, the calibration window shows the MT properties.

User can edit how many pixels = how many mm etc. HADI support
- centimeter
- millimeter
- micrometer
- nanometer.

Remove Calibration Info

Set 1 pixel = 1 pixel, will remove the calibration information of an image.
or just set pixel = pixel is OK.

5.2.6 Inspection-Batch Processing Tool

HADI supports Batch Processing Tool to simulate X-Ray inline inspection.
From an image data-set, user can conveniently do batch processing in HADI.

To do batch inspection, user needs to
1. Open Batch Processing Tool
2. Create a Configuration File
3. Match the image name with Template Name
4. Click Inspection.

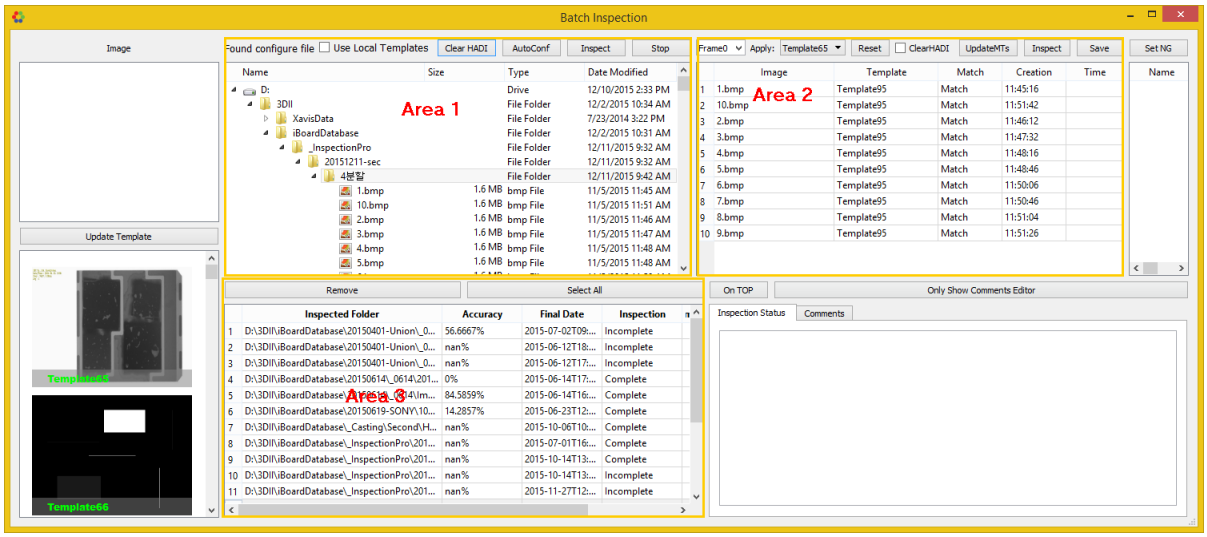
Open Batch Processing Tool

- **In HADI - Inspection Pro**

Click button "Batch" in toolbar "VOID INSPECTION"

- **In HADI - iBoard**

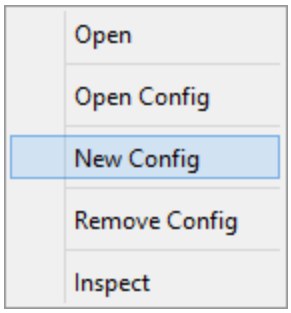
Click button "Batch" in toolbar "PCB INSPECTION"



Create a Configuration File

Suppose that user has created Template(s) to inspect a folder.

Right click on that folder, a context menu pop-up.



- **Open:** open the folder or image
- **Open Config:** the configuration file (the zoo.ini file in that folder)
- **New Config:** create a configuration file that match image name with Template name.
- **Remove Config:** remove the configuration file.
- **Inspect:** inspect the folder.

User needs to create a new config first to inspect the folder.
The configuration file saved in that folder and named as **zoo.ini**.
The configuration file contains a match relationship between image name and Template name.
When start inspection, HADI will load an image and find the right Template to do inspection.

The following figure shows

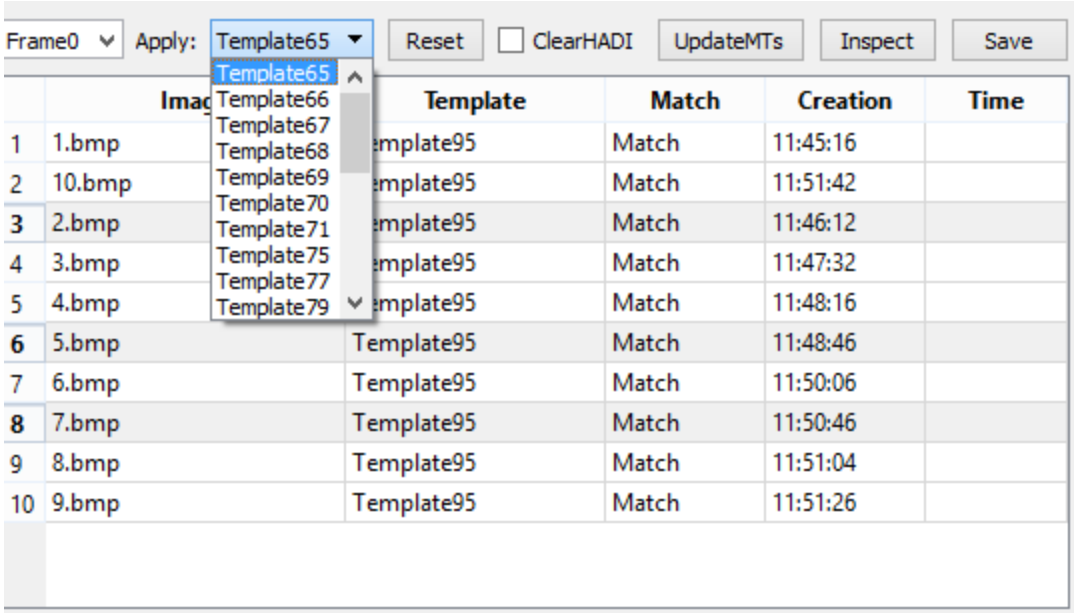
- the image 1.bmp will be inspected with Template95.
- the image 10.bmp will be inspected with Template95.
- the image 12.bmp will be inspected with Template95.

```
[1.bmp]
Template=Template95
Path=D:/3DII/iBoardDatabase/_InspectionPro/20151211-sec/4\xbd84\xd560
Chips=

[10.bmp]
Template=Template95
Path=D:/3DII/iBoardDatabase/_InspectionPro/20151211-sec/4\xbd84\xd560
Chips=

[2.bmp]
Template=Template95
Path=D:/3DII/iBoardDatabase/_InspectionPro/20151211-sec/4\xbd84\xd560
Chips=
```

Configuration file that matches image name and Template name.

Match the image name with Template Name

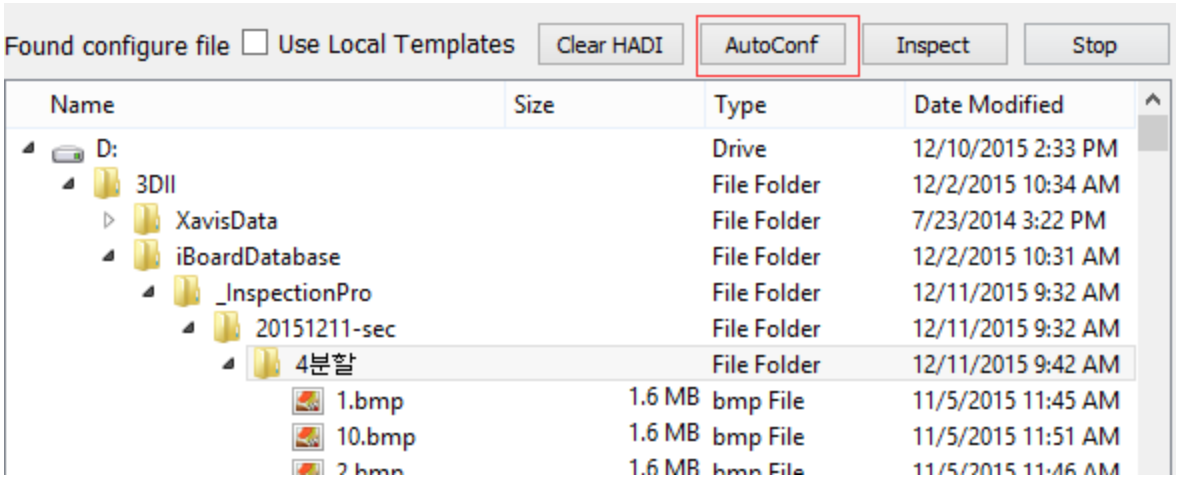
- User can manually select images in "Area 2" of Batch Processing Tool, and click the drop-down menu to set Templates.



- User can also use Auto Configuration method that automatically find out the match between image and Template.

If you have many Templates loaded in HADI, this process will be very slow.

So please try to unload non-necessary Templates when do Auto Configuration.



Click Inspection.

If the matching process between image name and Template name is complete.

- User can click "Inspect" in Area 1 to do inspection in whole folder.
- User can also click "Inspect" in Area 2 to do inspection with selected image items.

Others

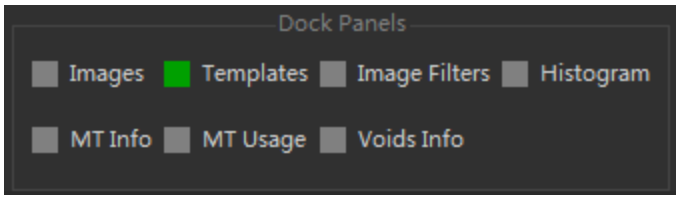
...

5.3 Dock Panels

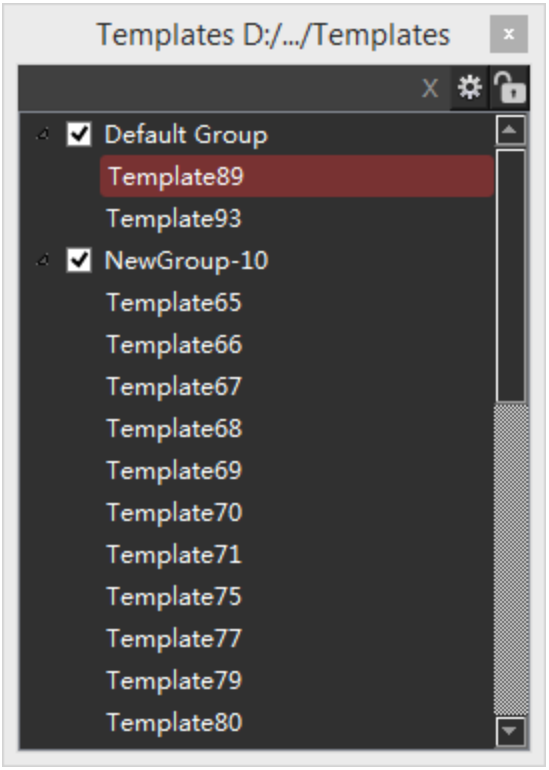
5.3.1 Templates

Show Templates Dock Panel

To display the Templates dock panel, user needs to check the item "Templates" on Toolbar "VIEW".

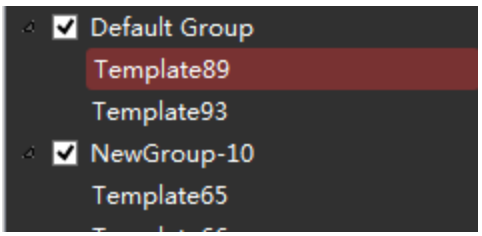


By default, the Templates dock panel appears on the bottom-right corner of HADI window.



UI Elements and Mouse Behavious

- **Search Window :** search template by keyword text.
- **Clear Search Text :** clear text.
- **Settings :** Template path settings.
- **Lock :** lock/unlock Template management, the default password is "3DII".

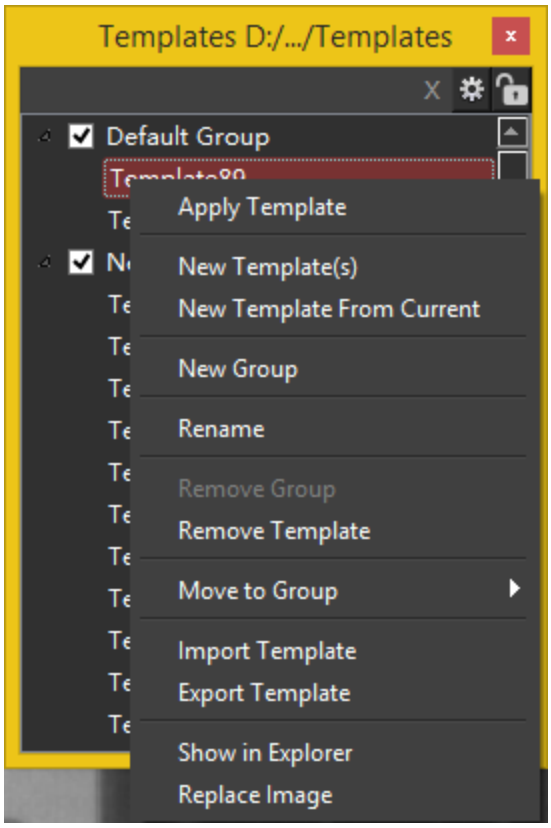


- **Grouping checked :** HADI will load all Templates in that group after restart.

- **Grouping unchecked :** HADI will not load Templates in that group after restart.
- **Mouse on Template :** Single click to select a Template, Double click to display a Template.

Context Menu

Right click on Templates dock panel, the context menu appears.



- **Apply Template**

  Apply Template to current display Image.

  Note: Do not apply Template to itself, or else, you will have duplicated MTs.

- **New Template**

  Create a Template by loading a new image from disk.

- **New Template From Current**

Create a Template from current displaying image, all the MTs and parameters will be copied.

- **New Group**

  Create a new group.

- **Rename**

  Rename a group or a Template

- **Remove Template**

  Remove selected Template(s), or remove selected group.

- **Move to Group**

  Move selected Template(s) to other group.

- **Import Template**

  Import Template(s) (XML file) into HADI. The Template will be copied to current Template directory.

- **Export Template**

  Export Template(s) into disk.

- **Show in Explorer**

  Show the Template in window explorer.

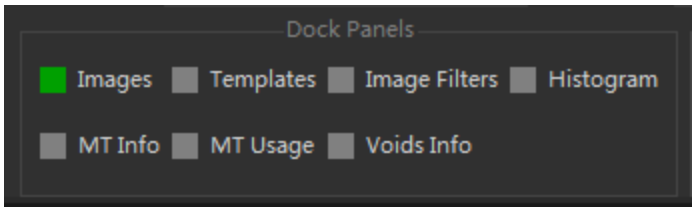
- **Replace Image**

  Replace Template image with new loading image.

5.3.2 Images

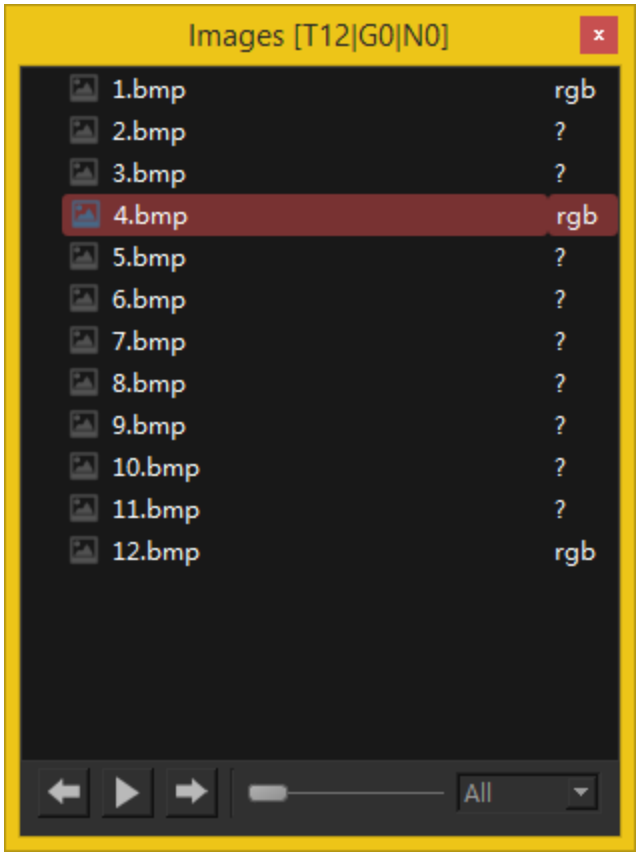
Show Images Dock Panel

To display the Images dock panel, user needs to check the item "Images" on Toolbar "VIEW".



If an image is loaded but never showed, HADI will not initialize it to save memory 55.

- For the uninitialized images, HADI shows the format as "?" in the second column of Images dock pane.
- For the initialized images, HADI shows the image format 54 like "rgb", "rgba", "8u" etc.



UI Elements and Mouse Behaviors

- **Title :** T = Total Image Count, G = Good Image Count, N = NG Image Count
- **Red Item :** shows selected Item. Single click on image item, the image will be displayed in the main view.
- **First Column :** shows the image display name.

- **Second Column :** shows the image format 54.
- **Click-Drag :** multiple selection.
- **Alt + Click-Drag :** drag image into different view 50.
- **Ctrl + Click :** select multiple images.
- **Shift + Click :** select multiple images.

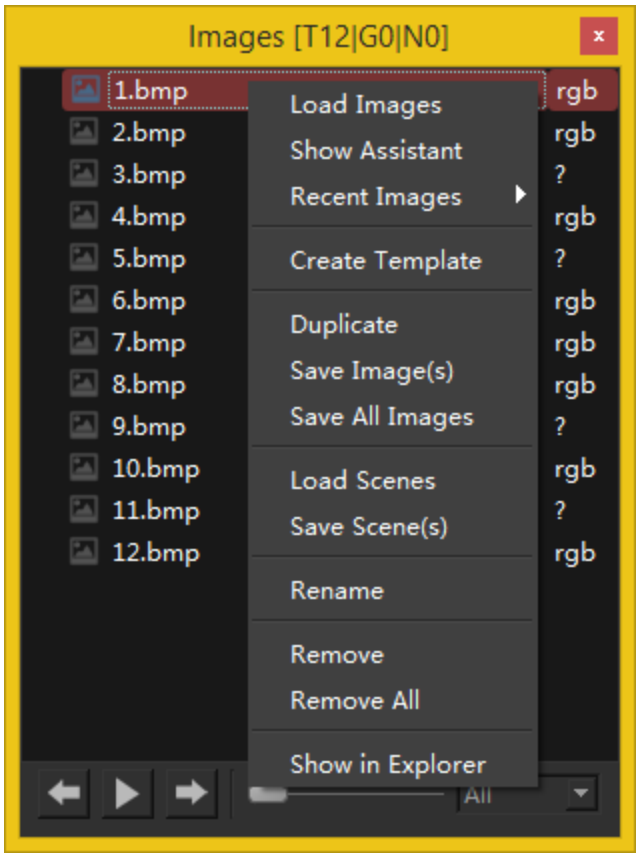
Bottom Toolbar

1. Click to show previous image.
2. Click to play image, the slider bar represents the interval time.
3. Click to show next image.
4. Set the interval time when playing image.
5. Set play "All Images", or "Good Images", or "NG Images".

Context Menu

Right click on Images dock panel, the context menu will be pop-up.

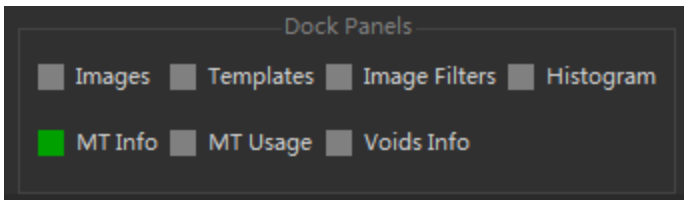
- **Load Images :** load images.
- **Show Assistant :** show the image loading assistant 53.
- **Recent Images :** load recent images or directories.
- **Create Template :** create a Template 63 from selected image.
- **Duplicate :** make a copy of selected image(s).
- **Save Image(s) :** save selected image(s).
- **Save All Images :** save all images.
- **Load Scenes :** load a working scene 49.
- **Save Scene(s) :** save selected images as scenes 49, individually.
- **Rename :** rename current displaying name.
- **Remove :** remove selected image(s) from HADI.
- **Remove All :** remove all images from HADI.
- **Show in Explorer :** show disk path of selected image.



5.3.3 MT-Info

Show MT Info Dock Panel

To display the MT Info dock panel, user needs to check the item "MT Info" on Toolbar "VIEW".



The MT Info shows the information and properties of Measurement Tools 87 in the current displaying image of main view 50,

The column,

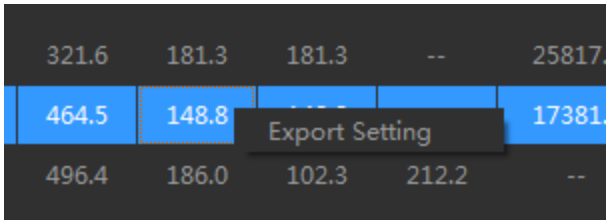
- **ID :** shows the Measurement Tool ID.
- **Type :** shows the Measurement Tool Type.
- **Usage :** shows the usage of a Measurement Tool 79.
- **Name :** shows the name of a Measurement Tool.
- **X :** shows the left position of a Measurement Tool on the image.
- **Y :** shows the top position of a Measurement Tool on the image.
- **W :** shows the width of a Measurement Tool.
- **H :** shows the height of a Measurement Tool.
- **Len :** shows the length of a non-closed-shape Measurement Tool.
- **Area :** shows the area of a closed-shape Measurement Tool
- **V. Area :** shows the total void area ratio 63 of a MT (Measurement Tool).
- **V. Dia** 61**. :** shows the total diameter ratio 63 of a MT.
- **V. Count :** shows the void count of a MT.
- **Status :** shows the evaluation status 63 of a MT (Good = "Good", NG = "NG", Pending = "Not Inspected", -- = "Not Inspectable").
- **Comments :** shows additional comments (or properties) of a MT. (e.g. Starting point and Ending point of a Line Tool)

Measurement Tools (in before vacuum.jpg)

ID	Type	Name	X(px)	Y(px)	W(px)	H(px)	Len(px)	Area(px²)	V. Area(%)	V. Dia.(%)	V. Count	Status	Comments
1	Rectangle		400.4	359.7	232.5	182.8	--	42487.1	8.9	60.0	6	NG	NG Definition: Width(10px~10...
2	Circle		188.9	321.6	181.3	181.3	--	25817.2	13.8	109.2	4	NG	NG Definition: Width(10px~10...
3	Circle_Cen...		29.6	464.5	148.8	148.8	--	17381.2	0.0	0.0	0	Good	NG Definition: Width(10px~10...
4	Line		198.4	496.4	186.0	102.3	212.2	--	--	--	--	--	Start Point (198.4,496.4), End P...
5	Horizontal...		663.7	502.2	221.6	0.0	221.6	--	--	--	--	--	Start Point (663.7,502.2), End P...
6	Chord		693.3	392.5	110.0	110.0	--	4753.8	0.2	0.0	2	Good	NG Definition: Width(10px~10...

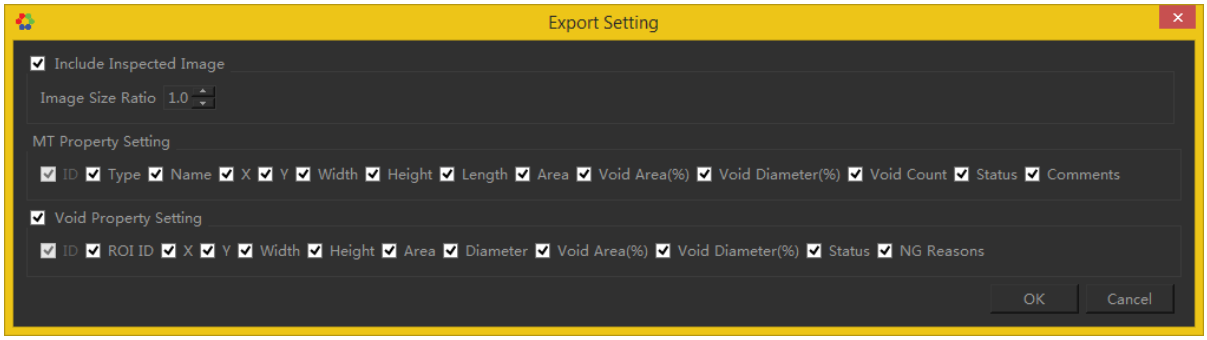
Export Settings

Right click on MT Info dock panel, the export settings pop-up.



The Export Settings has following options:

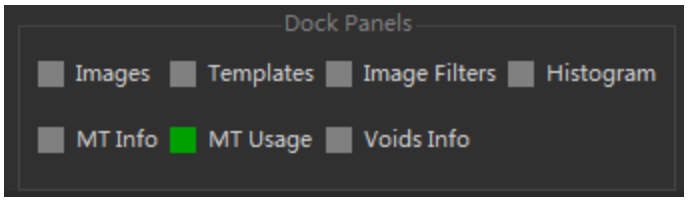
- **Include Inspected Image :** include the inspected image screenshot in the exporting file 54
- **MT Property Settings :** check/uncheck to show/hide columns of MT Info.
- **Void Property Settings :** check/uncheck to show/hide columns of Void Info 83.

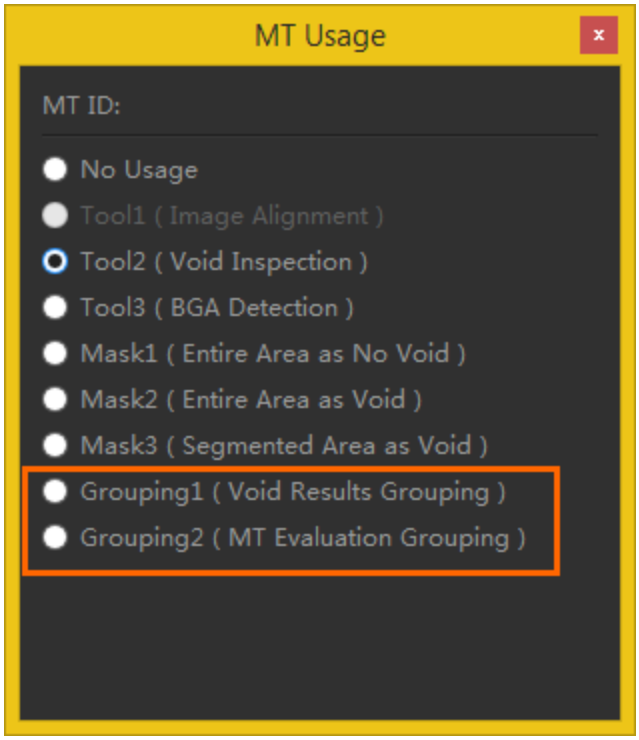


5.3.4 MT-Usage

Show MT Usage Dock Panel

To display the MT Usage dock panel, user needs to check the item "MT Usage" on Toolbar "VIEW".





When create a MT 87 from Measurement Tool panel, by default it is

- "Void Inspection Tool 61" for closed-shape MT 88.
- "No Usage" for non-closed-shape MT 91.

MT Usages

HADI support various MT usages for different products 6,

- **No Usage**

  No usage assigned to MT. Most non-closed-shape MT has no usage. User can also set closed-shape MT as no usage.

- **Tool1 (Image Alignment)**

  Set selected MT as image alignment tool.

  By default, HADI usage whole image information when doing the image alignment. It takes about 300ms for the image resolution size 1000x1000 .

  In some cases, if the image resolution is pretty high, user probably want to only use a certain area as alignment area to improve performance 55.

  Therefore, user can set a Rectangle Tool 90 as an alignment tool for a Template.

  Notice that,

  - The tool size should not be too small. it needs as much information to do image alignment.
  - One image can only has one image alignment tool. If you create more, the image alignment result is unexpected.

- **Tool2 (Void Inspection)**

  Set selected MT as Void Inspection 61 tool, the MT should be closed-shape 88 MT.

- **Tool3 (BGA Detection)**

  Set selected MT as BGA Detection 56 tool, the MT should be closed-shape 88 MT.

- **Mask1 (Entire Area as No Void)**

  Set entire area of selected MT as No Void area. see Mask Tools.

- **Mask2 (Entire Area as Void)**

  Set entire area of selected MT as Void area. see Mask Tools.

- **Mask3 (Segmented Area as Void)**

  Set segmented area of selected MT as Void area. see Mask Tools.

- **Mask4 (X-Ray Attenuation Mask)**

  Set selected MT as X-Ray Attenuation Mask. see Mask Tools.

- **Grouping1 (Void Results Grouping)**

  Set selected MT as Void Results grouping tool. see MT Grouping.

- **Grouping2 (MT Evaluation Grouping)**

  Set selected MT as MT Evaluation grouping tool. see MT Grouping.

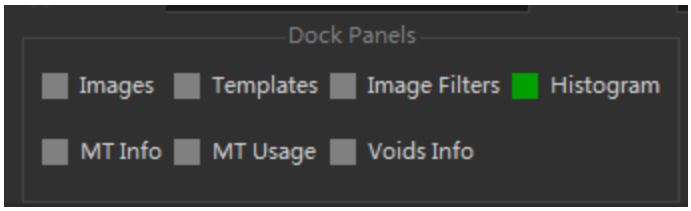
- **Grouping3 (PCB Evaluation Grouping)**

  Set selected MT as PCB Evaluation grouping tool. see MT Grouping.

5.3.5 Histogram

Show Histogram Dock Panel

To display the Histogram dock panel, user needs to check the item "Histogram" on Toolbar "VIEW".



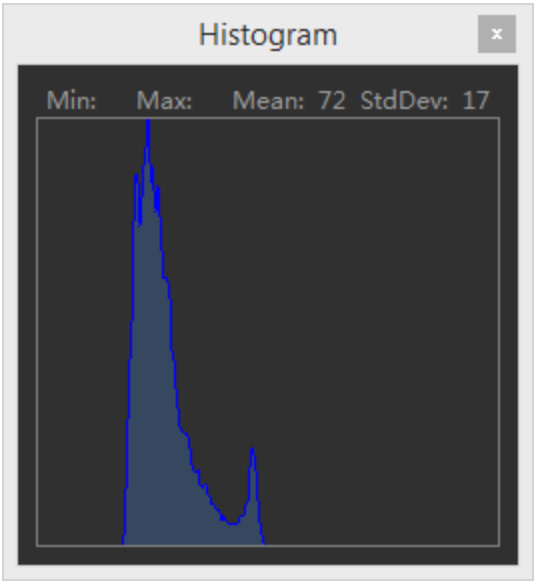
Histogram and Profile

The Histogram appears in the bottom-right corner of HADI main window.

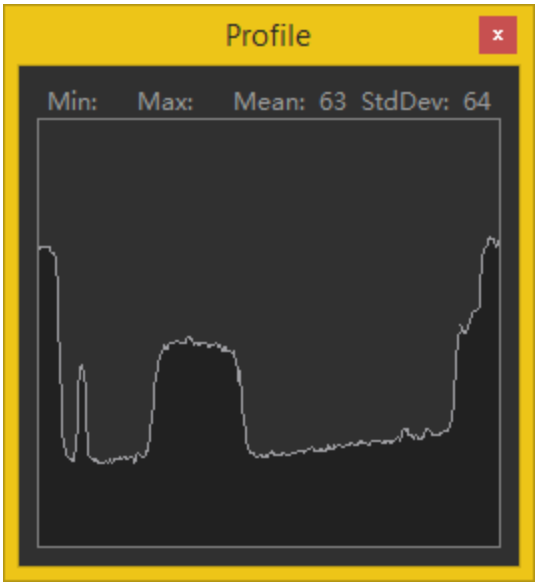
The Histogram dock panel shows the histogram of

- current selected ROI if it is closed shape.
- current image if there is no ROI selected.

The upper label shows the minimum value, maximum value, mean value and standard deviation of current image area of ROI.



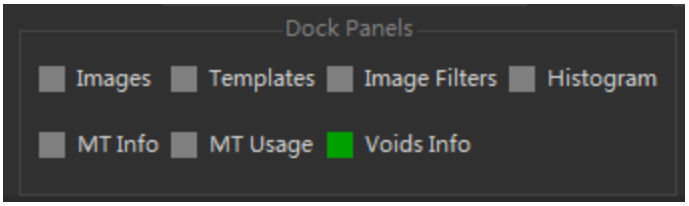
For non-closed-shape MTs like Line, Vertical Line, Horizontal Line etc., it shows the profile of it.



5.3.6 Voids

Show Voids Dock Panel

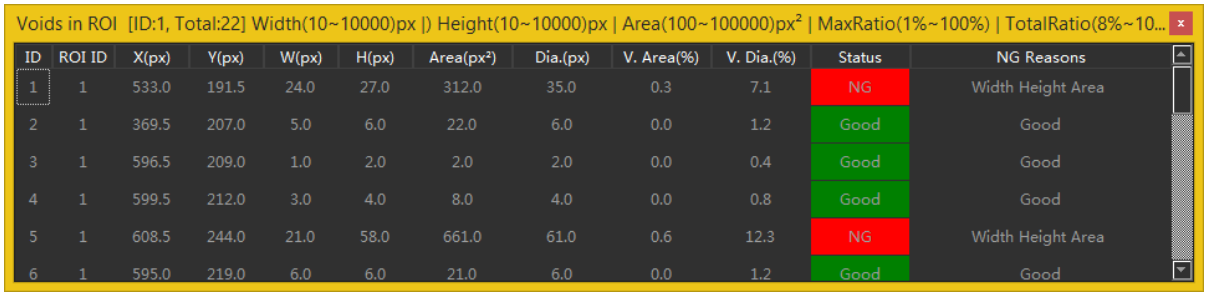
To display the Voids dock panel, user needs to check the item "Voids" on Toolbar "VIEW".



The Voids dock panel shows the properties of Voids in selected Measurement Tool 87 (ROI).

Dock Panel Title: the title shows the selected ROI ID and the Evaluation Definition 63 of the ROI

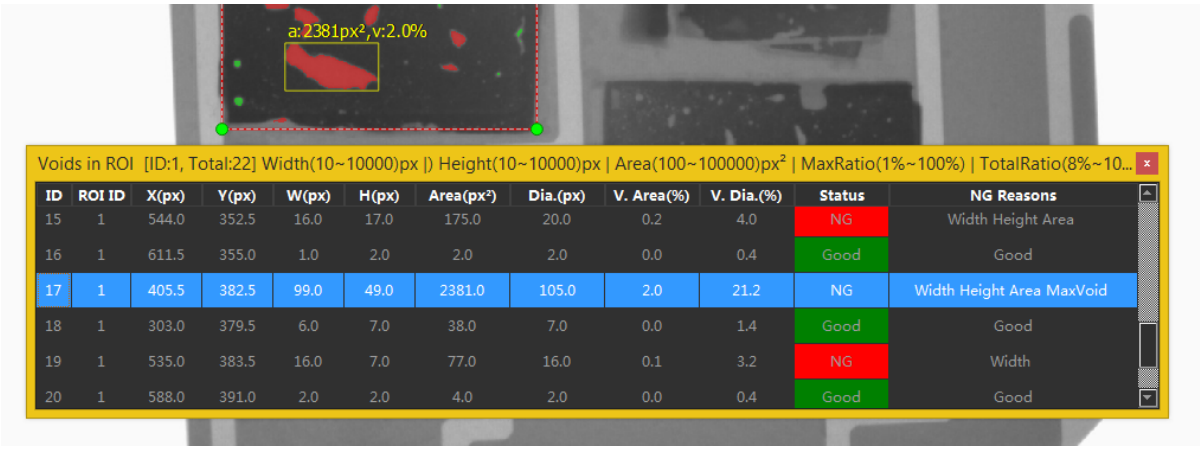
- **ID :** shows the ID of a Void.
- **ROI ID** : shows the ID of ROI which a Void belong to.
- **X :** shows the left position of a Void.
- **Y :** shows the top position of a Void.
- **W :** shows width of a Void.
- **H :** shows the height of a Void.
- **Area :** shows the Void Area.
- **Dia. :** shows the Void Diameter 61.
- **V.Area :** shows the Void Area Ratio.
- **V.Dia :** shows the Void Diameter Ratio.
- **Status:** shows the Void evaluation status after inspection.
- **NG Reasons:** shows the NG reasons if its evaluation is NG.



ID	ROI ID	X(px)	Y(px)	W(px)	H(px)	Area(px²)	Dia.(px)	V. Area(%)	V. Dia.(%)	Status	NG Reasons
1	1	533.0	191.5	24.0	27.0	312.0	35.0	0.3	7.1	NG	Width Height Area
2	1	369.5	207.0	5.0	6.0	22.0	6.0	0.0	1.2	Good	Good
3	1	596.5	209.0	1.0	2.0	2.0	2.0	0.0	0.4	Good	Good
4	1	599.5	212.0	3.0	4.0	8.0	4.0	0.0	0.8	Good	Good
5	1	608.5	244.0	21.0	58.0	661.0	61.0	0.6	12.3	NG	Width Height Area
6	1	595.0	219.0	6.0	6.0	21.0	6.0	0.0	1.2	Good	Good

Mouse Selection

- Mouse click on any cell, the row will be selected, and the Void on displaying image will also be selected.



- If mouse click on any Void on displaying image, the row in Voids dock panel will also be selected.

- it also supports multiple selection.

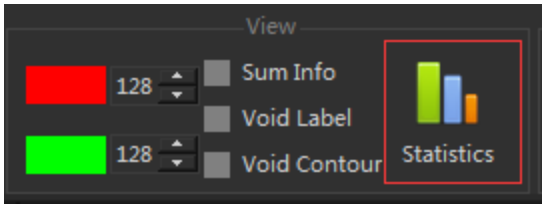
Export Settings

See "Export Settings 78" in dock "MT Info 77".

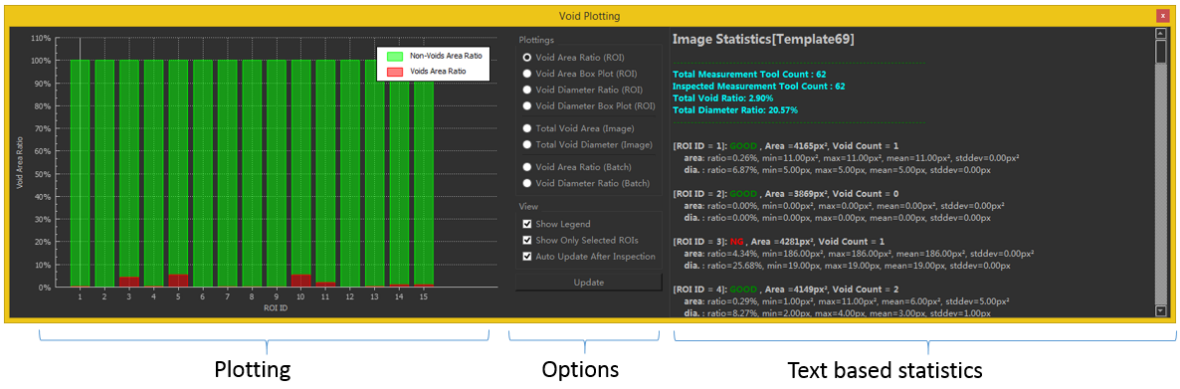
5.3.7 Void-Statistics

Show Void Statistics Plotting Dock Panel

To display the Void Statistics Plotting dock panel, user needs to click button "Statistics" on Toolbar "VOID INSPECTION".



The Void Statistics Plotting dock panel will be shown as following



It supports various plotting graphs:

Void Area Ratio Bar Plot (ROI Based)

- This option will plot the Void area ratio for each ROI
- X-Axis shows the ROI ID
- Y-Axis shows the void ratio
  - Void ratio using red bar area.

- Non-Void ratio using the green bar area.
- Void ratio + Non-Void ratio = 100%

5.4 Measurements

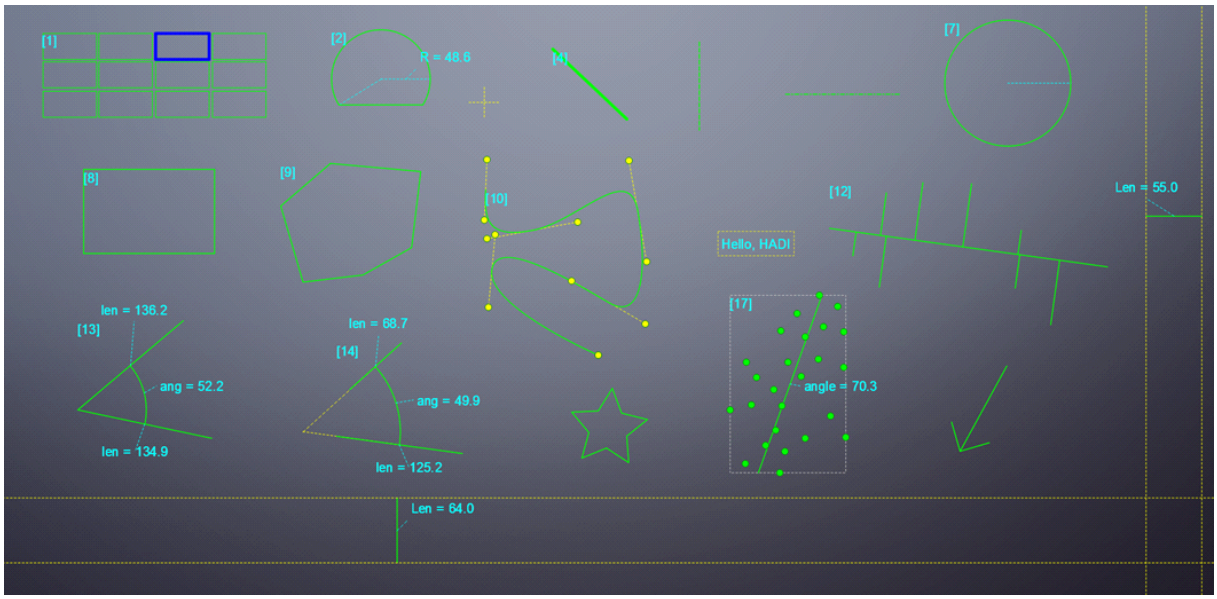
5.4.1 Measurement Tools

HADI provides a series of Measurement Tools (MT).

Clicking on the MT panel, user can draw MTs on the current displaying image.

User can also measure the calibrated images.

1. Grid	2. Chod	3.Lins	4. Rectangle
5. Angle	6. Text	7. Star	8. Arrow
9. Polygon	10. Spline	11. Circles	12. Parallel Lines
13. Point	14. Perpendicular Lines	15. Curvature	16. Lasso tool



5.4.2 Closed Shapes

Chord

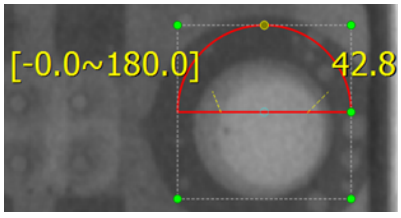
Usage

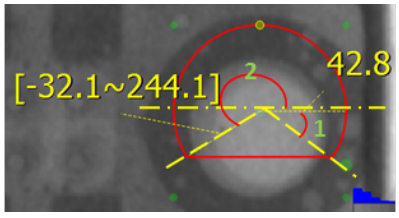
Usually used to inspect void.

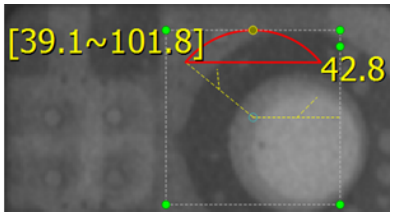
Annotation

Radius: 42.8

In this sample, 42.8 shows the radius of the potential circle.
Angle:[-32.1~244.1]
In this sample, angle 1 = -32.1, angle = 244.1







Circle

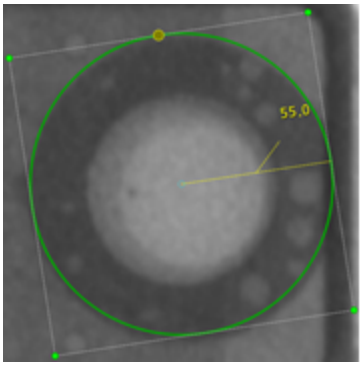
Usage

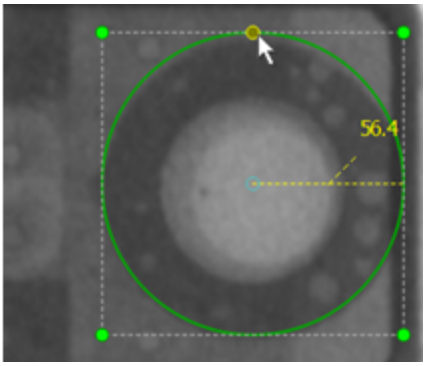
Usually used to inspect void.

Annotation

Radius: 56.4

In this sample, 56.4 shows the radius of the circle.





Circle to Circle

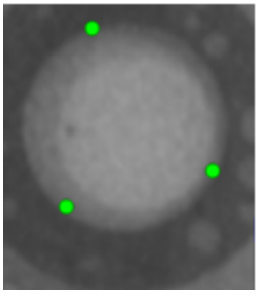
Usage

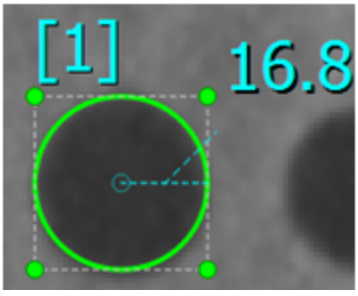
Usually used to inspect void.

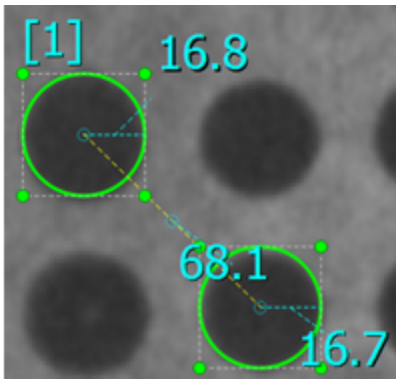
Annotation

Radius: In this sample, 16.8 and 16.7 show the radii of the two circles.

Distance: In this sample, 68.1 shows the distance between two circles(center to center).







Ellipse

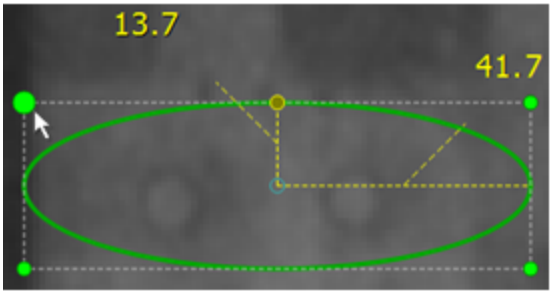
Usage

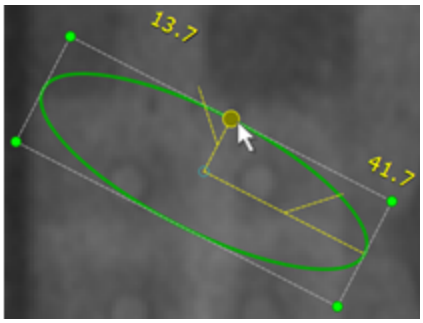
Usually used to inspect void.

Annotation

Major Radius & Short Radius:

In this sample, 41.7 and 13.7 shows the major radius and short radius of the ellipse, respectively.





Rectangle

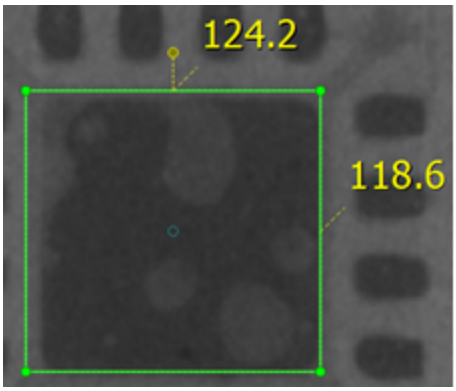
Usage

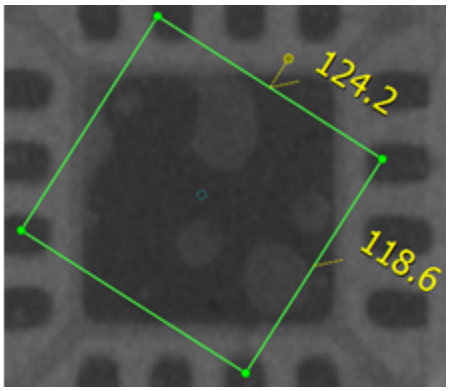
Usually used to inspect void.

Annotation

Length: In this sample, 124.2 shows the length of the rectangle.

Width: In this sample, 118.6 shows the width of the rectangle.

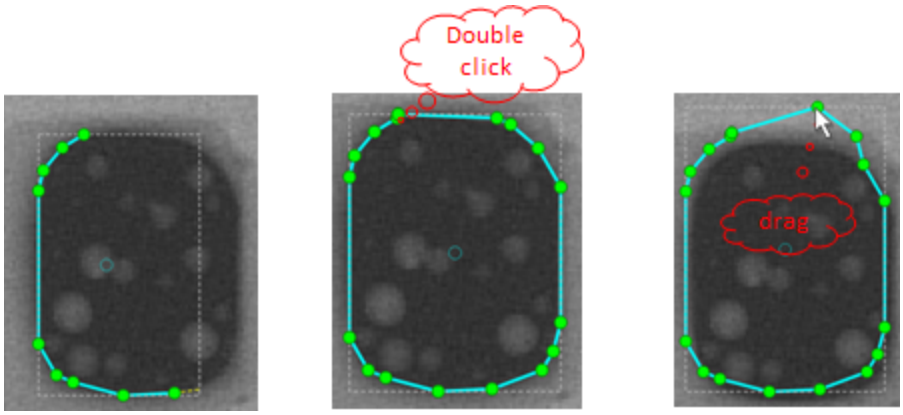




Polygon

Usage

Usually used to inspect void in irregular shapes.



5.4.3 Non-Closed-Shapes

Line Tools

Usage

Usually used to measure length or height.

NOTE:
HADI uses RED color and Green color to separate the line into interval sections according to the profile Threshold. If user cannot see the different sections, please try to use other color (not red) as Measurement Tool border color.

Annotation

1. Angle: the degree between horizontal line and the free line(counter-clockwise direction)

2. Length: calculated as pixels

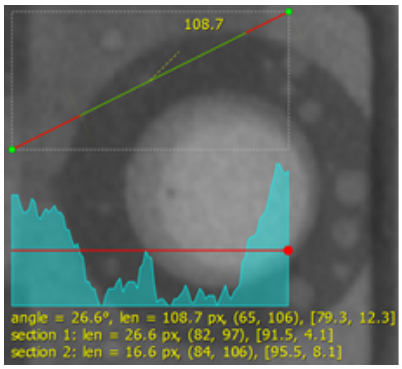
3. Intensity Value: (65,106) and [79.3, 12.3] are the (min, max) and [mean, variance] intensity value of the line.

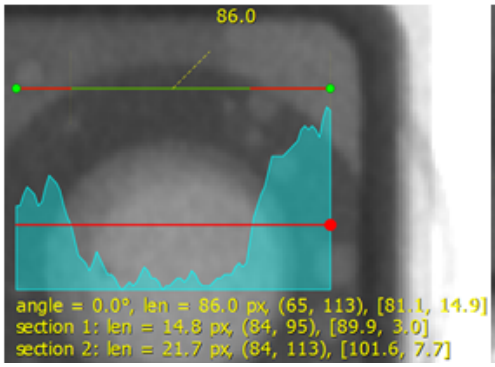
4. Section: length and intensity value of the red part.

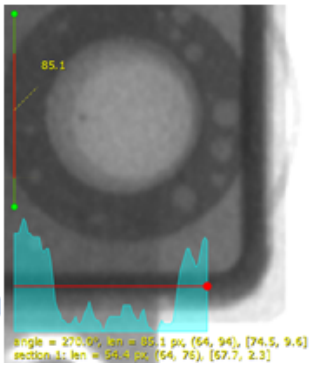
NOTE:

1. Double clicking changes the measure part(shown as red color)

2. Only measure(red part) information is shown in annotation.







Text Tool

Usage

Usually used to insert some information about Measurement Tools.

Ratio Tool

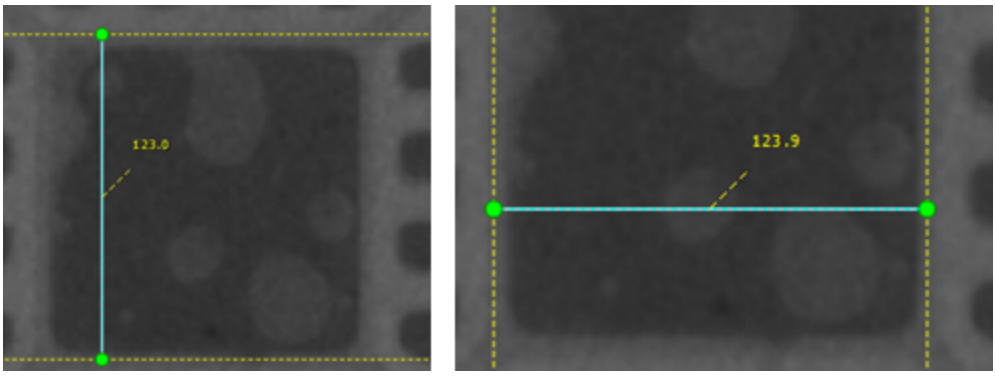
Distance Tool

Usage

Usually used to measure length or width of a chip.

Annotation

Length: HADI will measure the length from the start to the end of the ruler and calculated as pixels.



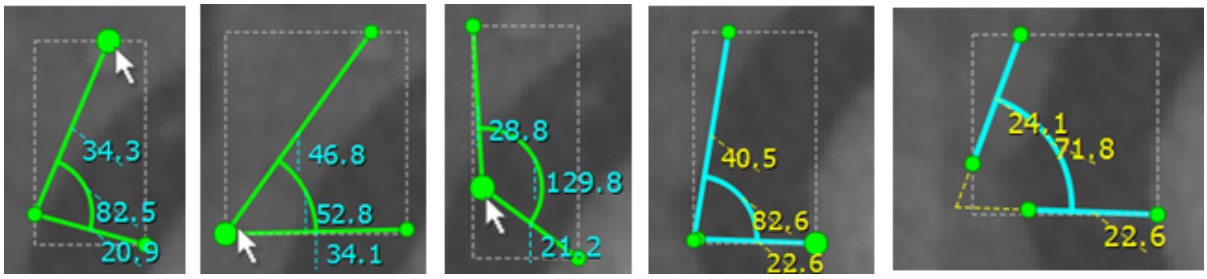
Angle Tools

Usage

Usually used to measure length or width of a chip.

Annotation

Length: HADI will measure the length from the start to the end of the ruler and calculated as pixels.



Others