Techniques to Expand the Capability of Your Camera

- High Dynamic Range - Mar 2
  - Combine images with range of exposures to increase dynamic range

- Panorama - Mar 16
  - Stitch together adjacent scenes to expand the field of view

- **Focus Stacking - Apr 6**
  - **Combine images taken at different focal distances to increase depth of field**

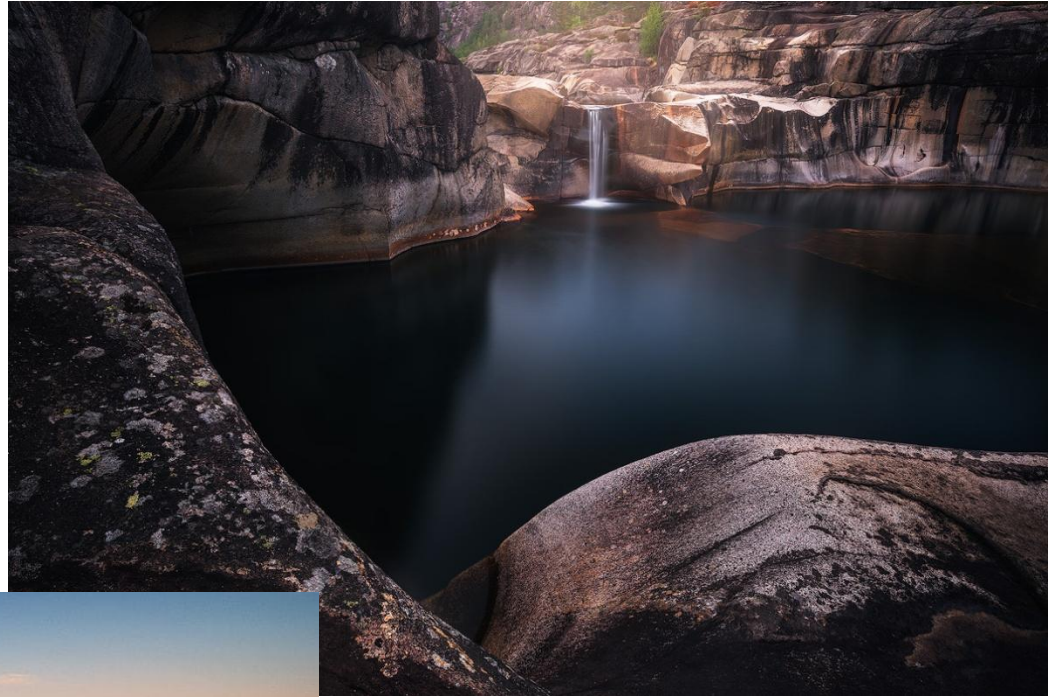Dallas Camera Club
Frank Richards 4-6-2021

Tonight

- What is focus stacking
- How to shoot a focus stacking sequence
- Useful equipment
- Shooting macro and landscape stacks
- Processing stack
- Source material
- Demo

- Attachment – Software 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 plane 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 is similar to HDR photography that we discussed last class.)
- Focus stacking can use sharpest aperture
  - A wide open aperture provides a shallow depth of field
  - A small aperture 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 landscape and macro photography may benefit from focus stacking
  - Macro - individual images have a very shallow depth of field
  - Landscape - may have a large separation between foreground and subject
- Make sure you need to focus stack. Take a test shot to see if the image is acceptably sharp throughout

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

Macro Photography

Macro Photography

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

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

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

Landscape Photography

Landscape Photography

- Generally want foreground and background to be sharp when photographing a landscape
- 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 multiple distances that may be brought into sharper focus.
- 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 are drivers
- If your scene contains moving elements, use high shutter speed to eliminate motion blur
- Make sure you really need to focus stack
  - Try setting focus to hyperfocal point to see if scene is sharp throughout
  - When using a wide-angle lens, the DOF may be sufficient

Useful Equipment

- Camera capable of shooting in manual mode or that has built in focus stacking capability

- Tripod

- Focus stacking software

- Some wishlist items:
  - Remote shutter release
  - Macro lens, close-up addon lenses or extension tubes
  - For macro photography, a focusing rail which mounts to your tripod allows small precise changes in the camera position
  - A depth-of-field app

Some Things to Consider
When Shooting Focus Stacking Sequence

- Compose your shot while focusing on nearest feature you'd like to be sharp. Your final subject will only be as large as seen in the nearest image
- The depth of field for each subsequent photo overlaps with the depth of field from the prior photo
- Use smallest aperture that is sharp for lens you are using. Using higher f-stop values allows for more sparsely spaced focusing distances
- 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 dynamic range down rather than shooting with harsh, contrasty lighting will give your stacking software a better chance to construct a decent stack
- If your software supports it, shoot RAW to provide processing latitude
- Use a self-timer or remote shutter release to avoid camera shake
- Use dark frames to separate sequence from surrounding images and other sequences. This will make it easier to tell where each series starts and ends.

Techniques to Move Focus Point

- There are quite a few ways to shoot a focus stack sequence
- **Manually shifting focus** – Using tripod, focus on the near point and move to a focus point further out for each shot. A DOF calculator app is helpful
- **Manual focusing rail -** focusing rails make it easier to make small, precise steps. Used for macro and close up subjects. Reasonably inexpensive
- **Automated focusing rail -** step sizes are electronically calculated and controlled. Ease and provides high precision. These are expensive
- **Automated stacking in-camera –** many newer cameras provide an internal focus stacking function. The number of shots and focus increment will vary depending upon the lens focal length and aperture, magnification and positioning of the depth of field within the scene
- **Handheld stacking -** takes a fair bit of practice, but provides flexibility

Cameras with Focus Stacking

- Various models of these cameras provide focus stacking image sequence acquisition functions. This is becoming a standard function on new cameras
    - Fujifilm
    - Canon
    - Nikon
    - Olympus
    - Panasonic LUMIX
    - Sony - coming?

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 narrow with just a tiny portion of the subject in focus

- So here's what you do:
  - Use camera with 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
  - **Frame the subject** and compose the shot using the nearest focus point
  - **Determine the exposure** and set the camera to manual mode to ensure that the exposure remains constant for each image
  - **Set the camera to live view** and place the focus point on the nearest element that you want to be in focus
  - **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's DOF. You could need 50 plus shots for a macro.

Shooting Landscapes
Using Focus Stacking

- **Find the right composition handheld**
- Place the camera on **a sturdy tripod at the selected shooting location**
- **Frame the subject** and compose the shot using the nearest focus point to frame the image
- **Determine exposure** for the scene
- **Set the camera to live view** and set the focus point at the nearest object you want to be in focus
- **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

Number of Images in Stack

61

20

16

15

13

8

Number of Images in Stack

8

7

6

5

4

3

Processing Focus Stacks

- The images are processed combining multiple photos with different focal points into a single image
- The field of view and thus subject size and perspective change slightly as the focusing distance changes
- This causes each individual photo to have a slightly different scale and alignment. Any camera movement will add to the misalignment
- Stacking software sizes and re-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 share features
- The software merges shots to create an image with all features in focus
- The stacking software may also have the tools to retouch stacked image
- After stacking, post processing may be used to adjust color and contrast, enhance details, remove distractions, remove noise, sharpen and prepare for presentation

Software Tools

- Specialized software is available for focus stacking. Most is reasonably priced. Here are several popular packages
  - **Helicon Focus*** - simple to use, first focus stacking program on the market and probably the most popular, accepts RAW images
  - **Zerene*** - 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 **RAW 2021 -** 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 run by Alan Whiteside and Frank Richards

Focus Stacked Panoramas

- The question came up last session 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

Source 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/

Image Processing Demos

2020 Misc – 2020 12 Leaf and Flower Stack – blue/4 star

2021 Misc – 2021 Landscape – blue/4 star

- Lightroom to Zerene Stacker
  - Export as full sized tiffs
  - Upload to Zerene Stacker
  - Stack and save
  - Import back into Lightroom and finish processing

- Lightroom to Photoshop
  - LR - Edit In > Open as Layers in PS
  - PS – Select all layers
  - PS – Edit > Auto-Blend Layers
  - PS – Process as needed and save
  - LR – Finish processing

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. Here is a [beginners guide to focus stacking](#).
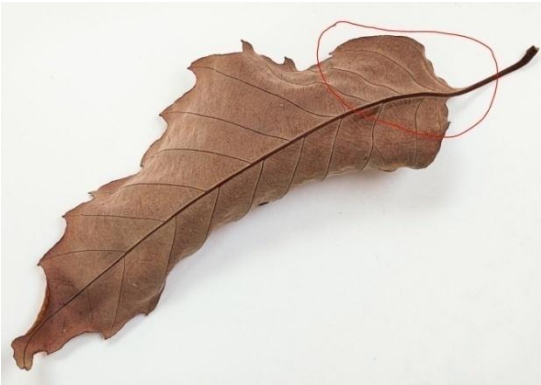
There are many post processing tools that can be used for focus stacking. We looked at the latest version of three widely used focus stacking software packages - Helicon Focus (HF), Zerene Stacker (ZS) and Photoshop align and stack (PS). To compare these, we looked at three scenes with different characteristics 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.
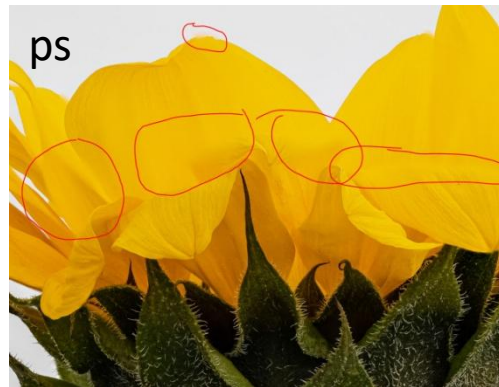
- All three apps provided acceptable results.

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.
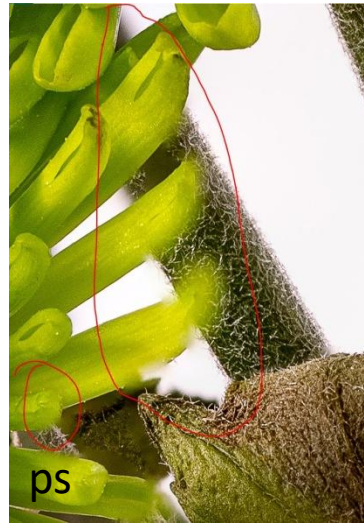- PS was not able to handle the low contrast, overlapping petals.

Software Comparison Testing

The carnation was probably the most challenging image with 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.