

MSRA

MSRA

GigaPix

User Manual



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2 Introduction

Thank you for your purchase of GigaPix super resolution digital camera solution. This manual has been written to help you taking pictures with GigaPix digital camera solution. Read this manual thoroughly before use, and keep it handy when using this product.

GigaPix is an end-to-end solution that creates continuous, perspective, flat images with gigapixels level at reasonable cost. It contains a GigaPix Camera and required softwares. With the focal stack technology provided by MSRA, GigaPix could be used to capture not only flat wall, but also the object with depth. This document will introduce the software UI, basic functionalities and classic capture process.

To make it easier to find the information you need, the following symbols and conventions are used.:

	This icon marks cautions, information that should be read before use to avoid wrong operation.		This icons marks tips, additional information that may be helpful when using the solution.
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2.1 Terminology

- Preparation: the initial step before camera normal works, including mount lens and power-on test.
- Grid: the area camera could capture is separated to several grids. The grid mean the area sensor could cover by one shot on current base plane.
- Homography: Calibrate the alignment between webcam and main camera. Homography is a factory setting. You don't need to set it unless the relative position between webcam and main camera changed.
- Base Plane: Base Plane is the reference to draw grid. It means the nearest plane in the object to sensor.
- Live View: To display current frame sensor captured. It could be used as a monitor to move sensor and focus.
- Snapshot: capture one picture with current settings.
- Bracket Snapshot: Capture a group of pictures with current exposure bracket and focal stack settings.
- Focal Stack: A set of capture distances calculated by near distance and far distance. It is used to ensure the camera could capture the object with depth.
- Local Focal Stack: Local focal stack could only apply on a particular part of object. It is used to reduce the overall capture image number.
- Focus: the value of focus in this system is the distance between object and sensor.

2.2 Getting to Know the Camera Solution

2.2.1 Accessories

2.2.2 Camera Body (Hardware Introduction)

2.2.3 First Step (Assembly)

2.2.4 Software Install/Uninstall

2.3 Getting to Know Software

There is a capture application and a post-processing application in this system.

- Capture application will collaborate with camera to complete the capture process.
- Post-processing application will stitch the capture result as a large picture.

2.3.1 Capture Application

2.3.1.1 Main Form

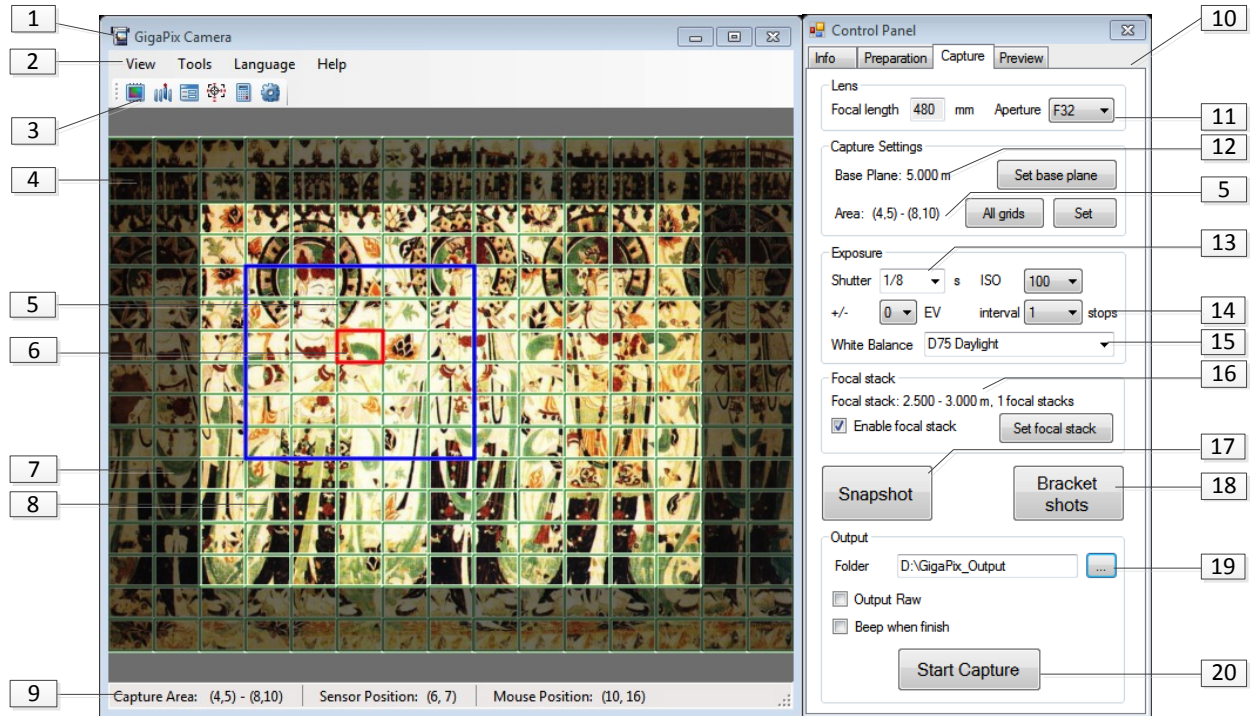
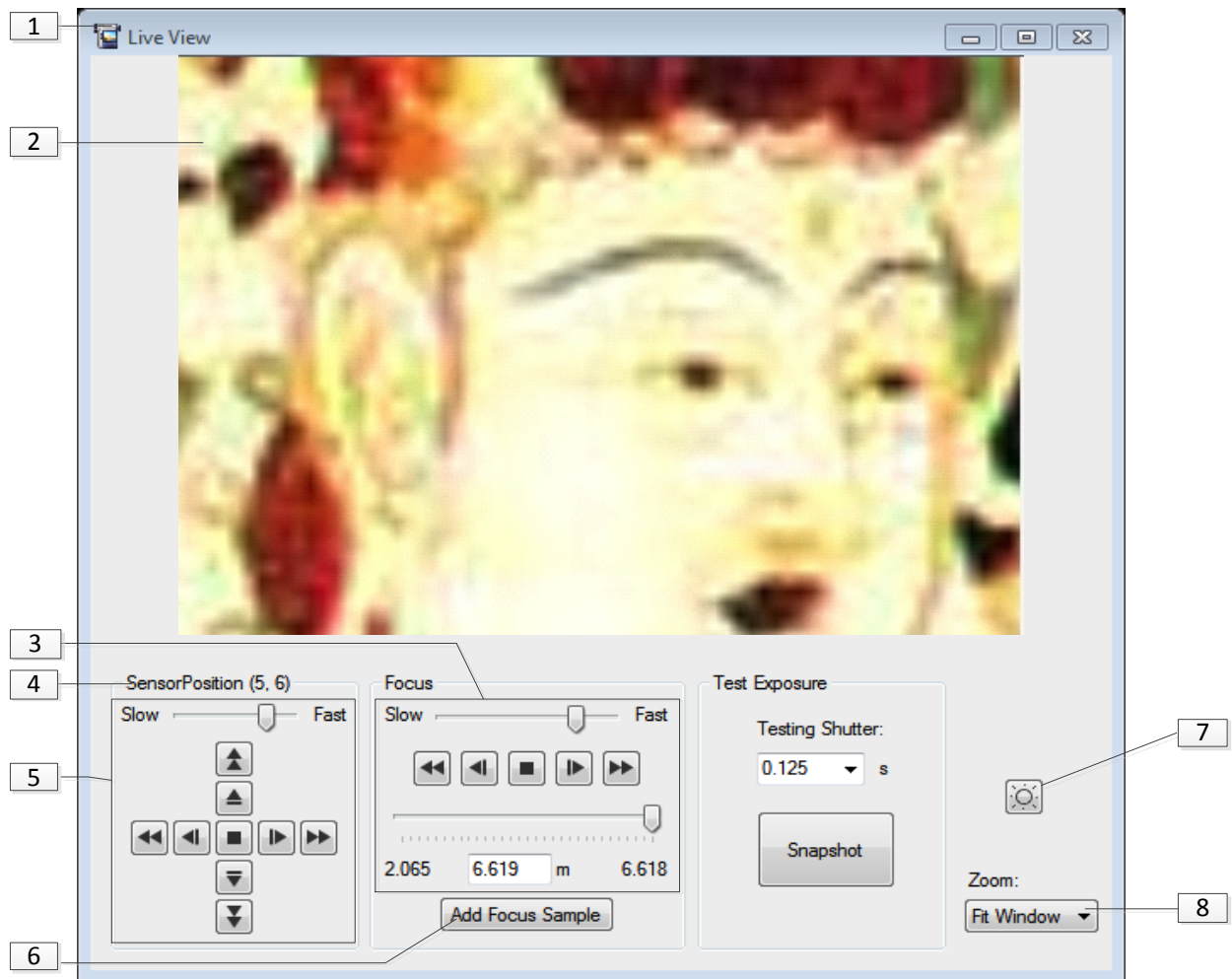


Figure 1

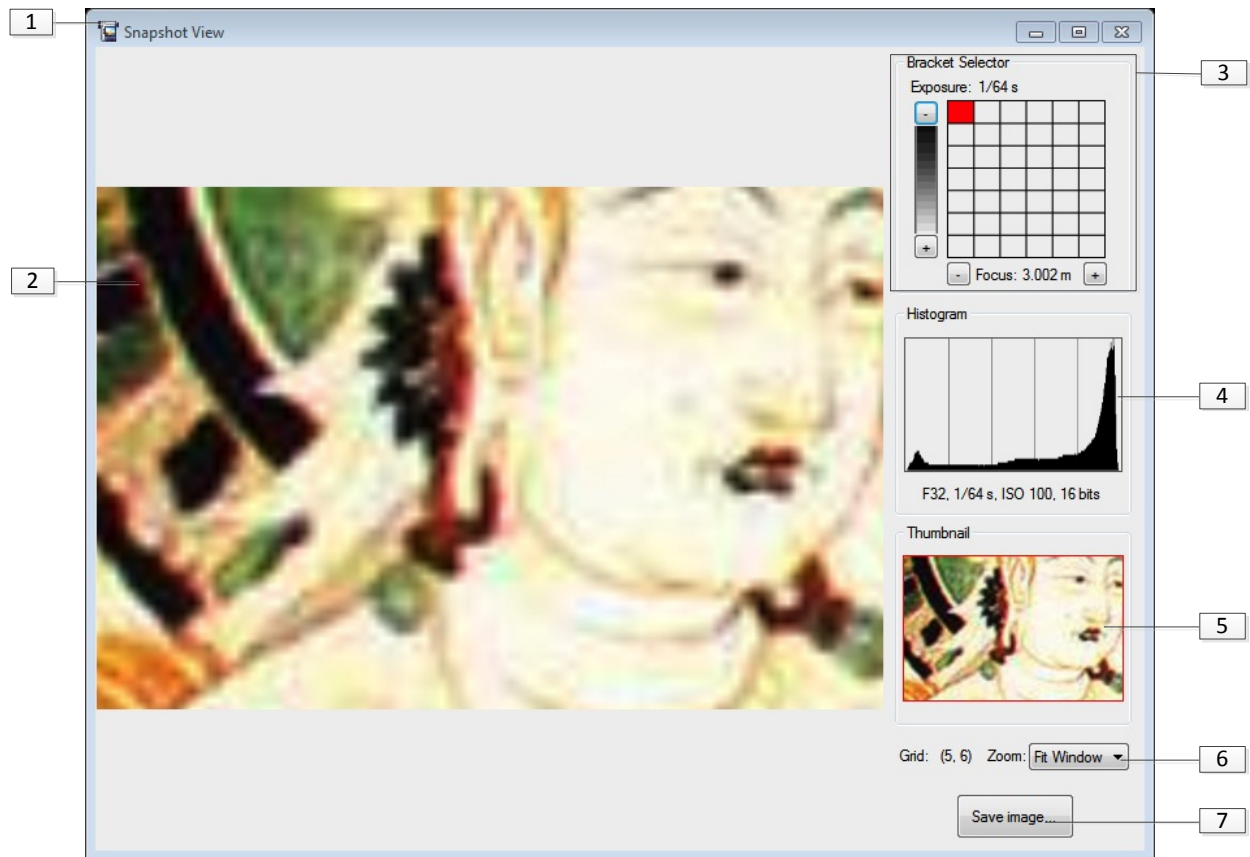
1	Main Window	10	Control Panel
2	Menu Bar	11	Aperture
3	Tool Bar	12	Base Plane
4	Grid View	13	Shut Value
5	Capture Area	14	Exposure Bracket Settings
6	Sensor Position	15	White Balance Settings
7	Area unable to capture (shadow area in Figure 1)	16	Focal Stack Settings
8	Area able to capture (bright area in Figure 1)	17	Snapshot
9	Status Bar	18	Bracket Shot
		19	Output Settings
		20	Start Capture

2.3.1.2 Live View



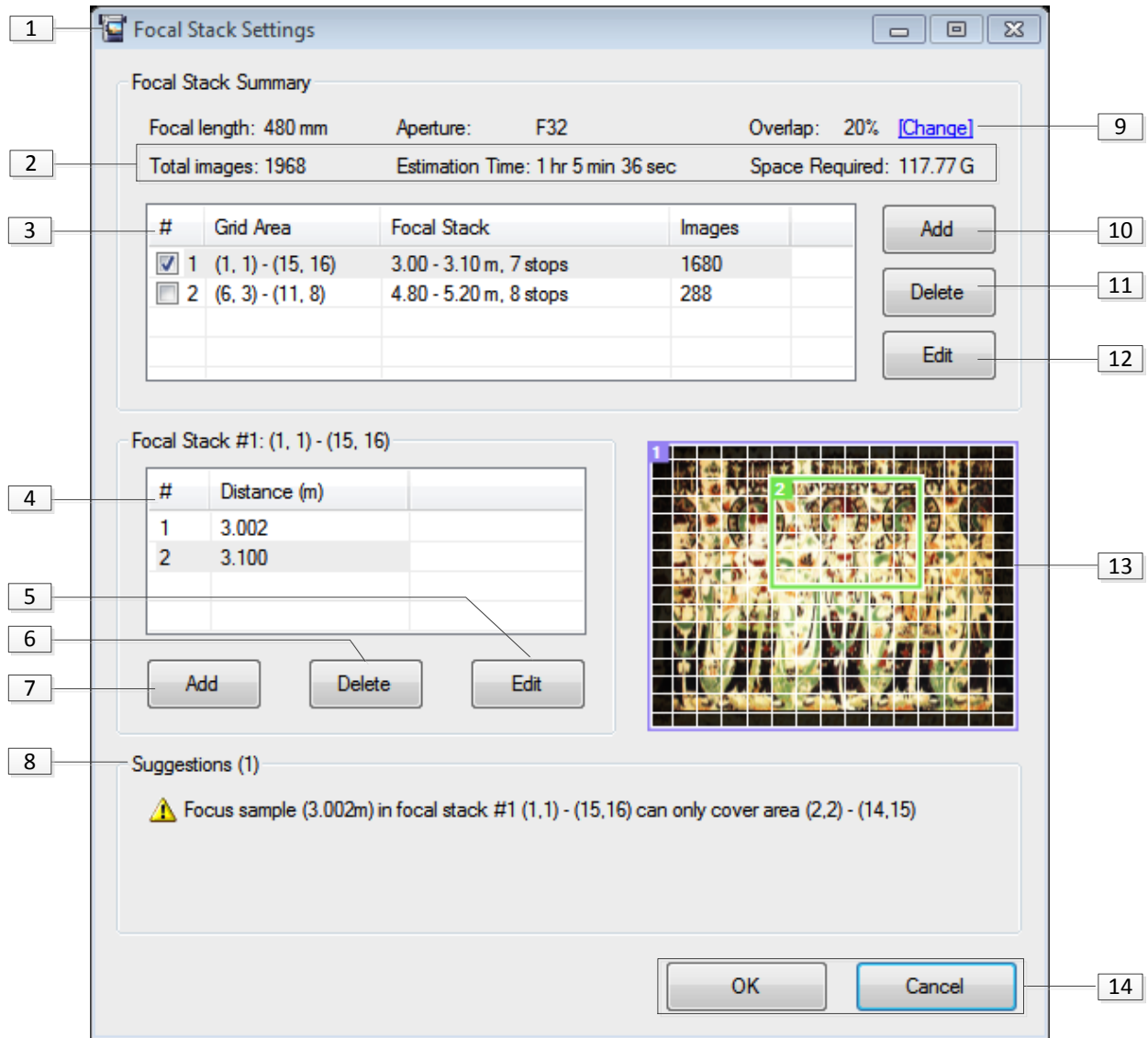
1	Live View Window	7	Brightness Control
2	Video Box	8	Zoom
3	Focus Control		
4	Grid Position		
5	Sensor Position Control		
6	Add Focal Stack Sample		

2.3.1.3 Snapshot



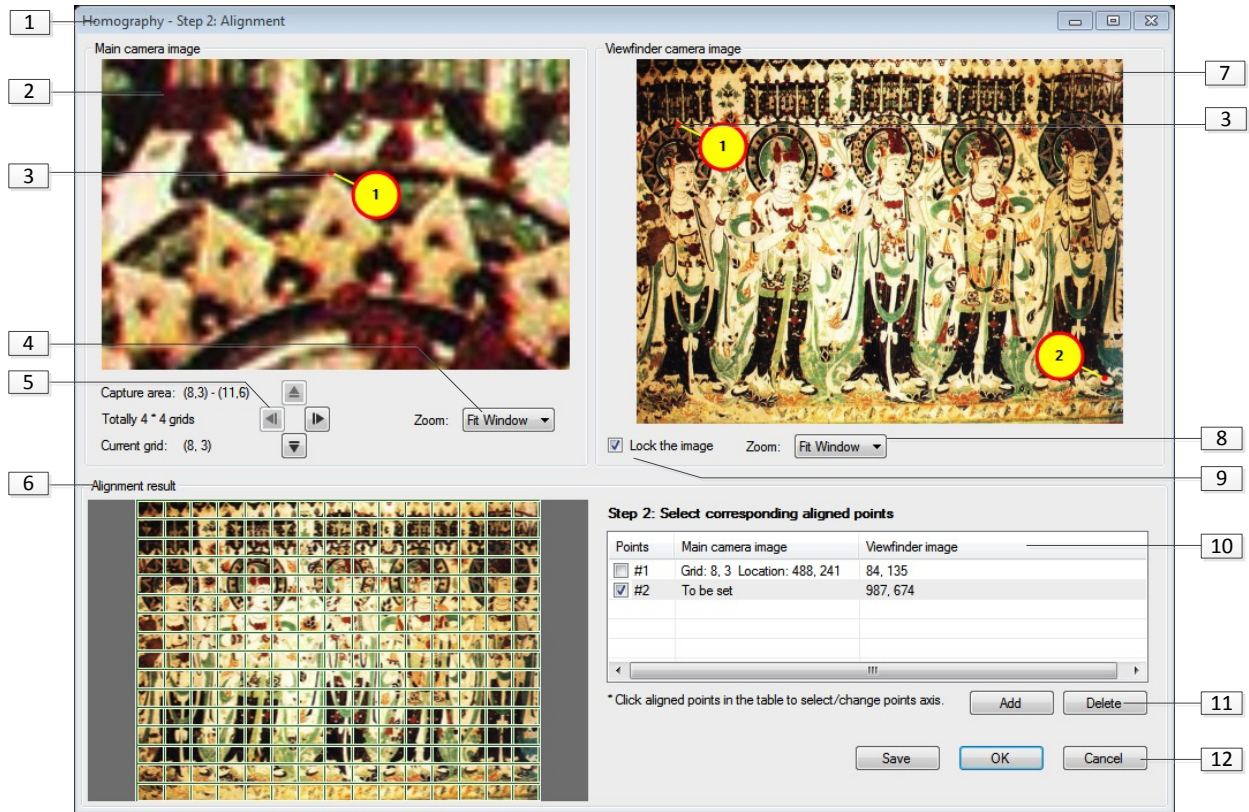
1	Snapshot Window	3	Bracket Selector
2	Snapshot Picture	4	Histogram
		5	Thumbnail
		6	Zoom
		7	Save

2.3.1.4 Focal Stack Settings



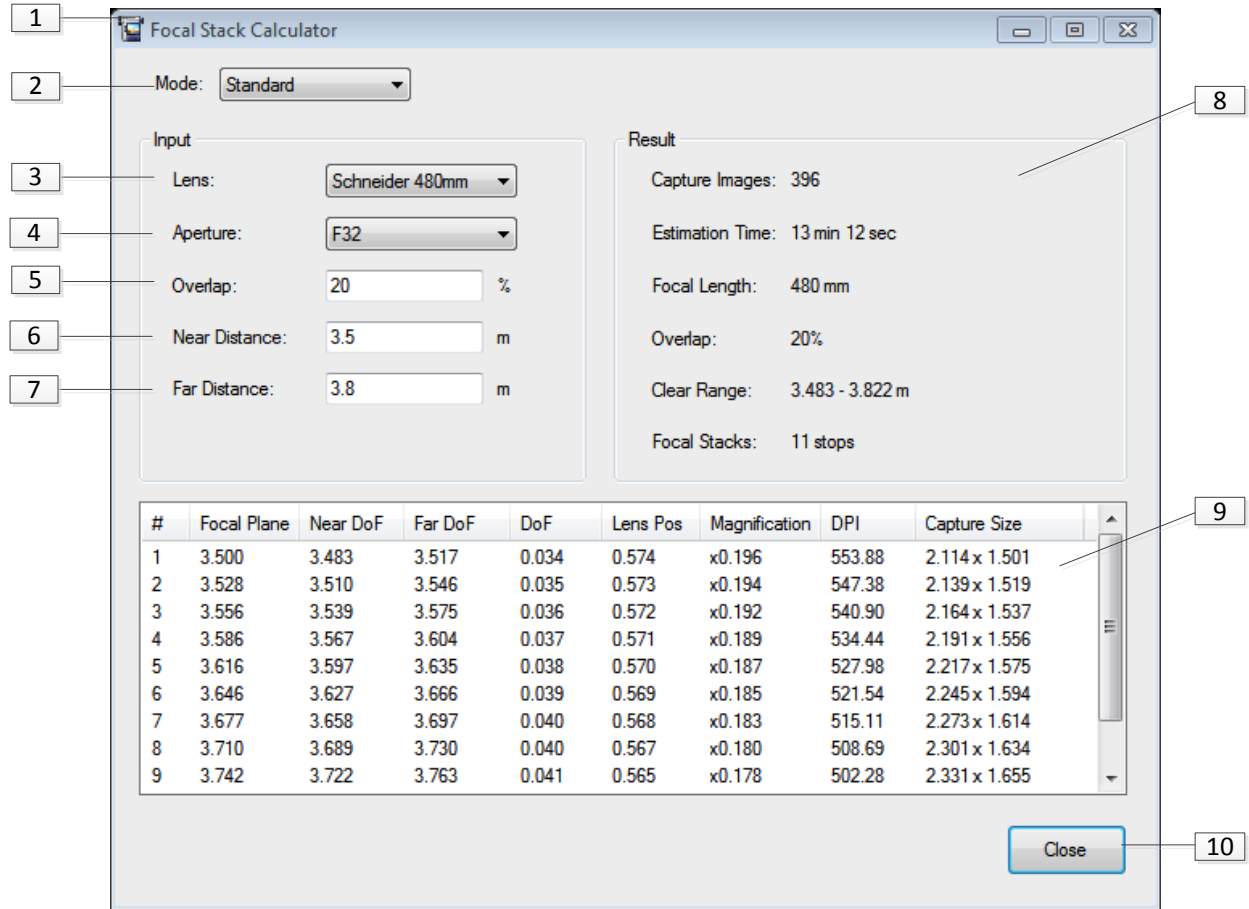
1	Focal Stack Settings Window	9	Change Depth Overlap
2	Focal Stack Result	10	Add Focal Stack
3	Focal Stack List	11	Delete Focal Stack
4	Focal Sample List	12	Edit Focal Stack
5	Edit Focal Sample	13	Focal Stack Preview
6	Delete Focal Sample	14	Conform/Cancel
7	Add Focal Sample		
8	System Suggestion		

2.3.1.5 Homography



1	Homograpy Window	7	Webcam Image
2	Sensor Image	8	Webcam Image Zoom Control
3	Alignment Point	9	Lock Webcam Image
4	Sensor Image Zoom Control	10	Alignment Point List
5	Sensor Image Switch Control	11	Add/Delete Alignment Point
6	Homography Result	12	Save, OK and Cancel

2.3.1.6 Calculator --- Standard Mode



1	Calculator Window	8	Result
2	Mode Switcher	9	Detailed Result
3	Lens	10	Close
4	Aperture		
5	Depth Overlap		
6	Near Distance		
7	Far Distance		

2.3.1.7 Calculator --- Capture Plan Mode

1 Focal Stack Calculator

2 Mode: Planning

3 Lens: Schneider 480mm

4 Aperture: F32

5 Overlap: 20 %

6 Depth of Field: 0.2 m

7 Capture Size: Greater than: 2 x 2 m

8 DPI: Greater than: 300

9 Near Distance: 4.290 4.504 m 5.326

10 Result

Capture Images: 180

Estimation Time: 6 min 0 sec

Focal Length: 480 mm

Overlap: 20%

Clear Range: 4.471 - 4.742 m

Focal Stacks: 5 stops

#	Focal Plane	Near DoF	Far DoF	DoF	Lens Pos	Magnification	DPI	Capture Size
1	4.504	4.471	4.538	0.068	0.546	x0.138	389.52	3.006 x 2.134
2	4.559	4.525	4.594	0.070	0.545	x0.136	383.34	3.054 x 2.169
3	4.616	4.580	4.652	0.072	0.544	x0.134	377.17	3.104 x 2.204
4	4.674	4.638	4.712	0.074	0.543	x0.131	371.01	3.155 x 2.241
5	4.704	4.667	4.742	0.075	0.543	x0.130	367.97	3.182 x 2.259

11

12 Close

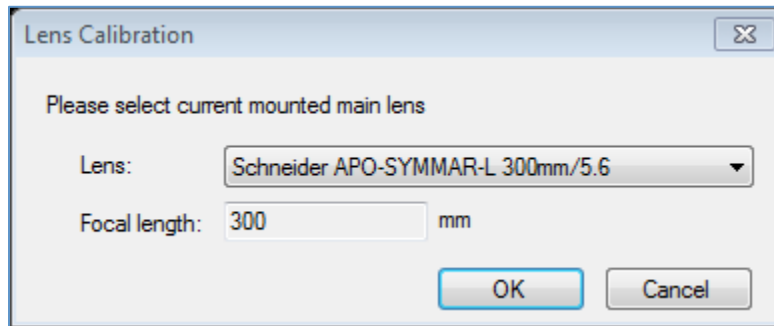
1	Calculator Window	10	Result
2	Mode Switcher	11	Detailed Result
3	Lens	12	Close
4	Aperture		
5	Depth Overlap		
6	Object Depth		
7	Capture Size		
8	Required DPI		
9	Range of Near Distance		

3 Basic Functionalities

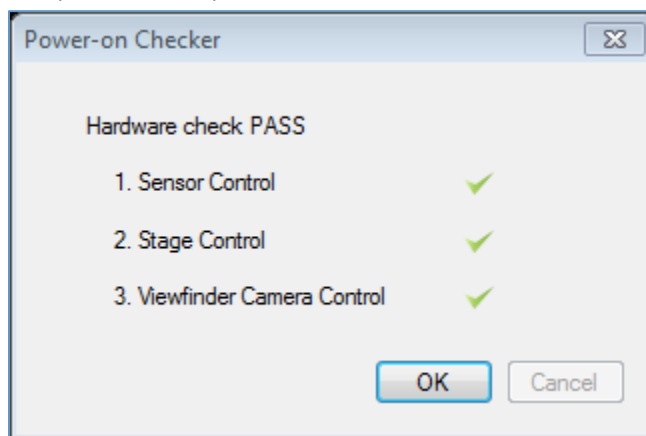
3.1 Preparation

The first step of capture application is preparation, which including mount lens and power-on test. Capture application cannot start work unless the preparation step completes.

- Step 1: Click “Lens Mounted” button and choose the lens you installed in this camera. Then click OK to complete this step.

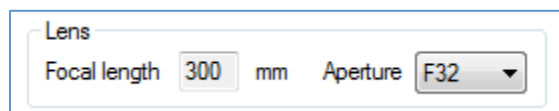


- Step 2: Click “Power-on Test” button and wait until all hardware test completed. Then click OK to complete this step.



3.2 Set Aperture

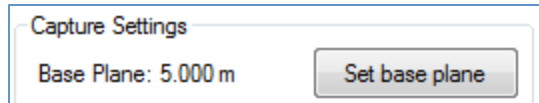
Select an appropriate aperture in control panel.



- ⚠ The aperture selected in control panel is only for file information purpose. It won't change the aperture in camera. Please manually change the hardware aperture to make them consistence!!!

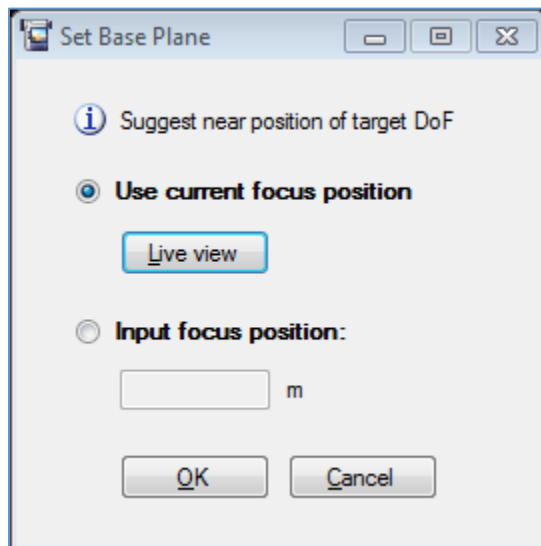
3.3 Set Base Plane

Click “Set Base Plane” button in control panel to set base plan.



Method 1: Set current focus position as base plane.

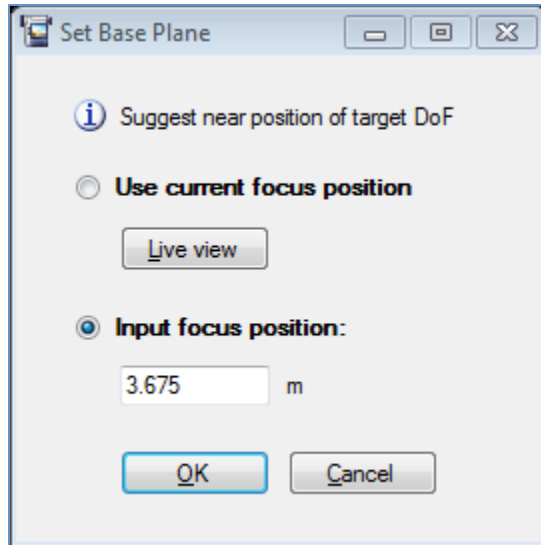
- Step1: Click "Set Base Plane" button in control panel.
- Step2: Choose "Use current focus position".



- Step3: Click "Live View" button to open live view.
- Step4: Focus on the near distance.
- Step5: Close live view window.
- Step6: Click "OK" button to complete this step.

Method 2: Manually input base plane.

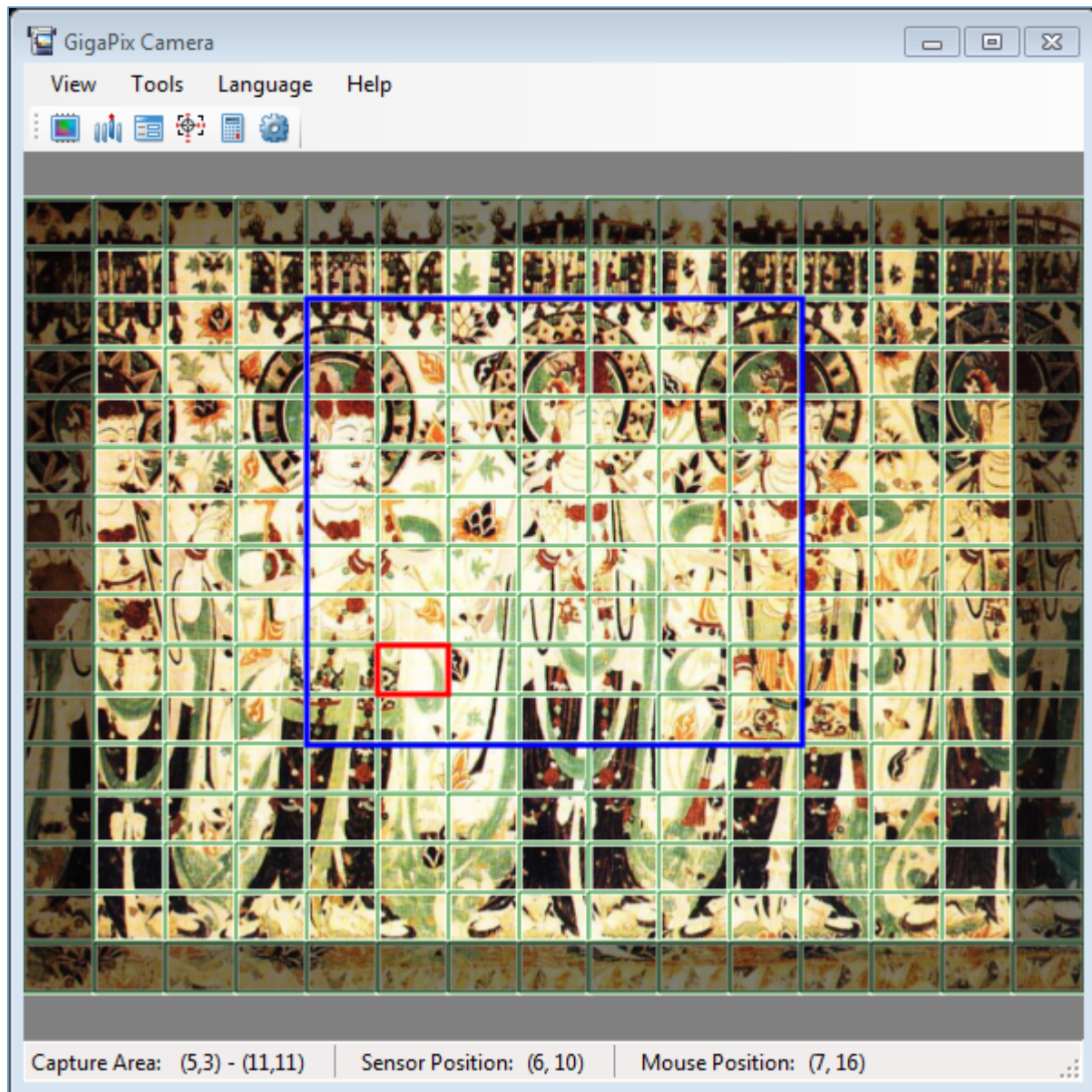
- Step1: Click "Set Base Plane" button in control panel.
- Step2: Choose "Input Focus Position".



- Step3: Input base plane position in the text box.
- Step4: Click "OK" button to complete this step.

3.4 Set Capture Area

Method 1: Click "Ctrl" + right click mouse to select capture area.

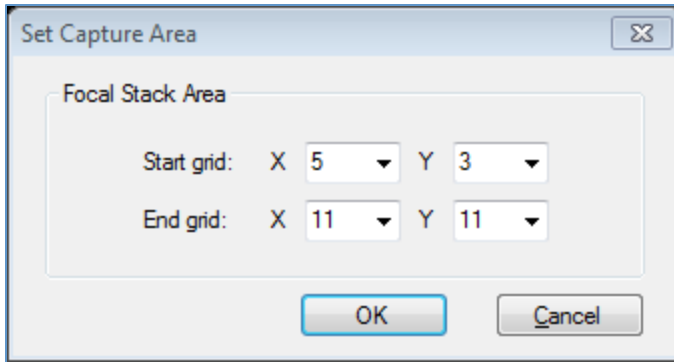


Method 2: Manually input capture area.

- Step1: Click "Set" button in control panel to open capture area setting dialog.

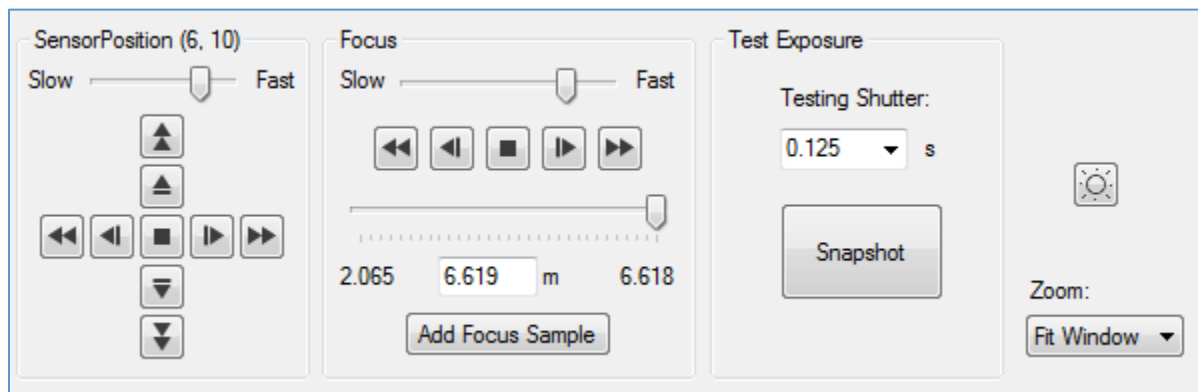


- Step2: Set the start grid and end grid. Click OK to close the dialog.

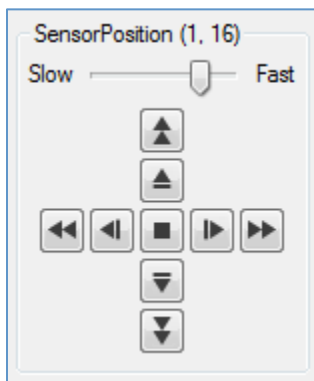


3.5 Focus

In Live view window, we can move the sensor and lens position to adjust focus.

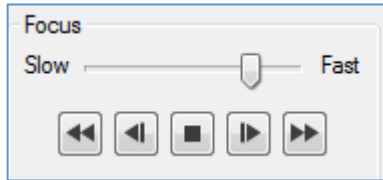


- Step1: Right click in the grid you want to see in Main Form. Choose "Move Sensor Here" to move sensor to current grid.
- Step2: Open live view window. There are 3 ways to open live view.
 - Context menu in main form
 - Tool bar in main form
 - Short-cut key in main form ("Ctrl+L")
- Step3: Adjust sensor. You could move the sensor freely along the x or y stage by using move buttons (⏪ ⏩ ⏴ ⏵), step move buttons (⏪ ⏴ ⏵ ⏩) and stop (■). Use the track bar to adjust the movement speed.



i If the video is too fuzzy to find object, you can do Step4 first and then step5.

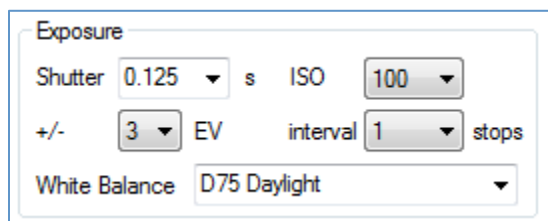
- Step4: You could move the lens to focus on far/near objects by using move buttons (⏪ ⏩), step move buttons (⏮ ⏭) and stop button (⏹). Use the track bar to adjust the movement speed.



- i** Draft estimate the distance and then input the number to do a draft tuning, and then use movement buttons to do fine-tuning.
- i** Adjust the Zoom and brightness can help you to see more details.

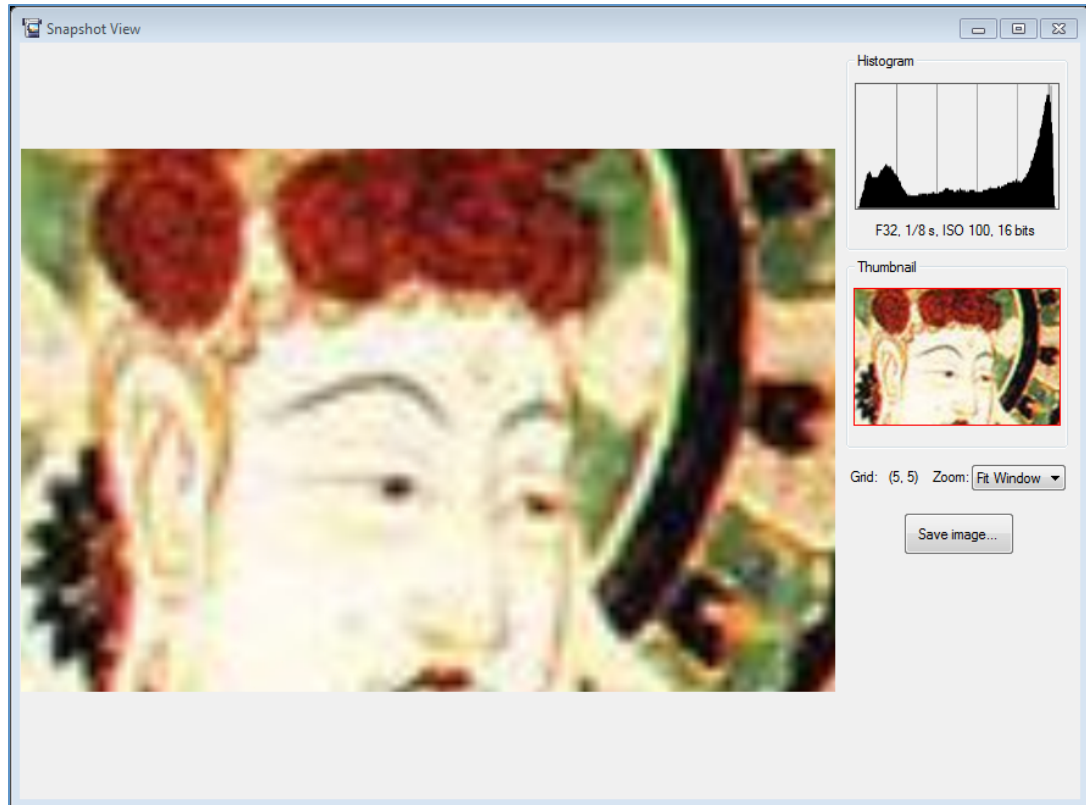
3.6 Set Exposure

The exposure could be set on control panel. You can use snapshot to verify exposure settings.



Method 1: Use snapshot to get an appropriate exposure.

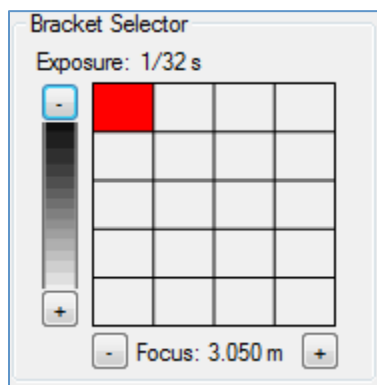
- Step1: Focus on object.
- Step2: Set a single exposure in control panel.
- Step3: Click snapshot in control panel to get a snapshot.
- Step4: Verify the exposure by the picture and histogram in snapshot window.



i You can see the exposure of details by zoom.

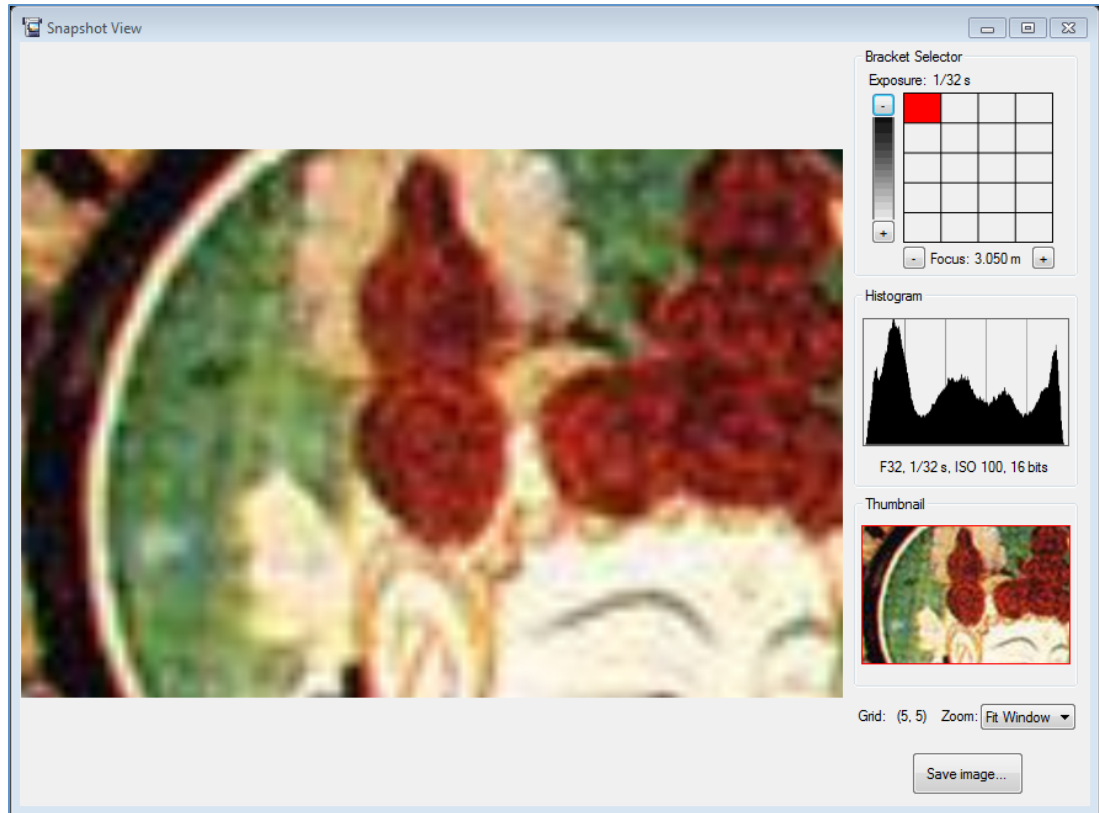
Method 2: Use bracket shot to get an appropriate exposure.

- Step1: Focus on object.
- Step2: Set a bracket exposure in control panel.
- Step3: Click bracket shot in control panel to get bracket snapshots.
- Step4: Switch the images by clicking the grid in bracket selector or (+, -) button.



i Bracket shot will take a long time. Please wait until it completes.

- Step5: Verify the exposure by the picture and histogram in snapshot window.

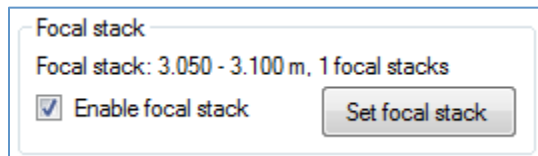


i You can see the exposure of details by zoom.

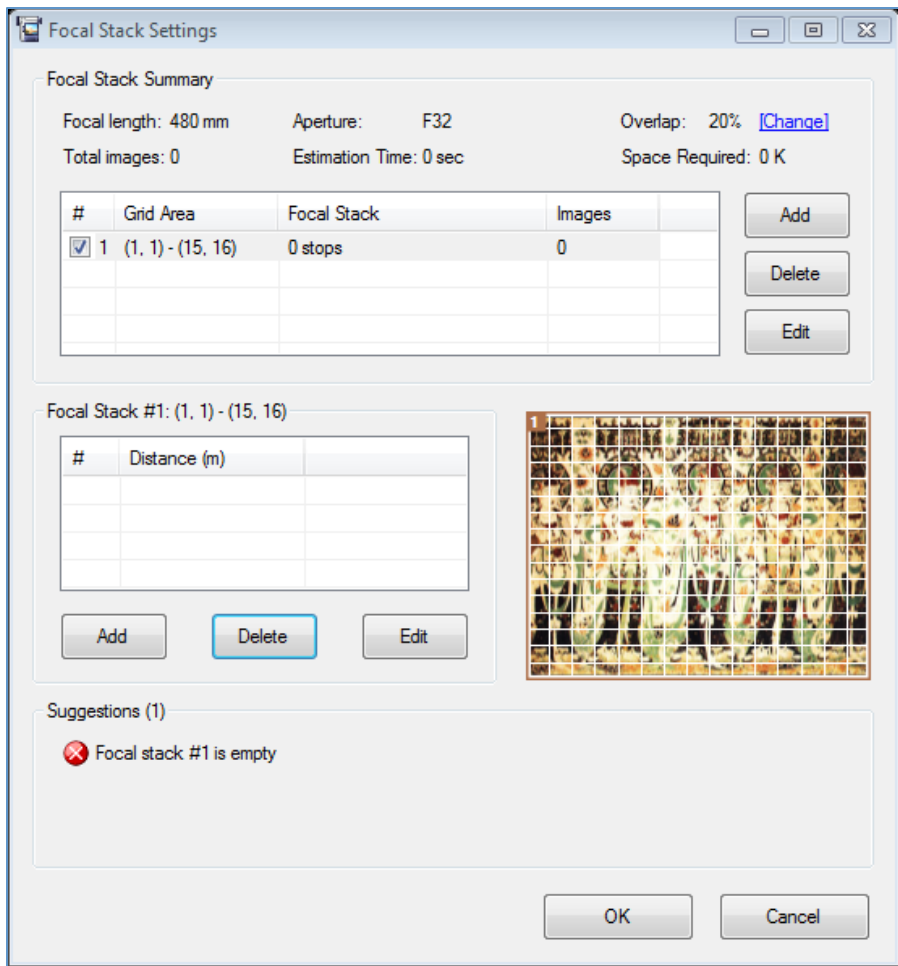
3.7 Set Focal Stack

You could set focal stack to capture the object with depth.

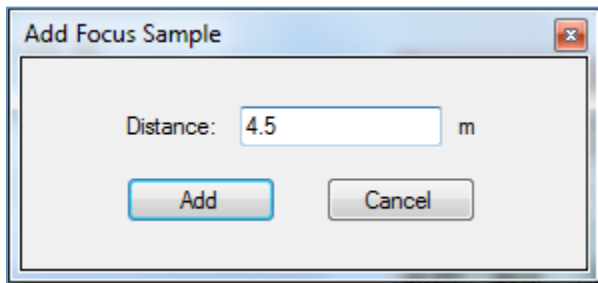
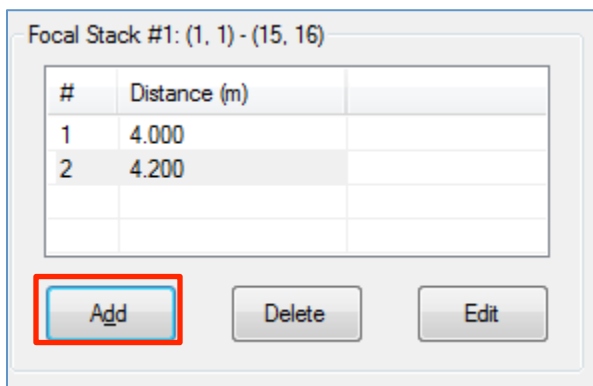
- Step1: Enable focal stack in control panel.



- Step2: Click "Set focal stack" button in control panel to enable focal stack.

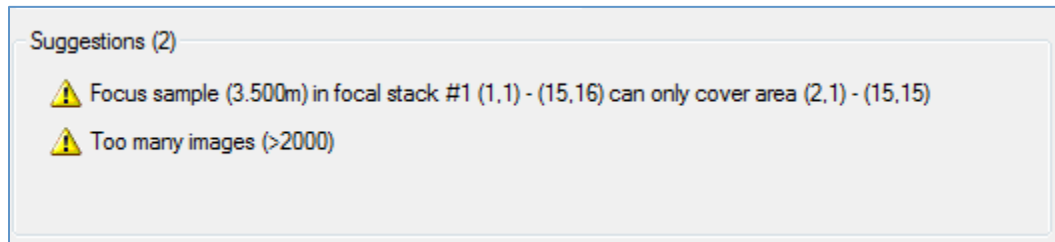


➤ Step3: Add the far distance and near distance as focal samples.



i You could also add focal stack samples in Live View window. System will automatically choose the far distance and near distance from the samples you've added.

- Step4: Update the focal stack settings according to the suggestion

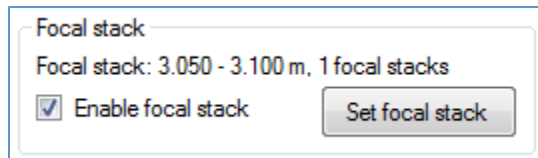


- Step5: Click "OK" to save the settings.

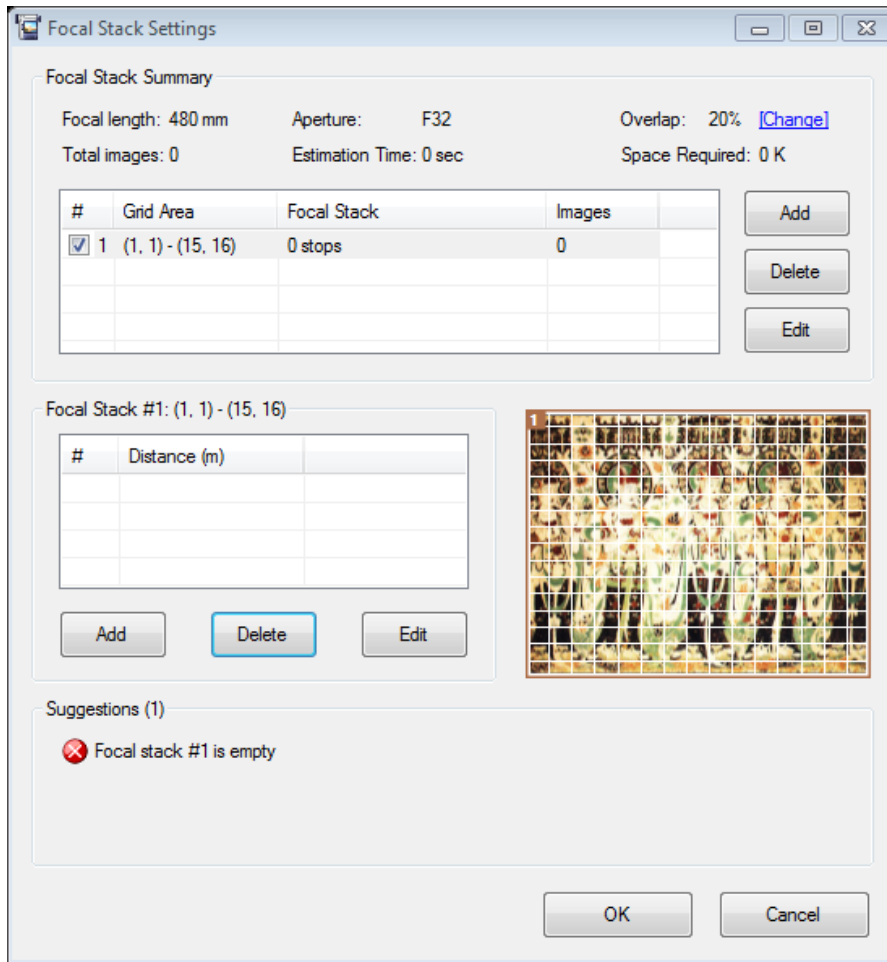
3.8 Set Local Focal Stack

Except global focal stack, you can also add local focal stacks for a particular area to reduce the capture images.

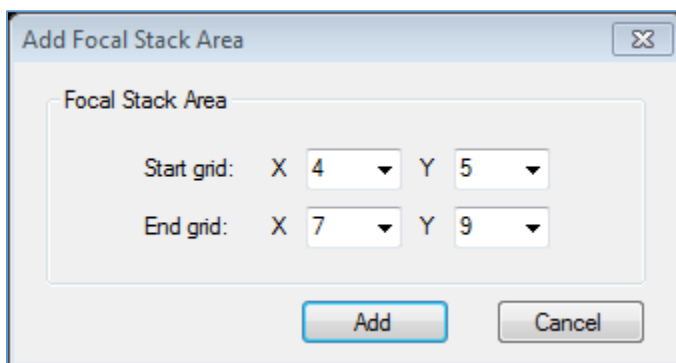
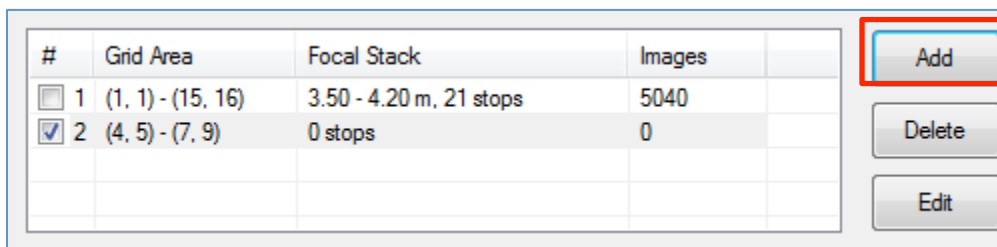
- Step1: Enable focal stack in control panel.



- Step2: Click "Set focal stack" button in control panel to enable focal stack.

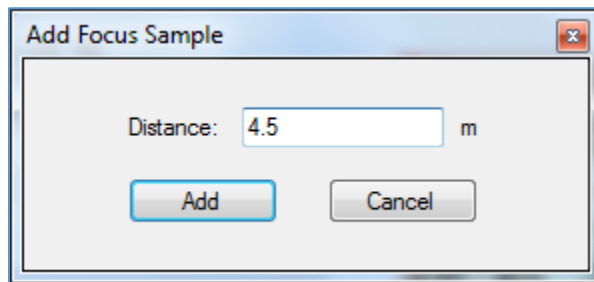
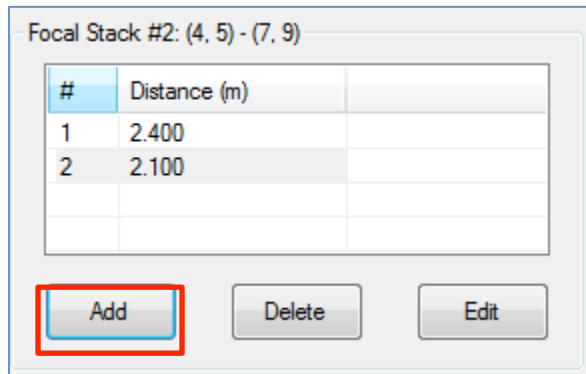


➤ Step3: Add a new focal stack



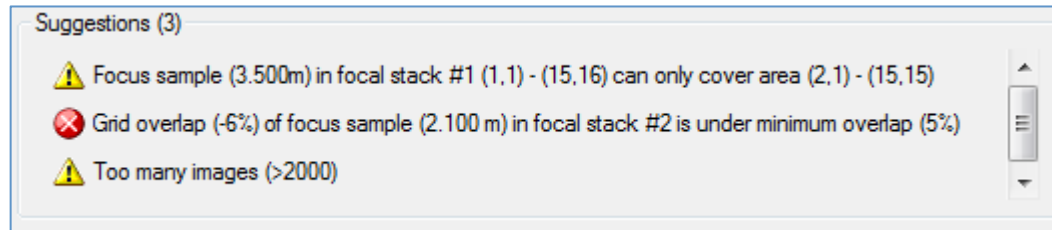
⚠ You can also choose an area in main window to set as local focal stack.

- Step4: Add the far distance and near distance as focal samples.



- i** You could also add focal stack samples in Live View window. System will automatically choose the far distance and near distance from the samples you've added.

- Step5: Update the focal stack settings according to the suggestion



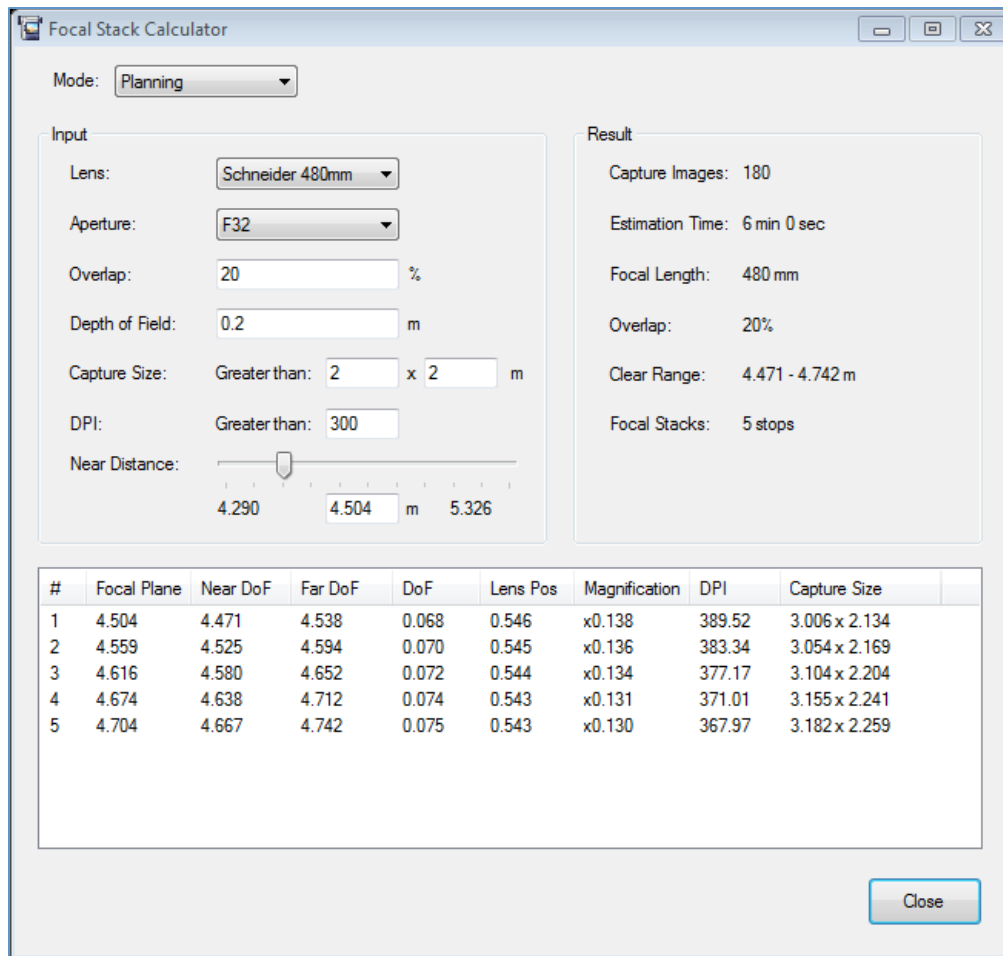
- Step6: Click "OK" to save the settings.

3.9 Calculator

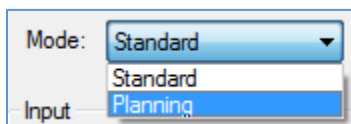
Calculator could be used in capture planning stage or capture stage to calculate the focal stacks, image number and capture area.

3.9.1 Calculator ---Capture Planning Mode

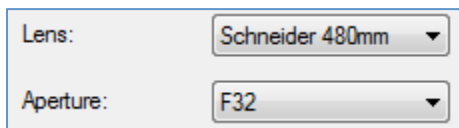
Capture planning mode is used in capture planning stage. You can get the draft position of camera and capture job estimation according to the capture requirements (capture size, depth, DPI requirements).



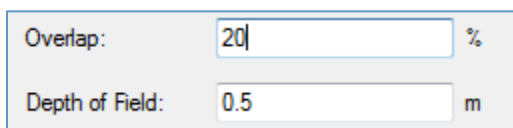
- Step1: Open calculator and choose capture planning mode.



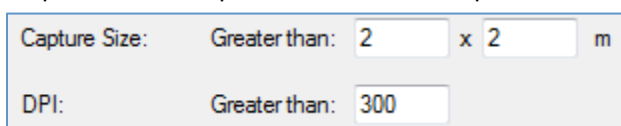
- Step2: Set the lens and aperture.



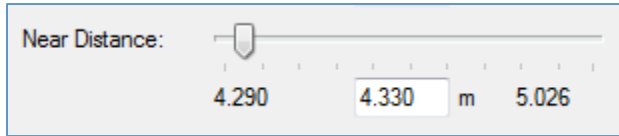
- Step3: Set the depth overlap and depth.



- Step4: Set the capture size and DPI requirements.

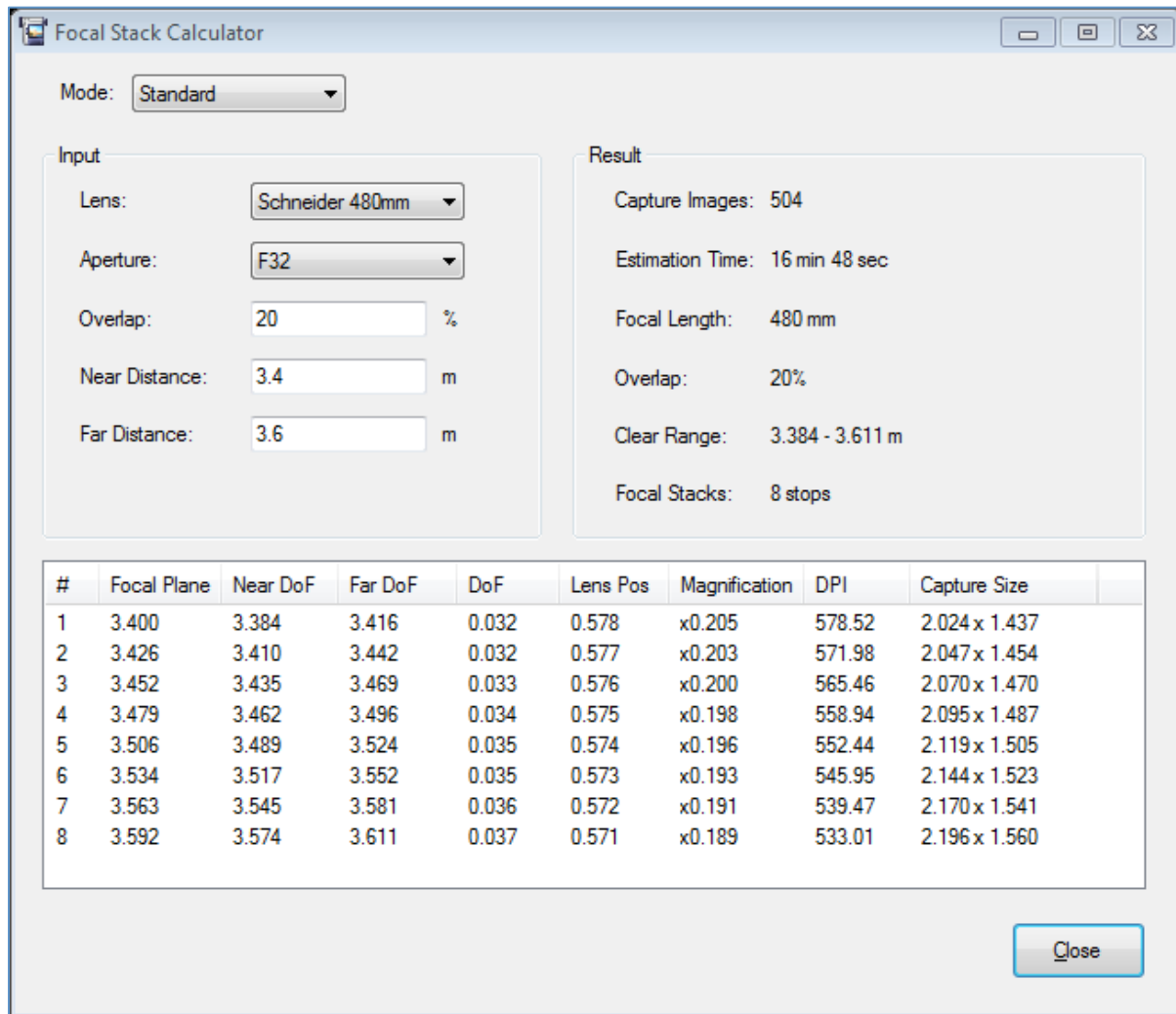


- Step5: Calculator will automatically come up the range of camera position, which is the range of valid near distance. Use can adjust this value by the track bar to get different calculator result.

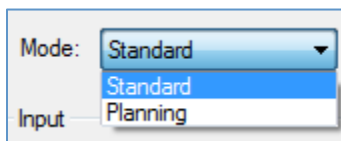


3.9.2 Calculator---Standard Mode

Standard mode is used in capture stage. You can get the exact capture job estimation according to the capture settings (Lens, aperture, depth overlap, near distance, far distance).



- Step1: Open calculator and choose standard mode.



- Step2: Set the depth overlap and depth.

Lens:	Schneider 480mm
Aperture:	F32

- Step3: Set the depth overlap.

Overlap:	20	%
----------	----	---

- Step4: Set the near distance and far distance.

Near Distance:	3.4	m
Far Distance:	3.6	m

- Step5: Calculator will come up the capture result. You can adjust parameters to get different result.

⚠ Before you start capture with current settings, please make sure the lens and aperture settings is the same as the parameters used in calculator.

3.10 Homography

Homography will correct the alignment between webcam and main camera.

- Step1: Set the capture area.
- Step2: Click "Menu"->"Tool"->"Homography"

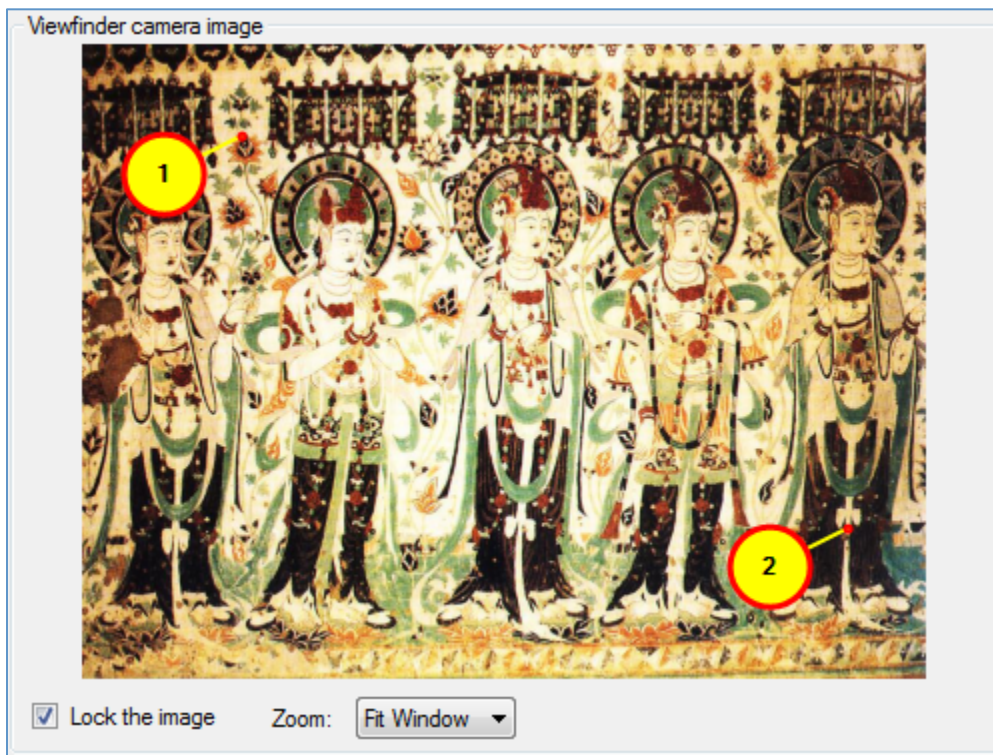
i You can also invoke this window by the button in tool bar.

- Step3: Open Live view and focus on object
- Step4: Click "Next" to start capture homography images
- Step5: Complete the capture

- Step6: Set the alignment point in camera image. You can switch the images in different grids by button (◀ ▲ ▶ ▼). Right clicking on the image could set an alignment point.



- Step7: Right click on the same position in the webcam image to set the correspond alignment point.



- Step8: Choose the second group of alignment point and repeat step 5 and 6 until you complete setting alignment points.


Points	Main camera image	Viewfinder image
<input checked="" type="checkbox"/> #1	Grid: 8, 6 Location: 367, 570	196, 109
<input type="checkbox"/> #2	Grid: 9, 4 Location: 481, 120	931, 584

* Click aligned points in the table to select/change points axis.

- Step9: You can see the homograph result in this window. Confirm the homography result by clicking "OK" button. Homography result will be applied to main form.

Homography - Step 2: Alignment

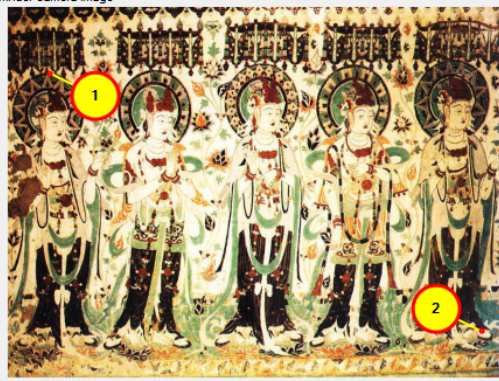
Main camera image



Capture area: (8,3) - (11,6)
 Totally 4 * 4 grids
 Current grid: (8, 3)


Zoom: Fit Window

Viewfinder camera image



Lock the image Zoom: Fit Window

Alignment result



Step 2: Select corresponding aligned points

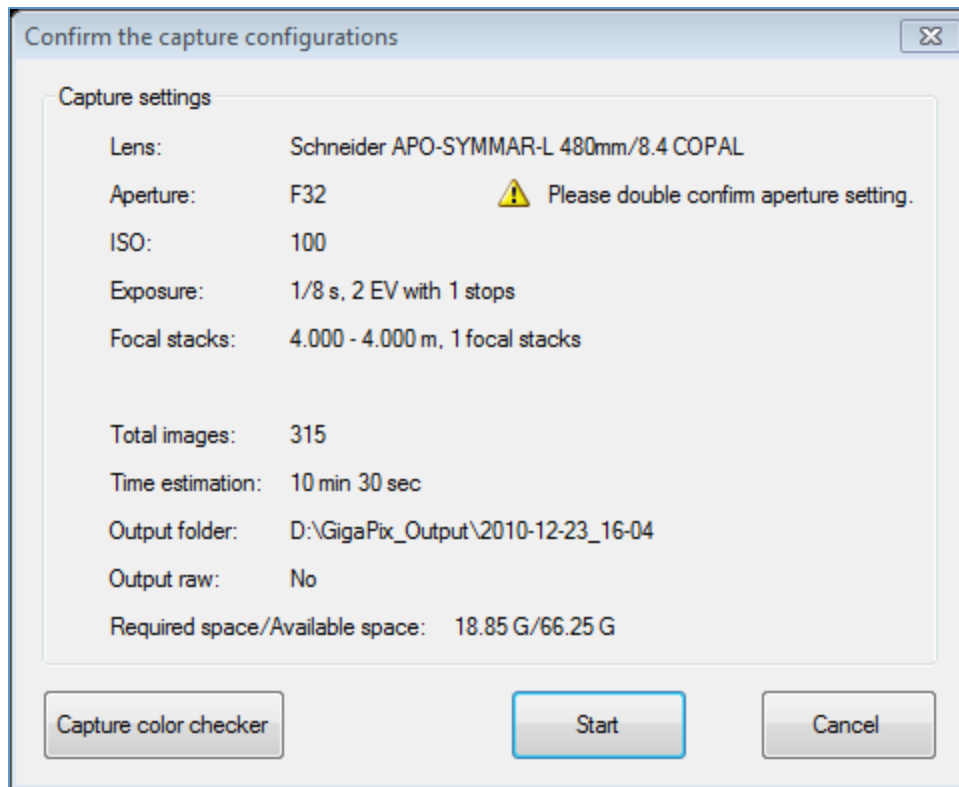
Points	Main camera image	Viewfinder image
<input type="checkbox"/> #1	Grid: 8, 3 Location: 488, 241	84, 135
<input checked="" type="checkbox"/> #2	To be set	987, 674

* Click aligned points in the table to select/change points axis.

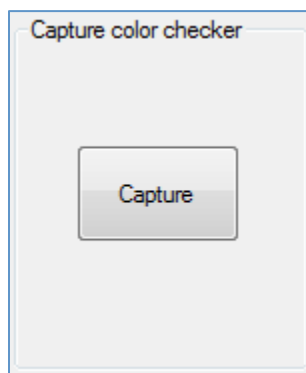
3.11 Capture Color Board

Sometimes, user may have strict requirement on colors. GigaPix provide the functionality to capture color board. You can capture the color board before capture with the same settings. These data could be used in post-processing to help color recovery.

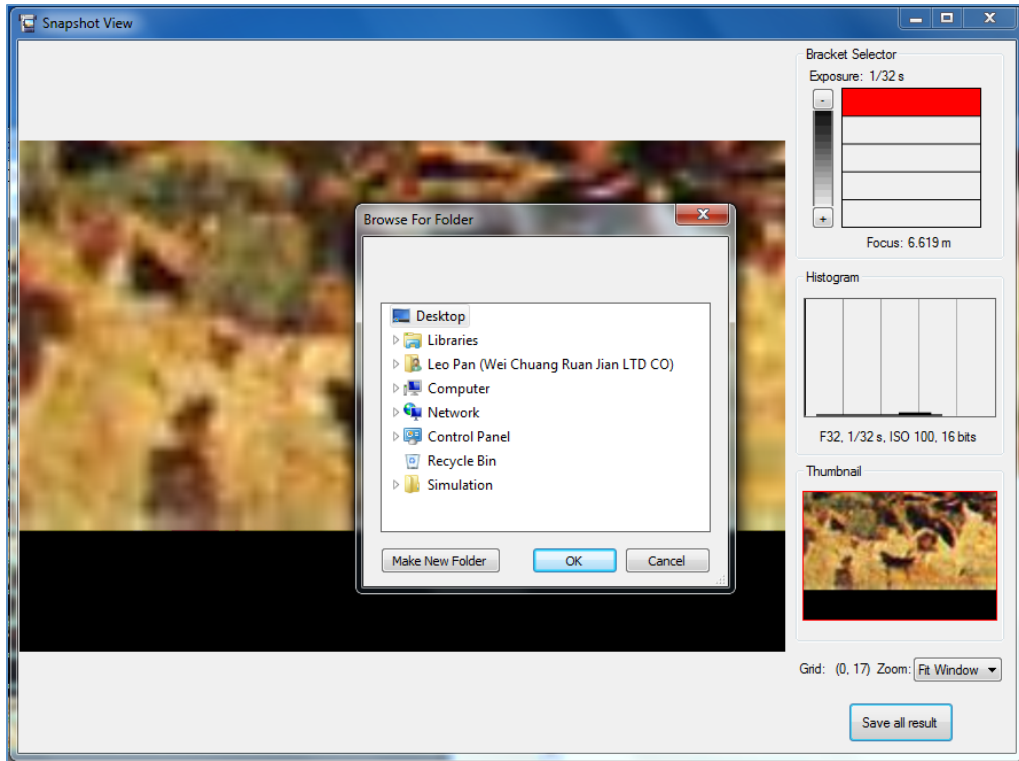
- Step1: Set the capture parameters in control panel.
- Step2: Click "Start capture" and confirm the capture settings in pop-up dialog.



- Step3: If the capture setting is correct, click “capture color board” to open the live view window with “Capture color board” mode.
- Step4: Put the color board near the capture object.
- Step5: Click “capture” button in live view window to capture color board.



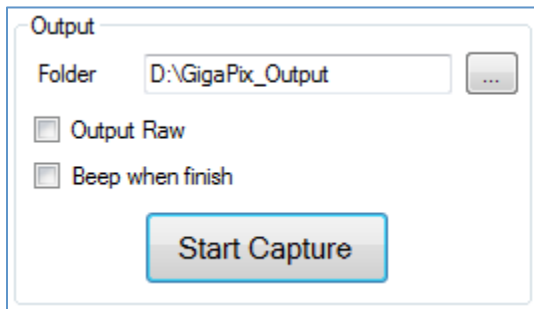
- Step6: Preview the capture result in pop-up snapshot window.
 - If the result is correct, click “Save all result” to save the color board data.
 - If the result is incorrect, click recapture to return live view window.



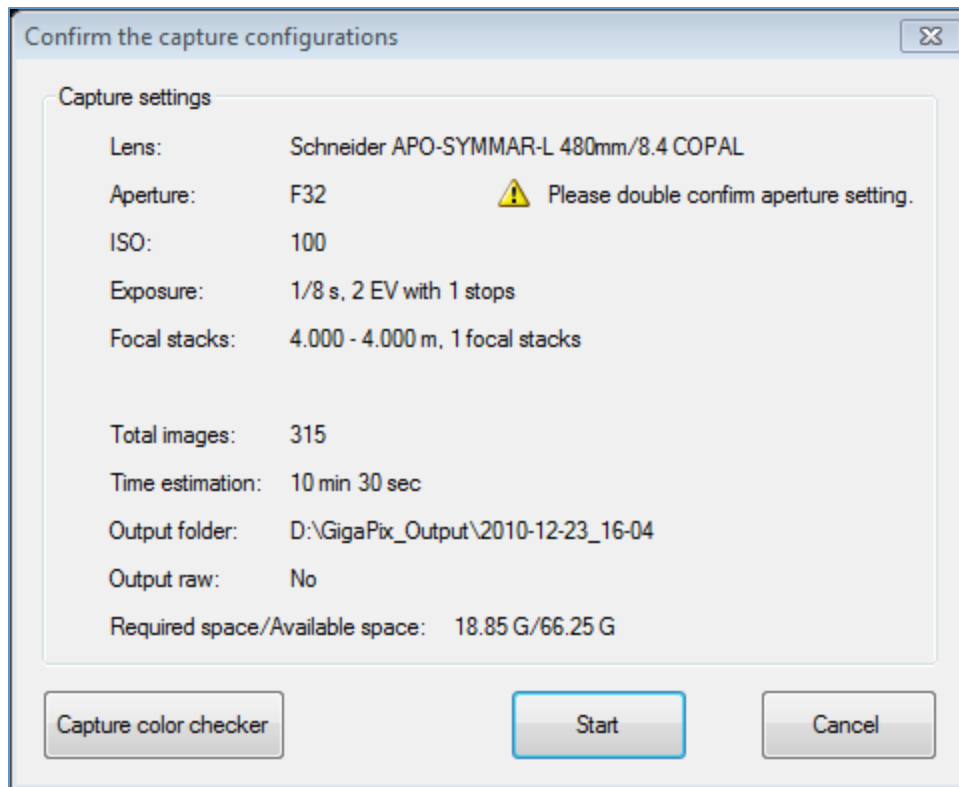
3.12 Start Capture

When you complete the focus, exposure and the other capture settings, you can start the capture.

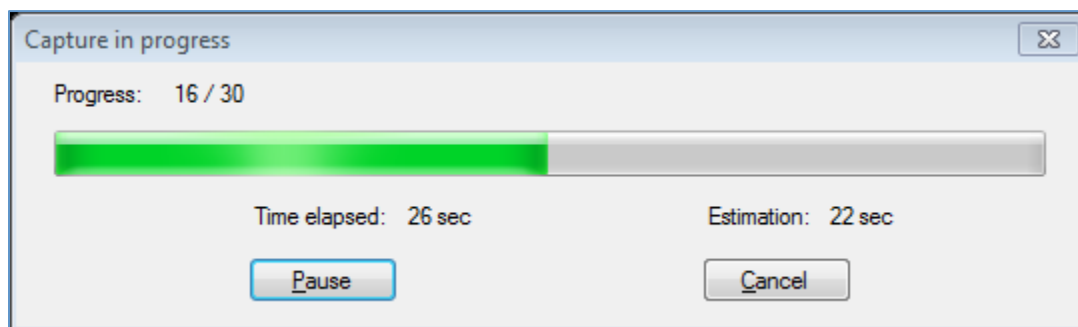
- Step1: Set the output parameters in control panel.



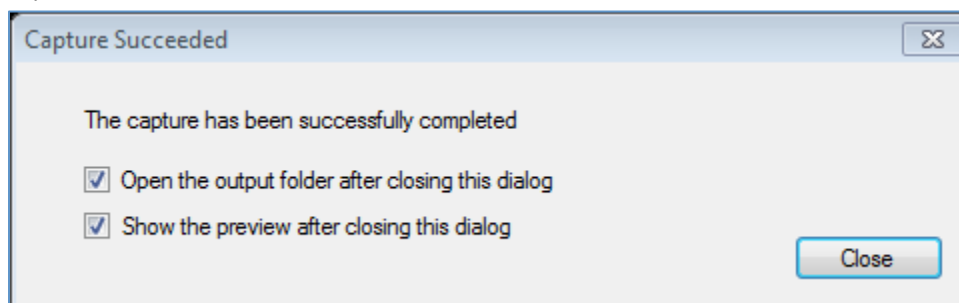
- Step2: Click "Start capture" and confirm the capture settings in pop-up dialog.



- Step3: If the capture setting is correct, click “capture color board” to capture color board. You could skip this step if you don’t have such kind of requirements.
- Step4: After color board capture complete, click “start” to start capture.
- Step5: If you need to pause the capture or cancel it, just click the buttons in progress bar.

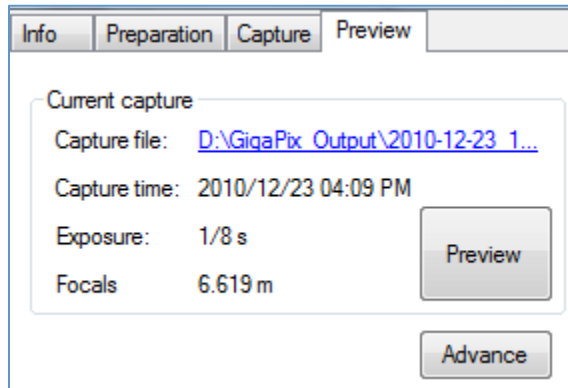


- Step6: After capture completes, you could choose to open the capture folder or preview the capture result.

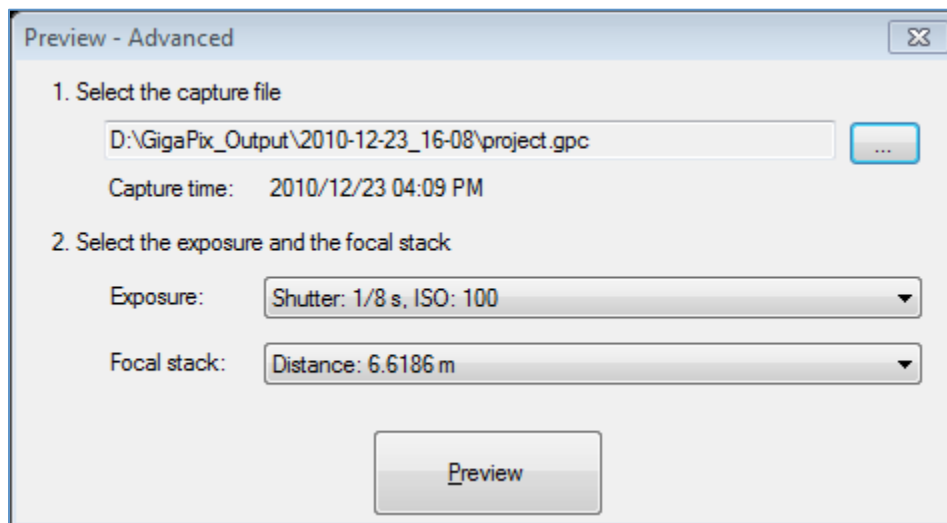


3.13 Preview

The preview feature allow user to preview current capture result or previous capture result. The stitching result of thumbnail will be generated in this step.



- Step1: Click the preview tab in control panel. The default preview file is current capture result of mid-exposure setting (if there is bracket exposure) and mid-focus setting (if there is focal stack).
- Step2: Click preview button to stitch the preview result.
- Step3: If you want to previous more preview capture result, click advance to choose a project file you want to preview.



3.14 Auto-naming

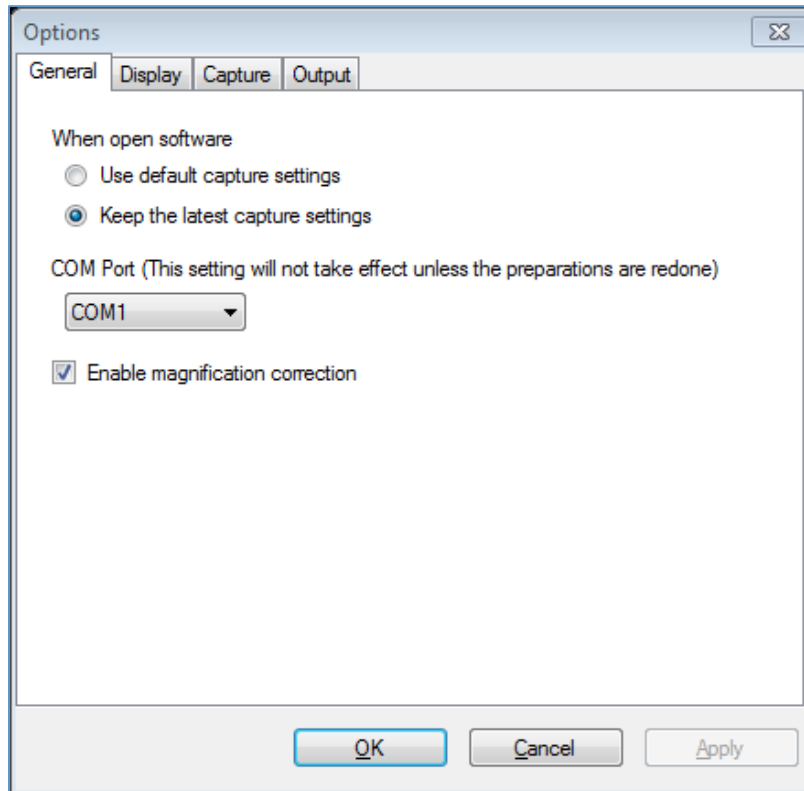
System will auto-name the output folder with current time, with the accuracy to minute. For example “2010-09-28_11-09” means the capture start time is 2010/9/28 11:09 am.

3.15 System Settings

You can do some personal configure in the option dialog. There is 4 tabs in the option dialog.

- **General:** The general settings of this software.
- **Display:** The colors of grids and some other diagrams.

- **Capture:** Capture related settings.
- **Output:** Output related settings.






4 Capture Planning

4.1 Capture Planning

To get draft capture job estimation, you should define a plan for your capture job. A classic capture plan should contains the following information:

1. Capture object
2. Basic capture parameters
 - 1) Lens and aperture
 - 2) Camera position
 - 3) Focal stack
 - 4) DPI requirements
3. Capture job estimation
 - 1) Capture number
 - 2) Image number
 - 3) Time estimation

The detailed steps are list below:

1. Define the capture object.
Confirm what you want to capture, measure the height, width and depth of the object.
2. Define the aperture and lens.
If no special requirement, please use the default lens.
3. Define the minimal DPI requirements.
If no special requirement, please use the default 300 DPI.
4. Confirm the camera location with GigaPix Calculator
Open GigaPix calculator with capture plan mode, input the parameters in previous step.
Calculator will automatically calculate the available range of camera position. (Please refer to section 3.9.1 for more details.)
 All the distance in our system is the distance from object to sensor.
5. Capture job estimation.
The position of camera will impact the capture number and capture time estimation. Please adjust the camera position until you get appropriate job estimation.
 Due to deviation in measurement, the data you get in capture plan is only a reference of real capture. Please double confirm these data in capture stage.
 You can change the aperture or lens to reduce the image numbers. But these changes will also impact the lens position and capture job estimation.

5 Classic Capture Process

5.1 Capture Flat Wall


1. Locate the camera
 - 1) Put camera on the position which calculated in capture planning.
 - 2) Make sure the camera is parallel to the object
2. Software Preparation
Complete the preparation step of software.
3. Focus and set base plane.
 - 1) Click “set base plane” button in control panel.
 - 2) Open the live view and focus.
 - 3) Set the position as base plane.
4. Set capture area
5. Set exposure
 - 1) Open Live View
 - 2) Verify different exposure values until you got an appropriate one
6. Capture color board
7. Start capture
 - 1) Choose the output folder
 - 2) Make sure the aperture matches to the hardware
 - 3) Click “start capture” button to start capture
8. Capture result

- 1) Preview capture result after capture immediately
- 2) If the result is correct, use post-processing application to stitch result.

5.2 Capture Sloap/Unflat Wall/Niche

Slope/Rough Wall/Niche: Unlike flat wall, sloap/rough wall/niche needs the help of focal stack to cover their depth.

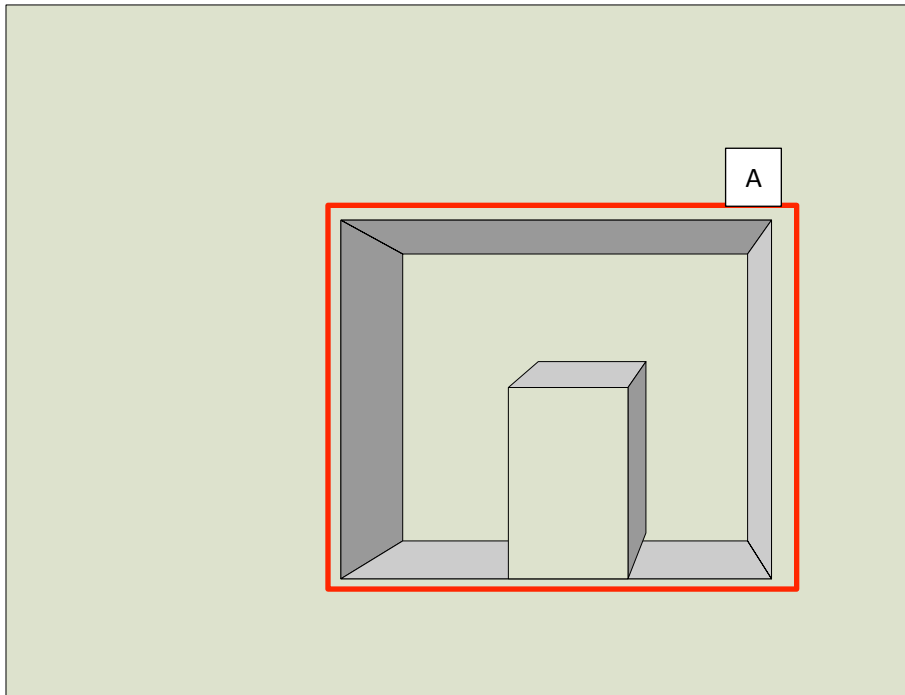
1. Locate the camera
 - 1) Put camera on the position which calculated in capture planning.
 - 2) Make sure the camera is parallel to the object
2. Software Preparation
Complete the preparation step of software.
3. Focus and set base plane.
 - 1) Click “set base plane” button in control panel.
 - 2) Open the live view and focus on the near distance of object
 - 3) Set the position as base plane
4. Set capture area
5. Set exposure
 - 1) Open Live View
 - 2) Verify different exposure values until you got an appropriate one
6. Set focal stack
 - 1) Click “Set focal stack” button in control panel
 - 2) Add the near distance and far distance as focal samples.
 - i. Method 1: Use some measure equipment to measure the far distance and near distance.
 - ii. Method 2: Use Live view to add different focal samples and let system choose the far distance and near distance automatically
 - 3) Click “OK” button to complete focal stack settings.

 **The distance in our system is the distance from object to sensor.**
7. Capture color board
8. Start capture
 - 1) Choose the output folder
 - 2) Make sure the aperture matches to the hardware
 - 3) Click “start capture” button to start capture
9. Capture result
 - 1) Preview capture result after capture immediately
 - 2) If the result is correct, use post-processing application to stitch result.

5.3 Capture Complex Sense

In the real scenarios, most sense is the combination of flat wall, niche and rough wall. To capture this kind of sense, set a global focal stack will bring large number of captures. An advice is setting local focal

stacks for different areas to reduce the overall capture number and capture time.



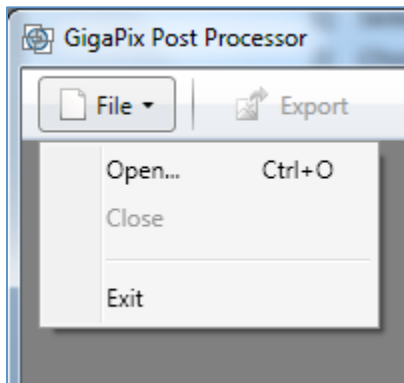
For example, the sense above is combined by a rough wall and a small niche. We assume the area of niche as “A”; here is the detailed capture process:

1. Locate the camera
 - 1) Put camera on the position which calculated in capture planning.
 - 2) Make sure the camera is parallel to the object
2. Software Preparation
Complete the preparation step of software.
3. Focus and set base plane.
 - 1) Click “set base plane” button in control panel.
 - 2) Open the live view and focus on the near distance of object
 - 3) Set the position as base plane
4. Set capture area
5. Set exposure
 - 1) Open Live View
 - 2) Verify different exposure values until you got an appropriate one
6. Set global focal stack
 - 1) Click “Set focal stack” button in control panel
 - 2) Add the near distance and far distance as focal samples.
 - i. Method 1: Use some measure equipment to measure the far distance and near distance.
 - ii. Method 2: Use Live view to add different focal samples and let system choose the far distance and near distance automatically

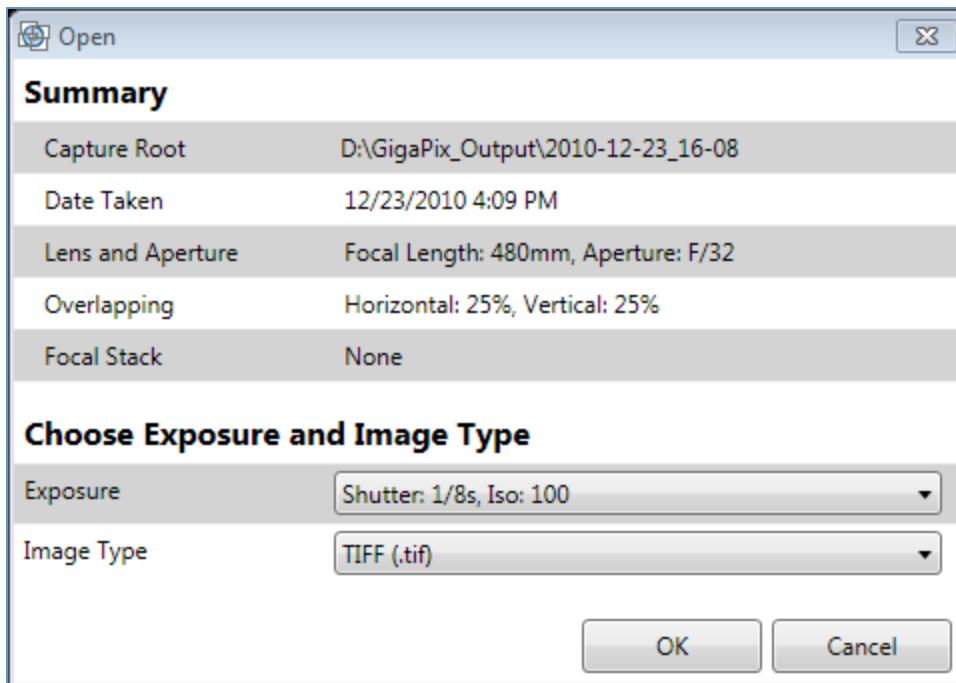
- 3) Click "OK" button to complete focal stack settings.
- ⚠ **The distance in our system is the distance from object to sensor.**
7. Set local focal stack
 - 1) Select area "A" in main window and right click to call the context menu
 - 2) Choose "Set as local focal stack" in the context menu
 - 3) Add the near distance and far distance for this local focal stack.
 - 4) Click "OK" to complete focal stack settings.
8. Capture color board
9. Start capture
 - 1) Choose the output folder
 - 2) Make sure the aperture matches to the hardware
 - 3) Click "start capture" button to start capture
10. Capture result
 - 1) Preview capture result after capture immediately
 - 2) If the result is correct, use post-processing application to stitch result.

6 Post Processing Application

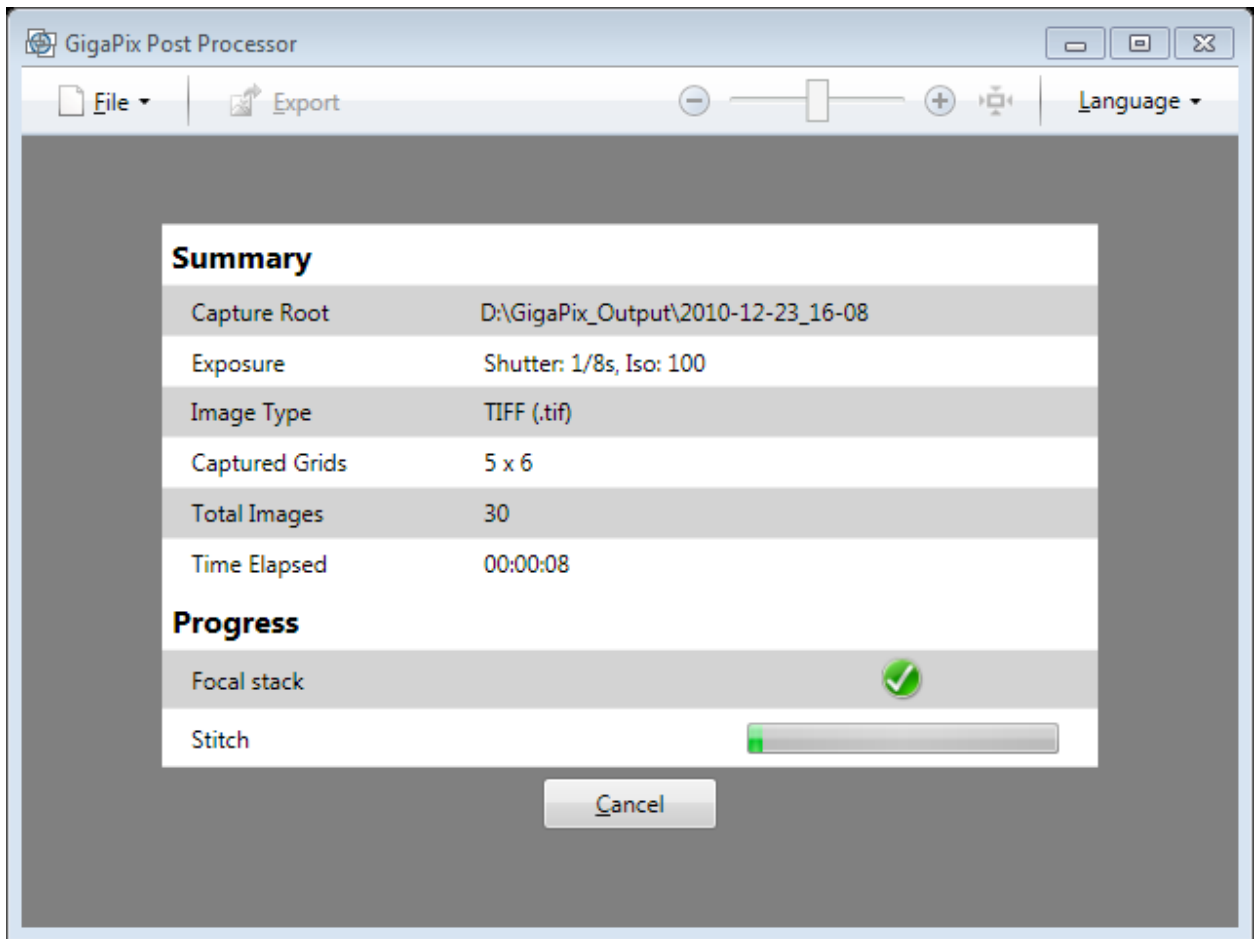
1. Open GigapixPostProcessor.exe
2. Click "File -> Open" to open a "*.gpc" file.



3. Select the exposure and image type you want to stitch.



4. Click "OK" to start stitching. There will be 2 steps in stitching:
 - 1) Focal stack stitch
 - 2) Images stitch



7 Q&A

Q: What should I do if there is mismatch between the content displayed in grid of main form and the content displayed in live view of the same grid?

A: The content display in grid of main form comes from the webcam when the content displayed in live view comes from the main camera. The reason of mismatch may be caused by:

- 1) The lens you've mounted is different as you've set in the application.
- 2) Base plan is incorrect
- 3) The related position between webcam and main camera is changed.

The solution could be :

- 1) If you didn't change the related position between webcam and main camera:
 - a. Check whether the lens setting in control panel is the same as the lens mounted in hardware.
 - b. If the lens is the same, redo setting base plane.
- 2) If you have changed the related position between webcam and main camera:
 - a. Set a capture area with some details to alignment (at least 3x3 grids)
 - b. Redo the homography follow the system's instructions.

Q: How to do focus efficiently?

- 1) Get draft distance by some measurement tool
- 2) Input the draft distance to live view window to draft-tune with the fastest speed
- 3) Fine-tune with low speed