**Focus Stacking for greater depth of field**

*by Josh Mayes, Tripod Camera Club, March 2013*

*What* is focus stacking?

> Focus stacking is a process in photography that combines two or more individual exposures, each with a different (overlapping) shallow plane of focus, into a single composite image, with an effective increased depth of field, and improved sharpness, beyond what could be captured with any single exposure.

*Why* do I need it?

> Focus stacking is necessary to overcome the physical limits of lens optics, when greater depth of field is demanded, especially for high magnification macro photography, but also useful to create sharp landscapes with maximum detail from foreground to background.

*When* should I use it?

> When traditional methods are insufficient to provide the photographer the depth of field and fine detail he/she desires of the subject. For example, capturing the full depth of a flower in rich focus, while still using a wide aperture to maximize background blur or bokeh.

*Where* do I start?

> A sturdy tripod and a camera with manual focus ability is a good place to start. Indoors in a controlled environment provides for best results, where lighting is constant and wind is not a factor.

*How* do I get there?

> First, use your camera to capture a number of images, at incremental steps of focus, enough to adequately focus "through" the desired range of the subject, or part of the scene you wish to be sharp. Then use software to combine the individual images into a single composite image with the desired focus.

<u>Examples</u>

- Thomas Shahan - http://thomasshahan.com/#photos
- Morten Aagaard - http://mortenaagaard.com/studio-macro/
- Zerene Stacker - http://zerenesystems.com/cms/stacker/docs/gallery
- Helicon Focus - http://www.heliconsoft.com/focus_samples.html

Common problems

- Moving subjects (try to isolate the subject from wind, and be persistent with living/moving subjects)
- Magnification changes (shoot wide and crop later)
- Perspective changes (worse when using rail systems, where the camera is moved versus only moving the focus ring)
- Subject larger than travel on rail (use focus ring method instead)
- Not enough overlap in source images (use automated systems when possible and experiment to get the right balance of shots for your setup and equipment)
- Software difficulties (try different options, and learn retouching techniques)

Best practices

- Use a tripod and cable release (not impossible without, but certainly not as precise or reliable)
- Use a tethered solution to a phone, tablet, or computer to automate or operate the controls without touching the camera (available options vary for equipment type)
- Know the right equipment and technique for your subject, usually either an automated focusing rail or a tethered device to precisely control camera's focus steps (depending on the subject, one method may be more advantageous over the other)
- Bring your subject indoors if possible (if practical and legal/ethical)
- Always take your best traditional single exposure, in case the stack doesn't give the results you expect (your stacked result should be better than the benchmark traditional image)
- Start in A or Av (Aperture priority) mode to determine starting point (meter and test exposure), then switch to manual and fine tune if necessary, then stick with these same settings for the entire series
- Use manual ISO 100 or lower (50 if available) for best quality (least digital noise)
- Use manual White Balance (auto can change slightly from frame to frame)

- Use your camera's Live View and zoom to manually focus with precision

- Consider using the Kendall Draeger "finger bookend" method to keep your stacks separate and organized (you can group the images as stacks later in Bridge or Lightroom, then delete the bookend images)

- When experimenting, take notes of your setup, photograph them or otherwise keep them digitally (perhaps using audio or text dictation on your phone or tablet)

Recommended tools (hardware / software)

- StackShot by Cognisys, Inc. - http://www.cognisys-inc.com/stackshot/stackshot.php
  100mm rail/controller - $525, Extended 200mm rail/controller - $600 ($375 for rail only)
  Camera specific cable - $45

- Smart phone or tablet (Android or iOS) - DOF calculators, tethering solutions, larger Live View option, etc.

- Zerene Stacker - http://www.zerenesystems.com/cms/stacker
  Student - $39, Personal - $89, Pro - $289, 30-day free trial

- Helicon Focus - http://www.heliconsoft.com/heliconfocus.html
  Helicon Remote - http://www.heliconsoft.com/heliconremote.html
  for desktop or Android/iOS, soon for iPad (big $$ for wireless transmitter needed), only Canon or Nikon cameras that support Live View
  Helicon Focus Lite - $30/$115 (1-year/unlimited), Helicon Focus Pro (includes Remote desktop) - $55/$200 (1-year/unlimited), Helicon Focus Premium (includes Remote for Android/iOS) - $65/$240 (1-year/unlimited), Helicon Remote for Android/iOS - $48 (if purchased separately)

- Photoshop - http://www.adobe.com/products/photoshop.html
  CS6 - $699 (CS6 Extended - $999), Creative Cloud Subscription $19.99/mo. (1-year commitment)

Technical terms/considerations

- *Magnification* is the ratio of a subject's size when projected onto the camera's image sensor (or film), compared to its actual size (My Sony APS-C is 23.5mm x 15.6mm)

- True "*macro*" is truly achieved at magnifications of 1:1 or higher, but often loosely used to describe "close-up" photography (magnifications typically starting at 1:10)

- *Depth of Field* is defined as the amount of the image (a distance range) that is *acceptably*

sharp or in-focus

- Circle of confusion is the blurring of light points (often referred to as bokeh), outside the depth of field, and it is often a polygon shape depending on the lens design and aperture size

- Smaller apertures (higher f-numbers like f/22) increase DOF, but also increase diffraction (softness), problem worsens with higher magnifications

- Longer focal length lenses provide a greater working distance (distance from lens to subject), to achieve the same magnification, but can also provide less dramatic perspective, leading to a flatter resulting image (can *appear* to have a more shallow depth of field due to magnification of the background)

Further study

- Cambridge in Color - http://www.cambridgeincolour.com/

- Morten Aagaard Digital Photography - http://mortenaagaard.com/focus-stacking-a-beginners-guide/

- Zerene Stacker Tutorials - http://zerenesystems.com/cms/stacker/docs/tutorials/tutorialsindex

- Helicon Focus Articles and Video Tutorials - http://www.heliconsoft.com/focus_articles.html and http://www.heliconsoft.com/video.html