Techniques to Expand the Capability of Your Camera

- High Dynamic Range
  - Combine images with range of exposures to increase dynamic range
- Panorama
  - Stitch together adjacent scenes to expand the field of view
- **Focus Stacking**
  - **Combine images taken at different focal distances to increase depth of field**

Dallas Camera Club
Frank Richards 11-14-2023

Tonight

- What is focus stacking
- How to shoot a focus stacking sequence
- Shooting macro and landscape focus stacks
- Processing stack
- Useful equipment
- Reference material
- Attachment – Software performance comparison

Focus Stacking Increases DOF

Focus Stacking Increases DOF
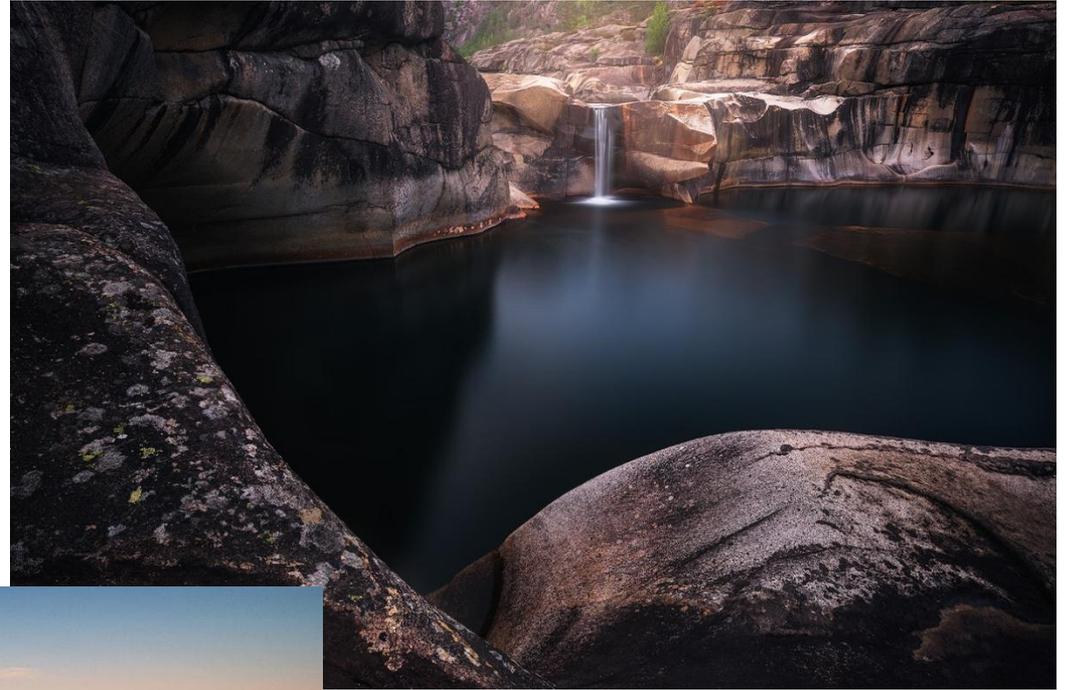
What and Why - Focus Stacking

- Have you looked at a scene and wondered why it looks different in your photo? Your eyes adjust focus as you look from point to point while a photo focuses on just one DOF slice at a time
- With focus stacking, images are captured with different focus points and combined to create an image with more DOF than is possible with a single exposure.
- Focus stacking can use sharpest aperture
  - A wide open aperture provides a shallow depth of field
  - A small aperture (high f-stop) will increase depth of field, but can result in soft focus due to diffraction. May also have to reduce shutter speed or increase ISO which increases noise
  - For most lenses, the aperture that results in the sharpest focus is 2-3 stops from wide open
- Both macro and landscape photography may benefit from focus stacking
  - Macro - individual images have a very shallow depth of field
  - Landscape (or large object) - may have a large separation between foreground and subject
- Do you need to focus stack. Take a test shot to see if the image is acceptably sharp throughout to see if focus stacking is really necessary

Focus Stacking a Series of 21 Images

Image 2

First image taken at closest point of focus

FOV gets larger as focal distance increases and subject gets smaller

Image 6

Image 10

# Image 13

Image 21

Final Stacked and Processed Image

Two Ways to Create a Focus Stack

- Move the focus point by refocusing the lens

- Move the camera

•Start with foreground
•Adjust lens to change focus distance
•Image gets smaller as focus distance increases
•DOF increases as with focus distance increases
•Focus stack can cover from foreground to infinity
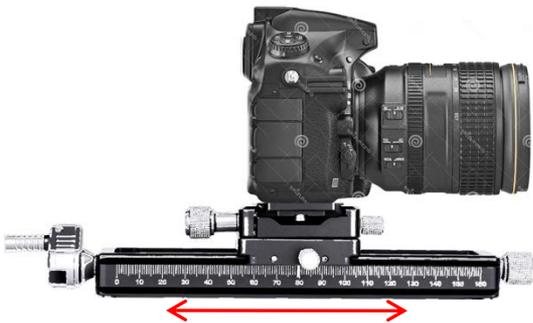
•Start with closest detail
•Use rail to move camera in DOF steps
•Each image stays the same size and
•DOF stays the same
•Subject size is limited by length of rail

Moving Focus Point

- There are quite a few ways to shoot a focus stack sequence

- Manually shifting focus – Using tripod or hand holding, focus on the near point and move to a focus point further out with each shot. A DOF calculator app is helpful

- Automated focus bracketing in-camera – many newer cameras provide the ability to automatically create a focus stacking sequence of images. The number of shots will vary depending upon the lens focal length and aperture, magnification and positioning of the depth of field within the scene

- Manually move the camera – hard to control small movements

- Manual focusing rail - focusing rails make it easier to make small, precise steps. Used for macro and close up subjects. Need to know DOF. Reasonably priced

- Automated focusing rail - step sizes are electronically calculated and controlled. Ease and high precision make these valuable if you are going to shoot a lot of macros. These are expensive

Some Things to Consider
When Shooting Focus Stacking Sequence

- Compose your shot while focusing on nearest feature you'd like to be sharp. Your subject will be largest when close
- The depth of field for each subsequent photo overlaps the depth of field from the prior photo
- Using smallest aperture (highest f-stop) that is sharp for lens you are using. Higher f-stop values provide larger DOF and need for fewer images.
- More closely spaced focusing distances often produce more consistent and natural looking sharpness, but try to avoid overdoing it as it takes longer to capture and process the stack
- Keeping the exposure dynamic range *down* rather than shooting with harsh, contrasty lighting will give your stacking software a better chance to create a decent stack
- If your software supports it, use RAW to provide processing latitude
- Use a self-timer or remote shutter release to avoid camera shake when shooting manual
- Use dark frames to separate sequence from surrounding images and other sequences. This will make it easier to tell where each series starts and stops.

Number of Images in Stack

61

20

16

15

13

8

Number of Images in Stack

8

7

6

5

4

3

Focus Stacking Macros

- The closer the subject is to the lens, the shallower the DOF. This creates a significant challenge in macro photography

- It may take a large number of photographs to achieve a sharp stacked image because the shallow DOF in each individual image

- Stacking combines the sharpest parts of several images focused at different points to create one sharp composite image.

Focus Stacked Macros
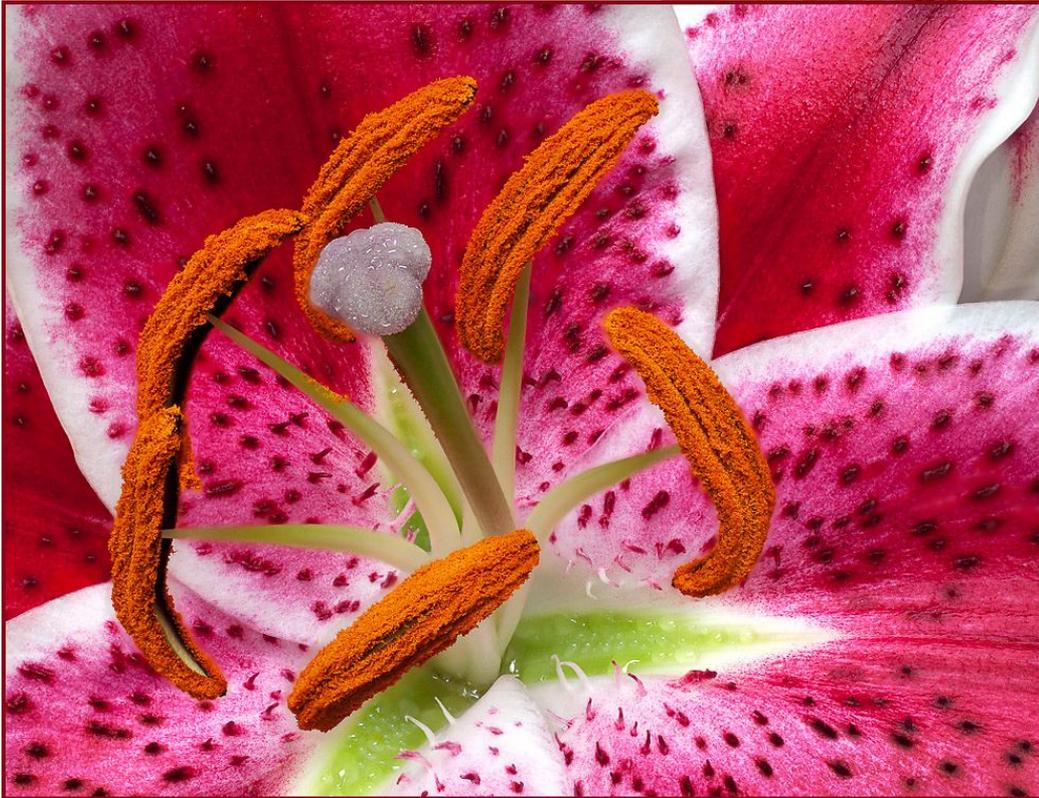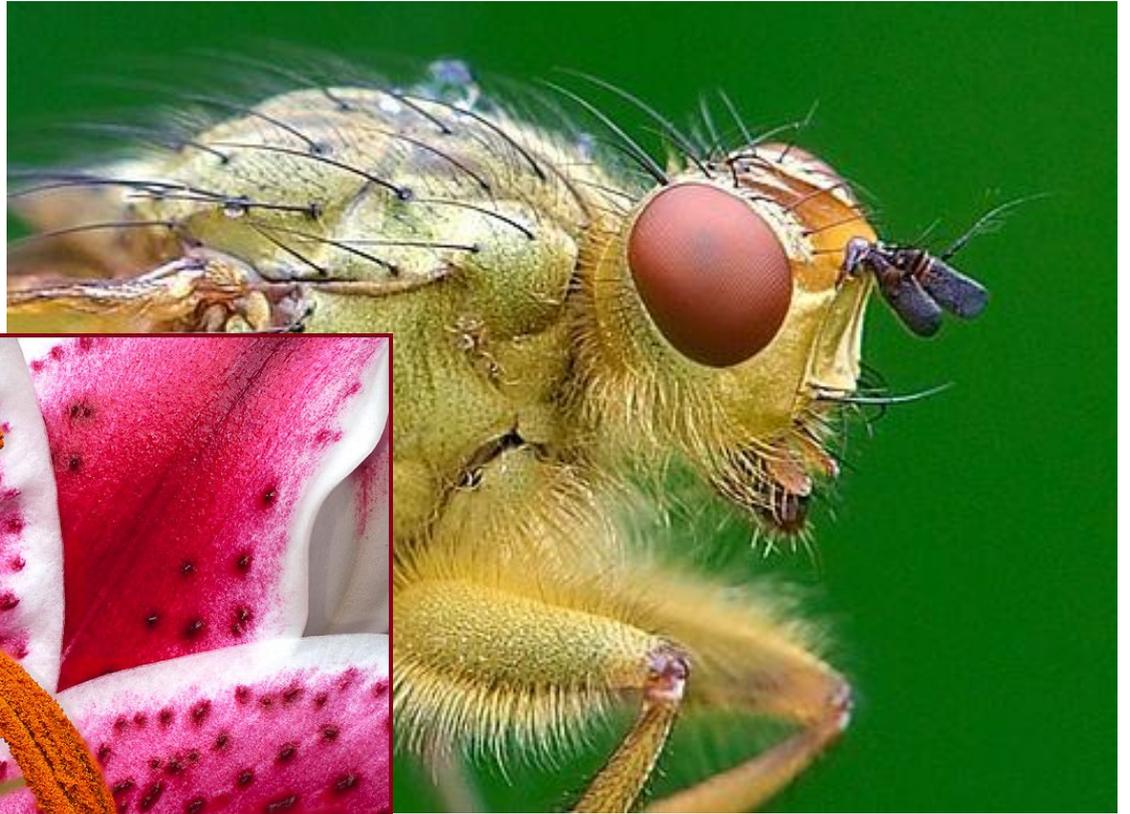
Macro Photography
Using Focus Stacking

- The number of shots required to have everything in focus in a macro photograph will be significantly more than for a landscape. This is because at high magnification, the depth of field will be incredibly shallow with just a tiny portion of the subject in focus

- So here's what you do:
  - Use a lens that allows you to get close to subject
  - Place the camera on a sturdy tripod – a must for very small subjects. May also want to use a focusing rail
  - Compose the first shot focusing on the nearest feature
  - Determine the exposure and set the camera to manual mode to ensure that the exposure and focal length remain constant for each image
  - Take the first exposure
  - Without adjusting any settings, move the focus point to a distance slightly farther away using one of the techniques discuss previously
  - Take as many photos as needed to cover the subject. You could need 50 plus shots for a macro.

Focus Stacking Landscapes

- Generally want the image to be sharp throughout when photographing a landscape. Applicable to other large subjects.

- There are two basic scenarios that may benefit from focus stacking
  - When the scene has a close foreground with the main subject some distance away and you want both to be in sharp focus.
  - When using a telephoto lens, which typically has a shallow DOF, and the subject covers more distance than the DOF.

- It may only take a few photographs to achieve a sharp stacked image because working distances are fairly large. Nearness of foreground and lens focal length and aperture are drivers.

- If your scene contains moving elements, use high shutter speed to eliminate motion blur

- See if you really need to focus stack
  - Try setting focus to hyperfocal point to see if scene is sharp throughout
  - Try using a wide-angle lens, the DOF may be sufficient

Focused Stacked Landscapes

Focus Stacking Landscapes

- Find the right composition handheld
- Place the camera on a tripod at the selected shooting location
- Frame the subject and compose the shot using the nearest focus point
- Determine exposure for the scene
- Take the first exposure
- Without moving the camera or adjusting any settings, move the focus point to an object in the mid-ground of the image and refocus. DOF should overlap first exposure.
- Take the second exposure
- Refocus on an object further into the scene and take images until the farthest point in the scene is reached or you have reached the hyperfocal distance or infinity. Three to 5 shots are generally enough

Processing Focus Stacks

- The images are processed combining multiple photos with different focal points into a single image.
- Do not process individual images prior to stacking
- The field of view and thus subject size and perspective change as the focusing distance changes
- This causes each individual photo to have a slightly different scale and alignment. Stacking software re-sizes and aligns the separate images
- Complex algorithms determine which images have the maximum sharpness for various features in the scene. Masks are created for each photo to isolate sharp features
- The software merges shots to create an image with all features in focus
- After stacking, post processing may be used to adjust color and contrast, enhance details, remove distractions, remove noise, sharpen and prepare for presentation
- The stacking software may also have the tools to retouch stacked image

Useful Equipment

- Camera with manual mode or one that has built in focus bracketing capability
- Tripod
- Focus stacking software

- Some wish list items:
  - Remote shutter release
  - Macro lens for small subjects
  - A focusing rail that allows small precise changes in the camera position for macro photography
  - App to calculate depth-of-field

Cameras

- Most recent cameras provide automatic image focus bracketing to focus stack in post. Some will also focus stack in-camera.
  - Canon – Focus Bracketing
  - Fuji – Focus Bracketing
  - Nikon – Focus Shift
  - Olympus – Focus Bracketing/Stacking Outputs
  - Panasonic Lumix – Focus Stacking Output
  - Sony – Focus Bracketing

Post Processing Tools

- Specialized software is available for focus stacking. Most is reasonably priced. Here are several popular packages
  - Helicon Focus* - first focus stacking program on the market and probably the most popular, simple to use, accepts RAW images
  - Zerene Stacker* - user friendly, gets very high marks for output quality, tiff input
  - Photoshop* - has a built-in stacking function and countless other tools that allow control and fine tuning, accepts RAW images
  - ON1 Photo - feature added several years ago, do not know anyone how has used it
  - Affinity Photo – do not know anyone how has used it
  - There is probably more

  *See attachment for comparison

Focus Stacked Panoramas

- The question came up about using focus stacking in panoramas
- Looks like generally accepted approach is to shoot focus stack a particular view and then move camera to next view within the pano scene
- Process each focus stack first
- Then use pano software to stitch the focus stacked views
- See link for some more info - https://forum.luminous-landscape.com/index.php?topic=133890.0

Reference Material

- General overview - https://digital-photography-school.com/a-beginners-guide-to-focus-stacking/ https://petapixel.com/2019/10/02/beginners-guide-to-focus-stacking-for-macro-photography/

- Processing in Photoshop - https://petapixel.com/2019/10/04/walkthrough-how-to-create-a-focus-stack-in-photoshop/

- Macro photography - http://extreme-macro.co.uk/focus-stacking/

- Landscape photography - https://iso.500px.com/tutorial-focus-stacking-for-landscape-photography/

Attachment

Comparison of Three Common Focus Stacking Applications
By Alan Whiteside and Frank Richards

Focus stacking is a digital image processing technique which combines multiple images taken at different focus distances to create an image with a greater depth of field than any of the individual source images. See *Beginners Guide to Focus Stacking*.

There are many post processing tools that can be used for focus stacking. We looked at the latest version of three widely used focus stacking software packages - Helicon Focus (HF), Zerene Stacker (ZS) and Photoshop align and stack (PS). To compare these, we looked at three scenes with different characteristics photographed with Frank's Canon R5 using the auto Focus Bracketing mode and a 100mm macro lens.

A complete stacked image is shown for each of the test scenes and the areas that we used to show app performance are indicated. Some typical problem areas were enlarged for all three apps. The carnation details are at 100% zoom. The other two were enlarged enough to be able to see the problem areas. You can touchup problem areas in all three apps, but none of these images were touched-up. They are the final processed stacked image in each case.

Software Comparison Testing

The leaf has good texture throughout and a smooth transition from near to far focus points. There were no overlapping areas. Stacked 11 images.

- All three apps provided acceptable results.

hf

ps

zs
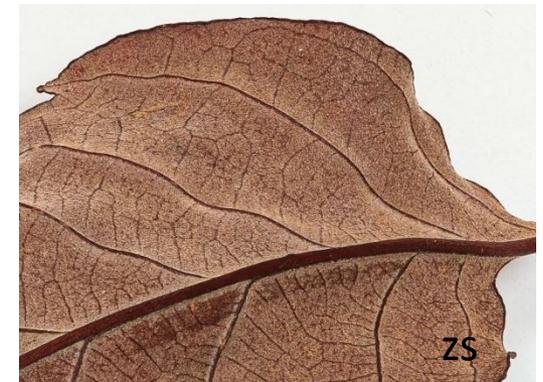
Software Comparison Testing

The sunflower had lots of texture on stem and receptacle and overlapping areas with low contrast in the petals. Stacked 17 images.

- All three apps handled the stem and receptacle well. There is an area at the base of the receptacle where it joins the stem that looks funky like the spins were not reproduced on all images. This is consistent with the original images.
- HF and ZS yielded acceptable results for the petals and the image as a whole.
- PS was not able to handle the low contrast, overlapping petals.

Software Comparison Testing

The carnation was probably the most challenging image with extreme DOF required and lots of overlapping elements with different textures. Stacked 20 images.

- •The overlapping areas were problematic with all three apps.
- •Both the HF and PS apps had trouble in the specific areas we examined. They were close, but
- •HF problem areas would have been a little less obvious when viewed at normal magnification.
- •ZS provided the cleanest result with acceptable results in the lower area by the small flower and minimal defects around the dead leaf above.

Software Comparison Testing
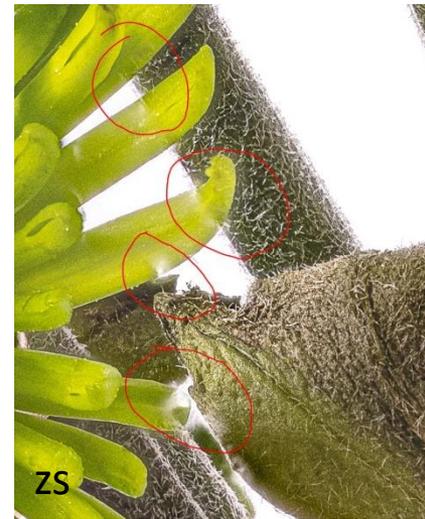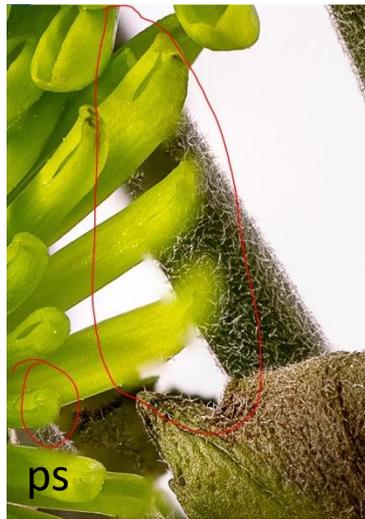
Software Comparison Testing

We concluded that if there are no overlapping elements and good contrast, all three of these tools work well. However, as the image becomes more complex, ZS and HF are the only contenders...and many times ZS comes out the winner. Touchup may be required on complex images with all three apps if you are going to print or display at a high resolution. ZS may just require less.

- Alan uses both HF and ZS. He generally starts with ZS, which takes longer to process an image than HF, and if it doesn't produce great results, he'll give HF a try.
- Frank decided to use ZS about 8 years ago, but all three tools have evolved significantly over that time frame and he had not revisited this decision.
- Based on the results of this little experiment, both Alan and Frank are satisfied with their current workflows and will continue to use them.

Feel free to contact either of us if you should have any questions.