Image Stitching 2.0

User Guide

Image Stitching 2.0

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Preface

Image Stitching 2.0 is an additional software module for *QuickPHOTO* programs intended for stitching together multiple fields of view from a microscope into a single image with an extended field of view.

The module consists of two parts:

- The separate Image Stitching 2.0 module for the stitching of acquired images
- The *Image Stitching* tab for live image stitching in control panels of PROMICAM USB 3.0 and PROMICAM LITE cameras

Installation

Note

For a successful Image Stitching 2.0 module installation, it is necessary to have the *QuickPHOTO CAMERA*, *QuickPHOTO MICRO* or *QuickPHOTO INDUSTRIAL* program in the 3.0 or higher version (the newest version is recommended) installed.

Note

In case you do not have the permission to use the Image Stitching 2.0 module contained in your dongle or you are installing the module into a trial version of the QuickPHOTO program (no dongle is used), the Image Stitching 2.0 module will run in a demo version mode. The demo version provides all the functions of a full version, but a watermark will be inserted into the created images. Each time you run the demo version you will be informed about that fact. If you want to purchase the full version, contact your software supplier.

To install the Image Stitching 2.0 module from the supplied installation disk:

- Make sure the *QuickPHOTO* program is not running.
- Insert the installation disk into the DVD drive. The autorun screen appears.
- If the autorun screen does not appear, run the *autorun.exe* file from the installation disk.
- Select *Install Image Stitching 2.0*.

To install the Image Stitching 2.0 module from the downloaded installation package:

- Make sure the *QuickPHOTO* program is not running.
- Run the installation package.
- Select the destination folder, where the installation files should be extracted.

- Wait until the installation files are extracted.

The installation wizard appears. Perform the following steps:

1. Select the desired language.
2. Click the *OK* button. The installation wizard searches for the installed *QuickPHOTO CAMERA*, *QuickPHOTO MICRO* and *QuickPHOTO INDUSTRIAL* programs.
3. If there are multiple versions of the QuickPHOTO program installed, select the version for Image Stitching 2.0 module installation.
4. Click the *Next* button. Continue following the on-screen instructions.

Module for the Stitching of Acquired Images

The separate Image Stitching 2.0 module allows you to stitch together images acquired using arbitrary imaging device. The module stitches images stored on the hard drive or images opened in the QuickPHOTO program. The module also allows you to stitch together images acquired using *the Deep Focus* EDF module, *HDR* module, or a combination of *Deep Focus* + *HDR* modules.

1. Acquisition of Images for Stitching

The first step of creating images with an extended field of view is the acquisition of a series of images with partially overlapping fields of view.

> **Important**
>
> Use the manual XY stage to acquire images for stitching.
>
> Do not use the Image Stitching 2.0 module to stitch images of moving samples, samples without any clear structure (e.g., a uniform surface or background), or samples with repeating regular patterns (stripes, squares, grids, dots, etc.).

The following procedure can be used for all imaging devices supported by *QuickPHOTO* programs, including the imaging devices controlled by the TWAIN interface.

Recommended Procedure for the Acquisition of a Series of Images for Stitching

1. In the *QuickPHOTO* program, run the control panel of your imaging device.
2. Place a sample under the microscope and fix it on the stage. Make sure that the sample will not change its position during the stage movement.
3. Move the stage to make sure that its range covers the whole sample area, which should be scanned. If the stage range does not cover the whole area, change the position of the sample on the stage and try it again.

4. Set the microscope illumination.
5. Move the stage and see the live view to find the edge (or preferably the corner) of the sample area, which should be scanned.
6. In the control panel of the imaging device, select the manual exposure mode and set the desired exposure time. If you prefer to use the automatic exposure mode, activate the exposure lock *(AEL)* function to avoid changes in exposure time during image series acquisition. Changes in exposure time cause a different brightness of images.
7. Focus the microscope using the live view of the imaging device.
8. Acquire the first image.
9. Move the stage so that the overlap between the live view and the acquired image is at least 20%-25%.
10. Acquire the next image.
11. Repeat steps 9 and 10 until the entire sample area is scanned. Acquire all images at the same resolution (e.g., 1928 x 1448 pixels). Always make sure that the microscope is in focus. If necessary, focus the microscope before the acquisition of each image.

Note

Each of the particular images intended for stitching can be composed by the *Deep Focus* EDF module, *HDR* module, or a combination of *Deep Focus* + *HDR* modules.

Recommendations and Tips for Image Acquisition

- Make sure that the stage and the imaging device are properly aligned to prevent "stairs" in the stitched image.
- Use the *Shading Correction* feature (if your imaging device offers it) to achieve the best illumination homogeneity of the stitched images. Refer to the user guide of the *QuickPHOTO* program for more information about this feature.

- Use a two-monitor workstation for the most comfortable work. Display the main program window on the first monitor. Display the control panel of your imaging device with the live view on the second monitor. You can see the acquired image right after its acquisition in the main program window. This provides you better control of the image overlaps.

- If the control panel of your imaging device is equipped with a central cross feature, display the central cross in the live view. It can give you better control of the image overlaps.

- The images can be acquired in arbitrary order. It is not necessary to keep a regular pattern, e.g., a so called "zig-zag", however, it is recommended. Make sure that the overlaps between neighboring images are at least 20%-25%.

- Do not change the microscope setup, the illumination or the exposure time of the imaging device during the image series acquisition.

- Do not rotate the sample, the stage or the imaging device during the image series acquisition. Do not move the sample on the stage by hand.

- If it is not possible to stitch some images together, try to acquire them again with larger overlaps.

2. Selection of Images for Stitching

The Image Stitching 2.0 module allows you to stitch together images opened in *the QuickPHOTO* program or stored on the hard drive, on the flash memory, etc.

The following paragraphs describe how to select the images for stitching:

1. Selection of Images Marked in the Thumbnail Browser

This option allows you to stitch images opened in *the QuickPHOTO* program.

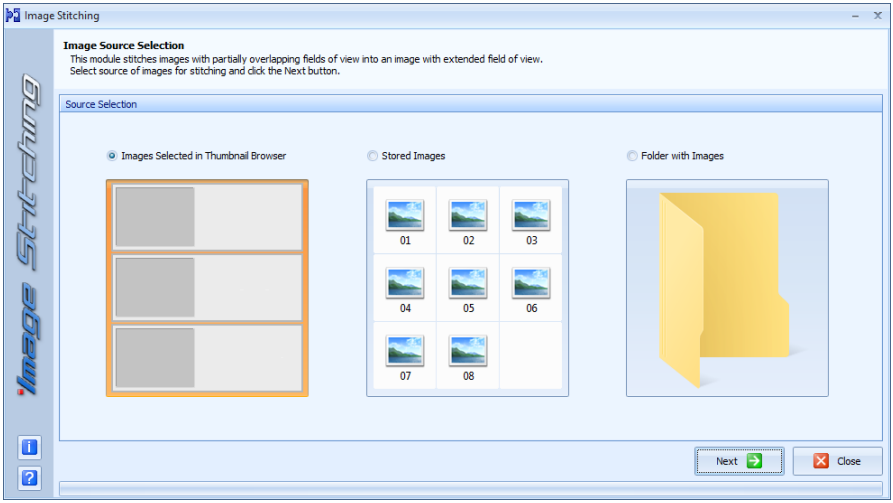
The procedure of use is the following:

1. Select the images intended for stitching, which are opened in the *QuickPHOTO* program, by selecting their thumbnails in the *Thumbnail Browser*. The selected images are marked by frames. The selection can be performed similarly to the selection of

files in Windows® Explorer (press [Ctrl+A] to select all images, hold [Shift] and click to make a continuous selection, hold [Ctrl] and click to make a discontinuous selection).

2. Launch the Image Stitching 2.0 module from the *Modules* → *Image Stitching 2.0* menu or by clicking the icon on the tool bar.

3. In the opened *Image Source Selection* dialog box, select the *Images Selected in Thumbnail Browser* option and click the *Next* button.



4. A dialog window with an automatically generated preview will appear. To continue see “Preview Generation and Stitching Settings“ on page 14.

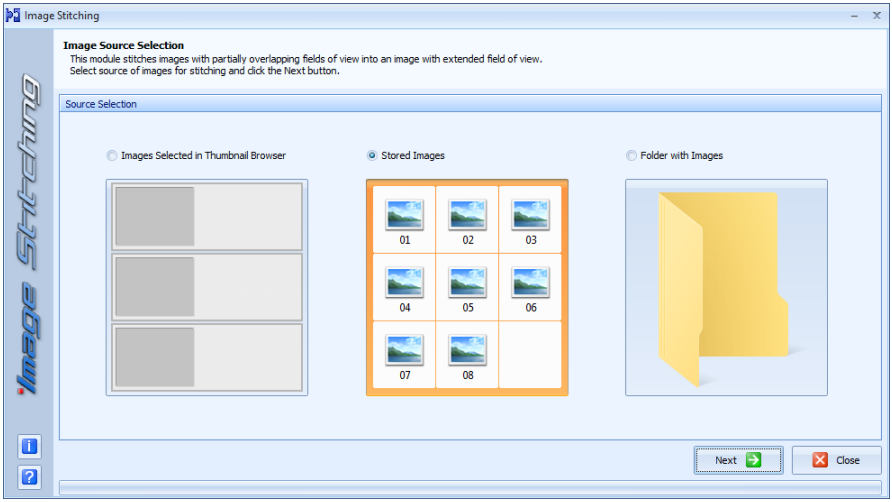
2. Selection of Stored Images

This option is intended for the stitching of images stored on the hard drive, on the flash memory, etc.

The procedure of use is the following:

1. Launch the Image Stitching 2.0 module from the *Modules* → *Image Stitching 2.0* menu or by clicking the icon in the tool bar.

2. In the opened *Image Source Selection* dialog box, select the *Stored Images* option and click the *Next* button.



3. Use the *Open* dialog box to select the images to be stitched. Make sure that the selection does not contain any unwanted images. Click the *Open* button to confirm the selection.

4. A dialog window with an automatically generated preview will appear. To continue see “Preview Generation and Stitching Settings“ on page 14.

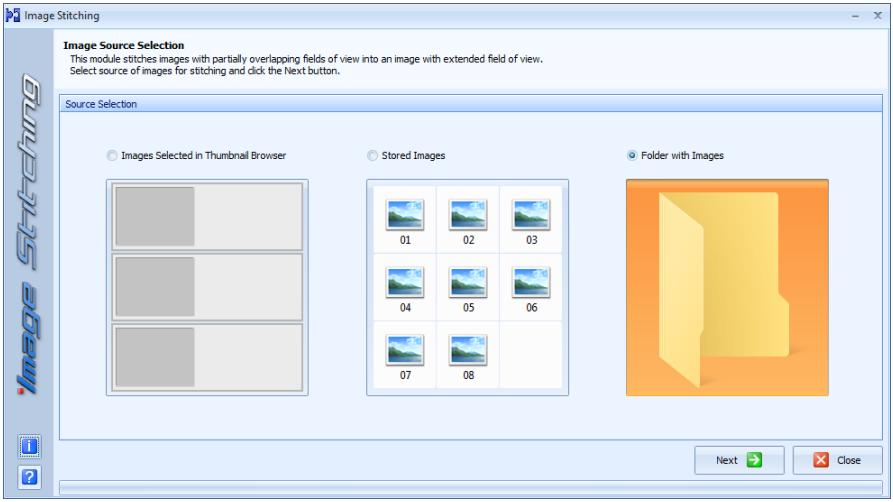
3. Selection of a Whole Folder of Images

This option allows you to select a whole folder of images stored on the hard drive, on the flash memory, etc. Each folder can contain only one set of images for stitching.

The procedure of use is the following:

1. Launch the Image Stitching 2.0 module from the *Modules* → *Image Stitching 2.0* menu or by clicking the icon in the tool bar.

2. In the opened *Image Source Selection* dialog box, select the *Folder with Images* option and click the *Next* button.

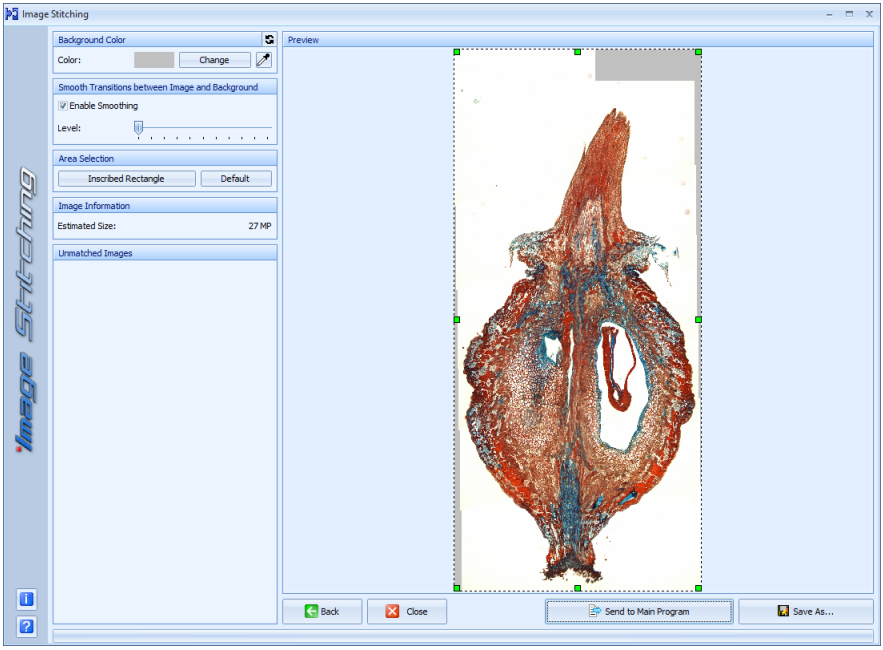


3. In the opened dialog window, select a folder with images intended for stitching. Confirm using the *Select Folder* button.

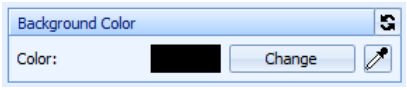
4. A dialog window with an automatically generated preview will appear. To continue see “Preview Generation and Stitching Settings“ on page 14.

3. Preview Generation and Stitching Settings

The dialog window with an automatically generated preview appears after the selection of images. The *Preview* is displayed on the right hand side of the dialog window. The preview uses downscaled input images to increase the processing speed. The full-size stitched image will be created in the next step, which is described in the next chapter.



When preview generation is complete, the following controls are activated. Changes of the controls appear interactively in the *Preview*. The changes will also be applied to the resulting stitched image.



Background Color: the controls in this section let you set the background color. The background is those places of the stitched image, where no input image is contained. The color box serves as an indicator of the currently selected color. Press the *Change* button to open the color selection dialog box. The button activates the *Pick Color from Preview* option, which allows you to interactively select the background color with a color picker tool directly from the stitched image *Preview*. For interactive color selection, follow these steps:

1. Click the icon.

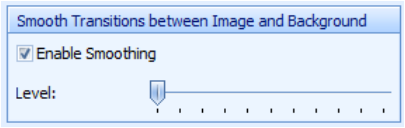
2. Hover over the desired color in the stitched image *Preview*. The cursor changes to a color picker. The background area in the *Preview* changes color to the selected one.

3. Move the cursor in the *Preview* to interactively select the most appropriate color.

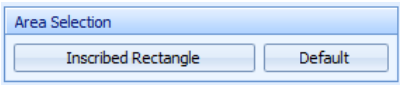
4. Click the left mouse button to select the chosen color. The color box is set to the selected color, the interactive selection tool is disabled, and the cursor changes to a standard one.

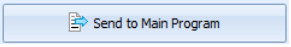
> **Note**
>
> It is not possible to select a color from the background of the stitched image with the color picker - a prohibition cursor is displayed .

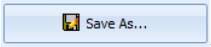
The icon restores the default background color.



Smooth Transition between Image and Background: the controls in this section allow you to smooth (soften) the transitions between the image and the background. The background color can be adjusted with the controls in the *Background Color* section described above. Use the *Level* slider to adjust the width of the transition. The higher width of the transition causes the transition to be smoother. Adjust the level so that the transition does not interfere with the image details.



Area Selection: the *Preview* of the stitched image shows the selected area. The selected area covers the entire preview by default. The selected area determines the area of the stitched image, that will be sent to the main program (or saved to the hard drive) at full size when you click 

or 

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- Drag the green squares or dashed lines to customize the selected area.
- Click the *Inscribed Rectangle* button to let the selected area contain the largest part of the stitched image without additional background.
- Click the *Default* button to reset the selected area to cover the entire preview.

> **Note**
>
> The area of the resulting full-size image can be slightly different as compared to the *Preview*. We recommend adding a margin when selecting the area in the *Preview*. This prevents the unwanted cropping of the resulting image.

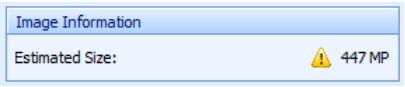


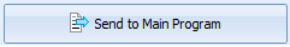
Image Information: this section displays the estimated size of the selected area in the full-size image. The estimated size is displayed in megapixels (MP). The value is recalculated when the selected area is changed. If the estimated size is larger than the "size safe for sending to the main program*", a yellow warning triangle icon appears in front of the numeric value.

Unmatched Images: if some images cannot be matched when generating the stitched image preview, their thumbnails are displayed in this section. The thumbnails of these images indicate which images are likely to be acquired incorrectly (for example due to insufficient overlaps). If some of the important images are in the list of unmatched images, try to scan the sample again better (e.g., with larger overlaps).

To select other images for stitching, click the *Back* button to return to the *Image Source Selection* window. You can also click this button while the preview is being generated - the preview generation will be terminated.

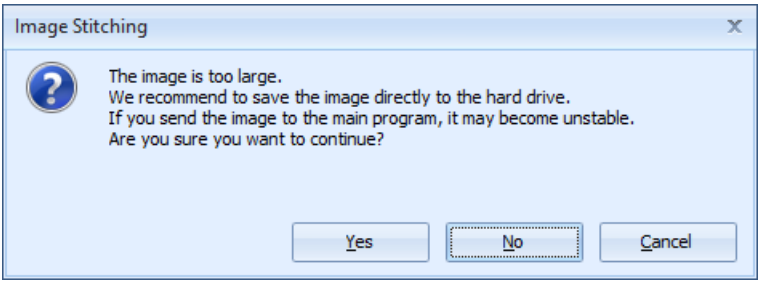
4. Creating a Full-size Stitched Image

Once you set the required parameters by the controls described above, send the full-size image to the main window of *the QuickPHOTO* program or save it to the hard drive.

Click the 

button to send the stitched image to the main program.

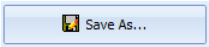
If the estimated size of the resulting full-size image is larger than the "size safe for sending to the main program*" (this is indicated by a yellow warning triangle icon in the *Image Information* section), the following warning appears:



We recommend clicking the *No* or *Cancel* button and saving the image directly to the hard drive instead of sending it to the main program. However, if you decide to continue anyway, sending to the main program may be successful, but the entire program may also crash - depending on the size of the image.

Note

"*Size safe for sending to the main program" is an experimentally determined maximum size of the stitched image, which can be safely sent to *the QuickPHOTO* program on all computers due to memory limitations. This size is different for 32bit and 64bit Microsoft® Windows® operating systems. The "safe" size is set to 30 MP for 32bit operating systems. For 64bit operating systems, it is set to 80 MP. The actual maximum size of the stitched image that can be sent to *the QuickPHOTO* program depends on your hardware configuration. For most computers, the maximum size is higher than the "safe" value set. The actual maximum size can only be determined experimentally on each computer.

Click the 

button to save the stitched image to the hard drive. A dialog box appears. Select the location and enter the name of the image. The image will be saved in an uncompressed TIFF file format.

Then, the full-size stitched image is created and sent to the main program (or saved to the hard drive). This operation may take some time. You can cancel the operation by clicking the *Cancel* button.

> **Note**
>
> The speed at which full-size images are created depends on the number of images being stitched, on their resolution, and on the performance of your computer. Creating very-high-resolution images (hundreds of MP and more) can take several minutes. With less powerful computers, the *QuickPHOTO* program can respond with a delay in such case. To save time, we recommend saving very-high-resolution images to an SSD (Solid-State Drive) hard drive.

5. Opening of Saved Stitched Images

The QuickPHOTO program allows you to work in a standard way only with images that are smaller than a certain size. The maximum size of images that can be opened in *the QuickPHOTO* program depends on your hardware configuration and on the operating system version.

> **Note**
>
> The maximum size of images that can be opened in the *QuickPHOTO* program is typically larger than the maximum size of images that can be sent to the *QuickPHOTO* program from the Image Stitching 2.0 module.

If the size of the TIFF file is between hundreds of MB and units of GB, open it using a standard image viewer.

If you stitch a large number of high-resolution images, the size of the resulting TIFF file can be up to several GB. Even image viewing programs cannot open such large images. To open such large files, use one of the so-called "Whole Slide Viewer" programs. Some of these programs can be downloaded for free, such as *OLYMPUS® OlyVIA*.

6. Measurements in Stitched Images

If you send the stitched image to the QuickPHOTO program (or you open the stitched image from the hard drive), you can measure in the image with high precision.

To activate the measuring tools, assign a calibration to the stitched image, i.e., in the tool bar, select the *Lens* and the *Zoom* which were used for acquisition of input the images. See the user guide of *the QuickPHOTO* program for more information about measurement options.

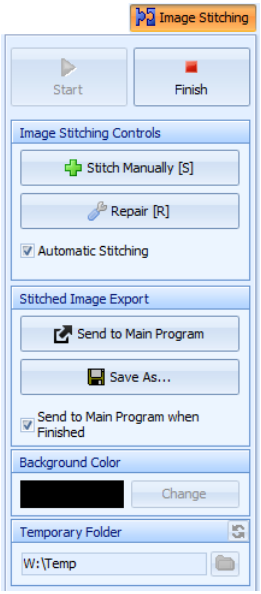
If any of the input images contains information about the calibration, the Image Stitching 2.0 module automatically assigns the calibration to the stitched image.

Live Image Stitching with PROMICAM USB 3.0 and PROMICAM LITE Cameras

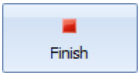
Using the PROMICAM USB 3.0 and PROMICAM LITE cameras, the image stitching can be done interactively using a live view directly in the camera's control panel, without first having to acquire images and then stitching them together as was described in the previous chapters.

1. Description of Image Stitching Tab Control Elements

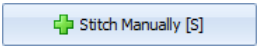
After the Image Stitching 2.0 module installation, a new tab named *Image Stitching* will appear in the control panels of PROMICAM USB 3.0 and PROMICAM LITE cameras. This tab contains elements to control the live image stitching functionality.



Start: this button enables the live image stitching feature. The live view window will divide into two parts. In the left part, a live view from the camera displays. In the right one, a preview of a stitched image with a diminished live view preview displays.

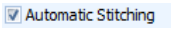


Finish: this button terminates the live image stitching feature.

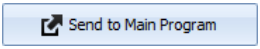


Stitch Manually [S]: this button commences manual image stitching. The [S] key can also be used.

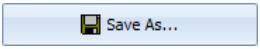
Repair [R]: this button commences the repair of an error state. The [R] key can also be used.



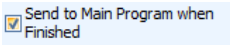
Automatic Stitching: when this checkbox is activated, the image stitching process will commence automatically during the movement of a microscope stage. When this checkbox is not activated, image stitching needs to be commenced manually each time by pressing the *Stitch Manually [S]* button or [S] key.



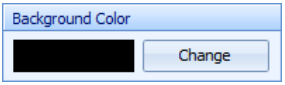
Send to Main Program: this button sends the stitched image to the main program. The maximum image size that can be sent to the main program is limited due to memory usage. If the stitched image size is larger than the "size safe for sending to the main program", a warning is displayed. In this case, instead of sending the image to the main program, it is recommended to save the image directly to the hard drive. However, if you decide to send the image to the main program anyway, the sending may be successful, but the entire program may also crash - depending on the size of the image.



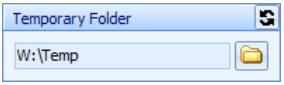
Save As...: this button opens the *Save As* system window for saving the stitched image to a hard drive as an uncompressed TIFF file type.



Sent to Main Program when Finished: when this checkbox is activated, the stitched image will be sent automatically to the main program after pressing the *Finish* button, if its size allows that. The maximum image size that can be sent to the main program is limited due to memory usage. If the stitched image size is larger than the "size safe for sending to the main program", a warning is displayed. In this case, instead of sending the image to the main program, it is recommended to save the image directly to the hard drive. However, if you decide to send the image to the main program anyway, the sending may be successful, but the entire program may also crash - depending on the size of the image.



Background Color: this control element defines the color of the parts of the stitched image where the image from a microscope is not present.



Temporary Folder: this control element defines a folder where a temporary file used by the module for its operation is located. If possible, it is recommended to select the temporary folder on an SSD drive (Solid-State-Drive). The default temporary folder can be renewed by the button.

2. Recommended Live Image Stitching Procedure

Important

Use the manual XY stage for live image stitching.

Do not use live image stitching for moving samples, samples without any clear structures (e.g., uniform surface or background) or samples with repeating regular patterns (stripes, squares, grids, dots, etc.).

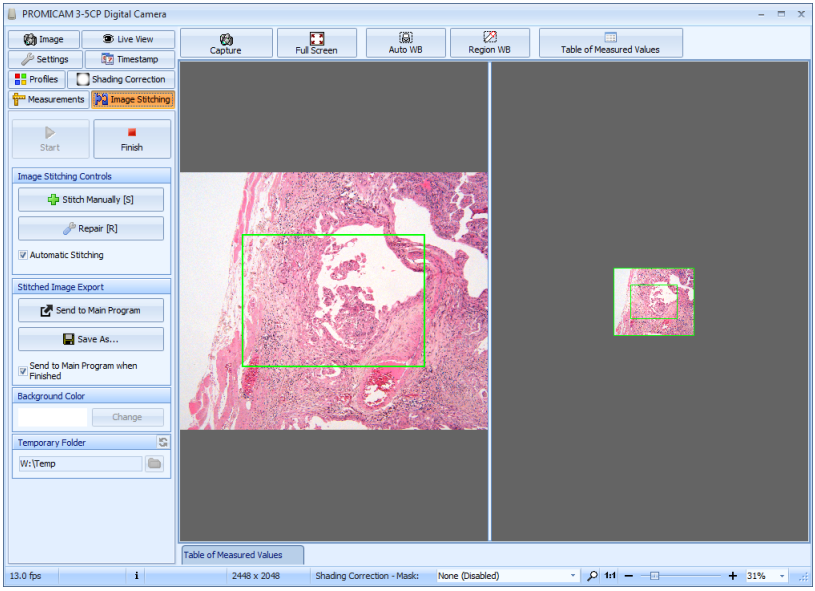
1. Place a sample under the microscope and fix it on the stage. Make sure that the sample does not change its position during the stage movement.
2. Move the stage to make sure that its range covers the whole sample area, which should be scanned. If the stage range does not cover the whole area, change the position of the sample on the stage and try it again.
3. Set the microscope illumination.
4. Run the control panel of the PROMICAM USB 3.0 or PROMICAM LITE camera.
5. Move the stage and see the live view to find the edge (or preferably the corner) of the sample area, which should be scanned.
6. On the *Image* tab, select the image resolution you want to use for image stitching and set the desired exposure.

Note

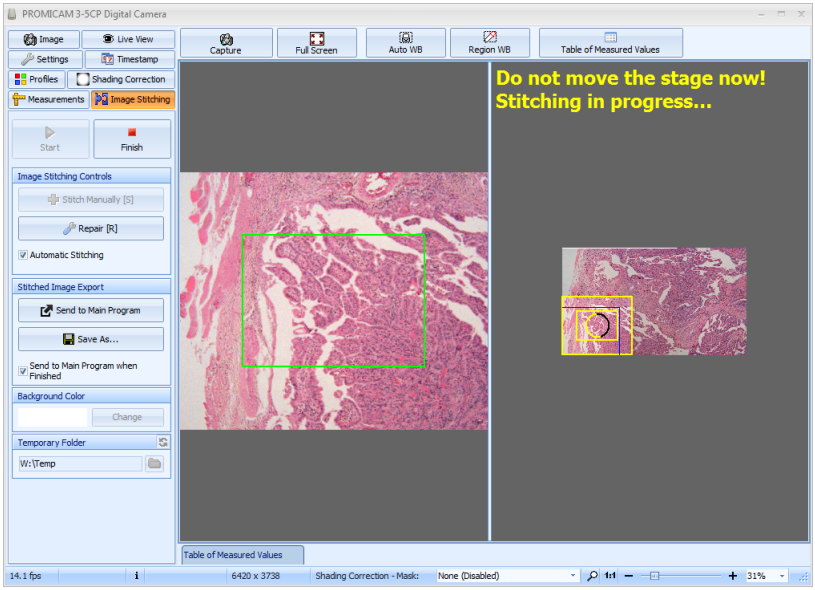
The camera will be set to the manual exposure mode automatically, when the live image stitching feature is activated to keep the exposure time set in this step until the process is finished. The camera will be set to the previously used exposure mode when finished.

7. Focus the microscope using the camera's live view.

8. Switch to the *Image Stitching* tab and press the *Start* button. Wait until the working area of the camera's control panel divides into two parts and the first image is automatically acquired. The left part of the window displays a live view from the camera with a green rectangle in it. The right window part contains a preview of the stitched image with a diminished live view in it. The ratio between the sizes of both parts can be changed by dragging the divider between them. The diminished live view in the right part contains two nested rectangles. The outer rectangle always represents the live view borders. The inner rectangle corresponds to the rectangle displayed in the live view in the left part of the window and it defines a so called "active area". If both rectangles are green you can move the stage.



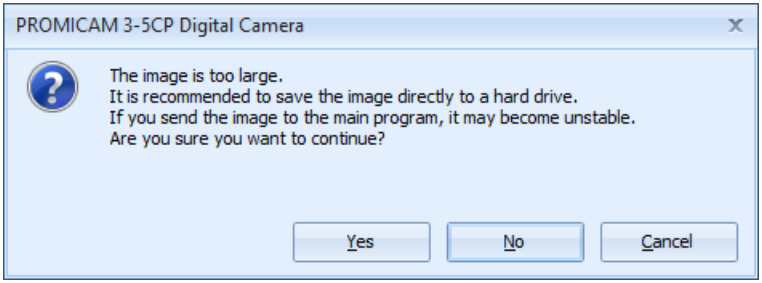
9. Move the stage slowly and fluently in the desired direction. Avoid fast abrupt stage movements. The active area defined by the inner rectangle must always contain some clearly identifiable structure. The diminished live view in the right window part will move at the stitched image preview. If the *Automatic Stitching* checkbox is activated, the image stitching will commence automatically, when the inner rectangle displayed in the live view moves outside the stitched image borders (displayed by blue line). Both rectangles will become yellow and the following label will appear in the top window part: *Do not move the stage now! Stitching in progress....* Stop moving the stage immediately and wait for the label to disappear and both rectangles to become green again.



Note

In case you want to stitch the current field of view to the stitched image at the stage position when image stitching does not commence automatically, or the *Automatic Stitching* checkbox is not activated, the image stitching can be commenced manually by pressing of the *Stitch Manually* button or [S] key.

10. Continue with the image stitching until the whole desired area of the sample is scanned. Then press the *Finish* button. If the *Sent to Main Program after Finish* checkbox is activated, the stitched image will be automatically sent to the main program window (if its size allows that). Current size of stitched image is displayed in the status bar of the control panel. If the stitched image size is larger than the "size safe for sending to the main program*", a warning will appear:



We recommend clicking the *No* or *Cancel* button and saving the image directly to the hard drive instead of sending it to the main program. However, if you decide to continue anyway, sending it to the main program may be successful, but the entire program may also crash - depending on the size of the image.

Note

"*Size safe for sending to the main program" is an experimentally determined maximum size of the stitched image, which can be safely sent to the *QuickPHOTO* program on all computers due to memory limitations. This size is different for 32bit and 64bit Microsoft® Windows® operating systems. The "safe" size is set to 33 MP for 32bit operating systems. For 64bit operating systems, it is set to 81 MP. The actual maximum size of the stitched image that can be sent to the *QuickPHOTO* program depends on your hardware configuration. For most computers, the maximum size is higher than the "safe" value set. The actual maximum size can only be determined experimentally on each computer.

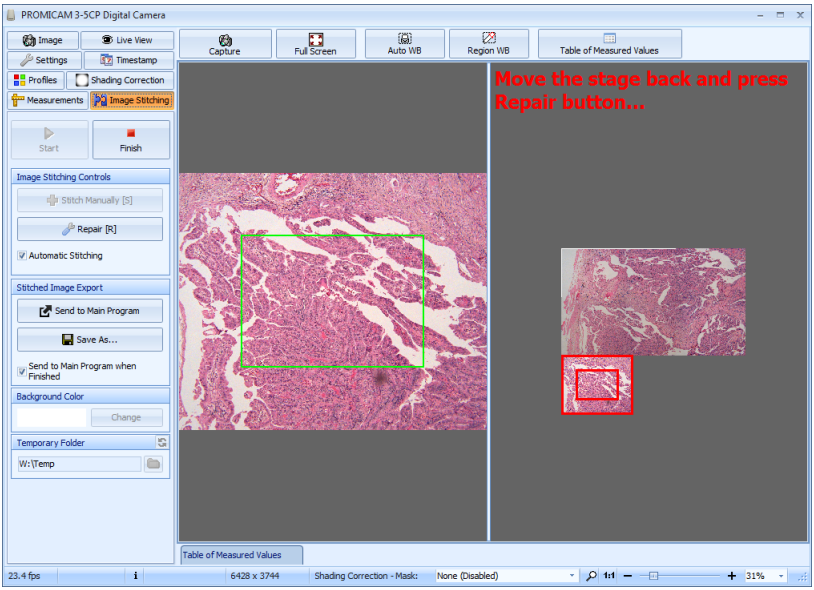
If the *Sent to Main Program after Finish* checkbox is not activated, you will be asked what should be done with the stitched image.

When stitching is complete, the camera control panel will return to the default state.

3. Repair of Error State

In certain situations the live image stitching feature can lose the information about the position of the live view in the stitched image or the image stitching process can fail. In such cases, the module will switch to an error state. A live view in the right windows part

will display next to the preview of the stitched image, both rectangles will become red and a message will appear: *Move the stage back and press Repair button....*



Move the stage back so there will be a spot, already contained in the stitched image, visible in the live view. Try to find such a spot, which can be clearly distinguished from its surroundings. Then stop moving the stage and press the *Repair* button or [R] key. The following label will display: *Do not move the stage now! Repair in progress....* The repair process may take some time. If the repair process succeeds, the diminished live view moves back to the correct place in the preview of the stitched image, both rectangles become green again and the label disappears. If the repair process fails, the following label displays: *Repair unsuccessful! Find another spot of the sample and try again.* In such case move the stage to find another spot of the sample and repeat the repair attempt.

4. Recommendations and Tips for Live Image Stitching

- Make sure that the stage and the camera are properly aligned to prevent "stairs" in the stitched image.

- Make sure that the "active area" of the live view (framed by a green rectangle in the live view in the left window part and by an inner rectangle in the right window part) always contains some clearly visible sharp structure. If this area contains e.g. a uniform background or some blurry part of a sample, the module can lose information about the position of a live view in the stitched image and go to an error state.

- Keep the microscope properly focused during the image stitching. Especially when stitching a larger amount of images, using a higher magnification or when a sample is not ideally flat, the microscope can go out of focus during the stage movement. Focus the microscope continuously when the image stitching or repair process is currently not in progress.

- Move the stage slowly and fluently. Avoid fast abrupt stage movements to minimize the probability of error state occurrences.

- Make sure that the illumination of a sample is intensive enough. The camera's exposure time should not be longer than 1/15 s for 3 and 5 MP cameras and 1/60 s for 10 and 12 MP ones. When using longer exposure times, the probability of error state occurrences increases. If needed, increase the camera's sensitivity by a *Gain* slider at the *Settings* tab. Increase the gain judiciously. If the gain value is too high, a noise can become visible in the image.

- Always set the image resolution, which covers the whole field of the camera's view, at the *Image* tab. Do not use ROI image resolutions.

- Use a *Shading Correction* feature to achieve the best illumination homogeneity of the stitched images. For more information about this feature, refer to the user guide of the *QuickPHOTO* program.

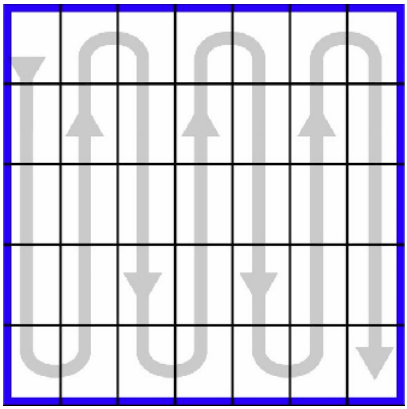
- Do not make any changes in the microscope setup or illumination and do not change the camera's exposure time during image stitching.

- Do not rotate the sample, camera or stage during image stitching. Do not move the sample on the stage by hand.

- It is recommended to use an SSD drive (Solid-State-Drive) and locate a temporary folder on it. The use of an SSD drive is advantageous especially for the stitching of a larger number of images e.g. of whole histology samples, printed circuit board etc.,

due to significantly higher read/write rates compared to standard hard drives. Select the folder with write permissions on a drive with sufficient free space. The size of a temporary file can reach up to several GB.

- Proceed using the zig-zag pattern (see image below) when stitching larger number images. If you would proceed randomly, inaccuracies in stitched images can appear.



- Always make sure that the live view has at least a 10-20% overlap with a stitched image preview.

5. HDR Live Image Stitching

The Image Stitching 2.0 module can also be used also in conjunction with the *HDR* module (optional). This combination enables live image stitching of HDR images.

Proceed as follows:

1. In the camera's control panel, enable and set the *HDR* feature and acquire an HDR test image, before you activate the live image stitching feature. For time efficiency, it is recommended to define the exposure time range for the *HDR* feature manually. For more information on setting the *HDR* function, refer to the *HDR* module's user guide.

2. Set the camera's exposure time with which the live view's exposure (brightness) corresponds best with the HDR test image, before you start image stitching.

3. During the HDR live image stitching, proceed according to the procedure described in the previous paragraphs. An HDR image, which will be used for live image stitching, will always be acquired.

6. Opening of Saved Stitched Images

Saved stitched images can be opened to a certain size in the *QuickPHOTO* program to work with them in a standard way. The maximum size of images that can be opened in the *QuickPHOTO* program depends on the specific hardware specification of the computer used and the operating system version.

> **Note**
>
> The maximum size of images that can be opened in the *QuickPHOTO* program is typically larger than the maximum size of images that can be sent to *the QuickPHOTO* program from the camera's control panel.

Larger images of the TIFF file size in the order of hundreds of MB to GB units that cannot be opened in *the QuickPHOTO* program, can usually be opened (if the computer has enough RAM) using standard image viewers.

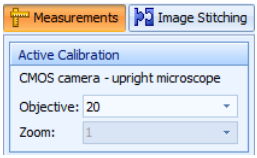
When stitching a large number of high-resolution images, the size of the resulting TIFF file can be up to several GB. Even image viewing programs cannot open such large images. To open such large files, use one of the so-called "Whole Slide Viewer" programs. Some of these programs can be downloaded for free, such as *OLYMPUS® OlyVIA*.

7. Measurements in Stitched Images

If you send the stitched image to the *QuickPHOTO* program (or you open the stitched image from the hard drive), you can measure in the image with high precision.

To activate the measuring tools, assign a calibration to the stitched image, i.e. select *Lens* and *Zoom* in the tool bar, with which the live image stitching was performed. See the user guide of *the QuickPHOTO* program for more information about measurement options.

The live image stitching module automatically assigns the calibration to the stitched image when creating it, if the appropriate magnification is selected in the control panel on the *Measurements* tab before the live image stitching feature is finished.



8. Information about the Live Image Stitching Functionality

- The live image stitching module uses a live view in lower resolution for navigation and a preview of a stitched image. For image stitching, it uses acquired images in resolution set at the *Image* tab to achieve the highest possible quality of the stitched image as well as the highest accuracy of measurements.

- The image stitching process takes place on a hard drive. This rapidly decreases memory consumption and enables the stitching of images with a resolution up to several gigapixels.

- On some occasions, a temporary file is enlarged on a hard drive during the image stitching process. In those cases, the image stitching process can take a bit longer than usual. This delay becomes most significant when stitching a larger number of images.

- When live image stitching is started, the *Capture* button can be used for the acquisition of still images in a standard way, except when image stitching or an error state repair is in progress.

System Requirements

Minimal Computer Requirements:

- Intel® Core i3 processor
- 2 GB RAM
- Microsoft® Windows® 7/8.1/10 (32bit or 64bit)*

Recommended Computer Requirements:

- Intel® Core i5 or better processor
- 4 GB RAM or more
- Microsoft® Windows® 7/8.1/10 (64bit)*

Supported QuickPHOTO Program Versions:

- *QuickPHOTO CAMERA 3.0* or newer
- *QuickPHOTO MICRO 3.0* or newer
- *QuickPHOTO INDUSTRIAL 3.0* or newer

* When using Microsoft® Windows® edition *"N"*, you may need to download and install the *Media Feature Pack* from Microsoft's website.

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