Banner Vision Inspector
Machine Vision Software
Operating Manual
Version 2.6

Dated: 18 December 2018

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Copyright and Notices

Banner Vision Inspector

Introduction

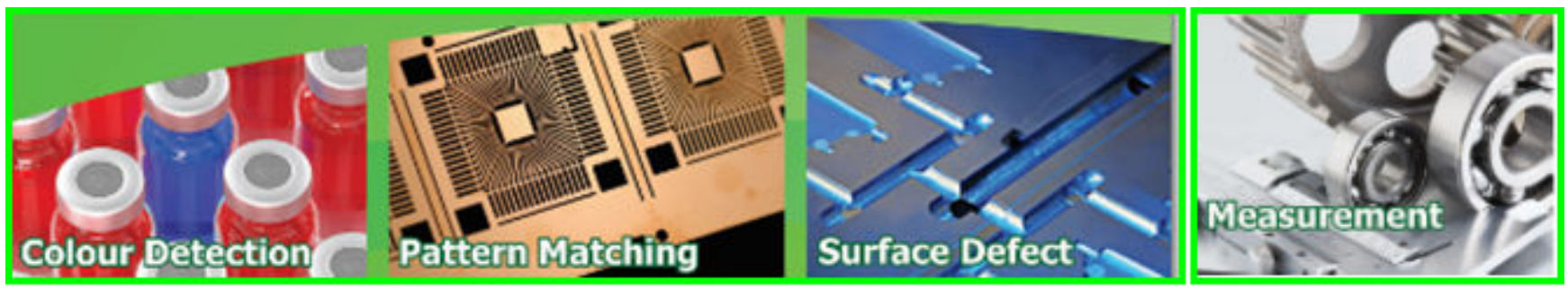
Banner Vision Inspector is image processing software for the machine vision industry and is a proprietary product of Banner Engineering. The software platform has been designed to allow engineers or non-programmers to be able to create a solution for any specific requirement without having the need to learn the actual programming skills in the shortest time. When integrated to the appropriate hardware, it offers a complete machine vision solution for any industrial automation's applications.

As the cost of labor is getting higher, it is a big challenge for companies to retain their staff in the long term. It is also difficult to find good replacement too. Machine vision is a complex product as it is largely dependent on the skills & experience of the programmer s to write the entire software for the solution. No one programmer is the same and thus the process in writing the program will never be the same. There will also be the frustration of trying to do software debugging which is very challenging & time consuming when the application is complicated. Business owners are frustrated on the lack of software continuity once the programmer quits the company and no one will be able to take over easily, and this will result in the need to re-write the program. Banner Vision Inspector platform is designed to overcome the concerns of software continuity and helping to modularize the tools, when needed.

Banner Vision Inspector platform allows flexibility in creating many different functions while it does not take too much effort to learn the usage. With the use of the Halcon library for the main inspection tools, the software offers superior & high performance with simple graphical user interfaces (GUIs)

The user can select the number of cameras, and followed by the type of camera, frame grabber or I/Os, integrated to the Banner Vision Inspector within a working menu. Each of the cameras will be running independently & will be running simultaneously. The Banner Vision Inspector platform will then launch a user-interface page which can be easily modified, including the change of the company's logo. The user can access to the configuration page for each camera to build up independent application program recipes.

With the wide suite of software tools, Banner Vision Inspector software covers applications including 1D/2D code reading, OCR/OCV, Filtering, Blob analysis, Robot Guidance, Measurement, Color, etc. The Banner Vision Inspector software does not have any limitation to any new tools to be included to its platform, as new functions or application tools can be created easily using Halcon, OpenCV or any 3rd party library, thus adding new features and unlimited possibilities to the software. The configuration page will allow the user to drag & drop required function tools easily into the program editor to build up the final program recipes. The Banner Vision Inspector platform provides an opportunity for apps developer to create applications modules for a diverse industries' requirements.



Getting Started with Banner Vision Inspector

System Requirement

The following table specifies the minimum system requirement for Banner Vision Inspector software. In order to optimize the performance, it is preferable to use the hardware better than what is recommended below.

S/N	Description	Specifications
1	Operating System	Windows 7 / 8 / 10 (64 bits)
2	CPU	1.9GHz or faster
3	Memory (RAM)	Minimum 2 GB
4	Storage	64 GB free space
5	Graphic Display	Minimum resolution of 1280 x 800 pixels
6	Licensing	USB security dongle

Preparation for Setup:

1. Make sure that the system system's date & time are set correctly.
2. Make sure that there is sufficient storage space where you want to install the application.
3. Make sure that your operating system version is up to date and the drivers for your cameras installed.

Installing Banner Vision Inspector

Steps to install Banner Vision Inspector

1. Download the Banner Vision Inspector software and patch from the links or CD provided.
2. Uninstall the **older version** of the Banner Vision Inspector software if you have installed it before.
3. Install the updated version of the Banner Vision Inspector software which you have downloaded.
4. You may require to disable the firewall or the anti-virus of your computer if you are not able to install the software successfully.
5. Copy and paste the Banner Vision Inspector monthly demo license to this path: C:\Program Files\MVTec\HALCON-13.0\license
6. Banner Vision Inspector software is ready to be used.

Licensing

Licensing

All **Banner Vision Inspector** licenses are bound to a dongle together with 2 corrsponding files (.dat & .lic files).

Place the license files into the specific directory as the following:

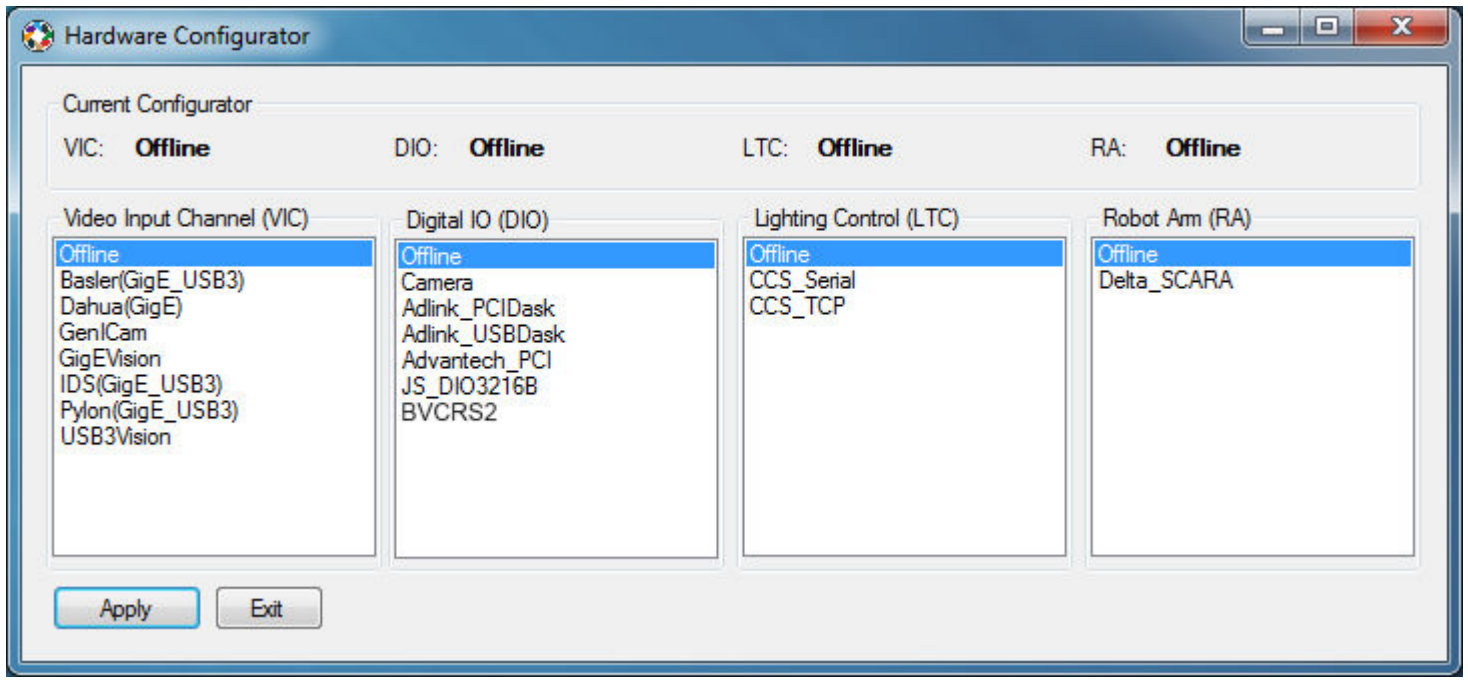
Runtime License:

Step 1: e.g: Copy the 3-xxxxxxx.lic to this path: C:\ProgramData\Banner Engineering\licence

Step 2: e.g: Copy the 3-xxxxxxx.dat to this path: C:\Program Files\MVTec\HALCON-13.0\license

Hardware Configurator

Hardware Configurator
Banner Vision Inspector software supports a wide variety brands of cameras and IOs module.



Video Input Channel: The user can select the brand of cameras to be used.
Digital IO: The user can select the brand of digital IO used.
Lighting Control (LTC): The user can select the brand of digital IO used.
Robot ARM: The user can select the brand of robot arm to be used.

Hardware Supported

List of brands of camera supported:

- Basler (GigE_USB3)
- Dahua (GigE)
- GenICam
- GigEVision
- IDS (GigE_USB3)
- Pylon (GigE_USB3)
- USB3Vision

List of IO module supported:

- Camera
- Adlink PCI Dask
- Adlink USB Dask
- Advantech_PCI
- JS DIO3216B
- BVCRS2

List of brands of Lighting Control supported:

- CCS_Serial
- CCS_TCP

List of Robot Arm supported:

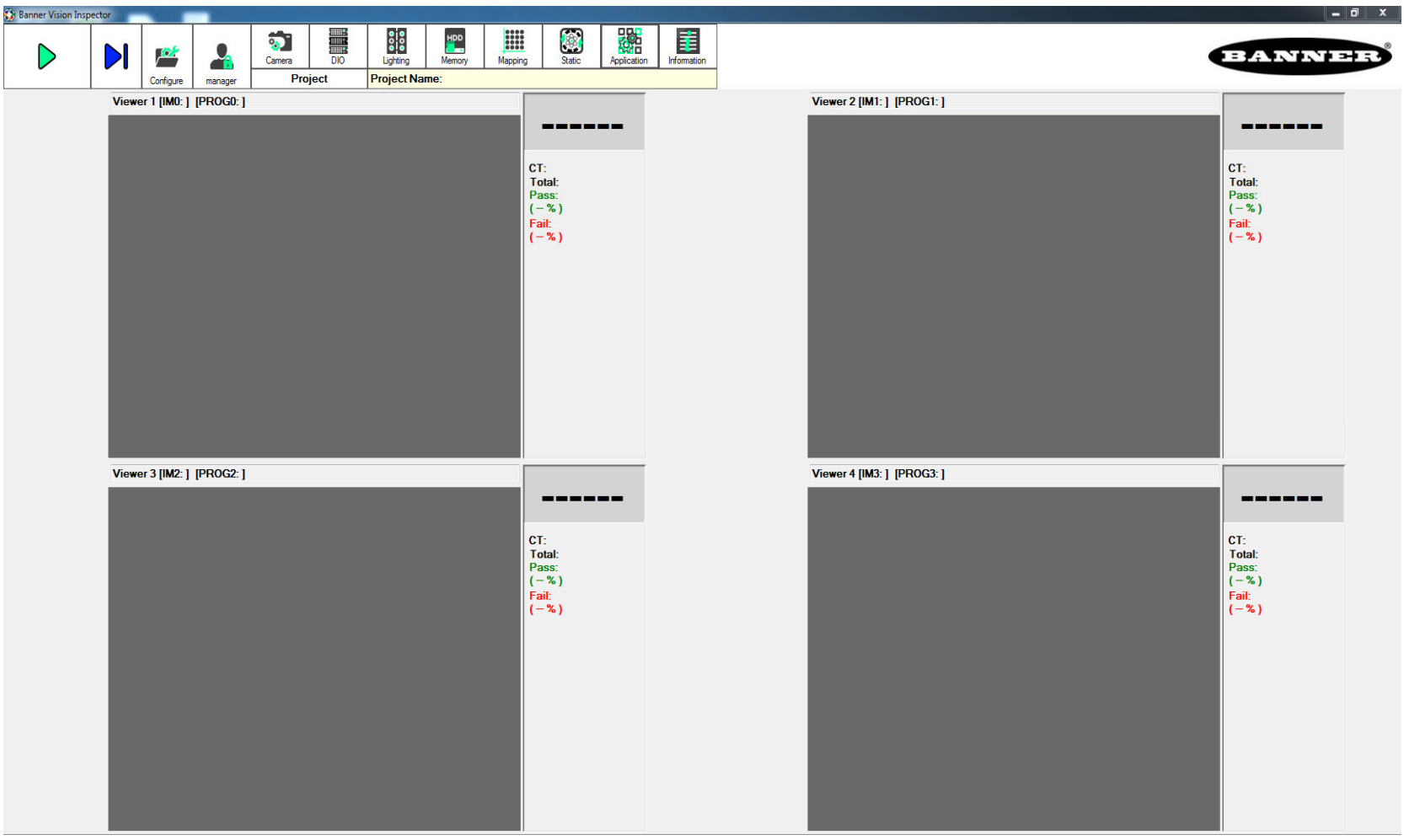
- Delta_SCARA

User Interface

User Interface

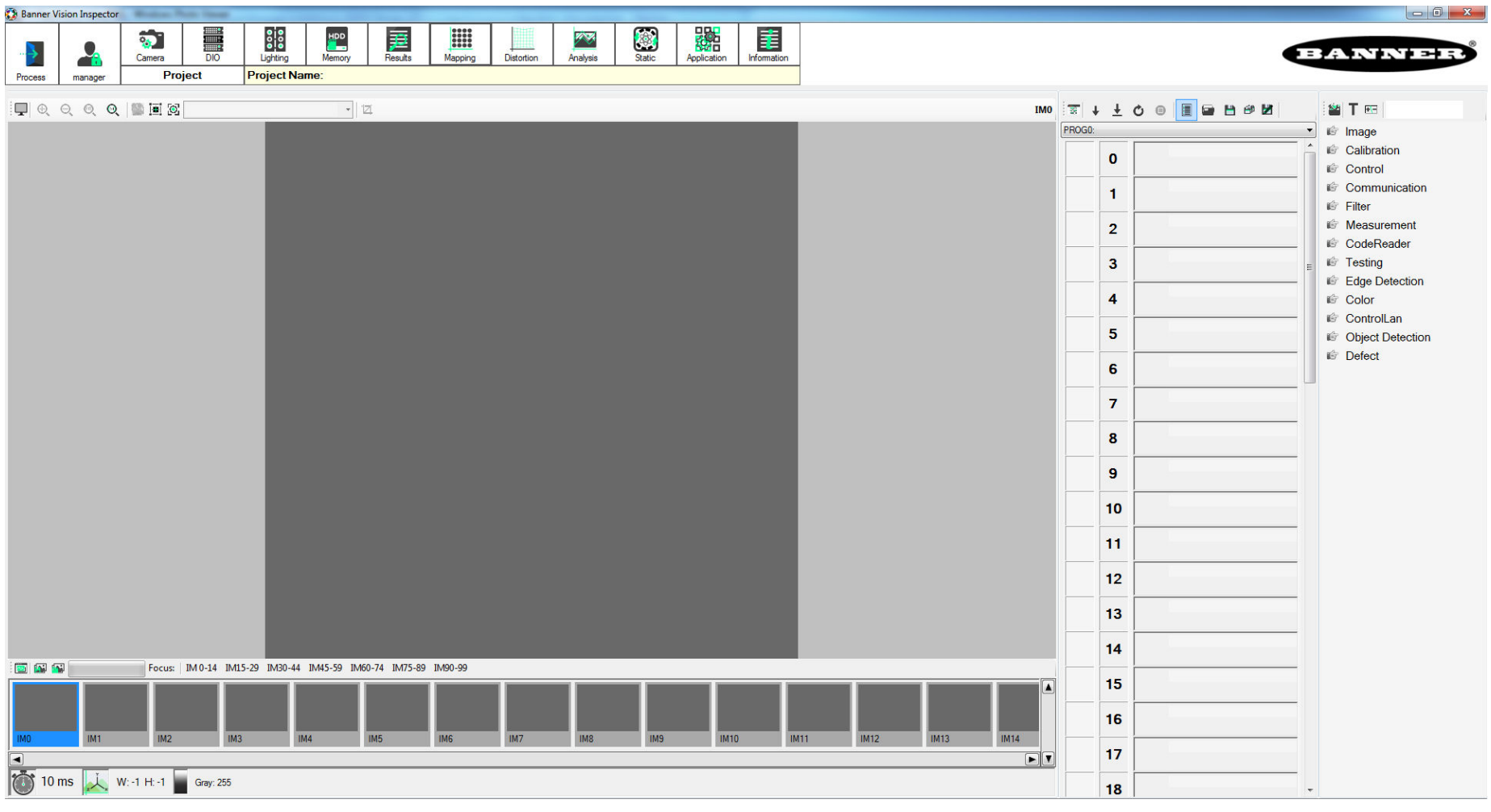
The Graphical User Interface is the interface between the user and Banner Vision Inspector.

When the Banner Vision Inspector software is launched, the user will be brought into a Process Menu as shown in the below picture.



After user has login the password, he/she is able to access the toolbars on the top panel.

And click the  button to access to the Configuration Menu as shown in the picture below.

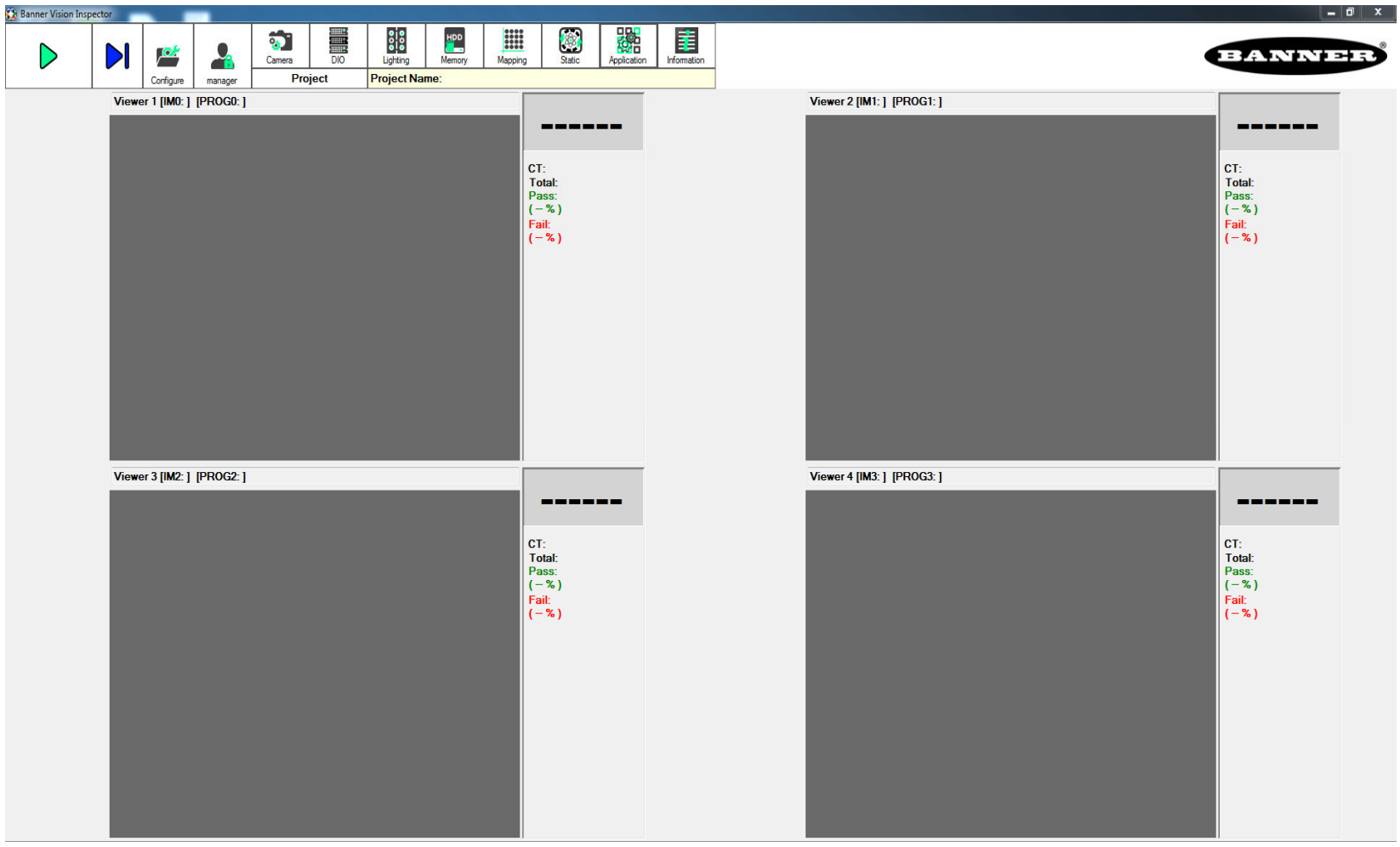


Process Menu

Process Menu

When the Banner Vision Inspector software is launched, the user will be brought into a GUI within the process mode.

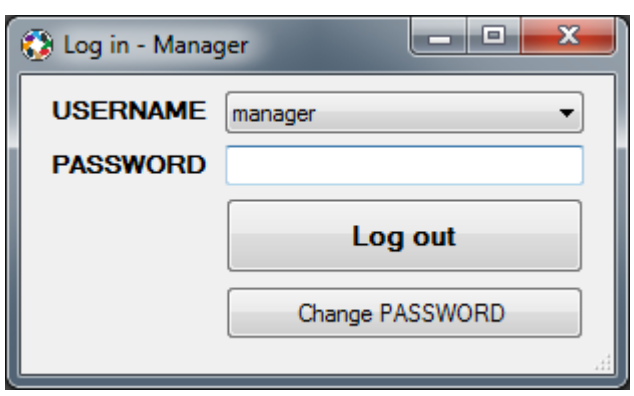
When the security dongle is not inserted to the USB interface on the computer, the Banner Vision Inspector will run on a demo mode for 60mins which will be shown on the bottom left side of the monitor screen. When the demo session expires at 60mins, the application will automatically shut down. User will have to relaunch the Banner Vision Inspector software again to continue.



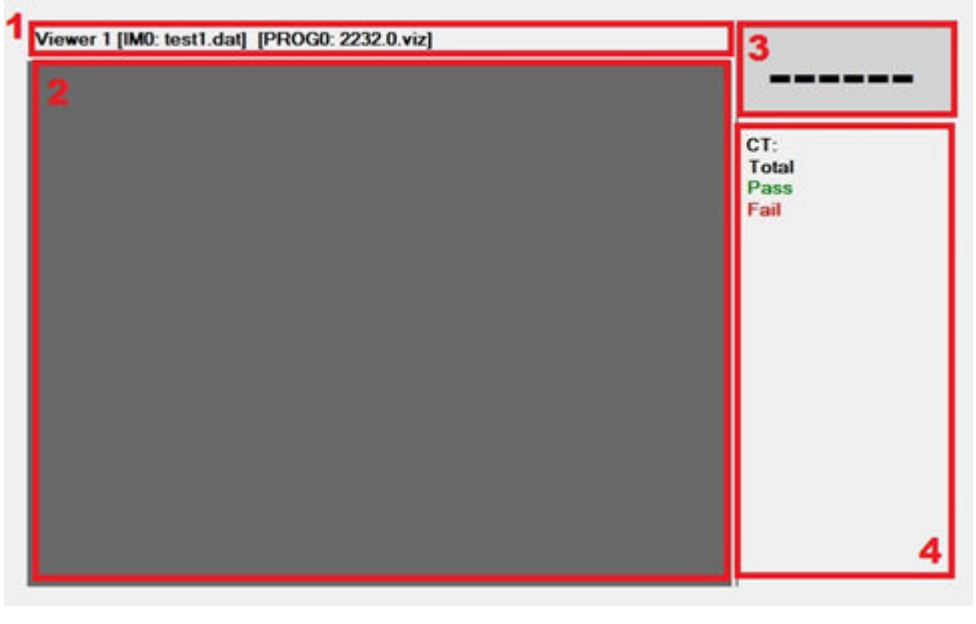
a. Run/Stop : To control the program to start or stop execution.
b. Run Once : To execute the program in a single run or cycle.
c. Configuration Mode : To access into the Configuration Menu where user create their inspection program.
d. Login : To login and logout for the software.
e. Camera Setting : To configure the selected cameras index and parameters.
f. Digital IO : To diagnose the selected IO status.
g. Lighting : To configure the selected lighting parameters.
h Memory : To display the Global Memory data (value, point & string).
i. Mapping : Transform image coordinates to world coordinates.
j. Reset Static : For resetting the static variable created in the program.
k. Application Setting : To configure all the parameters in the software.
l. Information : To show the software version.

Login into the system:

To access into the system, the user will have to press the button to enter the password code for the operator, engineer, and manager or administrator level. Each level will allow the access to different function tools within the process page.



Viewer:



(1) To show Viewer name, IM and Program name used for this viewer

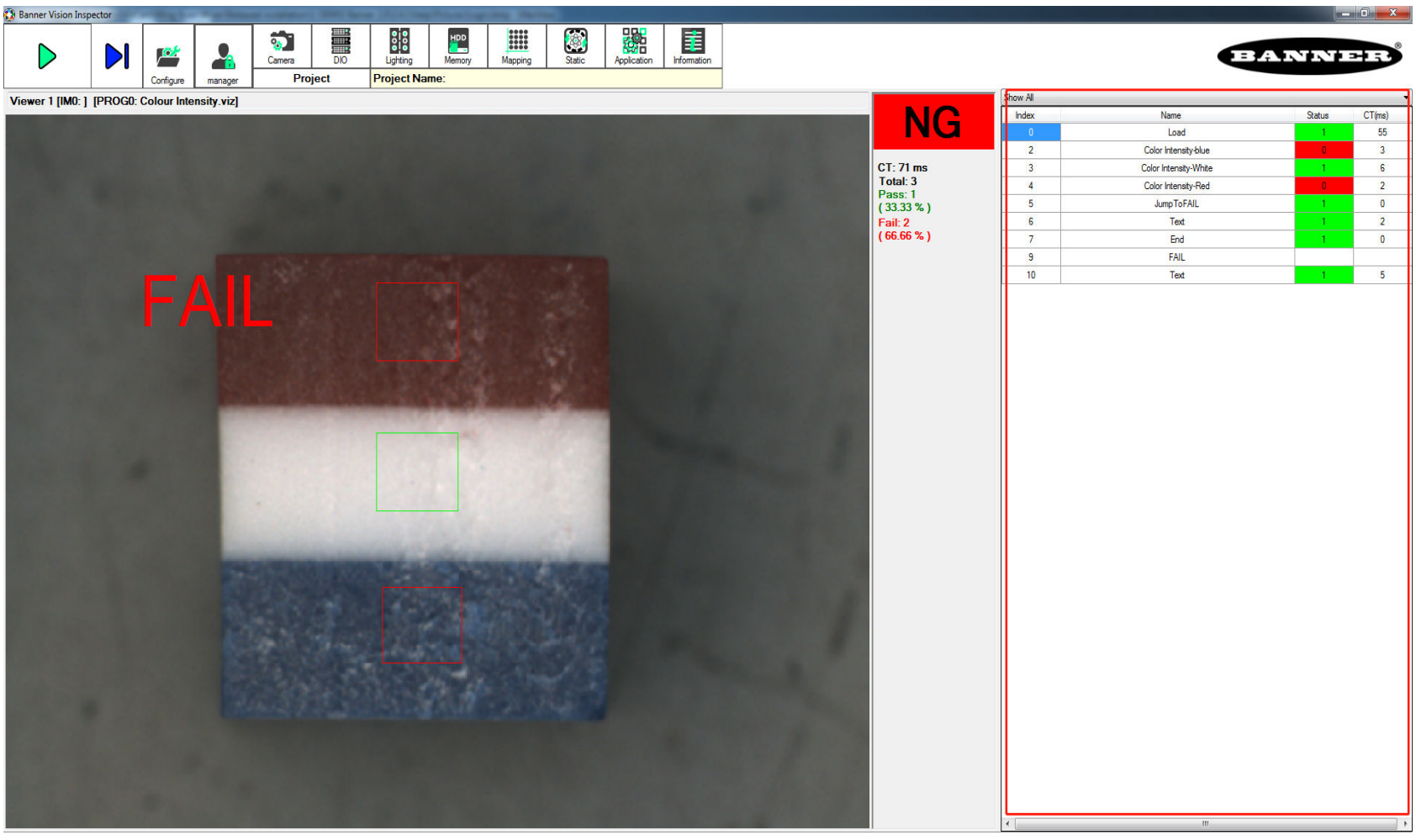
- [IM0: test.dat]: test.dat is the mapping file
- [PROG0: 22320.viz]: 22320.viz is the program file.

(2) To display inspection image

(3) To display the inspection overall result

(4) To display the inspection result

Double-click on the viewer to display the picture as shown below



At the program tool bar as highlighted red, it shows the inspection result and individual tool cycle time.

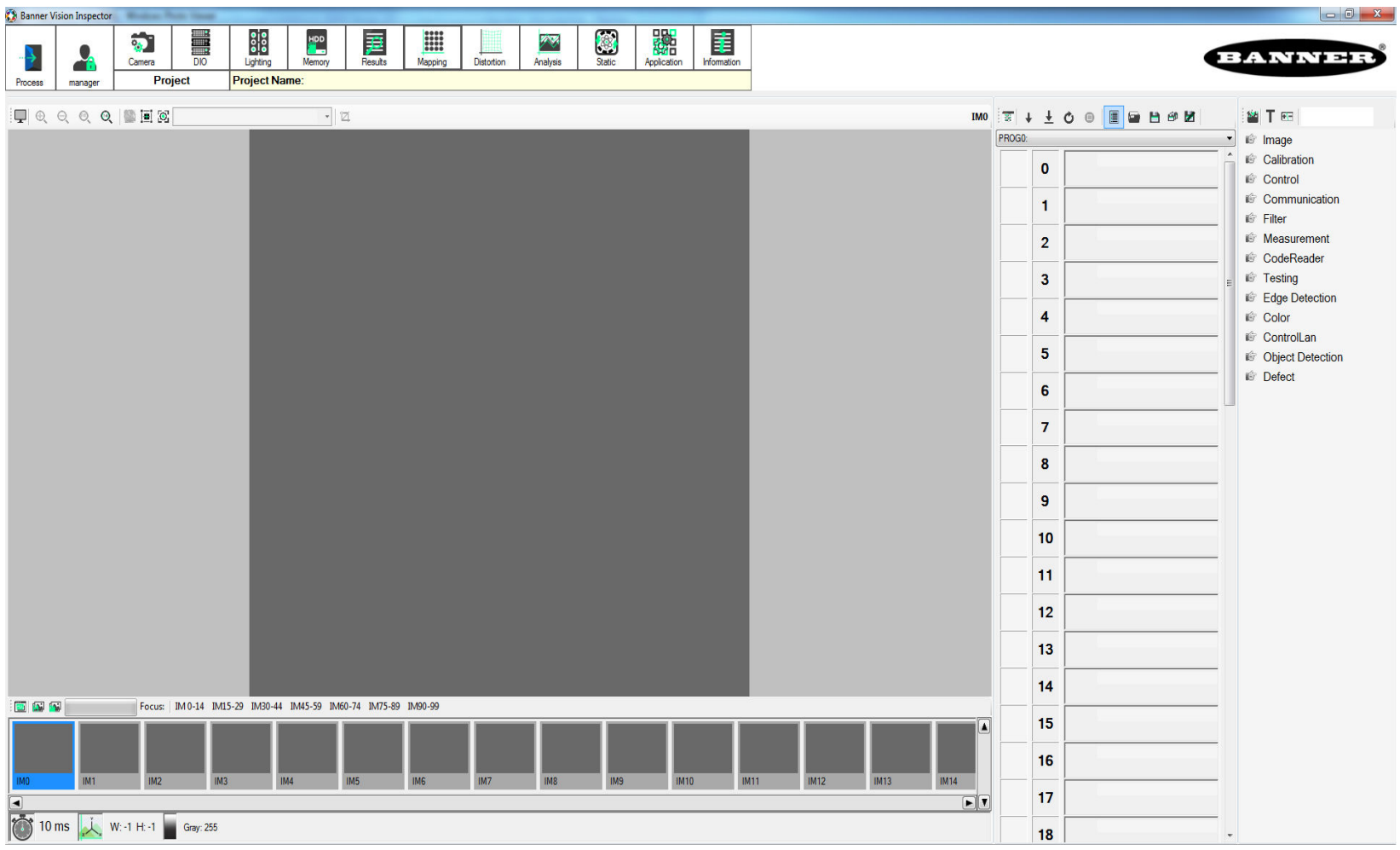
Double-click on the individual tools content where it shows that particular tool menu which allow user to edit the parameter.

Configuration Menu

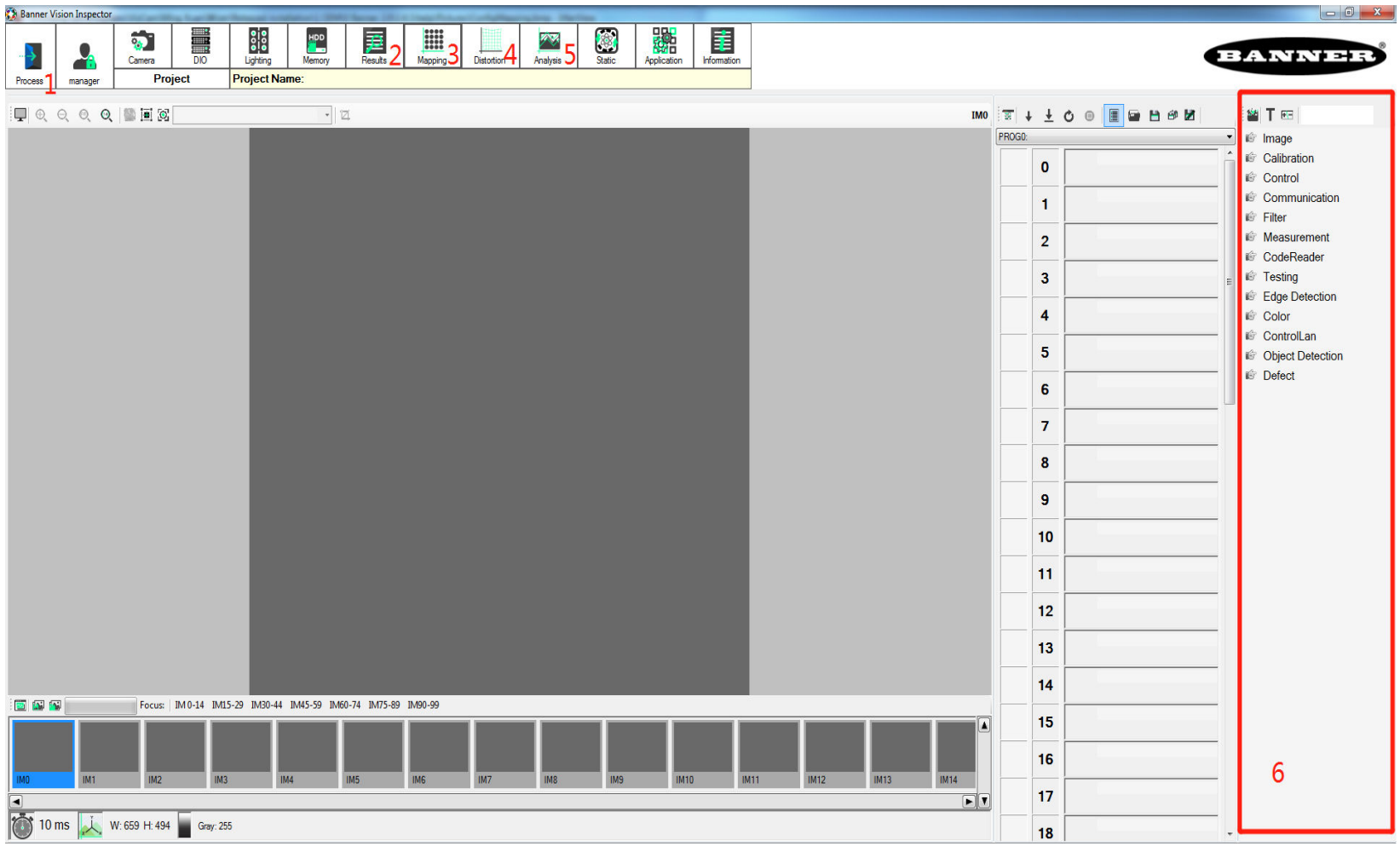
Configuration Menu

To access into this menu, the user has to click the  button.

At this menu, user is allowed to create or edit his/her inspection program. It is using drag and drop concept from the tools menu at the right side into the program editor.



The Program Editor shows the Banner Vision Inspector command list of your inspection program. The commands will be sequential processed. There can only be one command per line. It is recommended to use empty lines between commands to get a better overview in the program editor. You can add new empty lines later, if you need them. Commands can be easily put in this list by dragging them out of the command set and dropping them in their new position in the program editor. A new dialog will appear to modify the command for your use. Commands can be updated by clicking with the right mouse button on it and choosing "Quick edit".

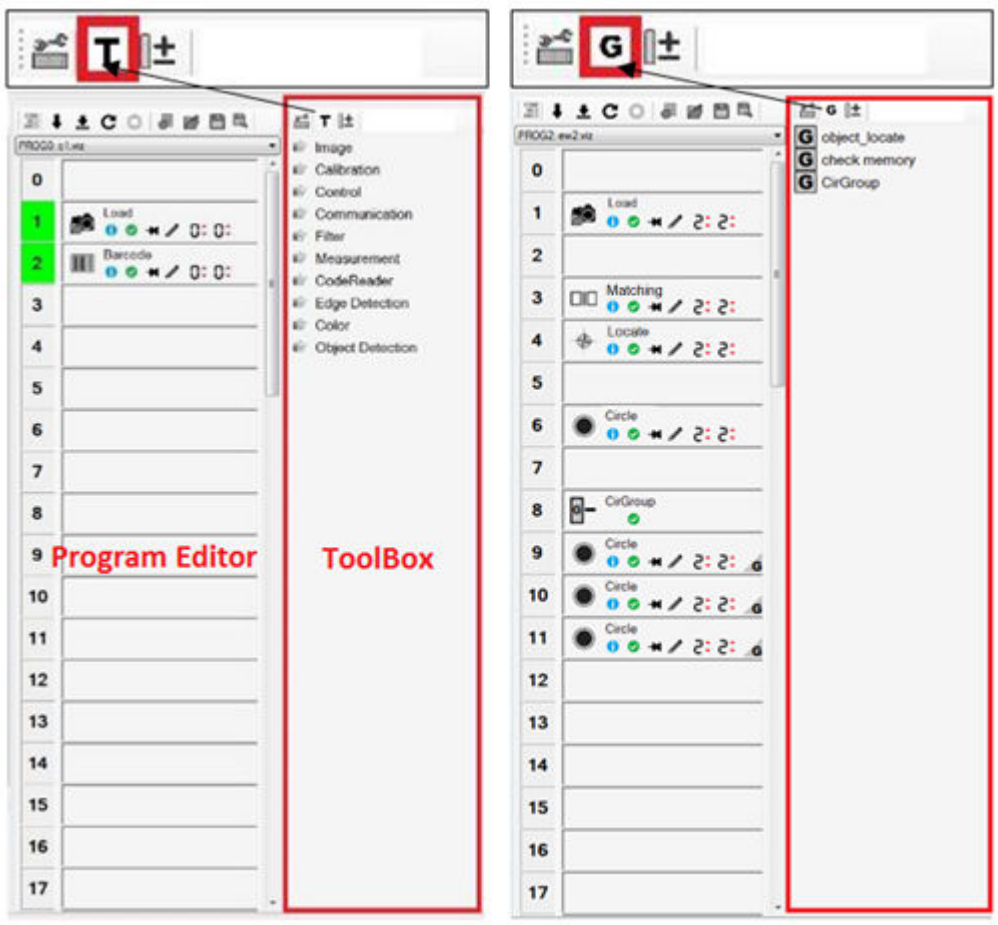


Banner Vision Inspector

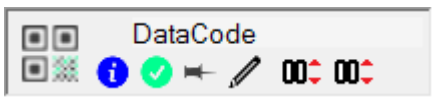
(1): Return back to Process Menu
(2): Result Viewer: To view all the results e.g. Long, Double, String etc. of the tools used in the Program Editor.
(3): Mapping: Transform image coordinates to world coordinates.
(4): Distortion Correction: Correct the deformation of the images caused by the optical used.
(5): Image Analysis: To extract the key information from the images to display as histogram or profile to allow user to have some idea of the image thresholding value.
(6): Toolbox: The commands that is developed for user to drag and drop into the program editor to create the inspection program.

Toolbox

ToolBox



The commands at the Toolbox that is developed for user to drag and drop into the program editor to create the inspection program.



- Click to get the information of this tool.

- Click to enable the processing of this tool.

- Click to disable the processing of this tool.

- Click to allow processing of this tool at initialization only.

- Click to disable processing of this tool at initialization only.

- Disable the tool ping function.

- Enable the tool ping function.

- Enable the tool overlay during inspection.

- Disable the tool overlay during inspection.

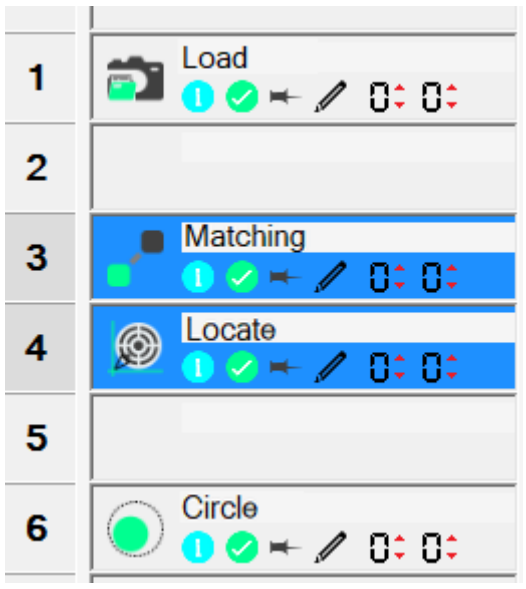
- Display the tool overlay when the tool result is pass.

- Display the tool overlay when the tool result is fail.

Creating grouping of commands used in the Program Editor:

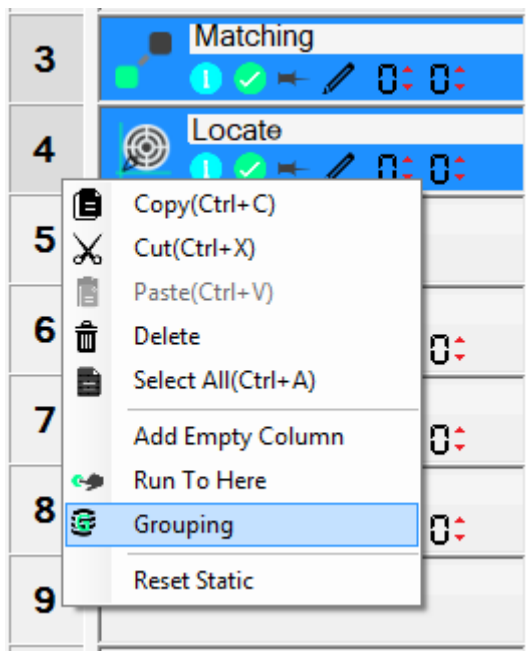
Step 1:

When the inspection program is completed. Select and highlight those Tools which you would like to grouping.



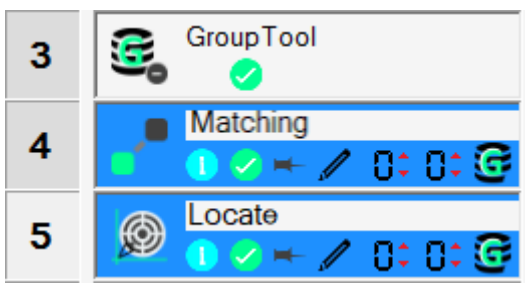
Step 2:

Right-click to select "Grouping"



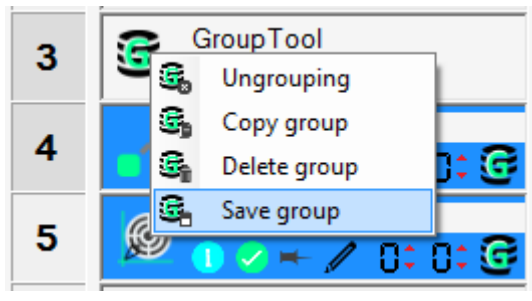
Step 3:

Selected tools will be gropued accordingly. User can enter a name for this created group.



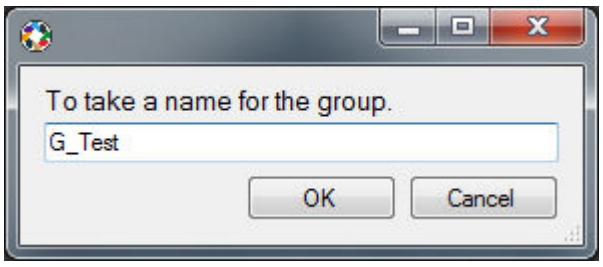
Step 4:

Right-click on the Grouping Icon and then select "Save group". This apply for the grouping features like the Ungrouping, Copy group & Delete group.



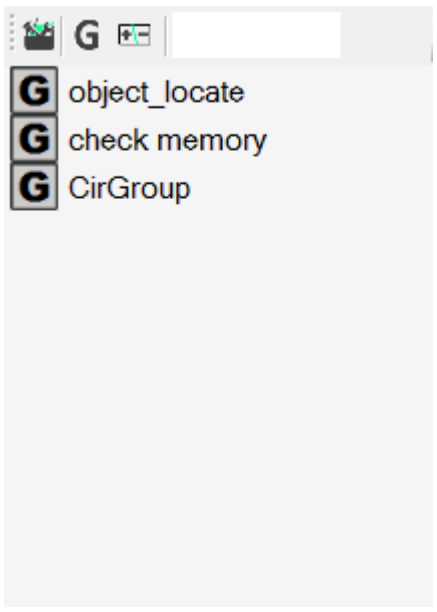
Step 5:

To create a name for the group. The software is unable to have duplicate naming for grouping.



Step 6:

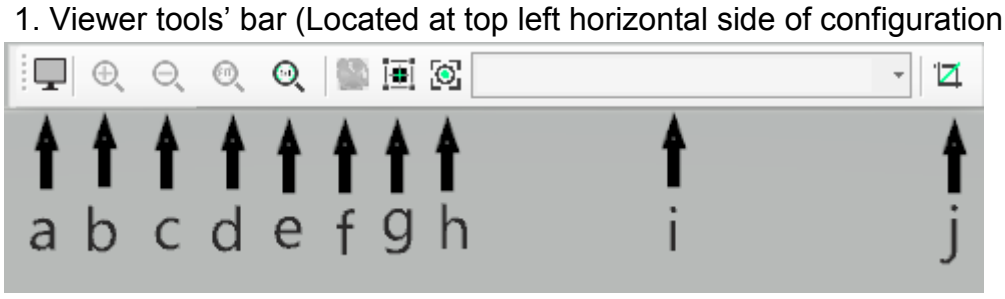
After the above steps. user will able to see and use the grouping tool in the toolbox. User can drag this grouping tool into your inspection program.



Toolbar

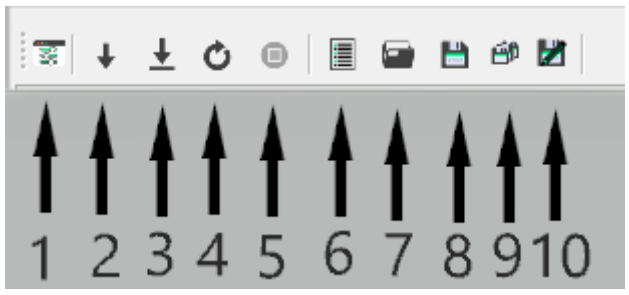
Toolbar

1. Viewer tools' bar (Located at top left horizontal side of configuration mode)



- "a" – Viewer tab window
- "b" – Zoom in image
- "c" – Zoom out image
- "d" – Fit image to screen
- "e" – 1:1 ratio aspect
- "f" – Live image
- "g" – Cross line
- "h" – Camera focus
- "i" – Camera list
- "j" – Crop

2. Cyclic / File management tools' bar (Located at top right horizontal side of configuration mode)

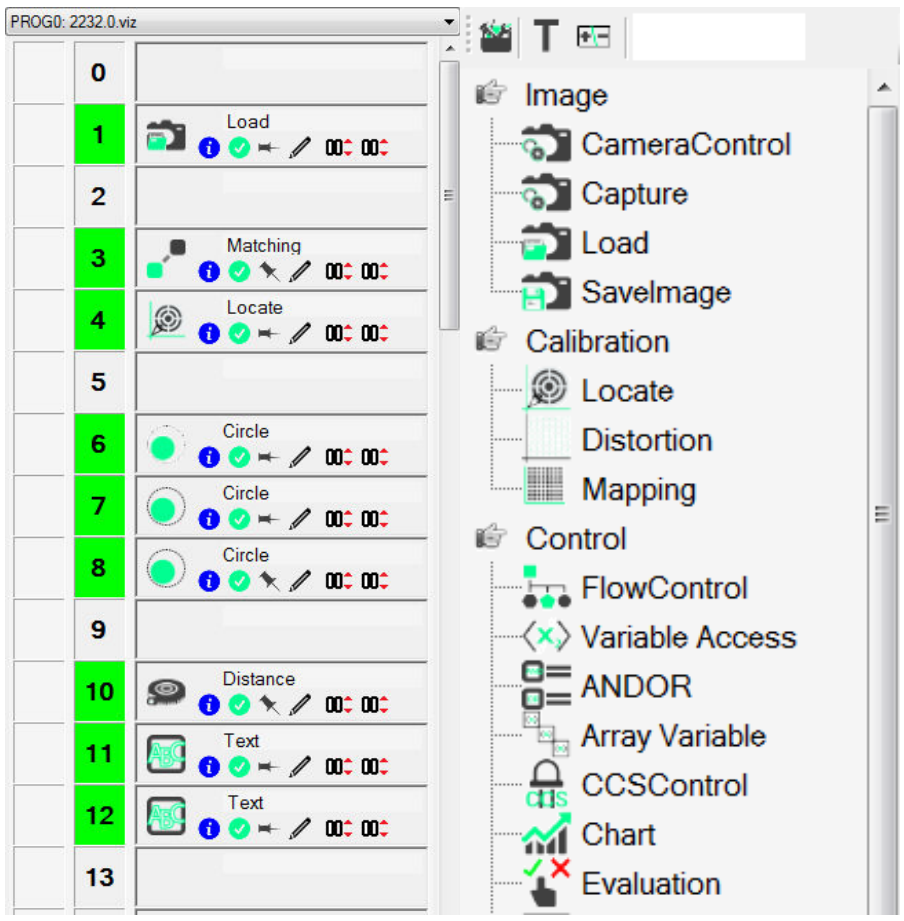


- "1" – Program tab window
- "2" – Run once
- "3" – Run one step
- "4" – Continuous cycle
- "5" – Stop
- "6" – Create new recipe file
- "7" – Open recipe file
- "8" – Save current recipe file
- "9" – save all recipe file
- "10" – Save as

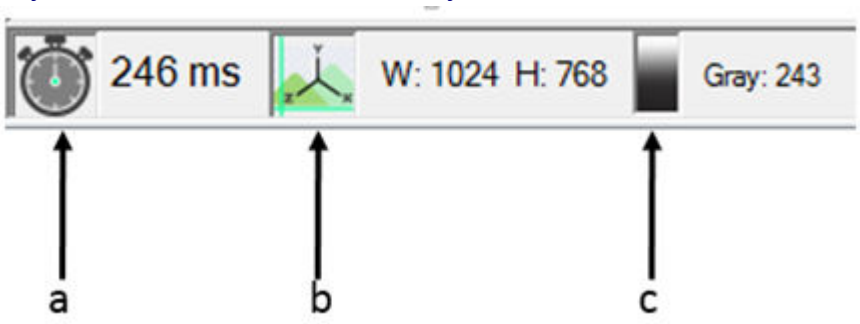
Program Editor

Program Editor

The below picture shown is the Program Editor (Displays inspection procedure of recipe file). This is table where user create the inspection program by drag and drop the commands from the tool table.



Cycle Time / Coordinates / Gray scale



"a" – Reflects the total cycle time for the entire process of the recipe within the program editor

"b" – Identify the XY (image or world) coordinates of the current mouse cursor location, of which the 0,0-default position is located at the top left corner of the image before calibration.

"c" – Identify the gray value of the current mouse cursor location. If a color camera is used, the value will be in RGB.

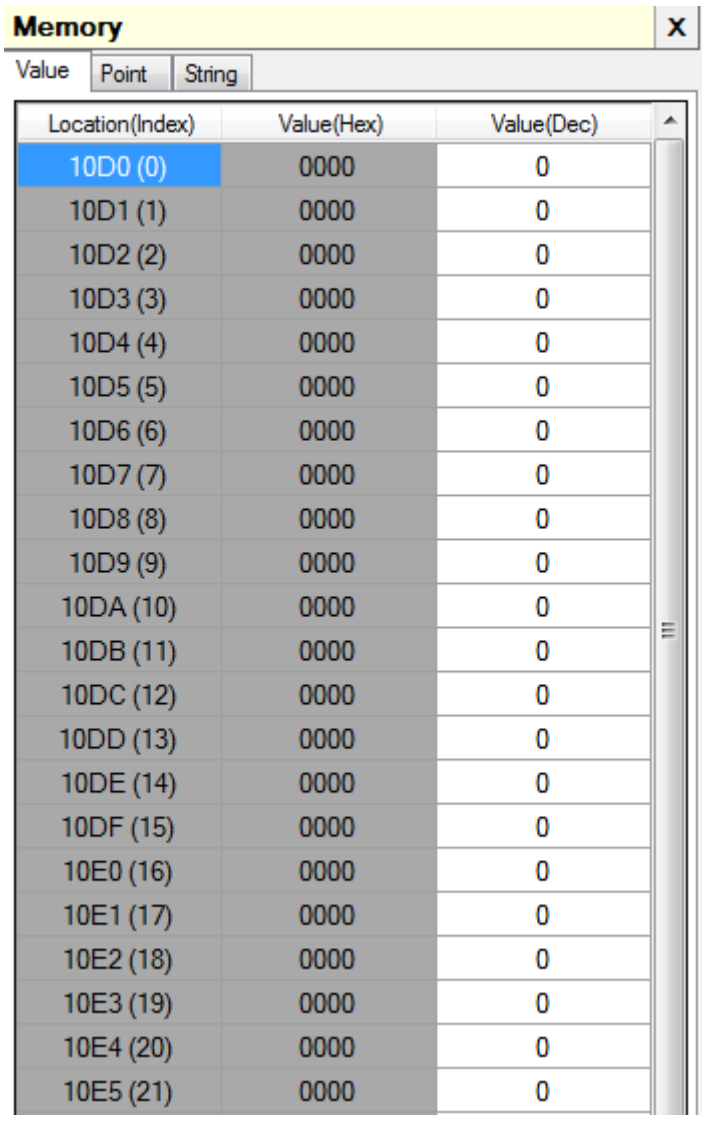
Image Memory

- Click ▼ to show or hide the IM bar
- Click to save the image from IM
- Click to load the image to IM

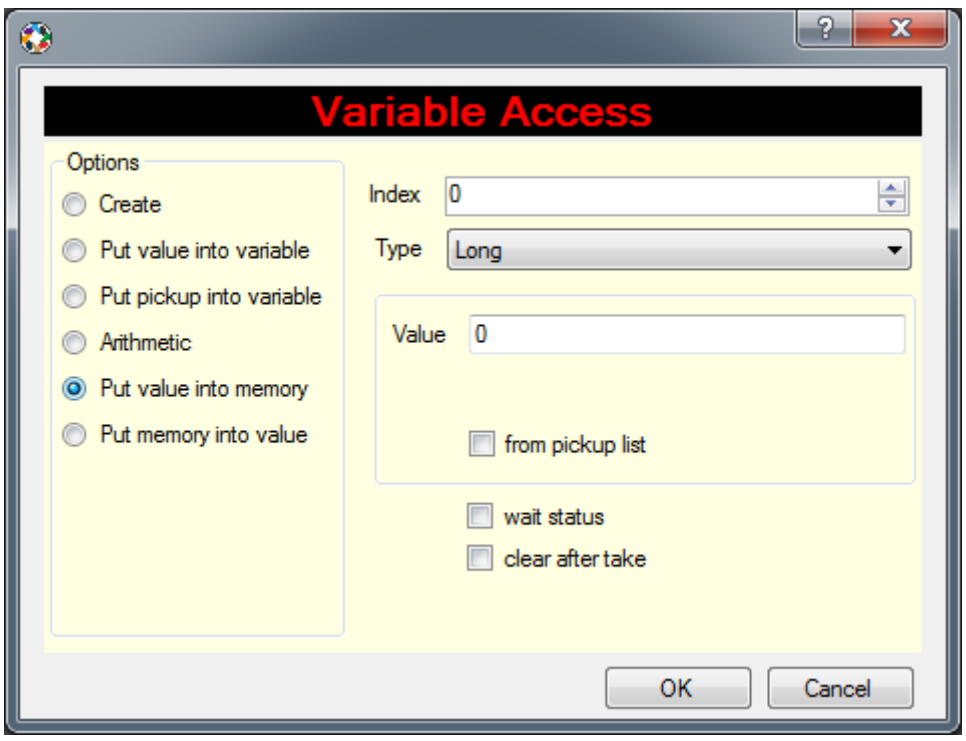
Memory Menu

Memory Menu

To display the Global Memory data where the tools results like the value or point or string used in the inspection program, are saved in this memory. This allows IPC, PLC and internal viz program to access this data.

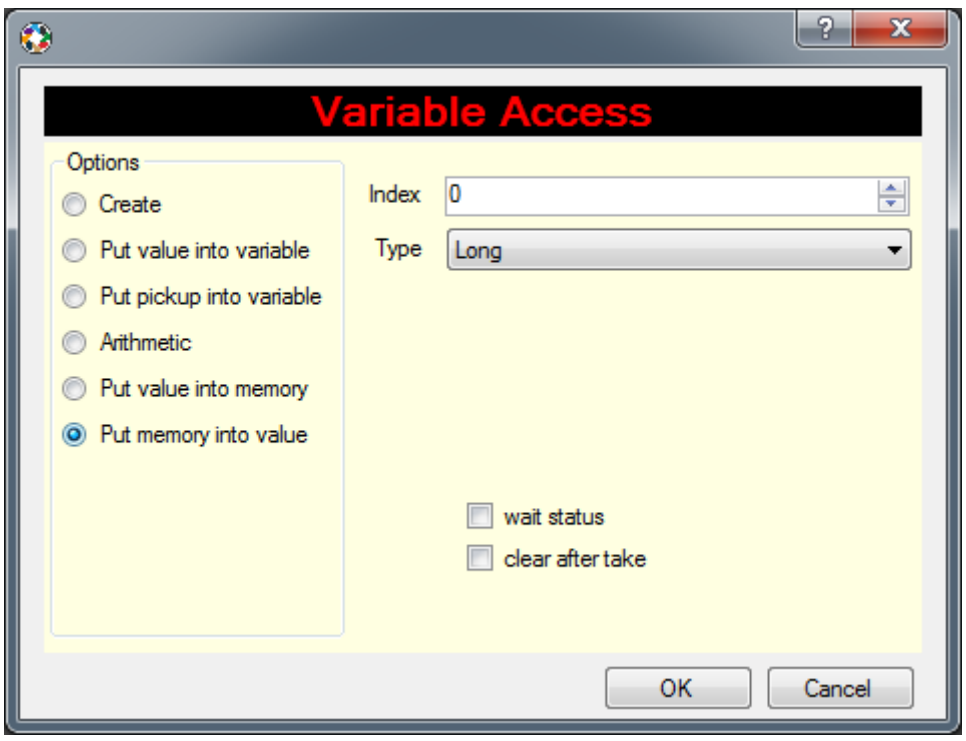


The **Variable Access** command is used to perform this feature to save the data like value, point or string into the desired memory.



Put value into memory:

- **Index:** To save the parameter (Long, Double, string, Point) into the memory location of a selected command.
- **From Pickup list:** To select the desired result to save into the memory.
- **Wait Status:** When this option is checked, it will wait until the specific memory is cleared before it saves the new data in.



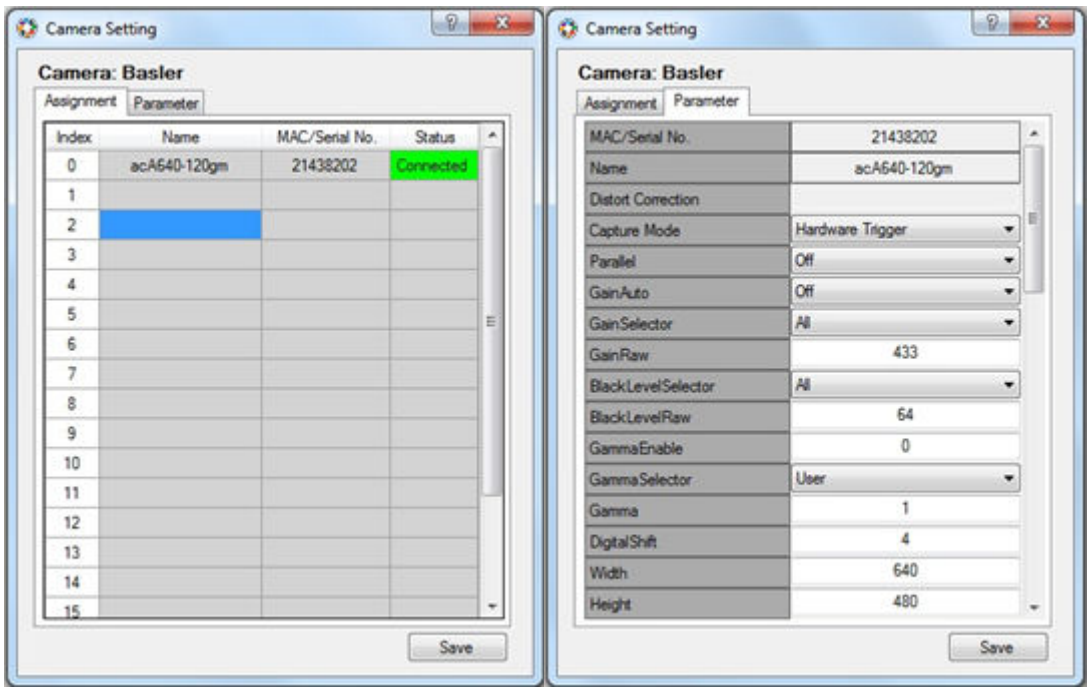
Put memory into value:

- **Index:** To get the parameter (Long, Double, string, Point) from the selected memory location and input into a value.
- **Type:** To set the format type of value after getting from memory.
- **Clear after take:** To clear the memory index after getting the result, to allow the next parameter to save into the memory index.

Camera Setting

Camera Setting

At this Camera Setting Menu, user can change the parameters for the cameras shutter, gain and AIO under the Parameter tab. Under the Assignment tab, user can arrange the sequence of the cameras accordingly.



Double click on your camera's name and the camera properties panel will open in the viewer as shown above.
You can use the selections in the camera properties pane to adjust all of the cameras settings such as gain, black level, and exposure.

You can adjust image quality with regard to these criteria by choosing appropriate settings. However, the "best" image quality will partly depend on the specific requirements of your application and therefore no generally applicable "best" setting can be recommended.

The adjustments will involve the following:

- adjusting the brightness of the illumination
- adjusting the focus
- setting the lens aperture
- setting the black level
- setting the shutter
- setting the gain
- adjusting white balance.

In addition, the quality of an image will be affected by other factors, e.g., by the choice of the lens. We recommend carrying out all fine adjustments using the illumination that you want to use in your actual application.

Focus:

You will obtain a focused image only if the lens is screwed into the lens adapter of the camera as far as it will go and if the glass surfaces are clean. The object to be imaged must be within the range of focus of the lens. You can obtain a focused image by turning the focal ring on the lens.

Depth of Focus:

If the objects you want to image are located at different distances from the camera, you must consider depth of focus. The depth of focus must be sufficiently deep to allow all objects to appear focused in the image. You can change the depth of focus by turning the aperture ring on the lens. Closing the lens aperture (turning the aperture ring to higher f-numbers) increases the depth of focus and vice versa.
Note that closing the aperture decreases the amount of light reaching the camera's sensor and
therefore results in a darker image.

Brightness:

Among the factors determining the brightness of an image are the intensity of the illumination, the setting of the lens aperture, and the settings for black level, exposure time, and gain.

- We recommend that you choose bright illumination if possible, but avoid excessive intensity. This will prevent you from needing to operate the camera using extreme camera settings. A bright but not excessively bright illumination is of central importance to achieving good image quality.
- In images acquired from CCD sensors, excessive brightness will cause artifacts such as smear (white stripes in the image) and blooming (local over-saturation that destroys contrast). You can decrease the proneness for smear and blooming by choosing a diffuse and less intense illumination.
- If illumination of sufficient brightness is not available, you can select a lens that is optimized for light utilization.
- Opening the lens aperture will allow more light to reach the camera's sensor and will therefore increase the brightness of the image. Note that opening the lens aperture also increases the effects of optical aberrations. This causes image distortions and the intensity of light decreases towards the edges of the sensor (vignetting). In addition, the depth of focus decreases.
- Change the brightness of the image by changing the camera's black level setting normally, you should increase the black level setting only as far as is necessary to make detail visible in the darkest portions of an image. (This is equivalent to avoiding the clipping of the low ray values of noise.)
  Note that high brightness settings will prevent high contrast. We recommend not using rightness settings above 64 when the camera is set for any output format that is greater than 8 bits per pixel.
- Increase the brightness of the image by increasing the camera's exposure time setting. With this method, brightness is increased by increasing the amount of photons collected for pixel readout. Note that increasing the exposure time setting may decrease the acquisition frame rate. If you reacquiring images of moving objects, increasing the exposure time setting may increase motion blur.
- Increase gain will also increase image brightness. Note unless your application requires extreme contrast, you should make sure that detail remains visible in the brightest portions of the image when increasing gain. Note also that noise is increased by increasing gain.

Exposure Time:

The exposure time setting determines the time interval during which the sensor is exposed to light.

Choose an exposure time setting that takes account of whether you want to acquire images of still or moving objects.

- If the object is not moving, you can choose a high exposure time setting (i.e., a long exposure interval). Note at high exposure time settings may reduce the camera's maximum allowed acquisition frame rate and may cause artifacts to appear in the image.
- If the object is moving, choose a low exposure time setting to prevent motion blur.

Gain:

Gain amplifies each pixel readout by a certain factor. Accordingly, signal and noise are both amplified.

Note that it is not possible to improve the signal-to-noise ratio by increasing gain.

- You can increase the contrast in the image by increasing the camera's gain setting.
- Increasing gain will increase the image brightness.

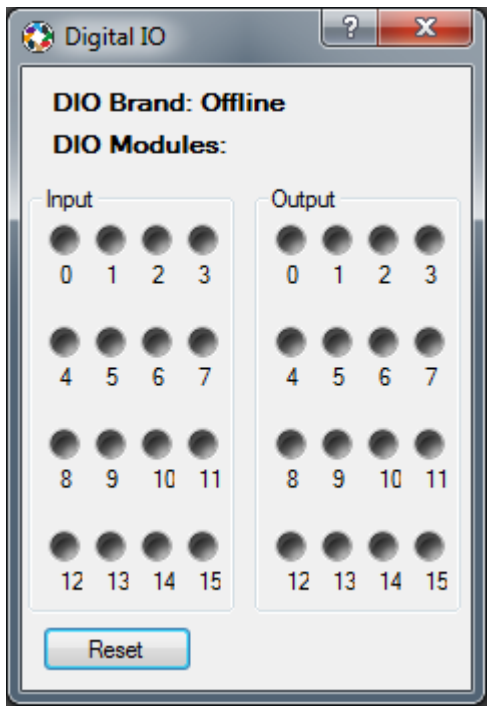
Unless your application requires extreme contrast, make sure that detail remains visible in the brightest portions of the image when increasing gain. Note also that noise is increased by increasing gain.

- Set the gain only as high as is necessary.

Digital IO

Digital IO

The digital In-/Output display shows all digital in-/output interfaces that are embedded into the system. Depending on the available interfaces, all virtual LEDs will be displayed. Those displays reflect the real in-/outputs and their conditions. You also can simulate the digital I/O in offline mode without IO connected.



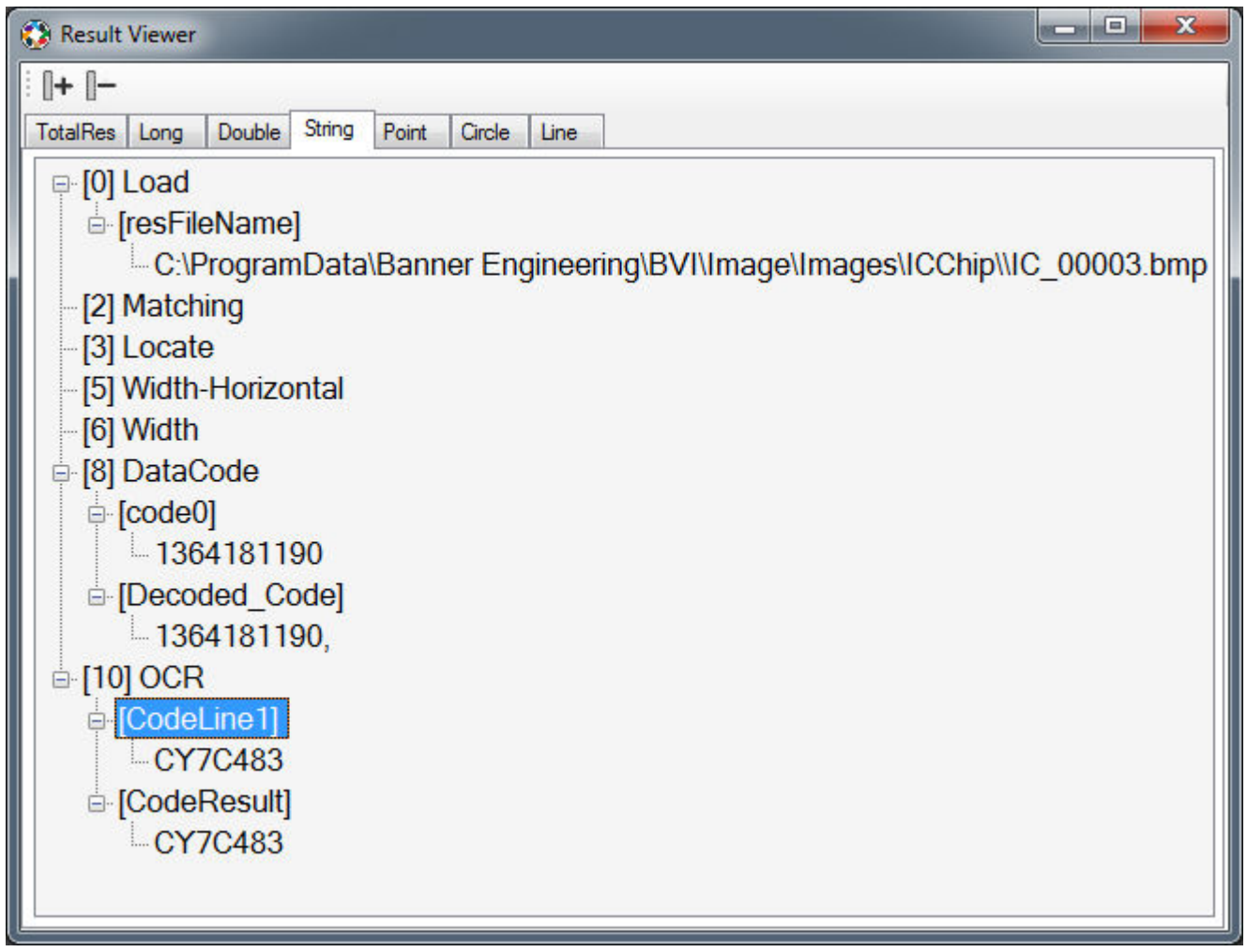
List of IO module supported:

- Adlink PCI Dask
- Adlink USB Dask
- Advantech_PCI
- JS DIO3216B
- BVCRS2

Result Viewer

Result Viewer

To view all the results e.g. Long, Double, String etc. of the tools used in the Program Editor.



To view all the results e.g. Long, Double, String etc. of the tools used in the Program Editor.

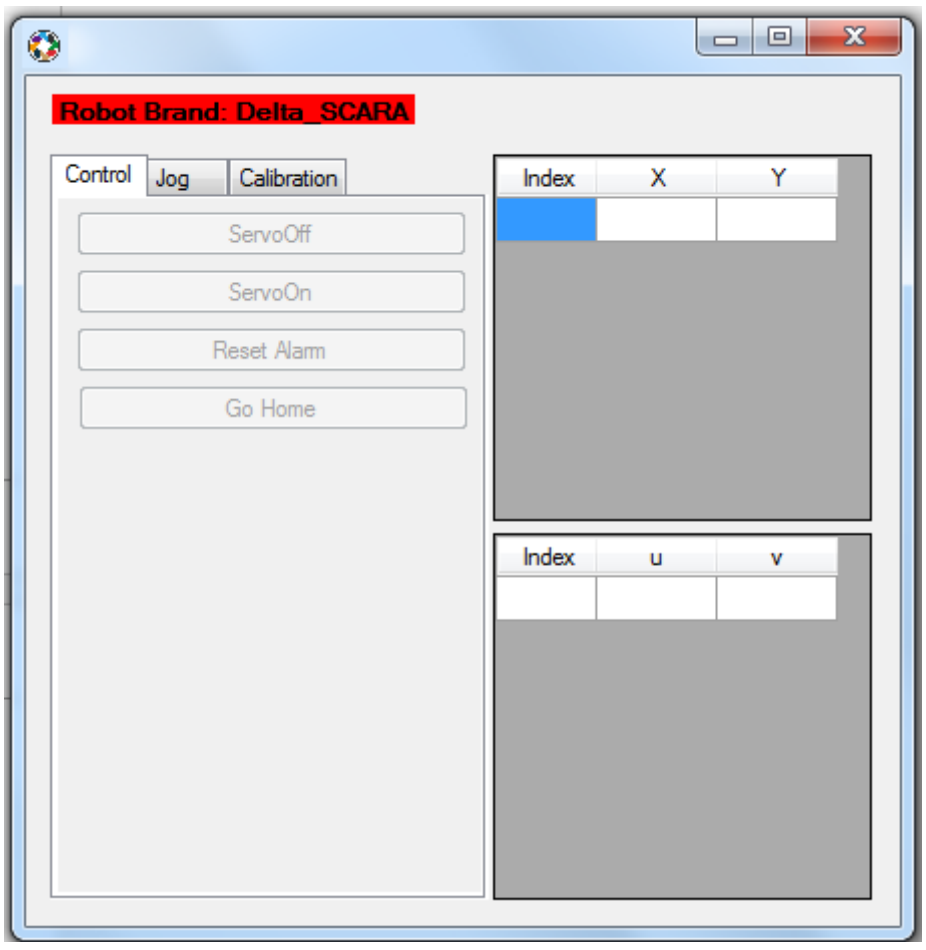
- TotalRes: The final result (1/0) of that individual command used
- Long: The value of a command used e.g. Count Object command – number of objects detected
- Double: A decimal value of a command used e.g. angle – where the measurement angle value is 38.54
- String: A result string of a command used e.g. DataCode – the decoded result as shown in the picture above
- Point: A point result of a X & Y coordinate used in a command e.g. Matching
- Circle: The radius and X & Y coordinate result of a circle command used
- Line: The X & Y coordinates of the 2 points that form a line.

Type	Range	Comment
TotalRes	0-1	The tool's results (Pass/Fail)
Long	2147483647 ~ -2147483648	The value is Integer
Double	1.79769e+308 ~ 2.22507e-308	The value is float
String		The value is string
Point	Px, Py	Point (2 float value)
Circle	Cx,Cy,Cr	Circle (1 point and 1 float value)
Line	Lx1, Ly1, Lx2, Ly2	Line (2 points)

Robot Control

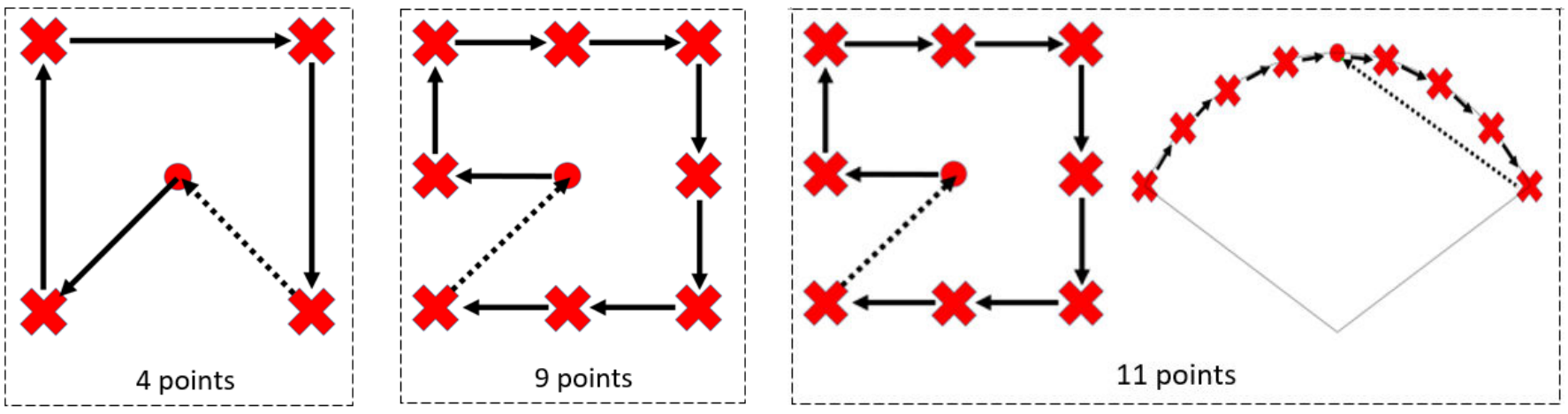
Robot Control

To control the robot arm position and automatically do the calibration. For now, support Delta SCARA robot arm only.



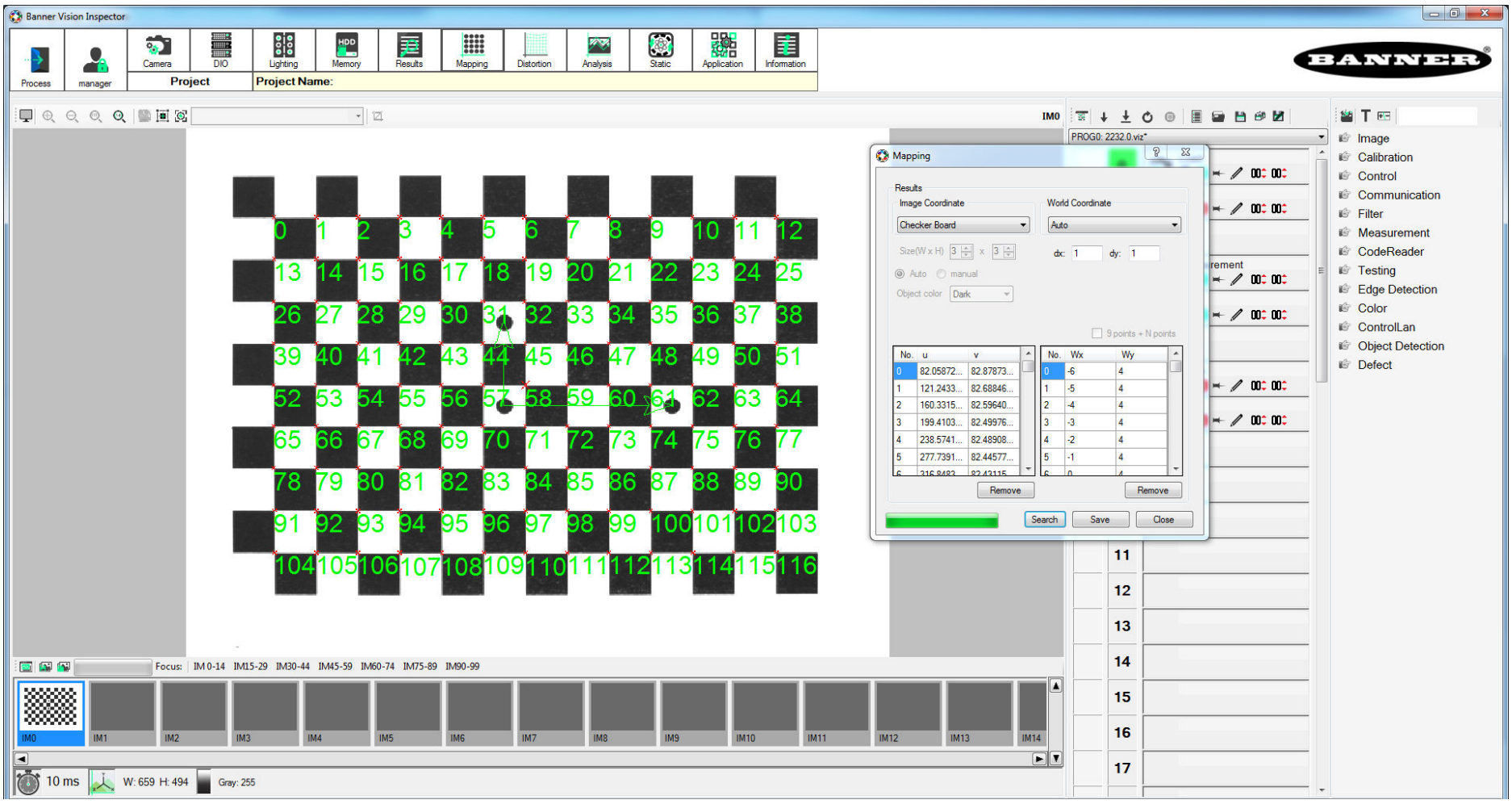
a. **Control:**
   The robot arm control operations.
b. **Jog:**
   To move the robot arm position operations.
c. **Calibration:**
   Two methods to find the target:
   1. Blob: To see the tool Countobject how to use it.
   2. Matching: To see the tool Matching how to use it.

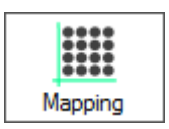
Methods how to move the robot arm:



Configure Mapping

Configure Mapping



1. Live the camera with a target glass as the picture above shown and ensure target is upright.
2. Disable live image and click 

icon and the above menu will appear.

Image Coordinate: Calibration method

- **Checker Board:** Select this option when the above picture's target glass is placed and select Auto option at the World Coordinate with dx & dy value entered. It will then perform automatically do a calculation to transform the image coordinates into world coordinates.
- **Manual:** When this option is selected, it is to perform a mapping between the vision and robot. Right-clicked on the display which is highlighted orange. A red cross line will after right-clicked. (Min. need 3 points). Then select Manual at the World Coordinate where user can enter the robot arm position accordingly after index to the selected individual cross line.
- **Load from file:** Option to allow user to load a file containing details of the world coordinate of the calibration glass.
- **Clear:** To delete all the data in this menu.

World Coordinate:

- **Auto:** Perform automatically do a calculation to transform the image coordinates into world coordinates.
- **Manual:** Allow user to manually enter the world coordinates corresponding to the image coordinates.
- **Load from file:** Option to allow user to load a file containing details of the world coordinate of the calibration glass.
- **Clear:** To delete all the data in this menu.

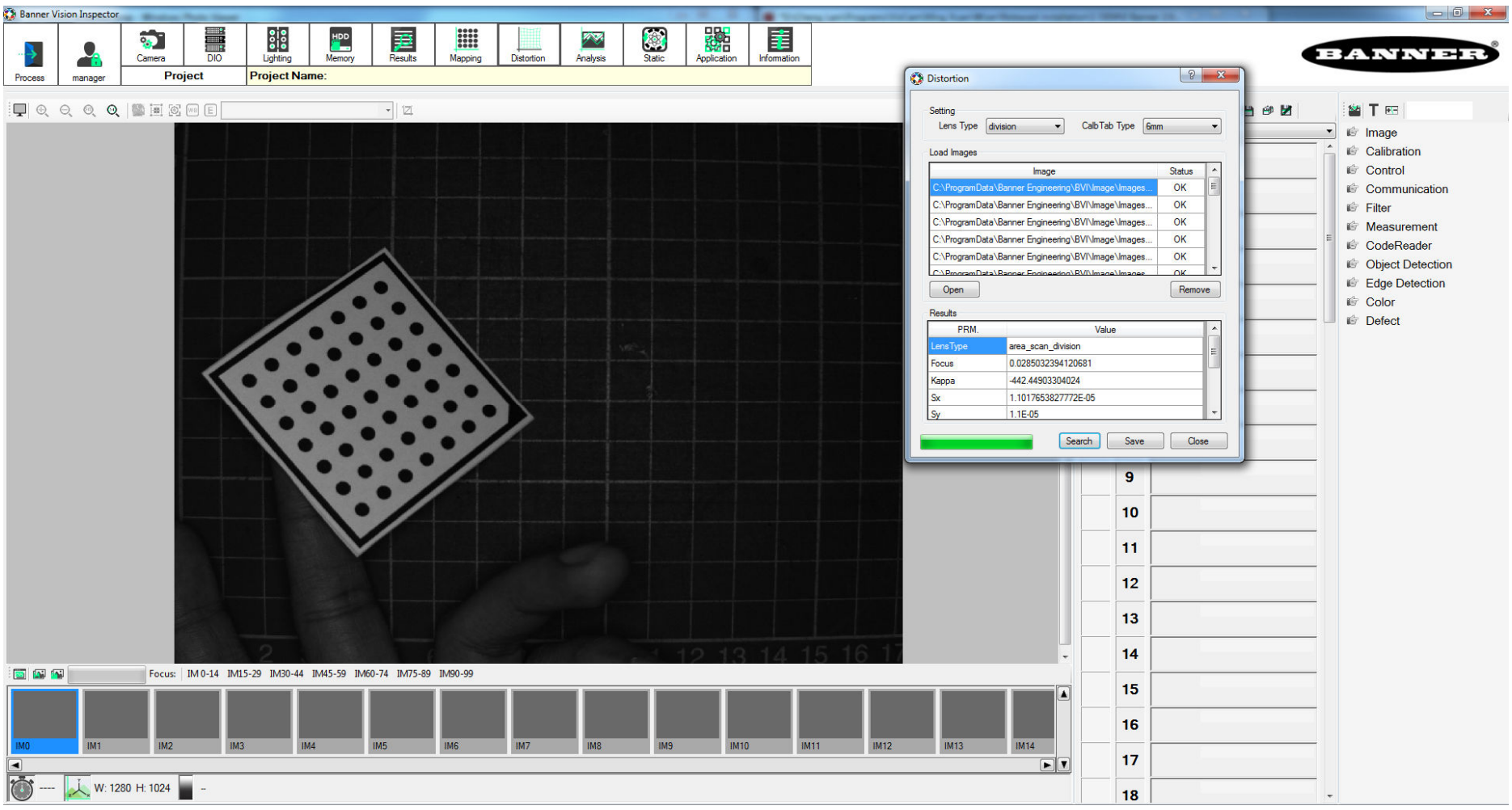
dx & dy: Distance between each point matrix (x and y in world coordinate values).

Search: Click the Search button where the software will automatically search all point matrixes from the field of view. The image & world coordinates will be computed automatically onto the 2 result tables.

Save: Data computed on the 2 result tables can be saved into a file with a desired path location and name. This file can be used when loaded into the mapping function of the calibration command.

Distortion Correction

Distortion Correction



This Distortion command corrects image distortion which occurs either by perspective error or by the lens aberration of the lenses used.

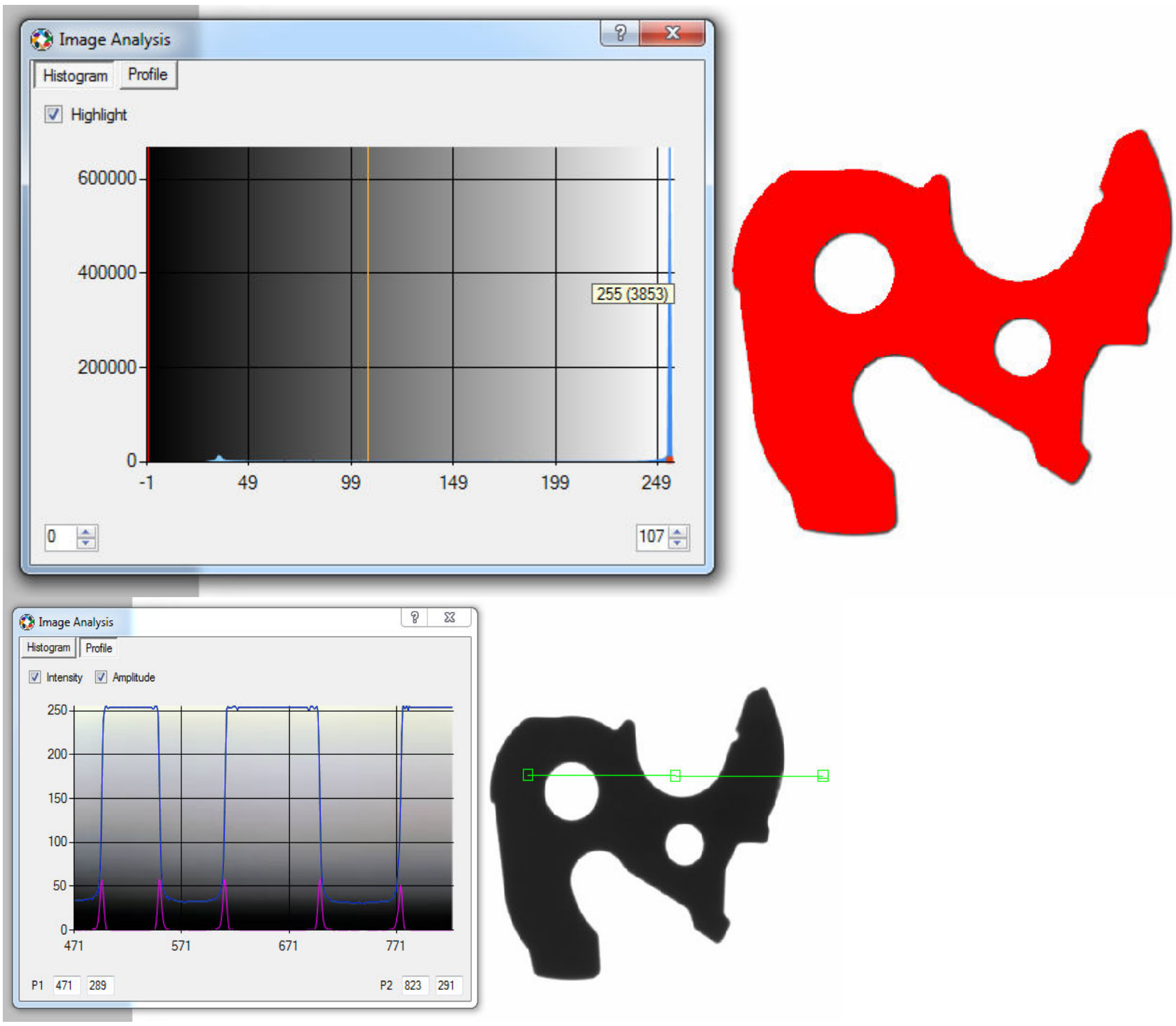
The main part of this distortion process consists of acquiring images of the calibration plates in different position and orientations relative to the vision system. These images at different position and orientations (especially the 4 corners) using the calibration plate must cover the complete field of view. Calibration results and accuracy will improve when more images are used in the calculation.

Need to acquire and save images of the calibration plates in different position and orientations relative to the vision system setup.

Load Image: Load the saved images of the calibration plates in different position and orientations relative to the vision system setup.
Lens Type: Option to select division, polynomial, tele-centric division & tele-centric polynomial
Calb Tab Type: Option to select based on the calibration size.
Search: Click the Search button where the software will automatically compute the distortion calculations basing on those saved images with the calibration plates in different position and orientations relative to the vision system setup.
Save: Data computed can be saved into a file with a desired path location and name. This file can be used when loaded into the distortion function of the calibration command.

Image Analysis

Image Analysis



To extract the key information from the images to display as histogram or profile to allow user to analysis the image.

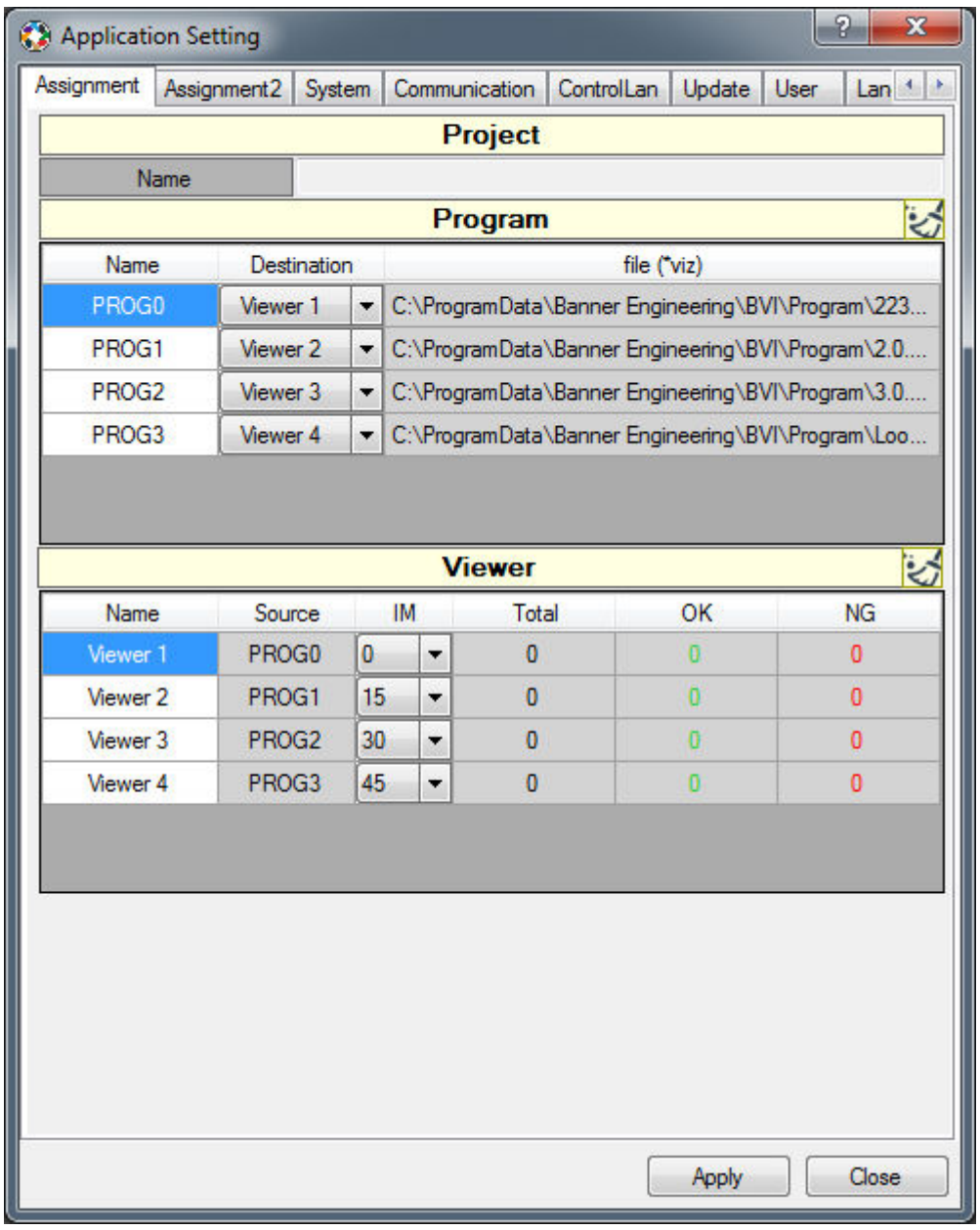
Histogram shows very gray value, the number of pixels which have a value. This tool is espcially usefull to check the saturation of the image.

For measuring using amplitude, a one dimensional gray profile is extracted. An edge is detected at a position where the gray value changes very quickily. This parameter is the minnimum amplitude gradient (the steepness) required to accept an edge.

Application Setting

Application Setting

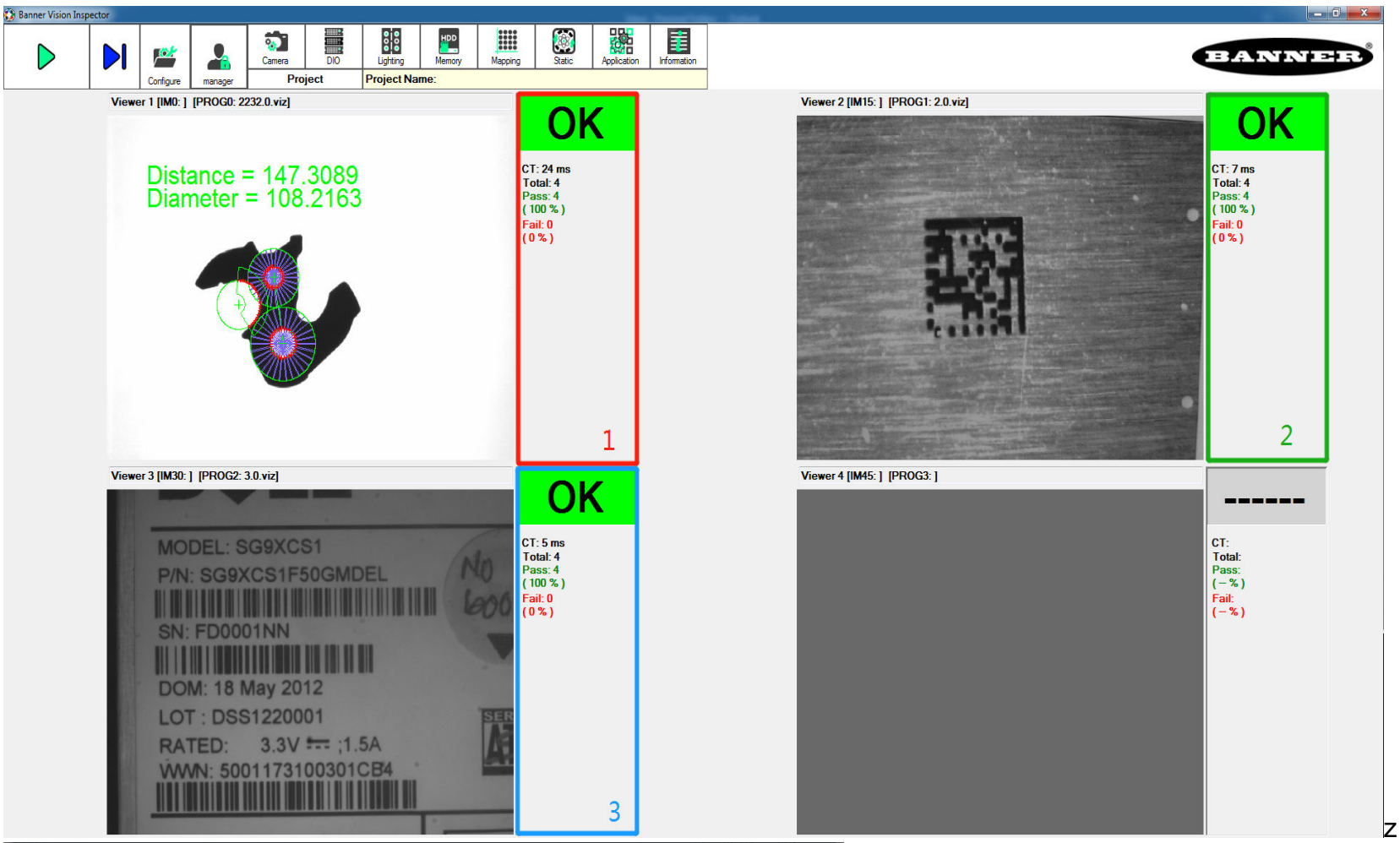
To configure the parameter for the Banner Vision Inspector software.

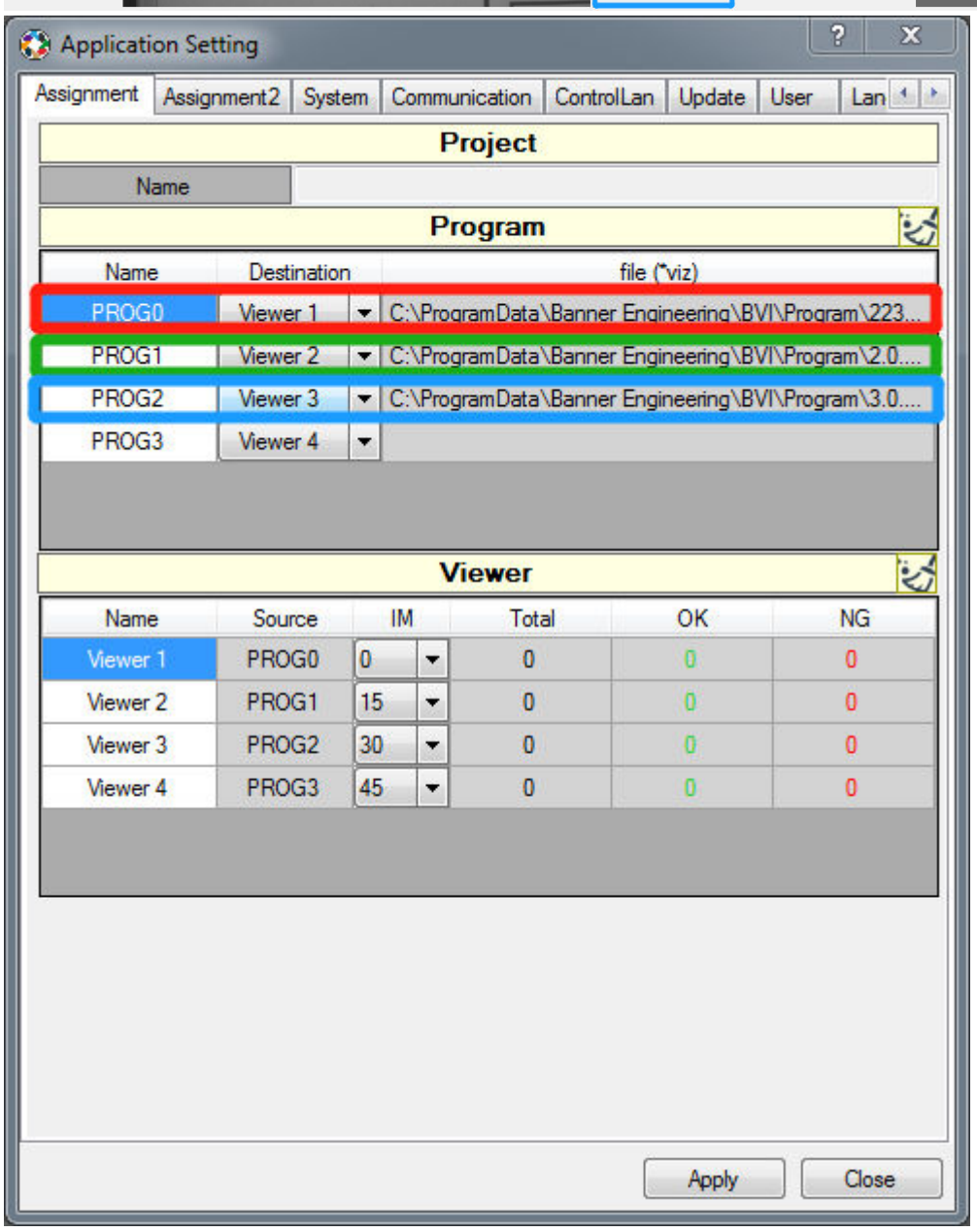


Assignment

Assignment

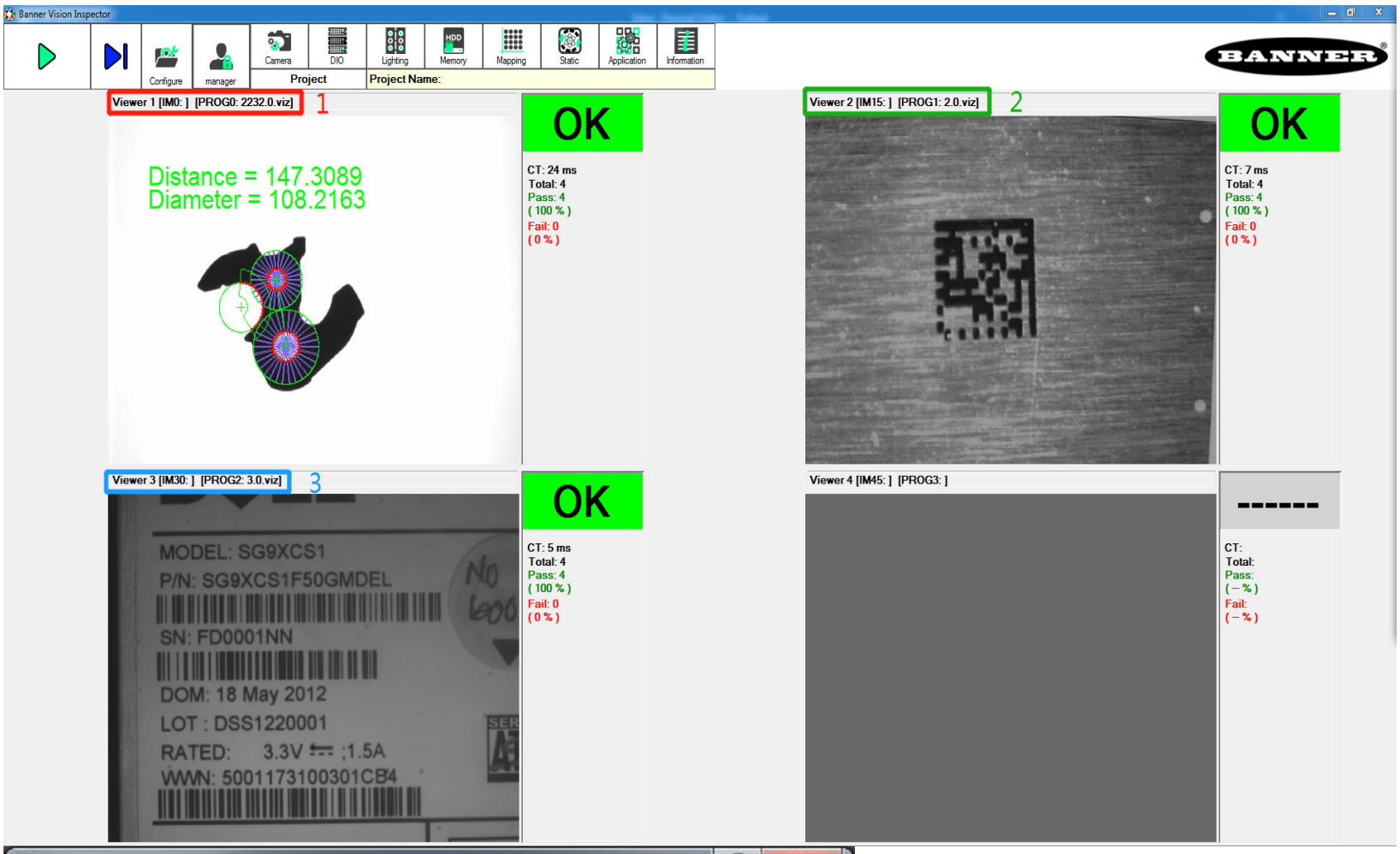
To assign the viewer and inspection program for the Banner Vision Inspector software.

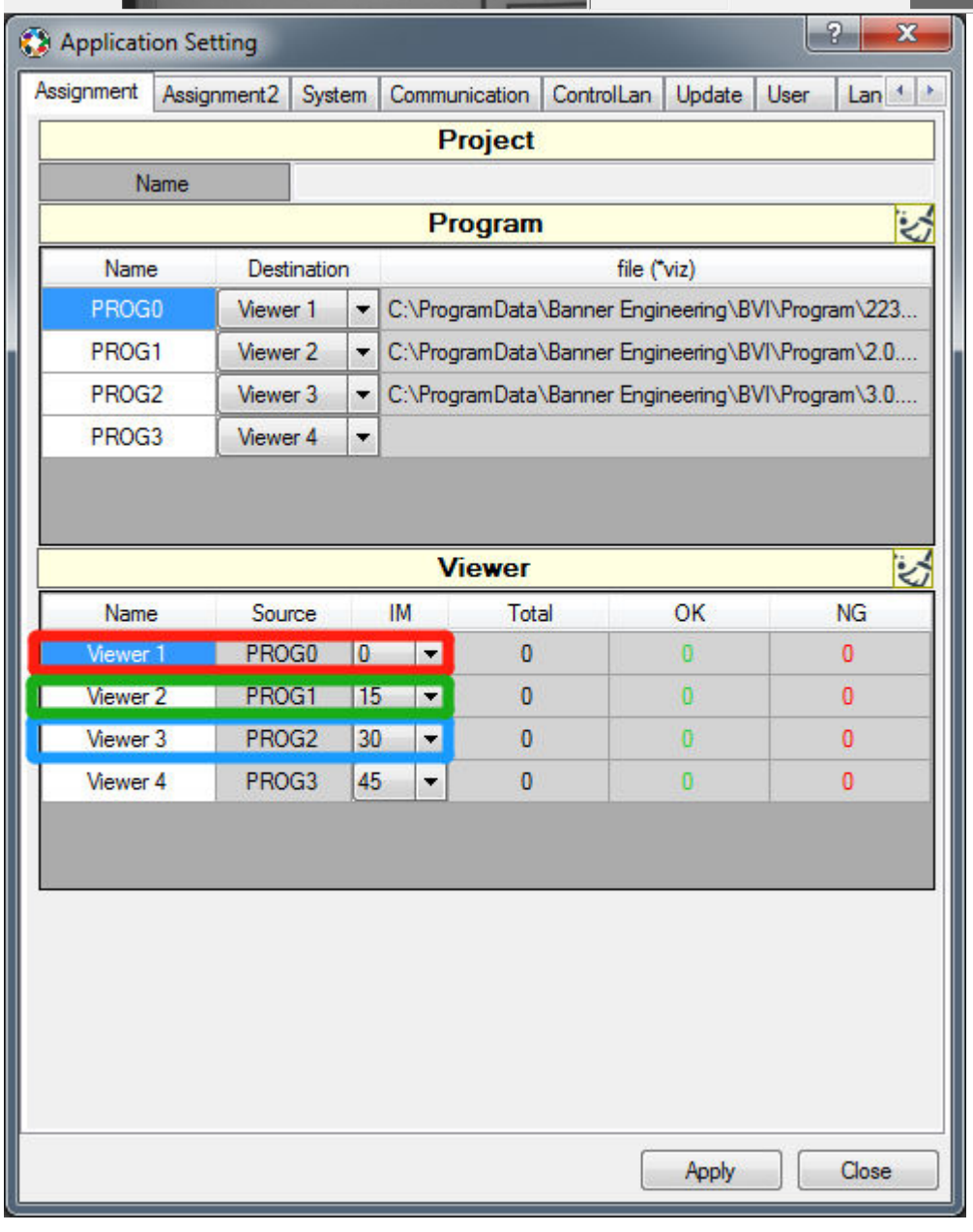




Banner Vision Inspector

- Destination is the program to display the inspection image & result to the respective viewer as defined in the selection provided.
- PROG1 with the Destination selected as Viewer 2 highlighted green will has the image and result display on Viewer 2.
- User is allowed to modify the inspection result and images basing on the destination selected.

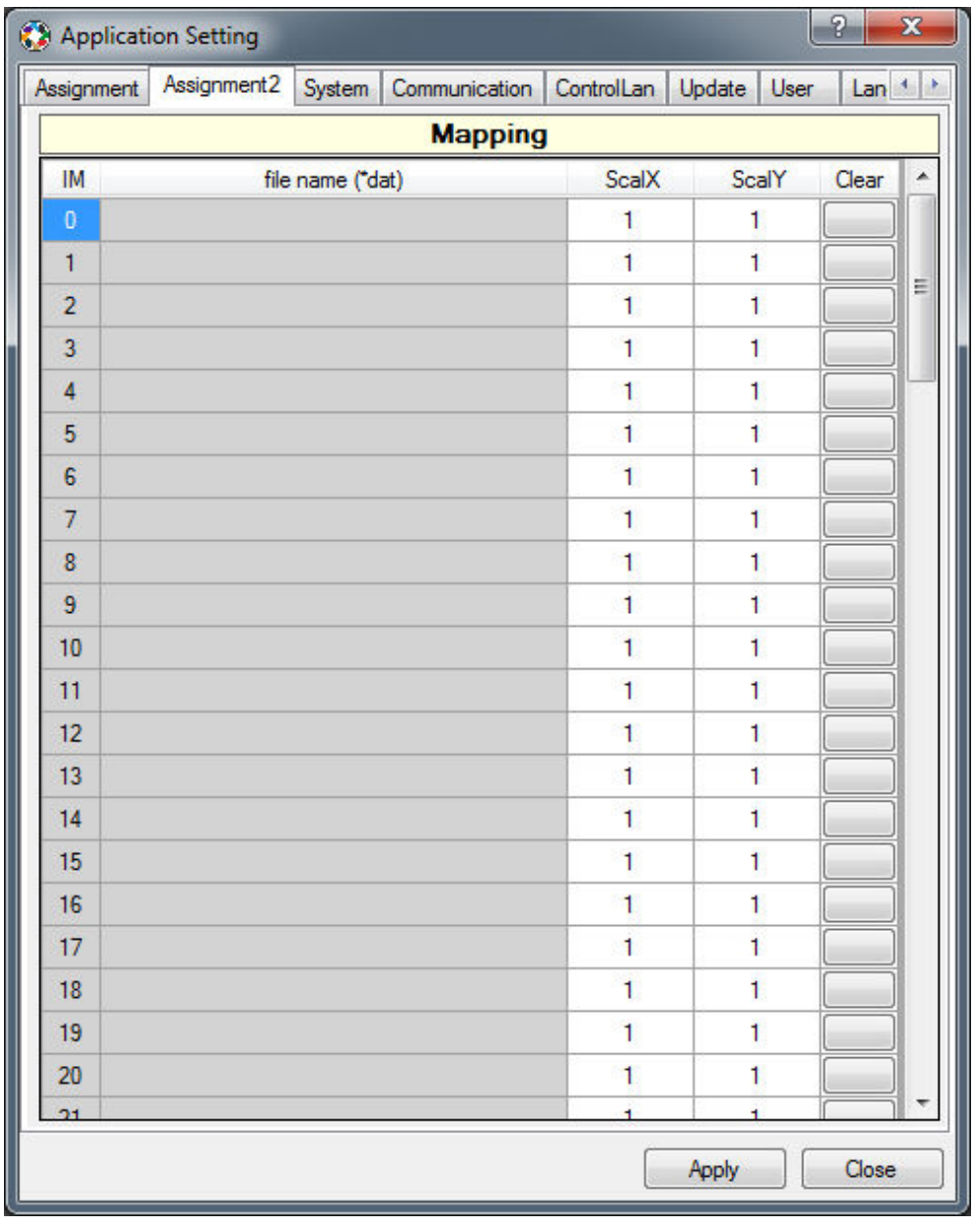




- User can modify the Viewer corresponding to the Image Memory (IM).
- The default is where Viewer1 to IM0, Viewer2 to IM1, Viewer3 to IM2 etc.

Mapping

Assignment 2

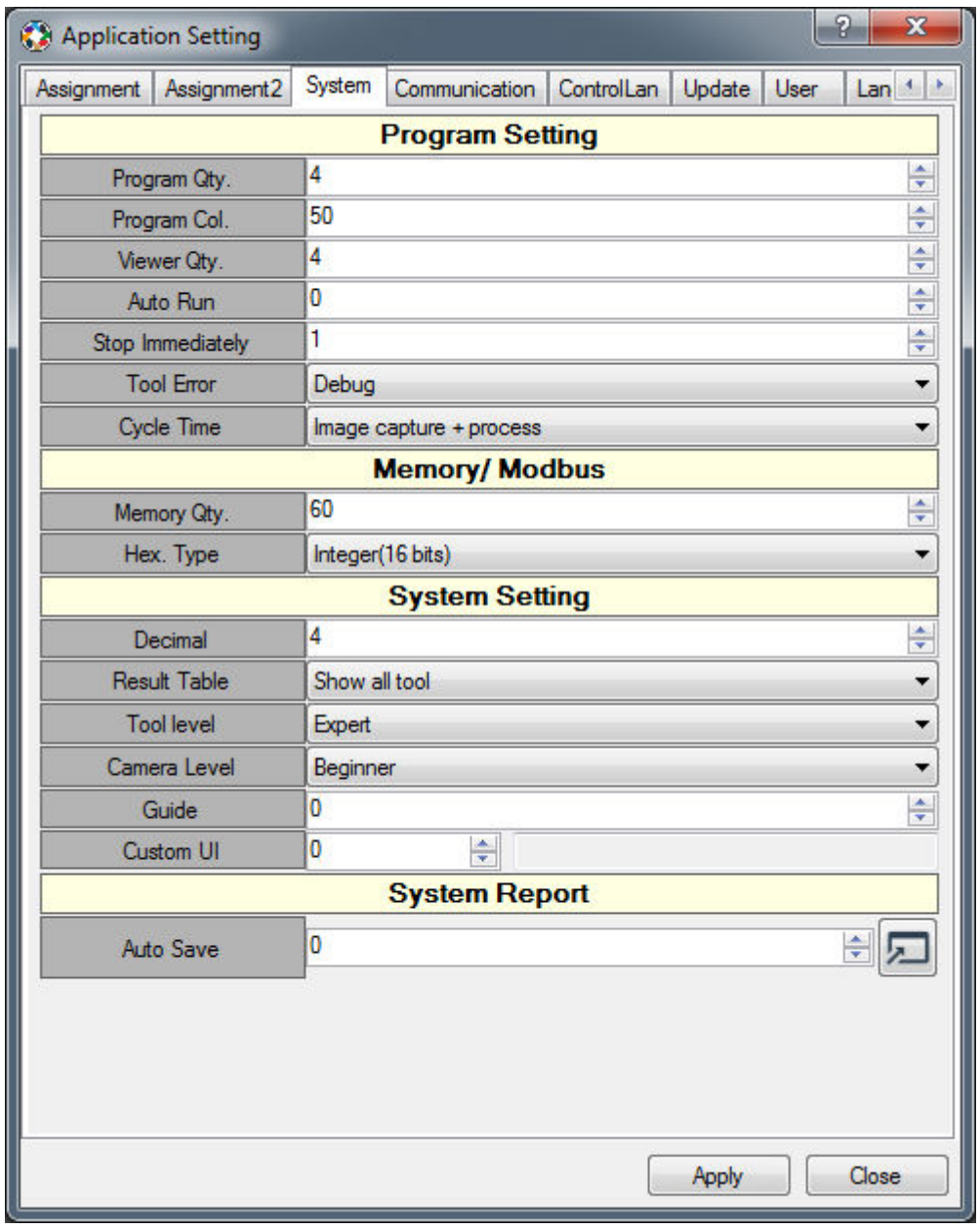


To load the pre-teached or saved mapping from different layer. The dat file is created by calibration mapping to see the Configure Mapping to show the more information on calibration mapping.

System

System

To system parameter for the Banner Vision Inspector software.



Program Setting:

- Program Qty.: To set the number of inspection program. (Max. 6)
- Program Col.: Preset the number of inspection lines.
- Viewer Qty.: Number of the Viewer at the Process Menu (Max.9)
- Auto Run: Automatically load the selected viz program after software is initialized.
- Stop Immediately: To stop process at once(1) or stop process after one cycle(0).
- Tool Error: To ignore or stop immediately, when tool is error.
- Cycle Time: Display timing for Image Capture + Image Processing or display timing for Image Processing

Memory / Modbus:

- Memory Qty.: Number of memory assigned for saving value, point and string.
- Hexadecimal. Type:
  - Integer(16bit)
  - Integer(32bit)
  - Floating Point

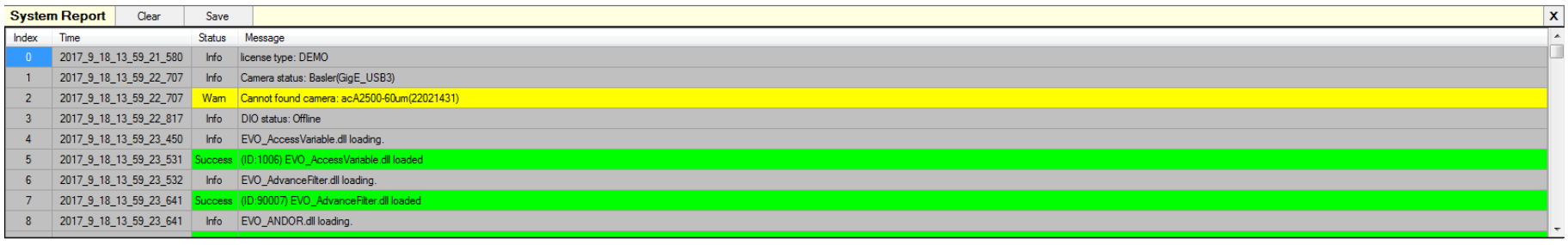
System Setting:

- Decimal: To set the number of decimal points for tools result.
- Result Table: Display the result at the Process Menu
  - Show all tools used in the inspection program at the Process menu
  - Tools that is PING to be shown at the Process menu.
- Camera level: Display the camera parameters according to level.
- Guide: Switch the software to guide mode.
- WUI: Not available.

Banner Vision Inspector

System Report:

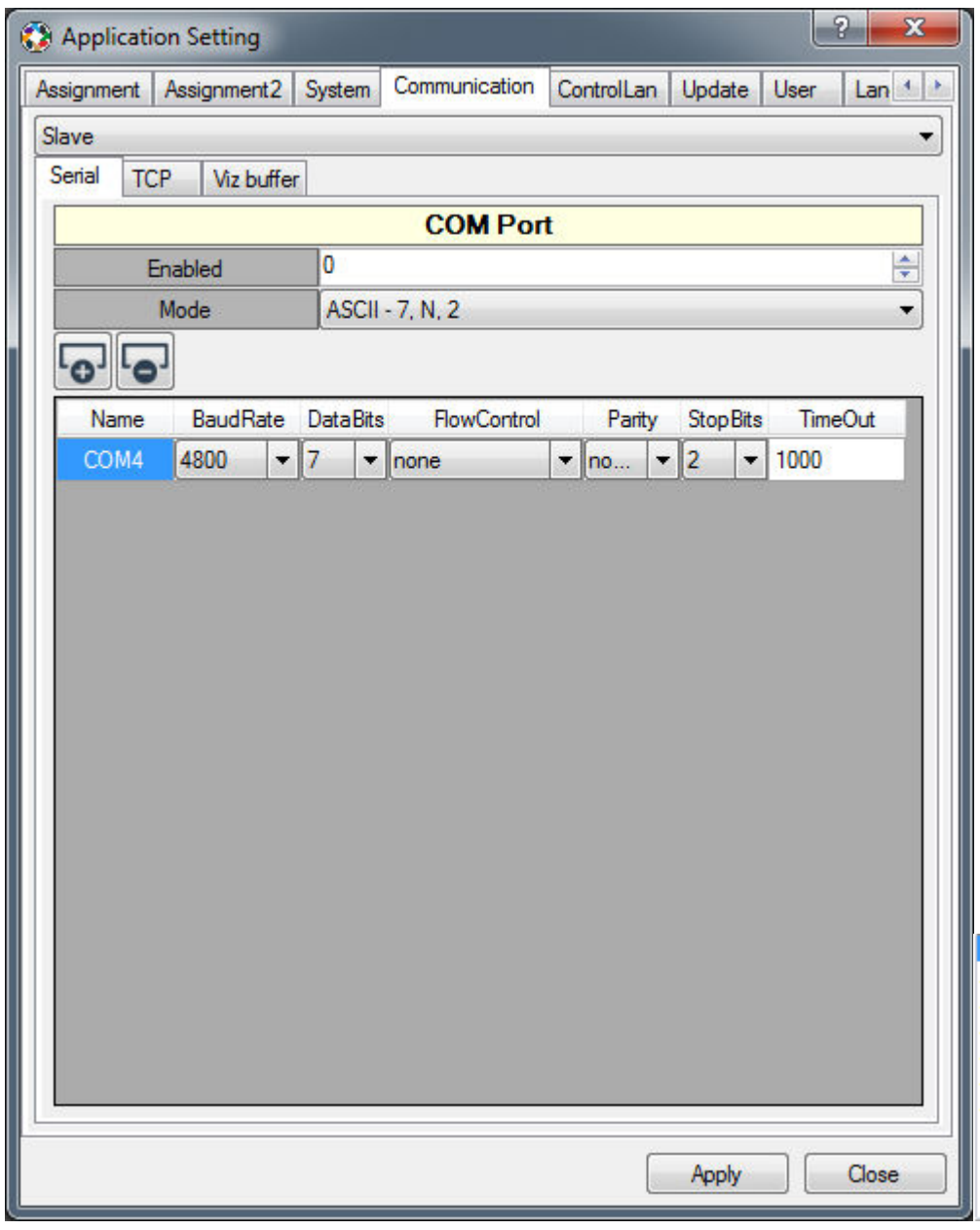
- System report: To save the log of the software events happening.
- User also can press **F10** to open the dialog.
- User can monitor the system report to know the software events.

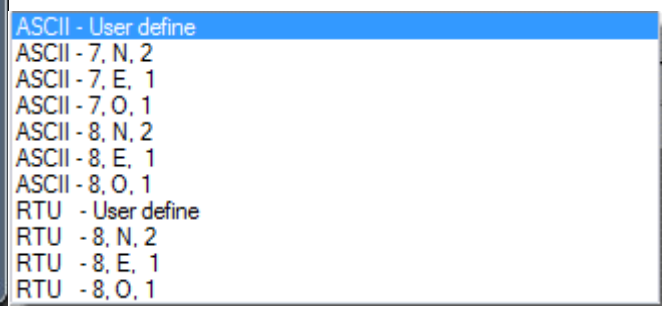


Communication

Communication

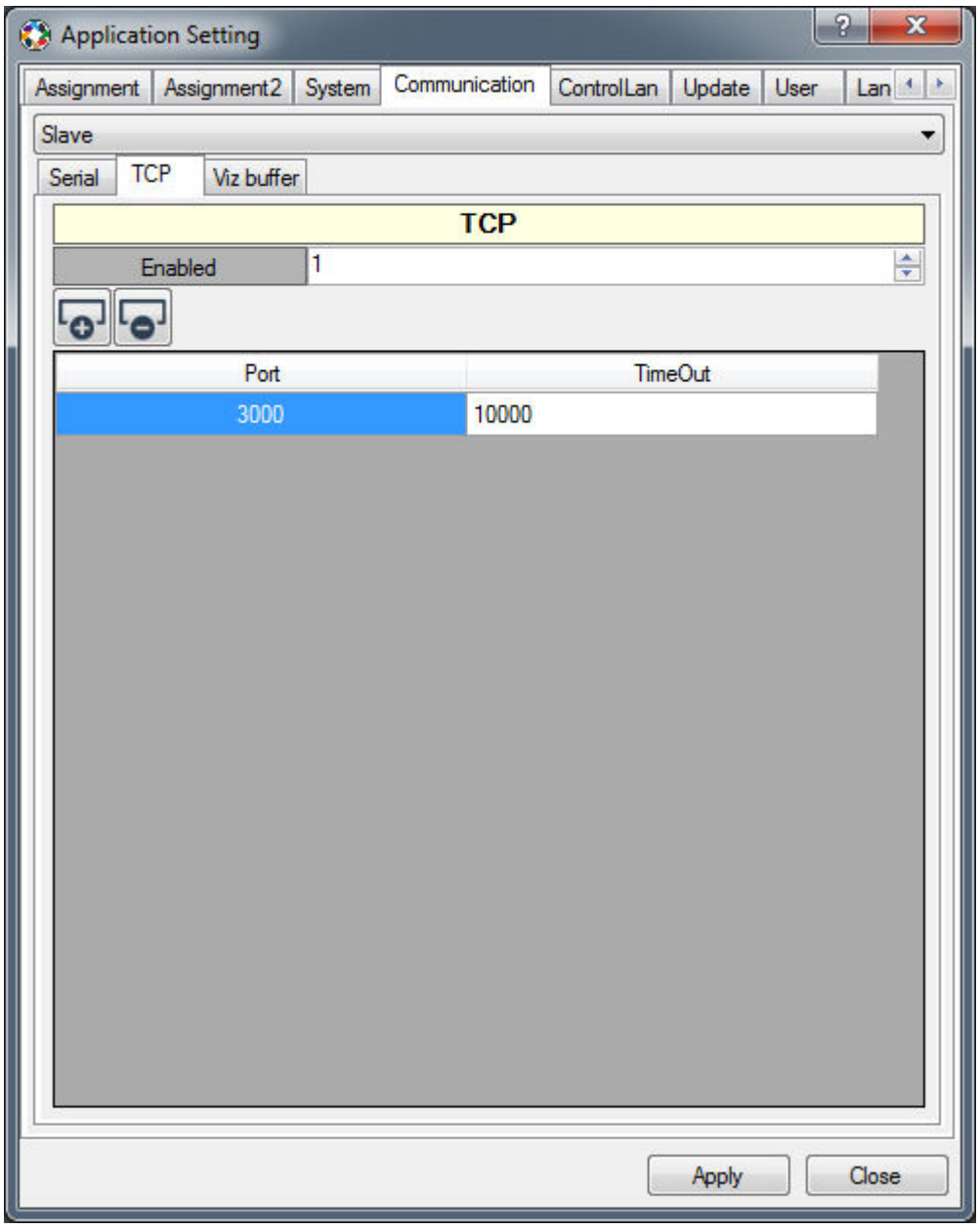
To setup standard protocol Modbus, when choose system is Slave, the system cannot be Poll. Below is when user set system is Slave.



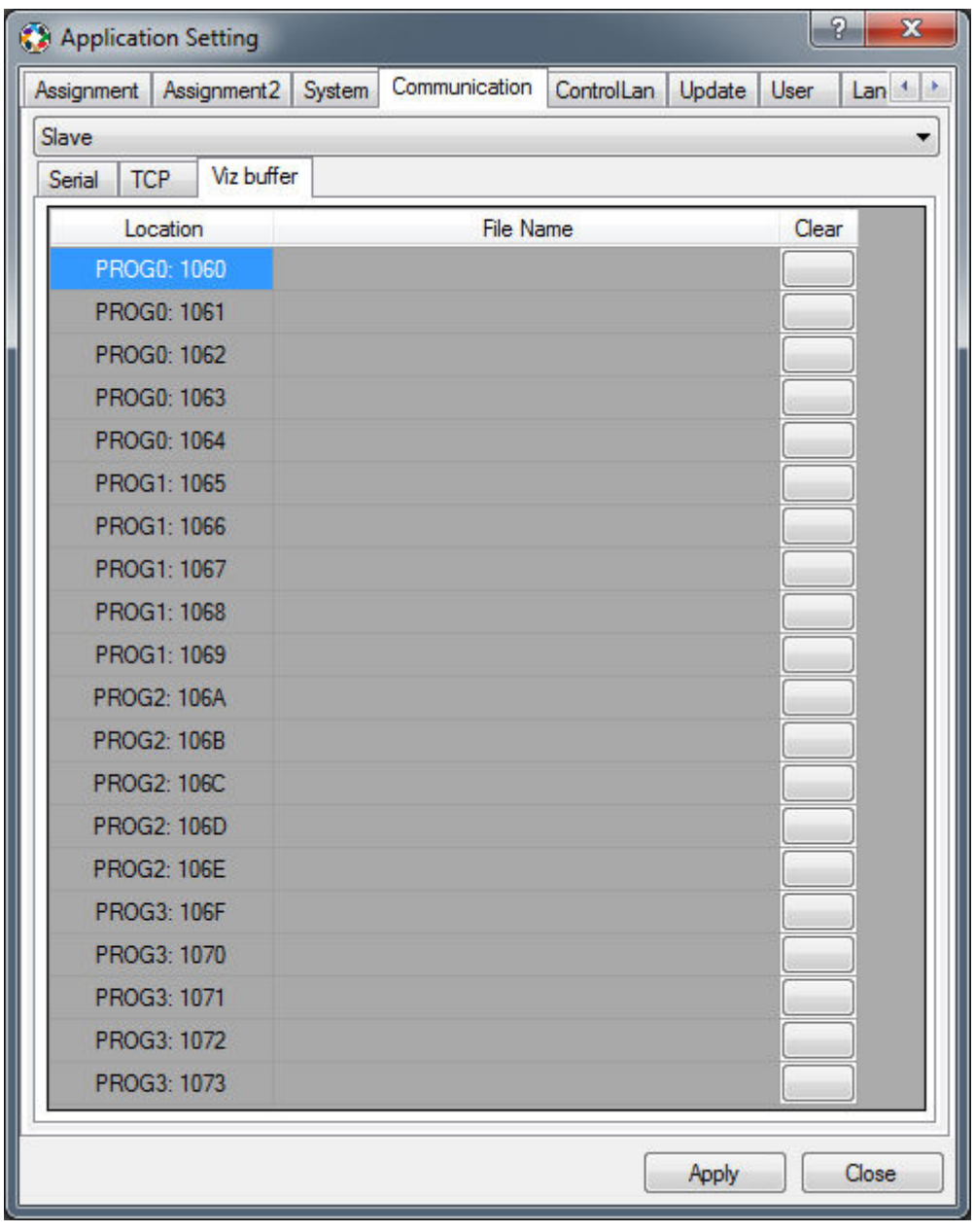


Serial: User can add the number of serial COM by changing the setting in this page as shown the above pictures.

Banner Vision Inspector



TCP: User can add the number TCP ports by changing the setting in this page as shown the above pictures.



Viz Buffer: User can setup the viz program to use Modbus communication to change the program in this page as shown the above pictures.

Function	Location
Run	1000H(06)
Once	1001H(06)
Stop	1002H(06)
Load viz	1060H ~ program qty. (06/10)
Get memory	10D0H ~ memory qty. (06/10)
Set memory	10D0H ~ memory qty. (06/10)
Password	1003H(06)
Get Total count	1004H ~ 1009H(03)
Get Pass count	100AH ~ 100FH(03)
Get Fail count	1010H ~ 1015H(03)
Reset Results count	1016H ~ 101BH(06)
Reset Static	101CH (06)

Slave mode can support modbus protocal ASCII, RTU and TCP standard:

1. Modbus_ASCII:

Read 03:

Send:

:	01	03	1010	0002	DA	CR CL
Head	Slave Address	Function	Starting Address	No. of Points	Error Check	

Feedback:

:	01	03	04	0010	0015	D8	CR CL
Head	Slave Address	Function	Byte Count	Data1	Data2	Error Check	

Write 06:

Send:

:	01	06	1000	0001	E8	CR CL
Head	Slave Address	Function	Starting Address	Data	Error Check	

Feedback:

:	01	06	1000	0001	E8	CR CL
Head	Slave Address	Function	Starting Address	Data	Error Check	

Write 10:

Send:

:	01	10	1070	0002	04	0060	0015	F4	CR CL
Head	Slave Address	Function	Starting Address	No. of Registers	Byte Count	Data1	Data2	Error Check	

Feedback:

:	01	10	1070	0002	6D	CR CL
Head	Slave Address	Function	Starting Address	No. of Registers	Error Check	

2. Modbus_RTU:

Read 03:

Send:

N.A.	01	03	10D0	0001	8133	CR CL
Head	Slave Address	Function	Starting Address	No. of Points	Error Check	

Feedback:

N.A.	01	03	02	000C	4100	CR CL
Head	Slave Address	Function	Byte Count	Data1	Error Check	

Write 06:

Send:

N.A.	01	06	10D0	007B	CCD0	CR CL
Head	Slave Address	Function	Starting Address	Data	Error Check	

Feedback:

N.A.	01	06	10D0	007B	CCD0	CR CL
Head	Slave Address	Function	Starting Address	Data	Error Check	

Write 10:

Send:

N.A.	01	10	10D0	0002	04	007B	01C8	432C	CR CL
Head	Slave Address	Function	Starting Address	No. of Registers	Byte Count	Data1	Data2	Error Check	

Feedback:

N.A.	01	10	10D0	0002	44F1	CR CL
Head	Slave Address	Function	Starting Address	No. of Registers	Error Check	

3. Modbus_TCP:

Read 03:

Send:

00 00 00 00 00 06 01 03 10 D0 00 02

Feedback:

00 00 00 00 00 07 01 03 04 00 01 00 01

Write 06:

Send:

00 00 00 00 00 06 01 06 10 D0 00 00

Feedback:

00 00 00 00 00 06 01 06 10 D0 00

Write 10:

Send:

00 00 00 00 00 0B 01 10 10 D0 00 02 04 00 01 00 01

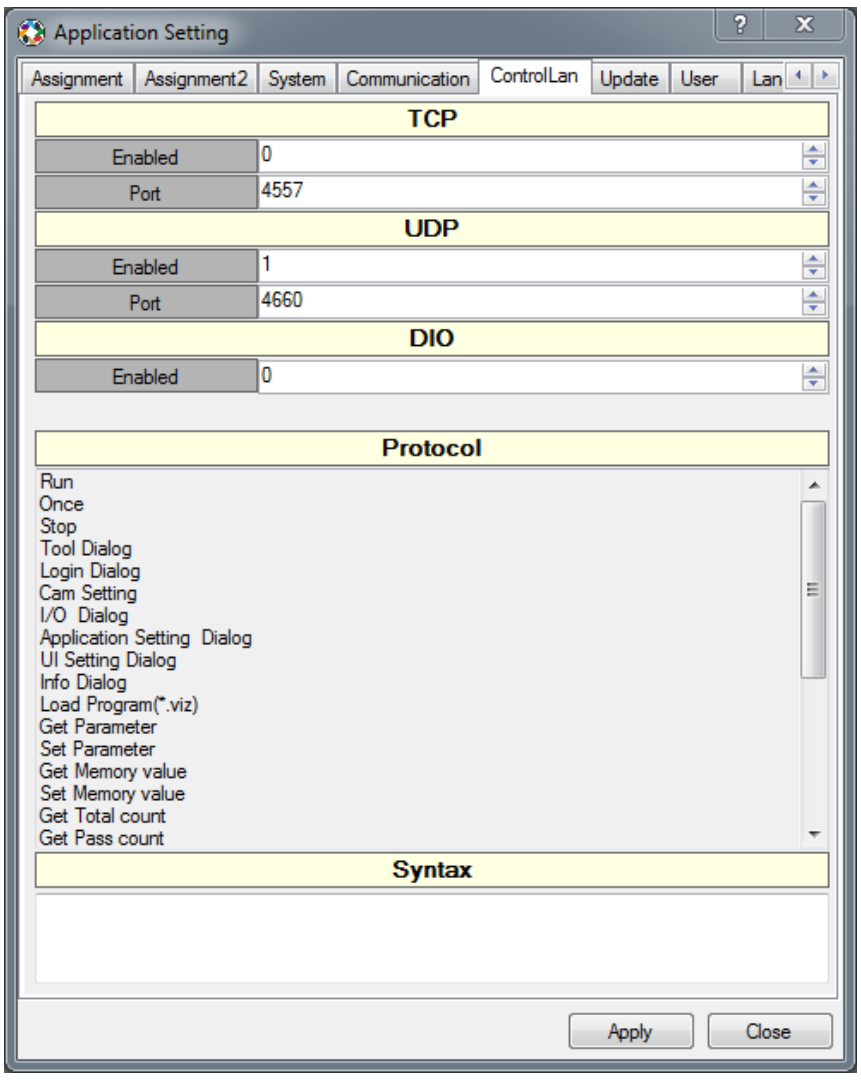
Feedback:

00 00 00 00 00 0B 01 10 10 D0 00 02

ControlLan

ControlLan

This is a custom communication format used by Banner Vision Inspector to communicate where 3rd party software sends instruction via UDP or TCP.



Function	Protocol	Example
Run	001	001
Once	002	002
Stop	003	003
Dialog	004; <ProgramName>;<ToolName>	004;PROG1;DataCode
Login	005	005
Camera setting	006	006
IO setting DIO	007	007
App setting	008	008
Info	009	009
Load viz	011;<ProgramName>;<folder\viz's name>	011;PROG1;C:\ProgramData\Banner Engineering\BVI\Program\IC.viz
Get parameter	012;<ProgramName>;<ToolName>;<ParameterName>;<Type>	012;PROG1;Width;NumofSide;long
Set parameter	013;<ProgramName>;<ToolName>;<ParameterName>;<Type>;<Value>	013;PROG1;Width;NumofSide;long;2
Get memory	014;<Index>;<Type>	014;0;long
Set memory	015;<Index>;<Type>;<Value1>;<Value2>	015;0;long;1
Password	Not available	Not available
Get total count	017;<ProgramName>	017;PROG1
Get pass count	018;<ProgramName>	018;PROG1
Get fail count	019;<ProgramName>	019;PROG1
Reset result count	020;<ProgramName>	020;PROG1
Reset static	021	021
Get user level	022	022
Camera status	023	023
Save all program	024	024
Mapping	027	027
LiveCam	030	030
Load vpj	031;<folder\vpj's name>	031;C:\ProgramData\Banner Engineering\BVI \Program\2D DataCode.vpj
Lighting setting	032	032
Ping	999	999

: Main PROG name

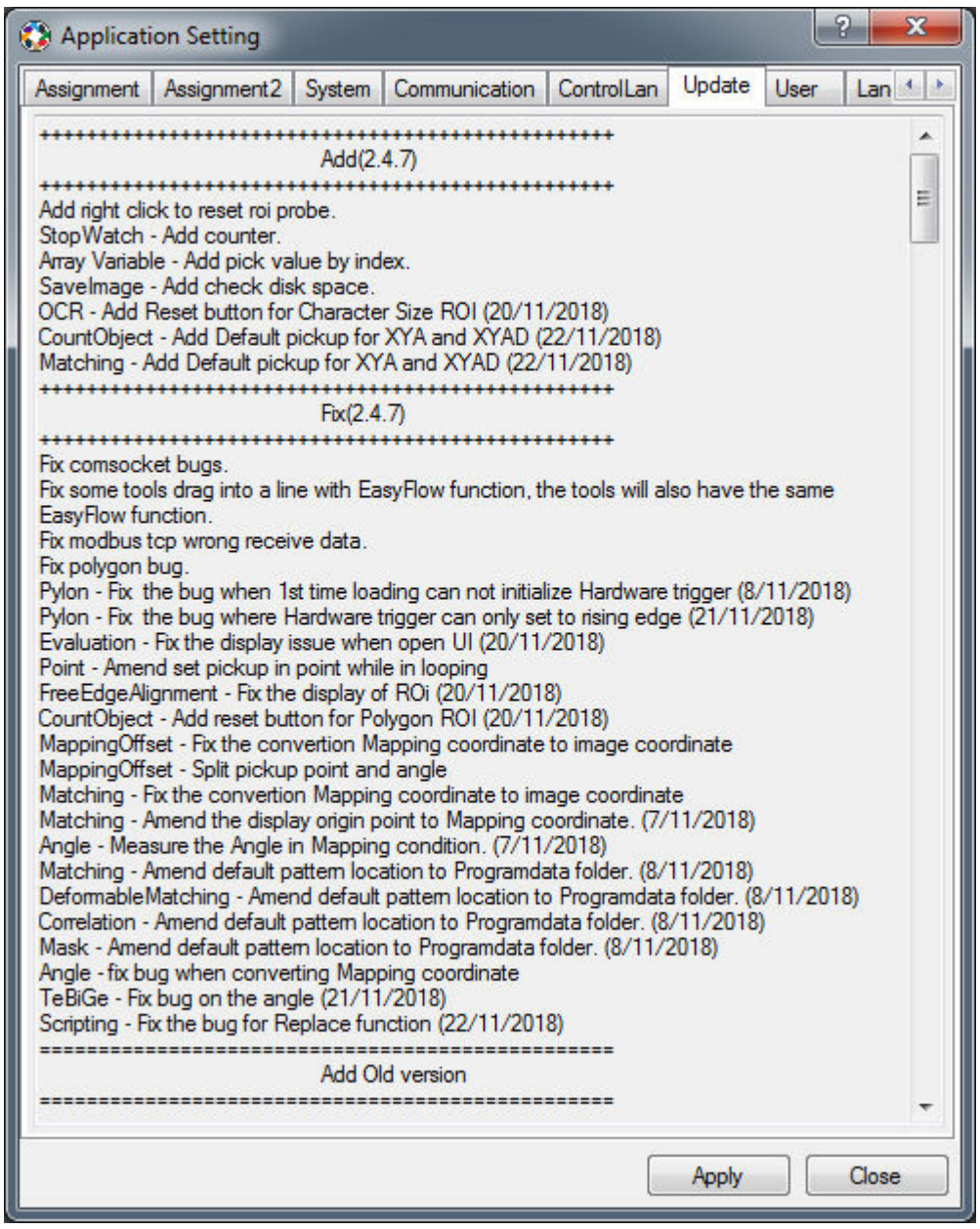
: Tool name

: Parameter name

: long, double, string, point

Update

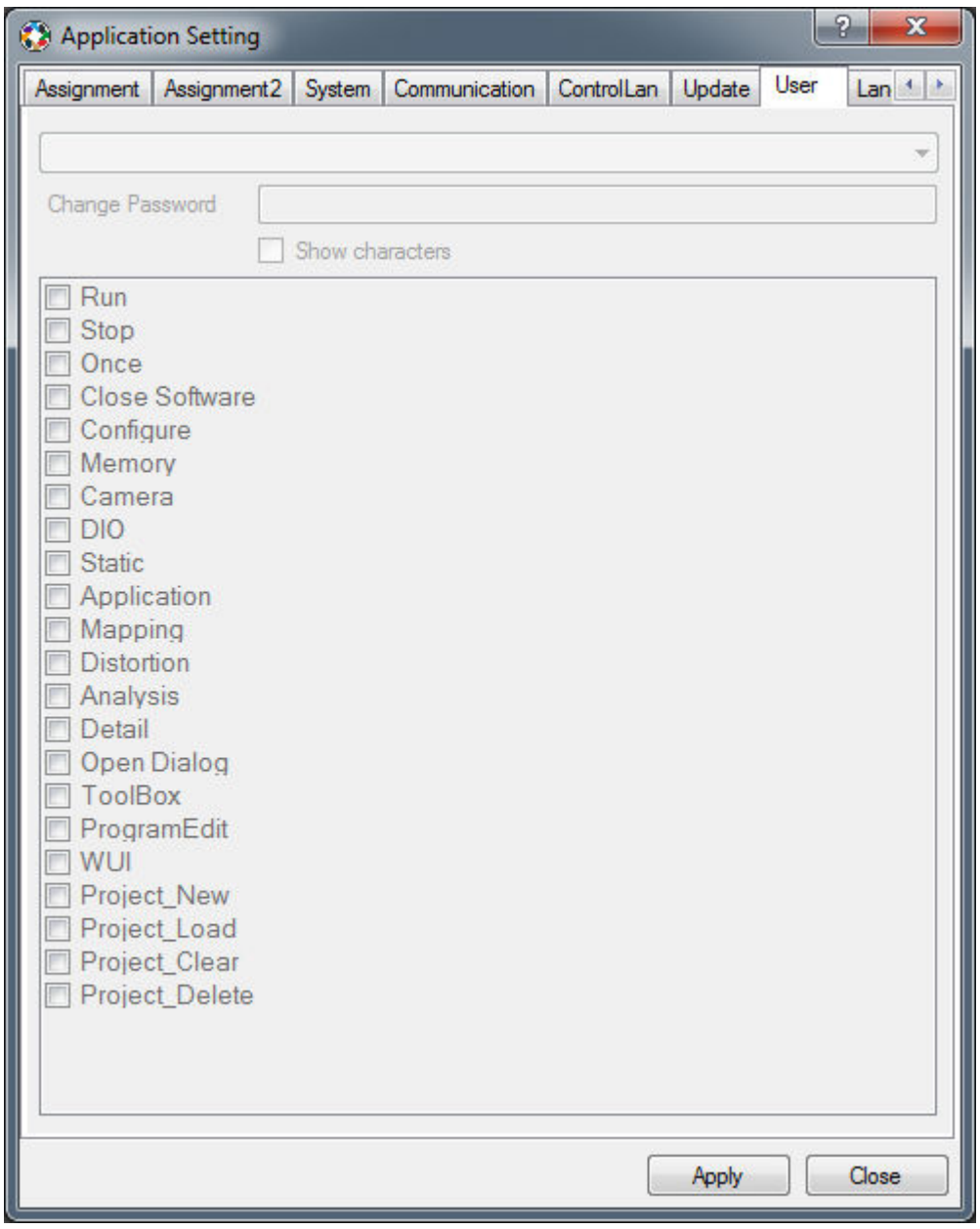
Update



New added applications or informations for the new version Banner Vision Inspector will be stated and explained here.

User

User



Administrator can authorise to enable or disable the application functions.

Language

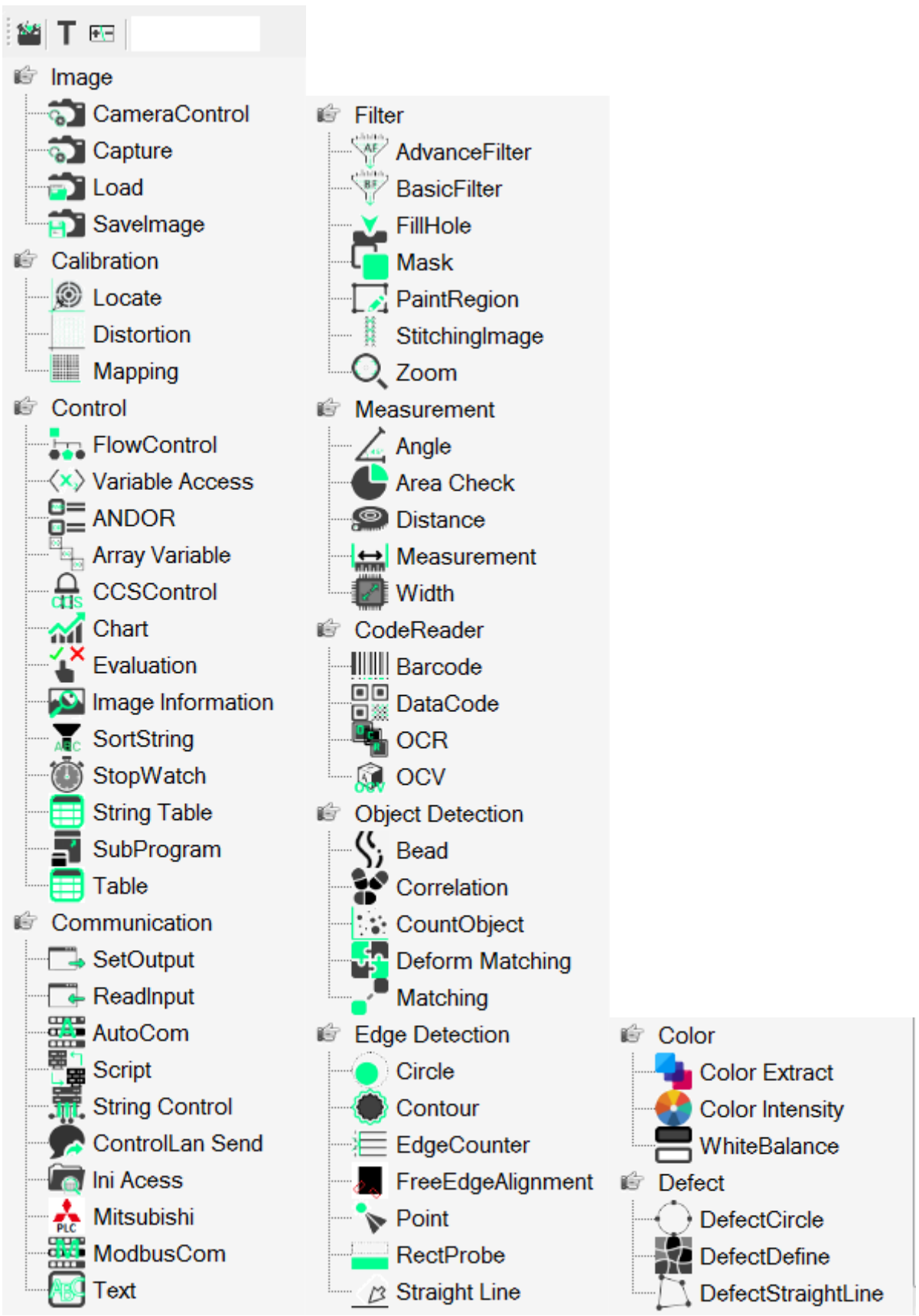
Language

Allow user to change the language type for the software.

Inspection Tools/Command

Inspection Tools/Command

This chapter provides detailed information of the graphical user interface of the inbuild commands/inspection tools.

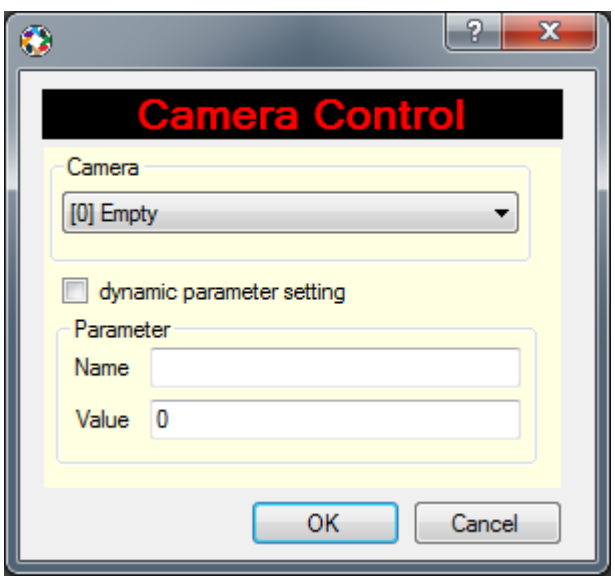


Image

Topic on Camera Control, Capture, Load and Save Image.

Camera Control

Camera Control



The Camera Control command is used to change the parameter of channealled camera directly.

Camera: To determine which camera is channelled to this camera control command.

Dynamic parameter setting: Refer to the process of choosing and load a complete parameter file anywhere in the computer.

Parameter

- **Name:** Name the shutter paratemer with your own reference
- **Value:** Set the value for the shutter parameter

Capture

Capture

The Capture command is used for capture images from the camera.

Camera: Camera index to determine which camera is channelled to this image capturing command. It will capture an image with the selected cameras at the Hardware Configurator software.

Capture mode:

[0] Same with camera setting: The camera will follow the capture mode with camera setting.

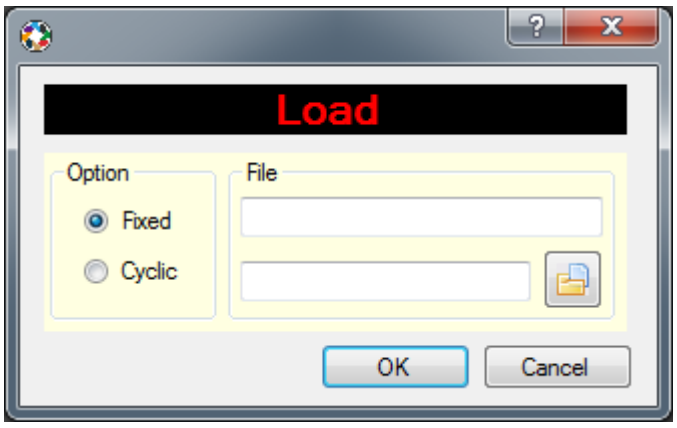
[1] free run: To force the camera to free run mode.

[2] Asynchronus: To force the camera to Asynchronus mode.

[3] Hardware Trigger: To force the camera to Hardware Trigger mode.

Load

Load



The Load command is used to load images from the desired directory to allow offline testing purposes.

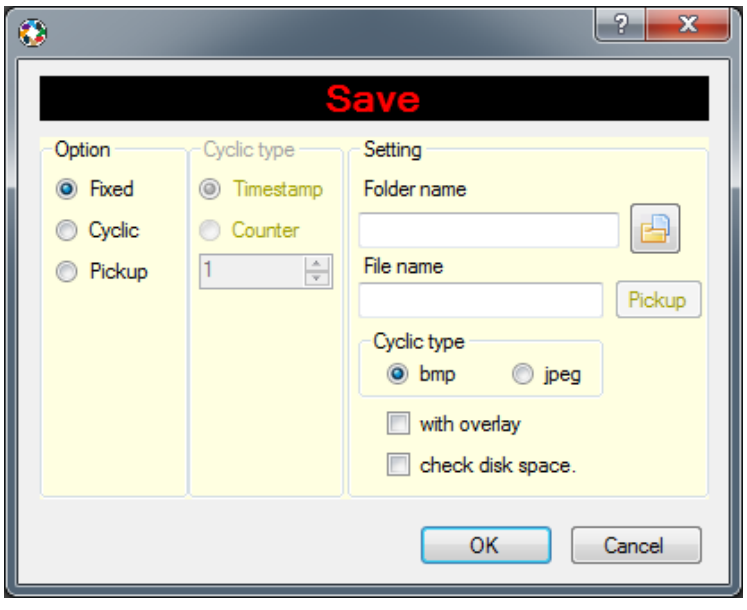
Option:

- **Fixed:** When choosing this option, a name and storage location of an image can be assigned by the file selection button.
- **Cyclic:** When choosing this option, the entire selected folder of the location is activated. All images in the selected folder are loaded sequential.

File: Displays of the current file location and name.

SaveImage

SaveImage



The SaveImage command is used to save the current acquired images into a desired directory in bmp or jpeg format.

Option:

- **Fixed:** When choosing this option, a name and storage location of an image can be saved and assigned by the file selection button.
- **Cyclic:** When choosing this option, all images are saved in the selected folder in sequential.
- **Pickup:** Able to save the file name basing on the inspection result.
- **File Name / Pickup:** To pick up the inspection result and save the image file name basing on the pick-up result.

Cyclic type:

- **Timestamp:** To save the images according to the filename_date_time. E.g.: Test_2017_7_6_14_31_14_684. Need to select the Cyclic option for his feature, enter a name under the File Name text and specific/open a folder name for saving the images.
- **Counter:** To save the images according to the internal counter. E.g.: Test_00001. Need to select the Cyclic option for his feature, enter a name under the File Name text and specific/open a folder name for saving the images.

Setting:

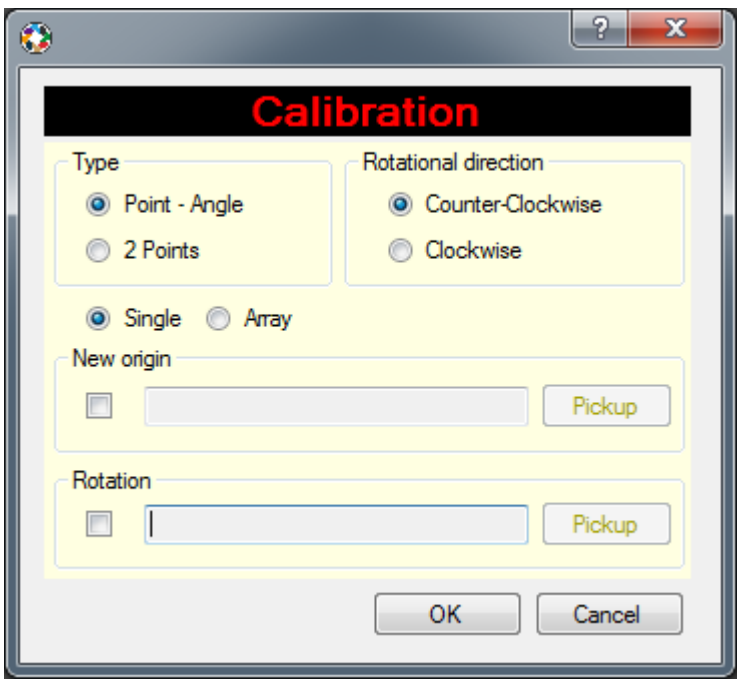
- **Folder name:** Displays of the current file location and name.
- **Bmp/Jpeg:** Image format to be saved. (bmp is original image size where else jpeg is compressed image)
- **With Overlay:** To save the images with overlay used in the inspection program created.
- **Check disk space:** Enable / disable check disk space function.

Calibration

Topic on Locate, Distortion and Mapping.

Locate

Locate



The Locate command is used for position tracking in X and Y direction as well as rotation position.

Type:

- **Point-Angle:** Based on a point and an angle to locate the object position.
- **2 Points:** Based on 2 points to locate the object position.

Single: Only pick up one coordinate result.

Array: Pick up an array coordinate result within a command. The particular command usually will find at 2 or more coordinate result, e.g. Matching or Count Object command. This array option is selected when using the looping concept in the viz program.

New Origin: A new origin of the X & Y can be defined. The X & Y coordinates are updated with a completely new starting point of the coordinate system basing on the new reference origin from the image.

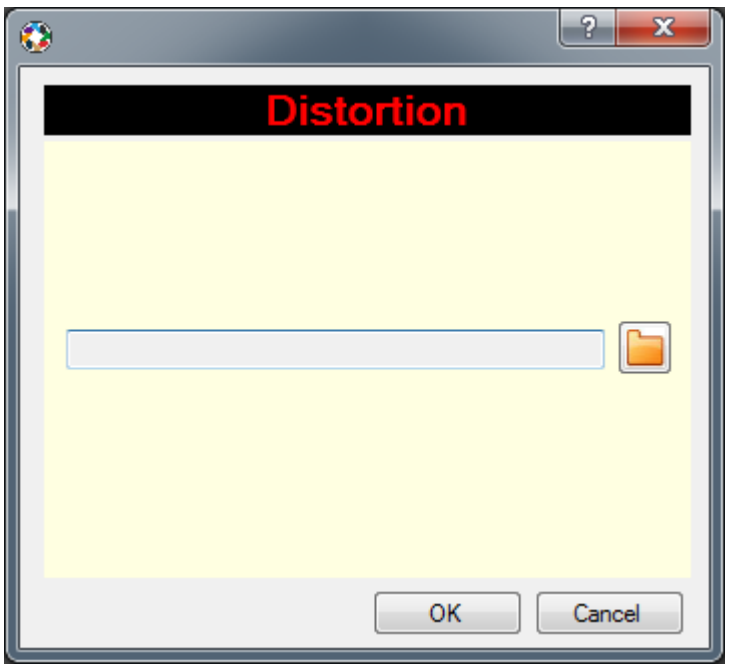
Rotation: With this option, a new coordinate origin is defined with turning position traced by an angle with respect to the selected reference.

Pickup: The Pickup refers to the process of choosing the result value generated by a command / function anywhere in the inspection program. The Pickup is a global data structure which uses the result values of the different commands into their position and stores them. This allows the user to have a specific access to the result and is not dependent on any possible shifts in the program.

Rotational direction: To set the rotational direction of the coordinate result.

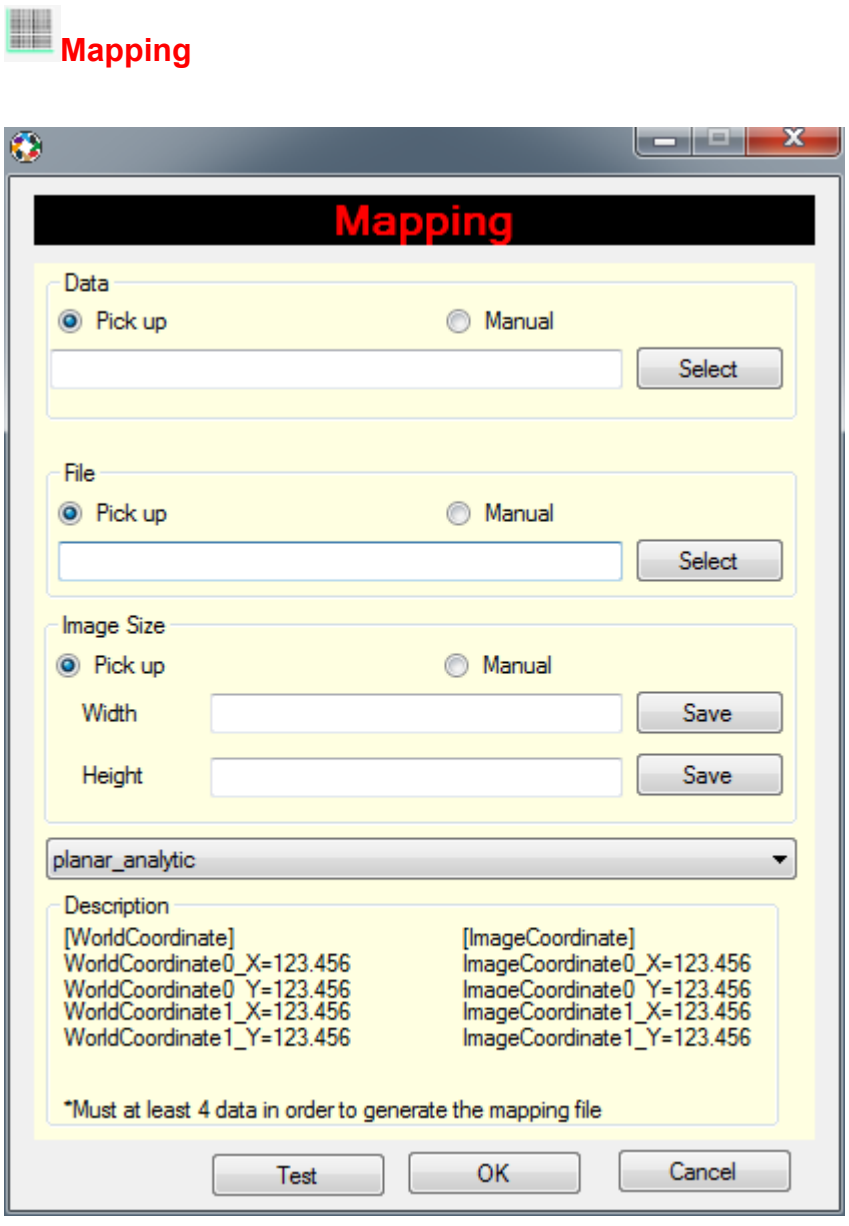
Distortion

Distortion



This Distortion command corrects image distortion which occurs either by perspective error or by the lens aberration of the lenses used.

Mapping



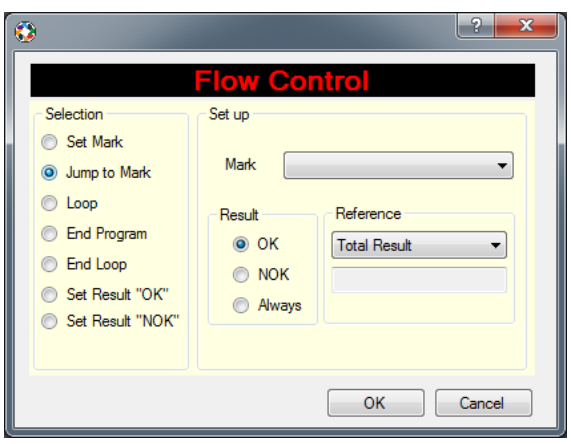
The Mapping command uses a saved reference file on a projection map which describes the mapping conversion between the image plane and the measured plane in a world coordinate system.

Control

Topic on Flow Control, Variable Access, ANDOR, Array Variable, CCS Control, Chart, Evaluation, Image Information, Sort String, Stop Watch, String Table, SubProgram and Table.

FlowControl

FlowControl



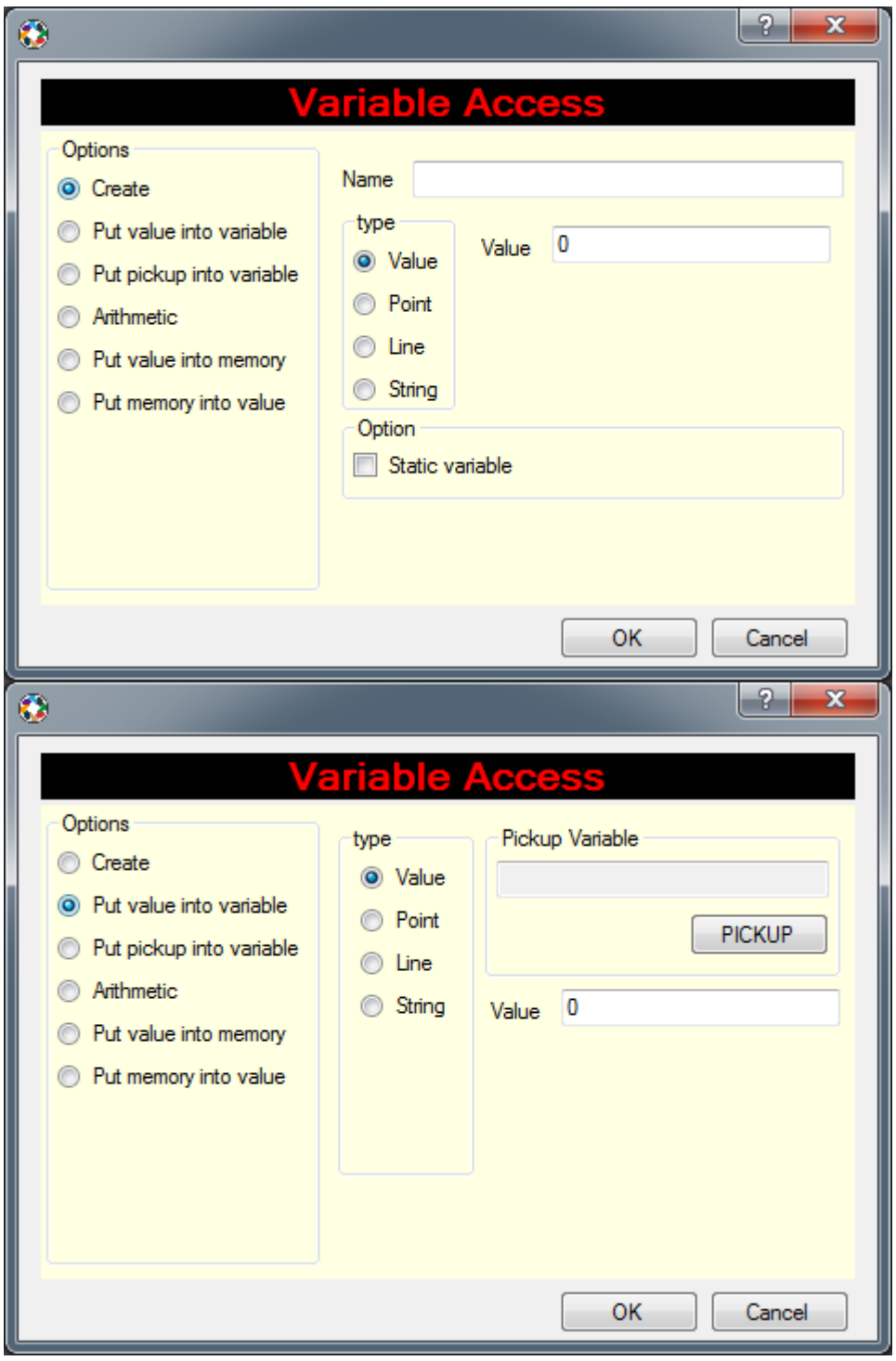
The Flow Control command provides several options to influence sequential flow of the inspection program.

Selection:

- **Set Mark:** Create a new node or mark in a viz program. A Mark is a unique label within the program where the mark name can be defined by user.
- **Jump to Mark:** A conditional jump to a pre-assign selected available Mark. Executes a conditional jump to a selected mark basing on the inspection tools result.
- **Jump to Mark (OK):** Jump to selected Mark if reference result is OK. Jump accordingly basing on the total result of the commands used or based on the selected command result.
- **Jump to Mark (NOK):** Jump to selected Mark if reference result is NOK. Jump accordingly basing on the total result of the commands used or based on the selected command result.
- **Loop:** Perform a loop with a defined number of cycles at the selected mark before proceeding to next command or action. Able to the set the number of looping manually under the Times textbox or loop the number of times basing on the pick up from the memory (result).
- **End Program:** Define termination point of an inspection program. Program will start again at the beginning.
- **End Loop:** Define a loop termination point of a mark. Program will start again after the looping process is completed.
- **Set Result OK/NOK:** To allow the user to set/force the viz program to be inspection result.

Variable Access

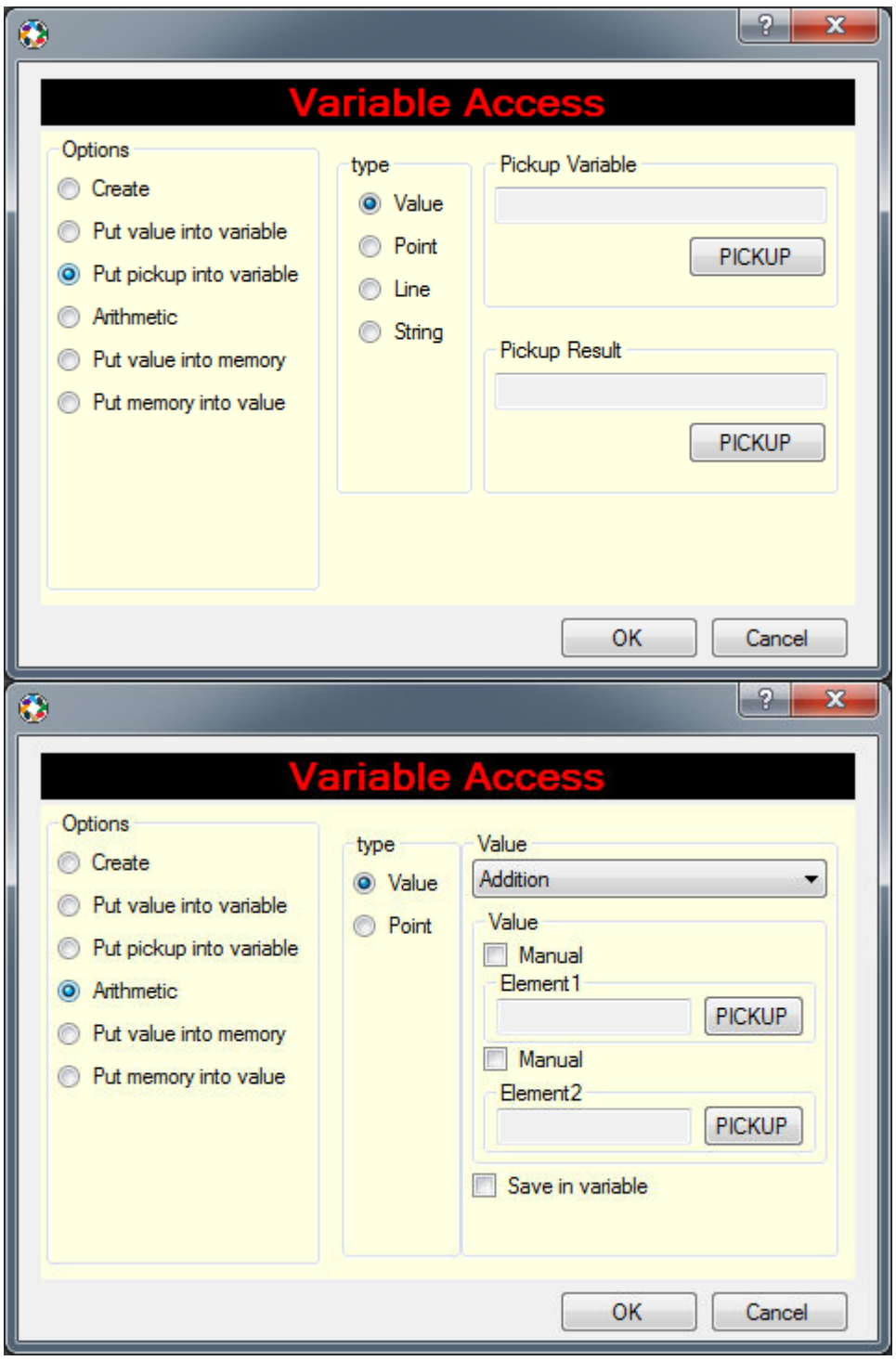
Variable Access



The Variable Access command deals with the system variable like in a programming language with the instruction to access the variable. It is able to establish and save variables and read them or calculate with them. These variables are stored in registers which are available for commands or functions to be used.

Create: A variable of the selected type of variable will be created. The user can define the variable name and select the variable type (value, point, line, string). It also has an option to create a static variable.

Banner Vision Inspector

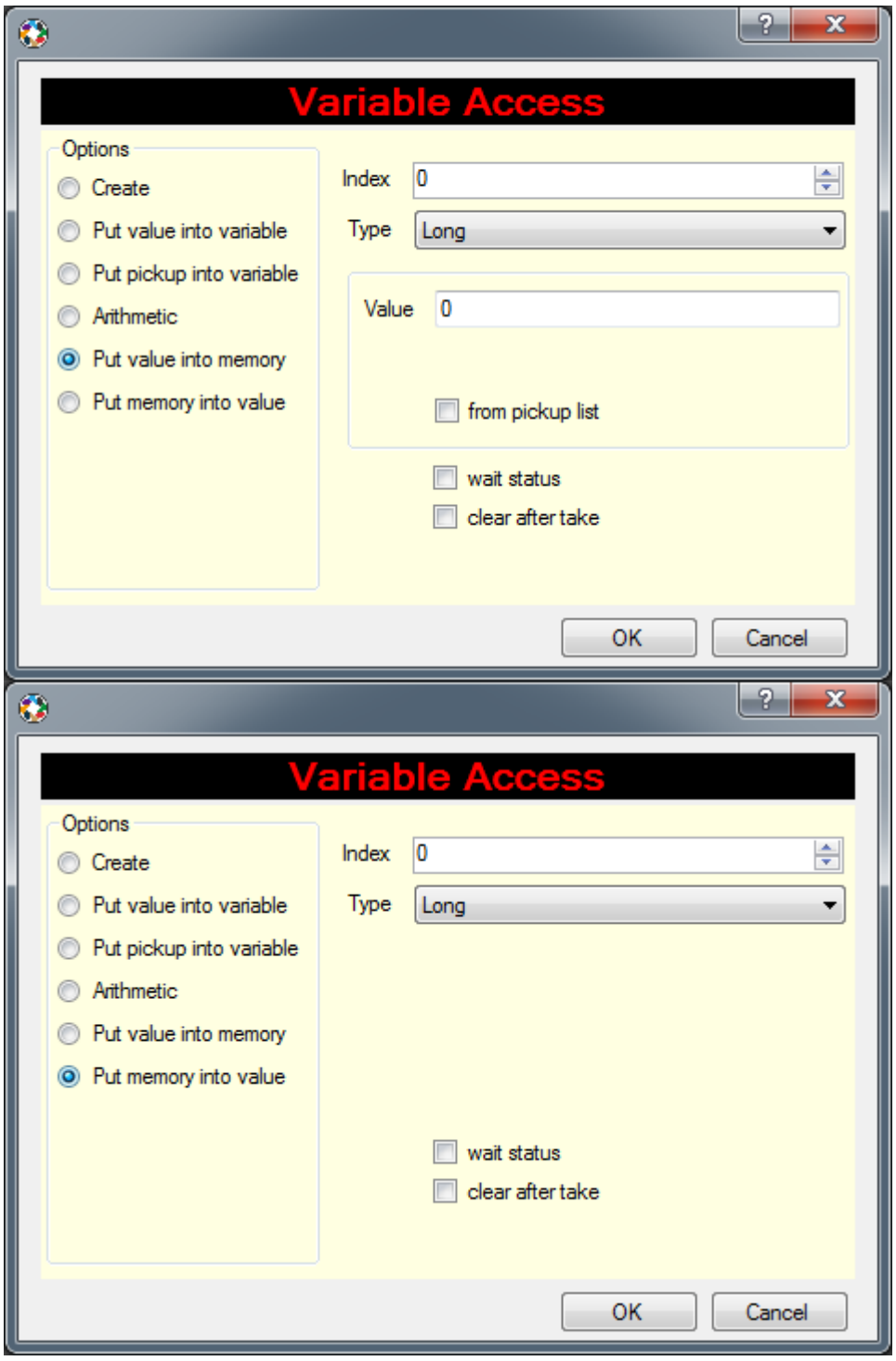


Put value into variable: Defined value, point, line or string to be input into the variable created.

Put pickup into variable: Selected the command result (value, point, line, string) to be input into the variable created.

Arithmetic:

- **Allow user to do Addition, Subtraction, Multiplication, Division basing on the result: value or point**
- **Value:** To manually enter the value to do mathematically calculation after checking the manual option or pick up the particular command result.
- **Point:** To manually enter the point to do mathematically calculation after checking the manual option or pick up the particular command result.
- **Save in variable:** To save the calculated value or point as reference to be used in the viz program.



Put value into memory:

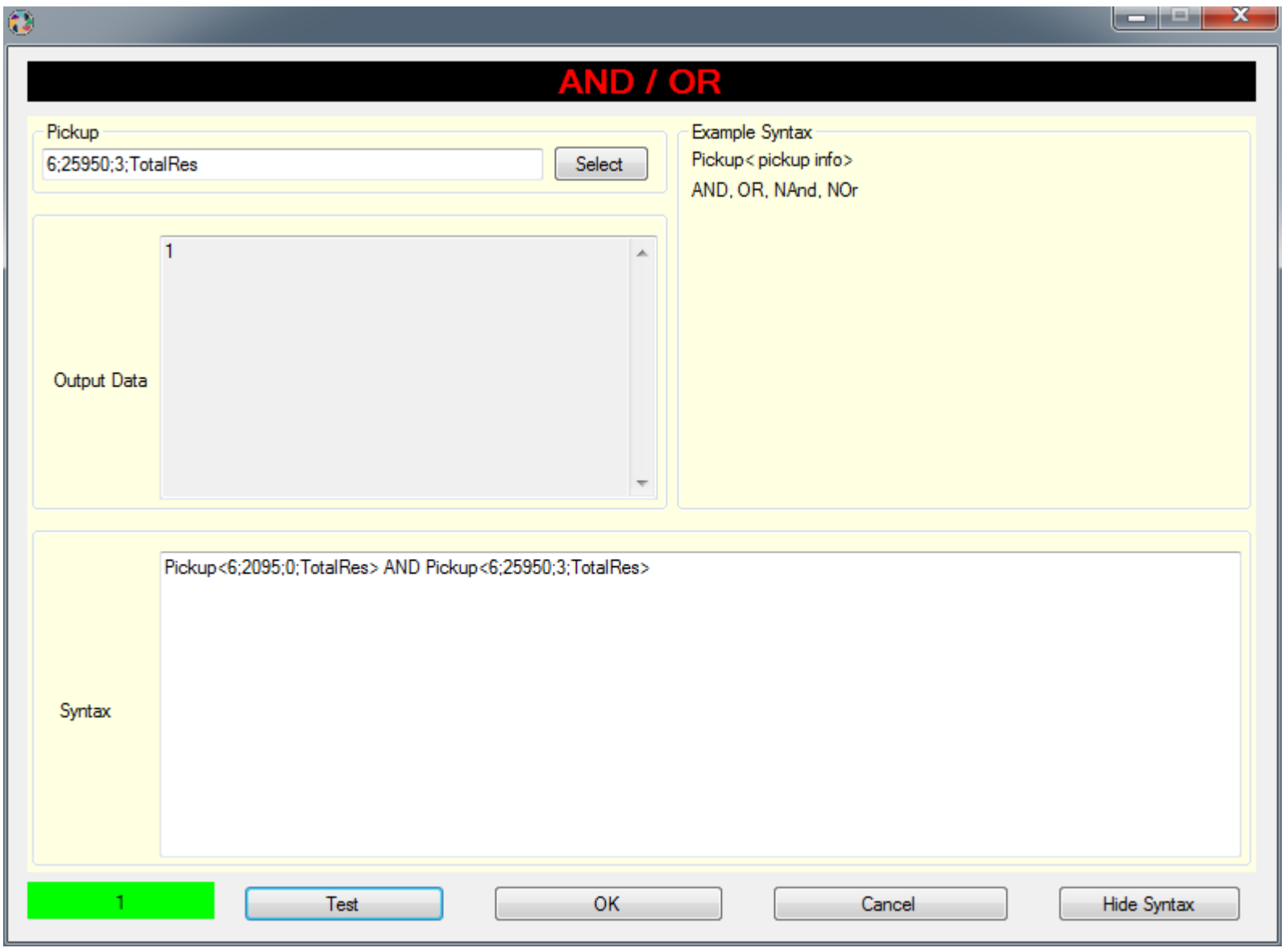
- **Index:** To save the parameter (Long, Double, string, Point) into the memory location of a selected command.
- **From Pickup list:** To select the desired result to save into the memory.
- **Wait Status:** When this option is checked, it will wait until the specific memory is cleared before it saves the new data in.

Put memory into value:

- **Index:** To get the parameter (Long, Double, string, Point) from the selected memory location and input into a value.
- **Type:** To set the format type of value after getting from memory.
- **Clear after take:** To clear the memory index after getting the result, to allow the next parameter to save into the memory index.

AND / OR

AND / OR

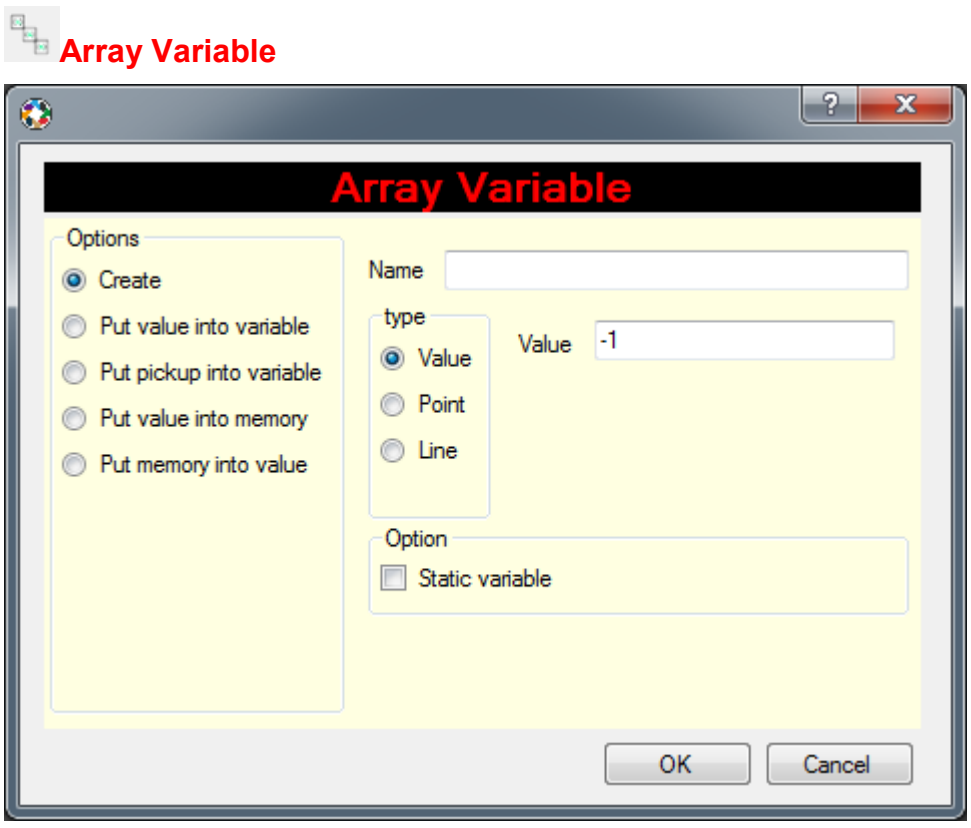


The AND / OR command is a basic scripting to set “and” & “or” condition for different commands result.

Pickup: To select the particular command result. The syntax will be shown after selecting.

Syntax: Manually enter “Pickup” with “< >” and then copy the syntax from the pickup textbox and paste between the “< >” as shown in the above picture.

Array Variable



The Array Variable command is used to collect a group of data structure which consisting of elements (values or variables).

The Array Variable command deals with the system variable like in a programming language with the instruction to access the variable. It is able to establish and save variables and read them or calculate with them. These variables are stored in registers which are available for commands or functions to be used.

Create: An array variable of the selected type of variable will be created. The user can define the variable name and select the variable type (value, point, line). It also has an option to create a static variable.

Put value into variable: Write a fixed value/point/line and place into a selected pickup array variable.

Put pickup into variable: Select a pickup value/point/line and place into a selected pickup array variable.

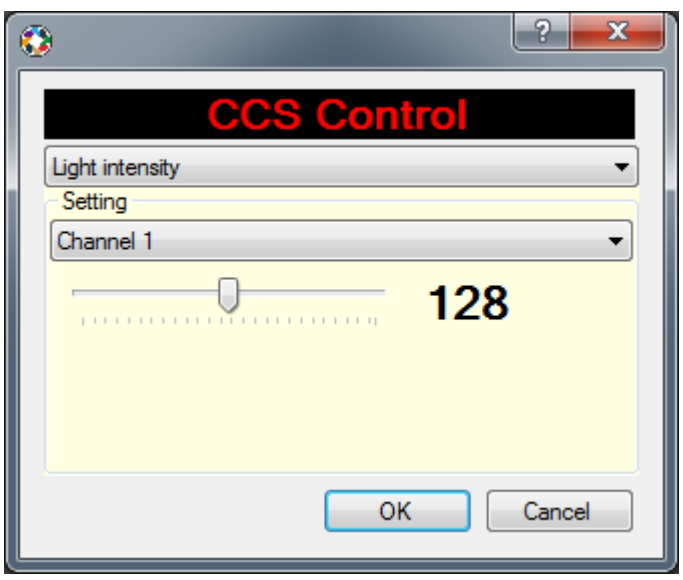
Put value into memory: Select a pickup array variable and place into a selected memory index.

Put memory into value: Select a memory index and range to pickup.

Pick value by index: Select a value/point by index from a pickup array variable. This function can be used for looping.

CCS Control

CCS Control



This CCS Control application command to control the lightning.

Setting: Adjust the light intensity from 0 to 255 (dark to bright), able to select the lightning mode and turn on and off of the light.

Chart

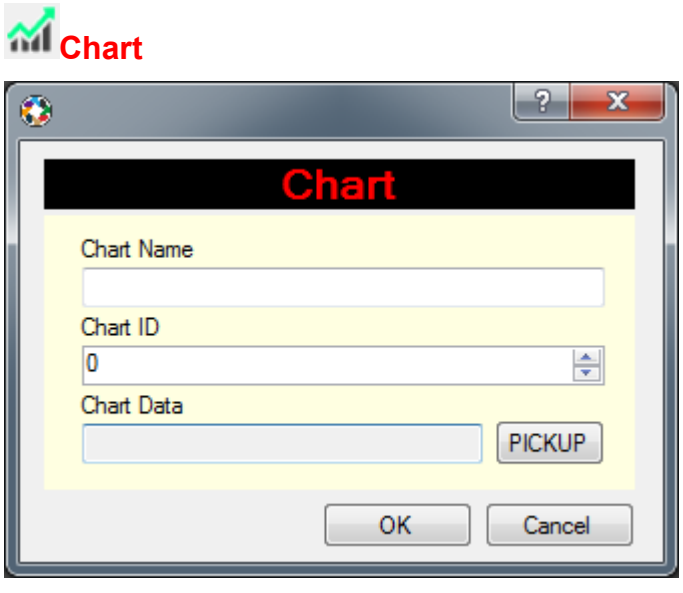


Chart command to create a chart for the program.

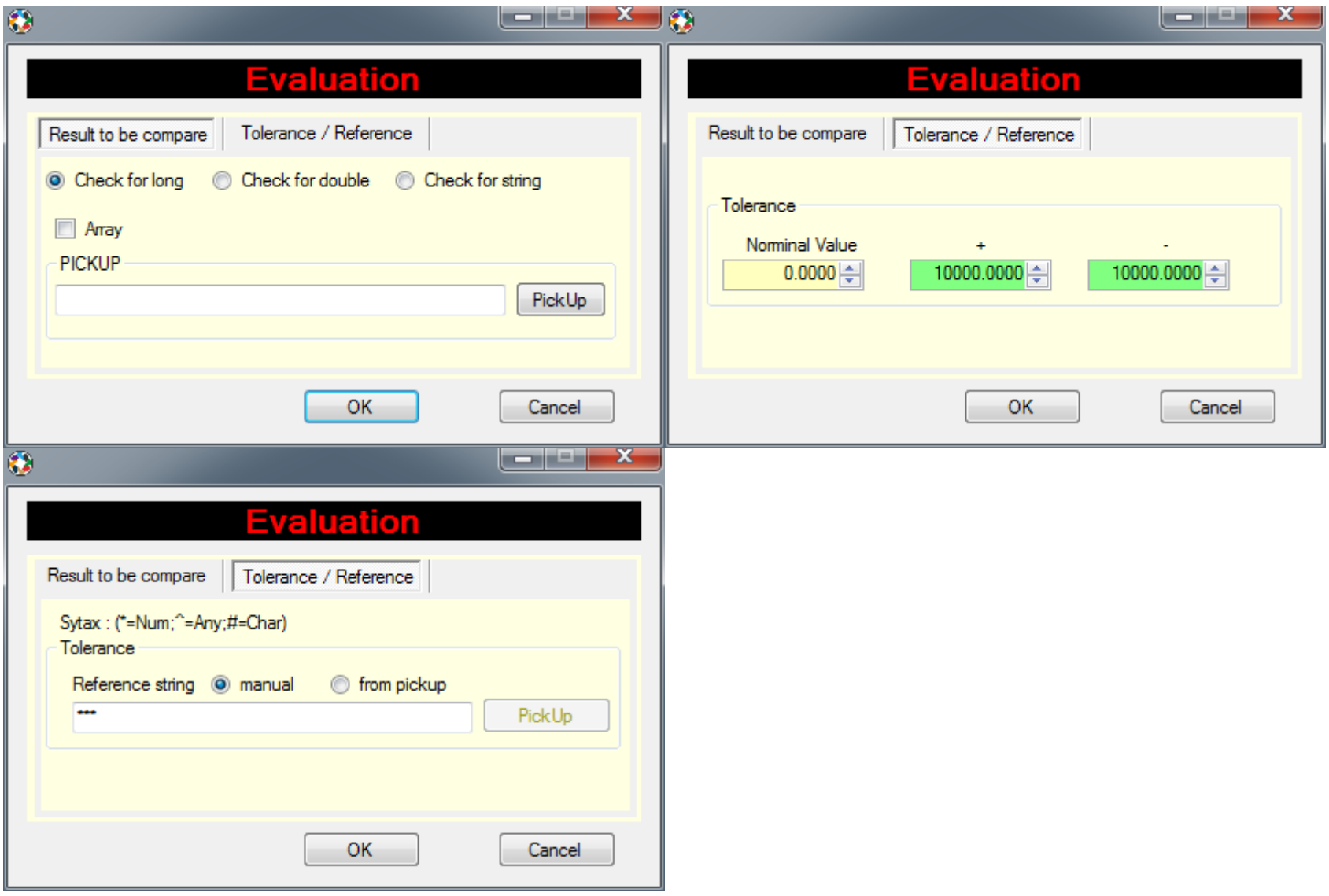
Chart Nama: Enter the desired name for the chart.

Chart ID: Set the ID for chart.

Chart Data: Pickup the parameter data from program for the chart.

Evaluation

Evaluation



The Evaluation command is to compare the result (long, double or string) of a command with desired reference or tolerance range.

Result to be compare:

Pickup: To select the particular command result; long, double or string to be compared.

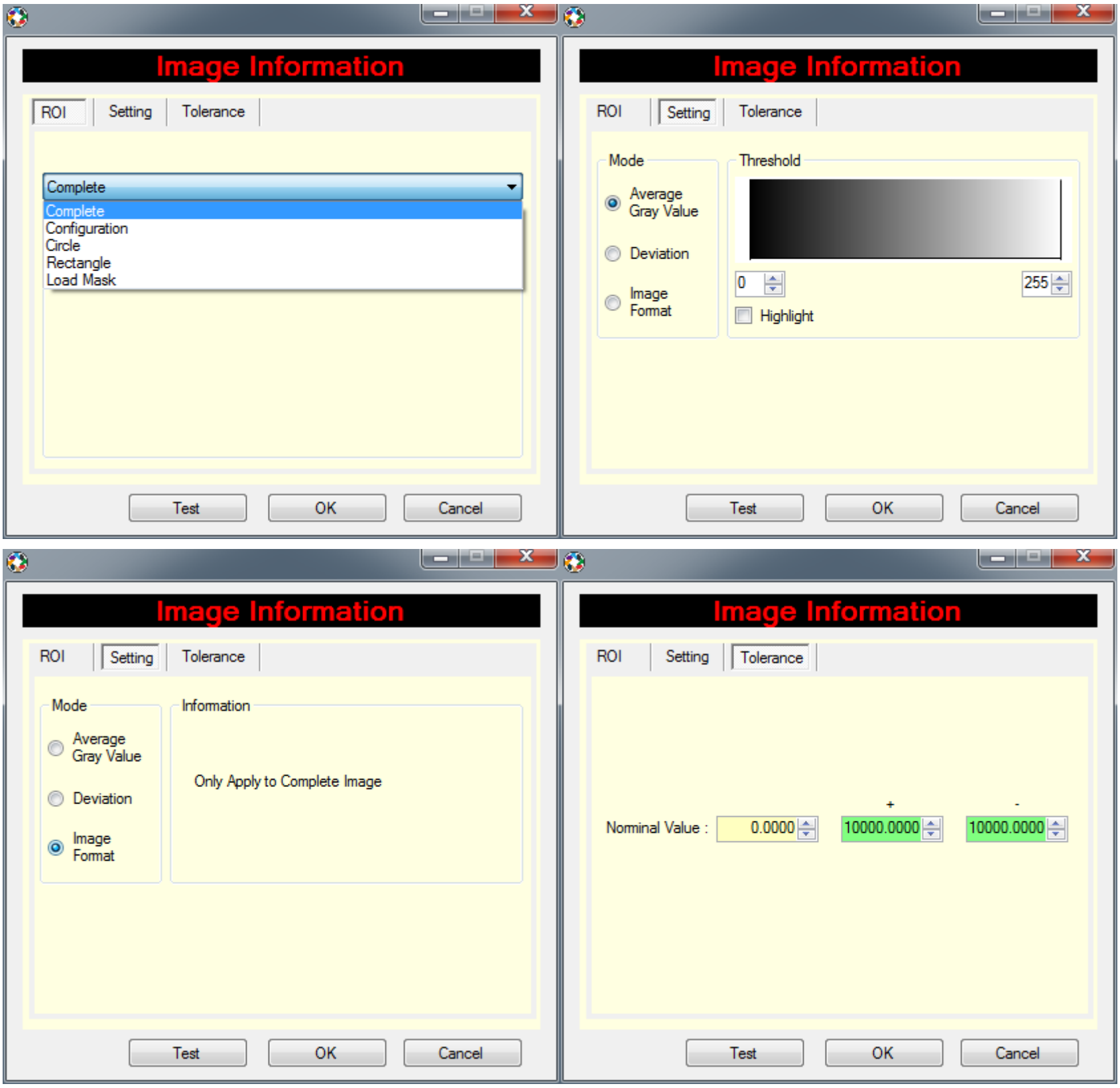
Tolerance / Reference:

Nominal value: Manually enter the value in long or double to be compared with the pickup result. State conditional acceptance of the inspected result.

Reference string: Manually enter the string or picked reference string to be compared with the pickup result.

Image Information

Image Information



The Image Information command is to determine or computed the various image information of that image.

ROI:

To set the region of interest of this command.

Setting:

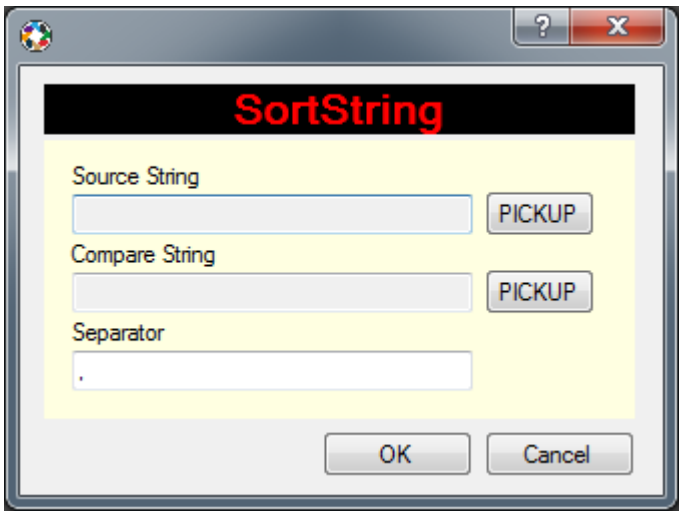
Mode:

- **Average Gray Value:**
- **Deviation:**
- **Image Format:**

Tolerance: Manually enter the value in long or double to be compared with the result. State conditional acceptance of the inspected result.

Sort String

Sort String



The Sort String command is used for sorting a data in a string.

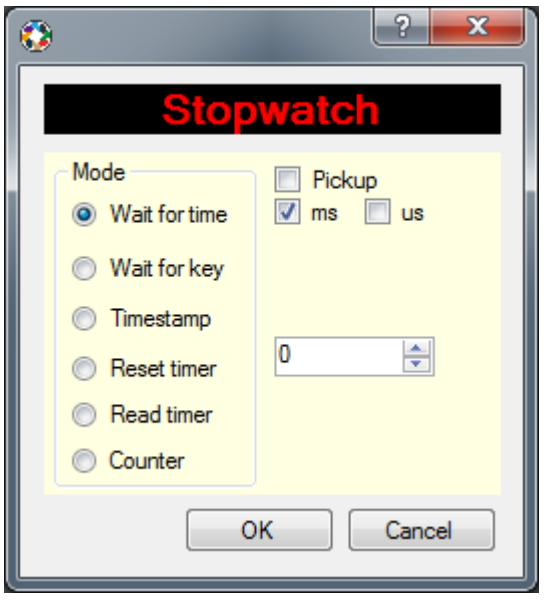
Source String: Select the source of the string of data.

Compare String: Select the string of data to compare.

Separator: Define the separator character used in the string of data.

StopWatch

StopWatch

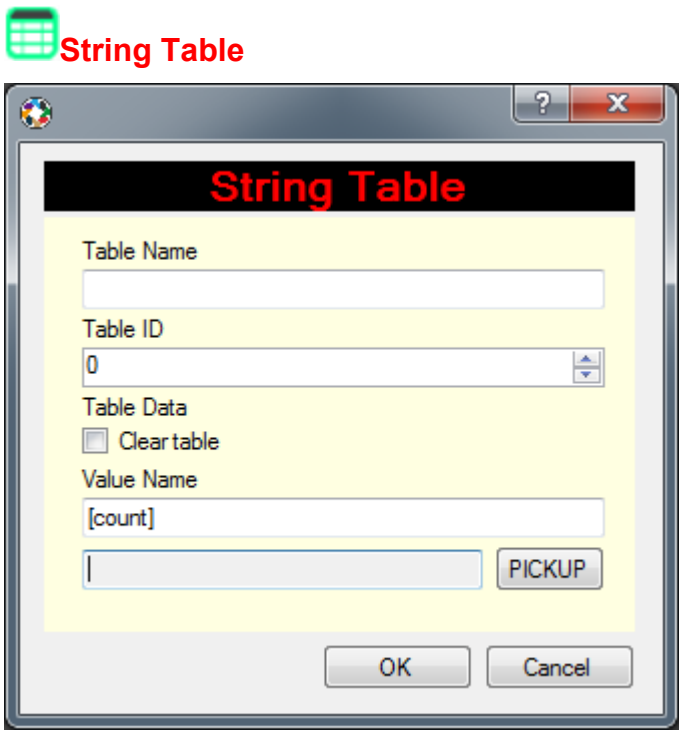


Stop Watch command allows a fixed defined waiting duration or condition to wait for an action from the operator.

Mode:

- **Wait for time:** The execution of the program stops for a defined waiting duration with value in milliseconds.
- **Wait for key:** The execution of the program stops until the user pushes a button on the keyboard.
- **Timestamp:** To get the CPU's date_time (e.g. 2017_7_6-17_4_38_193). To allow delay by day or month.
- **Reset timer:** To reset timer.
- **Read timer:** To get how many time from reset timer to read timer.

String Table



This String Table command creates a Table for program with string data.

Table name: Enter the desired name for the table.

Table ID: Set the table ID.

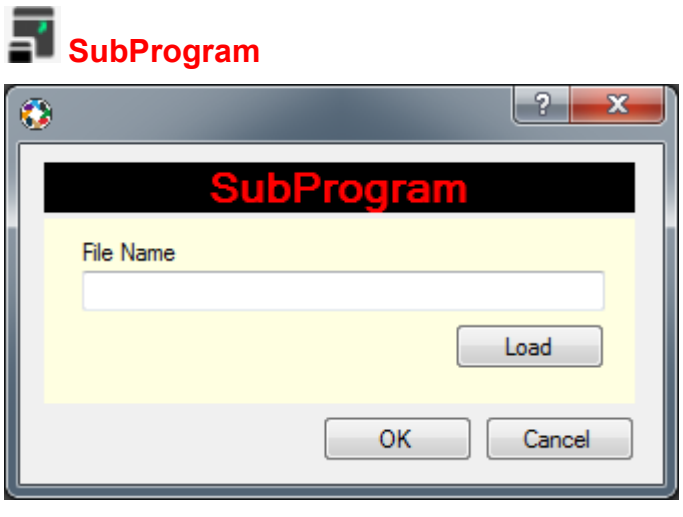
Table data: Pickup the parameter data for table.

Clear table: Enable the table to be cleared.

Value Name: Enter the desired value name for table.

Pickup: Pickup the string data for table.

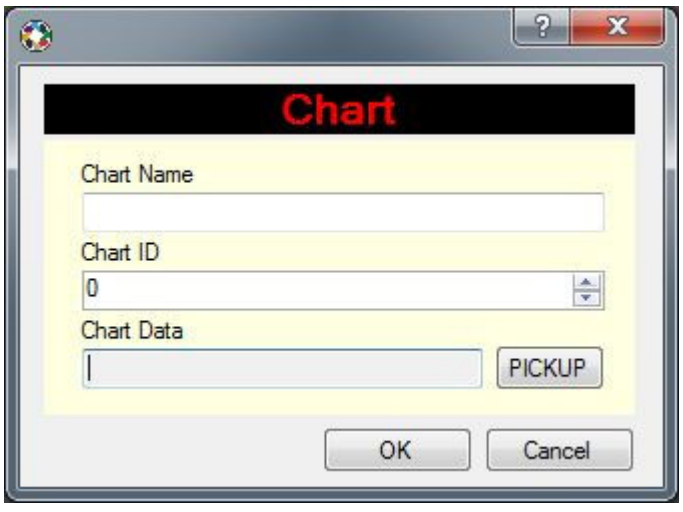
SubProgram



SubProgram application is command to Load Program in a new program.

Table

Table



This Table application command to create a Table for program.

Table name: Enter the desired name for the table.

Table ID: Set the table ID.

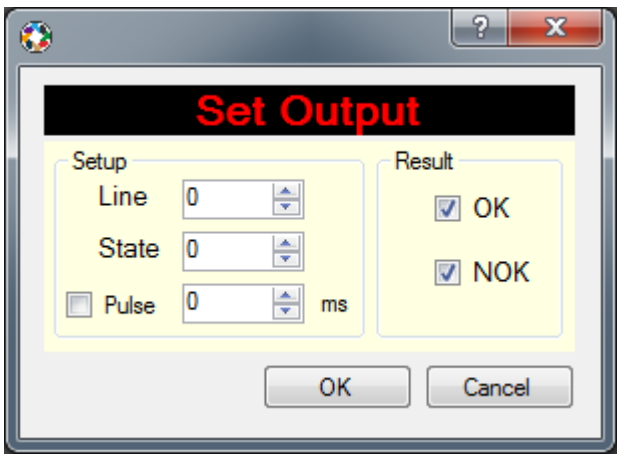
Table data: Pickup the parameter data for table.

Communication

Topic on Digital Output/Input, AutoCOM, Script, String Control, ControlLan Send, Ini Access, Mitsubishi, Modbus COM and Text.

SetOutput

SetOutput



All digital I/O output connected to the system are able to be activated.

Setup:

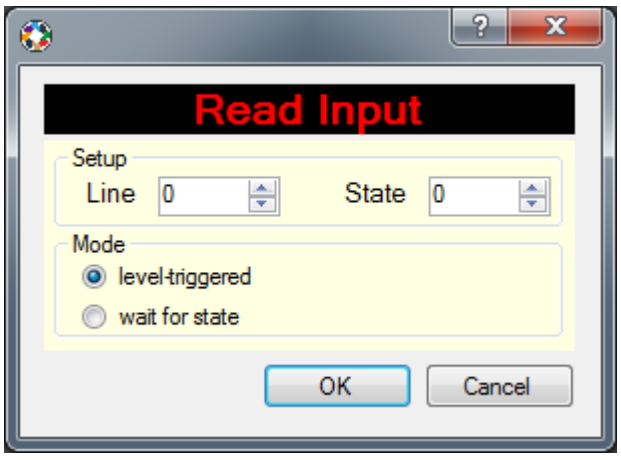
- **Line:** Select a output index (addressed by 0..N-1 when N-1 is the total number of outputs).
- **State:** Setting the output to the target condition (e.g. High=1 & Low=0).
- **Pulse:** Set the output ON for the duration set.

Result:

- **Result (OK):** Output will be set if the total result is OK (for good part).
- **Result (NOK):** Output will be set if the total result is NOK (for NG part).

ReadInput

ReadInput



A digital I/O input is checked for the expected condition. The I/O input can be accessed by the line index.

Setup:

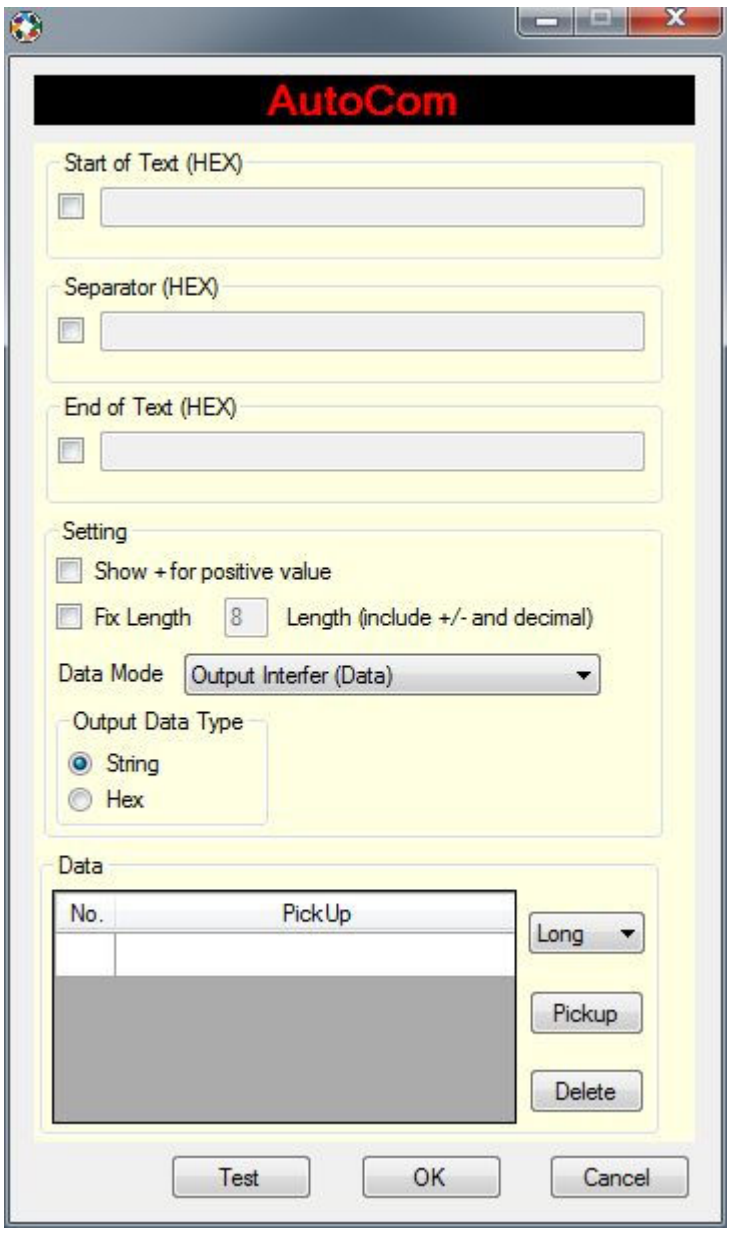
- **Line:** Select a sequential input index (beginning with 0 for the first I/O input).
- **State:** Comparing the input with the target I/O condition (e.g. High=1 & Low=0).

Mode:

- **Level-triggered:** When selected, the I/O announces if the target condition is reached.
- **Wait for state:** When selected, the I/O announces if the signal changes from the current condition to the target condition.

AutoCom

AutoCom



The AutoCom command allows to append multiple data into user preference order and format

Start of Text (HEX):

- HEX code which will be append on the start of the data.

Separator (HEX):

- HEX code which will be append to separate the data.

End of Text (HEX):

- HEX code which will be append on the end of the data.

Setting:

- Show + for positive value : Append additional + symbol for positive value.
- Fix Length : Fix each output data into same length which included +/- symbol.

Data Mode:

- Converting the Pickup data into the format.

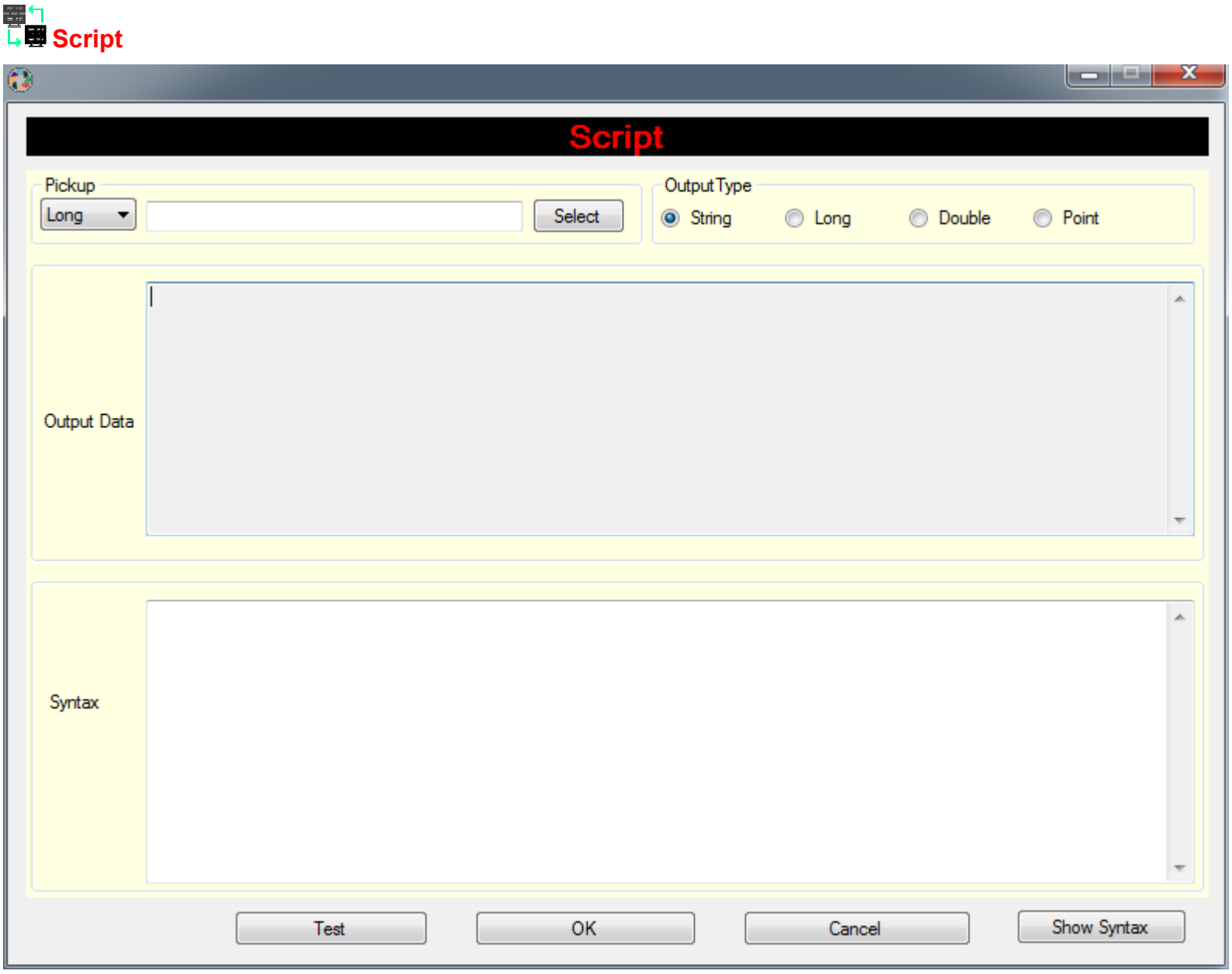
Output Data Type:

- **String:** Data output in string type of pickup (consist of alphabet, numbers, symbols and special characters).
- **Hex:** Data output in Hex code.

Data:

- **Long:** Pickup Long type of data.
- **Double:** Pickup Double type of data.
- **Point:** Pickup Point type of data.
- **Total Result:** Pickup Total Result type of data.
- **Long Array:** Pickup Long Array type of data.
- **Double Array:** Pickup Double Array type of data.
- **Point Array:** Pickup Point Array type of data.

Script



The Communication command allows simple calculation, scripting or special data arrangements.

Pickup:

- **Pickup:** Show pickup script of selected tool results.
- **Select:** Pop-up pickup list window for selection.

Output Type:

- **String:** Data output in string type of pickup (consist of alphabet, numbers, symbols and special characters).
- **Long:** Data output in long type of pickup (numbers only without decimals).
- **Double:** Data output in double type of pickup (numbers only with decimals).
- **Point:** Data output in point type with X & Y coordinates of pickup (numbers only with decimals).

Output Data (Window):

- **Output Data:** Show final scripting or calculation results.

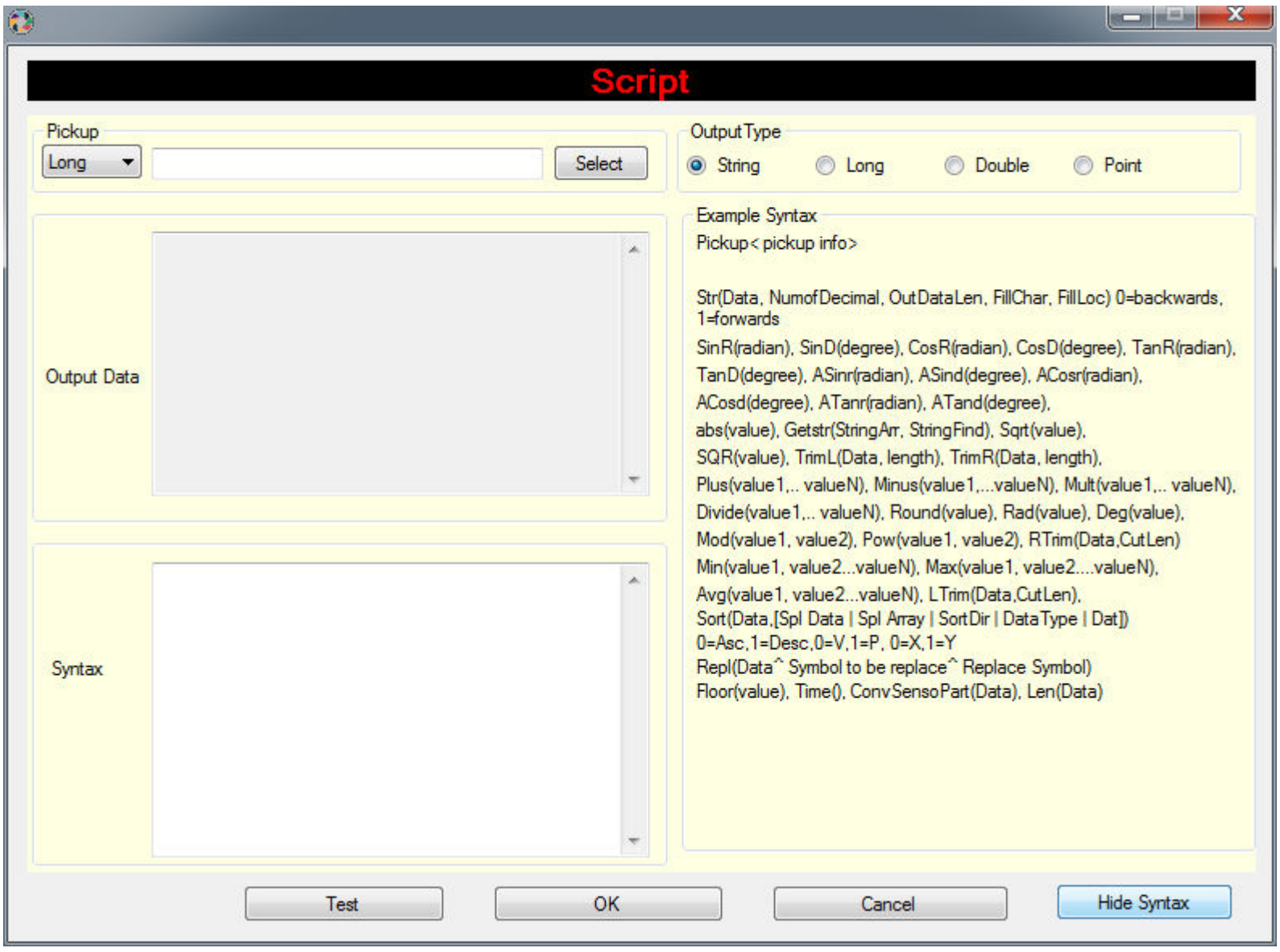
Syntax (Window):

- **Syntax:** Allow scripting text, syntax and calculations.

Show Syntax:

- **Show Syntax:** Display sample and syntax available for scripting / calculations as shown below.

Banner Vision Inspector



Example Syntax:

Pickup of single data

Syntax (commands)	Examples	Results
Pickup<>	Pickup<01,00,Number_Of_Object,(LONG),>	2

- "01,00,Number_Of_Object,(LONG)," is script from selected pickup list (single data) tool.

Pickup of array data

Syntax (commands)	Examples	Results
PickArray<>	PickArray<01,00,CenterPoint,(PointARRAY), [a|b|3]> Original: 134.4124/80.0751, 197.1047/125.4446,	Final: 134.412a80.075b 197.104a125.444b

- "01,00,CenterPoint,(PointARRAY), [a|b|3]" is script from selected pickup list (array data) tool;
- "a" is separator between single data;
- "b" is separator between array data;
- "3" is number of decimals.

Convert to string data

Syntax (commands)	Examples	Results
Str()	Str(Pickup,3,10,x,0) Original: 148.1283	Final: 148.128xxx

- "Pickup" is data script pickup;
- "3" is number of decimals;
- "10" is total string length;
- "x" is fill character if data length is insufficient;
- "0" is fill characters after the string (whereas "1" is fill characters before the string).

Trigonometric functions (Part 1 of 4)

Syntax (commands)	Examples	Results
SinR()	SinR(10)	-0.544021
CosR()	CosR(10)	-0.839072
TanR()	TanR(10)	0.648361

- Trigonometric function where “10” is angle in Radians.

Trigonometric functions (Part 2 of 4)

Syntax (commands)	Examples	Results
SinD()	SinD(20)	0.342020
CosD()	CosD(20)	0.939693
TanD()	TanD(20)	0.363970

- Trigonometric function where “20” is angle in Degrees.

Trigonometric functions (Part 3 of 4)

Syntax (commands)	Examples	Results
ASinr()	ASinr(0.1)	0.100167
ACosr()	ACosr(0.1)	1.470629
ATanr()	ATanr(0.1)	0.099669

- Inverse trigonometric function where “0.1” is Radians value.

Trigonometric functions (Part 4 of 4)

Syntax (commands)	Examples	Results
ASind()	ASind(30)	0.551069
ACosd()	ACosr(30)	1.019727
ATand()	ATanr(30)	0.482348

Inverse trigonometric function where “30” is Degrees value.

Convert value to positive number (absolute)

Syntax (commands)	Examples	Results
abs()	abs(-5)	5.000000

- “-5” is value before conversion.

Extract specific string data from selected string array

Syntax (commands)	Examples	Results
Getstr()	Getstr(PickArray,12345)	

- “01,00,Decoded Code,(STRINGARRAY)” is value before conversion.

Mathematics calculations (Part 1 of 7)

Syntax (commands)	Examples	Results
Sqrt()	Sqrt(9)	3.000000
SQR()	SQR(5)	25.000000

- “9” is value before square root,
- “5” is value before square.

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Mathematics calculations (Part 2 of 7)

Syntax (commands)	Examples	Results
Plus()	Plus(2,2,2)	6.000000
Minus()	Minus(3,3,3)	-3.000000
Mult()	Mult(4,4,4)	64.000000
Divide()	Divide(5,5,5)	0.200000

- "2" is value before addition,
- "3" is value before subtraction,
- "4" is value before multiplication,
- "5" is value before division.

Mathematics calculations (Part 3 of 7)

Syntax (commands)	Examples	Results
Round()	Round(6.789)	7.000000
Floor()	Floor(123.987)	123.000000

- "6.789" is value before rounding Up to whole number,
- "123.987" is value before rounding Down to whole number.

Mathematics calculations (Part 4 of 7)

Syntax (commands)	Examples	Results
Rad()	Rad(10)	0.174533
Deg()	Deg(5)	286.479140

- "10" is angle in Degrees to be converted to Radians,
- "5" is angle in Radian to be converted to Degrees.

Mathematics calculations (Part 5 of 7)

Syntax (commands)	Examples	Results
Mod()	Mod(10,3)	1.000000

- Finds remainder after division between 2 values,
- "10" is main value to be divided,
- "3" is dividing value.

Mathematics calculations (Part 6 of 7)

Syntax (commands)	Examples	Results
Pow()	Pow(5,2)	25.000000

- Value to the power of function,
- "5" is main value,
- "2" is power function.

Mathematics calculations (Part 7 of 7)

Syntax (commands)	Examples	Results
Min()	Min(10,5,30,3)	3.000000
Max()	Max(10,5,30,3)	30.000000
Avg()	Avg(10,5,30,3)	12.000000

- Finds and return Minimum, Maximum or Average value,
- "10", "5", "30", "3" are value to be compare.

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Time function

Syntax (commands)	Examples	Results
Time()	Time()	2017_04_06_12_33_03_824

- Returns current time in YYYY_MM_DD_hh_mm_ss_sss

Data trim

Syntax (commands)	Examples	Results
TrimL()	TrimL(abcde,4)	Abcd
TrimR()	TrimR(vwxyz,3)	Xyz
LTrim()	LTrim(fghij,2)	Hij
RTrim()	RTrim(qrstu,1)	Qrst

- "abcde" is data before trimming,
- "4" is length of data starting from Left after trimming,
- "vwxyz" is data before trimming,
- "3" is length of data starting from Right after trimming,
- "fghij" is data before trimming,
- "2" is length of data to trim from Left,
- "qrstu" is data before trimming,
- "1" is length of data to trim from Right.

Data sorting

Syntax (commands)	Examples	Results
Sort()	Sort(PickArray,[/|,|0|1|0]) Original: 107.1333/52.2228, 396.4163/80.1496, 212.4862/168.9366, 456.4062/257.5171, 135.8728/258.2039,	Final: 107.1333/52.2228, 135.8728/258.2039, 212.4862/168.9366, 396.4163/80.1496, 456.4062/257.5171,

- "PickArray" is data for sorting,
- "/" is splitting characters between data,
- "," is splitting characters between array,
- "0" is sorting by ascending (whereas "1" is sorting by descending),
- "1" represent data is Point type (whereas "0" represent data is Value type),
- "0" is sorting by X direction (whereas "1" is sorting by Y direction).

Data characters replace

Syntax (commands)	Examples	Results
Repl()	Repl(PickArray,/,x) Original: 107.3233/52.0798, 212.6762/168.7936,	Final: 107.3233x52.0798,212.6762x168.7936,

- "PickArray" is original data before replacement,
- "/" is character to be replaced,

"x" is character replaced with.

Banner Vision Inspector

Create special characters

Syntax (commands)	Examples	Results
Chr()	Chr(35)	#

- "35" is ASCII character decimal code as shown in table below.

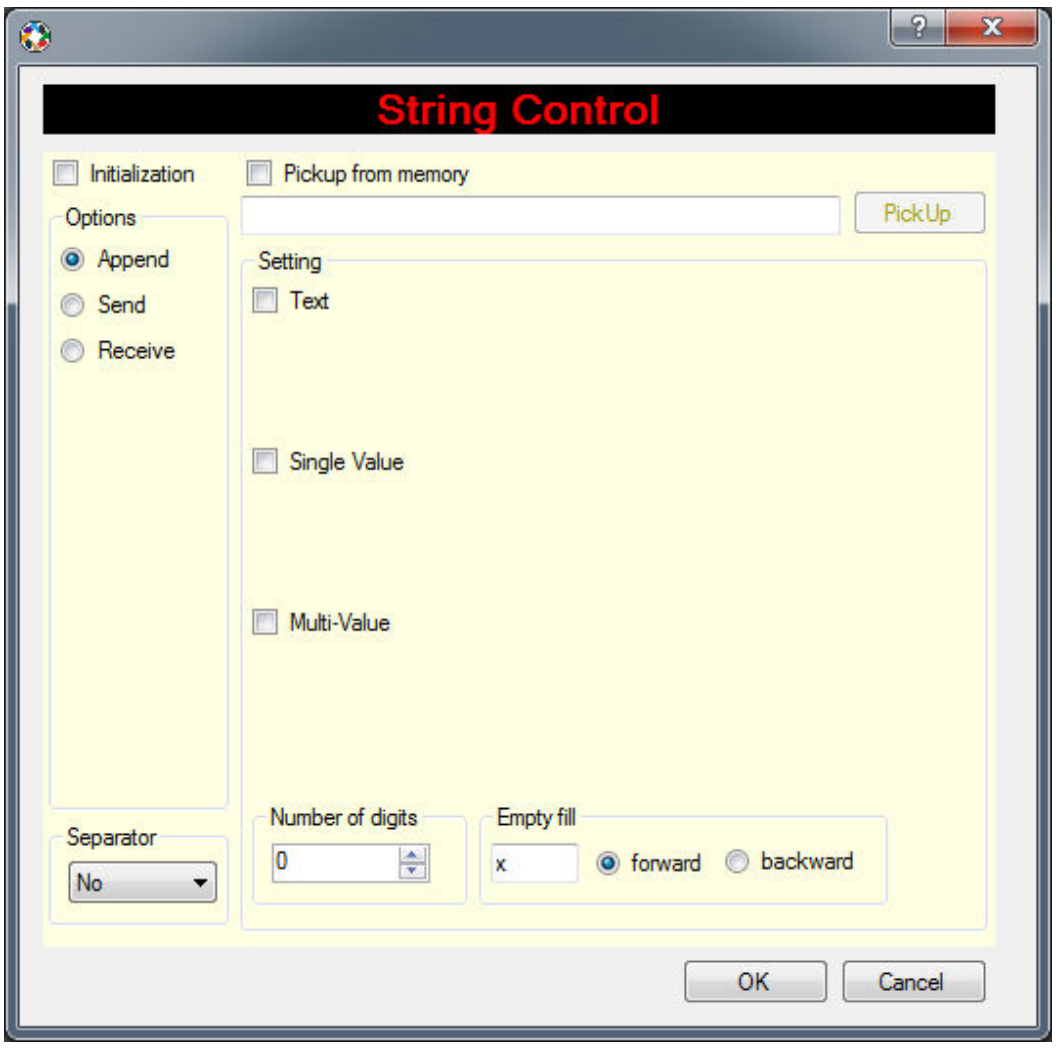
Dec	Hx	Oct	Char	Dec	Hx	Oct	Html	Chr	Dec	Hx	Oct	Html	Chr	Dec	Hx	Oct	Html	Chr
0	0	000	NUL (null)	32	20	040		Space	64	40	100	@	@	96	60	140	`	`
1	1	001	SOH (start of heading)	33	21	041	!	!	65	41	101	A	A	97	61	141	a	a
2	2	002	STX (start of text)	34	22	042	"	"	66	42	102	B	B	98	62	142	b	b
3	3	003	ETX (end of text)	35	23	043	#	#	67	43	103	C	C	99	63	143	c	c
4	4	004	EOT (end of transmission)	36	24	044	$	$	68	44	104	D	D	100	64	144	d	d
5	5	005	ENQ (enquiry)	37	25	045	%	%	69	45	105	E	E	101	65	145	e	e
6	6	006	ACK (acknowledge)	38	26	046	&	&	70	46	106	F	F	102	66	146	f	f
7	7	007	BEL (bell)	39	27	047	'	'	71	47	107	G	G	103	67	147	g	g
8	8	010	BS (backspace)	40	28	050	(	(	72	48	110	H	H	104	68	150	h	h
9	9	011	TAB (horizontal tab)	41	29	051	)	)	73	49	111	I	I	105	69	151	i	i
10	A	012	LF (NL line feed, new line)	42	2A	052	*	*	74	4A	112	J	J	106	6A	152	j	j
11	B	013	VT (vertical tab)	43	2B	053	+	+	75	4B	113	K	K	107	6B	153	k	k
12	C	014	FF (NP form feed, new page)	44	2C	054	,	,	76	4C	114	L	L	108	6C	154	l	l
13	D	015	CR (carriage return)	45	2D	055	-	-	77	4D	115	M	M	109	6D	155	m	m
14	E	016	SO (shift out)	46	2E	056	.	.	78	4E	116	N	N	110	6E	156	n	n
15	F	017	SI (shift in)	47	2F	057	/	/	79	4F	117	O	O	111	6F	157	o	o
16	10	020	DLE (data link escape)	48	30	060	0	0	80	50	120	P	P	112	70	160	p	p
17	11	021	DC1 (device control 1)	49	31	061	1	1	81	51	121	Q	Q	113	71	161	q	q
18	12	022	DC2 (device control 2)	50	32	062	2	2	82	52	122	R	R	114	72	162	r	r
19	13	023	DC3 (device control 3)	51	33	063	3	3	83	53	123	S	S	115	73	163	s	s
20	14	024	DC4 (device control 4)	52	34	064	4	4	84	54	124	T	T	116	74	164	t	t
21	15	025	NAK (negative acknowledge)	53	35	065	5	5	85	55	125	U	U	117	75	165	u	u
22	16	026	SYN (synchronous idle)	54	36	066	6	6	86	56	126	V	V	118	76	166	v	v
23	17	027	ETB (end of trans. block)	55	37	067	7	7	87	57	127	W	W	119	77	167	w	w
24	18	030	CAN (cancel)	56	38	070	8	8	88	58	130	X	X	120	78	170	x	x
25	19	031	EM (end of medium)	57	39	071	9	9	89	59	131	Y	Y	121	79	171	y	y
26	1A	032	SUB (substitute)	58	3A	072	:	:	90	5A	132	Z	Z	122	7A	172	z	z
27	1B	033	ESC (escape)	59	3B	073	;	;	91	5B	133	[	[	123	7B	173	{	{
28	1C	034	FS (file separator)	60	3C	074	<	<	92	5C	134	\	\	124	7C	174			|
29	1D	035	GS (group separator)	61	3D	075	=	=	93	5D	135	]	]	125	7D	175	}	}
30	1E	036	RS (record separator)	62	3E	076	>	>	94	5E	136	^	^	126	7E	176	~	~
31	1F	037	US (unit separator)	63	3F	077	?	?	95	5F	137	_	_	127	7F	177	&#127;	DEL

Source: www.LookupTables.com

reference: https://www.asciitable.com/

String Control

String Control



The String Control command: Append feature allows to add value and string of a result to a new result.

Pickup from memory: To pickup the process of choosing the result value generated by a command anywhere in the viz program for adding more data like value or string accordingly.

Setting:

- **Text:** When this checkbox is enabled, it is for entering any text string to add to the result pickup from the memory.
- **Single Value:** When this checkbox is enabled, it is to pick up an inspected result of long, double or string to add to the result pickup from the memory.
- **Multi-Value:** To pick up an array of values of a tool for appending purposes.

Separator: Space (“ “) ; semicolon(“;”), slash(“/”); underscore(“_”); hyphen(“-“); asterisk(“*”); comma(‘,”); point(‘.”) will be included to separator data at end of each string.

Number of digits: number of characters to be input in this string.

Empty fill: the characters to be filled in this string accordingly. e.g. “X”

Forward/ Backward: To fill the enter character e.g. “X” at the start of the string or at the end of the string.

Banner Vision Inspector

This String Control: Send/Receive command allows a global string buffer to be filled with a string which is then transferred/received to an indicated target or destination.

Pickup from memory: The Pickup refers to the process of choosing the result value generated by a command / function anywhere in the inspection program. The Pickup is a global data structure which uses the result values of the different commands into their position and stores them. This allows the user to have a specific access to the result and is not dependent on any possible shifts in the program.

Destination:

- **To File:** Save data string into a txt file with a desired path location with a file name.
- **RS232:** Data string will be transmitted via defined RS232 communication.
- **UDP or TCP:** Data string will be transmitted via defined Ethernet using a defined port to an IP address with UDP or TCP. On the target system, the same port number has to be used for reading and sending.

Banner Vision Inspector

Separator: Space (“ “) ; semicolon(“;”), slash(“/”); underscore(“_”); hyphen(“-“); asterisk(“*”); comma(‘,”); point(‘.”) will be included to separator data at end of each string.

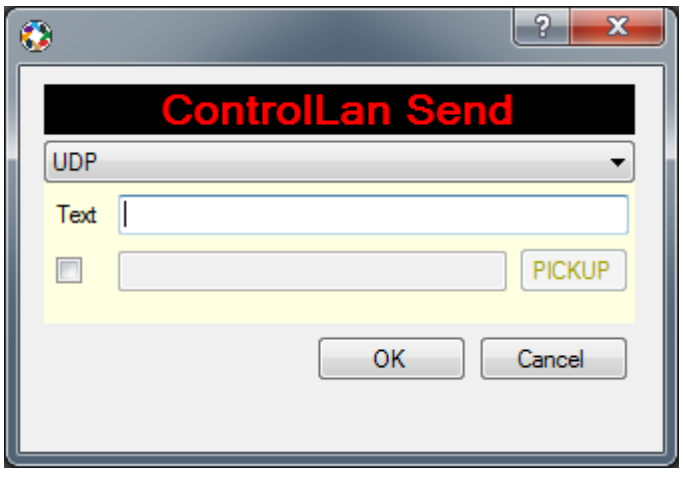
Decode:

This function is used by modbus protocal (Read Code 03)to decode feedback data to get the value.

- **Type:** the modbus protocal value type.
- **Digits:** the modbus protocal one of the data value is 16 or 32 bit.
- **Decimal:** the value decimal.
- **Low/High:** the modbus protocal one of the data position.

ControlLan Send

ControlLan Send



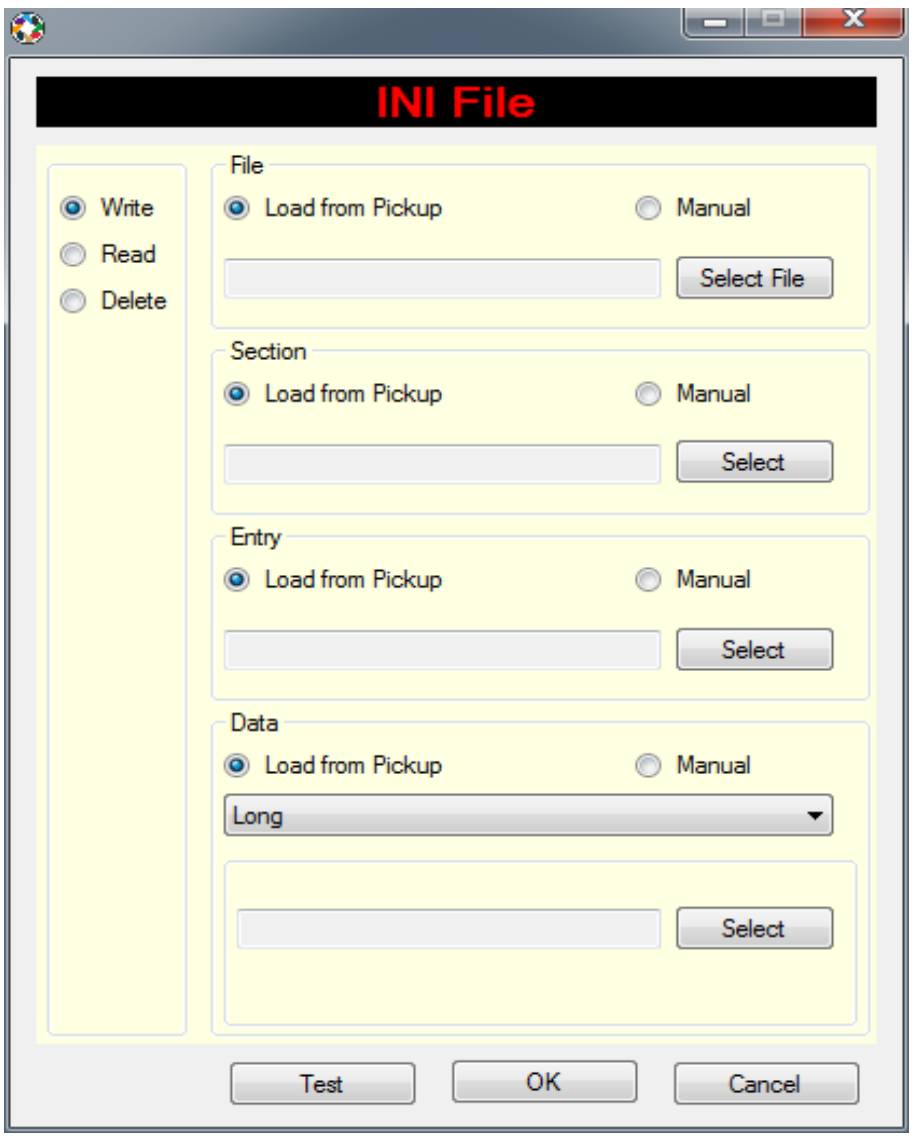
This ControlLan Send command is to send data to PC or server by UDP/TCP protocol.

Text: Enter and include desired text to be displayed.

Pickup: Pickup refers to the process of choosing the result value generated by a command / function anywhere in the inspection program.

Ini Access

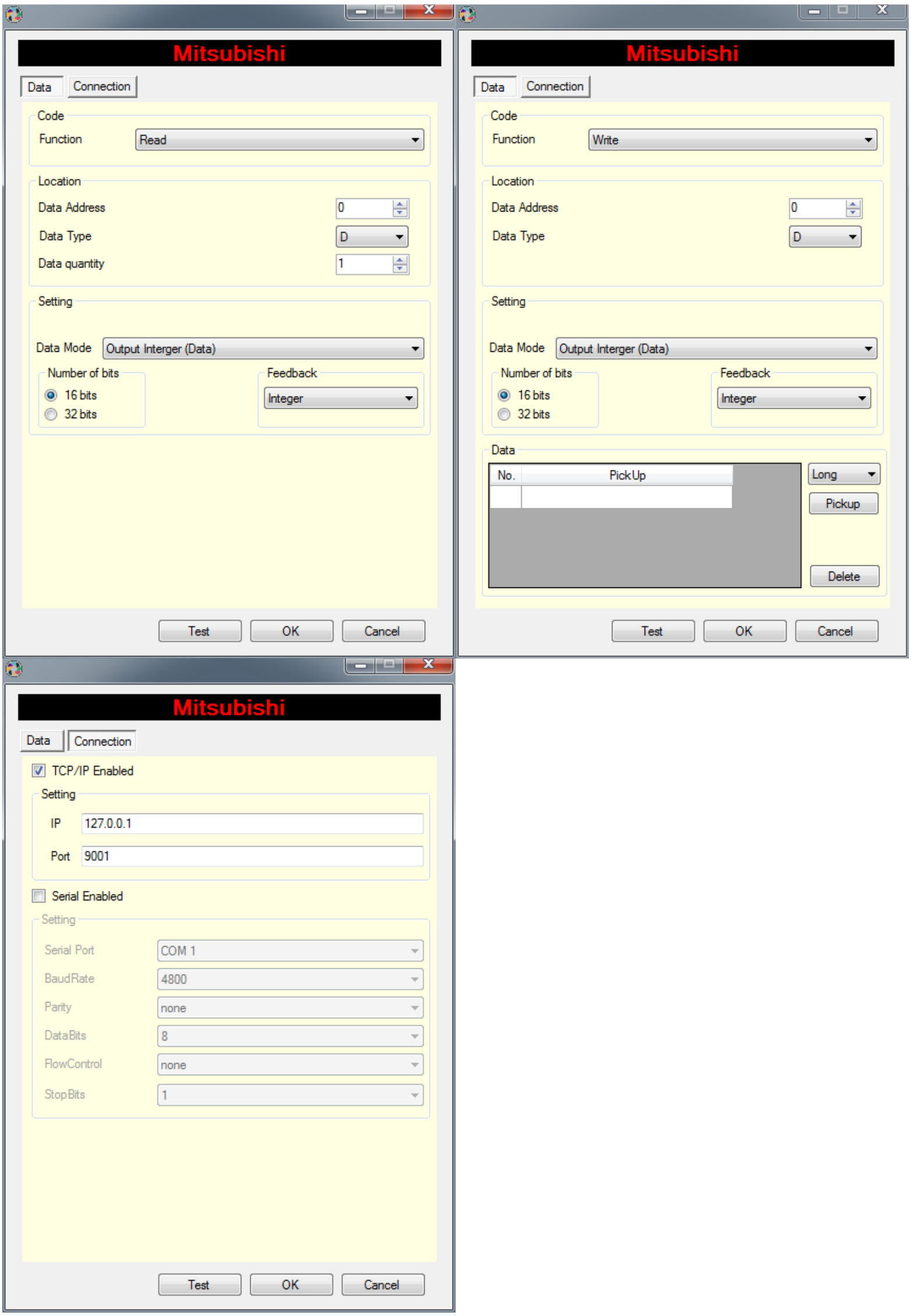
Ini Access



The Ini Access command has the options to write, read or delete the result of a command into desired ini file. This data can be read for in the program to be used within the inspection program.

Mitsubishi

Mitsubishi



The Mitsubish command (MC protocol, format 5) to allow two or more entities of a communication system to transmit data information via any kind of measurement.

Code:

- Function : Read (03) or Write (06 / 10).

Banner Vision Inspector

Location:

- Modbus Address : Data address on another side.
- Slave Address : PLC location address on another side.
- Data Quantity : Number of Data to be read. (Only for Read function)

Data Mode:

- Converting the Pickup data into the format.

Output Data Type:

- **RTU:** Data output in RTU protocol format.
- **Ascii:** Data output in Ascii protocol format.
- **Ethernet:** Data output in Ethernet protocol format.

Number of bits:

- **16 bit:** Data output in 16 bit format.
- **32 bit:** Data output in 32 bit format.

Arrangement:

- **Low:** Data output in Low High format.
- **High:** Data output in High Low format.

Data:

- **Long:** Pickup Long type of data.
- **Double:** Pickup Double type of data.
- **Point:** Pickup Point type of data.

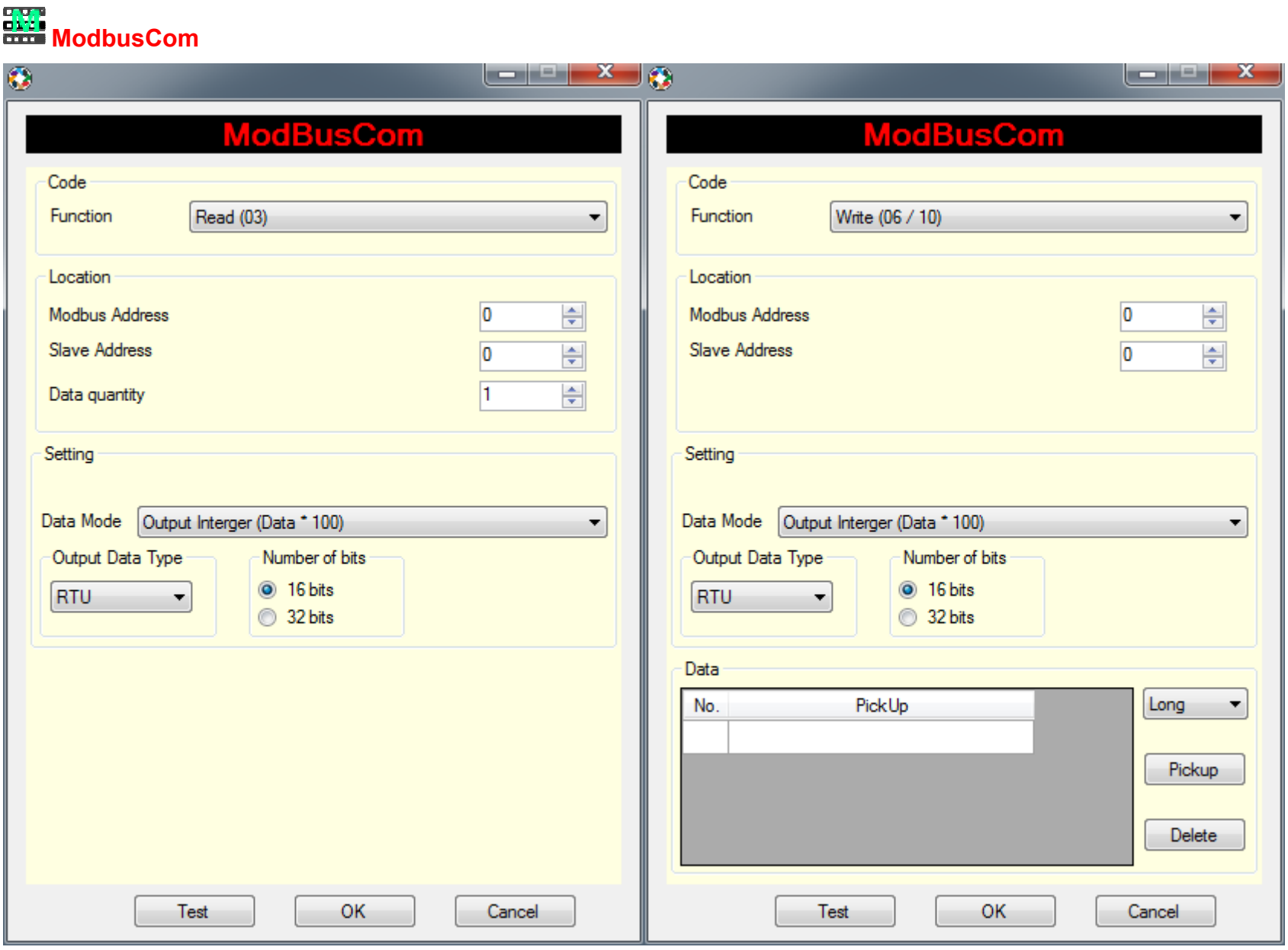
- **Total Result:** Pickup Total Result type of data.

- **Long Array:** Pickup Long Array type of data.
- **Double Array:** Pickup Double Array type of data.
- **Point Array:** Pickup Point Array type of data.

Connection:

- **TCP/IP:** To use TCP to send data.
- **Serial:** To use Serial to send data.

ModbusCom



The Modbus Com command to allow two or more entities of a communication system to transmit data information via any kind of measurement.

Code:

- Function : Read (03) or Write (06 / 10).

Location:

- Modbus Address : Data address on another side.
- Slave Address : PLC location address on another side.
- Data Quantity : Number of Data to be read. (Only for Read function)

Data Mode:

- Converting the Pickup data into the format.

Output Data Type:

- **RTU:** Data output in RTU protocol format.
- **Ascii:** Data output in Ascii protocol format.
- **Ethernet:** Data output in Ethernet protocol format.

Number of bits:

- **16 bit:** Data output in 16 bit format.
- **32 bit:** Data output in 32 bit format.

Arrangement:

- **Low:** Data output in Low High format.
- **High:** Data output in High Low format.

Data:

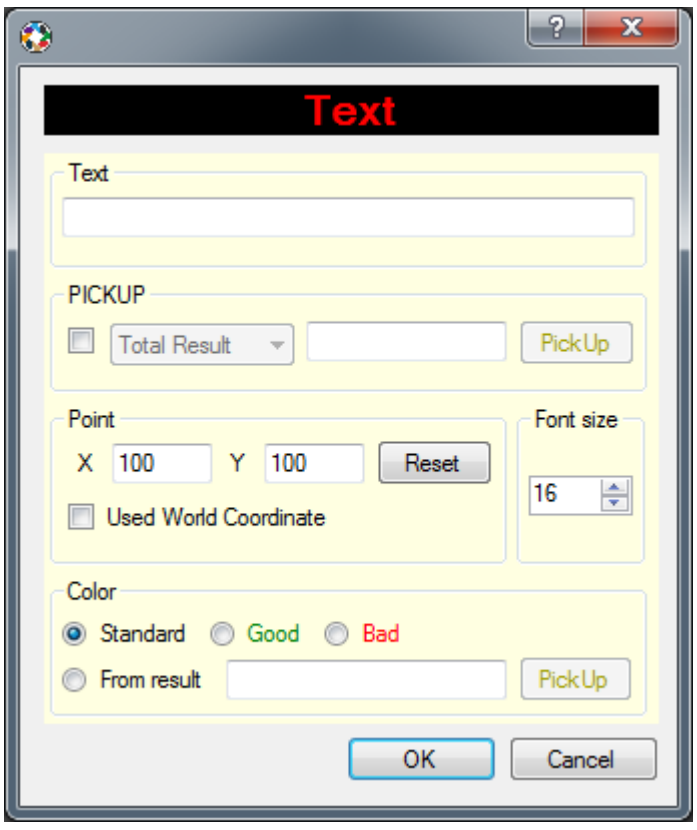
- **Long:** Pickup Long type of data.
- **Double:** Pickup Double type of data.
- **Point:** Pickup Point type of data.
- **Total Result:** Pickup Total Result type of data.
- **Long Array:** Pickup Long Array type of data.

Banner Vision Inspector

- **Double Array:** Pickup Double Array type of data.
- **Point Array:** Pickup Point Array type of data.

Text

Text



Display a text overlay on the viewer image with text, points, values or string.

Text: Enter and include desired text to be displayed.

Pickup: The Pickup refers to the process of choosing the result value generated by a command / function anywhere in the inspection program. The Pickup is a global data structure which uses the result values of the different commands into their position and stores them. This allows the user to have a specific access to the result and is not dependent on any possible shifts in the program.

Point: The position / location of the text overlay which can be determined either by direct numerical entry or by mouse click on the position / location of the display viewer.

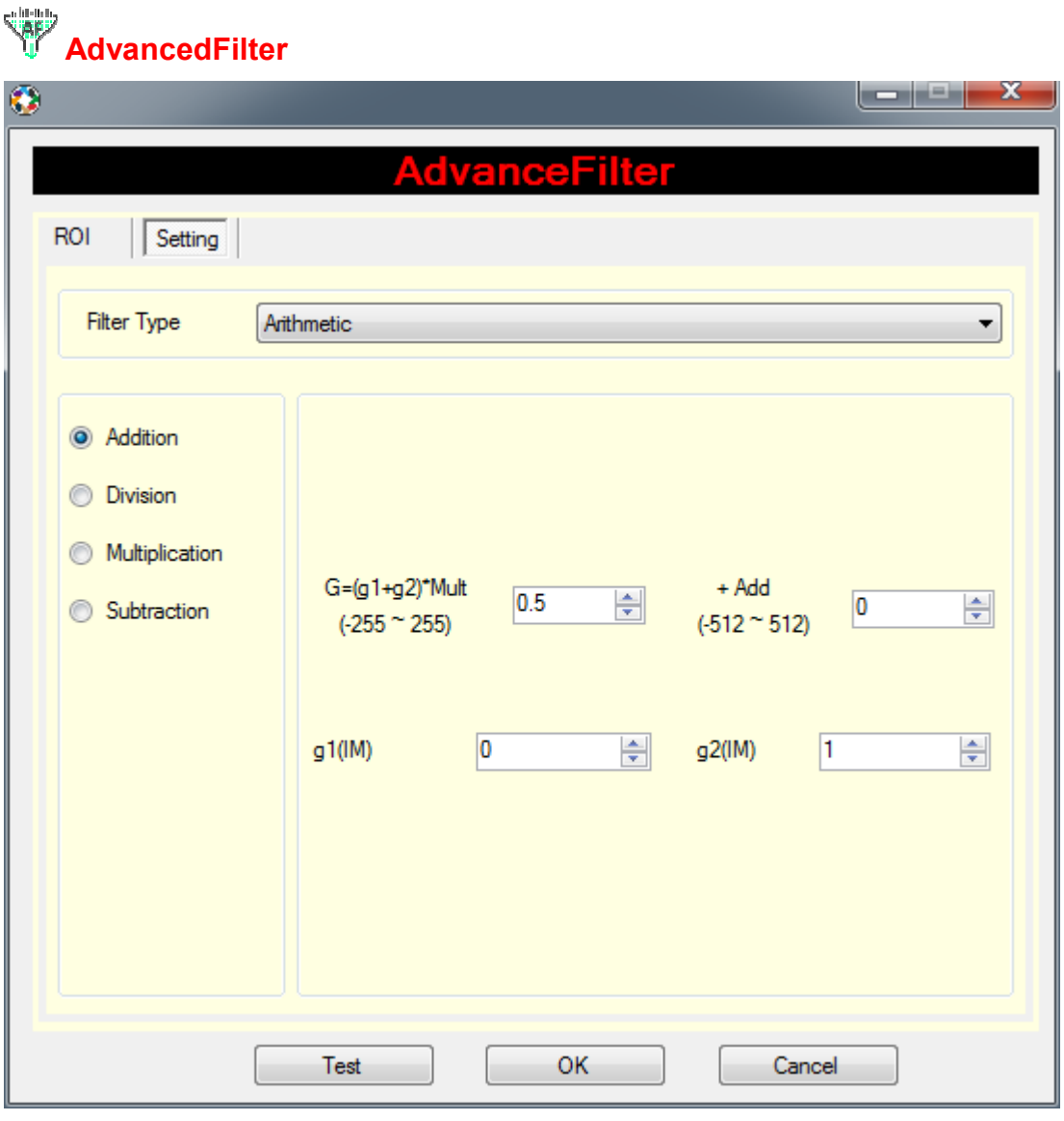
Font Size: Direct numerical input of the font size for the text overlay display.

Colour: Determine the colour condition of the text.

Filter

Topic on Advanced Filter, Basic Filter, Fill Hole, Mask, PaintRegion, StitchingImage and Zoom.

Advanced Filter



Arithmetic Filter:

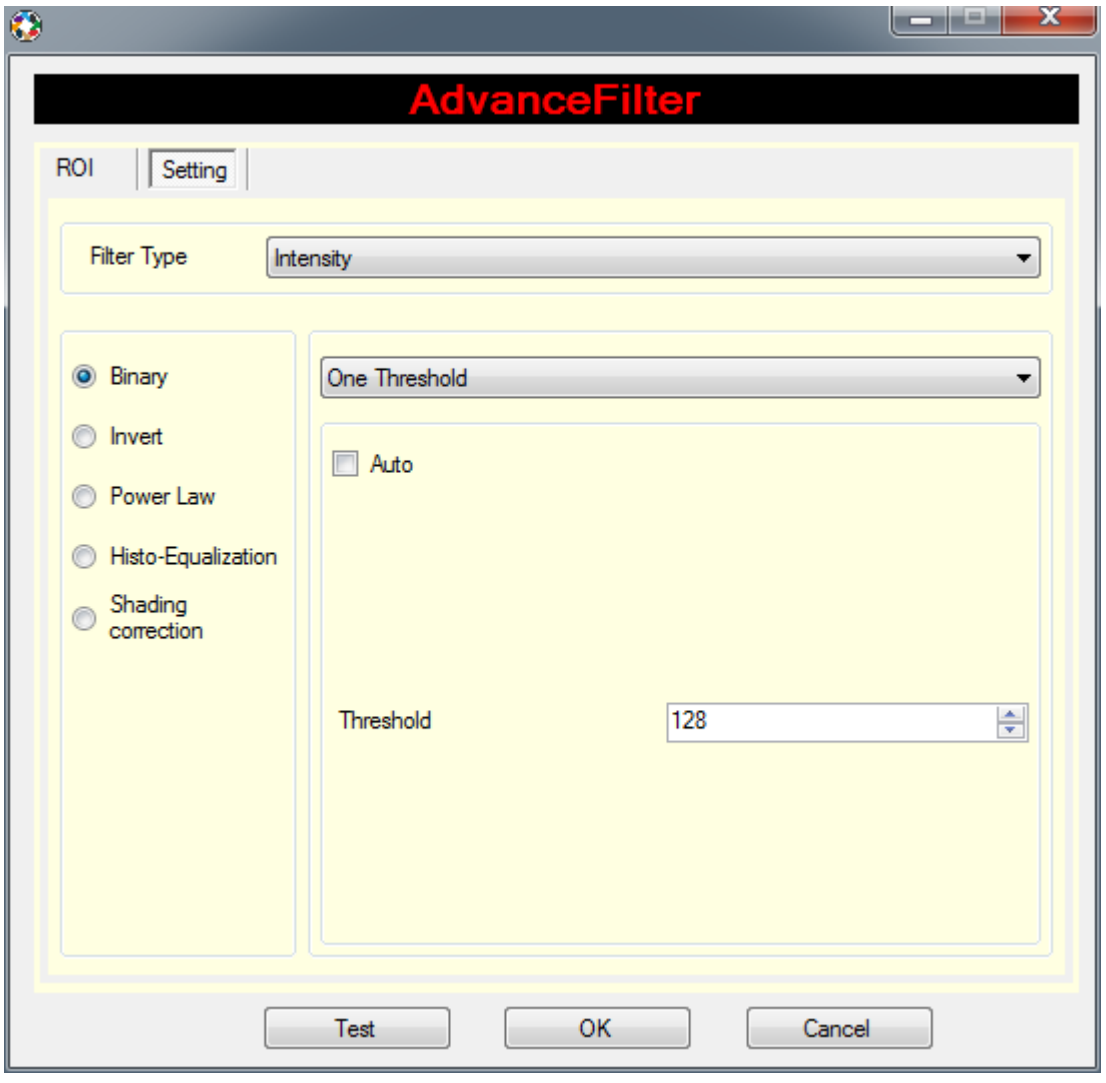
Addition: Combine 2 images (add each other) or adding a constant grey value to an image. Added values will not be larger than 255.

Division: Combine 2 images (division by each other) or divide by a constant grey value to an image. Divided values will not be smaller than 0.

Multiplication: Combine 2 images (multiple by each other) or multiply by a constant grey value. Multiplied values will not be larger than 255.

Subtraction: Combine 2 images (subtract each other) or subtract by a constant grey value. Subtracted values will not be smaller than 0.

Banner Vision Inspector



Intensity Filter:

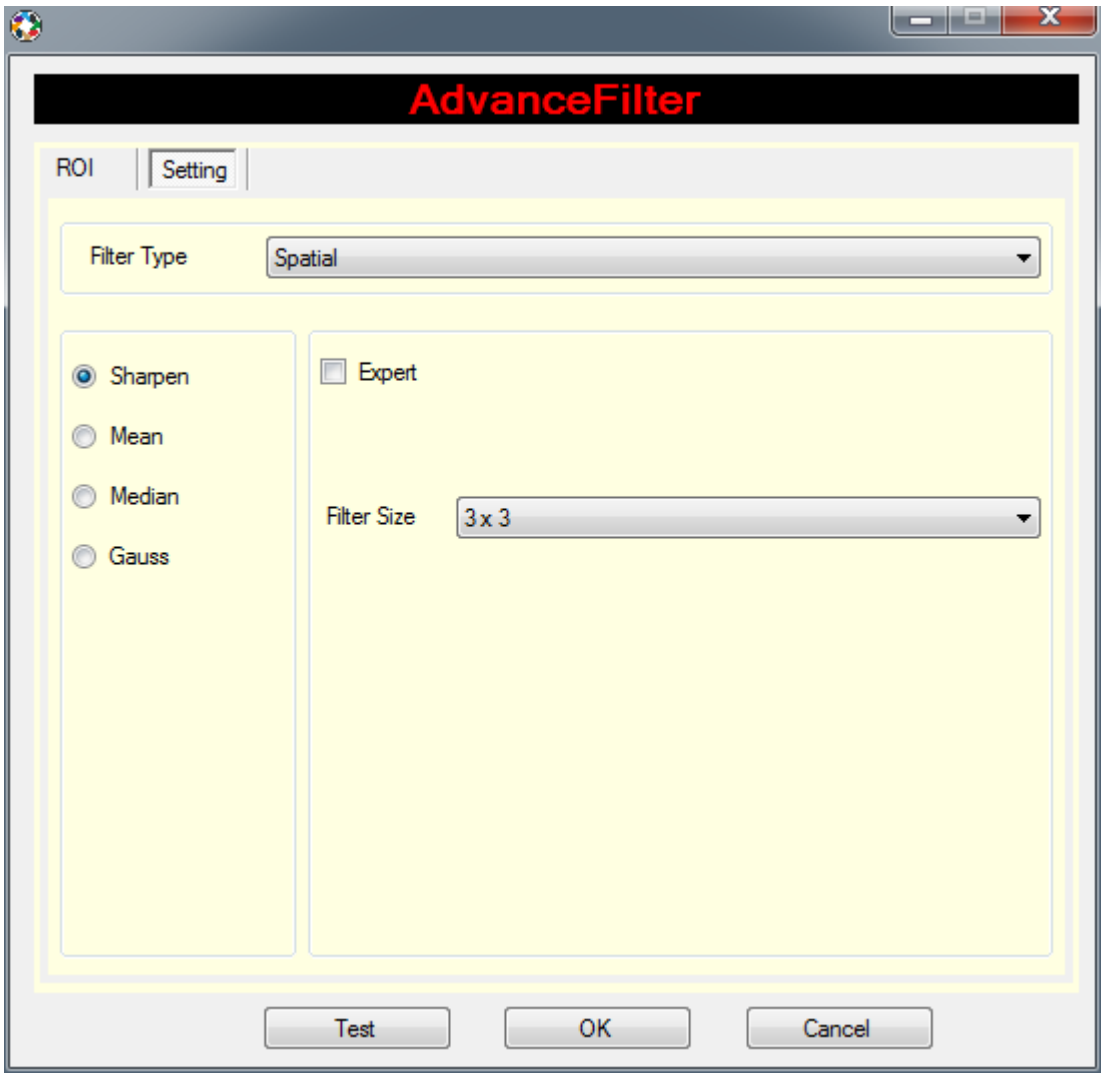
Binary: Binaries the image with the selected threshold value (selected threshold value will be replaced by 0 whereas the remaining will be replaced by 255).

Invert: Inverts the greyscale value of an image.

Power Law: Alter the image by encoding or decoding its gamma value.

Histo-Equalization: Contrast adjustment of the image histogram.

Shading Correction: To compensation non-uniform illumination or non-uniform camera sensitivity.



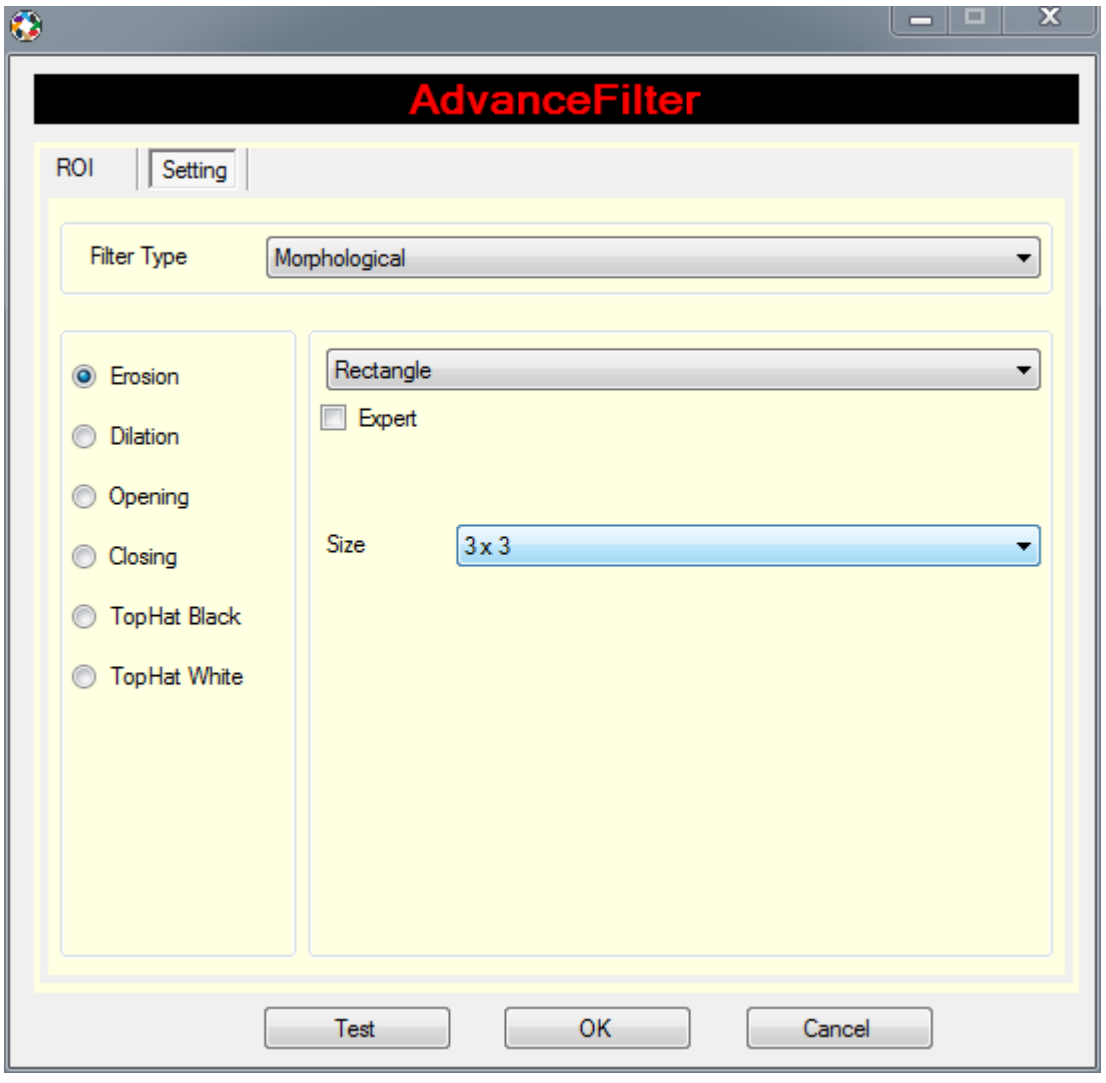
Spatial Filter:

Sharpen: Enhances the contrast in the image by emphasizing high frequency areas of the image edges and corners, resulting sharper images appearance.

Mean: Smooths the image by averaging and carries out a linear smoothing with the grey value of the source image.

Median: Compute a median filter with various square or circular masks.

Gauss: Smooths the image using the discrete Gaussian function. The smoothing effect increases with increasing filter size.



Morphological Filter:

Erosion: Erode a region of an image or the complete image where it boundary gets smoothed and also reduced.

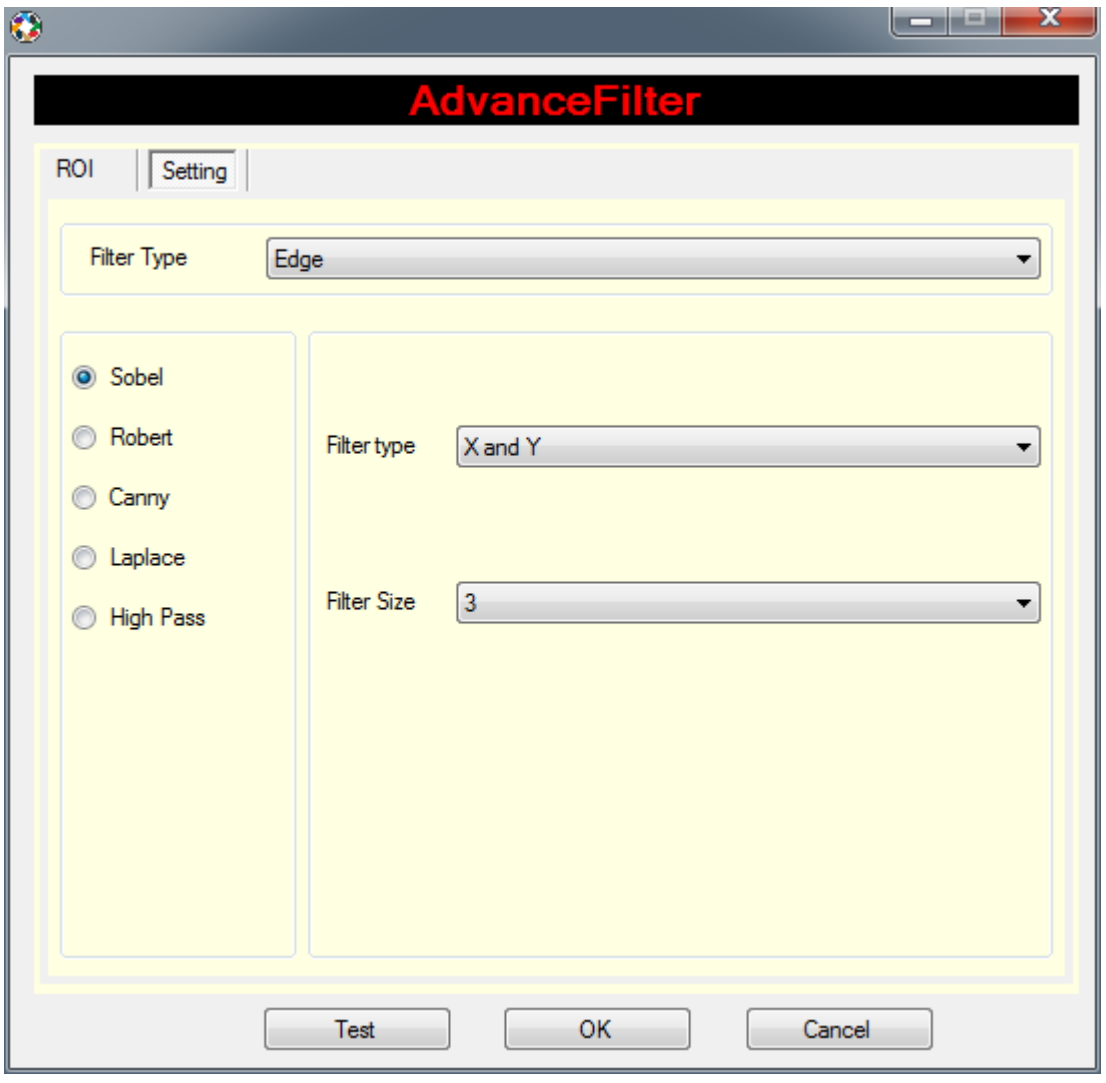
Dilation: Dilate a region of an image or the complete image where it boundary gets smoothed and also enlarged.

Opening: Combination of Erosion and Dilation filters. Denote dilation and erosion respectively.

Closing: Combination of Dilation and Erosion filters. Denote erosion and dilation respectively.

Top Hat Black: Extracts small black elements and details from the given image. This is used for feature extraction, background equalization and image enhancement.

Top Hat White: Extracts small white elements and details from the given image. This is used for feature extraction, background equalization and image enhancement.



Edge Filter:

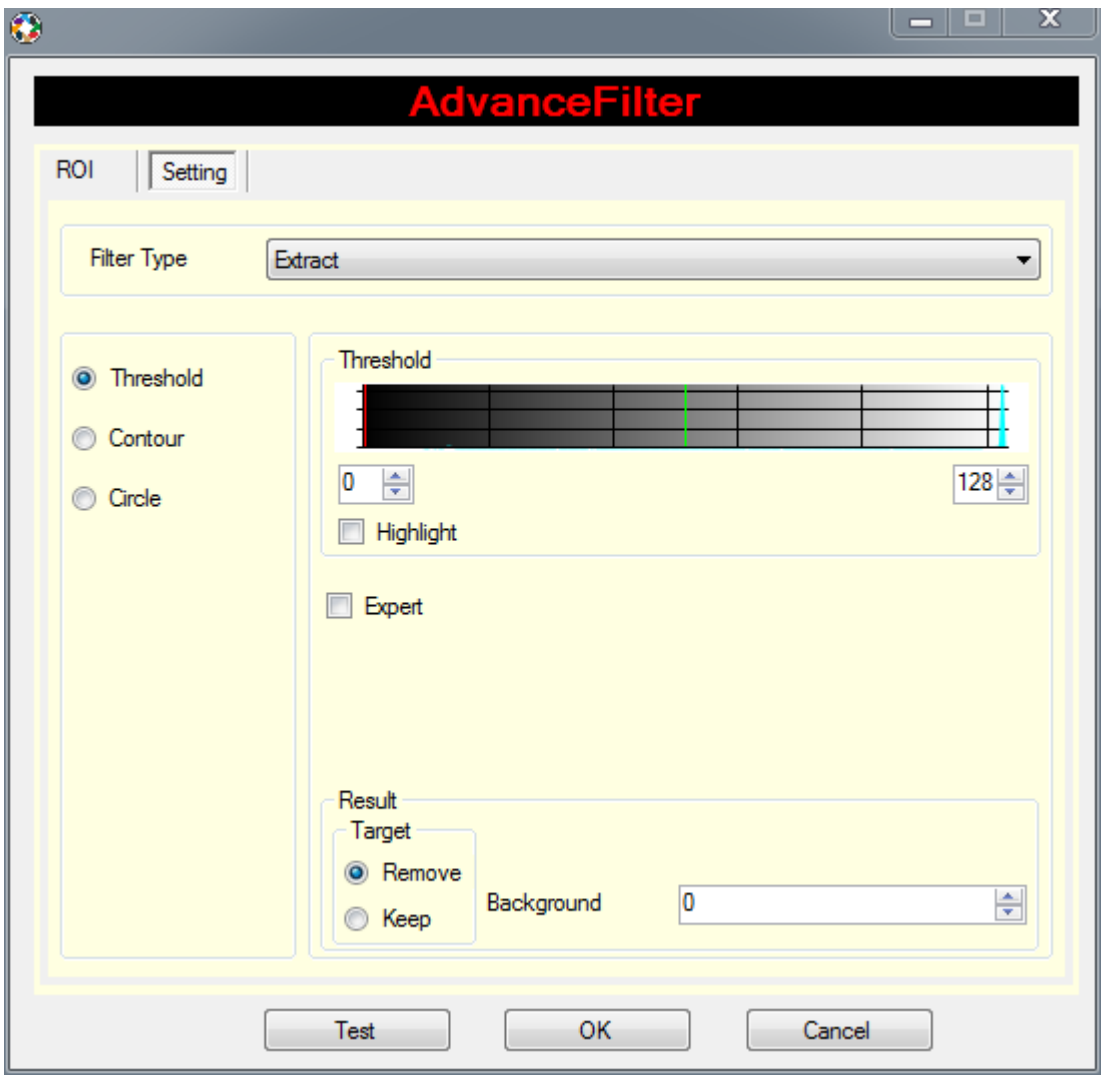
Sobel: Detect and filter the edges (amplitude and direction) of the images.

Robert: Detect and filter the edges of the images.

Canny: Detect and filter the edges of the images.

Laplace: Calculate the Laplace operator by using finite differences.

High Pass: Extract high frequency components in an image by applying a linear filter.



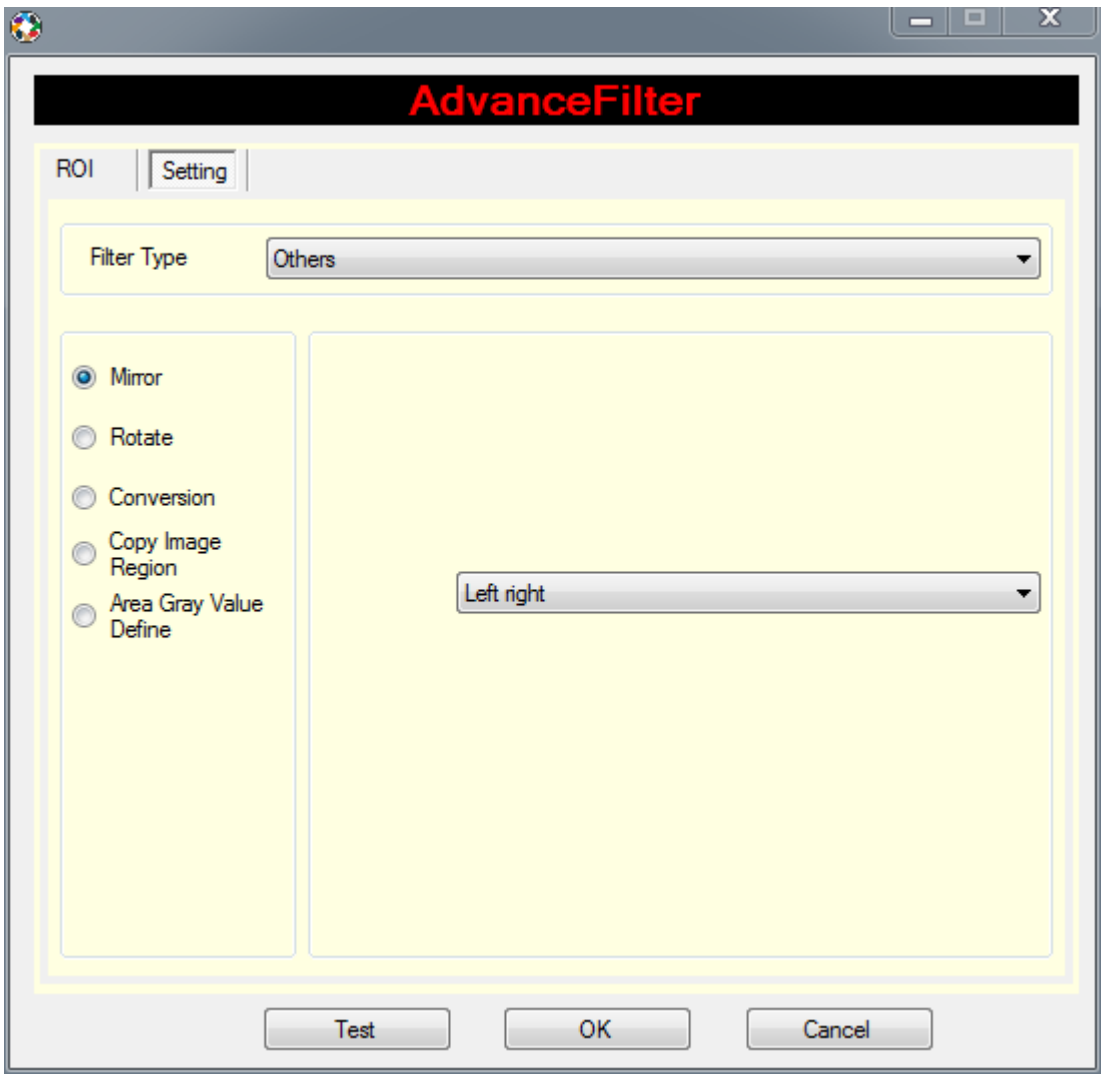
Extract Filter:

Threshold: Extract the image region by the selected threshold areas / ranges.

Contour: Extract the image region by the contour of a reference object shape.

Circle: Extract the image region by a circular defined size and location.

Banner Vision Inspector



Others Filter:

Mirror: Mirror an image by its horizontal or vertical axis.

Rotate: Rotate an image based on a defined angle.

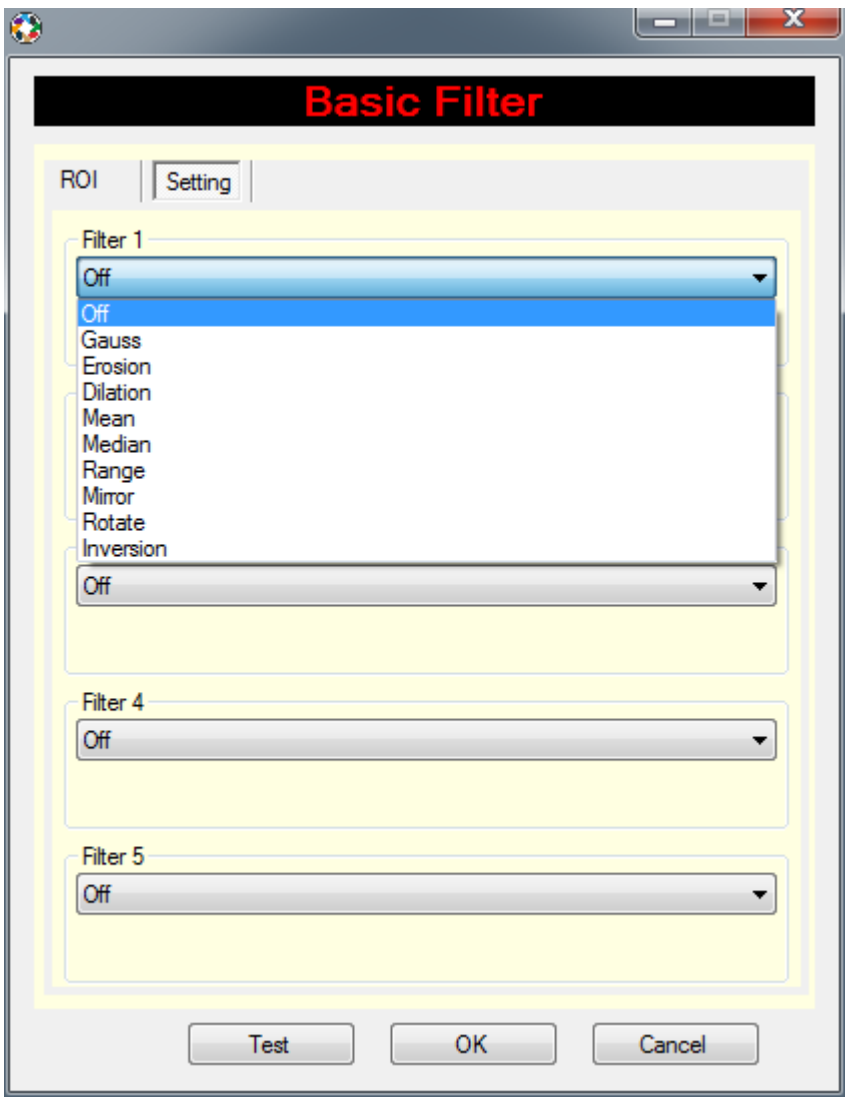
Conversion: Convert a RGB image to a greyscale image.

Copy Image Region: Copy a defined image region from the source image.

Area Grey Value Define: Define an image region with the desired grey value.

Basic Filter

BasicFilter



The Basic Filter command allow up to 5 different filter combinations within a single command and 9 different filter types selection.

Gauss: Smooths the image using the discrete Gaussian function. The smoothing effect increases with increasing filter size.

Erosion: Erode a region of an image or the complete image where it boundary gets smoothed and also reduced.

Dilation: Dilate a region of an image or the complete image where it boundary gets smoothed and also enlarged.

Mean: Smooths the image by averaging and carries out a linear smoothing with the grey value of the source image.

Median: Compute a median filter with various square or circular masks.

Range: Perform highlighting and outlining contour edges.

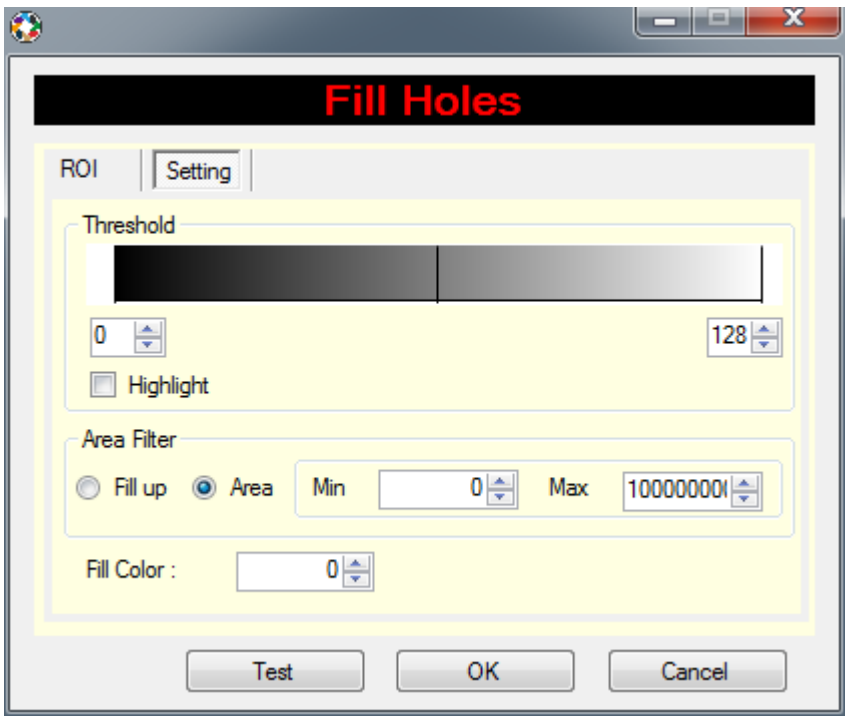
Mirror: Mirror an image by its horizontal or vertical axis.

Rotate: Rotate an image based on a defined angle.

Invert: Inverts the greyscale value of an image.

Fill Hole

Fill Hole



The Fill Hole command is filled up the desired area with a desired colour basing on the threshold set.

Threshold: To define the image region by the selected threshold areas / ranges.

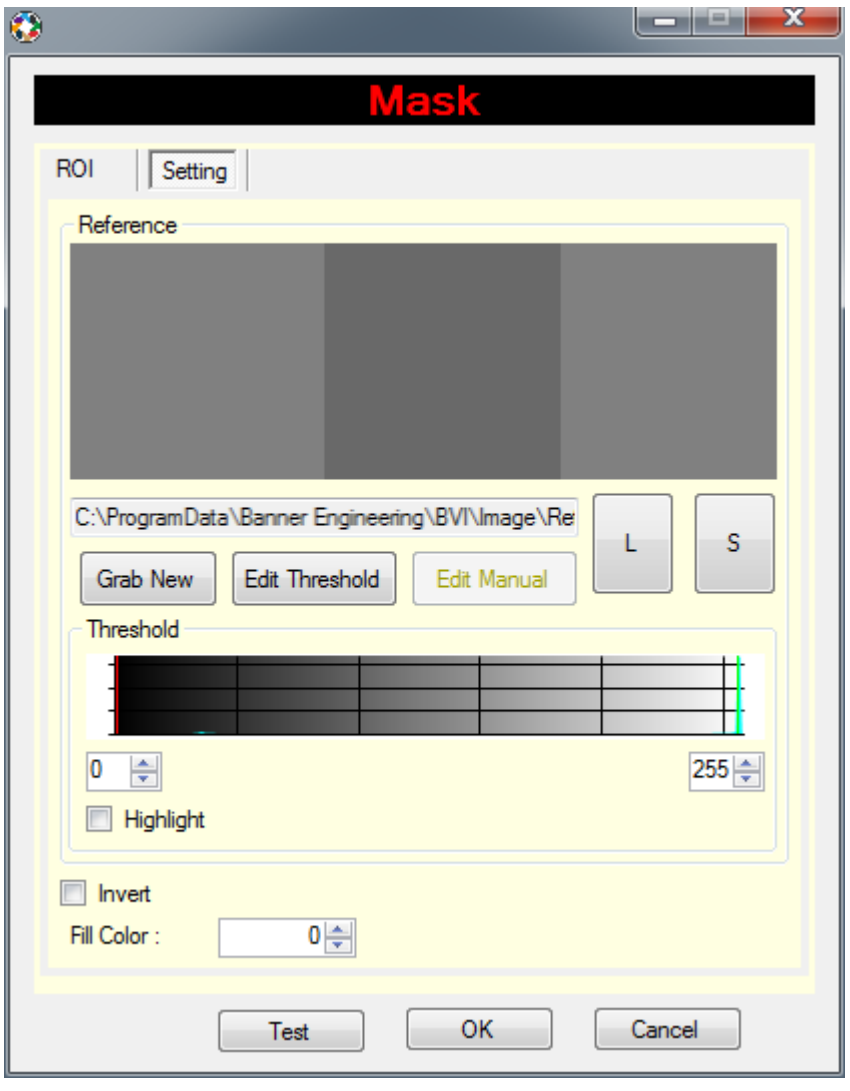
Area Filter:

- **Fill up:** To enable fill up hole feature basing on the search region.
- **Area:** Define minimum and maximum area size of detected objects. Values outside this range will be ignored.

Fill Colour: To set the gray value to be filled up basing on the area enter.

Masking

Mask



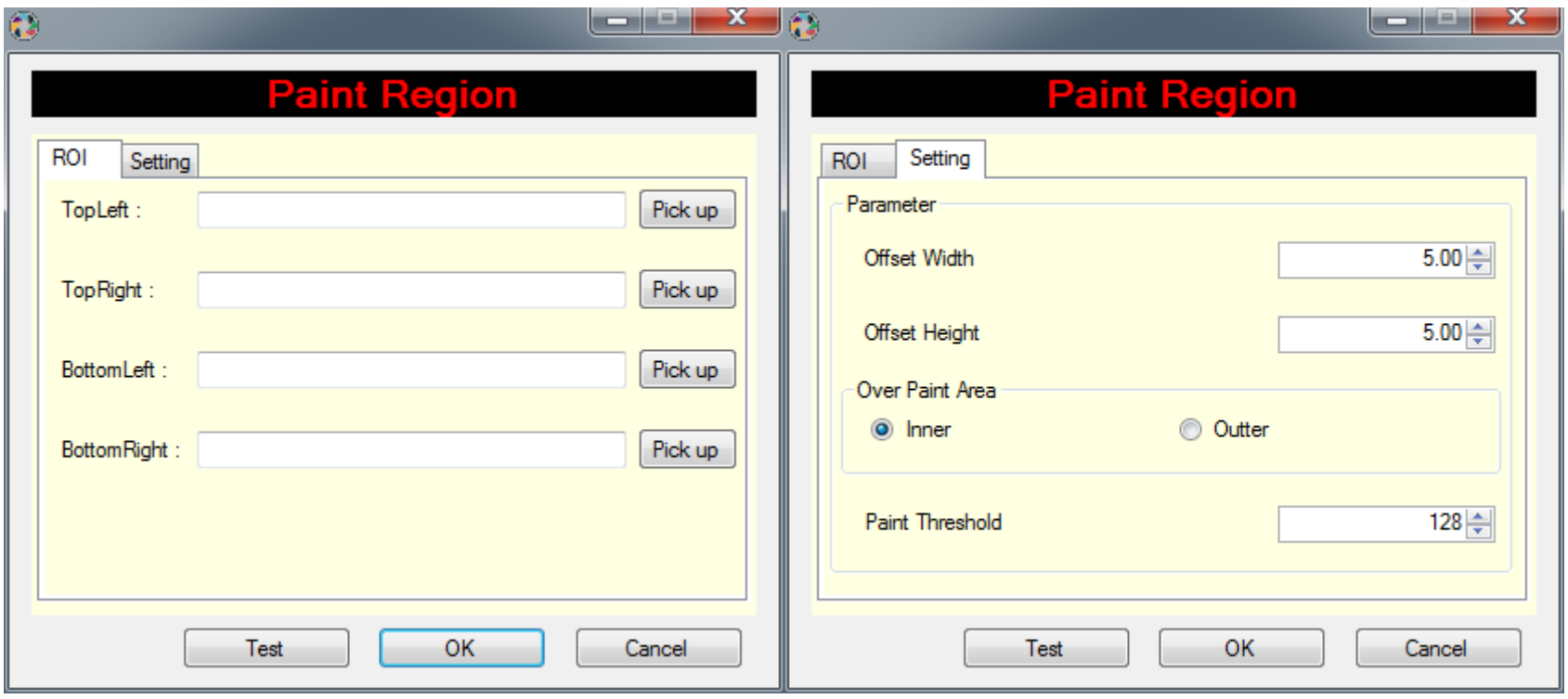
The Mask command is a masking tool which uses a pre-configured area to be ignored during the inspection.

Reference:

- **Grab Reference:** Define a teach reference image as masking reference.
- **Edit:** Define areas within the teach reference image to be ignored during inspection.
- **L:** Load a pre-configured teach reference image.
- **S:** Save the current teach reference image.
- **Invert**: To invert the masking reference result.
- **Fill Colour:** To fill the desired grey value colour of the masking result.

Paint Region

Paint Region



The Paint Region command is a 4 sided masking tool which uses 4 pickup points to configured the area to be ignored during the inspection.

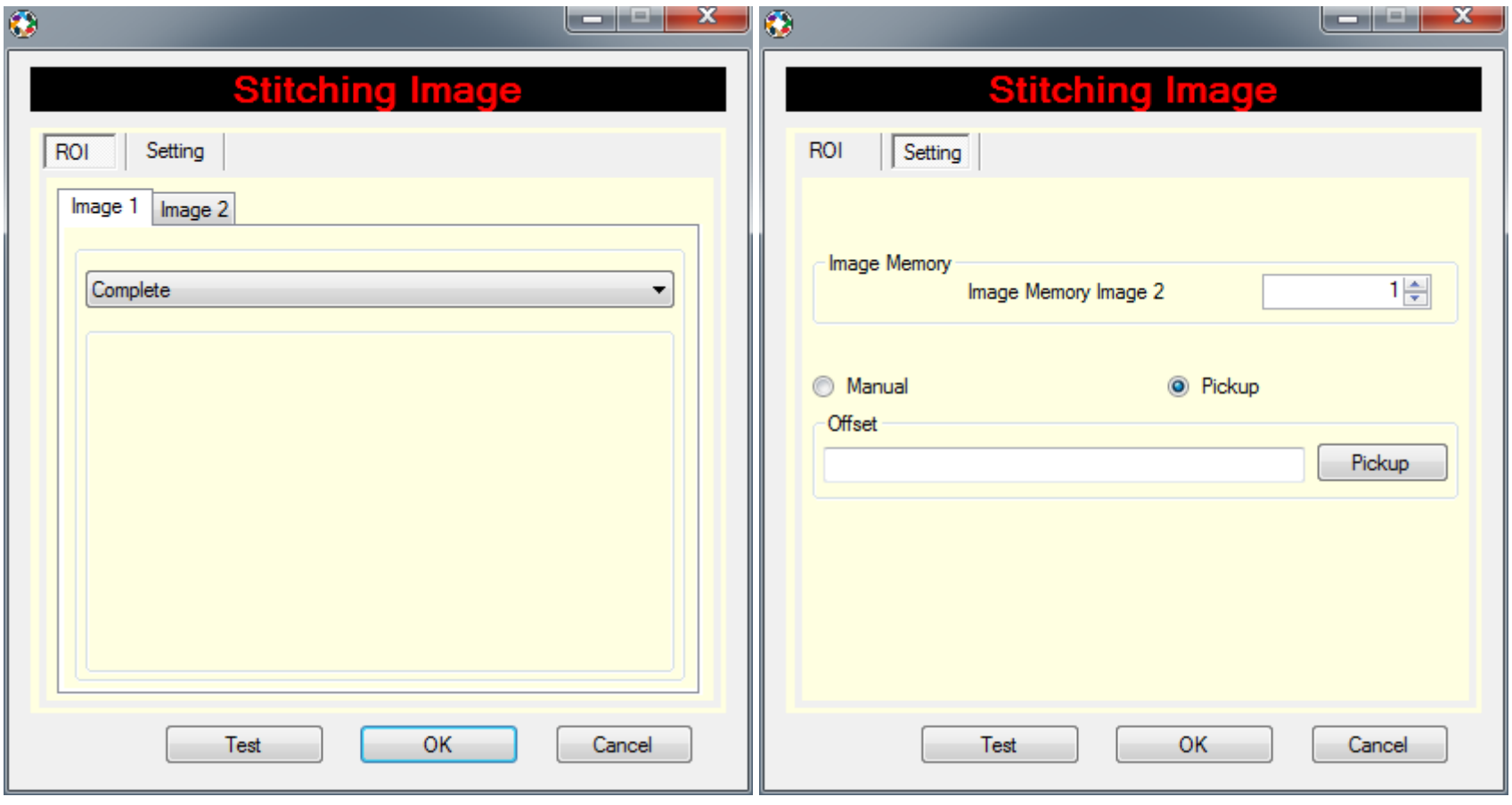
- **TopLeft:** Define top left point of masking reference.
- **TopRight:** Define top right point of masking reference.
- **BottomLeft:** Define bottom left point of masking reference.
- **BottomRight:** Define bottom right point of masking reference.

Parameter:

- **Offset Width:** Define additional offset in masking width from the points obtained in ROI.
- **Offset Height:** Define additional offset in masking height from the points obtained in ROI.
- **Inner / Outer:** Define mask over inner or outer from ROI.
- **Paint Threshold**: Define the threshold value to be used over the defined mask areas.

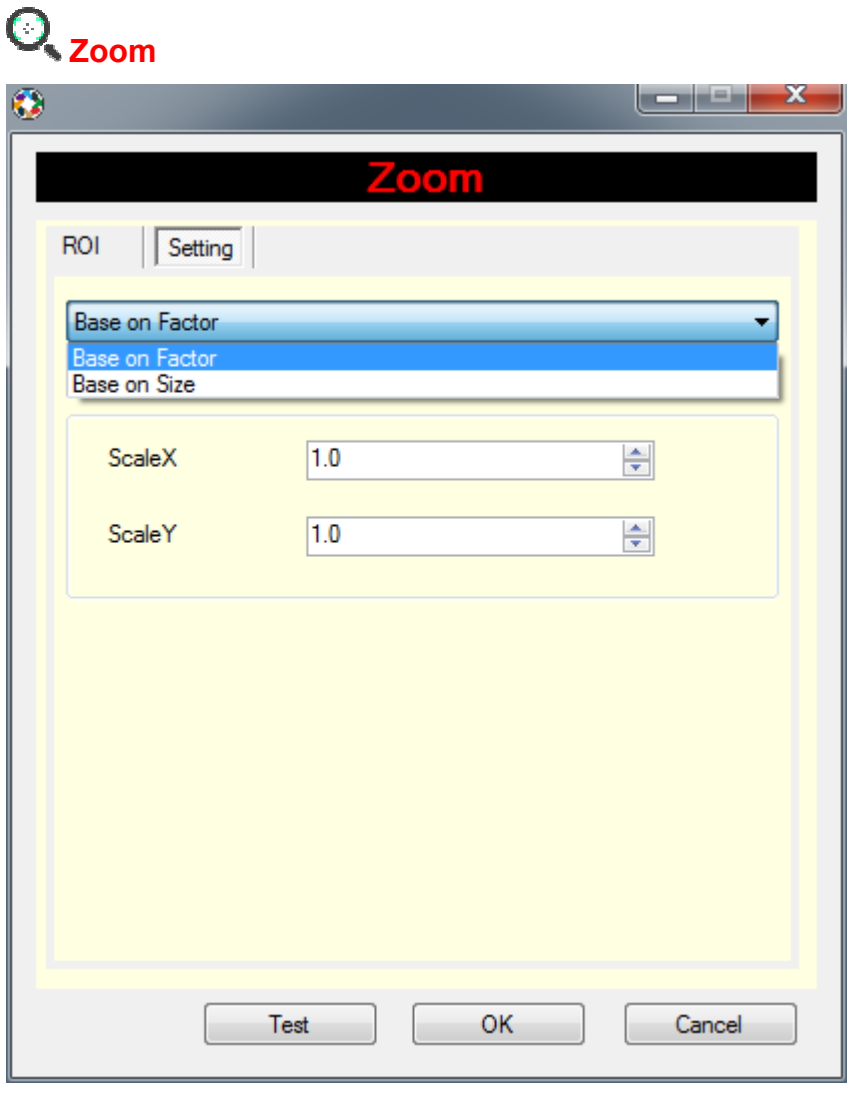
StitchingImage

StitchingImage



This StitchingImage command to Stitch two images together into one image.

Zoom



Zoom

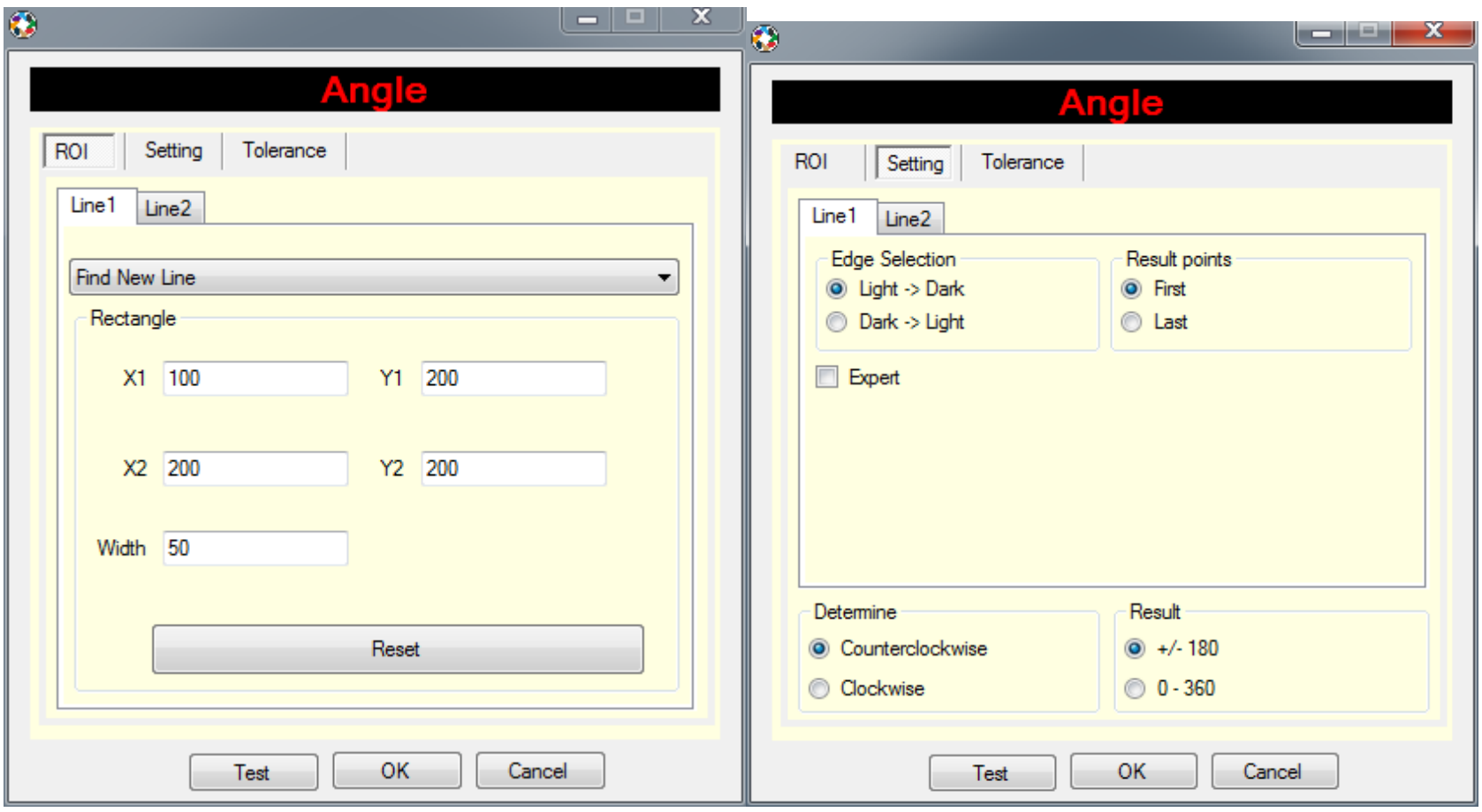
This zoom command to zoom large the region of interest base on factor or base on size.

Measurement

Topic on Angle, Area Check, Distance, Measurement and Width.

Angle

Angle



The Angle command measures the angle of 2 straight lines formed by 2 rectangular probes.

Line 1 / Line 2: Define the parameters to detect each line and measures the angle accordingly.

Find New Line: Create new line using the defined parameter settings for measurement of the angle.

Pickup: The Pickup refers to the process of choosing the result value generated by a command / function anywhere in the inspection program. The Pickup is a global data structure which uses the result values of the different commands into their position and stores them. This allows the user to have a specific access to the result and is not dependent on any possible shifts in the program.

X / Y Axis: Measure angle with respect to the selected X / Y axis.

Edge Selection:

- **Light -> Dark**: The greyscale colour for the object in demand is set to dark which is defined according to the arrow of the search region.
- **Dark -> Light:** The greyscale colour for the object in demand is set to bright which is defined according to the arrow of the search region.

Result Points:

- **First**: First point of the extracted edge points is returned.
- **Last**: Last point of the extracted edge points is returned.

Expert:

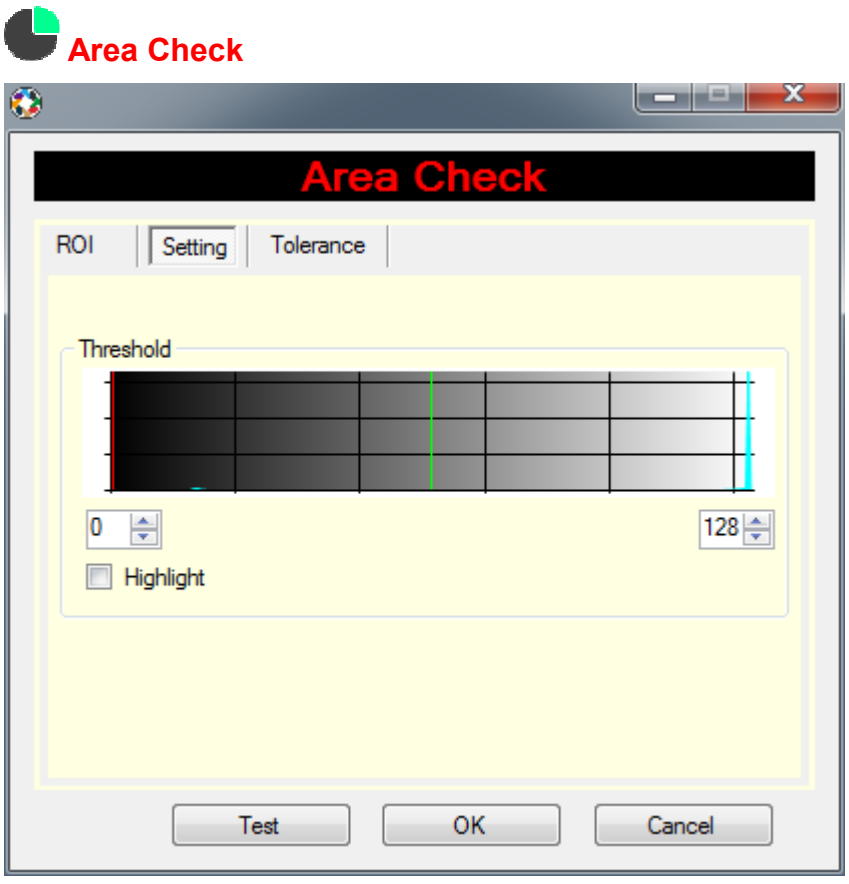
- **Denoise**: Sigma of the Gaussian functions for smoothing.
- **Amplitude**: Minimum edge amplitude changes between edges.
- **Number of point (>2):** Define number of detected points to be used within the probe to improve processing time.

Determine: Determine the angle calculated via clockwise or counterclockwise.

Result: To choose the angle result range at +/- 180 or 0-360.

Tolerance: State conditional acceptance of the inspected result.

Area Check



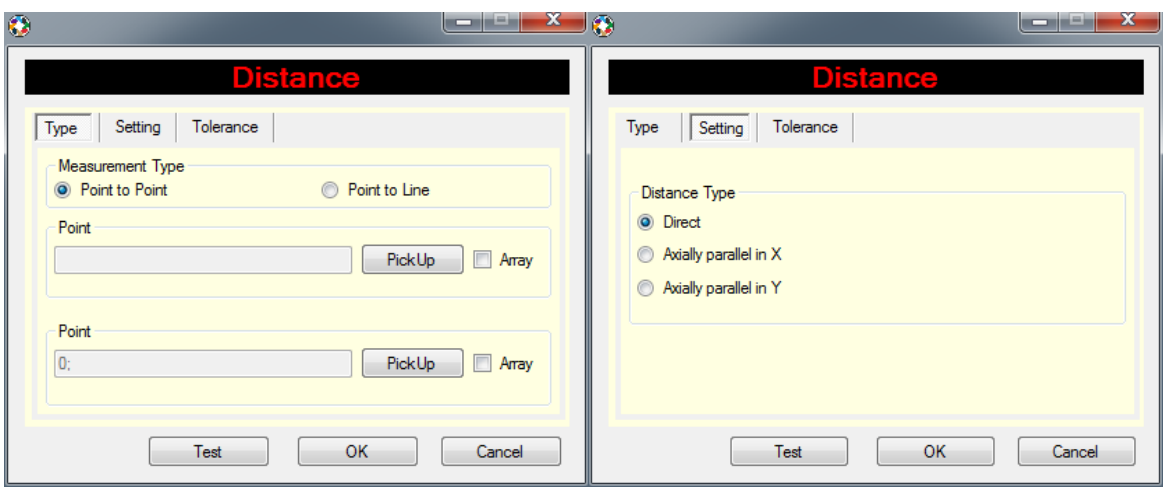
The Area Check command measures a desired area basing on the threshold selected.

Threshold: To set the desired threshold to measure the area**.**

Tolerance: State conditional acceptance of the inspected result.

Distance

Distance



The Distance command is to measure distance between 2 points or a point to a line that are detected using rectangular or circular probe.

Measurement Type:

- **Point to Point:** Measure the distance between 2 selected points.
- **Point to Line:** Measure the distance between a selected point and a selected line.

Pickup: The Pickup refers to the process of choosing the result value generated by a command / function anywhere in the inspection program. The Pickup is a global data structure which uses the result values of the different commands into their position and stores them. This allows the user to have a specific access to the result and is not dependent on any possible shifts in the program.

Array: To measure multi-points at a single command with multi points detect.

Distance Type:

- **Direct:** Measure the shortest distance between the selected pickup.
- **Axially parallel in X/Y:** Measure the distance with respect to the selected axis.

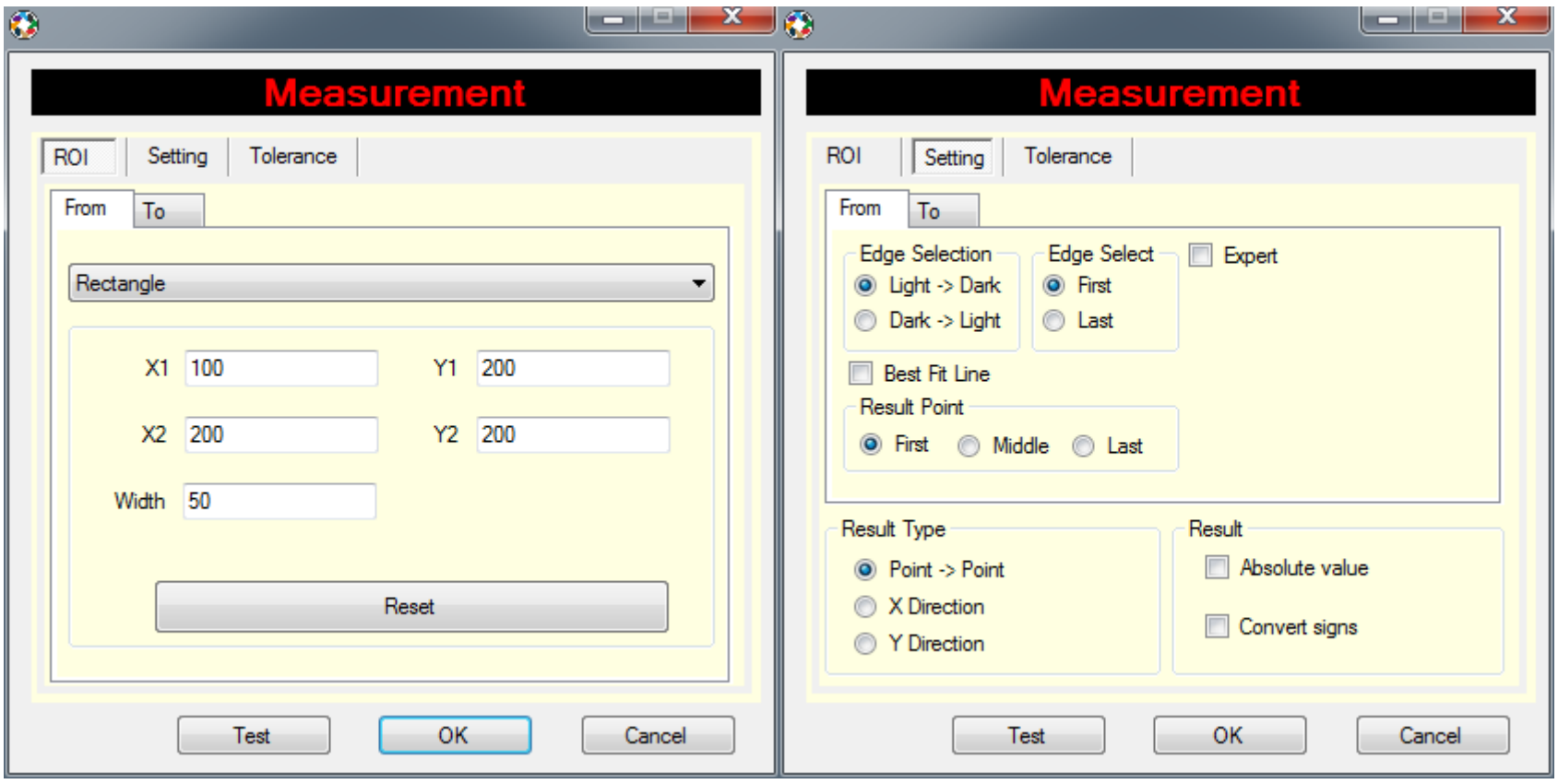
Edge Selection:

- **Light -> Dark**: The greyscale colour for the object in demand is set to dark which is defined according to the arrow of the search region.
- **Dark -> Light:** The greyscale colour for the object in demand is set to bright which is defined according to the arrow of the search region.

Tolerance: State conditional acceptance of the inspected result.

Measurement

Measurement



The Measurement command is to measure distance between 2 points or a point to a line that are detected using rectangular probe.

Edge Selection:

- **Light -> Dark**: The greyscale colour for the object in demand is set to dark which is defined according to the arrow of the search region.
- **Dark -> Light:** The greyscale colour for the object in demand is set to bright which is defined according to the arrow of the search region.

Result Points:

- **Middle**: Middle point of the extracted edge points is returned.
- **First**: First point of the extracted edge points is returned.
- **Last**: Last point of the extracted edge points is returned.

Edge Select:

- **First**: First point of the extracted edge points is returned.
- **Last**: Last point of the extracted edge points is returned.
- **Best Fit Line**: Option to form detected points into a straight line when selected.

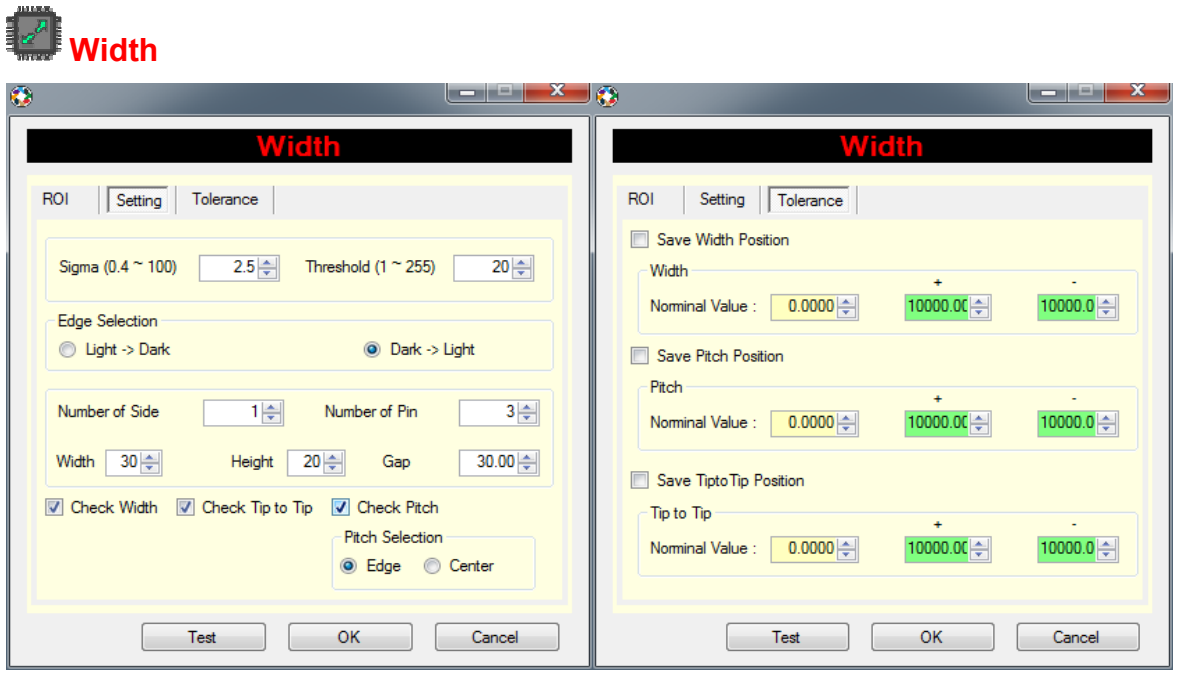
Expert:

- **Sigma**: Sigma of the Gaussian functions for smoothing.
- **Threshold**: Minimum edge amplitude changes between edges.
- **Number of point (>2):** Define number of detected points to be used within the probe to improve processing time.

Result Type:

- **Point to Point:** Measure the distance basing on the 2 points detected.
- **X Direction:** Measure the distance with respect to the X axis.
- **Y Direction:** Measure the distance with respect to the Y axis.

Width



The Width command is to measure distance like width, pitch tip to tip of parts with regular distance apart. This tool is useful for measurement in the connectors industry.

Number of Side: To determine the number of side of the part to be measured. (max. 2 sides)
Number of Pin: To defined the number of pins to be measured of on each side.
Width: To determine the width of each ROI.
Height: To determine the height of each ROI.
Sigma: Sigma of the Gaussian functions for smoothing.
Threshold: Minimum edge amplitude changes between edges.

Edge Selection:

- **Light -> Dark**: The greyscale color for the object in demand is set to dark which is defined according to the arrow of the search region.
- **Dark -> Light:** The greyscale color for the object in demand is set to bright which is defined according to the arrow of the search region.

Check Width: To measure each width of the pins.
Check Tip to Tip: To measure each tip to tip distance of the pins.
Check Pitch: To measure each pitch of the pins.
Pitch Selection: Sigma of the Gaussian functions for smoothing.

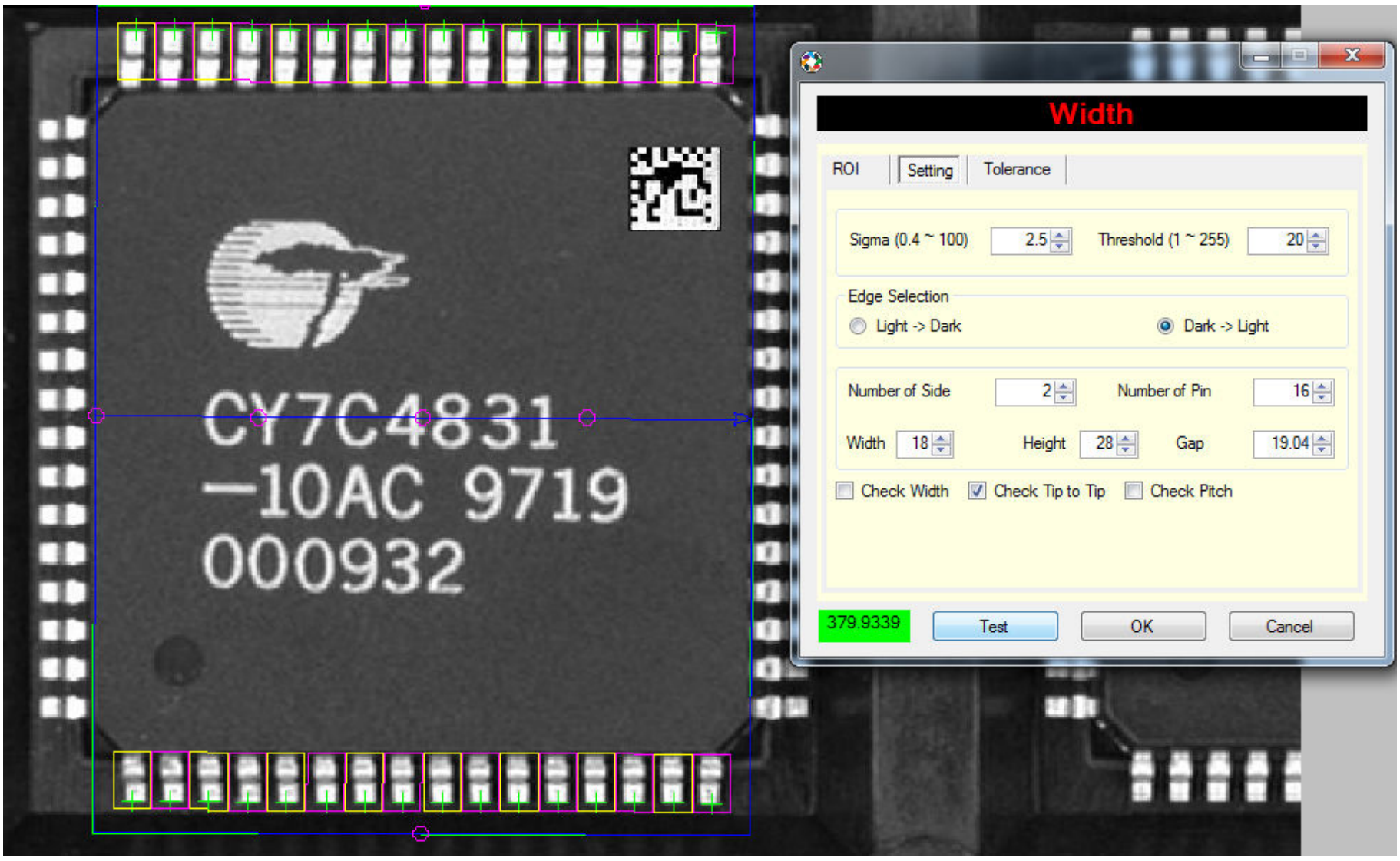
- **Edge or Center**: To determine the edge width of the pin to pin of the or the center width of each pin.

Tolerance: State conditional acceptance of the inspected result.

Above picture is measuring the width of each pin.

Banner Vision Inspector

Above picture is measuring the pitch of each pin either from the edge or center.



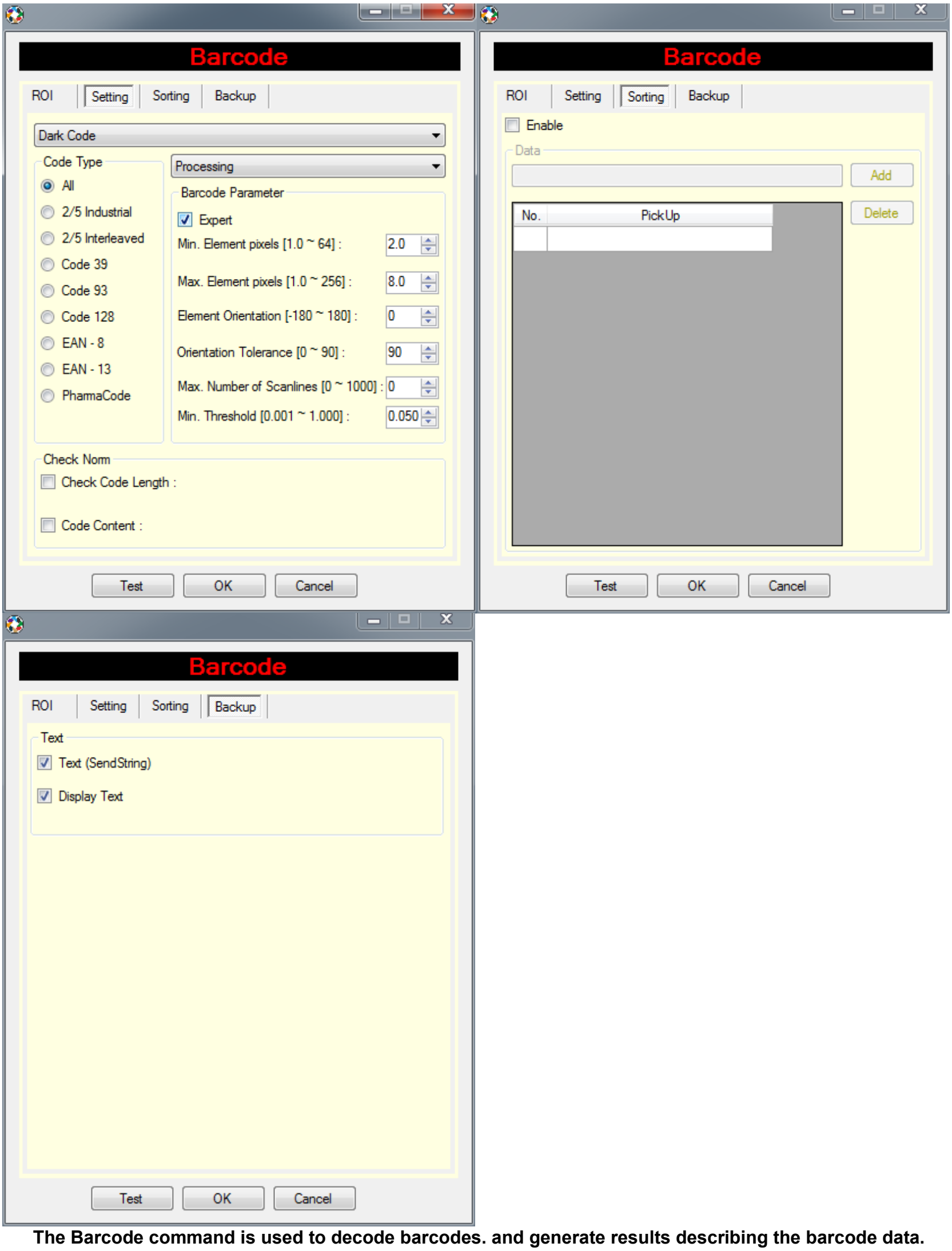
Above picture is measuring the distance of each pin tip.

CodeReader

Topic on Barcode, Datacode, OCR and OCV.

Barcode

Barcode



The Barcode command is used to decode barcodes. and generate results describing the barcode data.

Code Type: Define the barcode type for reading and decoding.

Processing/Training: Allow user to train the command based on the image's environment condition to improve the decoding speed.

Banner Vision Inspector

Expert	Min. Element pixels	Define minimal size of barcode elements.
	Max. Element pixels	Define maximal size of barcode elements.
	Element Orientation	Define expected barcode orientation or rotation.
	Orientation Tolerance	Define orientation / rotation tolerance of the element orientation.
	Max. Number of Scanlines	Define the number of detection lines for decoding.

Result:

- **Check Code Length:** Check the length of the decode barcode.
- **Code Content:** Compare the decoded barcode with a defined reference.

Sorting: Enable to read the barcodes in desired arranggement.

Text:

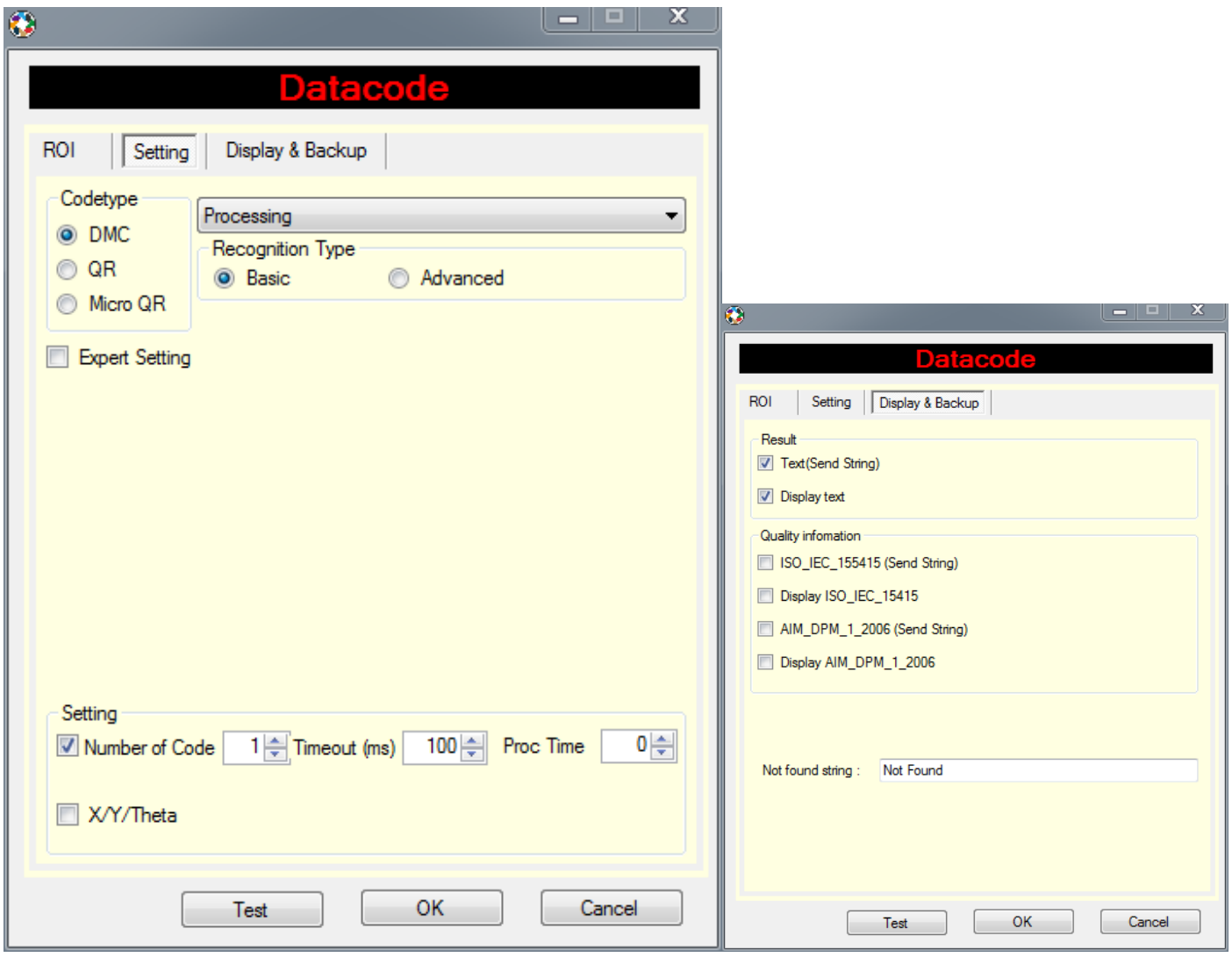
- **Text (SendString):** Save decoded barcode results in result viewer.
- **Display Text:** Display decoded result on image as overlay.

The idea of bar code reading is quite easy. You initialize the barcode tool and then execute it for reading bar codes. Within this, you specify the desired bar code type.

The result of the reading is a region that contains the bar code and the decoded string. No advanced experience in programming or image processing is required. Bar code reading can be sped up by using a region of interest. The more the region in which the code is searched can be restricted, the faster and more robust the search will be.

Datacode

Datacode



The Datacode command currently supports Data Matrix (ECC200), QR Code and PDF417, and it is able to read multiple codes of the same type within a single image. apart from reading the ecoded data, it can alos provide geometric features and feedback for process control.
Note: Possible reasons why a symbol might not be detected at all include severely damaged or distorted finder patterns, inadequate quiet zones around the symbol or strong curvature of the surface.
Code Type: Define the 2D code type for reading and decoding with option of DMC, QR & Micro QR.

Processing/Training: Allow user to train the command based on the image's environment condition to improve the decoding speed.

Expert	Mirrored Type	Define whether if code might be mirrored.
	Polarity Type	Define the polarity of the code within the image.
	Shape Type	Define module shape of code.
	Module Size	Define minimal and maximal pixel size of modules.
	Symbol Rows	Define minimal and maximal number of rows in symbol.
	Symbol Cols	Define minimal and maximal number of columns in symbol.

Multi DataCode:

- **Number of code:** Define the maximum number of codes available in the image.
- **Timeout (ms):** Define the timeout on this tool to ignore current decoding process and continue with remaining commands in the inspection process.
- **Proc Time:** Define the time taken to process and handle the datacodes.

X/Y Theta: Enable calculation of code location and angle with a defined angle reference.

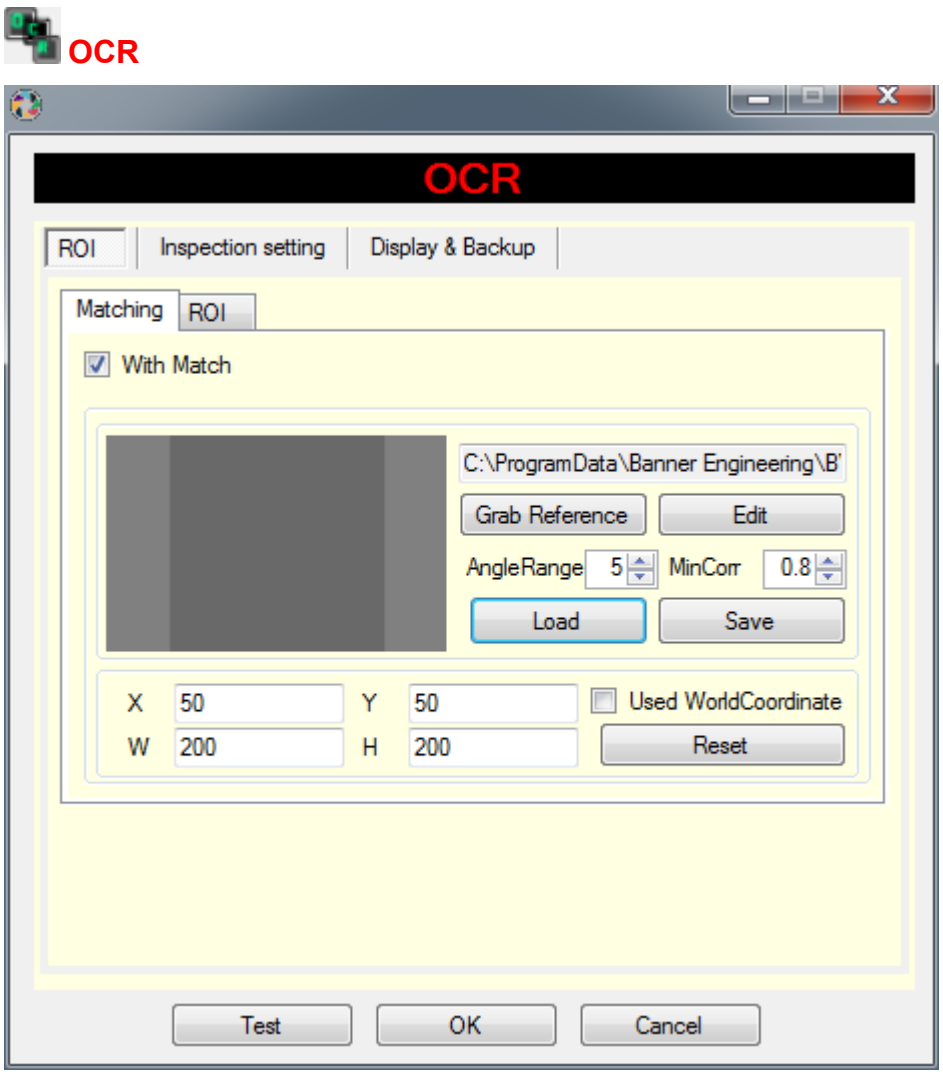
Reference Angle: Define a reference angle of the detected code.

Result:

- **Text (SendString):** Save decoded Datacode results in result viewer.
- **Display Text:** Display decoded Datacode on image as overlay.

Quality Information: Select options to check and display printing quality information of the Datacode based on international standards.

OCR



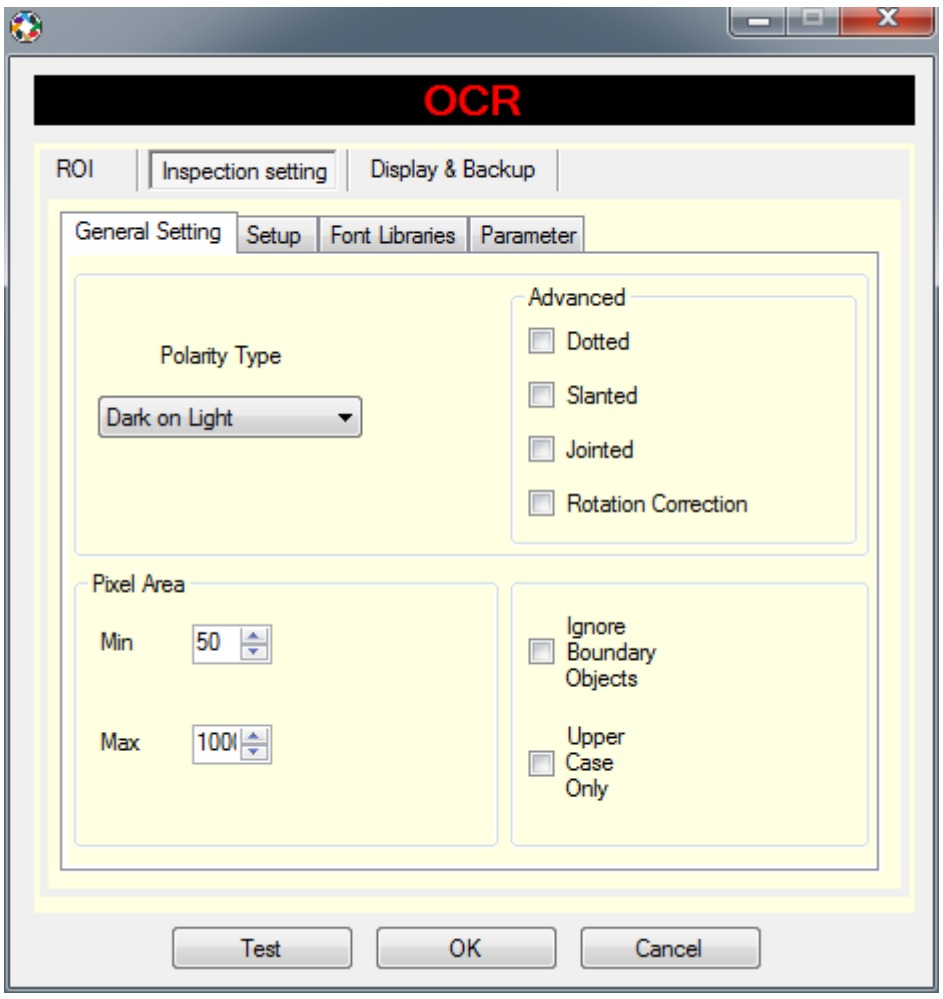
The OCR command is used to read characters from a defined library or manual teach font library. In this command, there is a matching feature to look for a pre-configured contour pattern in the search form for positioning purposes for the OCR search region to read the characters.
The OCR is performed in two major steps: First, the symbol regions need to be extracted from the image. This requires to find segmentation parameters which allow a robust extraction of all symbols in varying images and is usually the most demanding part of the configuration.

Then, the symbols are read using an OCR font, i.e. each symbol region is assigned a logical symbol name. You can choose from the list of stock OCR fonts, or create your own OCR font. To create your own OCR font, you must train it using a trainfile containing samples of the symbols to read.

Matching:

Grab Reference: To teach the command to match basing on the reference.
Edit: To allow user to delete certain portion of the grab reference where it will not match during inspection.
Load: To load the grab reference after saving it.
Save: To save the grab reference after teaching it.
Min. Corr: Minimum score where command match basing the reference image.
AngleRange: To limit the search area for rotating objects by a maximum and a minimum angle. In this case the increment indicates the noise for the search.

Banner Vision Inspector



Inspection Setting: General Setting:

Polarity Type: Define the polarity of the characters within the image.

Advanced:

Dotted: Select if characters are dot print.

Slanted: Select if characters are minor slanted.

Jointed: Select if characters are jointed or merged.

Rotation Correction: Select if characters are not upright and enables slight rotation correction in the search region.

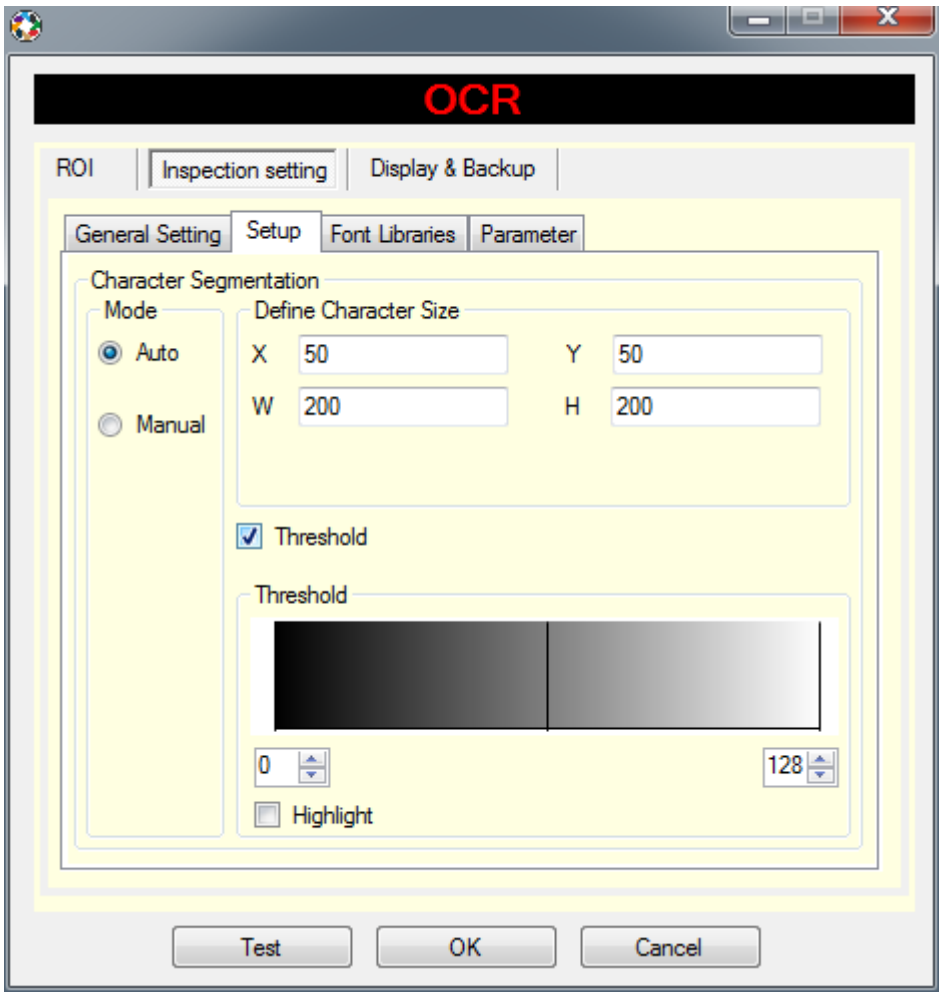
Pixel Area: Define the minimum and maximum pixel size of a character to be detected. Values outside this range will be ignored.

Area:

Ignore Boundary Objects: Ignore detected objects or characters which are in direct contact onto the search region.

Upper Case Only: Enable detection of upper case characters only.

Banner Vision Inspector

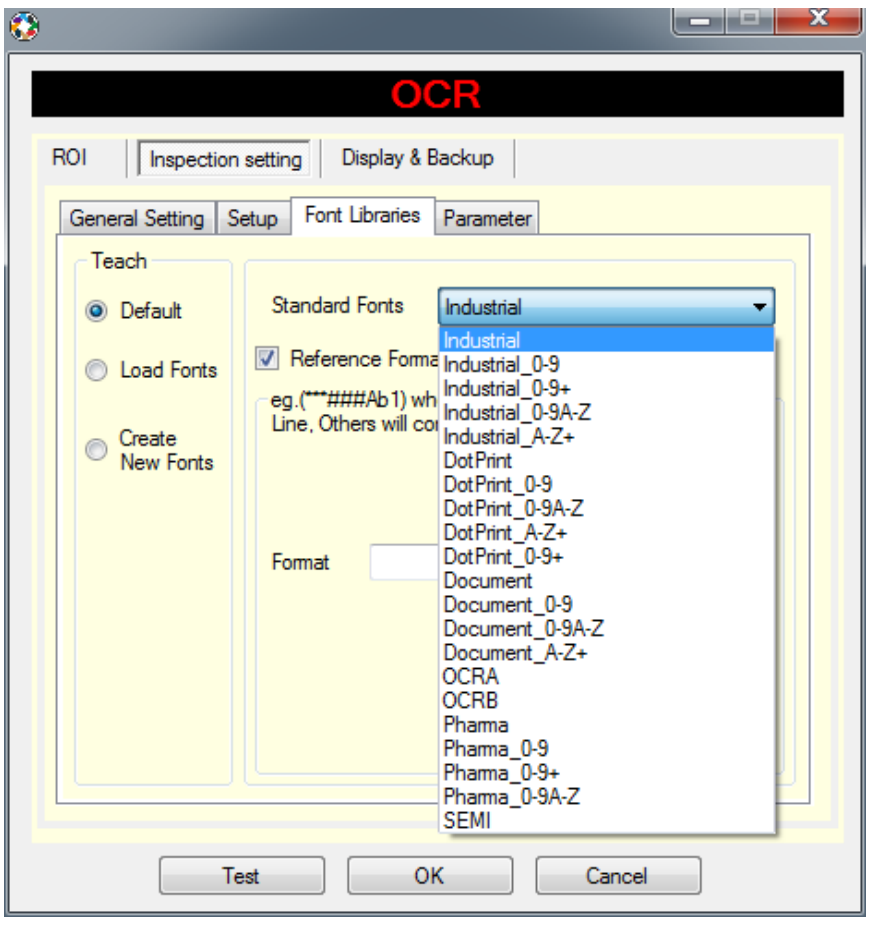


Inspection Setting: Setup

Mode: Selection of inspection methods.
Auto: Read characters automatically basing on the software default configuration.
Manual: Read characters manually basing on the user defined setting on the character size and stroke width.

Define Character Size: Define maximum possible width and height of the largest available character in the image.
Stroke Width: Define thickness of a character stroke.

Pixel Area: Define the minimum and maximum pixel size of a character to be detected. Values outside this range will be ignored.



Inspection Setting: Font Libraries

Teach:

- **Default:** Select character recognition from standard available font libraries.
- **Load Fonts:** Load a user pre-teached font library.
- **Create New Fonts:** Create and teach a new user font library.

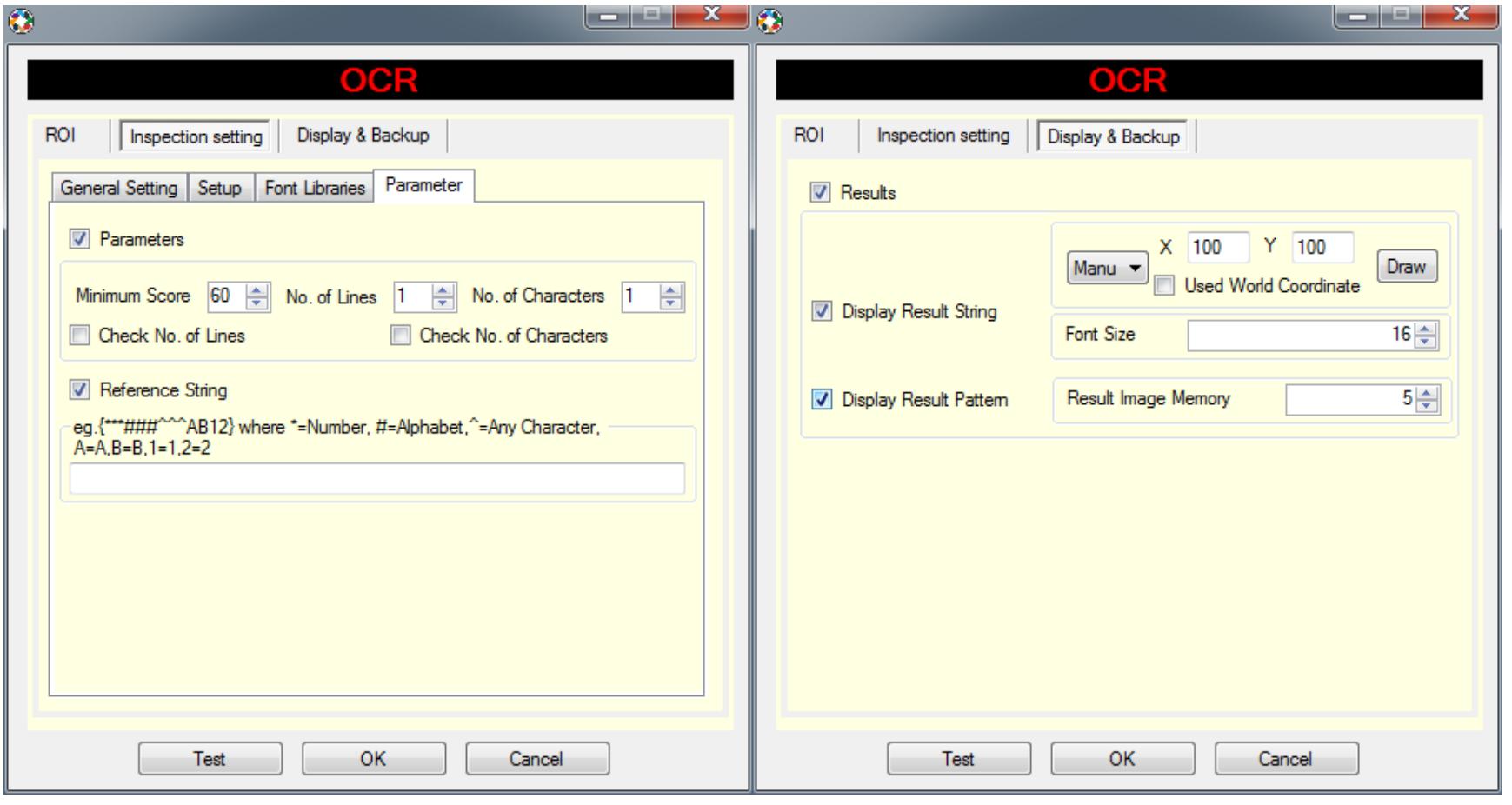
Banner Vision Inspector

Standard Fonts: Select character recognition from a list of available font's library.

Reference Format: Define an expected characters types during inspection to improve recognition accuracy (especially between the characters "O" and "0").

Sample example and symbol representations:
Inspected Characters: 15MAR2016-E
Format to be entered: (**###20**@#)

Symbols:	Representations:	Possible recognized characters:
(	Start of line	- NA -
)	End of line	- NA -
*	Numbers	0 ~ 9
@	Symbols (Vary between font libraries)	- NA -
#	Alphabets	A ~ Z a ~ z



Inspection Setting: Parameter and Results

Parameters:

Minimum Score: Accepted characters with minimum recognition score with respect to its selected font libraries.

No. of Lines: Define the expected number of character lines within the search region.

No. of Characters: Define the expected number of characters within the search region.

Reference String: Compares reference string with recognized string and return command result.

Result:

- **Display Result String:** Display character string result on image as overlay.
- **Display Result Pattern:** Display each character's segmentation results.

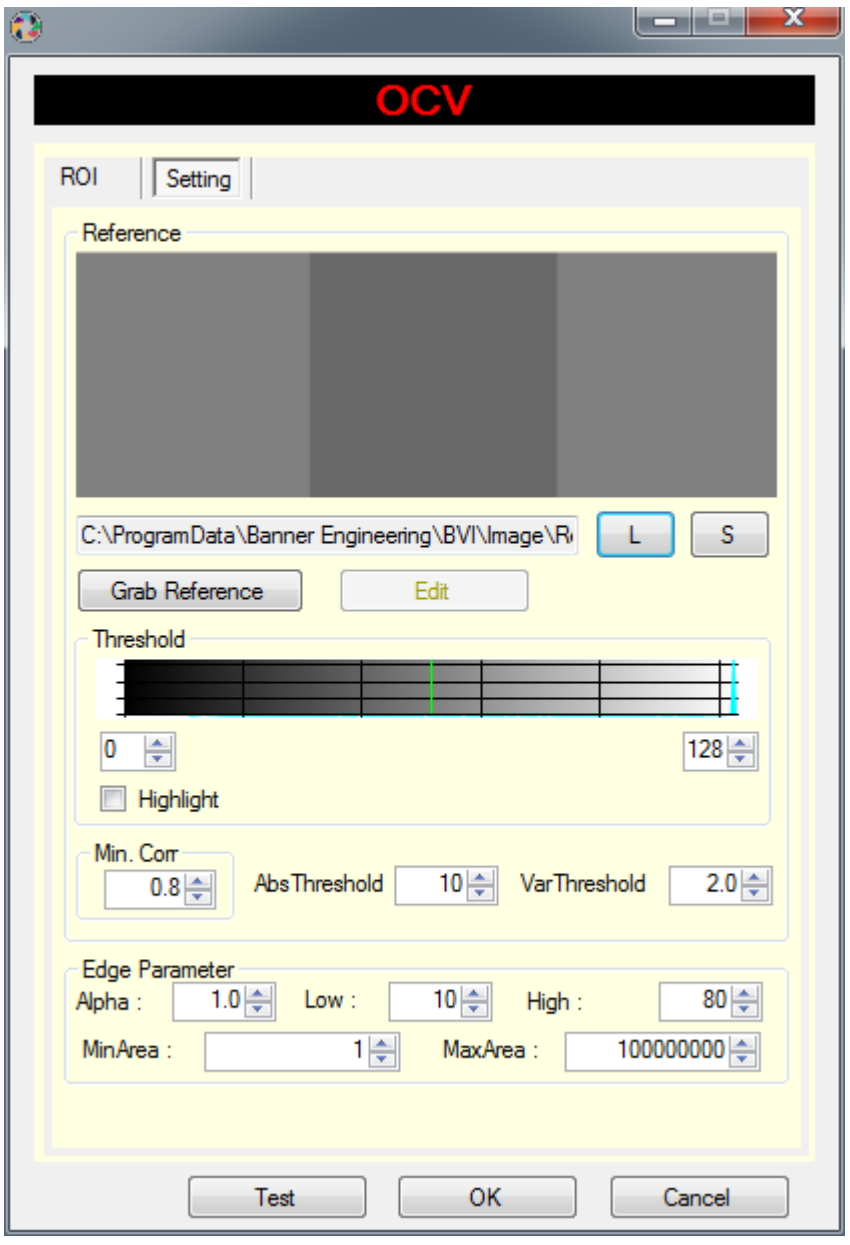
Manual/Draw: Define location to display character string result on image.

Font Size: Define font size of character string displayed on image.

Result Image Memory: Define desired image memory to display results.

OCV

OCV



OCV command to check the quality of signs regarding brightness and legibility or the general existence of an imprint with respect to its position.

Grab Reference: To teach the command to match basing on the reference.
Edit: To allow user to delete certain portion of the grab reference where it will not match during inspection.
L: To load the grab reference after saving it.
S: To save the grab reference after teaching it.

You can choose a threshold that all the pixels belonging to the object.

Min. Correlation Value: Minimum score where command match basing the reference image.

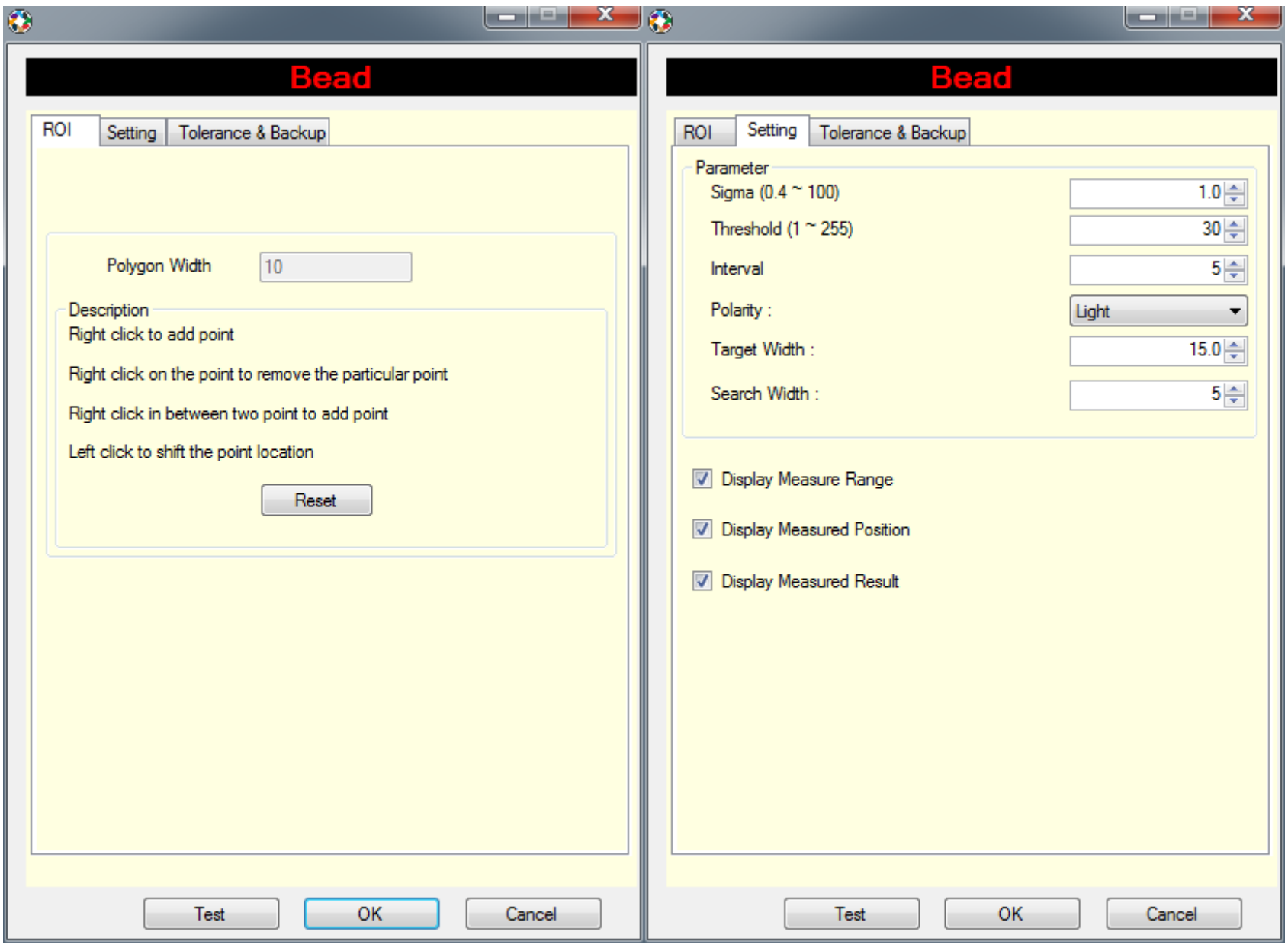
Edge Parameter: Adjust the parameter details where command match basing the reference image.

ObjectDetection

Topic on Bead, Correlation, Count Object, Deform Matching and Matching.

Bead

Bead

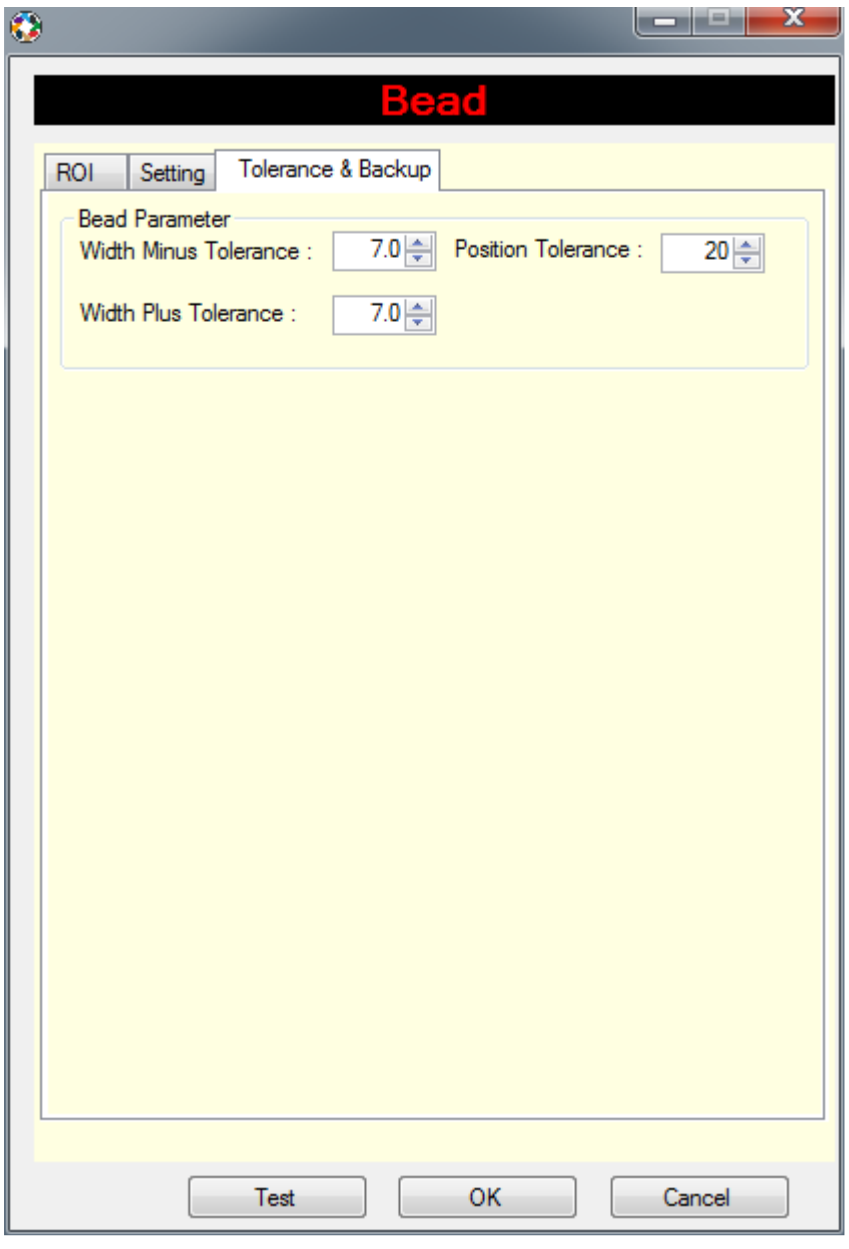


The Bead command uses polygon ROI as search region for detect defects on glue inspection applications.

Parameter:
Sigma: Sigma of the Gaussian functions for smoothing edges to reduce noise on the object/target.
Threshold: Minimum edge amplitude value changes between edges to be detected.
Interval: Sampling interval per inspection along the ROI.
Polarity: Select detection of object/target to be light or dark.
Target Width: Set standard target width of bead to be inspected. Setting can be manually adjusted on the image for the width of the bead or according to the measured average width.
Search Width: Set the detection search width within target to find the edges. (As shown in the screenshot above, Target Width is 15 pixels with Search Width as 5 pixels, the Search Width location will be 7.5 pixels from centre line of the sampling point ROI to be the edge search range).

Display Measure Range: Enable/Disable measure range
Display Measured Position: Enable/Disable measured position
Display Measured Result: Enable/Disable measured result

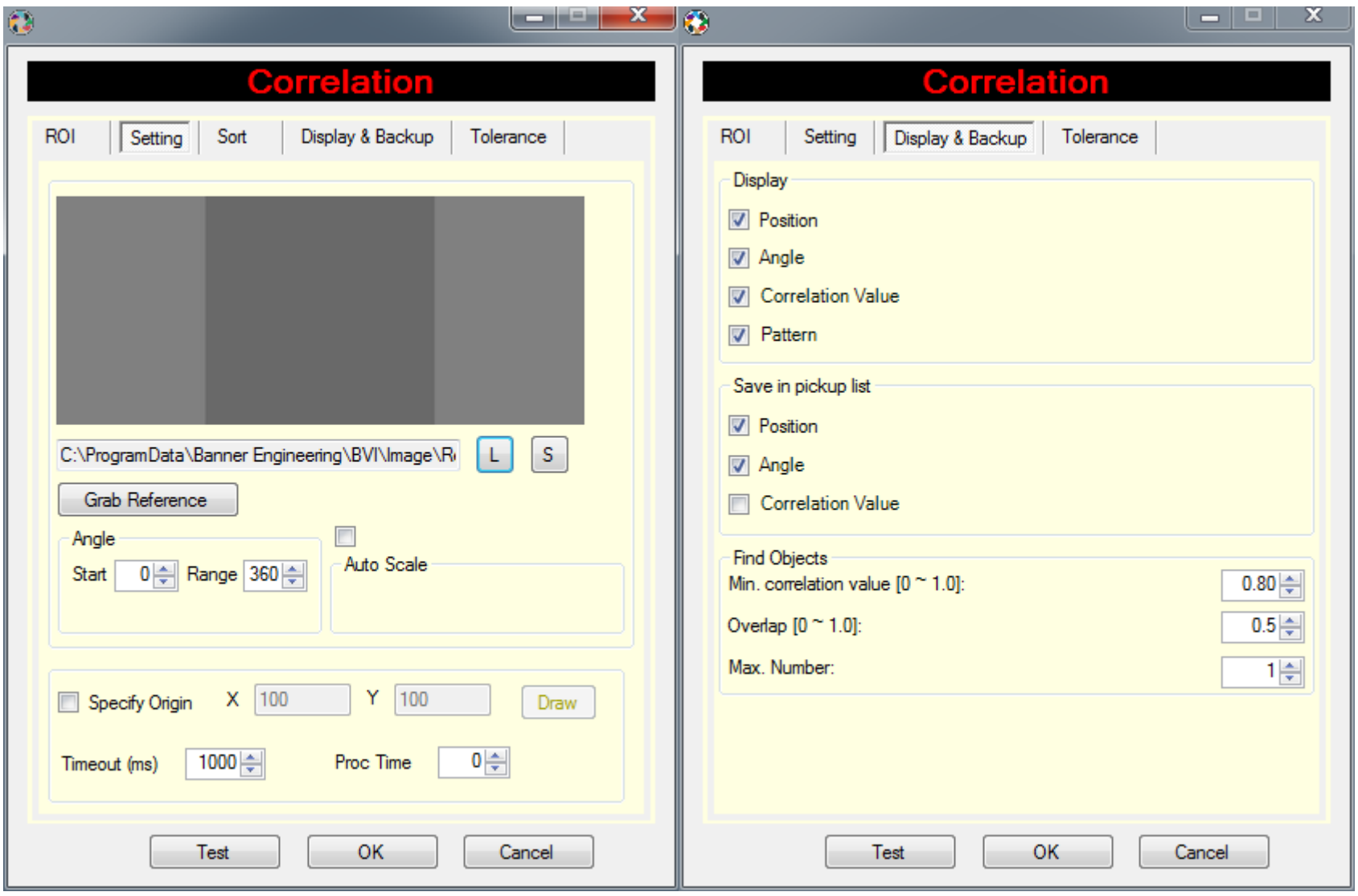
Banner Vision Inspector



Bead Parameter:
Width Minus Tolerance: Set allowable inwards tolerance
Width Plus Tolerance: Set allowable outward tolerance
Position Tolerance: Set allowable shifted centre of bead tolerance

Correlation

Correlation



The Correlation command looks for an already configured gray pattern in the search form. If it detects the pattern its position is reported. The correlation with the configured pattern is evaluated.

Grab Reference: To teach the command to match basing on the reference.
Edit: To allow user to delete certain portion of the grab reference where it will not match during inspection.
L: To load the grab reference after saving it.
S: To save the grab reference after teaching it.

Angle:
Start / Range: To limit the search area for rotating objects by a maximum and a minimum angle. In this case the increment indicates the noise for the search.
Auto Scale (Step): To finds in comparison with the reference image, highly enlarged/ highly downsized objects. The user can define which minimal/ maximal scaling should be found in the image.

Specify Origin: Set the origin manually to the reference picture grabbed by the user.
Timeout (ms): Define the timeout for this command.
Proc Time: Define the time taken to process and handle for this command.

Find Objects:
Min. Correlation Value: Minimum score where command match basing the reference image.
Overlap: the permissible range of overlapping during inspection.
Max Number: The number of part to match during inspection.

Display: To display result basing on the selected check.

Save in pickup list: Allow user to pick up this information.

Find Objects:
Min. Correlation Value: Minimum score where command match basing the reference image.
Overlap: the permissible range of overlapping during inspection.
Max Number: The number of part to match during inspection.

Tolerance: stating the conditional acceptance of the inspected result.

With the "Grab Reference", the so called template is created. The template contains the relevant information to describe the object of interest.

Banner Vision Inspector

If the objects's rotation may vary in the search images, you can specify the allowed range of angles and angle steps the object at which the model is created. We recomend to limit the allowed range of rotation as much as possible in order to speed up the search process and minimize the required memory.

For "Scale", you can specify the allowed scale with the parameter to locate the object. Again, we recomend to limit the allowed range of scale as much as possible in order to speed up the search process and minimize the required memory. It is recommended to used the default determined scale as it is suitable for most application.

With parameter "Min.Correlaton Value"(Score), yo can determine how much of the object or more precisely: of the model must be visible. When comparing a part of a search image with the model, the matching process calculates the so-called score, which is a measure of how many model points could be matched to points in the search image. A model point may be “invisible” and thus not matched because of multiple reasons:

- Parts of the objects's template are occluded.
- Parts of the template have a constrast lower than specificed in the parameter entered.
- The polarity of the template changes globally or locally.
- The object is deformed, parts of the contour may be visible but appear at an incorrect position and therefore do not fit the model.

Recommendation: The higher MinScore, the faster the search!

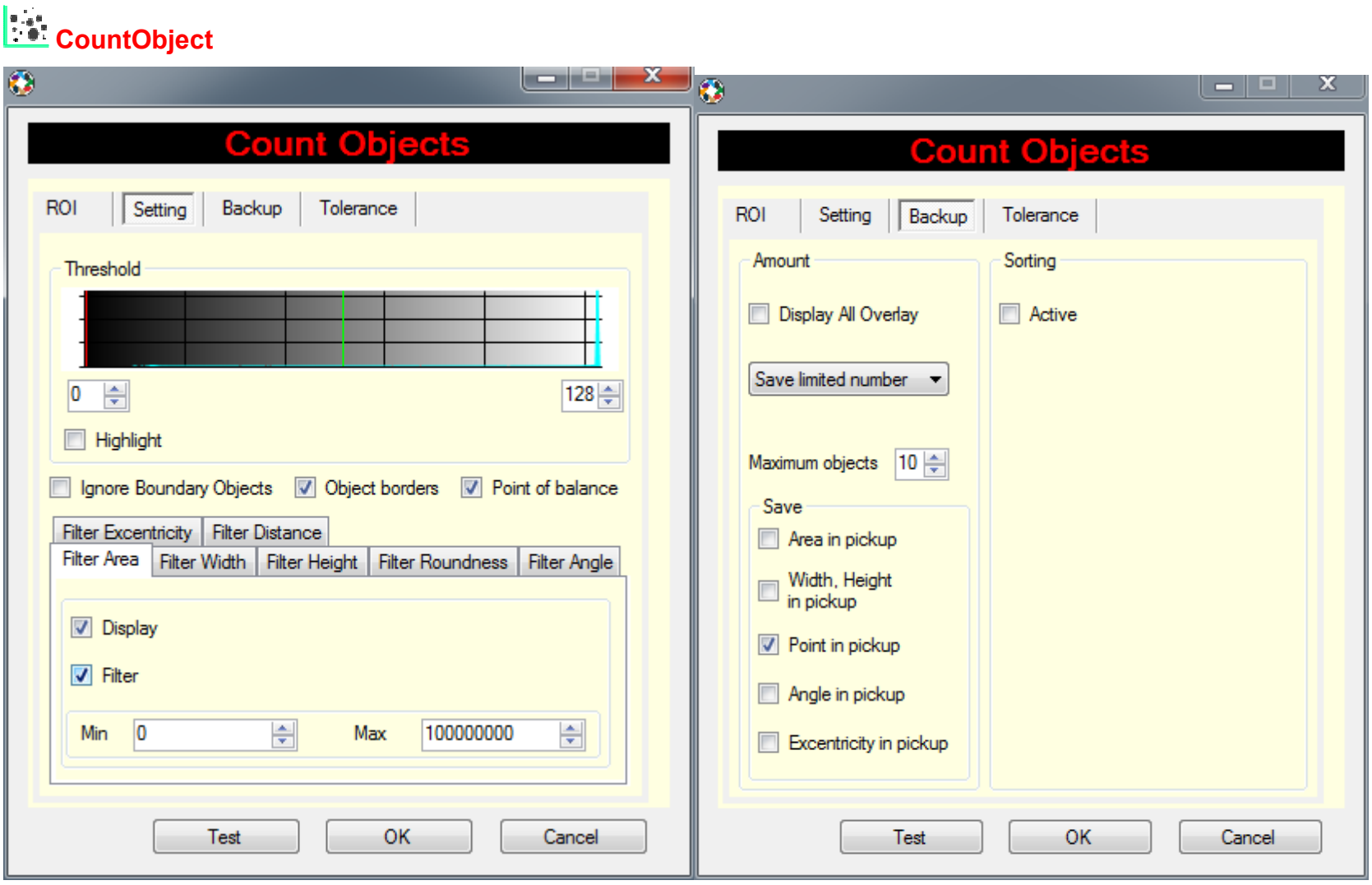
To search for multiple object, all you have to do to search more same objects is to set the parameter "Max Number" accordingly. It will automatically search the objects within the search region.

The parameter "Overlap" lets you specify how much 2 matches may overlap (as a fraction). To speed up the matching as far as possible, the overlap is calulated not for the models but for their smallest surrounding rectangle.

Restricting the Search Space:

An important concept in the context of finding objects is that of the so-called search space. Quite literally, this term specifies where to search for the object. However, this space encompasses not only the 2 dimensions of the image, but also other parameters like the possible range of scales and orientations or the question of how much of the object must be visible. The more you can restrict the search space, the faster the search will be.

CountObject



The Count Objects command is a very universally applicable command. It is based on the fact that the image contains various regions of brightness, which are separated clearly from each other. In an image, the pixels of the relevant objects (also called foreground) can be identified by thier gray value.

This command is to classify pixels according to their gray value. You can choose a threshold that all the pixels belonging to the object. There are varoius features like Area, Width or Height etc. to be calculated and with the numeric results which can then be further evaluated.
The results can evaluated by the formualting conditions for the features by specifying values in the Min and Max in each mode. Those features which their condition in green(OK), the others in red(NG). If at least features is not okay, the overall result result for this command is determined as Fail.

For example: if you want to find only objects with a surface around 1400 pixels then you indicate in the object filter the min. value with 1300 and the max. value with 1500. Thus the fluctuations on the surface caused by changing the lighting can be balanced and only objects with the desired size is indicated. In order to use the filter it is important that the filter is activated.

Ignore Boundary object: If this flag is active, objects, whose object color is identical with the window border, are deleted.

Object Borders: Marks the bounding box.
Point of balance: Marks the point of balance of an object.

Filter Area:

Display: Display the object areas result.
Filter: If active only objects, whose area is between these two values, are output.

Filter Width:
Display: Display the object width result.
Filter: If width is active, only object whose width lies between the min. and max. are output.

Filter Height:
Display: Display the object height result.
Filter: If height is active, only object whose height lies between the min. and max. are output.

Filter Roundness:
Display: Display the object roundness result.
Filter: If roundness is active, only object whose roundness lies between the min. and max. are output.

Banner Vision Inspector

Filter Distance:
Display: Display the object distance result.
Filter: If distance is active, only object whose distance lies between the min. and max. are output.

Filter Angle:
Display: Display the object angle result.
Filter: If angle is active, only object whose angle lies between the min. and max. are output.

Filter Excentricity:
Display: Display the object excentricity result.
Filter: If excentricity is active, only object whose excentricity lies between the min. and max. are output.

Backup:
Since the object command is not defined in the number of produced objects, it can be specified by this option how many objects are transferred e.g. to the point list.

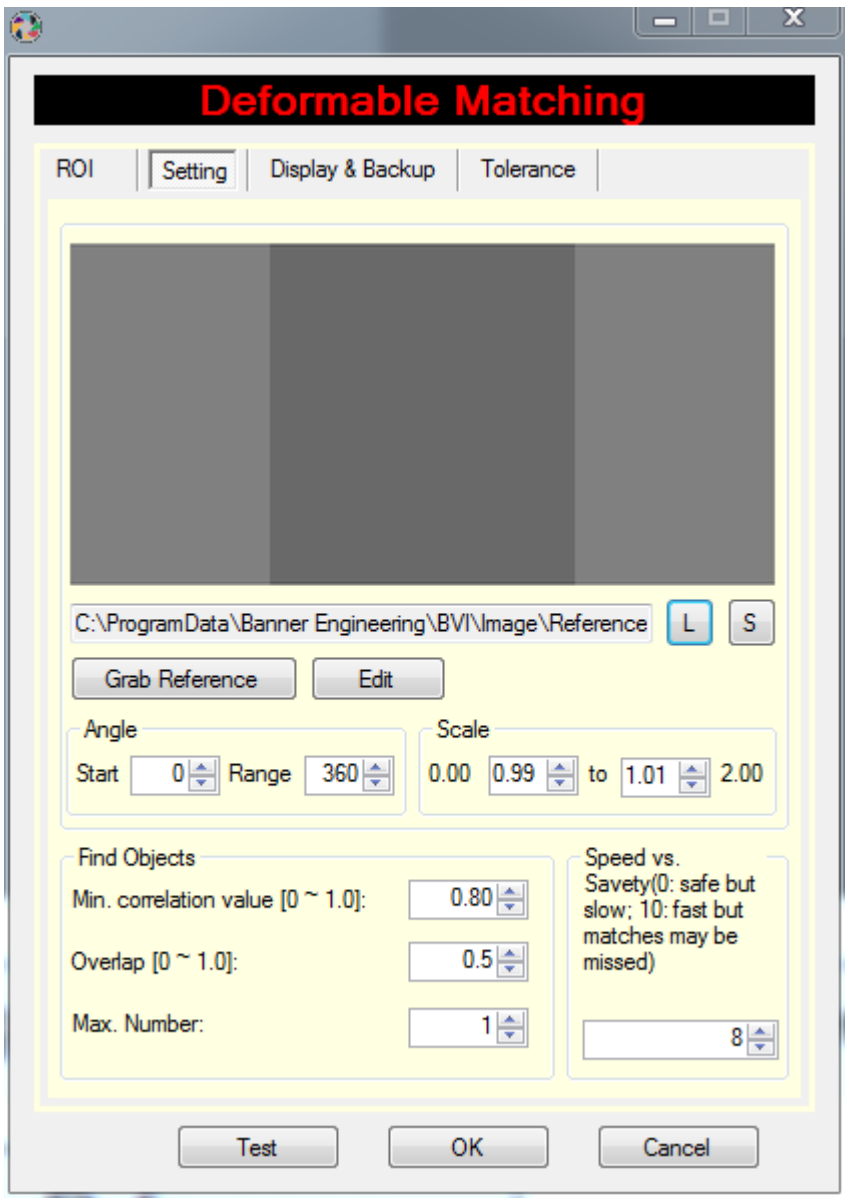
Display All Overlay: Able to display out the object which overlayed by other object.
Maximum objects: Here the number of object-results, which should be saved, is provided.
Save: Here the user can select, where the object-results should be saved, e.g. in the pickup.

Order & Sort By: Here it can be determined, how the objects should be sorted and in which order.

Tolerance: stating the conditional acceptance of the inspected result.

Deform Matching

Deform Matching



The deform matching command match for an already configured gray pattern in the search form. If it detects the deform its position is reported. The deformation with the configured pattern is evaluated.

Grab Reference: To teach the command to match basing on the reference.
Edit: To allow user to delete certain portion of the grab reference where it will not match during inspection.
L: To load the grab reference after saving it.
S: To save the grab reference after teaching it.

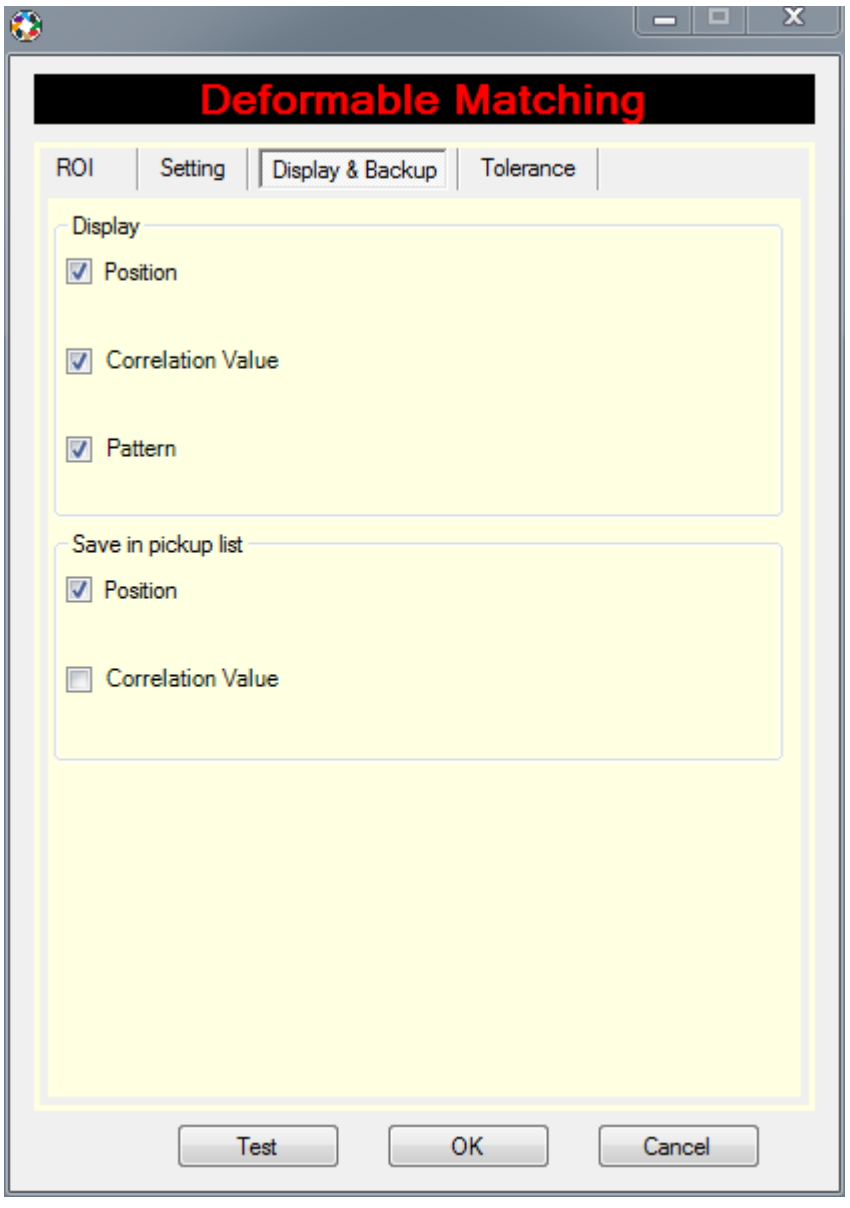
Angle: To limit the search area for rotating objects by a maximum and a minimum angle. In this case the increment indicates the noise for the search.

Scale: To finds in comparison with the reference image, highly enlarged/ highly downsized objects. The user can define which minimal/ maximal scaling should be found in the image.

Find Objects:

- **Min. Correlation Value:** Minimum score where command match basing the reference image.
- **Overlap:** the permissible range of overlapping during inspection.
- **Max Number:** The number of part to match during inspection.

Banner Vision Inspector

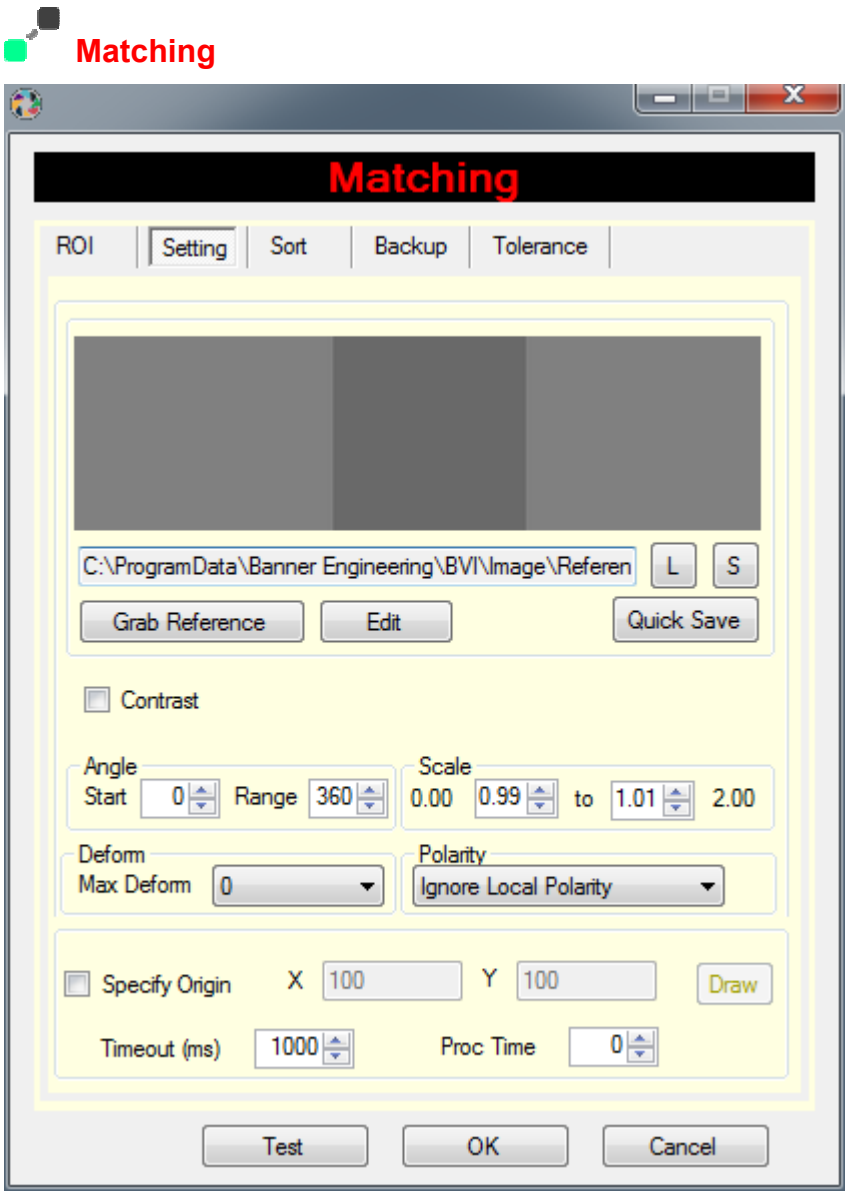


Display: To display result basing on the selected check.

Save in pickup list: Allow user to pick up this information.

Tolerance: stating the conditional acceptance of the inspected result.

Matching



The Matching command looks for an already configured contour pattern in the search form. If it detects the pattern its position is reported. The contour with the configured pattern is evaluated.

Setting:

Grab Reference: To teach the command to match basing on the reference.
Edit: To allow user to delete certain portion of the grab reference where it will not match during inspection.
L: To load the grab reference after saving it.
S: To save the grab reference after teaching it.

Angle: To limit the search area for rotating objects by a maximum and a minimum angle. In this case the increment indicates the noise for the search.

Scale: To finds in comparison with the reference image, highly enlarged/ highly downsized objects. The user can define which minimal/ maximal scaling should be found in the image.

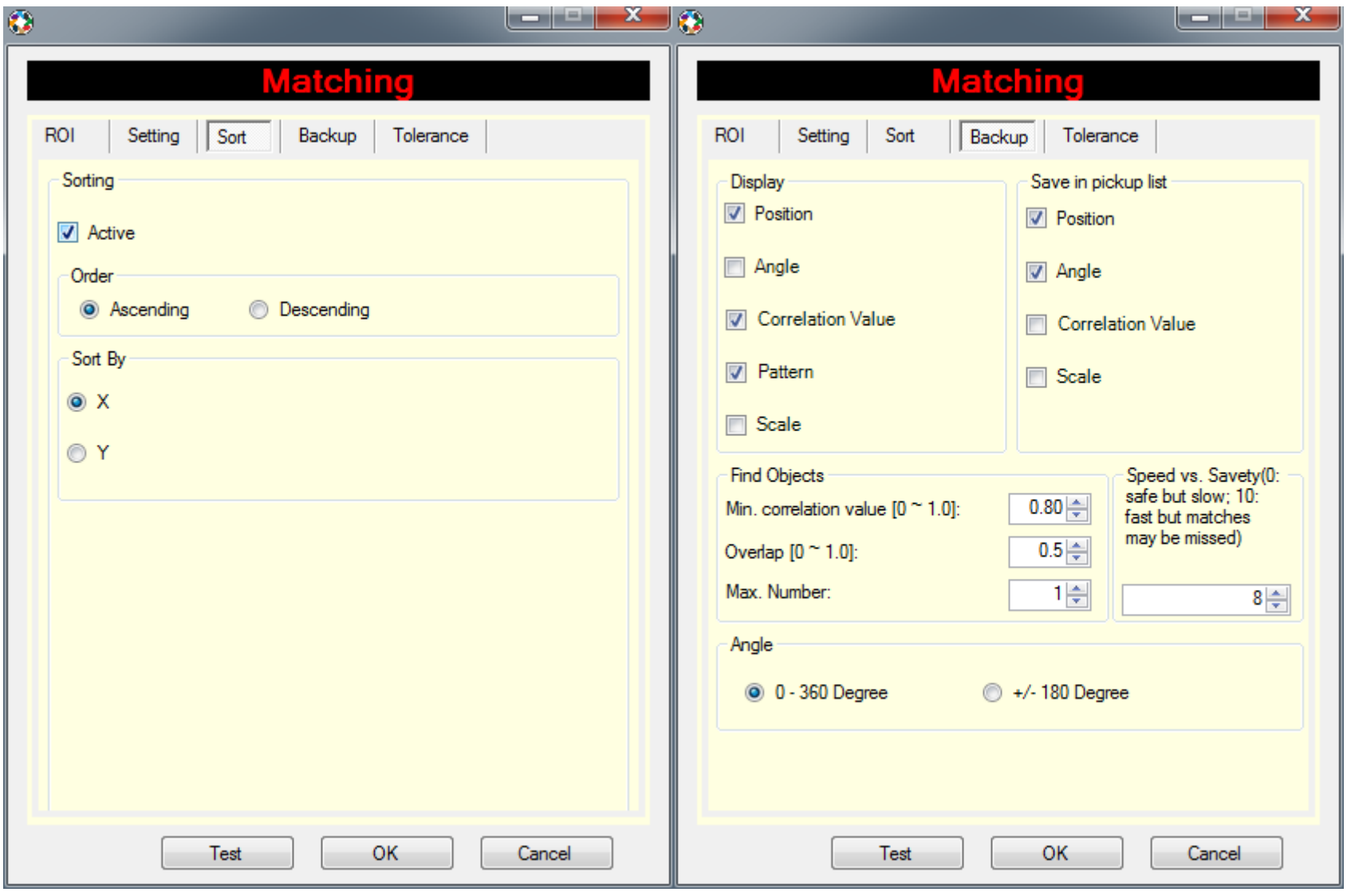
Deform: Define the maximum deform in the command.

Polarity: Can be set to use or ignore the polarity in command.

Specify Origin: Set the origin manually to the reference picture grabbed by the user.

Speed: Determine the matching speed.

Banner Vision Inspector



Order & Sort By: Here it can be determined, how the objects should be sorted and in which order.

Display: To display result basing on the selected check.

Save in pickup list: Allow user to pick up this information.

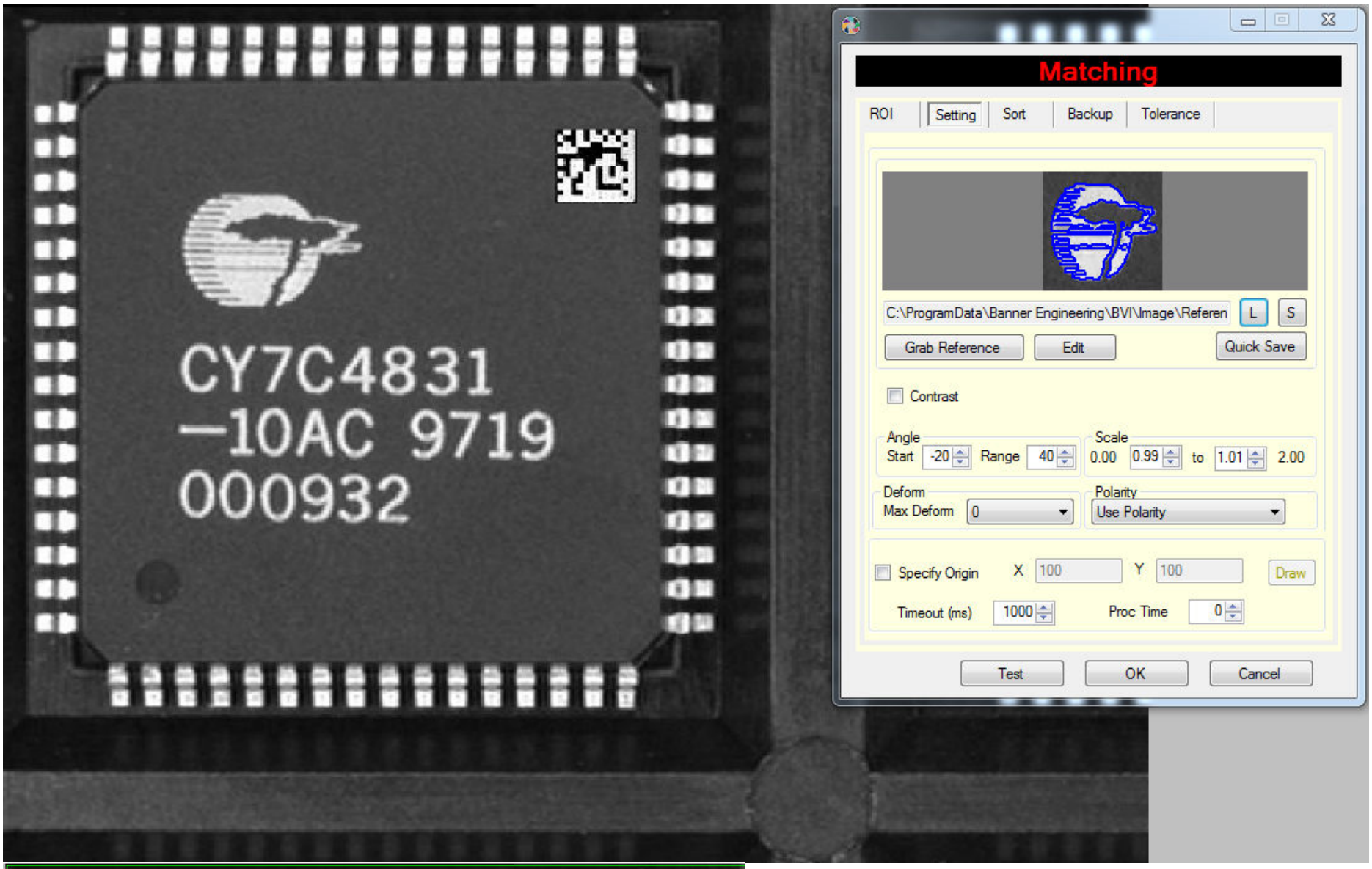
Find Objects:

- **Min. Correlation Value:** Minimum score where command match basing the reference image.
- **Overlap:** the permissible range of overlapping during inspection.
- **Max Number:** The number of part to match during inspection.

Angle: To choose the angle result range at +/- 180 or 0-360.

Tolerance: stating the conditional acceptance of the inspected result.

Banner Vision Inspector



With the "Grab Reference", the so called model is created. The model contains the relevant information to describe the object of interest where you can use the "Edit" to remove the unwanted noise or reference.

If the objects's rotation may vary in te search images, you can specify the allowed range of angles and angle steps the object at which the model is created. We recomend to limit the allowed range of rotation as much as possible in order to speed up the search process and minimize the required memory.

For "Scale", you can specify the allowed scale with the parameter to locate the object. Again, we recomend to limit the allowed range of scale as much as possible in order to speed up the search process and minimize the required memory. It is recommended to used the default determined scale as it is suitable for most application.

With parameter "Min.Correlaton Value"(Score), yo can determine how much of the object or more precisely: of the model must be visible. When comparing a part of a search image with the model, the matching process calculates the so-called score, which is a measure of how many model points could be matched to points in the search image. A model point may be “invisible” and thus not matched because of multiple reasons:

- Parts of the objects's contour are occluded.
- Parts of the contour have a constrast lower than specificed in the parameter entered.
- The polarity of the contour changes globally or locally.
- The object is deformed, parts of the contour may be visible but appear at an incorrect position and therefore do not fit the model.

Recommendation: The higher MinScore, the faster the search!

To search for multiple object, all you have to do to search more same objects is to set the parameter "Max Number" accordingly. It will automatically search the objects within the search region.

The parameter "Overlap" lets you specify how much 2 matches may overlap (as a fraction). To speed up the matching as far as possible, the overlap is calulated not for the models but for their smallest surrounding rectangle.

Restricting the Search Space:

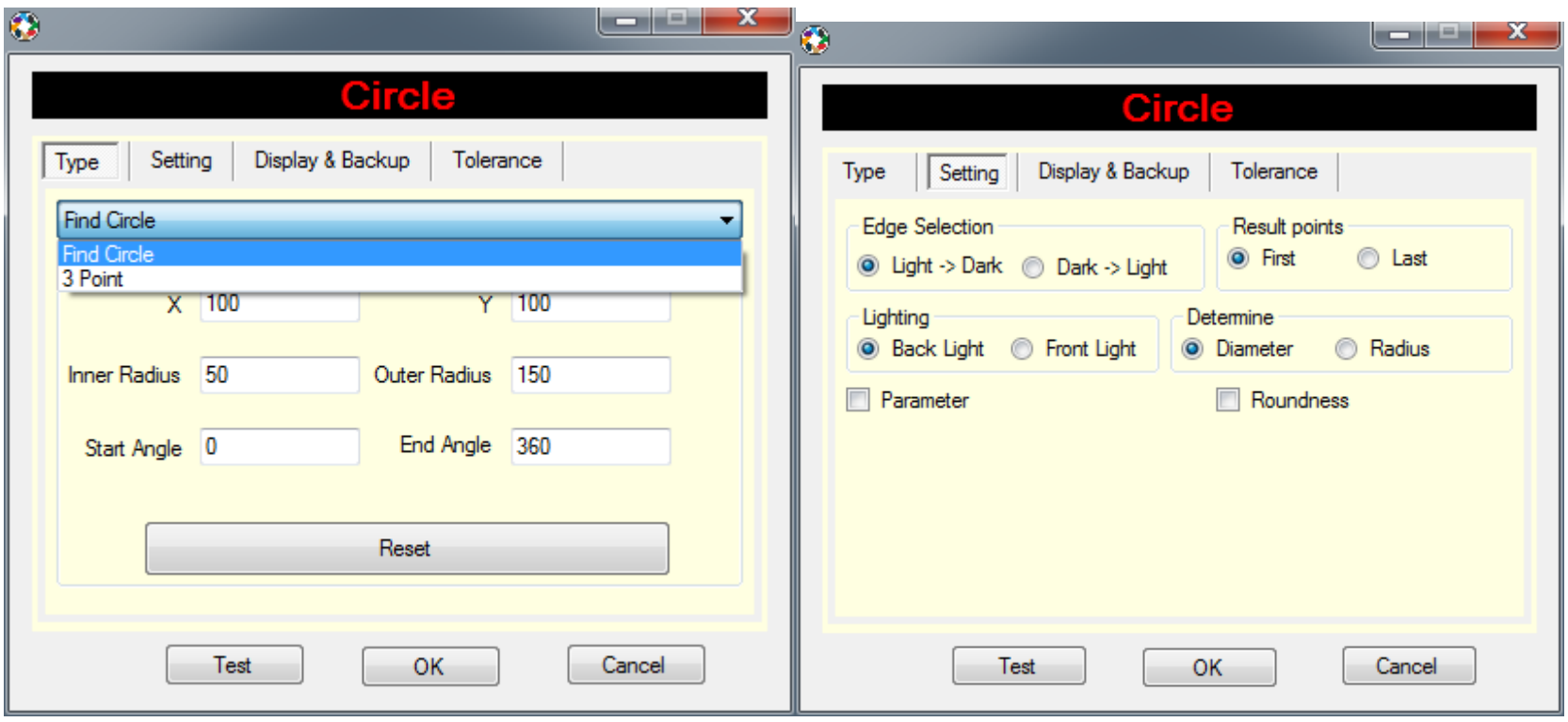
An important concept in the context of finding objects is that of the so-called search space. Quite literally, this term specifies where to search for the object. However, this space encompasses not only the 2 dimensions of the image, but also other parameters like the possible range of scales and orientations or the question of how much of the object must be visible. The more you can restrict the search space, the faster the search will be.

EdgeDetection

Topic on Circle, Contour, EdgeCounter, FreeEdgeAlignment, Point, RectProbe and StraightLine.

Circle

Circle



The Circle command is used to detect edges which might form a circle and return its diameter or radius values. Ability to get 3 points detected to form a circle.

Edge Selection:

- **Light -> Dark**: The greyscale colour for the object in demand is set to dark which is defined according to the arrow of the search region.
- **Dark -> Light:** The greyscale colour for the object in demand is set to bright which is defined according to the arrow of the search region.

Result Points:

- **First**: First point of the extracted edge points is returned.
- **Last**: Last point of the extracted edge points is returned.

Lighting: Define lightinhg set up as back light or front light.

Determine: Define measured value and reflect as diameter or radius.

Parameter:

- **Sigma**: Sigma of the Gaussian functions for smoothing.
- **Threshold**: Minimum edge amplitude changes between edges.
- **Number of point (>2):** Define number of detected points to be used within the probe to improve processing time.

Roundness: Return roundness value of detected circle.

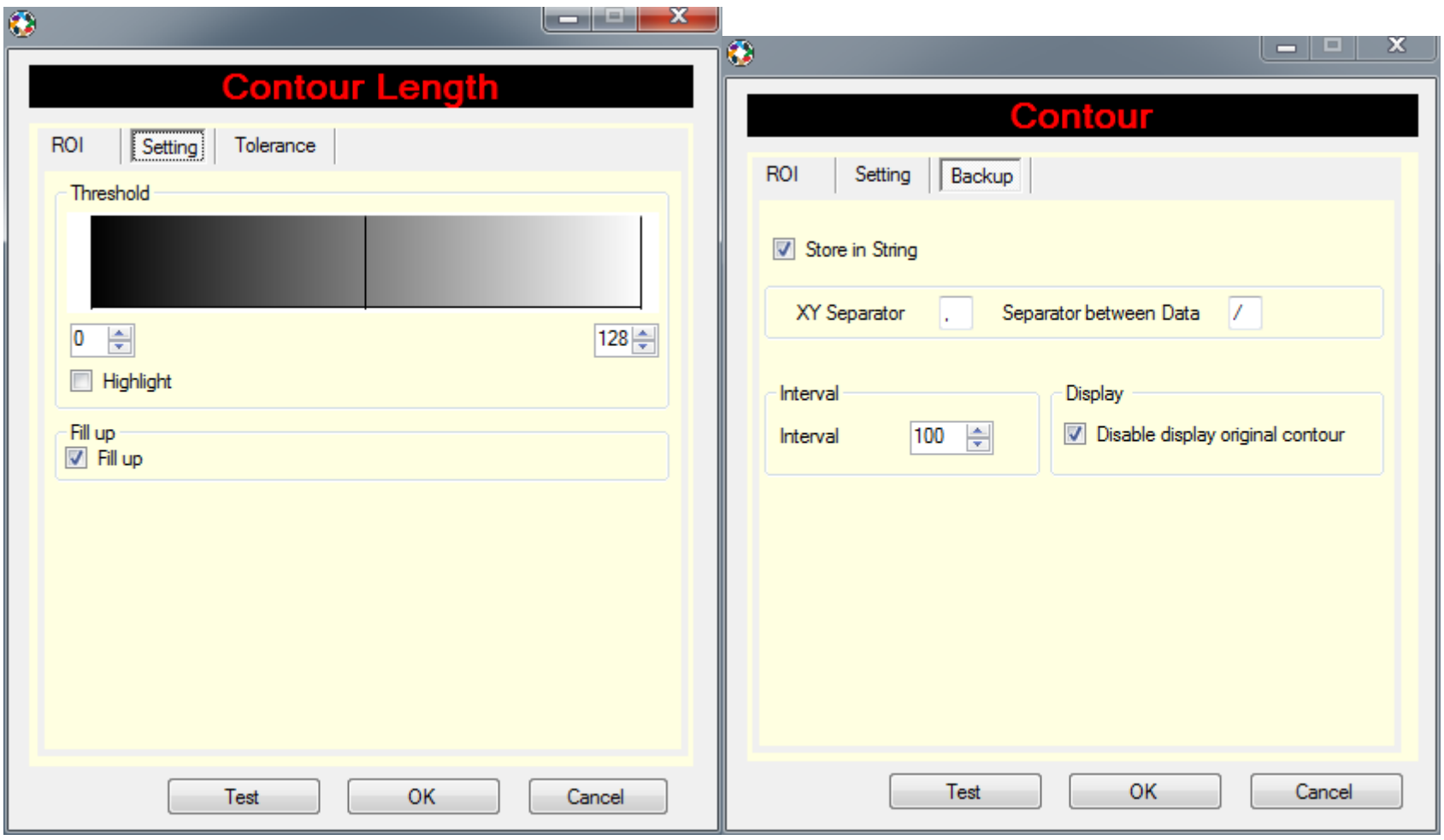
SavePoint: To save the minimum or maximum measured distance to be pick up.

Optimize Result: Percentage of stray points detected/found to be eliminated when forming a circle.

Tolerance: State conditional acceptance of the inspected result.

Contour

Contour



The Contour command is used to detect edges which return its X & Y coordinates of which points detect.

Setting:

Highlight: To set the threshold of the object to detect the contour outline.
Area:
- **Filter:** To define the area of the object to be detected

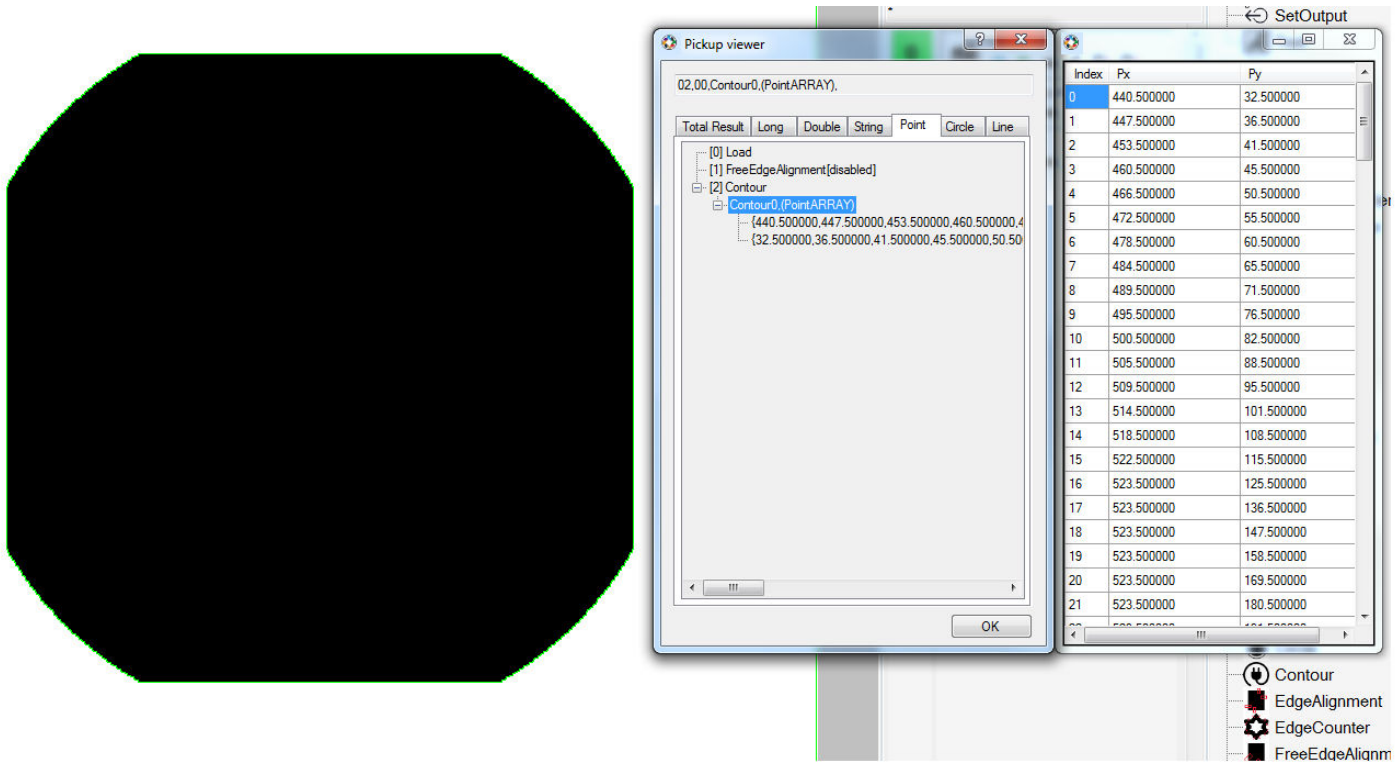
Offset:
- **Offset value:** To define the offset value of the contour points detected.

Setting:

Store in String: To save all the contour points into string for pickup.

XY Separator: The separator e.g. "," or "/" to be used for the X & Y coordinates. (e.g. "X, Y" or "X/Y)
Separator between Data: The separator e.g. "," or "/" to be used for the 2 or more X & Y coordinates. (X1, X1 / X2, Y2)

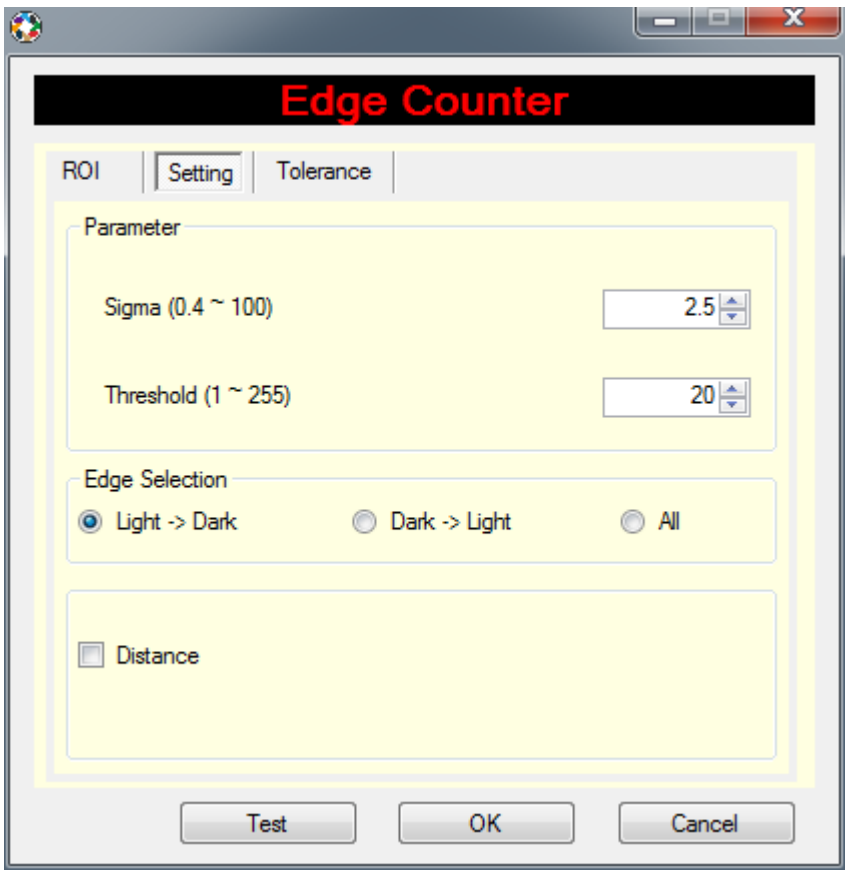
Interval: To get only the contour points of the XY coordinates at an interval value.
Disable display original contour: Not to display the overlay of the contour points during inspection. Disable this feature will speed up the inspection time of this command.



The XY coordinates of the edge detected at object contour is basing threshold value of the object .

EdgeCounter

EdgeCounter



The EdgeCounter command is used to detect numbers of points or edges.

Setting:

Parameter:

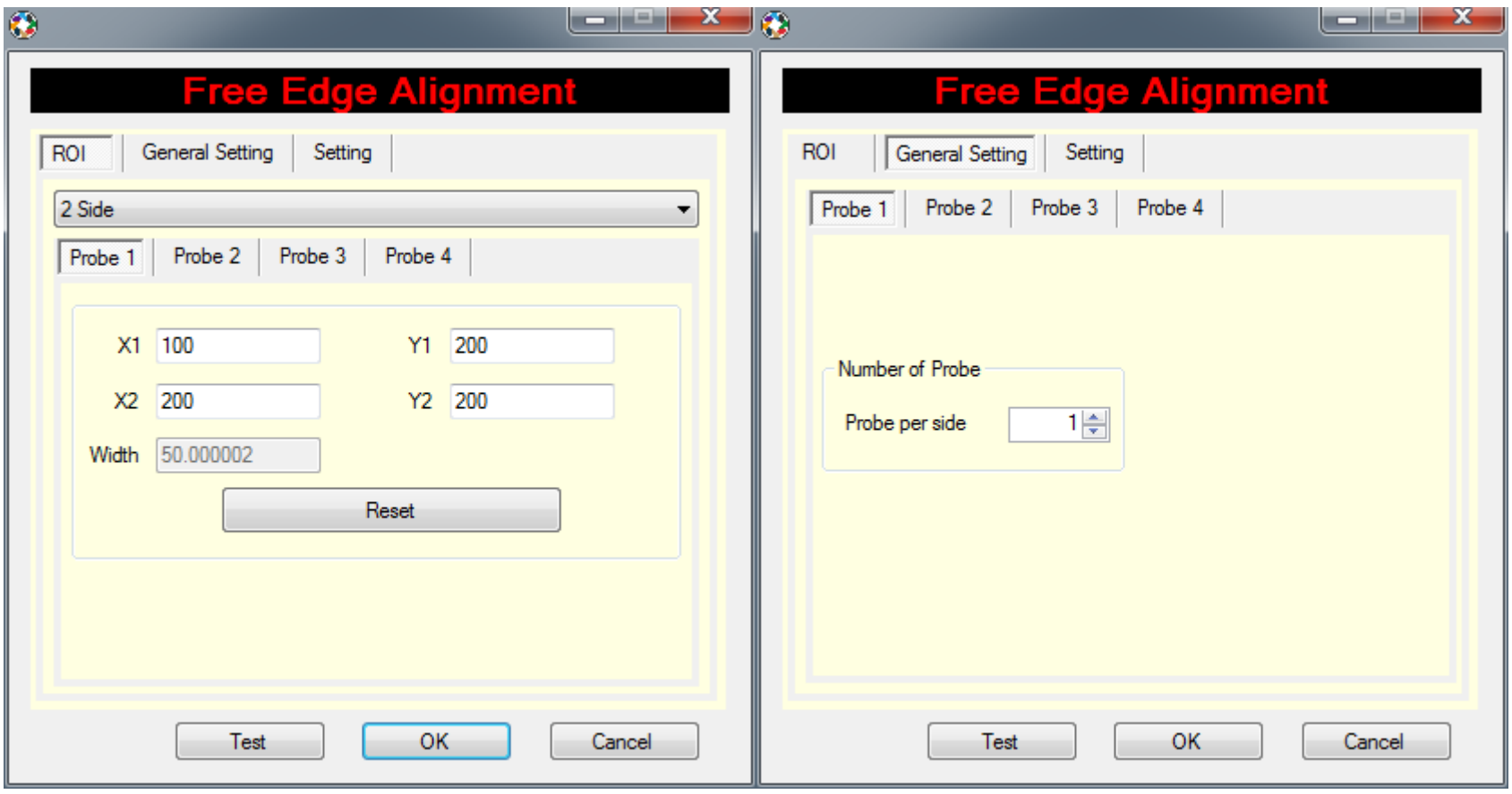
- **Sigma**: Sigma of the Gaussian functions for smoothing.
- **Threshold**: Minimum edge amplitude changes between edges.

Edge Selection:

- **Light -> Dark**: The greyscale colour for the object in demand is set to dark which is defined according to the arrow of the search region.
- **Dark -> Light:** The greyscale colour for the object in demand is set to bright which is defined according to the arrow of the search region.

FreeEdgeAlignment

FreeEdgeAlignment



The FreeEdgeAlignment command is used to detect edges using free-style defined search region which return its X & Y coordinates of which intersection points detect.

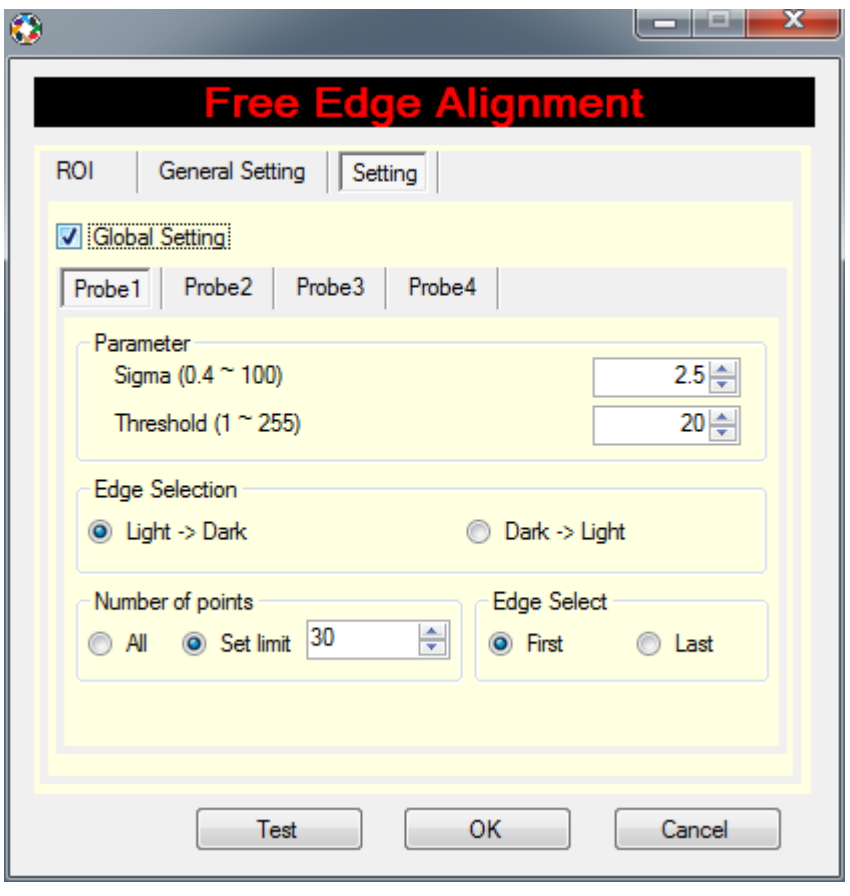
ROI:

To set the region of interest of this command.

2/4 Side: To determine the number of probes to use for this command.

General Setting:

Number of Probe:
Probe per side: To determine the number of probes of each side to use for this command.



Setting:

Global Setting: Enable to have the setting for the probes used.

Banner Vision Inspector

Parameter:

- **Sigma**: Sigma of the Gaussian functions for smoothing.
- **Threshold**: Minimum edge amplitude changes between edges.

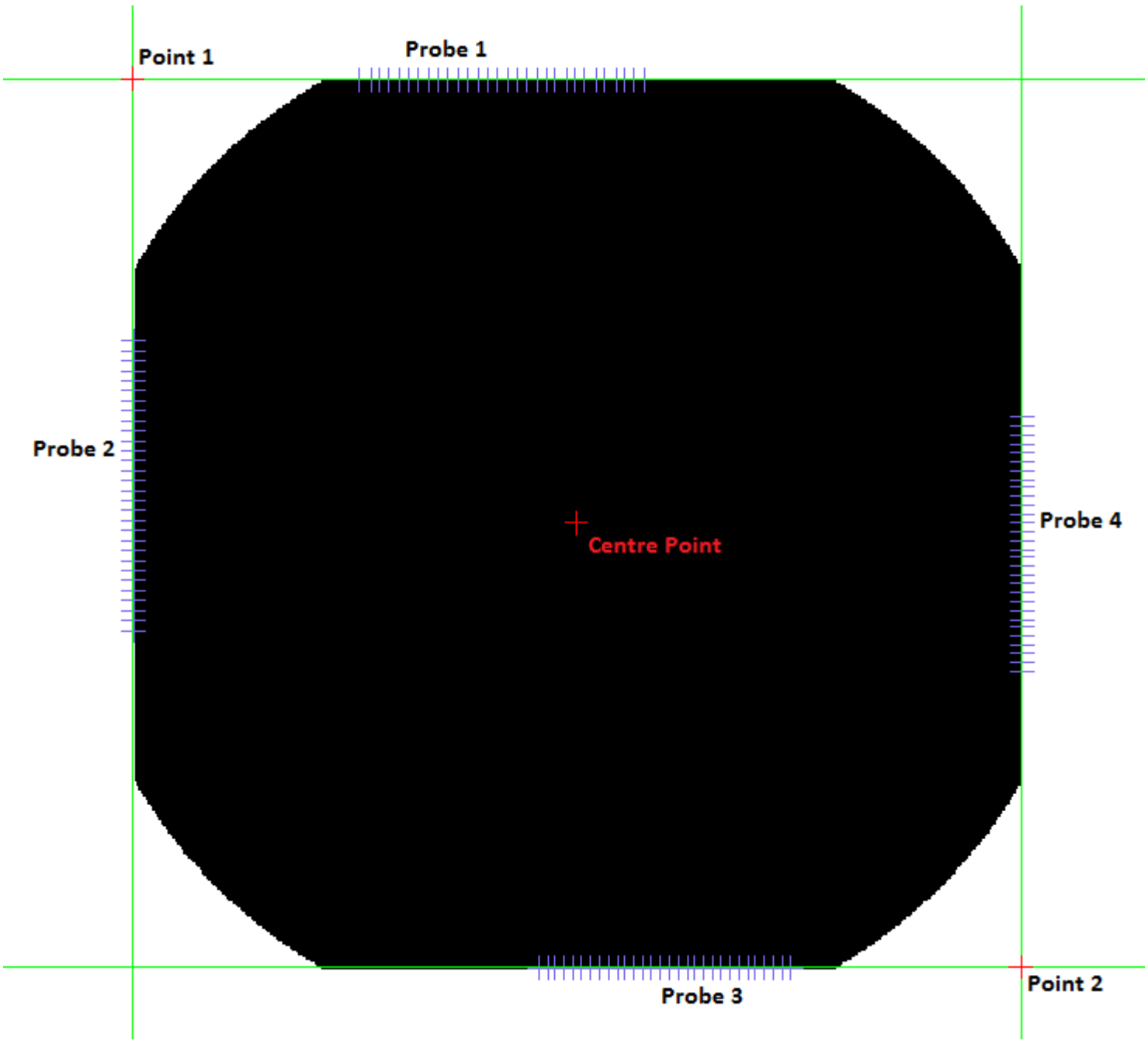
Edge Selection:

- **Light -> Dark**: The greyscale colour for the object in demand is set to dark which is defined according to the arrow of the search region.
- **Dark -> Light:** The greyscale colour for the object in demand is set to bright which is defined according to the arrow of the search region.

Edge Select:

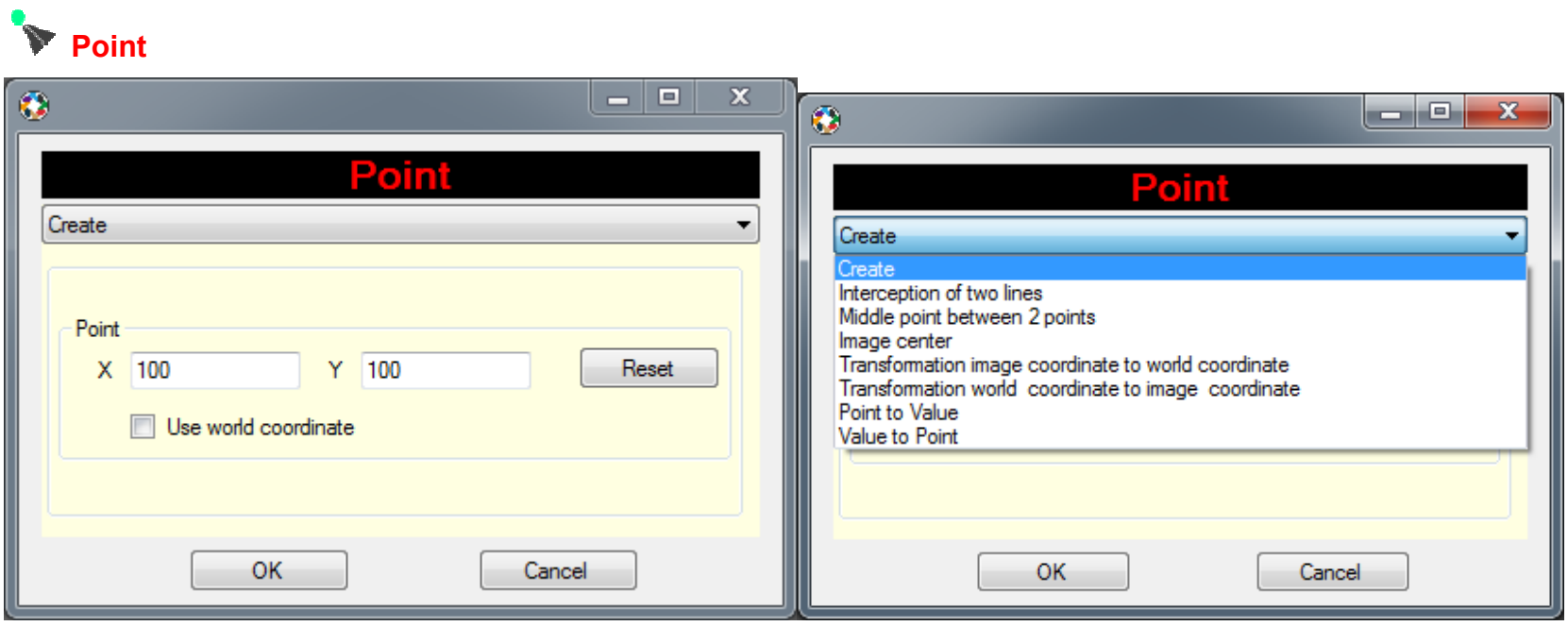
- **First**: First point of the extracted edge points is returned.
- **Last**: Last point of the extracted edge points is returned.

Number of point: Define number of detected points to be used within the probe to improve processing time.



Detecting (searching) the object edges to correct the position. One or two probes or four probes can be used. It has a feature to set 1 probe or 2 probes at per probe searching region. This tool detects the positions (Point 1 & 2) basing on the intersection lines of the edge detected. The coordinates of the midpoint between these point 1 and 2 is detemined.

Point



The Point command allow user to define the points in the image area in different ways

Create: The point can be defined either by direct number input or by moving the cursor in the Camera Viewer (by the configuration button).

Interception of the two lines: Two straight lines are determined and the intersection point of both of them is defined as the new point.

Middle point between 2 points: The middle point between two selected points is defined.

Image Center: The image center is determined as new point.

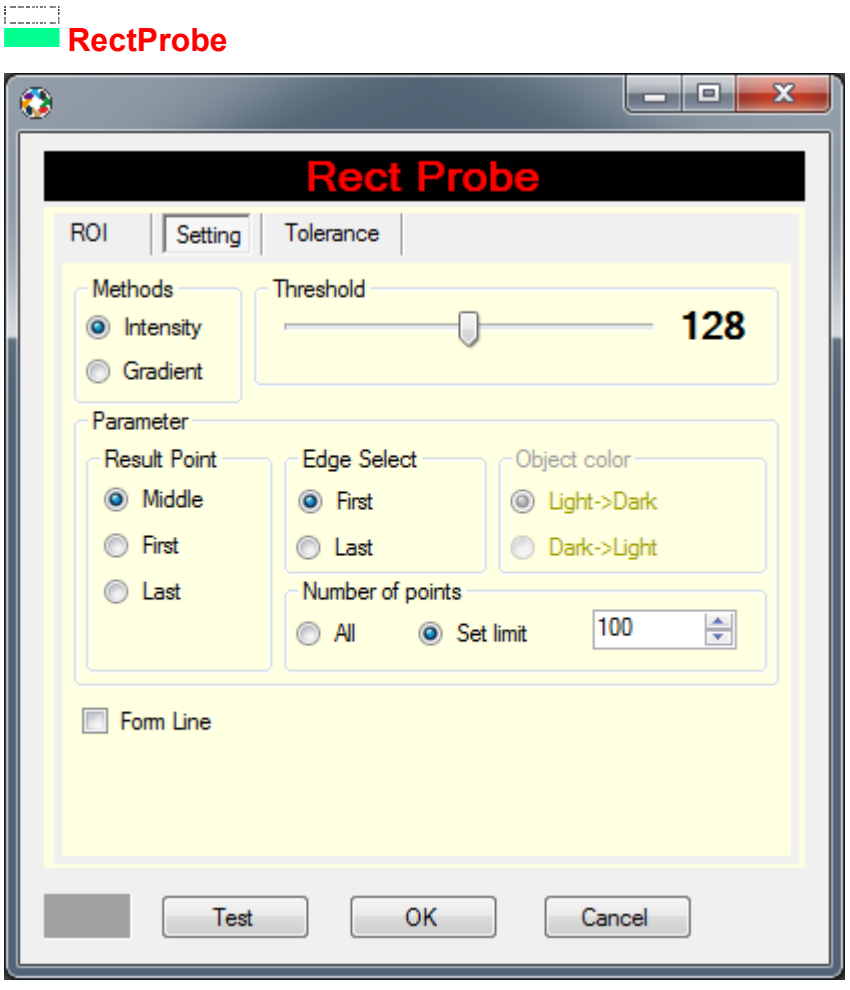
Transformation image coordinate to world coordinate: The point coordinates are transformed from image coordinates into world coordinates.

Transformation world coordinate to image coordinate: The point coordinates are transformed from world coordinates into image coordinates.

Point to Value: The X-value and the Y-value of the point are successively entered into the value register.

Value to point: The value register are successively entered into the X-value and Y-value of the point.

RectProbe



The Rect Probe command is to find the edges of the inspected part.

The Rect Probe is to extract the object edges from the edge amplitude image; applying threshold to select pixels with a high edge amplitude. The result of this step is a region that contains all edge points.

Methods:

- **Intensity:** To detect the edges basing on the grey value.
- **Gradient:** To detect the edges basing on the amplitude value.

Result Point:

- **Middle**: The middle of the extracted edge points is returned.
- **First**: The first of the extracted edge points is returned.
- **Last**: The last of the extracted edge points is returned.

Object Color:

- **Light -> Dark**: The color for the object in demand is set to dark.
- **Dark -> Light:** The color for the object in demand is set to bright.

Edge Select:

- **First**: First point of the extracted edge points is returned.
- **Last**: Last point of the extracted edge points is returned.

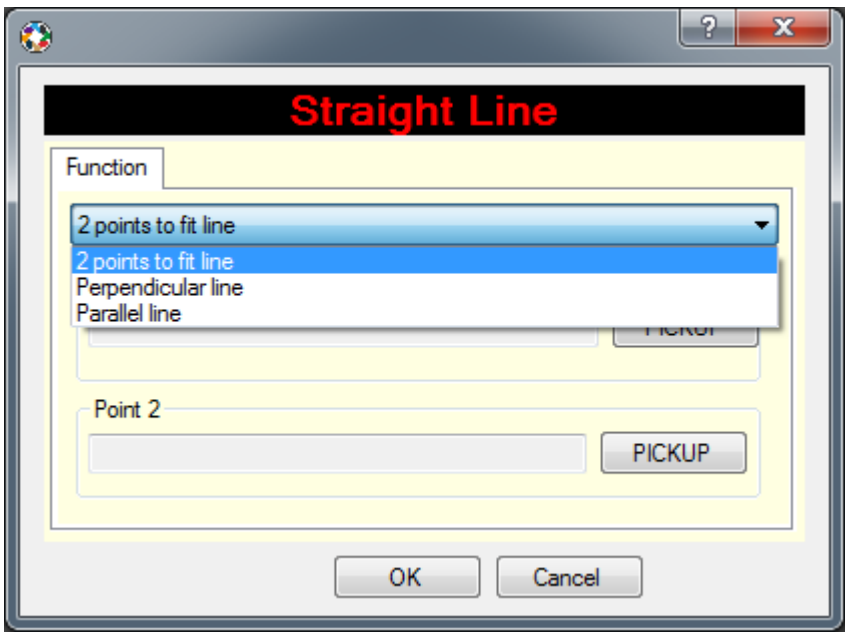
Number of points: To define the number of points the probe will find.

Best Fit Line: Option to form a straight line when the edges are detected.

Tolerance: stating the conditional acceptance of the inspected result.

StraightLine

StraightLine



The Straight-Line command is based on the points detected using Rect Probe where a straight line will be computed.

2 points to fit line: A straight line, which fits either through two points taken from the point register or two points determined by the pick-up list, is defined.

Perpendicular Line: Determines a perpendicular straight line to an existing straight line and a point.

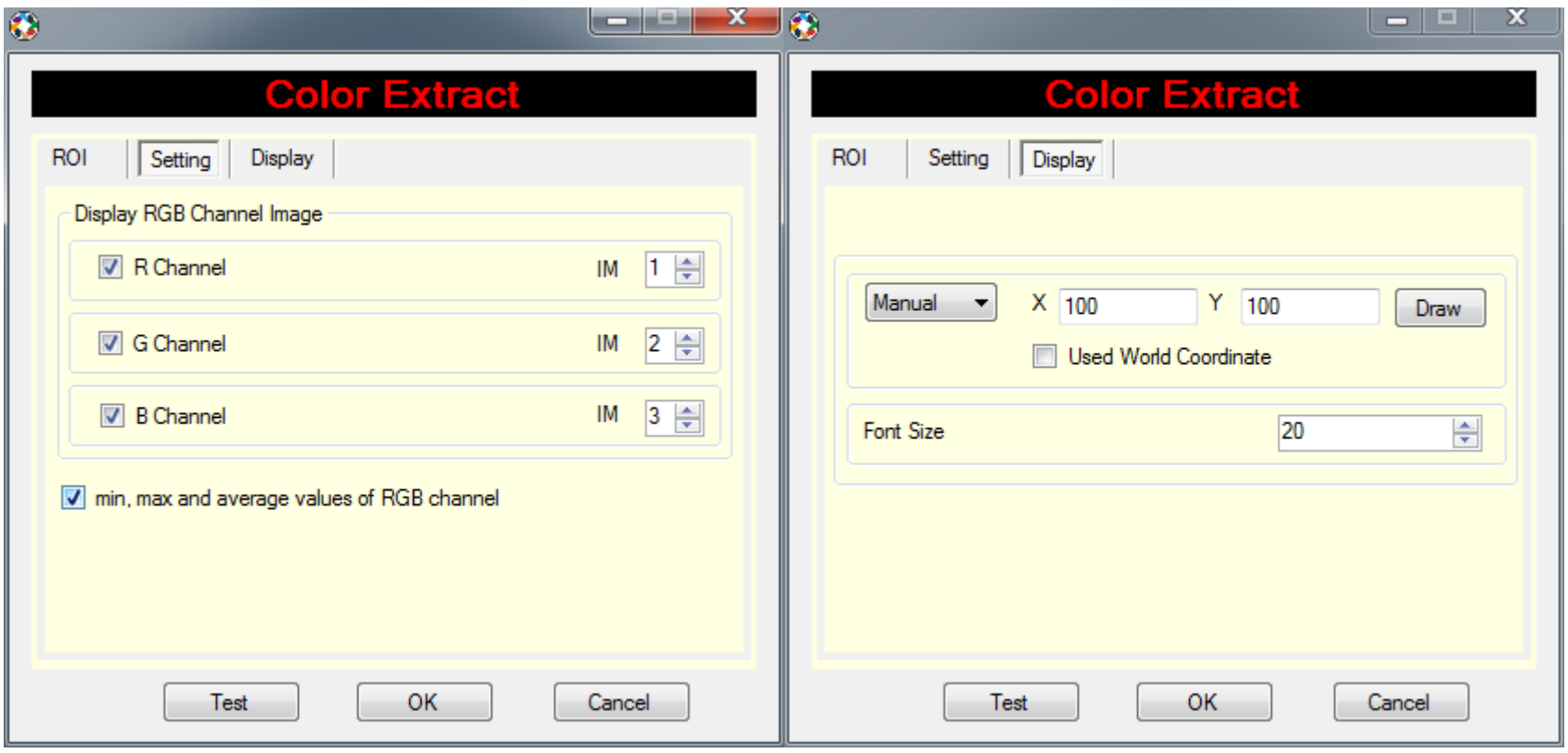
Parallel Line: Determines a parallel straight line to an existing straight line and a point.

Color

Topic on Color Extract, Color Intensity and White Balance.

Color Extract

ColorExtract



The Color Extract command is to extract the red or green or blue channels from the color image to fade out pixels for unwanted channels (e.g. red and green), leaving on the selected channel & intensity (e.g. blue) for further image processing.

Setting:

Display RGB Channel Image:

- **R Channel**: Extract the red channel of the color image.
- **G Channel**: Extract the green channel of the color image.
- **B Channel**: Extract the blue channel of the color image.

Min., Max. and average values of RGB channel: The parameter for

Display:

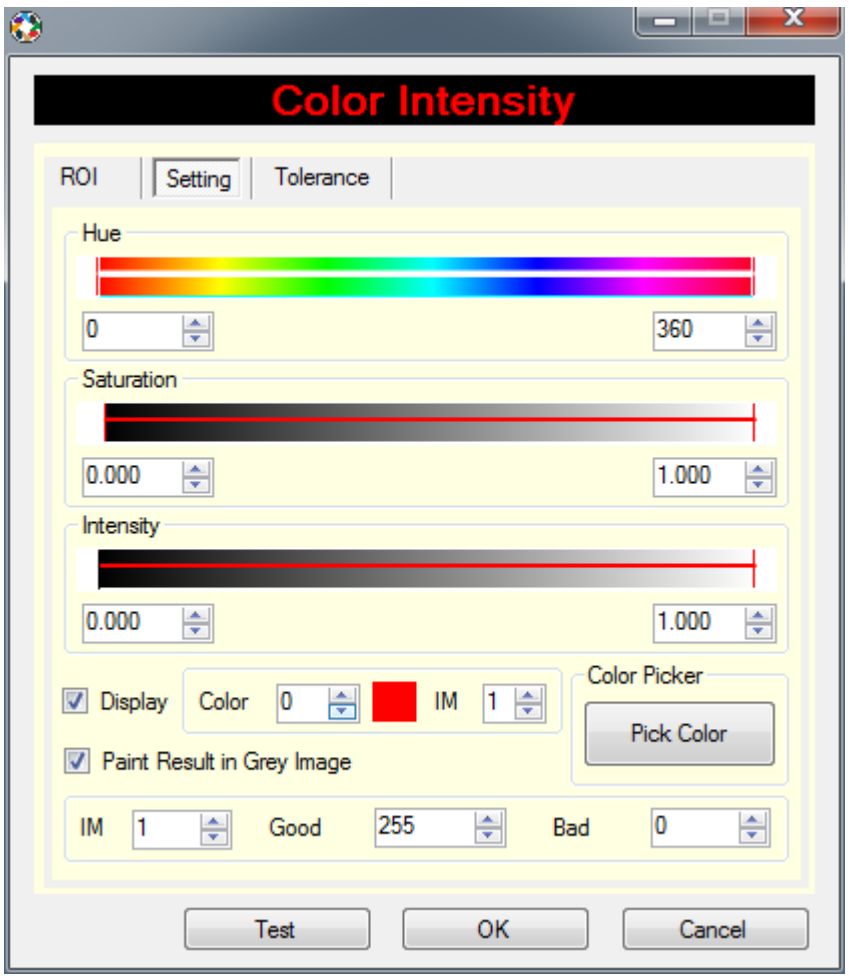
To position the inspection result of this command and setting the font size.

The idea of color processing is to take advantage of the additional information encoded in color or multispectral images. Processing color images can simplify many machine vision tasks and provide solutions to certain problems that are simply not possible in gray value images. First, the individual channels of a color image can be processed using standard methods like blob analysis. In this approach the channels of the original image have to be decomposed first.

An RGB image is acquired where the image is split into its channels. The red and green and blue channels are subtracted. The purpose of this process is to fade out pixels with high values in the other channels, leaving pure selected (e.g. blue) pixels only. Using threshold, the blue pixels with a certain intensity are selected.

Color Intensity

ColorIntensity



The Color Intensity command is to evaluate the number of pixels in the selected color range. It is defined by hue, saturation and the intensity range.

Setting:

Hue: The color range can be limited either by numerical values or by using the color picker to define the color selection form.

Saturation: To determine the color saturation. It can be adjusted either by direct value input or by color selection form.

Intensity: To determine the color brightness. It can be adjusted either by direct value input or by color selection form.

Color Picker: By clicking with the mouse on the eyedropper the cursor can be moved over the Camera Viewer and then can be clicked into the area of the desired color. With the pull-down option an environment of N pixels can be defined for the color characteristic extraction.

Display: If this option is active, the pixels matching the criteria will be displayed in color in the configured image memory (IM).

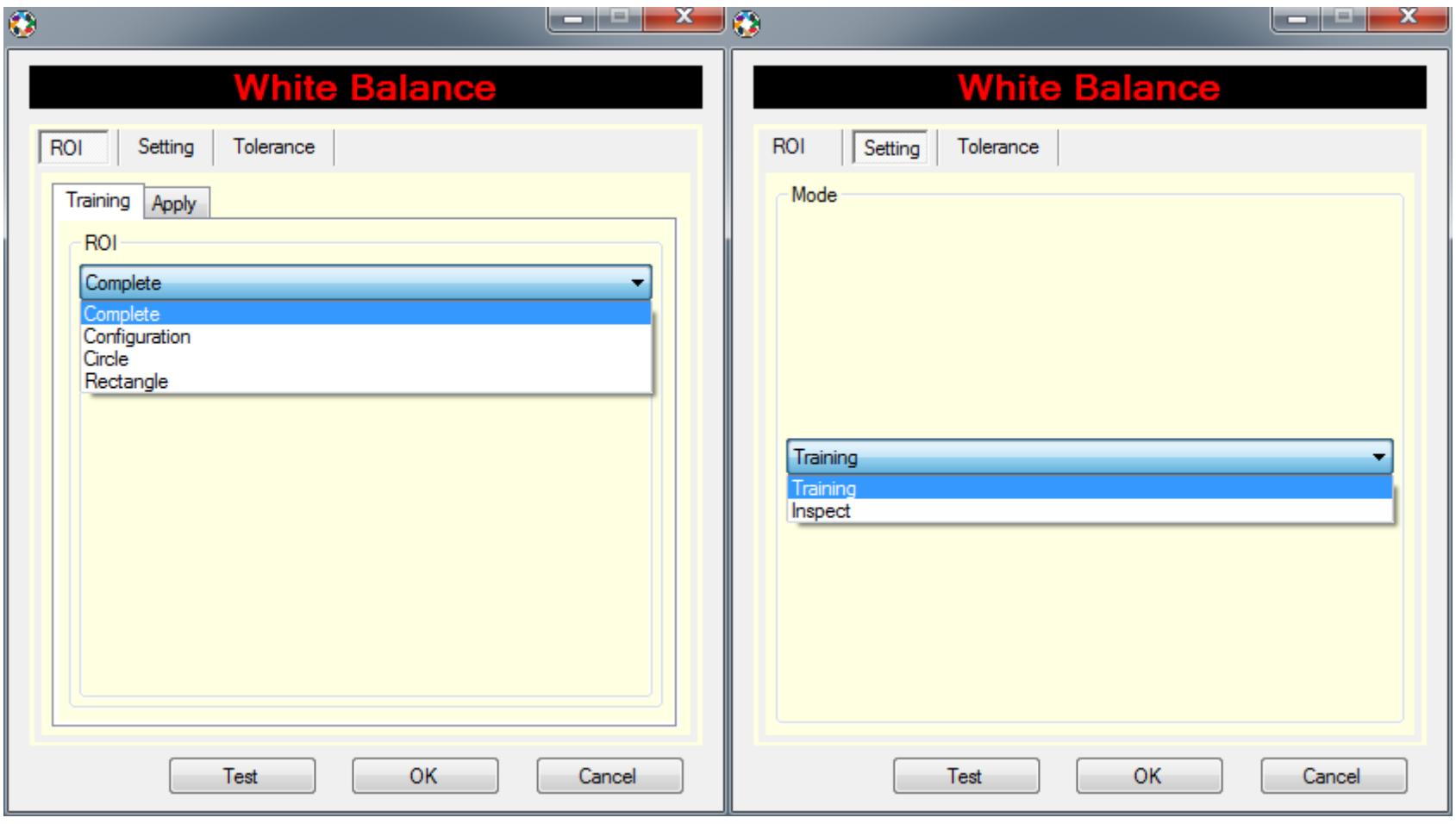
Tolerance: State conditional acceptance of the inspected result.

The idea of color processing is to take advantage of the additional information encoded in color or multispectral images. Processing color images can simplify many machine vision tasks and provide solutions to certain problems that are simply not possible in gray value images. First, the individual channels of a color image can be processed using standard methods like blob analysis. In this approach the channels of the original image have to be decomposed first.

An RGB image is acquired where the user need to set the color hue to be detected basing on the saturation and intensity of the objects to be detected. The task is to specify the object color by using the Color Picker to pick the color for detection.

WhiteBalance

WhiteBalance



The White Balance command is to adjust the offset color reference data for color camera.

ROI:

Training: To set the region of interest for training.

Apply: To set the region of interest for apply this command.

Setting:

Training: Allow user to train the command based on the image's environment condition

Inspect: Allow user to inspect the image's environment condition.

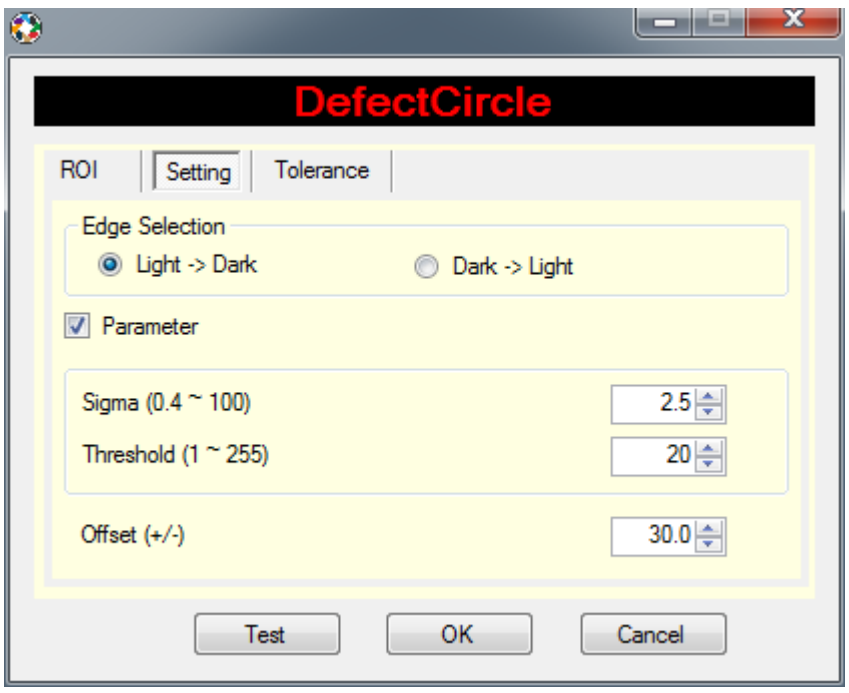
Tolerance: State conditional acceptance of the inspected result.

Defect

Topic on Defect Circle, Defect Define and Defect Straight Line.

DefectCircle

DefectCircle



The DefectCircle command is used to aid in detecting burr on circular object after some filtering commands.

Setting:

Parameter:

- **Sigma**: Sigma of the Gaussian functions for smoothing.
- **Threshold**: Minimum edge amplitude changes between edges.

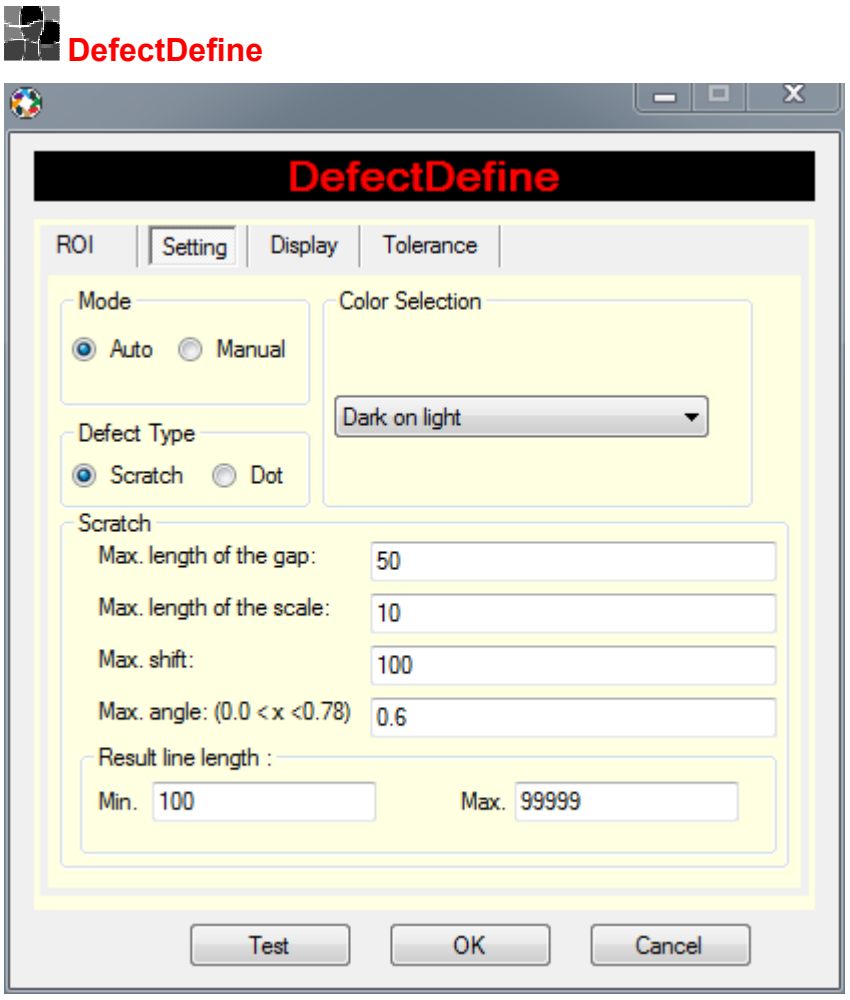
Edge Selection:

- **Light -> Dark**: The greyscale colour for the object in demand is set to dark which is defined according to the arrow of the search region.
- **Dark -> Light:** The greyscale colour for the object in demand is set to bright which is defined according to the arrow of the search region.

Offset (+/-): To define an offset value basing on the average points detected, to detect the defect. (value is in pixel format)

Tolerance: stating the conditional acceptance of the inspected result.

DefectDefine



With the Defect Define command, it aids in detecting scratch or dots after some filtering commands.

Mode: To select the mode of detection.
Auto: To detect the scratches or dot automatically basing on the software default configuration.
Manual: To detect the scratches or dot manually basing on the threshold set.

Defect Type: To detect scratches or dots.

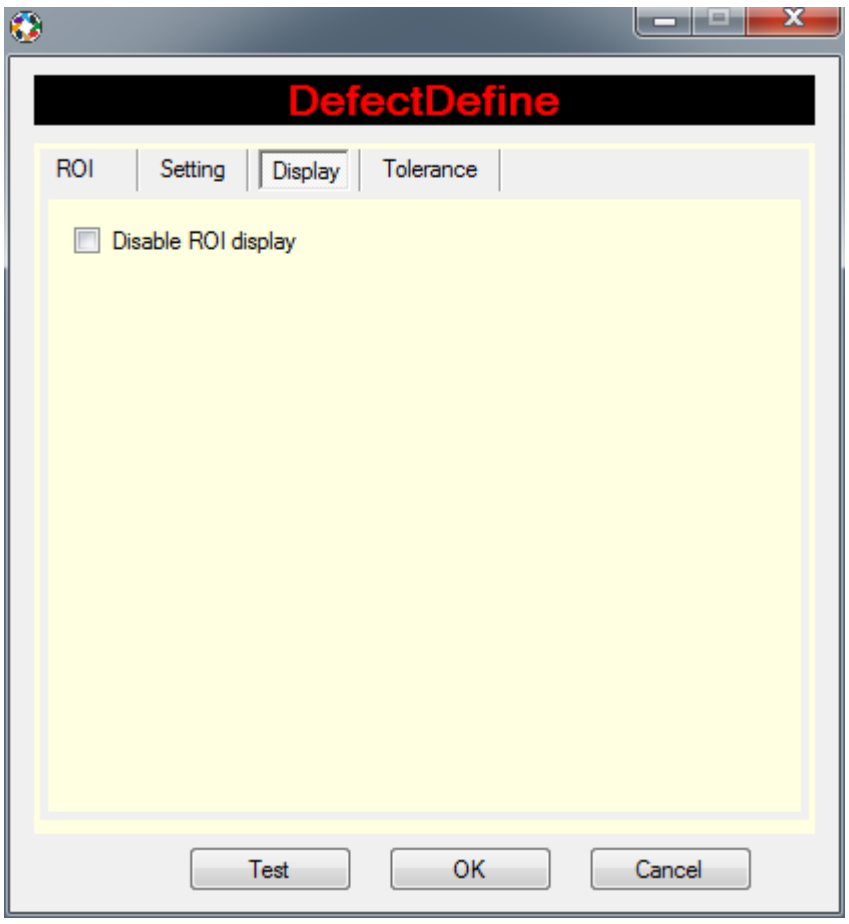
Scratch:
Max. length of the gap: The maximum accepted absolute distance between two contours. The gap is measured along the regression line of the reference contours. Thus, it is the length of the projection of the gap between the two contours onto the regression line of the reference contour.

Max. length of the scale: The maximum accepted relative distance between the two contours. The relative distance is calculated by dividing the distance by the length b of the reference contour.

Max. shift: The maximum distance of the second contour from the regression line of the reference contour. This distance is measured perpendicular to the regression line of the reference contour.
Max angle: The maximum angle (in radians) between the regression lines of the two contours.
Result line length: The minimum and maximum value of the line to be detected.

Line:
Result line size: The minimum and maximum size of the dot to be detected.

Banner Vision Inspector



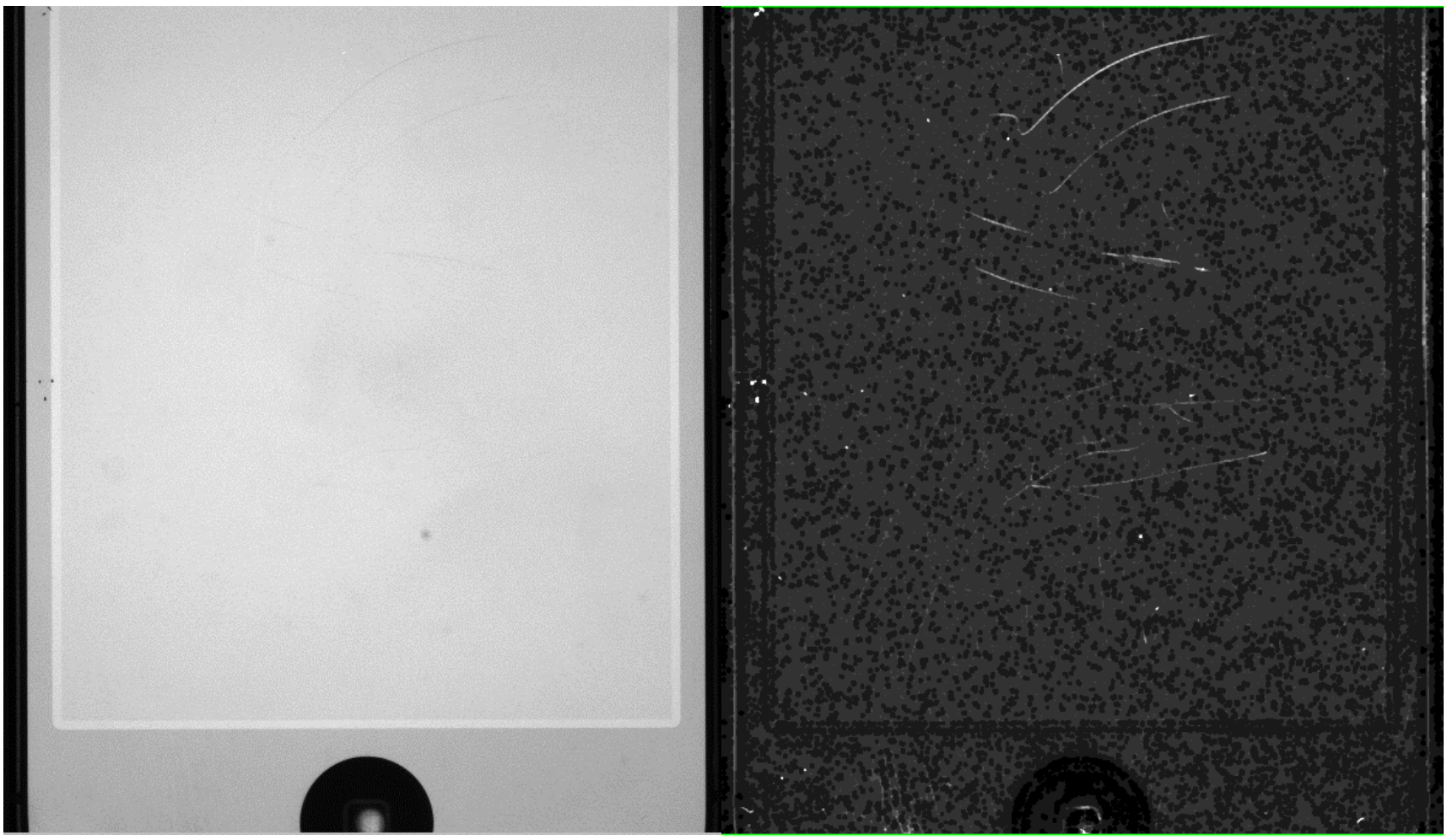
Display: Optional to enable or disable ROI display.

Tolerance: stating the conditional acceptance of the inspected result.

With the Defect Define command, it aids in detecting scratch or dots after some filtering commands.

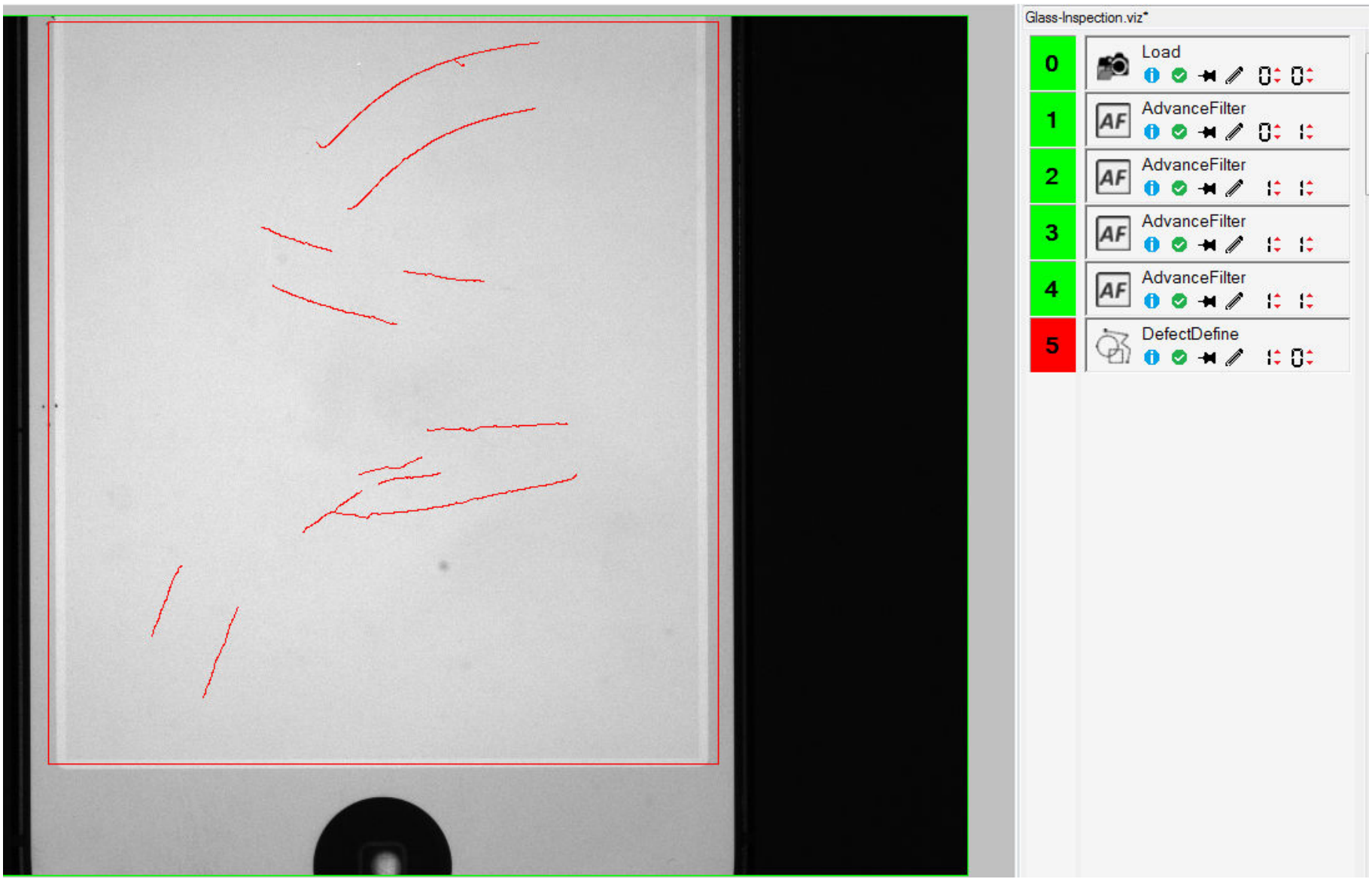
Mode: To select the mode of detection.
Auto: To detect the scratches or dot automatically basing on the software default configuration.
Manual: To detect the scratches or dot manually basing on the threshold set.

Defect Type: To detect scratches or dots.



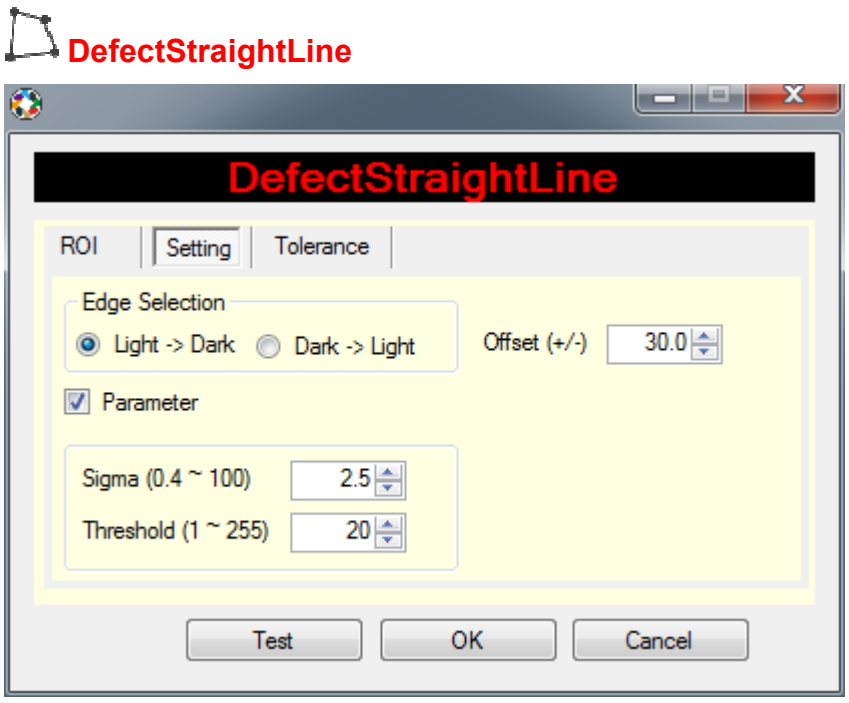
Orginal image after Advanced Filter processing.

Banner Vision Inspector



The result to detect the lines after image pre-processing using DefectDefine command.

DefectStraightLine



The DefectStraightline command is used to aid in detecting burr on straight object after some filtering commands.

Setting:

Parameter:

- **Sigma**: Sigma of the Gaussian functions for smoothing.
- **Threshold**: Minimum edge amplitude changes between edges.

Edge Selection:

- **Light -> Dark**: The greyscale colour for the object in demand is set to dark which is defined according to the arrow of the search region.
- **Dark -> Light:** The greyscale colour for the object in demand is set to bright which is defined according to the arrow of the search region.

Offset (+/-): To define an offset value basing on the average points detected, to detect the defect. (value is in pixel format)

Tolerance: stating the conditional acceptance of the inspected result.