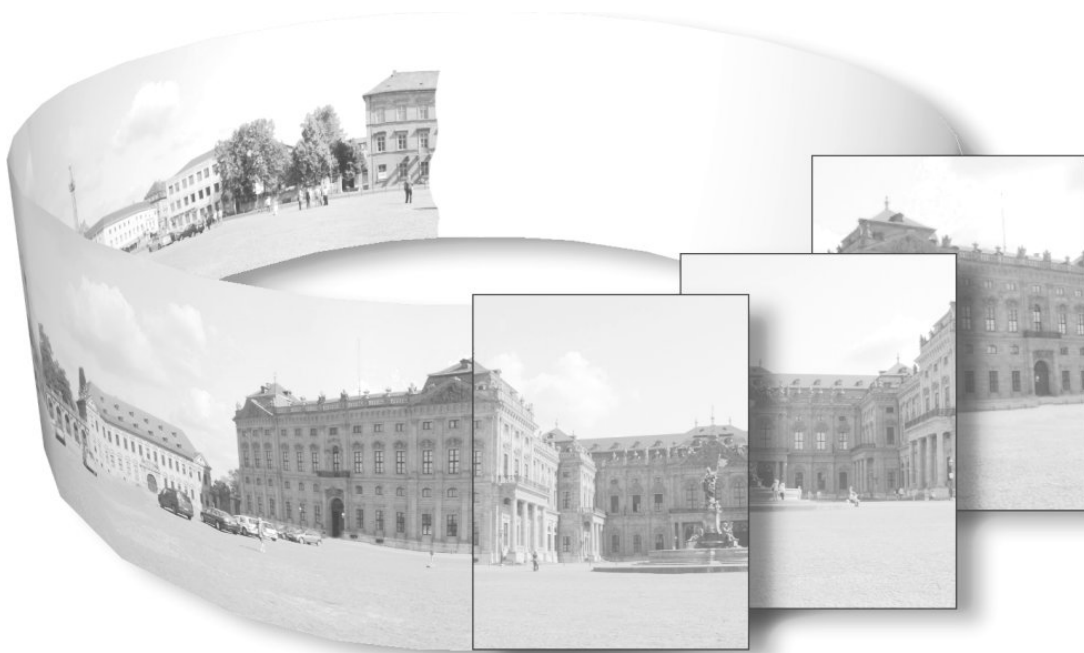


Manual

PanoramaStudio 4

and

PanoramaStudio 4 **Pro**



Version 4.0

© 2005-2024 Tobias Huellmandel, Tobias Huellmandel Software

PanoramaStudio Manual

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Chapter 1

Introduction

1.1 Overview of PanoramaStudio/PanoramaStudio Pro

PanoramaStudio enables the easy and highly efficient creation of panoramas and at the same time offers extensive editing functions for every step of the panorama creation up to the final export. The image material can be taken with any conventional camera and the individual images can be photographed in any arrangement. In this way, images can come from smartphones up to high-end DSLRs, taken freehand, using a tripod and panoramic head or even a drone. This makes panoramic photography possible without specific special equipment.

The focus of the application is on creating high-quality panoramic images as conveniently as possible. Overlapping individual images are seamlessly combined to create large panoramas.

The Pro version also offers additional features such as HDR panoramas, support for fisheye lenses, a grid assistant to help with huge gigapixel panoramas and more.

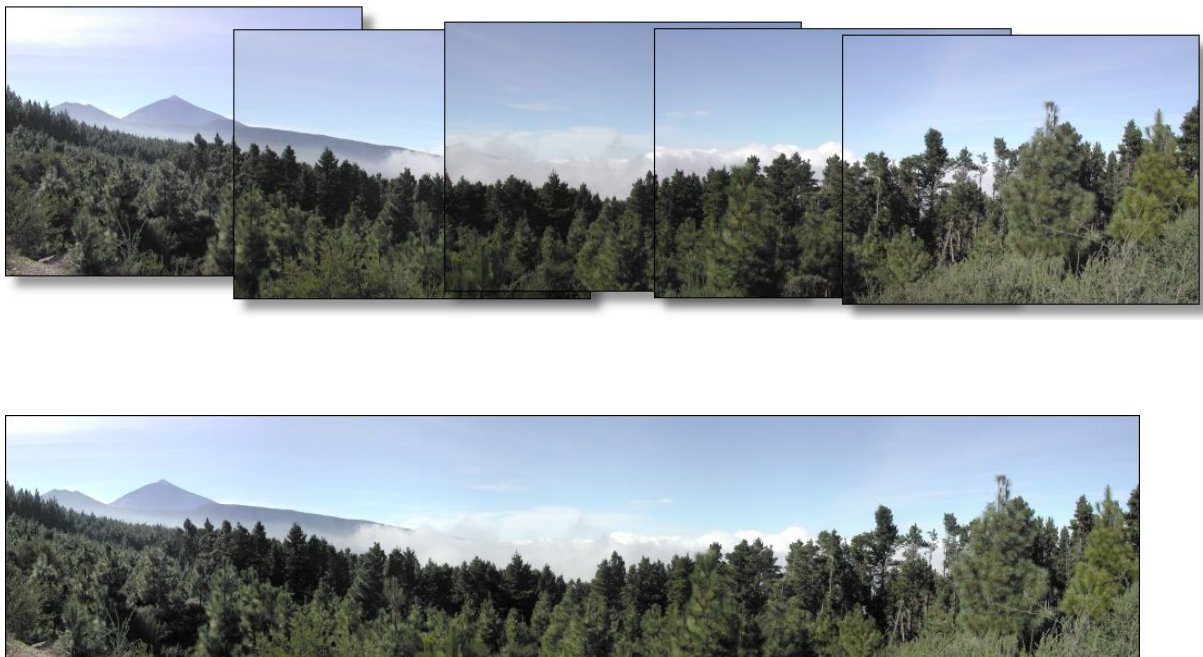


Figure 1.1: Automatically generated wide angle panorama

The finished panoramas can be exported in the common image formats and as interactive HTML5 panoramas for animated 3D visualization in websites or on the local computer. There is also a poster printing function that allows images to be printed over several pages.

1.2 System Requirements

- supported systems:
 - Windows 7, 8, 10, 11
 - MacOS 10.13 or newer
- free hard-disk space: 50 MB for the program, at least 10 GB temporary disk space for processing
- main memory (RAM): min. 4 GB of RAM, (16 GB of RAM recommended)
- CPU: 64 bit CPU
- graphics: resolution of at least 1280x720 pixels on Windows, 1504x864 on macOS
- optional for interactive panoramas: HTML5 compatible browser

1.3 Program Features

Panorama Creation

- Stitch any number of overlapping images into seamless panoramas, regardless of whether there are 2 or 2000 input images
- Creation of wide-angle panoramas up to full-spherical 360x180 panoramas
- Fully automatic alignment and blending of images into a seamless panorama
- All image material is processed internally in high dynamic range (HDR).
- Automatic vignetting correction
- Automatic exposure adjustment of the input images
- Automatic exposure correction of the panorama
- Automatic white balance adjustment (Pro version)

HDR Functionality (Pro version)

- Creates HDR panoramas using true HDR / tone mapping or quickly and impressively using Exposure Fusion
- Real-time preview for the configuration of tone mapping and exposure fusion in HDR panoramas
- Output of HDR panoramas as tonemapped SDR images or in various HDR formats

Camera and Lens Support

- Images can be taken with any normal camera - from smartphones to high-end DSLRs, freehand, using a tripod and panoramic head or even by drone
- Automatically recognizes more than 2700 cameras based on their Exif information and can process them more reliably based on their metadata
- Can also automatically determine the focal length of images from unknown cameras
- Support for focal lengths from 12 to 2500mm (35mm equivalent)
- Support for fisheye lenses (Pro version)
- Automatic lens correction for any conventional and fisheye lenses.
- A tripod is not necessary for most shots, although it is recommended for full spherical panoramas

Editing Options

- Full control over automatic image alignment due to the option of post-processing all individual steps

- Various filters to optimize the visual appearance of the panorama - no external image editor required. Adjustments are displayed in real time and can be changed until the image is exported (non-destructive)
- A real-time preview in three optional variants offers a preview of the panorama in 2D and 3D right after the first step
- Embed logos and other graphics directly into the panorama using the graphics tool
- Control point editor for manual post-processing of the image alignment
- Grid assistant, to pre-sort very large panoramas of hundreds or thousands of images (Pro version)
- Viewpoint correction which allows different camera viewpoints (Pro version)

Interactive HTML5 Panoramas and Virtual Tours

- Export of interactive HTML5 3D panoramas and zoom images for integration in websites
- Option for virtual tours. By inserting and editing hotspots in interactive HTML5 panoramas, multiple panoramas can be connected and links to external websites can be added.
- Enrich interactive panoramas with info hotspots, audio, a compass, maps and previews of other panoramas.

Image Formats and Printing Function

- Imports the image file formats JPG, TIFF, BigTIFF, PSD, PSB, WEBP, BMP and PNG
- Imports more than 1100 RAW formats
- Exports the image formats JPG, TIFF, BigTIFF, PSD, PSB, BMP and PNG,
- Imports the HDR image formats OpenEXR, Radiance HDR, 32bit-TIFF, 32bit-BigTIFF (Pro version)
- Exports the HDR image formats OpenEXR, Radiance HDR, 32bit-TIFF, 32bit-BigTIFF (Pro version)
- Export of panoramic images as layered Photoshop file, as a series of TIFFs, or as a Multipage TIFF
- Poster printing function to print images spread over several pages

Chapter 2

Quickstart - Creating Your First Panorama

This chapter will quickly enable you to create your first panoramas based on your own shots by guiding you briefly through all steps necessary. Detailed information on advanced options (e.g. manual adjustments) will be presented to you in subsequent chapters. Chapter 4 illustrates the versatile processing capabilities in detail. The graphical user interface of PanoramaStudio is described in chapter 5.

There are only a few simple steps for you to have your first panorama on your screen. Let's start with the shooting of your images:

- **Taking photos of the scene** (chap. 3, p.6)

Having found a nice scene for a panorama, please take notice of the following rules. The final panorama will be an assembly of a series of individual images. For the software to be able to automatically stitch the images without loss of information, adjacent images must overlap. Arrange the images so that they overlap each other by about 30 percent. In order to achieve a correct panorama, the camera had to be exactly in the center of the panoramic scene. Thus, try to rotate the camera while shooting the photos rather than turn your camera around you. Holding your camera quite close to you will be a good approximation for a correct positioning in most cases. To achieve a larger field-of-view in a single-row panorama, hold the camera in portrait format rather than landscape.

The use of a tripod is recommended especially for indoor shoots and for full spherical, multi-row panoramas. A tripod together with a panoramic head is the best equipment for optimal results. For multi-row panoramas, the rule for the overlap of the individual rows is also that the rows should overlap by approximately a quarter or a third.

- **Importing your images** (chap. 4.2, p.9)

Your first step in PanoramaStudio is to import the images. First you have to choose the type of your project. Select *Create Panorama*. After that, you can load the individual images using *Import...*. When importing, you can select several images at the same time and so load all the images of the panorama at the same time.

- **Parameters** (chap. 4.3, p.9)

You now may set some parameters which enhance speed and quality of the rendering process. Click on *Parameters* to open the dialog box.

Here you can specify the focal length of the camera and, under "Camera Type and Lens", other properties of the camera and the lens being used. Normally it is sufficient to enable the option *Use EXIF focal length* if your camera is known to PanoramaStudio.

- **Align** (chap. 4.4, p.11)

When the parameters have been set, PanoramaStudio can align the images. Click on *Align* to start the fully automatic alignment of the images to create a panorama.

- **HDR** (Pro version) (chap. 4.6, p.13)

If you would like to create an HDR panorama and have shot exposure brackets, you can activate and configure the HDR mode under *HDR*.

- **Render** (chap. 4.7, p.13)

After the alignment, the aligned panorama is initially shown in a low-resolution preview. If you would like to make corrections to the panorama, you can find more information on this under *Manual editing* (chap. 4.5, p.11). You can then start the high-quality rendering of the panorama. Click on *Render* to open the mode for cropping the image. Here you can set the desired image section for the panorama using the red marker lines and also set the output size, the blending method and a few other options in the dialog box. The panorama image is then rendered in high quality.

- **Saving and printing**

After the image is rendered you can save it as an image file or as interactive HTML5 panorama. In addition, the integrated poster printing function allows to print the image across several pages with crop marks and glue margins.

Chapter 3

How To Take the Individual Input Images

3.1 What To Take Into Account While Shooting the Photos?

Panoramas generated by PanoramaStudio are based on a series of individual images. PanoramaStudio is designed to produce panoramas from images shot with any regular camera without special equipment. One advantage is for example, that you can already create very good panoramas without a tripod. If you're on a day trip or on vacation and you're faced with great scenery that can't be captured in one photo, you can now simply take several photos with your normal camera and stitch them together at home.

Ambitious users can use a tripod to obtain source material that can be processed even more reliably than freehand shots. A tripod, preferably with a nodal point adapter, is therefore certainly recommended for multi-row panoramas and indoor shots.

In both cases, you should follow a few rules when taking the photos in order to achieve the highest possible quality and to avoid unnecessary reworking of the images.

Images must overlap

PanoramaStudio can merge the images automatically. For this to be possible, the images must overlap. Try to take the images in the series with an overlap of about one third. You can make this easier by memorizing an image area or an object in the right third of the image in the camera's viewfinder for each shot and then capturing this object again in the next image on the left edge of the image or in the left third of the image. Photograph as much of the scene as you want to capture in this way.

As it is difficult to estimate the overlap in freehand shots, larger or smaller overlaps between images are of course also recognized. However, you should try to take photos with at least 20 percent overlap between two images, otherwise it will be more difficult to identify them. Likewise, you should not exceed two thirds overlap. This only increases the computing time. If you have photographed several images with very large overlapping areas, you can exclude individual images from the series when importing them into a panorama project if the two neighboring images on the left and right already contain a sufficient overlapping area.

Order when taking the images

Individual images of the panorama can be taken in any order and arrangement. The image detection analyzes all images and automatically finds connected images based on similarities in the overlapping area of the images. In this way, the images are automatically aligned with each other, the focal length and lens properties are calculated and differences in brightness between images are adjusted.

Maximum Field of View, Zoom

If your camera has an optical zoom, you should zoom out to the largest wide-angle setting (shortest focal length) for a large field of view. If you only want to capture a small section of the scene and you are working with zoom, please still only use the optical zoom of your camera and not the digital zoom.

Use a constant focal length

It is particularly important that you do not change the zoom of the camera when taking a series of images for a panorama.

Shooting HDR panoramas (Pro version)

To create an HDR panorama, it is necessary to take a series of images with different exposure values (an *exposure bracket*) instead of individual images.

The easiest way to do this is to use your camera's **AEB mode** (Auto Exposure Bracketing) to automatically capture multiple shots of the same subject with varying exposures. When taking such exposure brackets, make sure that successive shots also overlap sufficiently to ensure seamless stitching.

Such series of differently exposed shots ensure that you have a range of exposures to capture details in the shadows as well as in the brightest areas. PanoramaStudio Pro can then merge these images during processing using *HDR / Tone Mapping* or *Exposure Fusion* to create an HDR panorama.

Single-row panoramas: Keep the horizon at constant altitude in your viewfinder

To achieve only minor clipping in a single-row panorama, you should try to aim your camera in a way that the horizon is always located at constant level in the images especially when shooting without tripod. Because of this, always try to shoot approximately in a constant angle relative to the horizon - upwards, downwards or straight ahead. Otherwise, the images would show up with a cascaded skew to one another after assembling. Moreover, parts of the images would have to be removed during the cropping step.

The series of images will be assembled to a panorama such that they are projected either onto the surface of a cylinder or of a sphere.

PanoramaStudio takes the actual position of the horizon into account in order to produce properly adjusted projections with the right perspective. Therefore, you are not forced to arrange the images with the horizon vertically centered. Especially when capturing a landscape from an elevated viewpoint, aiming the camera downwards to the objects of interest rather than 'waisting' more than half of the canvas with blue sky is recommended. You are also able to produce panoramas aiming upwards at high buildings in a city. The adjusted perspective will also be reproduced correctly in interactive panoramas, so that the effect of 'looking up' or 'looking down' as experienced at the original shooting will be conserved.

How to turn around when shooting without a tripod

Most important for the quality of your panorama is to turn around yourself and the camera properly. Basically, the camera needs to be as close as possible to the center of the scene. For this reason, try to turn around the camera rather than turning around yourself, so that the camera is the center. Holding the camera as close as possible to your body will be helpful. This is necessary anyway since you should also use the viewfinder to keep control of the overlap of the images as discussed earlier. Therefore, you might want to locate a turning point on the ground which you can use to verify the position of your camera before each image. PanoramaStudio is optimized to make the inaccuracies that occur between the images as completely invisible as possible. However, if you differ significantly from the optimum rotation, differences arise in successive images that can hardly be suppressed. The reason for this is simple. If the camera is not the center of the scene, it has undergone a more or less strong sideways shift between successive images. If there is a sideways shift, close and distant objects in the image appear more and more offset from each other. This results in a so-called parallax error. Special attention must therefore be paid to this circumstance in scenes with very close objects, as the effect is much more pronounced here than in landscape shots, for example, which can usually be taken freehand without any problems.

How to turn around when shooting with a tripod

If you try to stick to the recommendations for shooting without a tripod as given above, PanoramaStudio will be able to create high quality panoramas. The exact, if somewhat more elaborate, way is of course to use a tripod. As for overlap and horizon, the same rules as given above apply. If you have a tripod available, it's possible to perform the shooting with the camera centered to the scene almost perfectly. But still, a small parallax may remain. This is based on the fact, that actually, the focal point which is situated somewhere inside the lenses, needs to match with center of rotation.

In this case, a special panoramic head for your tripod might help you out. A tripod with panoramic head is especially recommended for indoor shots. It is also very helpful for multi-row panoramas, where you have to take several rows and a lot of images. This ensures a parallax-free panorama and you can rule

out that you miss regions while shooting the scene.

But, to point it out once again: tripods and corresponding special equipment might help to improve the quality of panoramas, but this type of equipment is not necessarily required.

Problems with exposure

Inhomogeneous lighting in the scene might cause problems. Especially the sun often causes significant differences to the exposures of the images. However, you should still use the camera's automatic exposure control. PanoramaStudio adjusts individual images of different brightness levels. If you try to take all images with a constant, manually set exposure, there is the risk that areas in many images will be overexposed or underexposed. In such areas, there are then no details left that the exposure correction could make visible again.

On the other hand, large differences in brightness in a scene are ideal for a **HDR panorama**. For users of the Pro version, it is therefore generally a good idea to activate the AEB mode (Automatic Exposure Bracketing) for such scenes and to take three or more different exposed images instead of individual images, which are then automatically merged into an HDR panorama by PanoramaStudio Pro.

Moving objects

Another difficulty for merging images are moving objects, which then appear differently in overlapping input images.

PanoramaStudio offers a special blending method for this problem (the *adaptive Multiband Blending*), which analyzes the image content and places transitions between images in matching, stationary areas wherever possible.

But you can already minimize potential problems caused by moving objects when taking the photos. You are on the safe side if you wait until no person or other object is moving in the current scene before taking a photo. In practice, however, this may be impossible. However, problems caused by moving objects only arise if the movement occurs in the entire overlapping area of two images. If moving objects cannot be avoided, try to wait or position the shot in such a way that moving objects are in the center of the shot if possible. The further towards the edge of the image the movement takes place, the more difficult it is for the blending process to adjust the differing image content.

Tip: Photograph single-row panoramas in portrait orientation!

For a maximum vertical image area, you should of course set your camera to the shortest focal length, i.e. zoom out to the maximum wide-angle setting. On the other hand, you can achieve a larger vertical field of view by taking the photos in portrait format.

Chapter 4

Workflow - Creation of a Panorama

4.1 Create a Panorama Project

Each panorama in PanoramaStudio is managed in a project that can be saved and reloaded later. At program start, a selection of possible project types is initially shown. You can choose between *Create panorama*, *Import panoramic image* and *Open project*. In addition, there are still the older modes *Create classic*, *single-row panorama* and *Merge document*.

Additional projects can be created at any time with *New project* in the toolbar or via the menu *File*.

4.2 Importing Images

For a new panorama, the first step will always be to import the required individual input images into the project. You may read in image files by clicking on the *Import...* symbol in the toolbar. Additionally, the same function is available in the menu at *File → Import images...*. Moreover, you may drag&drop images with your mouse directly into the panorama project.

You may choose multiple images at one time arbitrarily with the mouse from the file chooser dialog box by holding the *Ctrl* key. With the *Shift* key, you may choose multiple successive images. Thus, all images required for one panorama can be imported easily in just one step.

In addition to the conventional image formats, PanoramaStudio can directly open *RAW* image data from a large number of cameras. But this function can only be a simple way to quickly read and process raw images in PanoramaStudio. Extensive functions for fine-tuning when importing and converting raw image data are therefore not available and should be performed using a suitable *RAW* converter if required. However, PanoramaStudio offers some basic options for importing *RAW* images. If a *RAW* file is selected in the import dialog, a configuration tool can be opened using *RAW Parameters*. This allows you to set the exposure, the white balance, a color profile and the color depth (8 or 16 bit) used to import *RAW* files.

4.3 Setting Parameters for the Stitching Process

Are settings by the user necessary?

PanoramaStudio is able to automatically generate panoramas without any custom parameters specified by the user. However, specifying optional parameters may increase performance and quality of the stitching process. There are two important parameters: the focal length of the images and the lens type.

4.3.1 Focal Length and Camera

A vital parameter for the computation is the focal length.

The images imported in PanoramaStudio may already contain information about the focal length stored in their metadata. Depending on this, one of the following three cases occurs:

Known digital camera

If the images come from a digital camera which is present in the database of PanoramaStudio, you may simply activate the *Use EXIF Focal Length* option. The Focal length information will be taken from the Exif metadata included in the image files.

Unknown digital camera

If the digital camera cannot be recognized automatically, but Exif information is still available, PanoramaStudio offers you to add this camera to its database. In this case, you will find a button labeled *New camera ...* in the box *Camera and lens* (see also chap. 5.5.13 (→ p.47)).

As soon as you add the camera to the database, the camera will be detected afterwards, and image data will be evaluated properly.

Other camera

If the cases mentioned above don't apply, you can specify the type of the camera with *Camera type* as well as the type of the film. If you cannot specify the focal length, just leave the setting for the focal length at *Focal length unknown (automatic)*. Apart from that, you can give either the exact value or an estimation for the focal length in the input field *focal length*. In the latter case, you will also have to specify a percentage for the maximum deviation from the estimated value.

4.3.2 Lens

For most cameras and lenses the default setting *Regular (low distortion)* is appropriate. Only a small number of cameras may require a different setting. For fisheye lenses you can switch to *fullframe fisheye* or *circular fisheye* for a proper handling of such images.

With *Circular crop* for circular fisheye images you have the option to edit the boundaries around the images which will be cropped before further processing.

Some images, mostly from wide-angle lenses, show a visible brightness fall-off towards the edge of the image (*vignetting*). When you enable the *Vignetting Correction* PanoramaStudio will automatically eliminate an existing brightness fall-off so that the panorama shows a constant brightness afterwards.

When using the focal length from Exif data the information might be 'falsified' if you used an additional lens or converter lens mounted on top of the original lens because the camera might not take the modified focal length into account. In this case, select the option *Accessory Lens Used* and specify the corresponding conversion factor added by your accessory lens in the field *Wide Angle or Tele Converter*.

4.3.3 Advanced Settings

With *Quality of image detection*, the quality of the image detection can be configured. As a rule the default setting (*Regular*) is the best choice for most panoramas. If some images could not be assigned or if images are not well aligned you can set the detection here to a higher level (*High* or *Very high*) to achieve a better alignment of the images. However, a higher detection level results in a more time-consuming alignment. When the option to *Optimize control points automatically* is enabled, PanoramaStudio tries to sort out bad control points automatically while aligning the images. This often improves the overall quality of the image alignment noticeably, since less bad or wrong control points affect the alignment of the images.

4.3.4 Glossary

What is the focal length?

The focal length specifies the distance from the focal point of the lens to the projection layer. The projection layer is either the film or the CCD sensor. Together with the film or CCD sensor size, the captured field-of-view can be determined from the focal length. To calculate a panorama correctly, the focal length of the images must be determined as precisely as possible. For conventional cameras, the shortest focal length is usually in the range of 24 to 50mm.

What is 35mm film?

The type of film which is used by most analog cameras - SLR or viewfinder - (so called 35mm cameras) is

called 35mm film. A negative film has the dimensions of 24mm x 36mm. The APS format is another analog film format with different dimensions.

What does 35mm equivalent mean?

Since all analog 35mm cameras have the same film dimensions, they allow to directly compute the covering angle of the image just with the given focal length.

For digital cameras with their big variety of different CCD sensor dimensions, things are not that easy. The focal length itself is not that expressive or comparable. The size of the sensor must also be known.

To achieve better comparability throughout different camera models, reference values are given expressed in focal lengths of corresponding 35mm cameras. PanoramaStudio uses this reference value, namely the 35mm equivalent as focal length for digital cameras.

Exif data

Most digital cameras include additional information in their image files. This tagged information complies with the so called Exif Standard. The exif data contains values for date of shooting, exposure, aperture, focal length, focus and numerous other information. PanoramaStudio uses the information about focal length and camera model. Therefore, the exif data is used to detect a digital camera model automatically with the image files. Such images from cameras known by PanoramaStudio can be processed faster.

4.4 Aligning the Images

After you have imported the images and set optional parameters, PanoramaStudio can align the images. The *Align* step automatically performs an image analysis with exact detection of focal length and lens distortion. The images are then automatically linked and aligned. It also corrects vignetting and adjusts the exposure of the images. Subsequently, you can make changes under *Edit*.

4.5 Manual Editing of the Panorama

PanoramaStudio is designed to produce the best possible results when creating panoramas. However, if flaws or errors occur in the generated panorama, it is possible to manually correct all steps of the automatic processing.

Defects and errors naturally occur more frequently the more difficult the image material is to process. Therefore, it is always best to take care for optimal input images in advance when shooting the scene. Please refer to the advice given in chap. 3.1 (→ p.6).

4.5.1 Which Correction To Use in Case of a Specific Stitching Error?

The following are the most common problems and deficiencies that can occur in a stitched panorama.

Two input images don't match in the overlapping area

Please refer to *Change Image Alignment* in chap. 4.5.3 (→ p.12) or *Edit Control Points* in chap. 4.5.4 (→ p.12).

Brightness differs between two images

Please refer to *Adjust exposure correction* in chap. 4.5.6 (→ p.13).

The entire panorama is too dark or too bright

Please refer to *Adjust exposure correction* in chap. 4.5.6 (→ p.13).

Lines between two images are not continuous

Please refer to *Adjust focal length and horizon* in chap. 4.5.2 (→ p.12).

The assembled images don't seem to fit properly

Please refer to *Adjust focal length and horizon* in chap. 4.5.2 (→ p.12).

No assignment found for some images

Try to re-align the images with a higher setting of the *quality of detection* parameter in the *parameters* dialog box or insert manually some control points for these images with the *control point editor*. Please refer also to *Edit control points* in chap. 4.5.4 (→ p.12).

The panorama appears wavy or completely twisted in the preview

Please refer to *Straighten horizon* in chap. 4.5.7 (→ p.13).

4.5.2 Adjust Focal Length

The correct identification of the focal length is crucial for the quality of the panorama. If no information can be provided, the automatic identification of the focal length is very accurate in most cases. However, there are occasional exceptions.

Symptoms caused by an **incorrect focal length** are (see also figure 4.1):

- Straight lines get bended so that they form waves.
- Even moving the image overlaps around manually doesn't yield a proper overlap at all.
- Lines spanning multiple images bend differently.

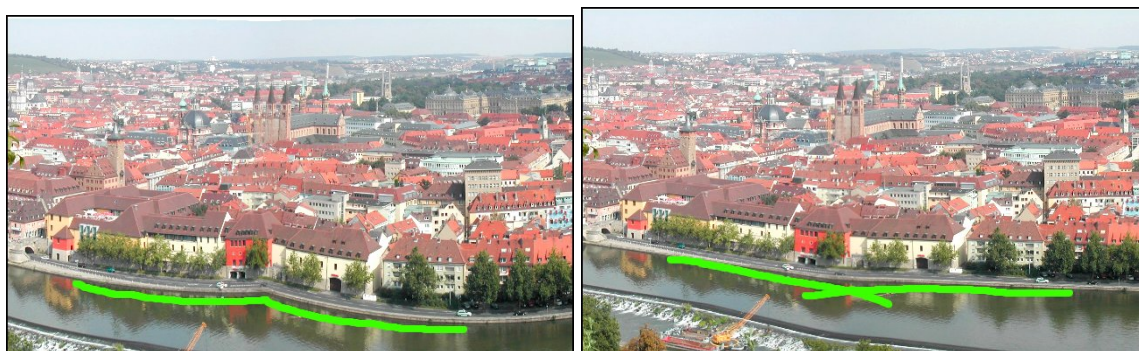


Figure 4.1: Left: Too small a focal length leads to too much curvature; Right: Too large a focal length leads to too little curvature

Vertical lines, which appear arcuated in a panorama are cues for **wrong barrel/pincushion correction**. Either more correction is necessary, or the applied correction is overdone.

To read about correction of focal length and horizon in more detail, please refer to chap. 6.3 (→ p.53).

4.5.3 Change Image Alignment

If the position of images in relation to each other cannot be determined correctly by PanoramaStudio, this can have various causes. Automatic positioning is very difficult if there is very little detail in the images. But also an incorrect focal length can lead to incorrect image alignment.

However, overlapping between two images can be adjusted manually. Therefore, call the command *Panorama→Edit→Change Image Alignment*. Further information for this adjustment mode is given in chap. 6.5 (→ p.57).

4.5.4 Edit Control Points

The image alignment can also be edited with the *Control Point Editor*. There you can inspect and edit all image links as well as add new links by adding control points between yet un-connected images. For further information please refer to chap. 5.5.4 (→ p.33).

4.5.5 Use Viewpoint Correction (Pro version)

The viewpoint correction allows to optimize images which are not exactly shot from the same viewpoint. It should be selectively enabled only for some images of a panorama.

It is especially helpful to insert a nadir image taken handheld into a panorama shot with a tripod.

You can enable the viewpoint correction for selected images in the image manager (chap. 5.4, p.29).

4.5.6 Adjust Exposure Correction

Adjusting the automatic exposure correction is the last step of the adjustment options. You may improve the overall brightness of the entire panorama, or the brightness of individual input images.

In case of a significantly differing brightness between two images, manual adjustments are recommended to compensate the differences between adjoining images. Problems concerning the overall brightness of the panorama may be tackled by either affecting the strength of automatic exposure correction, or by controlling the brightness manually.

Please refer to chap. 6.6 (→ p.58) for more details.

4.5.7 Straighten Horizon

PanoramaStudio Pro estimates the horizon of a multi-row panorama with an automatic procedure. This works quite well for most scenes. In the remaining panoramas you can edit the orientation of the horizon manually with the *Straighten horizon* mode. Use the command *Panorama→Edit→Straighten horizon*. You will find further details on how this mode works in chap. 6.7 (→ p.60).

4.5.8 Insert Graphics

You can embed graphics, e.g. logos, into the panoramic image, which will be blended in the panorama when rendering the image. Call *Panorama→Edit→Insert graphics* to switch into the mode to edit and insert graphics (chap. 6.8, p.60).

4.6 HDR Panoramas (Pro version)

The Pro version of PanoramaStudio can also create HDR panoramas. The only requirement is that when taking the images for the panorama, instead of taking individual images take a series of images with varying exposures (*exposure bracketing*). These differently exposed images are then first combined to create an image with a high dynamic range (HDR) and these HDR images are then stitched together to create the panorama. Another option is to import existing HDR images and stitch them together to create an HDR panorama.

HDR panoramas created from exposure brackets offer the advantage of capturing the entire dynamic range of a scene, by preserving details in both the brightest and darkest areas. This results in expressive images with increased detail and visual dynamics.

The easiest way to take bracketed shots is to use the AEB mode (Auto Exposure Bracketing) of your camera. In this way, you can automatically create series of differently exposed images instead of individual images. Exposure brackets consisting of 3 to 5 shots each are recommended.

Under **HDR** you can then activate and configure either true *HDR / Tone Mapping* or *Exposure Fusion* to create an HDR panorama from the images. For more details on the modes and a description of all parameters, see chap. 6.9 (→ p.61).

4.7 Rendering the Panorama

When the *image alignment* with its optional adjustments is done, then you can finish the panorama with the *Render* command which renders the panorama in full size and high quality. Therefore, choose either *Render* from the action toolbar, or *Panorama→Render* from the menu. PanoramaStudio switches then in a mode where you can set some parameters regarding the output size, the quality and primarily the the

cropping area.

The initial rectangle for the cropping area is a suggestion from PanoramaStudio and indicated by a red rectangle. You can adjust the edges of the rectangle by dragging them with the mouse. By clicking into a corner of the rectangle, you may rotate the cropping area if it is a partial single-row panorama. This will be indicated by a circular mouse pointer.

You can also set the exact output size in the dialog box. Set the desired size either with the slider in the *Output size* box or set the exact pixel size with the edit fields.

As an option for more sharpness of image details you can set *Interpolation* method to *Bicubic (normal)* or some even more complex image interpolation methods.

When cropping the panorama, it is also possible to include areas outside the panorama in the selection. This way you can also accept some undefined gaps, to keep the clipping of the image content low. The remaining gaps can either be filled with one color or with a smooth interpolation of the surrounding image content using the option *Interpolate image content*. To fill with color, select the option *Add color* under *Fill gaps* and select a color using the color selection button. Alternatively, you can select *Interpolate image content* to fill the gaps with interpolated image content.

Confirm your settings and start the final calculation with *OK*. (chap. 6.10, p.64)

4.8 Post-Processing the Panorama

After the *Render* step you have the option of post-processing the created panoramic image to improve the image even further. For this purpose, a range of image processing filters are available under **Postprocess**.

Color and Tone Adjustments

In the categories *Light & Color*, *Tone Curve* and *Color Balance* you will find filters to improve the visual appearance. Furthermore, when the HDR mode is active, the *Tone Mapping* parameters can still be adjusted. A description of all filters for color and tone adjustments can be found under chap. 6.11 (→ p.66).

Image Sharpness

For adjusting the image sharpness, there are the two filters *Sharpen* and *Unsharp Mask* (chap. 5.5.9, p.37).

Image Size

Although it is recommended that the panorama is already rendered in the desired size under *Render*, the size of the panorama can still be adjusted afterwards with *Resize*. More on this option under chap. 5.5.8 (→ p.37).

4.9 Inserting Hotspots

What are hotspots?

A *hotspot* is an arbitrary bitmap graphic in the panorama with an action attached to it. PanoramaStudio supports *link hotspots*, which can link to other panoramas or webpages, and *info hotspots*, which can show a dialog box with information.

PanoramaStudio embeds hotspots in interactive panoramas displayed with the *PanoramaStudio Viewer*. A click on the hotspot will open the corresponding webpage or panorama, or it shows information in a dialog box.

You can create virtual tours by connecting multiple interactive panoramas with hotspots. For information on how to export interactive panoramas for the *PanoramaStudio Viewer* please refer to chap. 5.5.12 (→ p.43).

Inserting and editing hotspots

To switch to the hotspot mode for inserting and editing hotspots, just click on *Hotspots* in the action toolbar or select *Panorama → Hotspots* from the menu. The corresponding hotspot dialog box will appear. Existing hotspots will show up when switching to hotspot mode. In the dialog box, you can insert new hotspots or delete existing ones. The URL for a selected hotspot can be entered as well as a short description. You find further details about editing hotspots in chap. 6.12 (→ p.69).

4.10 Saving and Printing the Panorama

Save the project

To save the current project, select *File*→*Save project* or *File*→*Save project as* Additionally, you may click *Save* from the action toolbar and choose *Save project as....*

The project may be saved at stage of the creation process - except while inside an edit mode. All necessary instructions will be saved into a project file, so that the current editing state with all its adjustments may be restored when loading the project again.

To avoid huge files, the input images will not be embedded into the project files. Therefore, the original input images will have to reside in the same directory as they were when saving the project file.

However, to be able to pass on the project to other computers, just save the project file in the same directory where the input images are. The project file and the input images may be copied arbitrarily as long as they reside in the same directory.

Save as image

Open the *File* menu or the *Save* button in the action bar and select *Save as image as...* to export the panorama as an image file.

The panorama can be saved in the image formats JPG, TIFF, BigTIFF, PSD, PSB or BMP. Depending on the format, settings for the compression strength or the compression method can be made under *Compression....* Furthermore, the color depth (8 or 16 bit) and a color profile can be configured for most formats.

The Pro version offers the additional option of exporting each image as an HDR image file. Available HDR formats are OpenEXR, Radiance HDR and 32-bit TIFF/BigTIFF. A color profile and the color depth can also be configured for HDR files. See also chap. 5.5.11 (→ p.41).

Save as interactive Panorama / Zoom Image

The *PanoramaStudio Viewer* offers the option to save a panorama for interactive viewing. It shows interactive panoramas embedded in websites using HTML5. The Viewer can display a panorama either in 3D where the user is in the center of the scene and can view around or as a flat 2D zoom image where the user can scroll and zoom in the image. This allows to display nearly arbitrarily sized images and panoramas on your local computer and embedded in webpages on the internet. These interactive panoramas can be viewed in any HTML5 capable web browser.

Call *File* → *Save as interactive Panorama / Zoom Image...* or click on the corresponding command from the *Save* button in the action toolbar to save a panorama for the Viewer.

Please refer to chap. 5.5.12 (→ p.43) for further information about the *PanoramaStudio Viewer*.

Print the panorama

The printing functionality of *PanoramaStudio* provides special features to support the requirements for wide format panoramas. Thus, the panorama may be printed as an extra large image spanning multiple pages. The size may be specified exactly. To generate an image without margins like a photographic paper, the margins need to be cropped manually after printing the panorama. Printing crop marks will be helpful for this purpose. Additionally, gluing marks maybe printed to assist you when assembling the sheets.

When selecting *File*→*Print* from the menu or *Print* from the action toolbar, the *Print preview* dialog box shows up. The preview sticks to the “what-you-see-is-what-you-get” paradigm by presenting the pages exactly as they will be printed.

Create, save, and print other projections In the menu *Panorama* you find the *Create projection* command. This allows to create perspective/planar projections from regions in the panoramic image. Furthermore you can create here the so called “Little Planet” projections.

Please refer to chap. 5.5.6 (→ p.34) for further information on these projections.

4.11 Special Modes: Classic, Single-Row Panorama and Merge Document

Known from older *PanoramaStudio* versions, there are still two other panorama modes that fulfill special tasks. With the *Classic, Single-Row Panorama* mode, you can stitch a series of images taken from left to

right. Some specific editing functions are available for this. With the *Merge Document* mode, you can merge a series of images directly without taking focal length and lens properties into account. This mode can be used for merging scanned images, for example.

4.11.1 Single-Row Panorama/Document: Editing Images

In a single-row panorama it may be necessary to edit the images at first. The most frequent operations are: arranging and rotating the images. The following options are not available for multi-row panoramas, because they are not required for the further processing.

Reverse order and re-arranging

If multiple images are imported at the same time, PanoramaStudio arranges them in lexicographical order by their filenames. In general, images shot with a digital camera are numbered consecutively. Thus, the images will appear in correct order, if they were taken clockwise. In any other cases, it may be necessary to alter the arrangement of the images in the project.

The menu item *Input images*→*Reverse order* as well as the corresponding button in the arrangement toolbar (chap. 5.2.3, p.21) enables you to reverse the order of the images. If only some separate images were selected with the mouse, the arrangement will be reversed only for this images.

Moreover, the position of the images may be altered via *drag&drop*. It's recommended to switch to the overview mode (see also chap. 5.2.2 (→ p.21)) and dragging the images to the desired position holding the left mouse key.

Rotate images

To rotate images in steps of 90 degrees, use the menu items *Input images* →*Rotate right*, *Rotate left*, and *Rotate 180 degrees*. As an example, you may want to rotate images from a series shot in portrait format back to the right orientation by clicking either *Input images* →*Rotate right* or *Input images* →*Rotate left*. Since these operations are used quite frequently, they may be also performed by clicking on the corresponding buttons in the arrangement toolbar (chap. 5.2.3, p.21). These operations apply to either all images at a time, or just to the selected images, if an active selection exists.

Select and rearrange individual images

To select either one or multiple images, just click on the corresponding image. Your selection will be visualized by a red borderline. In order to gain better usability, you might want to switch to *Overview* mode provided by the menu *View*. In this case, images will be displayed down-scaled in favor of a high number of visible images at a time. You can include several images into your selection by holding the *Ctrl* key when clicking on the desired images. In order to select a contiguous sequence of images, hold the *Shift* key.

Selected images can be rearranged by moving them around via *drag&drop*. Just move the images to the desired position while holding the mouse button. While moving around, a blue vertical line will show the resulting position of your selection.

Rotate images arbitrarily

If the horizon slopes away in some images, it may be helpful to align just these images as horizontally as possible. First, select the image which you want to adjust. For this operation, you may just select one of the images. Now, choose *Rotate current image arbitrarily ...* from the *Input images* menu to open the *Rotate image* dialog box (chap. 5.5.14, p.48). This dialog box enables you to enter any desired angle for your rotation.

Crop an image

Scanned images for example may need to be cropped. Again, before calling the command *Input images* →*Crop current image*, the corresponding image has to be selected. The program automatically switches to the crop mode for this image. Now, you can specify the cropping region by moving around the red lines. In order to rotate the red rectangle, click in one of the corners and move your mouse. By pressing the *OK* button from the cropping dialog box, you confirm and apply the specified cropping.

Remove images from the project

It may happen that your project contains unnecessary images - e.g. if you shot a part of the scene twice, or if you did a 360 degree panorama where the first image might be identical to the last one. If you want to remove such images from your project, just select the desired images and press the *Del* key. Alternatively, you may choose *Input images → Remove selected images* from the menu.

Restore the original images

If you like to undo resizing, rotating, or cropping operations of input images, PanoramaStudio offers you to restore all images by reloading the original ones from disk. Clicking *Input images → Restore original images* causes the program to re-import the original images.

4.11.2 Single-Row Panorama: Specific Parameters

How to adjust the horizon

For single-row panoramas it is necessary to adjust also the horizon. You can either drag the red line on the work space, or you directly enter it expressed as a percentage in the dialog box.

Please note, that hills or mountains may be misleading since the actual horizon which is the line between sky and *flat* countryside resides slightly beneath them. In case of buildings hiding the line of sight to the horizon you still may give an estimation. If the camera didn't always point to the same vertical angle while shooting, the position of the horizon may vary throughout several images. It is best to estimate the horizon so that it corresponds to the middle of the horizons of all input images.

Projection

You can specify the type of projection used for presentation of the panorama in the box *Projection*. It can be chosen either *Cylindrical projection* or *Spherical projection*. Cylindrical projection causes the program to transform the images so that they fit to the surface of a cylinder when being assembled. If you want the images to be projected on the surface of a sphere, choose spherical projection in order to transform the images properly. This type of projection causes the appearance of the upper and lower parts of the panorama compressed/smaller for higher vertical angles when viewed on a flat canvas. The cylindrical projection in contrary extends the appearance of the upper and lower parts of the images. It is up to you to decide which type of projection better suits your taste for further processing and printing.

4.11.3 Single-Row Panorama/Document: Aligning Images

After having imported the images and specified the according parameters, PanoramaStudio is able to start the automatic alignment of the images. Click on *Align* to choose between *Create (partial) panorama* and *Create 360 degree panorama* for a single-row panorama. Take into account that the first and the last image have to overlap for about 20 to 70 percent for a 360 degree single-row panorama. Check whether the first or last image can be removed from the project if there is a greater overlap. If these requirements are met, a 360 degree panorama can be created whose ends fit together seamlessly.

4.11.4 Single-Row Panorama/Document: Manual Adjustments

Which correction for which error

In addition to the general correction options, there are also some specific editing functions for the classic, single-row mode and the document mode:

Single-row panorama: Moving objects appear only partial

Please refer to *Change blendings* below.

Single-row panorama: Ghosting in images - parts of images which appear twice in parallel

Please refer to *Change detail adjustments* below.

Change detail adjustments

Since in practice even for exact processing and correct assembling two images never really match on a pixel-by-pixel basis, the overlappings additionally will be subdivided into small tiles and adjusted locally. But it's still possible, that no correction may be found automatically, or a tile will be processed faultily. A lack of details in the image can lead to faulty automatic detail adjustments for example.

Visible ghosting - parts of images which show up twice and translucent like ghosts in the panorama -

are an indication for a detail adjustment failure. The effect comes from two corresponding parts from adjoining images which don't match. Thus, the same part of the scene appears semi-transparent at different locations. Great deviations even might lead to deformations of the panorama for parts of the image.

Such faults can be defeated by manually adjusting details. The detail adjustment mode allows you to manually move around image tiles relative to each other in order to match them together.

The detail adjustment mode can be reached by clicking *Panorama*→*Edit*→*Change detail adjustments*. The use is explained in more detail in chap. 6.14.1 (→ p.71).

Change blendings

The default procedure for blending two images will always blend throughout the entire overlapping area for seamlessly assembling the images. However, defects or faults may occur in the panorama which cannot be defeated by the processing steps before.

The most frequently occurring defect is caused by moving objects inside the overlapping area. Due to blending, these objects may appear twice like a ghost image.

In the blending mode, you can modify the areas for blending so that problematic spots will be blinded out, as long as they don't span the entire overlapping area.

You can enter the blending mode by clicking *Panorama*→*Edit*→*Change blendings*. For further details, please refer to chap. 6.14.2 (→ p.73).

Chapter 5

The User Interface

5.1 The Actions Toolbar

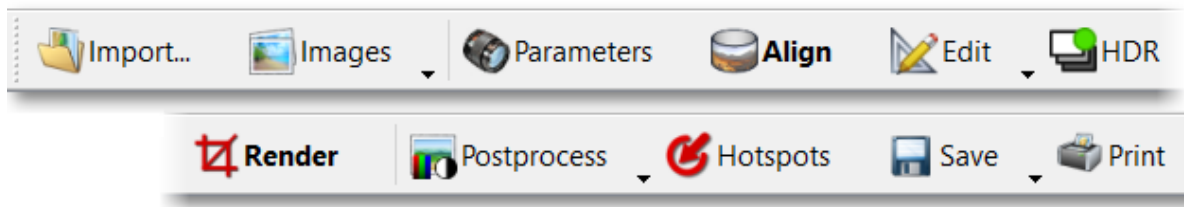


Figure 5.1: The *Actions toolbar*

The buttons of the actions toolbar correspond to the processing steps for creating and editing a panorama. Viewed from left to right, they represent the consecutive order of processing steps. Thus, you find every function needed starting from importing the images in order to create a panorama and to export it to different file formats or to print it.

The buttons of the actions toolbar viewed from left to right are...

Import...

Opens the *Import images* dialog box. This dialog box enables you to load the input images into your project. See also chap. 4.2 (→ p.9).

Input images

Opens a pop-up menu which is identical to the menu *Input images* from the menu bar. Mainly for single-row panoramas provides this pop-up menu all commands necessary for preparing the input images prior to the alignment. This involves e.g. changing the arrangement of the sequence, rotating and cropping. Please refer to chap. 5.3.3 (→ p.26) for an overview on the particular commands.

Parameters

Click on *Parameters* to enter the mode for specifying focal length and camera information (chap. 6.3, p.53).

Align

Call *Align* to start the automatic alignment of the panorama. If you are in the document mode you can similarly start here the alignment of the images of the document. More on this in chap. 5.2.5 (→ p.22).

Edit

Opens a menu to choose from various edit modes. To gather more information about which type of adjustment should be applied for an observed defect or fault, please refer to *Applying manual adjustments*, (chap. 4.5, p.11). The particular edit modes are explained in chap. 6 (→ p.51).

HDR (Pro version)

Opens the *HDR mode*. Here you can activate and configure either *HDR / Tone Mapping* or *Exposure Fusion* for the panorama. This way, you can process exposure brackets or imported HDR image material to create HDR panoramas, but also enhance conventional images using *Exposure Fusion on individual images*. See also chap. 6.9 (→ p.61).

Render

This command starts the final calculation and renders the panorama in high quality and full resolution. See also chap. 6.10 (→ p.64).

Postprocess

Under *Postprocess* you will find a range of non-destructive image processing filters in the categories *Light & Color*, *Tone Curve* and *Color Balance* and for HDR panoramas (Pro version) the option to refine the *Tone Mapping*. More about this under chap. 6.11 (→ p.66).

The *Sharpen* and *Unsharp Mask* filters can also be found here to correct the image sharpness (chap. 5.5.9, p.37) as well as the option to change the size of the panorama using *Resize* (chap. 5.5.8, p.37).

Hotspots

By clicking *Hotspots*, you can enter the hotspots mode which enables you to insert and edit hotspots and also lens flares in an interactive panorama. See also chap. 6.12 (→ p.69).

Save

This command provides different options to save your panorama. You can save it as a project, as an image, or as interactive HTML5 panorama.

Print

The *Print* command will open the print preview. The print preview enables you to spread your panorama over an arbitrary number of pages in any size and print it. Further details are given in *Print preview dialog box* (chap. 5.5.10, p.38).

Image Manager

Click the hamburger button on the right side of the actions toolbar to open or close the input image manager (chap. 5.4, p.29).

5.2 Other Toolbars

5.2.1 The Project Toolbar



Figure 5.2: The *Project toolbar*

New Project

Creates a new empty panorama project.

Open project

Opens an existing project from disk. The project will be restored to the state when stored the last time. Please notice that the imported images are not embedded into the project file, so that they have to reside in the folder where they were originally imported from.

Save project Saves an existing project with its current filename. If the project was not saved before, the dialog box *Save project as...* will be opened.

Properties of current image/Panorama properties

Depending whether the project still consists of individual images or a panorama already exists, a dialog box providing image properties corresponding to the current image or to the existing panorama will appear.

Open manual

Opens the PanoramaStudio manual.

5.2.2 The View Toolbar

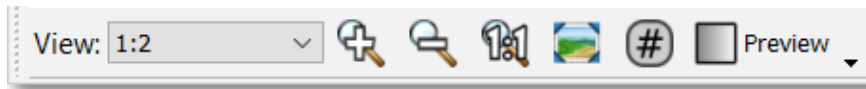


Figure 5.3: The *View toolbar*

The View toolbar can be used to zoom in and out and to configure the preview after the Align step. In the input images overview, the size of the preview thumbnails can also be set here.

Selecting the zoom

A drop-down list offers a selection of different zoom scales for displaying the current panorama.

Zoom in

Increases the displayed image size for the current project.

Zoom out

Decreases the displayed image size for the current project.

View in original size

Matches the pixel resolution of screen and image. Each image pixel covers a pixel on the screen.

Show/hide image numbers

The hash symbol shows/hides the image numbers.

Preview

Provides three options for the preview after the alignment.

- **No Blending**
Helpful for some editing functions, as the individual images can still be identified here if there are inconsistencies in the image alignment.
- **Linear Blending**
A linear blending of the individual images.
- **Multiband Blending**
Performs a high-quality blending so that the preview already corresponds roughly to static multi-band blending of the final Render step.

Thumbnail size

Changes the size of the thumbnail images in the preview before the Align step.

5.2.3 The Arrangement Toolbar (single-row panoramas only)

PanoramaStudio expects the images of a single-row panorama arranged in the right order and rotated in the right orientation previous to the automatic alignment. All necessary commands are available in the arrangement toolbar.



Figure 5.4: The *Arrangement* toolbar

Reverse order

The command *Reverse order* reverses the arrangement of the images in the project. If no images are selected, the order of all images will be reversed. If two or more images are selected, only the order of the selected images will be reversed.

Rotate right

Rotate right applies a clockwise rotation by 90 degrees to the selected input images. If no images are selected, all images of the project will be rotated.

Rotate 180 degrees

Rotate 180 degrees rotates either all images or if images are selected, just the selected ones by 180 degrees.

Rotate left

Rotate left applies a counter-clockwise rotation by 90 degrees to either all images or if images are selected, just the selected ones.

5.2.4 The Overview



Figure 5.5: The *Overview*

The overview toolbar provides a thumbnail display of the entire project. The currently visible area of the project is indicated by a red rectangle. You may navigate through the project by clicking with the mouse to the area of your interest. Holding down the mousebutton and moving it around enables you to scroll through the entire project canvas.

A large overview window can be opened by double-clicking or right-clicking the small overview.

5.2.5 The Task Type Bar

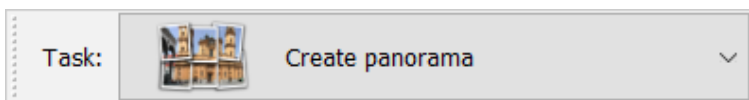
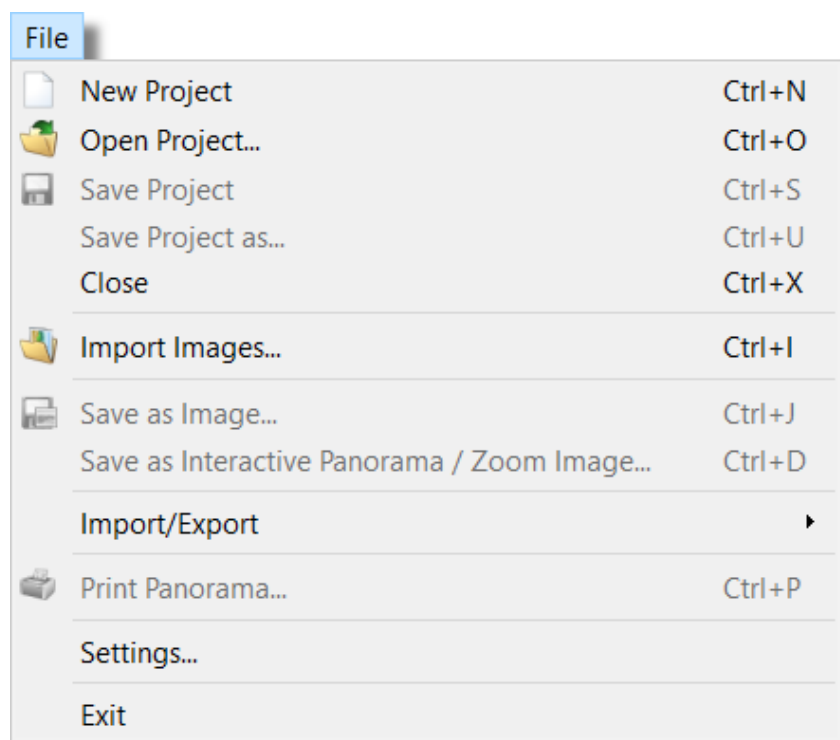


Figure 5.6: The *Task Type* bar

With the selection in the *Task Type* bar, the task type for the project can still be changed for an empty project. In addition to the regular project type, you can switch here to stitch a *Classic*, *Single-Row Panorama* or images in *Document Mode*.

Figure 5.7: The *File* menu

5.3 The Menu

5.3.1 File Menu

- **New Project**
Creates a new empty panorama project.
- **Open Project**
Opens an existing project from disk. The project will be restored to the state when stored the last time. The imported images are not embedded into the project file, so that they have to reside in the folder where they where originally imported from.
- **Save Project**
Stores an existing project with its current filename. If the project was never saved before, the dialog box *Save Project as...* will be opened.
- **Save Project as**
Opens the *Save Project as...* dialog box to store the current project with a new filename.
- **Close**
Closes the current project.
- **Import Images**
Opens the *Import Images* dialog box. This dialog enables you to load the input images into your project. See also chap. 4.2 (→ p.9).
- **Save as Image**
The current panorama can be saved here as an image in the image formats JPG, PSD, PSB, TIFF/BigTIFF, BMP or PNG. For some formats you may specify additional *options* concerning the type of compression, color depth and image quality.
In addition, the Pro version offers the option of exporting each panorama as an HDR image. The available HDR formats are OpenEXR, Radiance HDR and 32-bit TIFF/BigTIFF.
- **Save as Interactive Panorama / Zoom Image**
Opens the dialog box to save the panorama for the *PanoramaStudio Viewer*. Here you may save

the current panorama as interactive 2D or 3D HTML5 panorama including hotspots. This type of panorama format can be viewed in HTML5 capable internet browser. Please refer to the section *Save for PanoramaStudio Viewer dialog box* (chap. 5.5.12, p.43) for further details.

- **Import/Export**

This menu item comprises the various possibilities to either import existing panoramas or export the current panorama project as a series of individual images for further processing.

- **Export Individual Images**

This function allows you to export the transformed images after the stitching process for further editing with external professional image editing software.

The function *Export individual images* will save the images separately so that they can be assembled later to the panorama as computed by PanoramaStudio.

Three different image file formats are supported. You may specify for each of these three file formats whether you like to embed the blending information within the alpha channel or not (*Blendings in alpha channel*). These image file formats are available:

- * Photoshop PSD format. Each image will be stored in a separate layer of a photoshop image file.
- * Series of TIFF files. A numbered series of tiff files will be generated. Each file will contain one transformed input image of the panorama.
- * Multipage TIFF. A multipage TIFF image file will be generated. Every page will contain one transformed input image of the panorama.

- **Import Panoramic Image**

This function provides the option to import an existing panoramic image. After you selected the panoramic image for import, you will see a dialog box for setting the required parameters. Since an image file contains normally no information about the panorama type and field-of-view and these parameters are required for further processing as interactive panorama, you have to set these manually at this point.

The parameters should be set as accurate as possible. As for 360 degree panoramas, the adjustable parameters are restricted to the projection type (*cylindrical* or *spherical*) and the position of the horizon. If it is a partial panorama, the *Horizontal field-of-view* should be guessed as accurate as possible.

If the horizon in the imported panoramic image is not in level, you can adjust this with *Continue with Straighten horizon* first. See also chap. 6.7 (→ p.60).

If the panoramic image was created with PanoramaStudio, then the image metadata will provide the required information, so that no configuration is required.

- **Print Panorama**

Opens the print preview. Here, the panorama can be spread over multiple pages in an arbitrary size. It then can be printed as poster with glue margins and crop marks. As a matter of fact, printing to just one page is possible as well. See also *Print preview dialog box* (chap. 5.5.10, p.38).

- **Settings...**

Opens the *Settings* dialog box for program configuration and administration of the camera database. Please refer to section *Configuring PanoramaStudio* (chap. 7, p.75) for further details.

- **Exit**

Closes all open panorama projects and exits PanoramaStudio.

5.3.2 View Menu

- **Zoom in**

Use *Zoom in*, if you want to display the images or the panorama at a higher zoom level.

- **Zoom out**

Use *Zoom out*, if you want to display the images or the panorama at a lower zoom level.

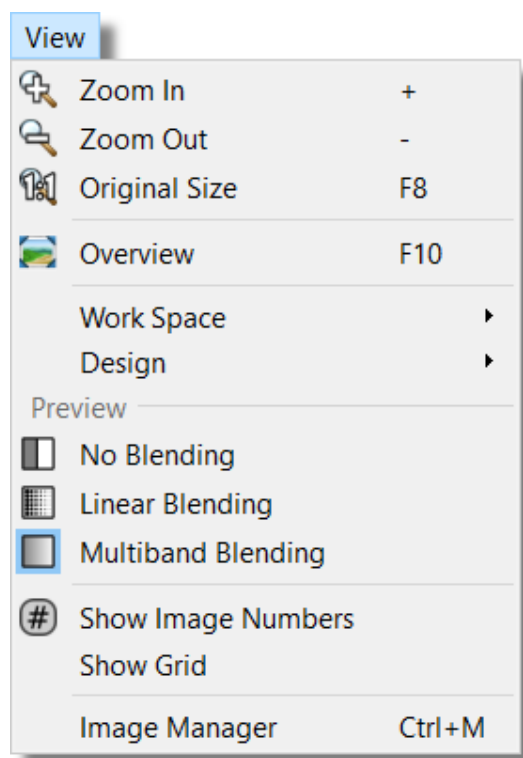


Figure 5.8: The View menu

- **Original size**

Use *Original size* to match the pixel resolution of the screen and the images. Each image pixel covers a pixel on the screen.

- **Overview**

Use *Overview* to fit the display size of the images or the panorama to the current window size.

- **Work space**

The *Work space* item contains a selection of color schemes for the work space. Among the choices are *white*, *dark gray*, and *black* as background for the images, the preview, and the dialog boxes.

- **Design**

Under *Design* you can switch between a light and dark mode for the user interface.

- **Preview**

Provides three options for the preview after the alignment.

- **No Blending**

Helpful for some editing functions, as the individual images can still be identified here if there are inconsistencies in the image alignment.

- **Linear Blending**

A linear blending of the individual images.

- **Multiband Blending**

Performs a high-quality blending so that the preview already corresponds roughly to static multiband blending of the final Render step.

- **Show Grid**

In multi-row projects PanoramaStudio Pro shows a grid overlay in the 3D and 2D view to illustrate the spatial orientation. Use *Show grid* to show or hide this grid.

- **Show Hotspots**

If hotspots are present in the panorama, they can be displayed permanently outside the hotspot mode using this option.

- **Image Manager**

Opens the input image manager. See also chap. 5.4 (→ p.29).

5.3.3 Input Images Menu

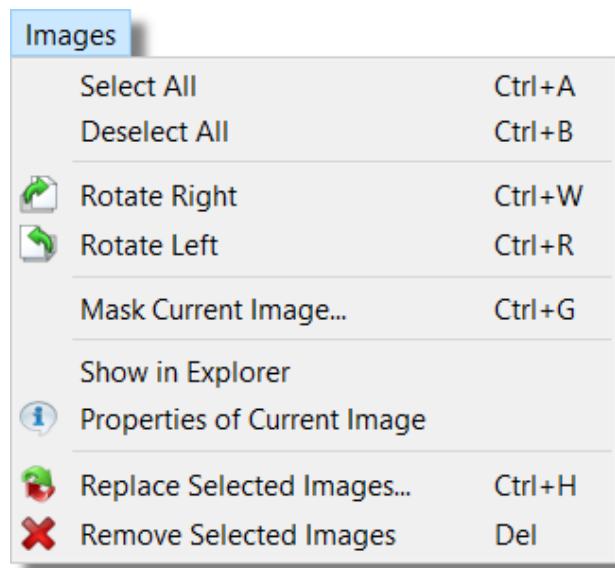


Figure 5.9: The *Input Images* menu

- **Select All**

Use *Select All* to select all images.

- **Deselect All**

Use *Deselect All* to deselect all images.

- **Rotate Right/Rotate Left**

Rotates the thumbnails in the preview. Only used for the preview, has no influence on the panorama.

- **Mask Current Image**

Opens the dialog box for editing masks. This allows to exclude image regions from being used in the panorama (chap. 5.5.1, p.31).

- **Show in Explorer/Finder**

Opens the folder containing the selected image in the Windows Explorer and OS X Finder respectively.

- **Properties of Current Image**

Opens the *Image Information* dialog box with in-depth information about the selected image (chap. 5.5.2, p.32).

- **Replace Selected Images**

Replaces selected images with others while transferring all calculated parameters to the new images. Allows for example the creation of identical panoramas for HDR panoramic images. After the creation of a panorama from one exposure level replace the images with the correspondent images of another exposure level to create another panorama with a different exposure.

- **Remove Selected Images**

Removes the selected images from the project.

Only for classic, single-row panoramas and documents:

- **Reverse Order**

The command *Reverse order* reverses the arrangement of the images in the project. If no images are selected, the order of all images will be reversed. If two or more images are selected, only the order of the selected images will be reversed.

- **Rotate Right**

Rotate right applies a clockwise rotation by 90 degrees to the selected input images. If no images are selected, all images of the project will be rotated.

- **Rotate 180 degrees**

Rotate 180 degrees rotates either all images or if images are selected, just the selected ones by 180 degrees.

- **Rotate Left**

Rotate left applies a counter-clockwise rotation by 90 degrees to either all images or if images are selected, just the selected ones.

- **Rotate current image arbitrarily**

This function is available for input images as long as just one image is selected. The *Rotate image* dialog box allows to specify an arbitrary rotation angle (chap. 5.5.14, p.48).

- **Crop Current Image**

This function is also available for input images as long as just one image is selected. PanoramaStudio switches into *Crop image* mode (chap. 6.10, p.64).

- **Restore Original Images**

Reloads the images from disk to reset them to their original state from the very beginning.

5.3.4 Panorama Menu

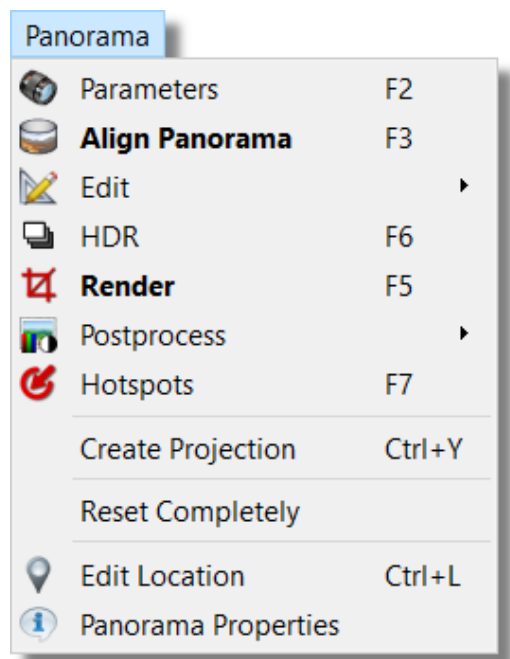


Figure 5.10: The *Panorama* menu

- **Parameters**

By clicking *Parameters* a dialog box opens for specifying the focal length and other camera information → p.53.

- **Align Panorama**

Starts the automatic alignment of the input images to create a seamless panorama.

- **Edit**

Opens a menu to choose from various edit modes. To gather more information which type of adjustment should be applied for an observed defect or fault, please refer to *Applying manual adjustments*, (chap. 4.5, p.11). The particular correction modes are explained in chap. 6 (→ p.51).

- **HDR (Pro version)**

Opens the *HDR mode*. Here you can activate and configure either *HDR / Tone Mapping* or *Exposure Fusion* for the panorama. This way, you can process exposure brackets or imported HDR image material to create HDR panoramas, but also enhance conventional images using *Exposure Fusion on individual images*. See also chap. 6.9 (→ p.61).

- **Render**

Here you set the parameters for the final step of the panorama creation which renders the image in high quality. Therefore, PanoramaStudio switches to an edit mode where you can set the output size and the cropping region of the panorama. See also chap. 6.10 (→ p.64).

- **Postprocess**

Under *Postprocess* you will find a range of non-destructive image processing filters in the categories *Light & Color*, *Tone Curve* and *Color Balance* and for HDR panoramas (Pro version) the option to refine the *Tone Mapping*. More about this under chap. 6.11 (→ p.66).

The *Sharpen* and *Unsharp Mask* filters can also be found here to correct the image sharpness (chap. 5.5.9, p.37) as well as the option to change the size of the panorama using *Resize* (chap. 5.5.8, p.37).

- **Hotspots**

By clicking *Hotspots*, you may enter the hotspots mode which enables you to insert and edit hotspots. See also chap. 6.12 (→ p.69).

- **Create Projection**

Use *Create projection* to create other projections from the panoramic image. You can create here projections from image regions in a perspective correct manner and also so called "Little Planet" projections. This command opens the corresponding dialog box. For details please refer to chap. 5.5.6 (→ p.34).

- **Reset Completely**

Use *Reset completely* to discard all settings and adjustments for the panorama project and to restore the input images to their original state.

- **Edit Location**

Opens the dialog box *Edit location* where you can add and edit GPS coordinates and orientation of the panorama (chap. 5.5.7, p.36).

- **Panorama Properties**

Opens the *Panorama properties* dialog box which provides information about the panorama in the current state (chap. 5.5.3, p.32).

Only for classic, single-row panoramas and documents:

- **Align (Partial) Panorama**

Starts the automatic alignment of the images for a partial single-row panorama.

- **Align a 360 Degree Panorama**

Starts the automatic alignment for a single-row 360 degree panorama.

- **Merge Document**

You can start the image alignment in the document mode with *Merge document*. More on this in chap. 5.2.5 (→ p.22).

5.3.5 Window Menu

- **Cascade**

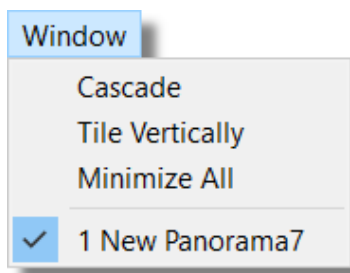
Arranges the project windows so that they overlap.

- **Tile Vertically**

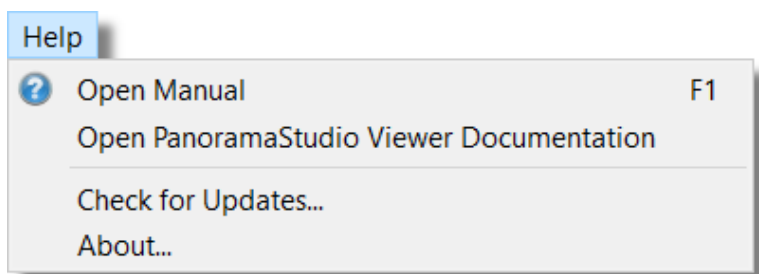
Arranges the project windows vertically in a non-overlapping style.

- **Minimize All**

Minimizes all project windows.

Figure 5.11: The *Window* menu

5.3.6 Help Menu

Figure 5.12: The *Help* menu

- **Open Manual**
Opens the PanoramaStudio manual.
- **How to order PanoramaStudio**
Provides information on how to purchase PanoramaStudio .
- **Enter License Key**
Opens a dialog box to enter the license key you obtained for PanoramaStudio .
- **About**
Shows program information.

5.4 Image Manager

You can open the *Image Manager* with *View→Image Manager* or with the *hamburger* button on the right side of the actions bar. It shows in any stage of the panorama creation an overview of the used input images. The image manager shows image information for each image in the panorama and after the image alignment the detected parameters.

After the image alignment you can use the image manager e.g. to open an edit mode for a specific input image (chap. 6.5, 6.14.1, 6.14.2, or 6.6). You can also edit the mask of a specific image (chap. 5.5.1, p.31) or enable the viewpoint correction or replace selected images with others while keeping all calculated parameters for each replaced image.

After the image alignment you can review in the *Alignment* category the detected focal length and the lens parameters for all images. Click on the focal length to edit the focal length and camera parameters (chap. 6.3, p.53). By clicking on the lens parameters in the multi-row mode of the Pro version you can also the edit lens parameters and vignetting (chap. 5.5.5, p.34).

Add Add images before the alignment step.

Remove Remove selected images before the alignment step.

Replace Replace images after the Render stage e.g. allows for HDR panoramas to render first a panorama from one exposure step and then using *Replace* to create an identical panorama of the corresponding images of another exposure step.

Image parameters Allows to apply corrections only on selected images. You can enable this option to apply the *Viewpoint correction* for selected images (Pro version) and after the initial image alignment you can also enable *selective alignment* as well as *selective exposure correction*. You can then enable or disable particular corrections for selected images with a checkbox in the corresponding column. That way you can also exclude particular images from further changes, for example of the exposure or the alignment, when *Optimize alignment* is applied.

Show [categories] The image manager can display various properties for each image. Use *show* to configure which properties are displayed.

Optimize alignment Tries to improve to alignment of the images in an additional run. Helpful, for example, to apply a previously enabled viewpoint correction.

5.5 The Dialog Boxes

5.5.1 The *Edit Mask* Dialog Box

You can mask the input images of the panorama. With a mask you can prevent unwanted regions of an image from being used in the panorama. This allows to exclude moving persons (which would otherwise maybe appear twice in the result), a tripod or other moving objects within the overlapping regions of the images from being used in the resulting panoramic image.

With this dialog box you can edit the mask of an image. Choose an image from the list and edit the mask with the mouse. You can add regions to the mask with the left button and remove regions with the right button. With the controls on the right side of the dialog box you can change the brush size and the preview color indicating the mask.

Select all Mask the entire image so that it is not visible in the panorama.

Delete mask Delete the current mask.

Copy Copy the mask to the clipboard.

Paste Apply the mask from clipboard on the current image.

Load mask Load and apply a saved mask.

Save mask Save a mask as PNG image file.

5.5.2 The *Image Information* Dialog Box

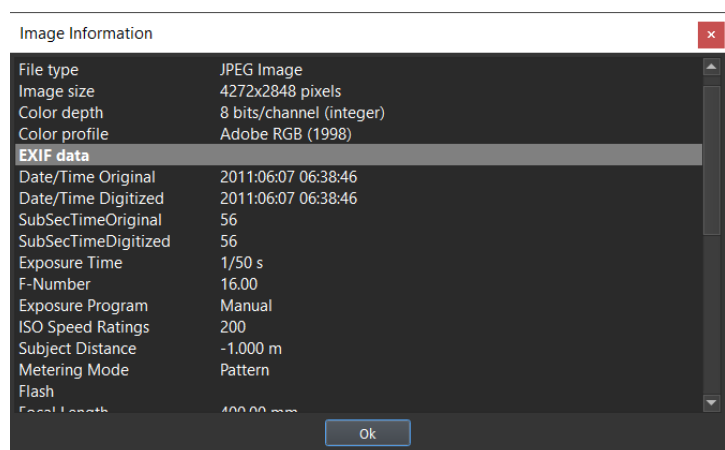


Figure 5.13: The *Image information* dialog box

This dialog box provides information about the selected image in the current project. This information comprises location on the storage device, file type and image dimensions. If available, existing Exif information will be displayed as well. This includes focal length, exposure, ISO setting, aperture, etc.

5.5.3 The *Panorama Properties* Dialog Box

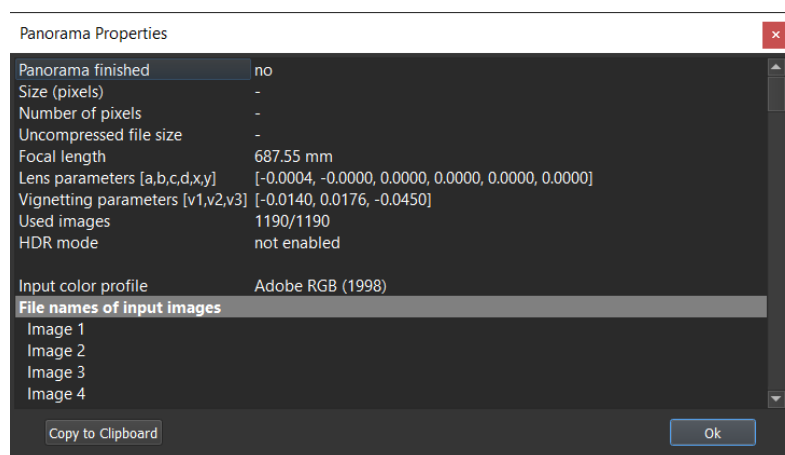


Figure 5.14: The *Panorama properties* dialog box

The *Panorama Properties* dialog box displays information on the created panorama, especially the pixel dimensions, the corresponding size expressed in megapixels, the applied focal length and the resulting covering angle of the entire panorama.

5.5.4 The Control Point Editor

To edit the image alignment for panorama you can use the control point editor as an alternative to the *Change Image Alignment* mode. The images of a panorama are connected with pairs of control points. PanoramaStudio tries to match the control points in the alignment stage as exactly as possible. To modify the image alignment you can therefore add, edit, and delete control points in this editor.

On the working area of this dialog box you can contrast one image with another. You have the option to select the images from the image lists above the working area or you can select an existing pair of linked images with a double-click in the *Image Links* tab.

The list on the *Image Links* tab shows all existing image connections. It shows each link with the number of control points and their average difference in the aligned panorama. The difference is a measure on how good the images are matched. Bad values are an indicator for a wrong image link or for at least some bad control points. If numerous image links have a bad alignment then this is an indicator for a wrongly set focal length or strong lens distortion.

Edit Image Links and Control Points

To add an image link open the two corresponding images in the editor and add at least three control points. If two images are connected wrongly, you can remove the connection using *Remove Link*.

Add a control point pair using the *Point Tool* by selecting a common feature in the two images in the left and right editor window. With the *Area Tool* you can select common areas and PanoramaStudio will automatically search and add control points within these areas.

To delete existing control points, select them in the *control point* list or in the working area and remove them with the *Del* key. With the *Point Tool* active you can drag and adjust bad placed control points with the mouse. PanoramaStudio shows a small magnifier attached to the mouse pointer or the selected control point to allow a better estimation of the control point position. The exact position of the control point accords to the cross-hair in the middle of the magnifier. For exact positioning, a selected control point can be moved pixel-precise using the cursor keys.

With *Re-arrange All Control Points* PanoramaStudio calculates all control points again based on the current parameters and all current image links. The command *Remove Bad Control Points* checks all control points in the panorama and deletes automatically control points, if they are classified as bad or wrongly assigned.

PanoramaStudio re-aligns the images with *Update Alignment* and updates the information about the quality of the control points. The images of the panorama will be re-aligned also if you leave the editor with *OK*.

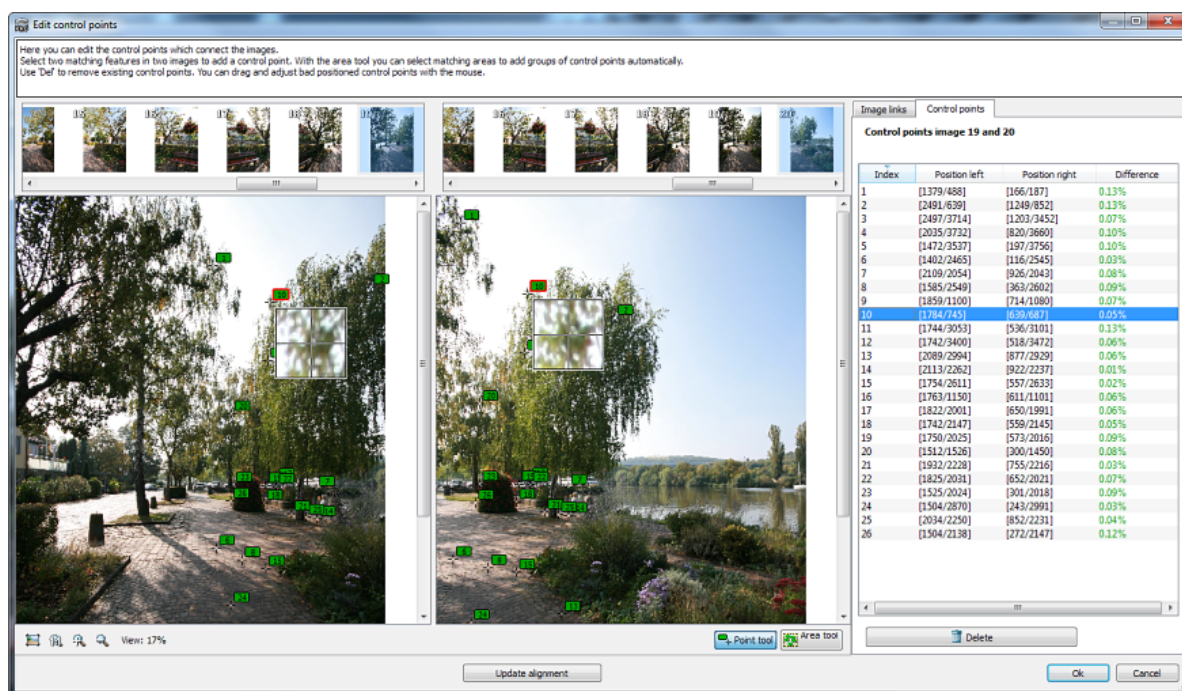


Figure 5.15: The control point editor

5.5.5 Lens Parameters and Vignetting

This dialog box for the configuration of lens parameters and vignetting allows to manually adjust the automatically detected parameters. When you deactivate the *auto-detect* option then manually modified parameters will be used even when the automatic alignment is reapplied. You can edit focal length, lens type and the lens distortion parameters. You can also edit the detected parameters of the vignetting correction.

Lens database Use the lens database to load and save lens parameters. In this way, you can load and apply previously detected parameters for your lens on the current panorama.

5.5.6 The *Create Projection* Dialog Box

Planar/Perspective Projection

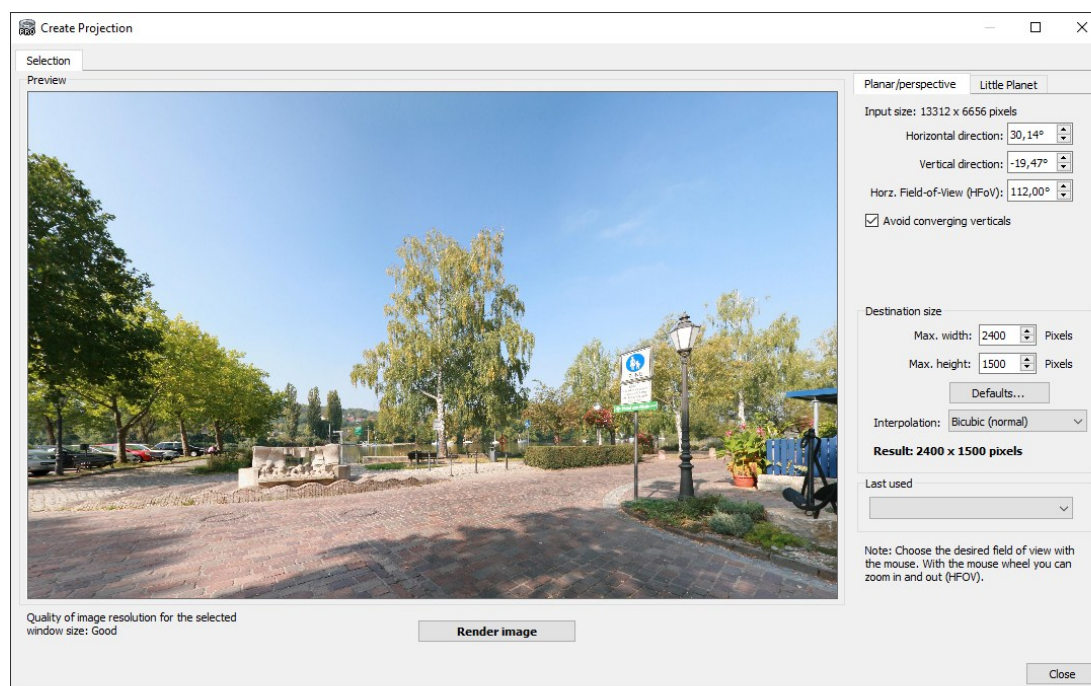
The completed panorama is either represented by a cylindrical or a spherical projection. Such images get bended when displayed on a flat surface rather than a cylinder or a sphere. Horizontal, straight lines turn into curves. On the other hand, a flat surface may not display a 360 degree panorama otherwise. However, it is possible to extract regions of the image for flat presentation so that they actually look like being taken with an ordinary camera. This is the purpose of *perspective* or *planar projection*.

The dialog box for planar/perspective projections enables you to extract views from the panorama with a covering angle of up to 160 degrees. Thus, it is possible to artificially create images which actually would have required a super wide angle lens under real world conditions.

For this purpose, the dialog box provides a preview as it can be seen in figure 5.16. It shows a certain section of the panorama. With the left mouse button pressed, you can scroll left, right, up, and down. With the mousewheel you can zoom the view in and out.

The section may also be set explicitly by specifying numerical values in the *Parameters* box. The input boxes *Horizontal direction* and *Vertical direction* are to specify the viewing direction. Possible values for horizontal direction range from 0 degrees to 360 degrees depending on the panorama. The vertical direction theoretically may vary between -90 degrees and +90 degrees whereas negative values symbolize viewing downwards and positive values symbolize viewing upwards.

The *Horizontal field-of-view (HFOV)* expresses the angle which covers the visible image area along a horizontal line. This value directly corresponds to the focal length or zoom level the image was actually shot with the camera.

Figure 5.16: The *Create projection* dialog box

So called *converging lines* are often an unwanted effect e.g. in architectural photography. Tilting the camera up or down results in converging verticals. Straight, vertical lines appear no longer vertical, objects (buildings) seem to tilt backwards. Enable the option **Avoid converging verticals** to avoid this effect and keep verticals vertical up to a certain tilt of the virtual camera.

The option **Restrict to valid area** restricts the virtual camera to areas, which are covered by the panoramic image. If you disable this option you can pan the camera within the complete environment.

When calculating the image, an **interpolation** is used to achieve better quality. There are several interpolation methods available for this. In addition to the conventional **Bilinear** and the more precise **Bicubic (normal)** interpolation, PanoramaStudio also offers some more complex methods.

The **Bicubic (sharper)** and **Bicubic (smoother)** are variants of the bicubic interpolation. These methods use the surrounding 4x4 pixels to calculate a resampled pixel which preserves details and at the same time avoids jagged edges and other artifacts of the image projection.

The methods **Lanczos3 (sinc36)**, **Lanczos4 (sinc64)**, and **Lanczos8 (sinc256)** are more complex and computationally expensive. These methods use the surrounding 36, 64, oder 256 pixels to calculate a sharp result and to preserve as much details as possible while avoiding artifacts of the image projection. However, apart from the **None (Nearest Neighbor)** option, the visible differences are very subtle. Therefore, the recommended method for most images is the normal bicubic interpolation.

To specify the pixel dimensions of the new image, enter the desired values in the **Destination size** box. **Defaults** provides some frequently used standard values. **Max. width** and **Max. height** allows to specify custom values. For example, a pixel dimension of 4000 x 1800 pixels corresponds to about 5 megapixels, which is sufficient for printing in letter format. Note that the **Destination size** box specifies only maximum values. The actual image dimensions can be smaller in case of unsufficient width or height of the original panorama. The resulting dimensions are displayed in the **Result** line. The preview area shows the actual resulting display window.

Further on, image quality of the perspective projection depends on the size of the panorama. Thus, the line **Initial size** in the **Parameters** box displays the size of the underlying panorama. The initial size gives an idea for reasonable dimensions for the projected image. Destination sizes unreasonably exceeding the initial sizes will cause blurred image details due to extensive magnification. The same applies for projections with high zoom settings - blurring will be clearly identifiable with the preview in such cases. To assist you selecting reasonable projection parameters, PanoramaStudio rates your current settings

at **Quality of image resolution for the selected window size**. This rating comprises destination size, display detail and initial pixel dimensions.

In the **Recently used** field you will find the last used settings and can reapply a projection this way (Field-of-View and size).

The **Render** button triggers the generation of the projected image as displayed in the preview area with the specified dimensions. When done, the dialog box switches to the **Result** tab to show the rendered image. This tab allows you to save the image (**Save as...**) or to print it using the built-in poster printing feature (**Print...**).

Little Planet Projection

Besides the option for planar projection you can also create so called *Little Planets* or stereographic projections from a panoramic image. This projection type is especially suitable for full spherical 360x180 degree panoramas created with the multi-row mode of PanoramaStudio Pro. The **Little Planet** projection displays a spherical panorama projected from above onto a plane. This allows to create fascinating views for suitable panoramic images.



Figure 5.17: *Little Planet* projection

5.5.7 The **Edit Location (Geotagging)** Dialog Box

With *Edit location* you can assign or edit the GPS coordinates of a panorama. The GPS data will be added as metadata to the panoramic image when saved. This allows numerous other applications and online services to automatically assign the panorama to a location.

Longitude and latitude can be written in decimal notation (e.g. -74.0445) or degree notation (e.g. W74°2' 40.2" or 74°2.670' W). Alternatively, you can copy a Url from Google Maps, Bing Maps, or Yahoo Maps containing location information into one of the fields for latitude or longitude. You can furthermore define the orientation of the image center in degrees and the height above sea level in meters.

5.5.8 The *Resize Panorama* Dialog Box

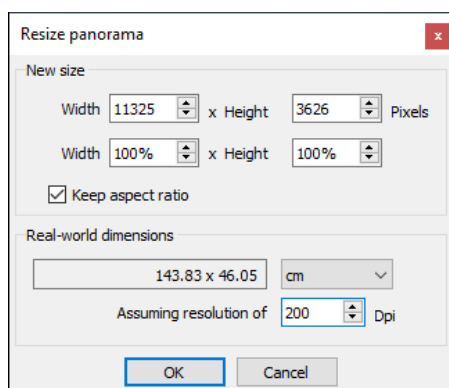


Figure 5.18: The *Resize panorama* dialog box

The pixel size of the finished panorama can be changed using *Scale*. The dialog is located together with the image processing filters under *Postprocess*.

Height, width

Change width and height of the panorama. Specify new pixel sizes for width and height either directly, or expressed as percentage. Changing a value automatically causes the corresponding value to be updated.

Keep aspect ratio

When selected, this checkbox causes width and height to be updated so that the original aspect ratio always remains constant.

Real-world dimensions

Computes the real-world image dimensions for the panorama assuming it is printed or displayed at the given resolution. You may choose from *mm*, *cm* and *inches*. The *Assuming resolution* textbox allows you to enter an arbitrary resolution given as *Dpi* (pixels/inch) as input to this computation.

5.5.9 Filters for Optimizing Image Quality

Most of the following filters are now available in a new form, as non-destructive filters and with a real-time preview under *Postprocessing* (chap. 6.11 (→ p.67)).

Only *Sharpen* and *Unsharp Mask* are still used in the regular mode. The other filters described here are only used in classic, single-row mode.

The following filter dialogs each have a preview in common. The two buttons under the preview allow to switch between a split view and a regular view. With the split view, you may directly compare the original image with the filtered one whereas the regular view only displays the latter.

All filter dialog boxes can be closed without any effect by clicking *Cancel*. *Reset* restores the settings when the dialog box was opened.

Sharpen

Sharpen offers simple sharpening with three levels of intensity to choose from.

Unsharp Mask

Although the name suggests otherwise, this filter is a high-quality sharpening filter. The name comes from the fact that for sharpening, the image is compared with a blurred copy and the differences are used to enhance contrasts. With the *Radius* box you can adjust the radius where sharpening information for

a pixel will be searched. *Threshold* determines the minimum brightness difference to the original pixel sufficient to replace it.

Filters for the Classic, Single-Row Mode

Brightness/Contrast

Adjusts contrast and brightness of an image. Additionally, *Gamma* correction can be applied to brighten or darken the midtones of an image. In general, the latter method performs better since light and dark areas remain unchanged.

Tone Curve

The *Tone curve* dialog box enables you to redistribute the levels of luminances. It provides a histogram illustrating the luminance distribution by clustering the pixels according to their gray value for your convenience. Initially, the dialog box starts up with no changes to the luminance distribution which is represented by a straight line from the lower left to the upper right corner of the graph. Each point of this tone curve corresponds to a distinct original luminance value and some destination luminance value. The original value can be found in the horizontal gray scale beneath its corresponding point, and the destination value is displayed by the vertical gray scale to the left at the vertical position of the point. Moving or bending the tone curve upwards for example would brighten the image.

Additionally, this redistribution can be applied to single color channels specified by the *Channel* listbox in the same way. The *Mode* listbox offers three manipulation procedures for the tone curve:

- **Manual:** The course of the tone curve can be modified by redrawing it with the mouse. Applying the *Smooth* button will smooth the curve.
- **Curve:** Set anchors by clicking with the mouse and move them around to the desired position. Pulling one anchor very close to another one removes it. These anchors specify the tone curve which is automatically interpolated through all of them.
- **Linear:** Anchors are to be set and moved around like in *Curve* mode. In contrast to the previous mode, this mode generates the tone curve by directly connecting the anchors with straight lines.

Load and *Save* enables you to save your custom redistribution settings for later use.

Levels

The *Levels* dialog box serves to adjust the luminance distribution of the image. The ruler for the *Input values* limits the input luminance range. This range will be stretched to the range given in *Output values*. To enhance contrast for example, limit the input range, but leave the output range maximal. While light and dark areas will collapse, the contrast for the midtones will increase. To make the image look foggy, leave the input range maximal but compress the output range. The entire image will loose contrast. Very light and very dark areas turn foggy.

Additionally, the *Gamma* ruler enables you to apply a gamma correction to the result of the levels transformation.

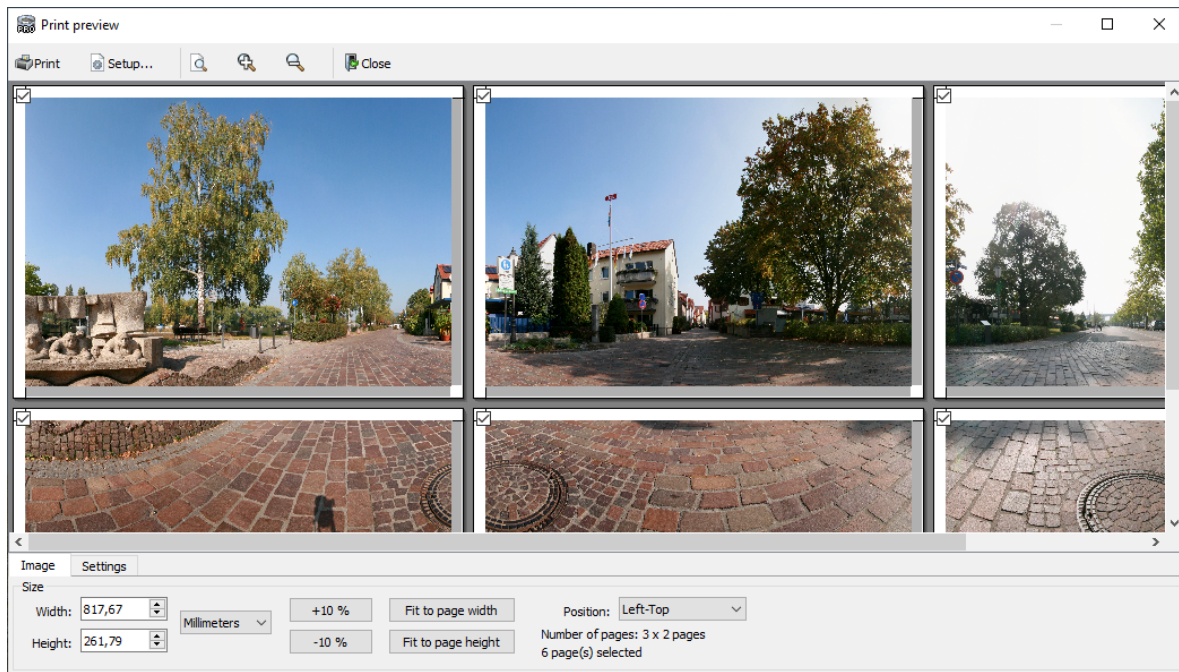
All operations may be applied either to all colors at once (grey channel), or to each color channel, namely red, green and blue, at once.

Color Balance

The *Color balance* control enables you to perform color correction in selected light, mid or dark areas of the picture. Incorrectly balanced colors in a picture can be corrected by adjusting the balance between *red-cyan*, *green-magenta* and *blue-yellow*.

5.5.10 Print Preview Dialog Box

You can adjust the size and position of the image to be printed, and configure your printer using the *Print preview* dialog box. A panorama can be printed on a single sheet of paper, or in poster size on any number of sheets. Additionally, you can print crop marks and glue edges.

Figure 5.19: The *Print preview* dialog box

The preview window

The chosen position and arrangement of the panorama picture on the poster pages can be viewed in the preview window. Particular problems, for example low ink levels, can occur when printing a poster on more than one page, sometimes making it necessary to re-print some pages. For this reason, each page in the print preview has a checkbox. If every page is checked, the entire poster will be printed. To re-print individual pages you should open the pop-up menu by a right-click. There, you can call *Deselect all* and mark just the desired pages again.

The toolbar

- **Print** - Starts the printing process
- **Setup...** - Opens the System dialog, so you can select and configure the printer (e.g. page orientation)
- **Fit poster** - Fits all pages of the displayed poster into the preview window.
- **Zoom in** - Increases the size of the previewed image
- **Zoom out** - Decreases the size of the previewed image
- **Quit** - Closes the Print Preview

Image

- **Width, Height** - Here you can define the exact size of the image to be printed, in millimeters or inches
- **-10%, +10%** - Increases or decreases the present size of the image in 10 percent increments.
- **Fit to page width, Fit to page height** - increases the size of the panorama image so that the width or height corresponds to the width or height of the allocated page.
- **Position** - Here you can determine the position of the panorama on the paper.

Settings

- **Page Borders** - This is used to specify the page margin, again in mm or inches.
- **Markers: Crop marks and glue edges** - Mark these fields when you want to print crop marks or glue edges with your picture. The glue edges indicate where to apply the adhesive used to stick the individual pages together. Crop marks show you where to trim the pages in order to obtain a borderless poster.
- **Trapping** - One of the difficulties encountered while joining the individual pages is the accurate cutting of page edges. The slightest inaccuracy can lead to white edges showing between glued sheets.

This can be avoided by using the *trapping* tool, which enables you to print an overlap of up to 2 mm, at the left and upper page edges. This means you don't have to cut the sheet edge quite so precisely, and you can also avoid gaps when gluing the sheets together.

5.5.11 The *Save as Image* Dialog Box

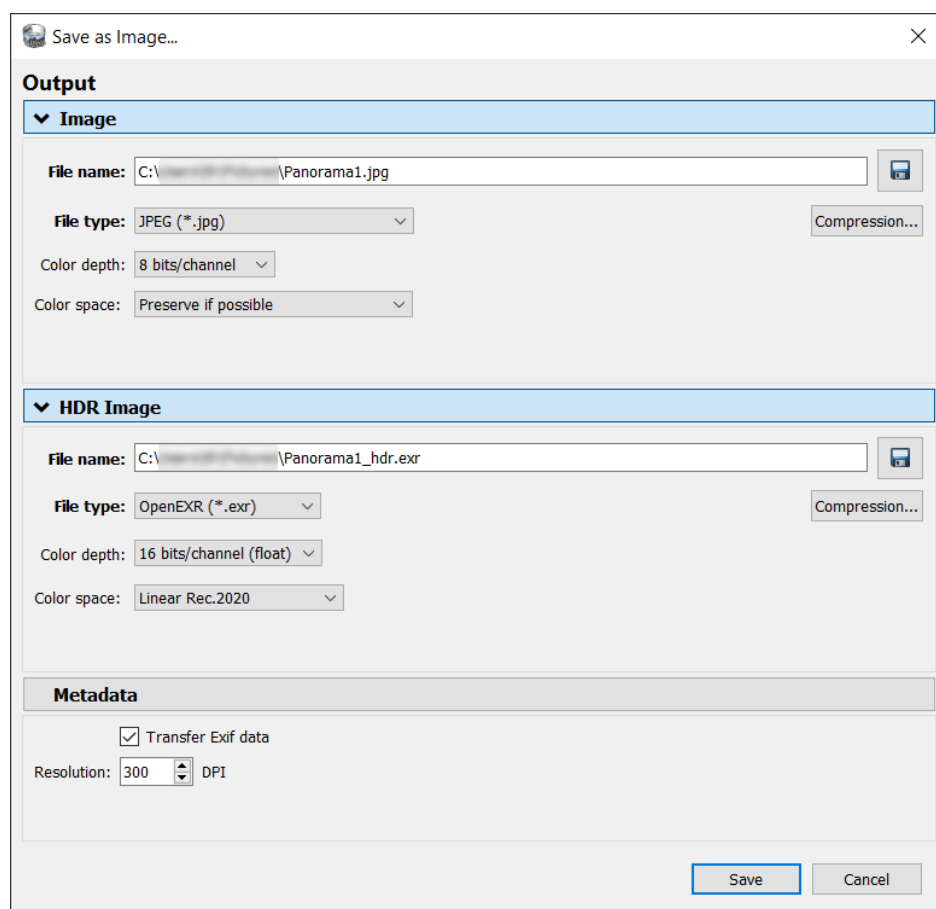


Figure 5.20: The *Save as Image* dialog box

The panorama can be exported as an image using the *Save as Image* dialog box. Besides the image format, other settings such as compression, color depth, color profile and the addition of metadata can also be configured.

In the Pro version, panoramas can be exported both as a conventional image suitable for display (*Standard Dynamic Range / SDR*) and as an HDR image with a *High Dynamic Range* - for example to be processed further in HDR software.

Image / HDR Image

By clicking on the save icon or the suggested file name, you can set the output path and the *File name* in the following save dialog. Select the image format under *File type*. For most formats, you can make further specific settings under *Compression*. You can also select the desired *Color depth*. For normal images, the options are 8- or 16-bit, if supported by the image format. When exporting as an HDR image, the possible color depths also depend on the selected format.

PanoramaStudio processes all data internally in a special color space in HDR color depth, which is why the *Color space* can still be freely selected during output. For normal images, it is a good choice to keep the input color space. If the image is to be used later in a website, the standard color profile *sRGB* is recommended. Other color profiles can be selected for both images as well as HDR images from the corresponding list under *Color space*.

Metadata

If the option *Transfer Exif data* is activated, the adjusted Exif metadata of the first individual image is transferred to the panorama image when it is saved. In this way, you can transfer camera and location information to the panorama image, for example.

A DPI specification may be necessary for specific applications. If required, enter the desired value under *Resolution*.

5.5.12 The *Save as Interactive Panorama / Zoom Image* Dialog Box

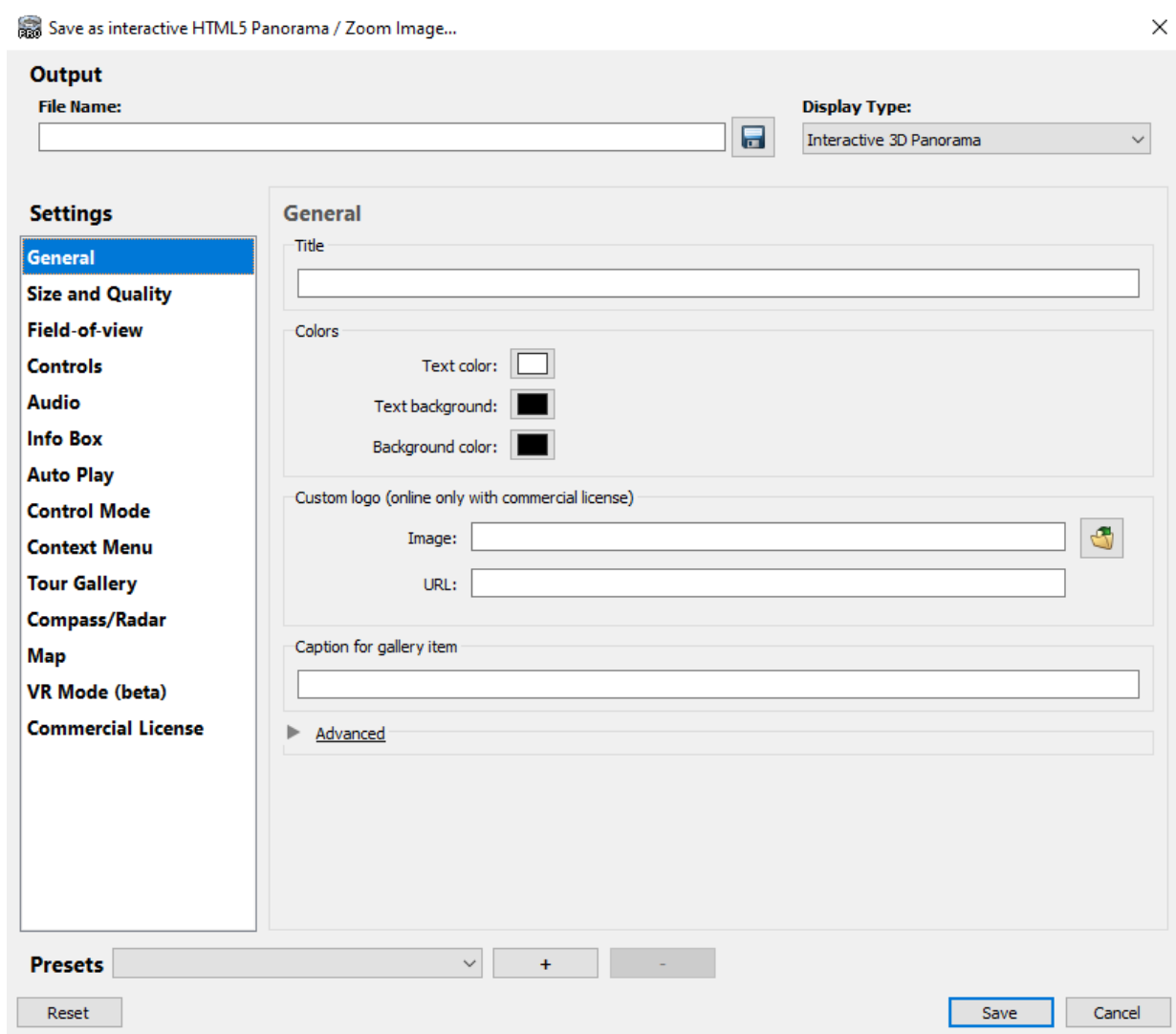


Figure 5.21: The *Save as interactive Panorama / Zoom Image* dialog box

This dialog box is used to save the panorama as interactive 3D panorama or as 2D zoom image. The visitor can freely look around in such a panorama and interact with it by mouse or touch.

PanoramaStudio provides its own viewer for this purpose, the so-called *PanoramaStudio Viewer*. This is a standalone web application based on HTML5, which allows to view interactive panoramas in any current web browser, both locally on the computer and online integrated into any webpage. In the dialog box the *PanoramaStudio Viewer* is configured and when you save it then, all the necessary files are created automatically.

If hotspots were previously inserted into the panorama, then several connected interactive panoramas form a virtual tour. You can find more about this also in chap. 6.12 (→ p.69).

Output

When you save a panorama for the Viewer, a number of files are created in the target folder. The main file is an HTML file that is specified under *File Name* and is displayed in the browser after it is saved. Furthermore, .js or .json files containing the configuration and parameters are created, a folder with the image data and the Viewer files itself are copied to the target folder. To view such a panorama, just open the HTML file. If you want to copy or move such a panorama, please make sure that all files belonging to the panorama are copied. The easiest way to do this is to save the panorama into an empty folder and copy the entire folder each time.

With the selection at *Display Type* you can select if the panorama is displayed as a flat 2D zoom image or as interactive 3D panorama. In a 3D panorama the viewer is in the center of the scene and can look around. In a 2D zoom image the user can zoom and scroll in the image.

Settings

Under the selection *Settings* the various configuration options are organized into categories as follows:

General

You can enter a name for your panorama in the *Title* field. This name will appear in the Viewer's title bar. You can select the color and background color of the embedded text with the *Text Color* and *Shadow Color* buttons. The *Background Color* option is used for zoom images when the image does not fill the entire Viewer and the background becomes visible. Furthermore, a Viewer with the commercial license allows to show a custom (company) logo in place of the PanoramaStudio Viewer logo. Therefore you can select an image file as logo at *Own logo*. The *URL* field can be used to provide a hyperlink on your logo. At *Caption for gallery item* you can add a short text used as caption of the preview image if the panorama is part of a thumbnail gallery in a virtual tour.

In the box *Advanced: extension of parameter files* the extension of the parameter files can optionally be changed to `.json` for better clarity (JavaScript Object Notation). Strictly speaking, however, the parameter files are JavaScript. For a better compatibility on various, current web servers, the parameter files should therefore be created as `.js`.

Size and Quality

In the *Display in browser* box you can set the size of the Viewer window in pixels or percent. This is the size of the panorama window as it is displayed in the browser. If the *Fit to page* option is enabled, the panorama or zoom image will cover the entire browser window.

Use the *Output size* option to save a downscaled version of the panoramic image. But, since the *PanoramaStudio Viewer* loads only the parts of the image which are necessary for display, the output size has not that much influence on the bandwidth or the loading time. Therefore you can also save very large panoramas in full size even for displaying them on websites. Large panoramas just need more disk space.

By adjusting *Image Quality/File Size* it is also possible to affect the output image material. This allows you to choose between higher quality or smaller files by setting the JPEG compression.

Field-of-View

The easiest way to set the initial field-of-view is in the graphical preview using *Set in preview mode*. It opens another dialog box showing a view similar to the initial display of the saved panorama. There you can set the position and the field-of-view with the mouse and the mouse wheel, respectively.

You can also set viewing direction numerically with the parameters *Pan* and *Tilt*. They respectively determine the position of horizontal pan and vertical tilt of the field-of-view. You can adjust the extent of the initial field-of-view by setting the *HFov* (horizontal field-of-view). In the *Min* and *Max* fields you can set the smallest and largest field-of-view. Usually, using a low resolution means there's no reason to set a very low value here, as zooming in too tightly merely reveals a lack of detail. In this case, it is useful to limit yourself to a relatively large minimum field of view.

Controls

The Viewer offers optional controls for navigation and information. Check *Include controls* to add these to the interactive panorama. The option *Initially hidden* minimizes the controls and shows just a small button in a corner of the Viewer, which will unfold the controls with a click.

Select the desired look from several default settings with the *Design* drop-down box and select the preferred placing of the controls with *Position*.

Select one of several, predefined looks in the *Design* dropdown menu. Place the controls on the preferred position in the interactive panorama.

- **Show 'Play' button** Adds a button to start/stop the Auto play.

- **Show fullscreen button** Adds a buttons to switch the panorama into fullscreen mode.
- **Show Info box at startup** If an *Info box* is present, show it when the Viewer starts.
- **Show arrow buttons** Adds arrow buttons for navigation.
- **Show 'Zoom in/Zoom out' buttons** Adds buttons for zooming in and zooming out.
- **Show 'Audio on/off' buttons** Shows an audio button if an audio element is present in the panorama.
- **Add 'Gyroscope' button** Adds a button to enable and disable the control of the panorama with the motion sensors of the device. This button is available, if this control option is enabled and if the device has motion sensors.
- **Add 'Show/Hide hotspots' button** Adds a button to show or hide the hotspots in the panorama.

Audio

The *Background music or sounds* input box allows to embed a MP3 sound file into the panorama. Enable the option *Use for all panoramas of a virtual tour* to play the audio file continuously without stopping when the Viewer enters another panorama - as long as the new panorama does not provide an own audio file.

Info box

The *Info box* is an optional field for information or notifications with text and images. The information box is optionally shown at startup or when the *Info* button is clicked. The field can contain arbitrary HTML formatted text, images and other HTML elements. Enable the option *Use for all panoramas of a virtual tour* to show this info box also in other panoramas of a virtual tour if the *Info* button is clicked.

Auto play

The parameters for automatic playback of the panorama can be set under *Auto Play*. If the user interacts with the viewer, the auto-play stops and starts again after the time set in *Restart after user action*. The speed and direction of movement can be set with the values *Pan rate*, which is a horizontal pan, and *Tilt rate*, which is a vertical pan. The speed can be set under *Reference* either in relation to the total panorama in degrees per second or in relation to the screen in percent per second. If a pan hits the edge of the panorama, the direction of movement is reversed. It is similar with the automatic zoom under *Zoom rate*. There is no zoom at a value of 1.0. Values less than 1.0 zoom into the panorama, values greater than 1.0 zoom out of the scene.

The option for a *LittlePlanet Intro* is available for 360x180 panoramas. If enabled, it shows the panorama at startup in a Little Planet view and performs an automatic pan from this initial view to the regular view which can be configured in *Field-of-view settings*....

Control mode

Configure the properties for the interaction with the Viewer.

With *Mouse control* and *Touch control* you can configure the control type for mouse and touch devices. Set it to *Move camera* to pan the scene in the direction of the movement, set it to *Drag image* to grab and drag the panorama.

The parameter *Zoom with mouse wheel* provides two options. It can optionally zoom to the image center or it can zoom onto the position of the mouse cursor.

Enable the option *Add gyroscope control* to control the view in the panorama optionally with the motion sensors of suitable devices.

Context Menu

If the option *Add context menu* is enabled, then the Viewer shows a context menu on a right mouse button click or a long tap on touch devices. The entries of this context menu can be configured.

Besides entries for fullscreen mode or a switch for Little Planet view and regular view, you can also insert a configurable entry at *User-defined entry*. The entry requires a *Caption* and a JavaScript action which is

executed when the item is clicked. The action can contain arbitrary JavaScript and in particular functions to control the Viewer. A detailed description on how to control the PanoramaStudio Viewer can be found in the *PanoramaStudio Viewer documentation*.

Tour Gallery

The *Add gallery* option can automatically create a thumbnail gallery of multiple panoramas and embed this gallery in the Viewer window.

If enabled PanoramaStudio registers all other interactive panoramas in the output folder when saving. It creates preview images of these panoramas for a thumbnail gallery which can be displayed in the Viewer. Additionally you can add buttons to navigate to the previous or next panorama on the left and right edge of the Viewer or embedded in the controls bar. The thumbnails are displayed in a row which can be placed above or below the controls.

Compass/Radar

You can visualize the viewing direction in the panorama with a compass or radar element.

Orientation information of the panorama is required to enable this option. If this is not defined yet, you can add/edit the orientation with *Edit location and orientation...*

See also chap. 5.5.7 (→ p.36).

You can then choose from various compass and radar designs either as stand-alone element on the panorama or embedded in the controls.

Map

The map feature allows to show the locations of the current panorama and other panoramas of a virtual tour on a map.

If location information for the panorama is available, then you can enable the map with *Display location on map*. Otherwise you can first add location information with *Edit location and orientation...*. See also chap. 5.5.7 (→ p.36).

When saving PanoramaStudio registers also all other panoramas in the output folder. Each of these panoramas with location information is displayed with a marker on the map.

You can place the map above or below the controls bar with the *Position* selection.

The Viewer uses *Google Maps* and embeds the provided map with with the *Google Maps JavaScript API*. To use the Google Maps platform you need an *API key* which you can request at Google. Depending on the number of page views, costs for the use of the *Maps JavaScript API* may be incurred at Google. However, most use cases will be free.

Under the following link you find further information and the option to request an API key at Google:

<https://developers.google.com/maps/documentation/javascript/get-api-key?hl=en>

Enter the API key at *Google Maps API key* to use the map. You can then configure various properties such as the *Map type*, *Initial Zoom*, *Zoom controls* and *Map type controls*.

You can also add a radar overlay to visualize the viewing direction in the current panorama on the map (See *Compass/Radar*).

VR Mode (beta)

The VR Mode (currently in beta phase) provides the option to display panoramas in VR on mobile devices and VR headsets such as Google Cardboard, GearVR, or stand-alone headsets like Oculus Go. It uses WebXR or the older WebVR, if supported by the browser, otherwise an emulated split screen display is used, for example on smartphones used with Google Cardboard.

The VR mode requires spherical 360x180 degree panoramas. Partial panoramas can not be displayed in VR.

Commercial license

It should be noted that the use of the *PanoramaStudio Viewer* on commercial websites requires a separate license for the viewer. If you have purchased a license for this case, you can enter it on this tab. Further information and the current version of the Viewer can be found here on the website: http://www.tshsoft.com/en/psv_index

Presets

All of the above settings can be saved under *Presets* for reuse.

5.5.13 The *Edit Camera Settings* Dialog Box

In this dialog box you can enter data for digital cameras which are identifiable by their EXIF information. The technical data for the focal length of the digital cameras as well as their EXIF identifier are required:

Name

In the *Name* box, you can enter the camera maker and model, as you wish them to appear in the program.

Entering the camera specifications using the specification via 35mm equivalent focal length or focal length multiplier

The camera or lens attributes can be entered in the *35mm equivalent focal length* or *focal length multiplier* fields. The 35mm equivalent focal length is the more commonly used in compact digital cameras and describes the focal length required to produce results equivalent to those achieved by an analog camera loaded with 35mm film, whereas a focal length multiplier is common in digital SLR cameras with interchangeable lenses. The factor is identical to the size of the camera's digital image sensor relative to a 35mm film negative.

Entering data via 35mm equivalent focal length

35mm equivalent focal length Here, you can enter the focal length in a form identical to that of a 35mm analog camera. The focal length equivalent to 35mm camera can usually be found in the manufacturer's technical data. Enter the minimum and maximum focal lengths in the corresponding fields. If your camera has a *fixed focal length*, in other words, no optical zoom, enter the same value in both fields. For more information on focal length read chap. 4.3 (→ p.9).

Effective focal length of digital camera

In this box you can enter the effective minimum and maximum focal lengths. These are usually smaller than the 35mm equivalent focal lengths. Again, the information can usually be found in the manual. For fixed focal length cameras, with no optical zoom, it's once again necessary to enter the same value in both field.

Entering the data using the focal length multiplier

When entering the data using the focal length multiplier, you need to enter only this value. Digital SLR camera users can often find this multiplier in the camera's technical data. Otherwise, it is possible to calculate it by working out the size of a 35mm negative (36x24mm) in relation to the digital CCD or CMOS camera sensor. Common values are 1.5 or 1.6.

EXIF ID of the camera

If you insert a new camera manually, you can enter the identifier by which the camera is to be recognized through its image files. To identify the camera, the *MAKE* and *MODEL* tags are evaluated. Therefore, you have to enter here exactly the respective values.

We recommend using the *Focal length and horizon* dialog box for adding a new camera. There, you can switch to this *Settings* dialog box with the *New camera...* button, if the camera is not already found in the database, but contains nevertheless the necessary EXIF information to be recognized here. In this case PanoramaStudio will already have completed the fields for the EXIF ID.

5.5.14 The *Rotate Image* Dialog Box

(Only for classic, single-row panoramas and in document mode)

The *Rotate image* dialog box allows you to rotate an image by an arbitrary angle very precisely.

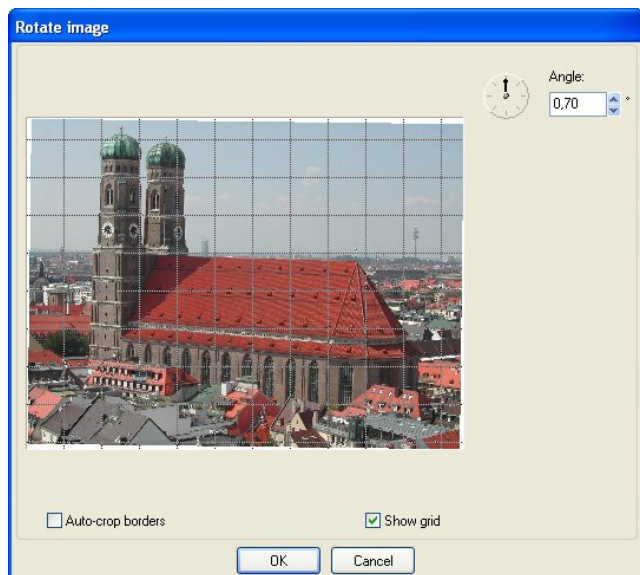


Figure 5.22: The *Rotate image* dialog box

Therefore, even subtly misaligned shoots may be corrected so that the horizon will match horizontally again. This is critical for assembling the images, because adjacent images can only be merged correctly when all images are in line with each other.

The option *auto-crop borders* automatically crops the undefined areas caused by rotating the image. A grid can be displayed by clicking *Show grid* for better orientation while rotating.

5.6 Keyboard Shortcuts

Here is a list of commands for which shortcuts PanoramaStudio provides a keyboard shortcut.

Command	Shortcut
New Project	Ctrl+N
Open Project	Ctrl+O
Save Project	Ctrl+S
Save Project as...	Ctrl+U
Import Images...	Ctrl+I
Save as Image...	Ctrl+J
Save as Interactive Panorama...	Ctrl+D
Print Panorama...	Ctrl+P
Close Project	Ctrl+X
Zoom In	Num+
Zoom Out	Num-
Original Size	F8
Overview	F10
Image Manager	Strg+M
Mask Current Image	Ctrl+G
Edit Location	Ctrl+L
Create Projection	Ctrl+Y
Select All	Ctrl+A
Deselect All	Ctrl+B
Reverse Order	Ctrl+T
Rotate Right	Ctrl+W
Rotate 180 Degrees	Ctrl+E
Rotate Left	Ctrl+R
Remove Selected Images	Del
Replace Selected Images	Ctrl+H
Edit → Change Settings / Focal Length	Ctrl+Shift+F
Edit → Edit Mask	Ctrl+Shift+G
Edit → Edit Control Points	Ctrl+Shift+K
Edit → Change Image Alignment	Ctrl+Shift+A
Edit → Adjust Exposure Correction	Ctrl+Shift+E
Edit → Straighten Horizon	Ctrl+Shift+H
Edit → Insert Graphics	Ctrl+Shift+I
Parameters	F2
Create Panorama	F3
Create 360 Degree Panorama	F4
Render	F5
HDR	F6
Hotspots	F7
Help topics	F1

5.7 Command Line Parameters

There are several command line switches which allow to start PanoramaStudio from the command line and run various functions.

The options are as follows:

```
-mm          Start in panorama mode
-ms          Start in classic, single-row mode
-md          Start in document mode
-i <path>    Initial path for input files
-oi <file>   Save rendered panorama as interactive HTML5 panorama
-o <file>    Save rendered panorama as JPG image(same as -oj <file>)

-x          Quit automatically
-P <file>    Provide all parameters via text file

file(s):    one project file or a list of input images.
             Configuration options are applied on input images only, not on project files.
```

The other options are only available in the regular panorama mode:

```
-pA          Align input images
-pR          Render panorama
-pf <num>    Estimated focal length (otherwise use Exif focal length)
-pl [0-2]    Lens Type: 0(regular), 1(fullframe fisheye), 2(circular fisheye)
-pq [0-3]    Detection quality: 0(lowest), 1(normal(default)), 2(high), 3(highest)
-pi <type>   Interpolation type:
             Lin:linear,CNo:Cubic normal,CSh:Cubic sharper,CSm:Cubic smoother,
             La3:Lanczos3,La4:Lanczos4,La8:Lanczos8,Non:No interpolation

-pa          Adaptive blending, static multiband blending otherwise
-ps <num>    Render scale [0.1;1.0] (default = 1.0)
-pF          Fill gaps with interpolation of image content
-ph          Fixed orientation, the automatic horizon adjustment keeps the orientation
             of the input images
-pE          Render full 360x180 equirectangular section also for partial panorama
```

For example to stitch 4 images (img1.jpg , img2.jpg, img3.jpg, img4.jpg) with the Pro version, save the panorama as *panorama.jpg* and quit PanoramaStudio:

On Windows:

```
C:\Program Files\PanoramaStudio4Pro\PanoramaStudio4Pro.exe -mm -x -pA -pR -o panorama.jpg
-i C:\path\to\images img1.jpg img2.jpg img3.jpg img4.jpg
```

On Mac OS:

```
Open -a "PanoramaStudio 4 Pro" --args -mm -x -pA -pR -o panorama.jpg
-i /Path/To/Images img1.jpg img2.jpg img3.jpg img4.jpg
```

Chapter 6

The Editing Modes

6.1 The Input Images Mode

In *Input Images Mode*, before the panorama creation starts, the individual input images are displayed in an overview of thumbnails. Individual images can be selected with a single mouse click, while multiple images can be selected by holding down the Ctrl key. Alternatively, you can select a continuous series of images by simultaneously pressing the Shift key with the mouse.

In a regular panorama, the images are just displayed as a thumbnail preview; in a classic, single-row panorama, the individual images are presented in their full size on the workspace, and you can rearrange the selected images using *drag & drop*.

6.2 The Preview Mode After the Image Alignment

After the *alignment* of the individual images, three different views of the aligned images are offered. You can switch between the views using the tabs at the bottom of the window:

- **Input Images Overview**

In the input images overview you will see small thumbnail images of the input images and the connections between them. The connecting lines indicate with their color and the attached difference value the quality of the match for the individual image pairs. Green indicates a very good match, red a bad match. To edit an image link double-click on a connecting line to open the control point editor for this image pair. Double-click on an image to open the control point editor for this image (read also chap. 5.5.4 (→ p.33)).

Images which could not be automatically assigned to the panorama, are shown in the upper part of the window without connections to the other images. Unconnected images can be added to the panorama using drag&drop. PanoramaStudio switches then into the image alignment mode (chap. 6.5, p.57) and allows there to move the added image into the right position.

- **3D View**

The 3D view shows the aligned images spatially in a 3D environment. The preview can be displayed in three different quality levels. The *View Bar* can be used to configure the preview from *no blending* to *multiband blending* (chap. 5.2.2 (→ p.21)). You can pan around in this view by holding down the mouse button as you would with a camera. You can zoom in and out of the view using the mouse wheel.

The preview can be used to assess whether corrections are still required using the functions under *Edit* or whether the panorama can be completed using *Render*.

The 3D view in this mode is similar to how it will appear later in an interactive panorama. You can read more about interactive panoramas and the PanoramaStudio Viewer in chap. 5.5.12 (→ p.43).

- **2D View**

The 2D view shows a rough preview of the panorama as it will appear later after the image has been rendered. As in the 3D view, the quality of the preview can be adjusted in three stages via the view bar.

In this view, in addition to the image alignment and exposure adjustment of the images, you can also assess the image orientation relative to the horizon. If the panorama is displayed in a slanted,

wavy or twisted manner, the horizon needs to be straightened. To do this, go to *Edit*→*Straighten Horizon*. More on the *Straighten horizon* mode in chap. 6.7 (→ p.60).

To edit the image alignment you can either use the control point editor (chap. 5.5.4, p.33) or switch to the mode for the manual image alignment (chap. 6.5, p.57). Using *Edit*→*Adjust Exposure Correction* allows to adjust the automatic exposure correction (chap. 6.6, p.58).

Classic, Single-Row Panoramas and Documents

After the image alignment for single-row panoramas and documents you will see a full-size preview which shows already a quite precise view of the final panorama. However, the detail sharpness and especially the brightness adjustment of the final panorama will clearly be even more improved over this preview. On the basis of this preview you can switch in various edit modes for manual adjustments or you can continue with the *Render* mode and finish the panorama.

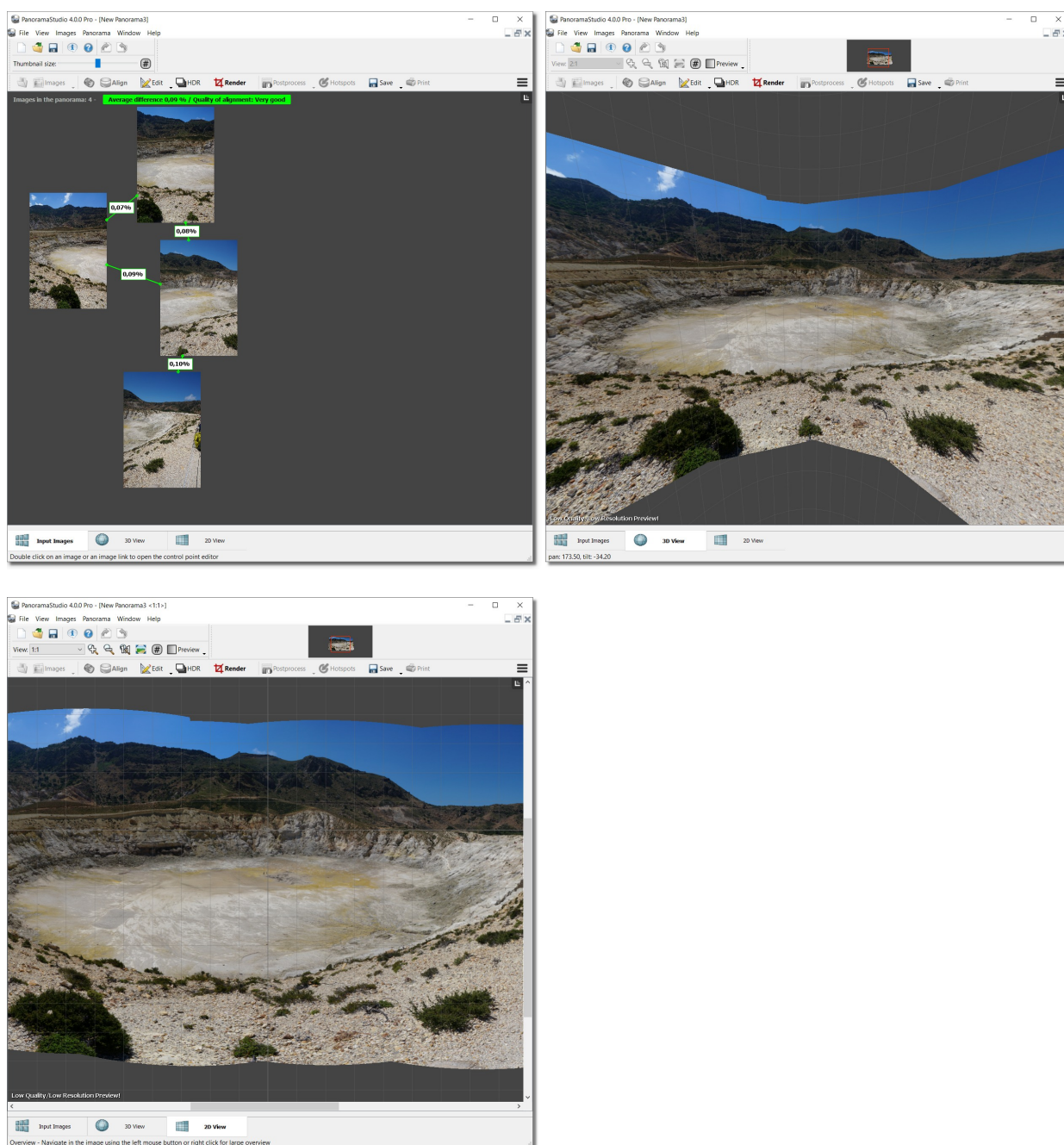


Figure 6.1: a) Input images overview, b) 3D view and c) 2D view in the multi-row mode

6.3 Parameters and Focal Length

To adjust camera properties and focal length call *Panorama*→*Parameters* before the image alignment, or afterwards call *Panorama*→*Edit*→*Change Settings / Focal Length*.

The work space

For classic, single-row panoramas it is also necessary to specify the position of the horizon in this mode. A red line indicates the current position of the horizon in this case. To move this line, just drag it with the mouse.

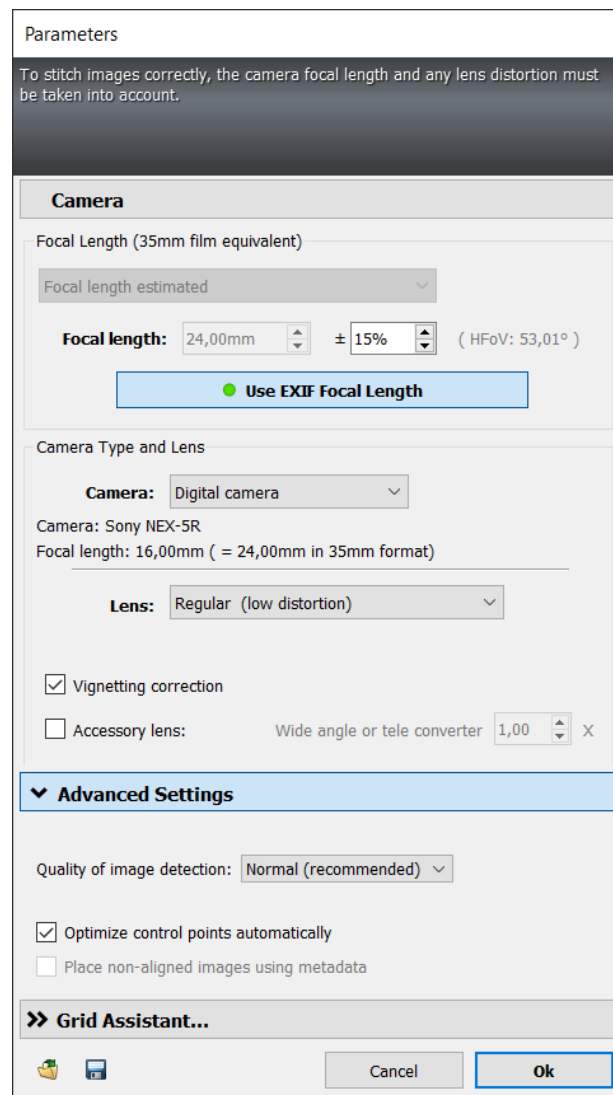


Figure 6.2: Set parameters and focal length

The tool window

You can specify or adjust the focal length and other camera properties in the tool window.

The Focal Length setting

Depending on what you know about the focal length of your images, select the best option here. If you don't know anything about the focal length of your images, select *Focal length unknown (automatic)*. PanoramaStudio then tries to find a matching focal length automatically. If you can roughly estimate the focal length, select *Focal length estimated*.

If you know the focal length exactly, select *Focal length exactly known*. But even if you know the theoretical focal length, an estimation of the focal length is still the recommended setting. Numerous factors influence the exact focal length in practice. The image detection can usually determine this value very accurately based on an estimated value and at the same time has sufficient margin to find the best alignment of the images.

Focal length value, tolerance

If you know or estimate the focal length, enter the value in millimeters in the field *Focal length*. For an estimate, you can specify the search range in percent of the focal length in the box behind.

For digital cameras, use the equivalent of the 35mm film as the focal length. For analog cameras, especially the different APS picture ratios, use the actual focal length.

Use EXIF Focal Length

If you use a digital camera that embeds *EXIF* information into the images and PanoramaStudio recognizes this, it is possible to use this value with *Use focal length from EXIF* as estimated focal length value.

List of different camera types

The used type of camera can be chosen out of the following list.

- Digital camera - A digital camera was used.
- 35mm analog film - An analog camera with a 35mm film was used.
- APS panorama - Images are a scans of an APS shoot in panorama format.
- APS HD - Images are scans from an APS shoot in the HD format.
- APS classic - Images are scans from an APS shoot in the Classic format.
- Other film size - Images are scans from a film of an unknown format. You can enter the dimensions of the film in the associated input boxes.

New Camera...

If the button *New camera...* is visible, PanoramaStudio has detected a new camera which provides focal length information within its EXIF data. However, that camera was not yet added to the database. When clicking this button, a dialog box for adding this camera to the database appears. Just enter the data about focal length provided by the camera manual.

For further details see chap. 5.5.13 (→ p.47).

Lens

For most cameras and lenses the default setting *Regular (low distortion)* is appropriate. Only few cameras need another setting here. For special wide angle lenses (fisheyes) you can switch to *fullframe fisheye* or *circular fisheye* for a proper handling of such images.

With *Circular crop* for circular fisheye images you have the option to edit the boundaries around the images which will be cropped before further processing.

Vignetting correction *Vignetting* is a flaw where photos have a brightness falloff to the image corners. You should use the *Vignetting correction* if the image overlap regions look darker than the overall panorama. This correction brightens the corners of the input images in an adequate way.

Accessory lens used

This field is only relevant if the EXIF focal length is used. If this is the case and an accessory lens is used the actual focal length from EXIF may differ from the real focal length which is modified by the additional lens. Check *Accessory lens used* in this case.

Wide angle or tele converter

After checking *Accessory lens used*, this input box turns active and allows you to specify the factor of your accessory lens. The actual focal length will be computed by PanoramaStudio from the EXIF focal length multiplied by the specified factor.

Advanced Settings

Quality of image detection Multi-row panoramas offer the option to change the quality of the automatic image detection here. As a rule the default setting (*Normal*) is the best choice for most panoramas. If some images can not be assigned or if images are not well aligned you can set the detection here to a higher level (*High* or *Very high*) to achieve a better alignment of the images. However, a higher detection level results in a more time-consuming alignment.

Optimize control points When the option to *Optimize control points automatically* is enabled, PanoramaStudio tries to sort out bad control points automatically while aligning the images. This often improves the overall quality of the image alignment noticeably, since less bad or wrong control points affect the alignment of the images.

Place non-aligned images using metadata Some cameras store the orientation angles of the image in the metadata. These can be used for placement in the panorama. If orientation angles are present, you can use this option to also place images that can not be automatically aligned by the image recognition feature, such as images that only show blue sky or can not be assigned for other reasons.

Grid Assistant Allows you to presort the images in a grid layout. See chap. 6.4 (→ p.56).

Classic, Single-Row Panorama

Projection: Cylindrical or Spherical Selection of the panorama projection. Please refer to *Projection* in chap. 4.11.2 (→ p.17) for further details. For regular panoramas you can set the projection type later in the *Render* mode.

Position of the horizon In single-row panoramas: Enter here the position of the horizon as a percentage of the image height.

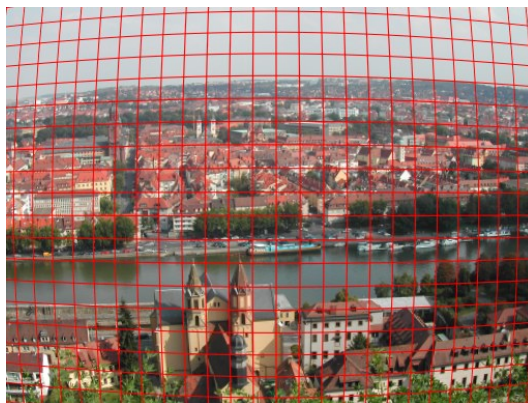


Figure 6.3: Barrel distortion

Load and save settings

You can save the various settings which can be adjusted in the *Parameters* dialog box for a later re-use. The current settings can be saved by a click on the disc symbol. With the folder symbol you can choose a setting out of a list of the previously saved settings.

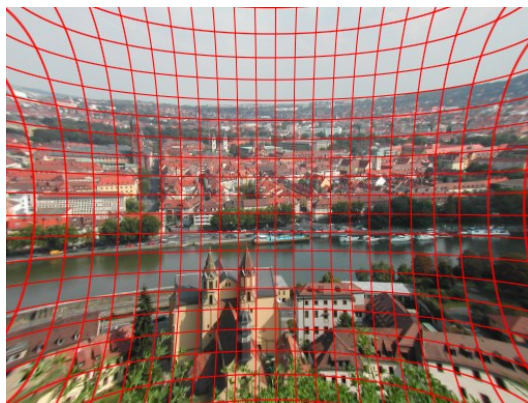


Figure 6.4: Pincushion distortion

6.4 Grid Assistant

Enable 'Align to Grid'

Enable *Align to Grid* to pre-sort large numbers of regularly arranged input images into a grid of rows and columns - for example images taken with a (motorized) panoramic head. This allows to stitch images even if they do not contain sufficient features for an automatic detection and assignment. This can be particularly helpful for gigapixel panoramas consisting of hundreds or thousands of individual images.

Rows and Columns

Adjust the number of rows and columns of images in your grid.

First image

The grid can contain only a part of the total input images. Enter the first image used for the grid here. All images not used for the grid can be arbitrarily arranged and will be stitched using the regular image alignment.

HDR exposure brackets (Pro version)

If exposure brackets consisting of several images instead of individual images are present, the number of images per exposure bracket can be set here. This allows the grid assistant to align also HDR panoramas.

Layout

Select an arrow symbol appropriate for your shooting configuration or set up the shooting configuration with *Order*, *Start* and *Direction*.

With *Order* you configure if the images were shot in rows or columns. With *Start* you configure the starting corner of the shooting. With *Direction* you configure if each of the rows or columns were shot in *uniform* direction or in an *alternating* direction.

Overlaps/Spacing

The automatic image alignment will be also applied to images in a grid to achieve an exact alignment of the images. However, you can position the images here already with an appropriate spacing to get a good preview. Configure the vertical and horizontal positions of the images as spacing in degrees or as overlaps in percent. In addition the vertical and horizontal position of the overall panorama can be configured here. If required you can rotate all images of the grid with the *Rotate* parameter.

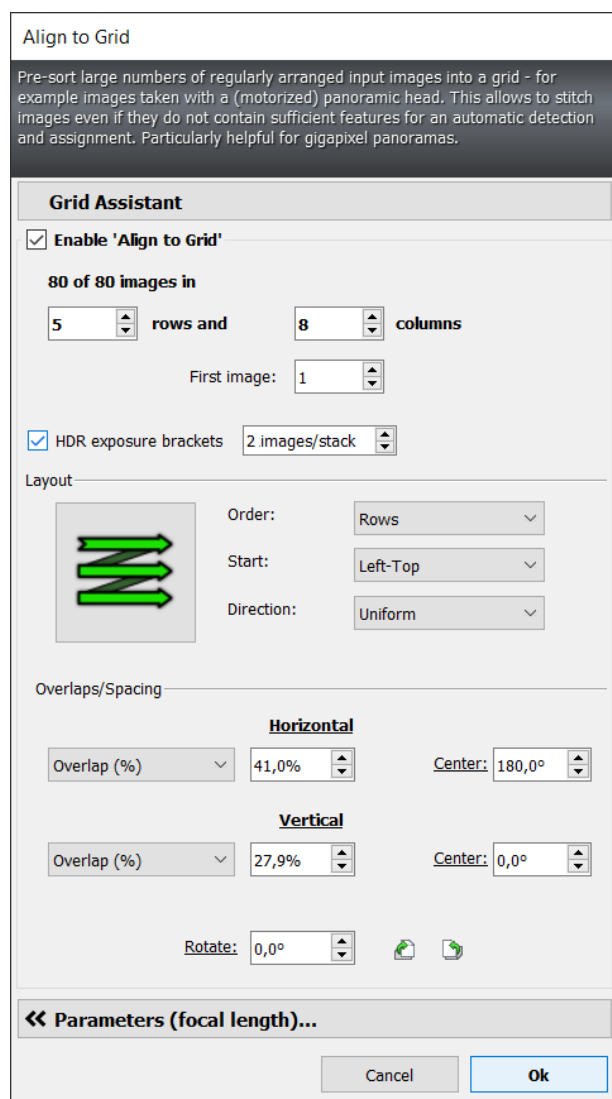


Figure 6.5: Initialize the input images in a grid of rows and columns

6.5 Change Image Alignment

For an aligned panorama, you can enter the image alignment mode from the menu item *Panorama→Edit→Change image alignment*. This mode allows you to adjust the image overlaps by altering the positions of the images. Pressing the *Done!* button leaves this mode applying your changes. The *Reset* button restores the overlaps to their initial state.

The work space

You can select an image with the mouse and move it relative to the other images. Grab the corners of an image to rotate it. This works in both the 2D view and the 3D view.

In a single-row panorama the active image overlap is indicated by a red frame. You can change the relative position of the images in the overlap by dragging the overlap with the mouse.

The tool window

You can edit the spatial position of the image using the angles *Yaw*, *Pitch*, and *Roll* for the horizontal and vertical position and the rotation of the image.

In the *Advanced* section of the Pro version you can additionally edit the viewpoint correction of the image. This allows to correct the spatial position of images, which were not shot exactly from the center



Figure 6.6: Adjust an image overlap with the mouse

of the scene. The displacement of the three spatial axes can be adjusted with the parameters *VP-X*, *VP-Y* and *VP-Z*, the horizontal and vertical tilt angles with *VP-Yaw* and *VP-Pitch*.

In a single-row panorama you can edit the active image overlap here pixel by pixel with the *Horizontal overlap* and *Vertical offset* controls.

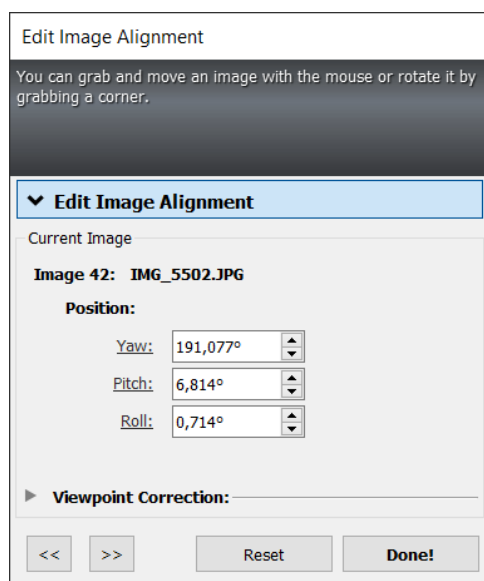


Figure 6.7: The image alignment tool window

6.6 Adjust Exposure Correction

After the image alignment you can edit the *exposure correction* with *Panorama→Edit→Adjust Exposure Correction...*. In this mode you can edit the automatic exposure adjustments made by PanoramaStudio. The Pro version also provides an optional *white balance* correction. You can adjust both, the brightness of the overall panorama as well as the brightness of each individual image. Apply your changes with the *Done!* button or reset all changes with *Reset*.

The work space

Select an image with the mouse to adjust its exposure parameters in the exposure correction dialog box. The active image is highlighted with a red frame.

You can preview the changes in the 2D view as well as in the 3D view.

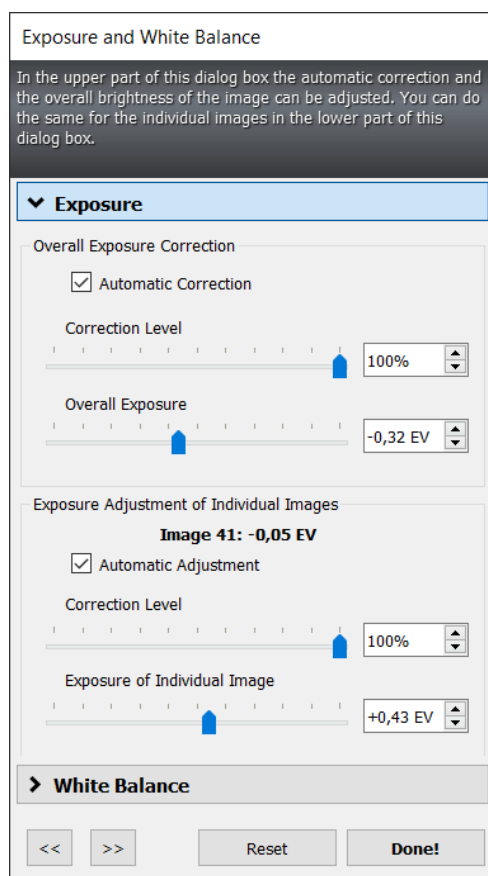


Figure 6.8: Tool window for exposure adjustments

The tool window

Exposure

Overall Exposure Correction

- **Automatic Correction**
Enable the *Automatic Correction* to apply an computed exposure adjustment for the overall panorama.
- **Correction Level** of the panorama
The level of the automatic correction can be controlled with the *Correction Level* slider.
- **Overall Exposure**
You can adjust the brightness of the overall panorama in addition to the automatic correction with the *Overall Exposure* slider.

Exposure Adjustment of Individual Image

- **Automatic Adjustment**
If you enable the *Automatic Adjustment*, the exposure of adjacent input images will be adjusted automatically.

- **Correction Level** for the input images
If automatic adjustment of input images is enabled, you can adjust the intensity with the *Correction Level* slider. This affects the correction level of all input images.
- **Exposure of Individual Image**
With this slider, the exposure of the currently selected image can be adjusted.

White Balance (Pro version)

Overall White Balance

Under *White Balance Panorama*, the color temperature of the overall panorama can be set. Using the sliders for *Red* and *Blue* the white balance can be moved to warmer or colder color temperatures.

White Balance of Individual Images

Enable the *Automatic Adjustment*, to match images with variable white balance. For this the software tries to adjust different color temperatures of overlapping images.
You can also manually adjust the color temperature of each individual image using the sliders for *Red* and *Blue*.

6.7 Straighten Horizon

The position of a panorama and therefore also the horizon in the panorama can be corrected after alignment if the automatic system has not yet delivered a perfect result. The position can be edited manually by opening *Panorama*→*Edit*→*Straighten horizon*.

The work space

The workspace shows the panorama in its current position in the 2D view. A red grid is displayed for orientation. The horizon is marked as a thick line. You can grab the panorama at any point with the mouse to adjust its orientation. The aim is to align the panorama so that it is positioned straight on the screen without appearing wavy or twisted.

As a further point of reference, in a correctly aligned panorama, all vertical lines in the image should be exactly vertical again. By grabbing and moving the panorama at different points, you can gradually find a position that will display the panorama correctly in this regard.

The tool window

In the tool window you have the buttons *Rotate 90 degrees to the right*, *Rotate 180 degrees*, and *Rotate 90 degrees to the left* to rotate the panorama. You can also use *Automatic Horizon* to call up the automatic leveling again.

If the image is an imported panoramic image and it contains metadata regarding the orientation of the image, you can use *Align to Metadata* to position the image accordingly.

To move a panorama horizontally only, for example, to move the center of the panoramic image, the tool window also offers the option *Constrain to Horizontal Moving*. This allows you to easily shift the position of the entire panorama to the left and right.

6.8 Insert Graphics

This mode allows to insert graphics into the panorama. That way you can insert for example a logo into the panorama to cover a tripod.

The work space

The work space shows a preview of the aligned images of the panorama. You can move inserted graphics using the mouse. When grabbing the corners or edges you can rotate and resize the graphics.

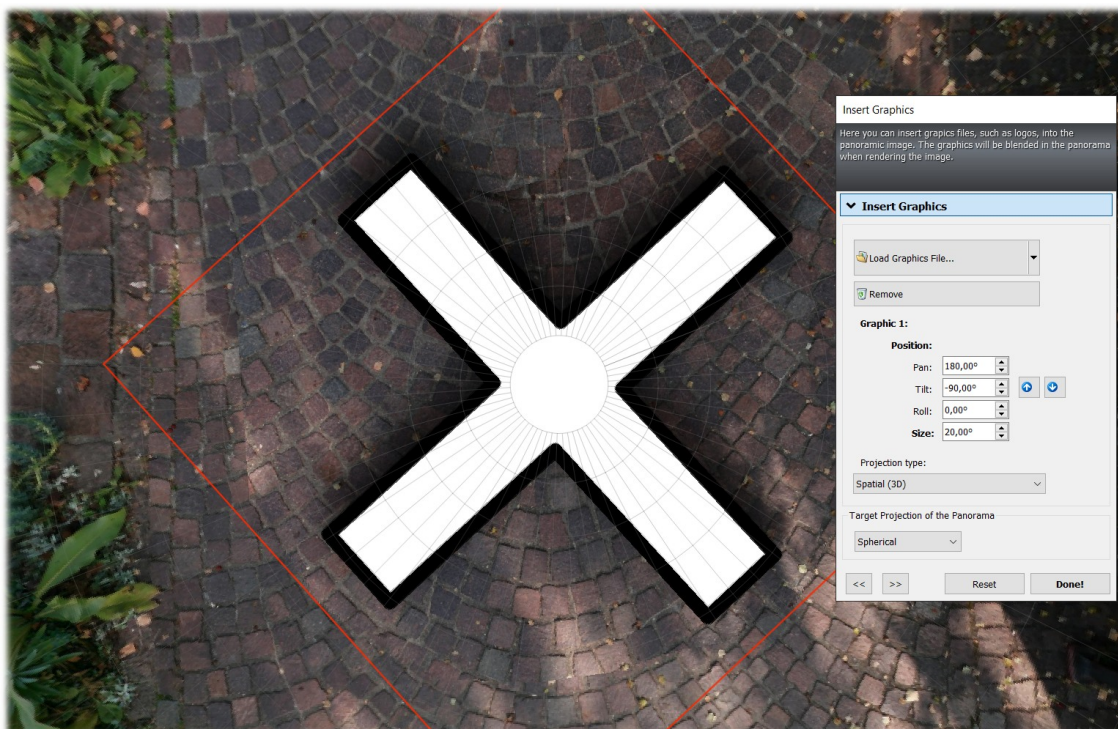


Figure 6.9: Insert graphics

The tool window

With *Load graphics file* you can load and insert PNG, GIF, WEBP, TIFF, and JPEG image files into the panorama. Besides placing the graphic using the mouse you can edit the position and size also numerically in the tool window.

Furthermore, graphics can be projected as planar 2D image as well as spatial image in 3D. With *Projection type* you can switch between these two types of embedding a graphic into the panorama.

In case of a multi-row panorama you use *Target projection of the panorama* to switch the 2D preview of the panorama with the embedded graphics between cylindrical and spherical projection. This provides an accurate preview of the panorama with the embedded graphics.

With the two arrow buttons *Place in zenith/nadir* a graphic can be placed exactly vertically upwards or downwards to cover a tripod on the ground or a gap in the sky.

6.9 HDR (Pro version)

Two different HDR modes can be activated and configured here: True **HDR / Tone Mapping** and **Exposure Fusion**.

Real *HDR* creates an HDR image with a high dynamic range from series of differently exposed individual images. The dynamic range of the generated high dynamic range (HDR) image is then reduced using *tonemapping* so that it can be displayed on standard displays.

On the other hand, the *Exposure Fusion* process combines exposure series in a single step to create a harmonious overall image. In contrast to tone mapping in HDR, *Exposure Fusion* takes a more natural approach by combining the best parts from each shot. This achieves a balanced exposure and brings out details and colors even in areas that would be overexposed or underexposed in a single shot.

The respective mode can be activated by clicking on *HDR / Tone Mapping* or *Exposure Fusion*. PanoramaStudio shows a real-time preview of all modifications so that the desired image impression can be easily configured.

Both modes can also be activated if only individual images and no exposure brackets are present.

In the HDR mode, the tone mapping is then applied to the individual images. This way, HDR images can be imported directly, stitched into a panorama and optimized for display using tone mapping.

In contrast, if *Exposure Fusion* is activated for non-HDR panoramas, PanoramaStudio internally creates brighter and darker exposures from the existing individual images. The fusion process is then applied to this artificially created exposure series. As a result, the appearance of light and dark areas is usually much clearer and more detailed while retaining colors and saturation.

Especially for images with a high color depth (RAW images or 16-bit image material), ***Exposure Fusion on individual images*** can lead to impressive results, without the need for series of exposures.

The tool window also offers a number of basic, non-destructive image processing filters under ***Postprocessing - Basics***, which can already be configured here. Like the tone mapping settings, these settings can still be changed after the *Render* step under *Postprocess*. See also chap. 6.11 (→ p.66).

The work space

In HDR mode, the preview is displayed exclusively using high-quality multiband blending. This ensures that all changes to the *HDR / Tone Mapping* or *Exposure Fusion* settings can be displayed precisely and in real time.

The tool window

HDR / Tone Mapping

Click on *HDR / Tone Mapping* to activate the HDR mode for the panorama.

- **Exposure**
Adjust the overall exposure of the HDR image to control the brightness distribution so that the image is displayed in the best possible way.
- **Compression**
Control the compression of the brightness values to reduce the dynamic range of the HDR image and achieve as much detail as possible in the shadows and highlights.
- **Black Point**
Set the darkest point of the image to enhance the dark values and create a clear contrast in the shadow areas.
- **White Point**
Adjust the brightest point in the image to control highlights and avoid overexposure while maintaining the overall brightness of the image.

Exposure Fusion

Click on *Exposure Fusion* to activate the exposure fusion mode for the panorama.

- **Divergence**
A high value for the divergence specifically uses only the best areas from each exposure; the lower the divergence, the more evenly all images are averaged.
- **Weighting**
Select smaller values to give more weight to images with dark areas and larger values to give more weight to images with light areas when the exposure fusion is applied.
- **Highlights separation**
Similar to the divergence parameter, this is used to separate light areas more or less distinctly. Smaller values average, larger values separate the highlights when the images are fused.
- **Shadows separation**
Same as *Highlights separation* but for the dark areas of the images.

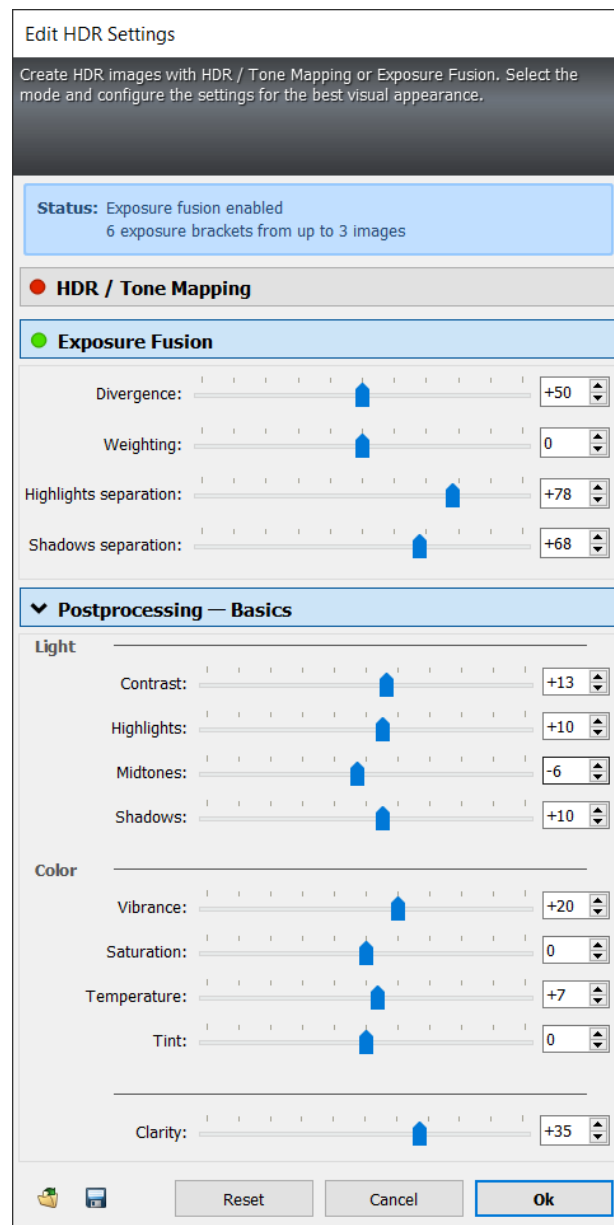


Figure 6.10: HDR tool window

Postprocessing - Basics

All filters here are non-destructive and can be changed until the panorama is exported. After the *Render* step, you can further customize these filters under *Postprocess* (chap. 6.11 (→ p.66)).

The only exception is the *clarity* filter. This is applied to the image during rendering and can no longer be changed afterwards.

- **Contrast**
Give the image more depth by enhancing or softening the difference between highlights and shadows.
- **Highlights**
Control the brightness of the brightest areas in your image to preserve or correct details in overexposed regions.
- **Midtones**
Optimize the brightness in the mid tones to achieve a balanced and detailed picture.
- **Shadows**
Adjust the brightness of the shadow areas to bring out more or less detail in dark parts of the image.
- **Vibrance**
Control the local color saturation in the image by making greater adjustments in less saturated areas than in more saturated areas.
- **Saturation**
Increase or decrease the intensity of all colors in the image to adjust the overall color saturation.
- **Temperature**
Change the color temperature of the image to make it appear warmer (more yellowish) or cooler (more bluish).
- **Tint**
Adjust the green or pink tint in the image to improve the overall coloring.
- **Clarity**
Enhance or soften local contrasts to emphasize or reduce details in structures.

6.10 Render

Use *Render* to complete the creation of the panorama by defining the image section and starting the rendering process to calculate the final panorama in full size and high quality. To do this, select *Panorama*→*Render* after the *Align* step.

The work space

On the workspace, PanoramaStudio already suggests a rectangle for cropping. This rectangle represents the image area which is then rendered as panorama. You can move the edges of the rectangle by dragging them with the mouse to change the image area of the final panorama.

In the case of classic, single-row panoramas, the lateral edges of 360 degree panoramas cannot be moved separately from each other, as they must match exactly for a seamless transition. Instead, by moving such a lateral boundary, the seam of the 360 degree panorama and thus the edges of the image in the finished panorama are shifted. Furthermore, the position of the cropping rectangle can be rotated at the corners for single-row non-360 degree panoramas. If the mouse pointer is positioned over a corner, you can recognize the option to rotate by the circular shape of the mouse pointer. The orientation of the rectangle can then be rotated by dragging the corners.

The tool window

Once you have specified the parameters and the image area, confirm your settings with the *OK* button to start the high-quality rendering of the panorama.

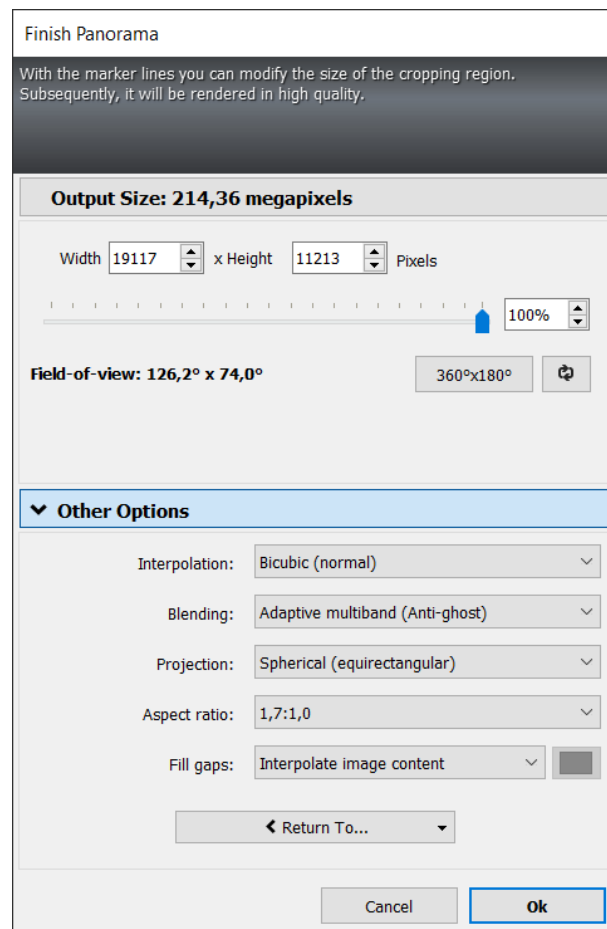


Figure 6.11: Render settings

Output size

In the *Output size* box you can set the exact size of your panoramic image. PanoramaStudio shows the size in megapixels as an indication for the resulting size. You can either set the dimensions using the slider or use the input fields to specify the exact pixels.

Other options

- **Interpolation**

Interpolation is used when the images are projected into the panorama. There are several interpolation methods available for this. In addition to the conventional *Bilinear* and the more precise *Bicubic (normal)* interpolation, PanoramaStudio also offers some more complex methods.

The *Bicubic (sharper)* and *Bicubic (smoother)* are variants of the bicubic interpolation. These methods use the surrounding 4x4 pixels to calculate a resampled pixel which preserves details and at the same time avoids jagged edges and other artifacts of the image projection.

The methods *Lanczos3 (sinc36)*, *Lanczos4 (sinc64)*, and *Lanczos8 (sinc256)* are more complex and computationally expensive. These methods use the surrounding 36, 64, oder 256 pixels to calculate a sharp result and to preserve as much details as possible while avoiding artifacts of the image projection.

However, apart from the *None (Nearest Neighbor)* option, the visible differences are very subtle. Therefore, the recommended method for most images is the normal bicubic interpolation.

- **Blending**

Two methods are available for blending: the faster *Static Multiband Blending* and the more complex *Adaptive Multiband Blending*.

The adaptive method determines blending seams depending on the image content in order to achieve the best possible blending result for moving objects and other differences in the overlapping areas of the images, so that the transition is as seamless as possible without breaks or so-called "ghosting".

- **Projection**

The type of projection for the panoramic image can be configured here. The *spherical (equirectangular)* and the *cylindrical* projection are available.

The cylindrical projection is a method in which the panorama is mapped onto a cylinder. It is characterized by the fact that all vertical lines are displayed straight, while the horizontal lines, with the exception of the horizon line, are curved. The image is increasingly stretched at the upper and lower edges of the image at larger image angles and therefore cannot reproduce complete sphere panoramas.

The spherical projection represents the mapping of a sphere onto a flat surface. Accordingly, the projection can map up to 360° horizontally and 180° vertically and thus the entire environment, including *Zenit* and *Nadir*. In the spherical projection, all verticals are also exactly perpendicular.

- **Aspect Ratio**

Here you can optionally select a value from a list of default values for the aspect ratio. This is useful if you want the finished panorama to have a specific aspect ratio.

- **Fill gaps**

If the selected cropping area for the panorama contains areas that are not covered by an image, PanoramaStudio can fill these gaps, either with *Add color* or with *Interpolate image content*. To fill the gaps with a color, the fill color can be selected with the color selection button to the right. With the option *Interpolate image content*, the undefined areas within the panorama are smoothly interpolated according to the surrounding image content. In this way, small gaps at the edge of the panorama are filled almost invisibly.

- **Return To...**

Here you can go directly back to one of the previous editing modes, for example, to change exposure correction, image alignment, or the orientation of the horizon.

6.11 Postprocess

Use the filters in post-processing mode to further refine and improve the appearance of the finished image. A range of filters are available in the categories *HDR/Tone Mapping* (in the Pro version with

previously activated HDR mode), *Light & Color*, *Tone Curve* and *Color Balance*.

All these filters are non-destructive, meaning that they do not change the underlying image and can still be changed until the panorama is exported.

The work space

You can see a real-time preview of all changes to the filters on the workspace.

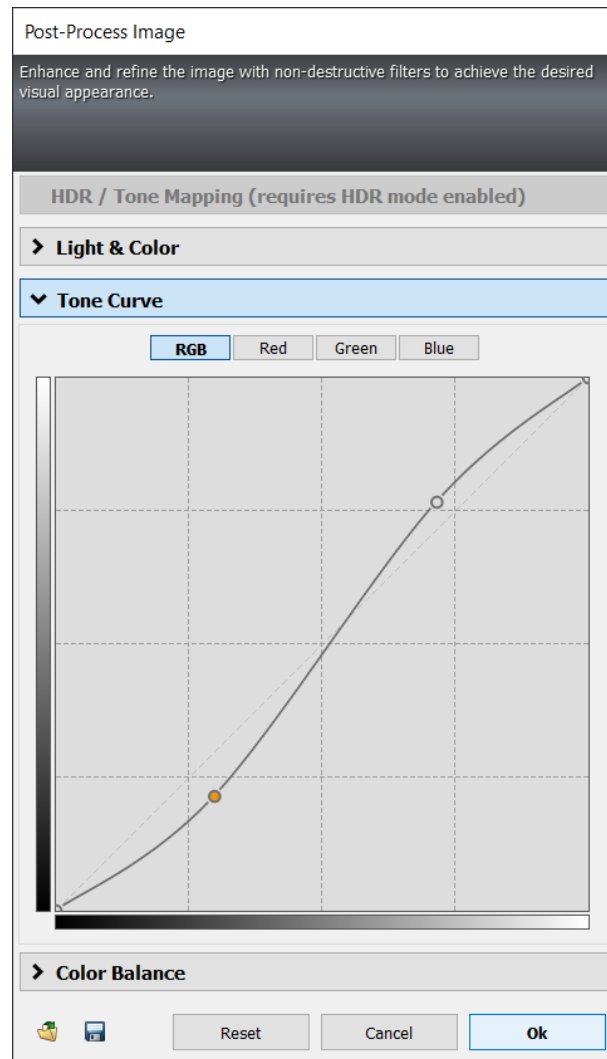


Figure 6.12: Post-processing tool window

The tool window

HDR / Tone Mapping (Pro version)

If true *HDR / Tone Mapping* was previously activated for the panorama, the tone mapping parameters can be further adjusted here in post-processing.

- **Exposure**

Adjust the overall exposure of the HDR image to control the brightness distribution so that the image is displayed in the best possible way.

- **Compression**

Control the compression of the brightness values to reduce the dynamic range of the HDR image and achieve as much detail as possible in the shadows and highlights.

- **Black Point**

Set the darkest point of the image to enhance the dark values and create a clear contrast in the shadow areas.

- **White Point**

Adjust the brightest point in the image to control highlights and avoid overexposure while maintaining the overall brightness of the image.

Light & Color

Light & Color contains a range of image editing filters to adjust the contrast, brightness distribution, color saturation and color temperature of the image.

- **Contrast**

Give the image more depth by enhancing or softening the difference between highlights and shadows.

- **Highlights**

Control the brightness of the brightest areas in your image to preserve or correct details in overexposed regions.

- **Midtones**

Optimize the brightness in the mid tones to achieve a balanced and detailed picture.

- **Shadows**

Adjust the brightness of the shadow areas to bring out more or less detail in dark parts of the image.

- **Vibrance**

Control the local color saturation in the image by making greater adjustments in less saturated areas than in more saturated areas.

- **Saturation**

Increase or decrease the intensity of all colors in the image to adjust the overall color saturation.

- **Temperature**

Change the color temperature of the image to make it appear warmer (more yellowish) or cooler (more bluish).

- **Tint**

Adjust the green or pink tint in the image to improve the overall coloring.

- **Clarity**

Enhance or soften local contrasts to emphasize or reduce details in structures.

Tone Curve

With the tone curve tool, you can precisely adjust brightness, contrast and color by editing the tonal values of the image using a graphical curve.

By changing the shape of the tone curve, you can assign new values to either the overall brightness (**RGB**) or individual channels (**Red, Green, Blue**). The initial values represent the original brightness distribution. Changes to the RGB curve affect the brightness of the image. Changes to the color channels *Red, Green Blue* affect the coloring.

You can edit the curve by clicking on the curve to add anchor points or grab and drag existing anchor points. If you drag an anchor point close to another one, it will be removed automatically. A curve is automatically interpolated between the anchor points, which then represents the new brightness curve of the selected channel. In this way, specific ranges of luminance can be brightened or darkened very precisely. Drag anchor points upwards to brighten the area and downwards to darken it.

Color Balance

With *Color Balance* you can apply specific color corrections to light, medium and dark areas of the image. You can adjust incorrect colors or the atmosphere in an image by changing the balance with the sliders between *Red - Cyan*, *Green - Magenta* and *Blue - Yellow*.

6.12 Hotspots

A *hotspot* can represent a link to another panorama or webpage or it can provide information which is displayed when the hotspot is clicked.

To edit hotspots in your panorama, you can enter the *Hotspot mode* with *Hotspots* in the *Panorama* menu or using the *Hotspots* button in the toolbar (chap. 4.9, p.14).

The hotspots will be embedded in the interactive panoramas you can create with the output option *Save as interactive Panorama / Zoom Image* (chap. 5.5.12, p.43).

This edit mode also allows to insert artificial lens flares into an interactive panorama to get a more immersive look of the scene.

The work space

All hotspots and lens flares included in the panorama are displayed in this mode. They can be selected and moved with the mouse. Furthermore, the size of *embedded* hotspots can be modified with the anchors displayed around them. The anchors can be moved by dragging them with the mouse.

The tool window

In the tool window of this mode you can add, edit and delete hotspots and lens flares.

New hotspot

Click on *New Hotspot...* and then on the desired position in the panorama to insert a new hotspot.

When inserting the hotspot an *Open file* dialog box will be opened where you can select an image file (PNG, GIF, WEBP, or JPEG format) as hotspot. In addition, you can pick a hotspot from a list of included static and animated icons.

Configure Hotspot...

In the configuration menu of the hotspot you can adjust various properties such as the transparency of the hotspot and for animated hotspots the play speed, number of iterations and more.

New Lens Flare

Select an artificial lens flare from a list of pre-defined types. A lens flare should be placed on a light source in the panorama, e.g. the sun. When displaying the panorama with the PanoramaStudio Viewer the lens flare produces a typical reflection of light in the lens system of the virtual camera similar to a real camera.

Remove

Removes the active hotspot or lens flare.

Link Hotspot

A *link hotspot* represents a link to another panorama or a webpage.

Link Hotspot: URL

Enter a hyperlink to a webpage where this link hotspot should refer to.

Another option is to directly specify another panorama as a link, which will then be opened in the same Viewer window. All parameters of a panorama previously saved e.g. as *Panorama1.html* are stored in an additional file with .js extension, here *Panorama1.js* (older versions used the .json extension). If the hotspot URL refers to such a .js parameter file and in addition the keyword *myself* is specified in the *HTML-Target* field, the linked panorama opens directly in the same Viewer instance.

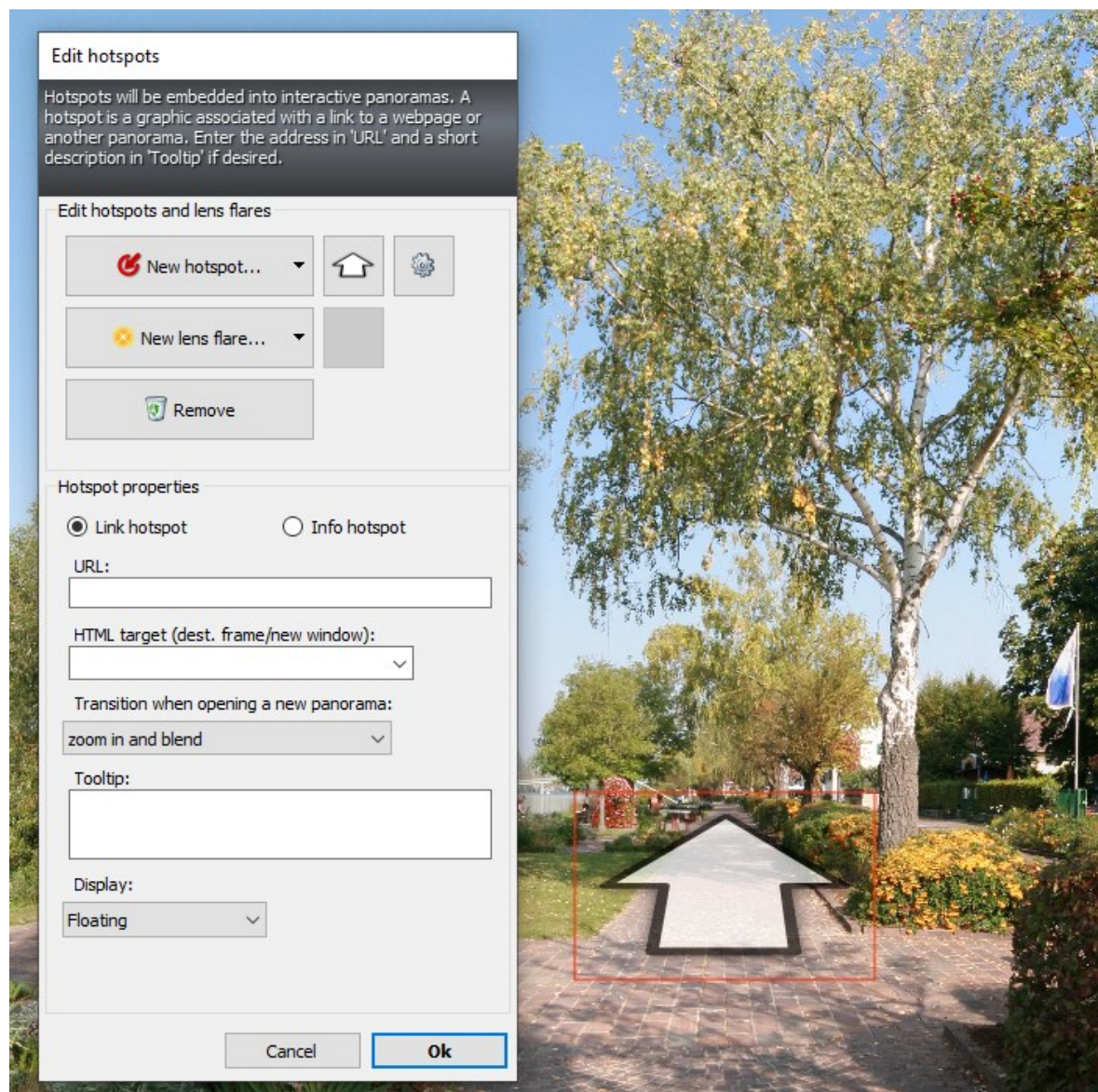


Figure 6.13: Edit hotspots

Link Hotspot: HTML Target

Like for regular HTML pages, this field allows to specify a target frame for the hyperlink. When the user clicks on the link, the specified URL will open in the given frame. The usage is conform to HTML, e.g. entering 'blank' as HTML target will open a new browser tab or window for the referred URL.

A special case is the keyword *myself* noted above. This allows to open another panorama in the current Viewer window. You find more information about this topic also in the documentation of the *PanoramaStudio Viewer*.

Link Hotspot: Transition When Opening a New Panorama

If the hotspot targets another panorama, then the Viewer can optionally show a transition effect when the hotspot is clicked. The Viewer can zoom to the clicked position and then smoothly fade into the other panorama.

Info Hotspot

An *info hotspot* shows a message box with information or other content when clicked.

Info Hotspot: Content (</>HTML)

An info hotspot can contain arbitrary HTML formatted content. Which means that you can insert plain text as well as images and other HTML elements in the *contents* field.

Tooltip

Here you may enter a short description of the hotspot appearing when the mouse hovers over the hotspot. Besides plain text tooltips may also contain arbitrary HTML elements, including images. The tooltip field supports full HTML.

Display

Select the display type for the hotspot here. A bitmap hotspot can be displayed either *floating* at its position over the panorama or spatially *embedded* into the panorama. If the hotspot is embedded, then it is fixed permanently on the panorama. You can rotate and scale the hotspot on the work space to the desired position and size.

6.13 The Panorama Mode

A project is in panorama mode after the stitching process is finished and when no adjustment or correction modes are active. This mode allows to directly navigate through the panorama by dragging the panorama on the work space with the mouse. The panorama mode is indicated by a hand-shaped mouse cursor.

6.14 Classic, Single-Row Panoramas and Documents

6.14.1 Change Detail Adjustments

For an aligned single-row panorama, you can enter the detail adjustments mode from the menu at *Panorama→Edit→Change Detail Adjustments*. This mode allows you to adjust small regions within the overlapping area. Thus, it is possible to fix problems concerning only parts of the image in an overlapping area. Pressing the *Done!* button leaves this mode applying your changes. The *Reset* button restores the overlaps as they were when entering detail adjustment mode.

The work space

The work space displays the active overlapping area split up into small tiles. Each tile represents one detail overlap of the active overlap for which the relative position of the two overlapping images may be set individually by drag and drop with the mouse. Hold down the Ctrl key to select multiple tiles. This allows to edit areas consisting of multiple tiles in one step.

To assist you finding the right position, each image is displayed semi-transparently. You found the best position, when both image tiles match and look like just one image.

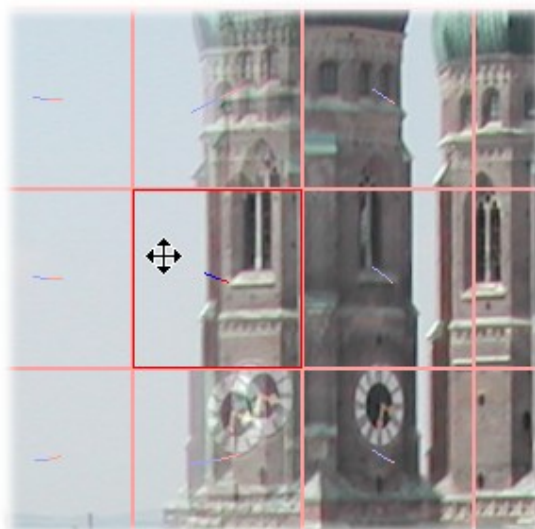
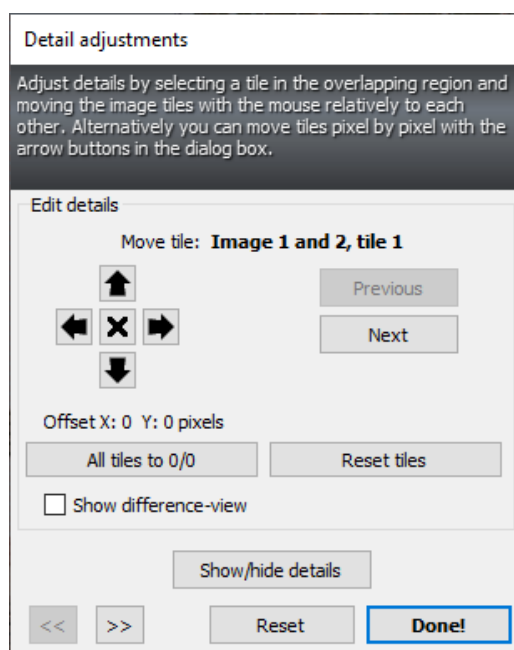


Figure 6.14: Change an image tile

To move the focus from the active overlap to another, just click with the mouse on the desired overlap to activate it.

The tool window

Figure 6.15: The *Detail adjustments* tool window

The corresponding tool window of the detail adjustments mode enables you to specify the pixel offsets for each tile of the the overlapping images individually.

Arrow buttons for the tile position

A click on an arrow of the arrow button field increments or decrements the relative position for a pair of tiles by one pixel. Thus, you may adjust the relative positions for each tile precisely in both dimensions

- horizontally and vertically. Clicking on the X in the middle of the arrows resets your changes to the original position.

Previous tile, next tile

Moves the focus to the previous, or the next tile in the active overlap.

All tiles to 0/0

Resets all tiles to the zero position and consequently discards all correction values determined in the automatic alignment as well as all manual changes.

Reset tiles

Resets all changes on details made since entering the adjustment mode.

Show difference-view

Switches to alternative kind of view while working on tiles. Rather than blending the two overlapping images, this view shows their differences with mid gray indicating no difference. In some cases, this view allows better judgement of the detail adjustment success.

6.14.2 Change Blendings

Merged images are continuously blended within the image overlaps. Width and position of the blending area can be individually adjusted in *blending mode* for every individual overlap. For a processed panorama, you can switch to *blending mode* by calling *Panorama→Edit→Change Blendings....* Clicking the *Done!* button causes PanoramaStudio to apply your changes and exits the *blending mode*. Clicking the *Reset* button restores the original values when entering blending mode.

The work space

Width and position of the blending area are displayed on the work space in a dark red color. The active



Figure 6.16: Removing doubles of moving objects by reducing the blending area

area appears in red - the others are dashed.

To activate an area, just click with the mouse on it. You can drag the marker lines now to the desired position. Thus, you can hide e.g. duplicates deriving from moving cars or walking persons.

Doubles - so called *ghosts objects* or *ghosting* - are problems often occurring when blending images. They are caused by moving objects which occur often only partial or doubled at different positions in adjacent images. There are two ways to diminish such effects. First, you should enable the *Adaptive multiband blending* which takes the visual content into account when blending the images and tries to find a blending around moving objects and other differences in the overlapping images. A second way to deal with this

problem is to change the overlapping areas by moving and resizing them on the working area so that the ghosting vanishes.

The tool window

You can adjust width and position of the active blending area in the corresponding blending tool window via sliders. Furthermore, the blending method can be selected.

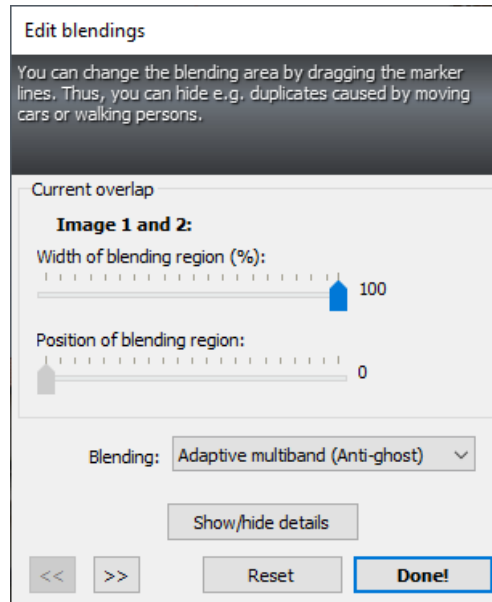


Figure 6.17: The tool window *Edit blendings*

Width of blending region

This slider controls the width of the blending.

Position of the blending region

This slider controls the position of the blending area inside an overlap. As the blending area must be part of the overlap area, this slider only allows positions inside the overlap.

Adaptive/Static multiband blending

The Adaptive multiband blending is a method which tries to minimize the differences between the images in the blending process. While it is more time expensive, it takes the visual content of the images into account to find an optimal blending, in contrast to the static method. This avoids blendings through moving objects and other troubles which can occur in the static method.

Chapter 7

Configure PanoramaStudio

You can edit the default parameters for the panorama creation, the use of temporary disk storage and the data contained in the camera database in PanoramaStudio with the Settings dialog box. You can access the *Settings* via the menu *File*→*Settings*.

7.1 General

Assigning a folder for temporary data

The section *Folder for Saving Temporary Data* allows you to change the drive for storing temporary data. The rendering of large panoramas can require many gigabytes of memory. This memory is only required when rendering. However, it is possible that the default partition will run out of disk space during this phase. PanoramaStudio then informs you about this and offers the option of choosing a folder on another partition.

By default, the temporary directory of the operating system is used (*Use system's Temp folder*). To switch to another folder, select *Use other folder*. Then enter the path for the temporary data in the text field or simply select a folder from the file dialog that opens when you click on *Folder...* Data generated during the rendering process is then stored in a subfolder in the specified path and deleted again when it is no longer required.

7.2 Import/Export

7.2.1 Importing Images

Auto rotate according to EXIF orientation

Most cameras store the orientation of the camera in the image metadata when the photo is taken. This allows the software to automatically recognize whether an image was taken in portrait or landscape format. If the option is activated and orientation information is available, images are automatically rotated when imported into PanoramaStudio .

7.2.2 Exporting Images

Transfer EXIF data to panorama

If this option is activated, the adjusted EXIF data of the first individual image is written to the finished panorama image. This allows camera and location information to be transferred to the panoramic image.

Add metadata for Google+™/Google Maps™ Views

This option adds metadata to spherical (equirectangular) panoramas for the automatic detection in Google+ /Google Maps Views.

Suggest panorama name based on input image

If this option is activated, a file name is created based on the name of the first individual image when a panorama is saved for the first time. Serves for better assignment of created panoramas and the input images used.

Suggested output

As a default for the output folder, you can choose between the *source folder* of the images and the *folder last used*.

SDR images output format

The image format set here is suggested as the output format when saving. The format can be changed again when saving.

Color depth SDR images

The preset color depth for the output of conventional images. If the selected image format allows it, images can be output in either 8- or 16-bit color depth.

HDR images output format

The image format set here is suggested as the output format when saving as HDR image. The format can be changed again when saving.

7.2.3 Exporting Interactive Panoramas

Suggested output

As a default for the output folder when saving an interactive panorama, you can choose between the *source folder* of the images and the *folder last used*.

7.3 Align

7.3.1 Image Alignment

Preset 'Use EXIF Focal Length'

If set, the corresponding option under *Parameters* is active by default.

Control Points

You can control the effort used to find control points for the image alignment with the *Quality of image detection* parameter. The higher the setting the more control points will be used for the image alignment. In general, the default is the best choice for most panoramas. You can also change this parameter in the *Parameters* dialog box for each panorama individually.

When the option *Optimize control points automatically* is enabled, PanoramaStudio tries to sort out bad control points automatically during the image alignment process. This costs some processing time, but often improves the overall quality of the image alignment noticeably, since less bad or wrong control points affect the alignment of the images.

Fisheye Lenses

For very short focal lengths, it can optionally be assumed that the lens is a fisheye lens. Activate *Automatically switch to fisheye lens setting for short focal lengths* to set this as the default.

7.3.2 Exposure Correction

If the *Match exposure of input images* option is activated, exposure differences between the images are automatically corrected. The option *exposure correction of the panorama*, on the other hand, improves the exposure of the overall image. The Pro version can also perform an automatic white balance correction with the option *Adjust white balance of individual images*. This adjusts the white balance of neighboring images.

7.4 Render

7.4.1 Blending

Two methods are available for blending: *Static Multiband Blending* and the more complex *Adaptive Multiband Blending*. The adaptive method determines blending seams depending on the image content in order

to achieve the smoothest possible transition without discontinuities or so-called *ghosting* in the case of moving objects and other differences in the overlapping area of the images. As the adaptive method requires slightly longer processing times, the method can be set here depending on the output size of the panorama.

7.4.2 HDR (Pro version)

If exposure brackets are detected in the input images, the HDR functionality offers different options. Here you can configure how HDR image material should be processed by default.

This allows you to activate either automatic *Exposure Fusion* or true *HDR/Tone Mapping*. Alternatively, if exposure brackets are found, you can also be asked how to proceed or the exposure brackets can be ignored.

The option *Enable tone mapping for imported panoramic HDR images* automatically enables the HDR/Tone Mapping mode if the image format of the imported panorama is a HDR format.

7.5 Cameras

The *Cameras* section provides a list of all cameras which will be recognized by their EXIF data for further processing.

You can edit camera data, add cameras and delete cameras here. Adding new cameras is, however, more convenient using the *Parameters* tool window. Please refer to *New camera...* in section chap. 6.3 (→ p.53) and chap. 5.5.13 (→ p.47).

7.6 Color Management

PanoramaStudio supports color profiles contained in images and offers accurate color display on the screen and when printing. The color corrected rendering on the screen uses the display profile of the computer and the color profiles of the images.

On the *Color management* tab you can change the settings. With *Display rendering* you can control, if the display shows a color corrected rendering or if the ICC color profiles from the input images are just kept and transferred into the output image file.

7.7 Classic Mode

7.7.1 Overlap of Input Images

Minimal overlap and *Maximal overlap* defines the range for valid overlaps (in single-row panoramas and in the document mode). The automatic overlap search algorithm only searches within this range. Manual adjustments are also limited to this area. You may extend these overlap regions if needed. If your image overlaps are all quite precisely within a certain range, you can reduce the permitted overlap limits here. This will result in a slightly faster calculation of the panorama.

The same applies to the slider *Max. vertical offset*, which restricts the permitted displacement in the vertical direction.

7.7.2 Detail Adjustments Between Images

With the two parameters for configuring the detail adjustments between images, you can significantly influence the quality of the panorama. The most important setting here is *Number of iterations*. The higher the value, the finer the details in the overlapping area of the images are adjusted. However, the computing time also increases to a similar extent. The smaller the *Number of iterations* is set, the coarser the overlaps are adjusted.

The parameter *Minimum tile size* (in pixels) specifies a minimum size for the subdivision into image tiles during detail adjustment.

7.7.3 Blending

The *blending method* can be switched between *static* and *adaptive multiband blending*. With *Adaptive blending (anti-ghost)*, PanoramaStudio attempts to find an optimal blending seam depending on the image content, avoiding blending through areas with differing image content.

PanoramaStudio displays a relatively accurate preview of the panorama in classic, single-row mode after the images have been aligned. However, due to the large amount of data that a large panorama consisting of many images can have, it is recommended that the preview is not displayed in full size, but slightly reduced. This significantly reduces the time required to generate the preview as well as the memory usage and has no effect on the finished panorama after it has been rendered. A maximum size for the individual images in the preview can be set by selecting *Reduce size of individual images in preview to*. The default setting of 3 megapixels per individual image already produces a fairly accurate preview of the panorama, even if the actual images are significantly larger. The original images in full size nevertheless form the basis for the final calculation of the panorama, which can always be rendered in its original size regardless of the preview.

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