

SCSH CAMERA CLUB

ADVANCED PHOTOGRAPHY AND PROCESSING ("APP")

2023-01-20 APP Presentation - Focus Stacking - Outline and Resources

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1. FOCUS STACKING: BASIC CONCEPT

1.1. What is focus stacking?

1.1.1. Use this technique when the depth of field you can achieve in a single capture isn't wide enough to obtain sharp focus on all the scene elements that you want to have sharp.

1.1.2. To focus stack, take two or a series of photos ("brackets") of the same composition, moving the focal plane between each bracket, then assemble the brackets into one photo ("render the stack").

1.2. Focus stacking is useful in two types of photography.

1.2.1. Use focus stacking in landscape photography:

1.2.1.1. If your composition has an object very close to your camera position (think flowers or rocks as a foreground element) and using a wide angle lens at a very small aperture (to widen your depth of field) will render your background (think mountains) too small and soft, so then you choose a longer focal length lens and your resulting depth of field is not wide enough to obtain a sharp foreground (your flowers or rocks), your middle ground (whatever it might be) and your background (your mountains), OR

1.2.1.2. If your composition requires a telephoto lens to compress your scene and the composition is close to you (think standing on the bank of

a small creek shooting a detailed scene of rocks, roots and rivulets) and you can't get sharp focus on all elements even if you use a very small aperture such as f/16 or f/22.

1.2.2. Use focus stacking in macro or close up photography:

1.2.2.1. Macro and Close Up Photography Defined

1.2.2.1.1. Macro photography means the size of the subject is equal to or greater than the image of the subject on the sensor; and

1.2.2.1.2. Close up photography is not technically macro photography, but the subject is really close anyway).

1.2.2.2. In macro and some close up photography, the distance to the subject makes it difficult or impossible to keep the entire subject in sharp focus, regardless of aperture.

1.2.2.3. Controlling depth of field

1.2.2.3.1. In some close up photography, even if a small aperture will allow reasonable sharpness of the subject,

1.2.2.3.2. you may want to throw the background out of focus

1.2.2.3.3. (think of a flower in the field where you want to capture the flower but set it off from the leaves, twigs and other flowers in the background).

1.2.2.3.4. Use focus stacking with a larger aperture to get your flower sharp throughout and leave your background unfocused.

1.2.2.4. Getting Close – most lenses won't focus close enough on their own, so:

1.2.2.4.1. Use a dedicated macro lens;

1.2.2.4.2. Use extension tubes or a bellows between your camera and lens;

1.2.2.4.3. Use a close focus filter; OR

1.2.2.4.4. Use an adapter to mount your lens to your camera in reverse (rendering your lens fully manual).

1.3. Other uses of focus stacking mentioned in the literature:

1.3.1. Use focus stacking to avoid diffraction

- 1.3.1.1. At smaller apertures, image softness results from the bending of light rays through the lens.
- 1.3.1.2. When decreasing the aperture to improve sharpness yields more softness due to diffraction, your lens is said to be “diffraction limited.”
- 1.3.1.3. May not be a practical problem in most cases, but something you should be aware of.
- 1.3.2. Use focus stacking so that you can use the “sweet spot” of your lens
 - 1.3.2.1. Every lens has an aperture where it is the sharpest.
 - 1.3.2.2. Again this isn’t a practical problem in most cases, but also something you should be aware of.

2. FIELD WORK: TAKING FOCUS STACKING “BRACKETS”

2.1. Move the Focal Plane

- 2.1.1. Recall that to take our focus stacking brackets, we must move the focal plane between each bracket
- 2.1.2. There are two ways to move the focal plane. Either:
 - 2.1.2.1. with your camera stationary, shift the focal plane by shifting the lens focus farther from or nearer to the camera (we can call this “change lens focus”); OR
 - 2.1.2.2. without changing the lens focus, move the camera closer to or farther from the subject so that the focal plane moves along the subject (we can call this “move the camera”).

2.2. Ways to Change Lens Focus

- 2.2.1. Manually, by changing lens focus with the focus ring.
- 2.2.2. Automated by camera
 - 2.2.2.1. Some cameras have settings that can be used to shift the focal plane automatically for a series of brackets.
 - 2.2.2.2. These tend to be mirrorless cameras.
 - 2.2.2.2.1. Olympus cameras have had focus bracketing for many years.

- 2.2.2.2.2. Sony just added bracketing to its popular Alpha 7R series in the forthcoming V.
- 2.2.2.2.3. Canon has focus bracketing in its R series mirrorless cameras, as well as the 90D and M6 MkII and a couple of Powershots.
- 2.2.2.2.4. Nikon started with focus bracketing in its D850 and now in its mirrorless models.
- 2.2.2.2.5. Panasonic Lumix has focus stacking in its G models.
- 2.2.2.3. Focus Stacking vs. Focus Bracketing
 - 2.2.2.3.1. Some of these cameras will also render the brackets into a new “focus stacked” image.
 - 2.2.2.3.2. Others will take the brackets, but leave rendering of the brackets to you or other software.
- 2.2.2.4. Automated by camera doesn’t work if there is no connection between the camera and the lens (such as with some macro tubes or bellows or when reversing the lens).
- 2.2.3. Applications and camera control devices exist that can be used to control the camera to shift the focal plane and take a series of brackets. These include:
 - 2.2.3.1. Helicon Remote (an application that controls lens focus via a computer-to-camera connection);
 - 2.2.3.2. CamRanger (a device to wirelessly control many functions on certain cameras, including automatic focus bracketing); and
 - 2.2.3.3. Helicon FB Tube (HeliconSoft, the developer of the Helicon Remote and Helicon Focus software, has in the past sold a macro extension tube for either Canon EF or Nikon F mount cameras and lenses that can be used to change the lens focus while taking the brackets. According to their website, the FB Tube is out of production due to the war in Ukraine (HeliconSoft is located in eastern Ukraine near the Russian border)).

2.3. Ways to Move the Camera

2.3.1. Focus Rails

- 2.3.1.1. Also sometimes call macro rails or slides.
- 2.3.1.2. Fix the camera on the rail, then move the camera along the rail.
- 2.3.1.3. Can be by hand or motorized.
- 2.3.2. Hand Held – see the quick and dirty method below.
- 2.4. The Exposure Triangle in Focus Stacking
 - 2.4.1. Aperture: use an aperture that will give each successive bracket sufficient depth of field to overlap the depths of field of the nearer and farther brackets.
 - 2.4.2. Shutter speed: select your shutter speed based upon any motion of the subject and whether you are hand holding your camera.
 - 2.4.3. Adjust ISO to correct the exposure after setting the aperture and shutter speed. If hand holding, consider increasing your ISO so that you can increase shutter speed. Use a fixed ISO, not auto ISO.
 - 2.4.4. Exposure settings for all brackets should be the same.
 - 2.4.5. Use manual mode so you can select and fix your aperture, shutter speed and ISO.
 - 2.4.6. An exception might be if the exposure range exceeds the camera's capability so that you take some brackets at different exposure values so that you can blend the brackets for both depth of field and exposure.
- 2.5. Number of Brackets
 - 2.5.1. The number of brackets you need can vary from two or three up to 100 or more.
 - 2.5.2. It all depends on the depth of field of each bracket and the distance from the nearest and farthest points in the composition that you want to have in sharp focus.
 - 2.5.3. Use a depth of field calculator to determine the depth of field for each bracket at the aperture you have selected and the focus distance for the bracket (your type of camera (for sensor size) and your lens focal length must be set in the calculator but will remain constant for each set of brackets).

2.5.4. For macro photography focus stacking, use a macro depth of field calculator.

2.6. Taking the Brackets

2.6.1. General

2.6.1.1. Remember that the cleaner the composition the easier it will be for you, or your stacking app, to render the stack.

2.6.1.2. Shoot RAW photos.

2.6.1.3. Overlap your brackets to avoid bands of softness.

2.6.1.4. Take more brackets than you think you will need.

2.6.1.5. Review your brackets in the field, making sure you have at least one bracket that is sharp in each area you want sharp.

2.6.2. For landscape focus stacking

2.6.2.1. You will generally want to use a tripod. All of the brackets must align perfectly. Although some apps such as Photoshop can align the brackets, its much easier if they are already aligned.

2.6.2.2. Take the first bracket with focus near the camera then take subsequent brackets while moving focus up the LCD screen.

2.6.2.3. No need to zig-zag across the LCD screen.

2.6.2.4. Brackets can be set by distance from the camera (bearing in mind the depth of field for each bracket at your aperture setting and lens focal length), OR

2.6.2.5. By focusing on the major areas you want in sharp focus.

2.6.3. For macro and close up photography with moving objects (think bugs), a quick and dirty approach may work.

2.6.3.1. Hand hold your camera, put it in manual focus mode and burst mode, use a fast shutter speed (at least 1/250) and a smaller aperture (say f/8) then focus first on one end or the other of the subject and either turn the lens focus ring or move the camera either in or out while taking a burst along the length of your subject.

- 2.6.3.2. If your camera has an electronic (silent) shutter, the better practice is to use it. You will be taking many shots and using the electronic shutter will save wear and tear on your mechanical shutter.
- 2.6.4. For macro and closeup photography with a relatively stationary subject
 - 2.6.4.1. Again, use a tripod.
 - 2.6.4.2. Manually focus on the closest point you want in sharp focus.
 - 2.6.4.3. If your camera does bracketing for focus stacking, by all means use it.
 - 2.6.4.4. If not, take your first bracket.
 - 2.6.4.5. Zoom in and refocus for each successive bracket, taking individual shots.
 - 2.6.4.6. In general, you don't need to zig zag left and right. However, if you are shooting a relatively flat object and want to ensure sharpness throughout, use auto focus and take brackets in each of the four corners and the middle.
- 2.7. White Balance
 - 2.7.1. Your white balance should be the same for all brackets.
 - 2.7.2. Choose a white balance setting and fix it for all brackets or shoot RAWs and synchronize in Lightroom or other raw converter before rendering the stack.
- 2.8. Focus
 - 2.8.1. Use a small AF target or manual focus so you can get the focus point for each bracket where you want it.
 - 2.8.2. If you use auto focus, switch to back button focus before focusing (or switch to manual focus after focusing but before snapping) so that your camera doesn't refocus when you take the shot.
- 2.9. Focus breathing
 - 2.9.1. Some lenses change their focal length as you shift focus.

- 2.9.2. The farthest focal plane will have the smallest field of view and all of your other brackets will be cropped to this field of view. Thus, compose for the farthest focal plane.
- 2.10. How do you know when you need to focus stack in landscape photography?
- 2.10.1. Take a photo focused one third into scene. Zoom in and check focus at various points in depth of photo. If everything you want to be sharp isn't, then use focus stacking.
- 2.10.2. But see if you can get everything in the composition sharp that you want to be sharp by using a smaller aperture or by moving the focal plane nearer or farther from the camera.
- 2.10.3. Sometimes a focus stacked landscape image doesn't look natural. As things get farther from us, they become softer and less distinct. Add depth to an image by leaving more distant areas in softer focus. Ask yourself: would you be able to see the entire scene in sharp focus? If so, focus stack may be called for. Otherwise, not so much.
- 2.10.4. Pay attention to the hyper-focal distance at the aperture and focal length you are using. Focus at the hyper-focal distance to get your depth of field from one half of the hyper-focal distance to infinity. In practice, focus just beyond the hyper-focal distance to avoid coming up short. Determine hyper-focal distance by using a depth of field calculator such as the one in PhotoPills.

3. PROCESSING FOCUS STACKING “BRACKETS”

3.1. Basic Adjustments

- 3.1.1. Make basic adjustments in Lightroom or your other raw converter of choice (you generally want to do basic edits on your RAW file if possible).
- 3.1.2. First adjust one of the brackets (usually, the one with focus closest to the camera).
- 3.1.3. Don't crop or sharpen it.
- 3.1.4. Perhaps adjust white balance.

- 3.1.5. Adjust exposure, contrast, highlights, shadows, lights and darks as needed.
- 3.1.6. Check lens corrections.
- 3.1.7. Synch the edited bracket to the other brackets.
- 3.2. Full featured apps with stacking capabilities
 - 3.2.1. Photoshop, Affinity Photo, On1 Photo Raw and Luminar Neo (with an extension) all have focus stacking capability built in. Photoshop Elements will focus stack with an add-on called Elements+. Among the full featured apps with stacking capabilities, I have used only Photoshop.
 - 3.2.2. Photoshop's automated procedure
 - 3.2.2.1. Open the brackets you initially processed as explained above as layers in Photoshop
 - 3.2.2.2. Arrange the layers (usually with closest on bottom, progressively to the top). To reverse the order of layers select Layer > Arrange > Reverse.
 - 3.2.2.3. Align the layers
 - 3.2.2.3.1. Select all layers
 - 3.2.2.3.2. Select Edit > Auto Align Layers
 - 3.2.2.3.2.1. Leave Auto Checked
 - 3.2.2.3.2.2. Select OK
 - 3.2.2.3.2.3. Ignore Vignette Removal and Geometric Distortion (these will probably have been dealt with in Lightroom).
 - 3.2.2.3.3. Auto align layers will take care of lens focus breathing.
 - 3.2.2.3.4. As mentioned above, you may lose part of your composition (depending upon the focus breathing of your lens).
 - 3.2.2.3.5. To get rid of white lines around the edge of the layers (which results from the alignment process), select C for crop, set the current ratio (upper left corner) to Original Ratio, move boundaries in as needed, and check Delete Cropped Pixels, then select the check mark.
 - 3.2.2.4. Blend the layers

3.2.2.4.1. Select Edit > Auto Blend Layers

3.2.2.4.2. Leave on Stack Images

3.2.2.4.3. Check: Seamless Tones and Colors

3.2.2.4.4. Check: Content Aware Fill Transparent Areas

3.2.2.4.5. Select OK

3.2.2.5. Check and save the merged result

3.2.2.5.1. These steps will create a new merged layer from the bracket layers, positioned at the top of the layer stack.

3.2.2.5.2. Each of the bracket layers will now have a mask that is white where Photoshop used the bracket in the merged layer and black where it did not.

3.2.2.5.3. Check the merged result at 100%, looking for areas where Photoshop's automated process messed up. Fix as discussed below.

3.2.2.5.4. If all looks good or after fixing any issues, you may delete all of the bracketed layers leaving the merged result.

3.2.2.5.5. Save the merged result in Photoshop to return to Lightroom.

3.2.2.6. The TK8 Plugin for Photoshop has buttons to facilitate blending using the Photoshop automated process.

3.3. Hand blending

3.3.1. You can blend focus stacked brackets by hand in any application that has layers and masks.

3.3.2. Also, use hand blending to correct mistakes from Photoshop's automated process.

3.4. Single and special purpose apps

3.4.1. There are many apps that only process focused stack brackets or that do that and other specialized photo merge functions (such as HDR or panoramas). The two best single purpose apps for focus stacking are:

3.4.2. Helicon Focus

3.4.2.1. Will render stacks that are in most RAW formats, JPEGs, TIFFs, or DNGs.

3.4.2.2. Rendered images can be saved as JPEGs, TIFFs or DNGs.

- 3.4.2.3. Has 16 bit processing available.
- 3.4.2.4. Much faster than Photoshop's automated process.
- 3.4.3. Zerene Stacker
 - 3.4.3.1. I haven't used, but has a free 30 day trial version
 - 3.4.3.2. Will render stacks that are JPEG or TIFF files.
 - 3.4.3.3. Has 16 bit processing available.
- 3.5. Camera brand specific apps
 - 3.5.1. Some camera brands have photo processing apps that come with the camera or can be obtained from the camera manufacturer and some of these apps have focusing stacking capability. These include:
 - 3.5.1.1. OM Systems (used to be Olympus) has OM Workspace.
 - 3.5.1.2. Canon's Digital Photo Professional.
 - 3.5.2. There may be others as well. Check the processing app for your particular camera brand if there is one.

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