

## Panoramas: software and shooting

These notes were prepared after the presentation on February 9<sup>th</sup> 2009 and accompany the slides presented at that time.

**Definition:** Panorama - an assembly of separate images into a single image, covering a greater area with higher resolution than is achievable with a single image. "Panorama" also is used to describe a long narrow horizontal image, but an assembled panorama need not be of this format.

There are three types of panoramas based on how the images are arranged:

- Single row: the typical wide and narrow panorama that is assembled from a single row of images, which may be taken either in portrait or landscape mode. Using portrait mode provides a relatively deeper image.
- Multi-row: this can have any aspect ratio and is assembled from multiple horizontal rows, giving a more rectangular format.
- 360° "surround": this type of panorama is constructed from multiple rows and includes closing images for the overhead sky, giving the appearance of the complete view that you would see standing at a point on the ground, looking all around you, down and above (this type is not covered in this presentation).

The presentation focuses on camera setup, camera settings, using PhotoShop or PhotoShop Elements, and, using AutoPano to assemble the images. We will discuss single and multi-row panoramas only in this workshop.

## Camera setup

The key items for camera setup using a tripod are:

- The tripod head baseplate (set with the tripod bubble level), and the ballhead plate (set with a bubble level on the head top plate or camera body) must both be horizontal. This ensures that as you pan horizontally, the horizon line stays horizontal and thus the images all line up.
- The optical centre of the lens should ideally be over the pivot point of the tripod head. This ensures that objects in the near ground and far ground stay in the correct optical alignment as you pan (parallax).
- For multi-row panoramas, the lens also needs to pivot vertically through the optical centre of the lens.

These camera setup items can be done with a standard ballhead and one sliding rail for single row panoramas. However, repeating the settings for future images means going through the entire setup again. Several manufacturers produce mounting assemblies specifically designed for panoramas that allow you to "do the setup once" and then return to the same settings for each lens (and focal length if it is a zoom lens). These also have the advantage of a more visible graduated baseplate showing horizontal angle, which assists in overlapping the images evenly.

Setting up the optical centre is a matter of trial and error since real-life camera lenses are far from the ideal single piece of glass with a fixed focal point. The process is to identify a near and far object, note their alignment, when in the left side of the frame, then rotate the lens so that they are now in the right side of the frame, and ensure that their relative alignment is the same.

If this is not the case, then, the lens is not positioned correctly over the centre of the tripod. To correct this the camera/lens assembly has to be slid backwards or forwards until the optical centre is in the correct location and the relative positioning of the two objects does not change as the camera is rotated.

This process is not critical for distant panoramas where there is no foreground, but becomes critical when there are significant objects in the foreground that will otherwise be misaligned and it may not be possible to resolve this ambiguity with the software.

The same process needs to be followed for the vertical rotation axis if a multi-row panorama is being shot.

Single row panoramas can also be done successfully hand holding the camera. However, care is required with image alignment, and processing is more challenging to ensure consistent alignment.

## **Camera settings**

Although acceptable panoramas can often be shot using automatic exposure and focus controls, it is preferable to set everything manually in order to minimise the corrections that have to be done in the software. For example, autofocus will change the focal point of the lens if the active focusing point rests on objects that are at different distances from the camera. This will result in slight differences in magnification, and thus alignment, between adjacent frames.

Most normal scenes vary in average illumination, and in colour balance, as you pan across them. To minimise these changes it is best to select a standard exposure that covers the full range between frames, and to set this manually.

In extreme cases, where there is a very high density range, you can also do HDR exposures for each frame. This would normally be done using exposure compensation and bracketing, resulting in sets of multiple exposures for each camera position. Each set is then treated as an HDR set and processed appropriately. The results are then combined in the panorama software. (See note on pre-processing below)

For colour balance it is best to set a standard balance manually for all frames, which for landscapes would normally be daylight or cloudy, depending on the weather conditions.

## **Pre-processing images**

If you are shooting RAW images, you can pre-process the images using Adobe Camera Raw (ACR) or another raw processor such as DXO Optics. You need to take care to ensure that, if you use manual camera settings, all your pre-processing changes are identical for each image in the set. If you did not use manual exposure control then this may help in allowing you to manually correct some exposure issues. However Autopano, for example, can do a very good job of matching and adjusting exposure as we discuss later.

Of course there may be reasons other than exposure where you wish to pre-process the images. One of these is the use of HDR sets. When using HDR great care needs to be taken to ensure that the HDR images have the same effective exposure and other corrections otherwise later corrections may not be as effective when made in the panorama software. Another example would be using DXO Optics for the DXO lighting control and specific lens corrections that are available in that software.

## **Making the exposures**

Panorama stitching software relies on having adequate overlap between adjacent frames in order for the software to match identical points in adjacent images. It is generally best to allow an overlap of between 25 and 50% to ensure that the software can pick an adequate number of clearly defined points (30% often works well).

This overlap can be judged manually by noting the position of an object at an appropriate point (say 30% in) on the frame on the right side and then planning so that the object is now in the same relative position on the

left side. Alternatively, if the camera base plate is graduated in degrees, the change required for one frame can be noted and the same change should then be applied to all subsequent frames.

If a different lenses to be used the angular overlap will change as the field of view of the lens changes. The same is also true when changing from landscape to portrait modes, as the width of the image is different to the height.

There are a couple of situations in which it is best to avoid when making panoramas. The most important of these is identifiable moving objects such as people or vehicles. However, having said that some software is capable of eliminating these where they do not match.

Another problem is clouds and waves in water. Clouds can often be faked, and corrected by touching up the final image. However, doing this with waves may be problematic if they are discrete, rather than just a roiling surf.

## **Using PhotoShop and PS Elements**

Like most things in the PhotoShop family, you can do the merging in several different ways. (Note that there may be slight variations in menu items and options between versions of the various components of the PhotoShop family, e.g. CS 4, has some improved functionality).

Adobe calls, the process "Photomerge", which can be started using Bridge by selecting the images in the set and going to the Tools menu and selecting PhotoShop then Photomerge.

Alternatively, you can start from PhotoShop and from the file menu select Automate and then Photomerge.

Users of Photoshop Elements can start with the Organiser and select Get Photos from Files and Folders or can start with Edit, and in both cases then go to File, New, Photomerge Panorama,

If you are using Lightroom, you can start from the grid view window, selecting all the images in the set, right click and select Edit Merge to Panorama in PhotoShop, which will then open all the images with your Lightroom adjustments in PhotoShop.

With all of these methods, you end up in the same place, Photomerge, where you can select the merge method to use, which includes:

- Auto
- Perspective
- Cylindrical
- Spherical
- Collage
- Reposition

Each of these variations has specific attributes applicable to particular image interpretations. If you are not sure which is the best for your image, and then try each until you find a good fit. However, auto, perspective, and cylindrical are the most commonly used.

## **Using AutoPano**

AutoPano is a much more sophisticated piece of software for merging images than Photomerge in PhotoShop. It has an extensive array of controls and appears to use a more complex matching algorithm, which produces better results particularly with "more difficult" image sets.

The general process is quite similar, you open a set of files, set the processing options while viewing a low-resolution preview image (not available in PhotoShop's Photomerge) so that you get an impression of the results, and then sit back while the software processes your images. The program also has a batch mode where you can set up several image sets to be processed and then let them run when your computer is not busy, or when you are doing some other task elsewhere.

Autopano also saves an instruction file that you can use to go back and change parameters without redoing the whole setup. At first this might be confusing as the file menu contains two options open and select. "Open" opens the Pano instruction file while "select" allows you to select images to be processed. Autopano can also do the image selection automatically for you based on the time at which the images were taken. This is done by setting a time band and allowing the software to pick the images.

When the images have been selected Autopano displays thumbnails with a summary of the image information, including focal length, shutter speed and aperture and date/time. At the same time, it also displays the low-resolution interpretation of what the final panorama will look like in the right-hand window on the screen. If you deem this to be "good enough", you can go directly to processing the image otherwise, you go to the edit window to fine-tune the parameters.

This is where it begins to get interesting! The menu bar contains a number of options including:

- Projection (planar, cylinder, sphere)
- Image orientation.
- History
- Settings
- Colour correction and levels

Projection was discussed briefly in reference to PhotoShop and is the same here. Image orientation allows you to rotate images and make other changes to orientation that is very useful for fine tuning misalignment.

The next and probably most important selection is the colour and luminosity adjustment. Of course ideally, if you use manual settings, you wouldn't have to do anything here - in theory anyway!

The luminosity adjustment (none, low density range, high density range) applies to the whole image, while the colour and "transfer function" adjustments apply to each image individually, allowing you to effectively balance the colours and luminance, if necessary.

Typically, you would pick one image as the control and set that as a "hard anchor" and then adjust each image using the appropriate anchor codes. Options include white balance, transfer function, etc.

In addition to these controls there is a levels control, which is very similar to that in PhotoShop and a "filters" control, which applies tone mapping to the image.

These are the key controls in Autopano, when you have made these adjustments then you can process (render) the image. Since you saved the instructions, it is quite easy to go back and change things if the result is not quite how you envisaged it.

The settings menu (under edit) includes a number of preset parameters that rarely need changing but which should be set for optimal results. The General tab is straightforward. The Detection tab includes:

- Quality of detection (of panorama sets)
- Key points (50 works well)
- Optimisation (I have it set for "Strong")

- File naming settings to construct file names showing the image sources
- Auto crop/render/save, colour correction and level options

The Optimization tab includes:

- Strong algorithm (I select this)
- Adjust lens distortion (see note re pre-processing above)
- Control point selection settings (again I select 50)
- Auto fine tuning using geometry analysis and bad point cleaner

The Editor tab includes settings for preview size (depends on your screen size in pixels), interpolation and blending methods, and the initial colour anchor type.

The final tab is Rendering which controls the final image production and includes:

- Interpolation (Bicubic)
- Blending (Smartblend)
- File format (PSD/PSB, never jpg)
- Bit depth (16 bit preferred)
- Layers (embedded, larger file but more versatile)
- DPI (240 or 300)
- Output folder and filename settings

## **Key References:**

Two important references are:

Max Lyons: [www.tawbaware.com/maxlyons/index.html](http://www.tawbaware.com/maxlyons/index.html) - PTAssembler (PT Tools)

AutoPano: [www.Autopano.net](http://www.Autopano.net) Software and tutorial info