

Focus stacking principles

Focus stacking is a technique that combines multiple images taken at different focus distances to create a final photograph with greater depth of field than would be possible in a single shot.

Camera lenses can only keep a limited range of distances in sharp focus at once—the depth of field. With macro photography or landscapes with close foreground elements, you often can't get everything sharp in one frame, especially at wider apertures.

Take a series of photos of the same scene, shifting the focus point slightly between each shot so that different parts of the subject are sharp in each image. Then software analyses all the images and selects only the sharpest areas from each frame, blending them into a single composite image where everything from front to back appears in focus, building a synthetic image with depth of field that exceeds the physical limitations of the lens.

Key considerations:

1. The camera and subject must remain perfectly still between shots—any movement creates misalignment that's difficult to correct: *use a tripod and manual exposure mode (M) to ensure consistent exposure. Some realignment is possible in post-processing, but risks artefacts.*
2. Use manual focus and re-focus in tiny steps. Use a remote shutter release or timer to avoid camera shake (*add a delay if using flash*).
3. The focus steps need to overlap sufficiently. *If you move the focus too far between shots, you'll have gaps where nothing is sharp.* This depends on aperture, focal length, and subject distance- typically 10-30 shots for macro work, 3-5 for landscapes. Keep aperture consistent across all shots.

(usually lens sweet spot around f/8 to f/11 for optimal sharpness).

Graphical representation:

Each coloured bar represents a different depth plane in the scene (objects at different distances from the camera), each one has different areas in sharp focus (full opacity and thick borders) while other areas are soft or blurred (out-of-focus). The final composite illustrates how the software selects only the sharp regions from each image, blended seamlessly.



Post-processing software:

Options include the focus stacking option in Photoshop (Auto-Align and Auto-Blend Layers) or similar programs, dedicated software like Helicon Focus or Zerene Stacker (that offer more control), or in-camera focus stacking (if available).

Before stacking, it may be useful to to adjust settings (*e.g. white balance, black levels etc or run denoise if needed*); sync settings across the stack if possible. There may be optional models to choose from (*e.g. optimised for complex images, reflections etc*).

The software uses sharpness detection algorithms that analyse the fine detail and contrast in each image at the pixel level:

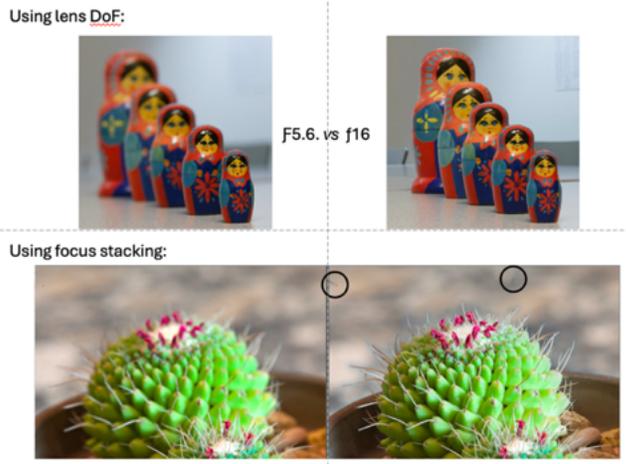
1. Edge detection and contrast analysis: The programs look for areas with the highest local contrast and the sharpest transitions between light and dark pixels. *When something is in focus, edges are crisp and well-defined. When out of focus, those same edges become soft and blurred, with gradual transitions. The software essentially asks "which version of this particular spot has the crispest edges?" across all the images in the stack.*
2. Frequency analysis: Some algorithms look for high-frequency detail. Sharp areas contain lots of fine, high-frequency information, while blurred areas have mainly low-frequency (smooth, gradual) information, *like the difference between a detailed texture versus a soft gradient.*
3. The selection process: The software compares each location across all the source images and picks whichever version scores highest on these sharpness metrics. *It's not choosing entire objects—it's working at a very granular level, sometimes pixel-by-pixel or in small neighbourhoods of pixels.*
4. Blending and transition zones: Good focus stacking software creates smooth transitions in areas where the focus changes,

blending between adjacent sharp zones to avoid visible seams or halos. *This is crucial because the boundaries between in-focus and out-of-focus areas often don't align perfectly with object edges.*

Comparison of approaches:

Even using a high f stop may not be sufficient to capture detail across a wide DoF (top)

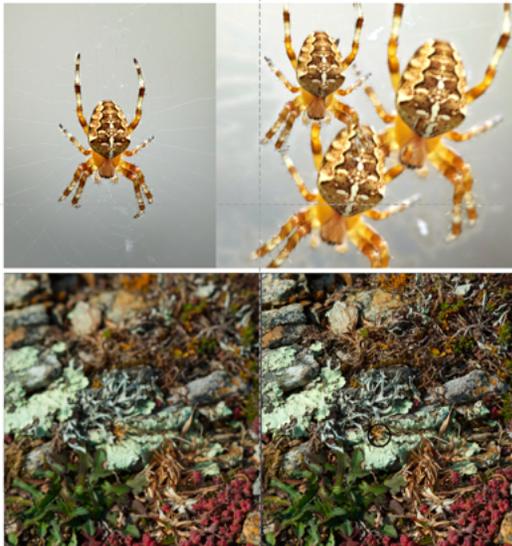
Focus stacking allows greater depth of field, but beware of problems (circled)



5.

Challenges: Algorithms can struggle with areas of uniform tone or texture where there's no detail to measure sharpness against. They can also be fooled by motion, noise, or artefacts, which is why some programs let you manually adjust the automatically generated focus map after processing (*e.g shifting clouds in landscapes*).

Beware of YouTube gurus who advocate a hand-held approach (it takes a LOT of practice), or using variation in focal point due to outdoor breeze: the spider shot with a macro lens isn't fully sharp all over, but in focus stacking a series of 20 shots the software identified 3 sets of images with a similar focal point!



For a lichen shot the first image in the series is shown on the left and final rendering on the right; easily missed, but the one point of the yellow lichen was higher than the foreground objects, so remains unfocussed.

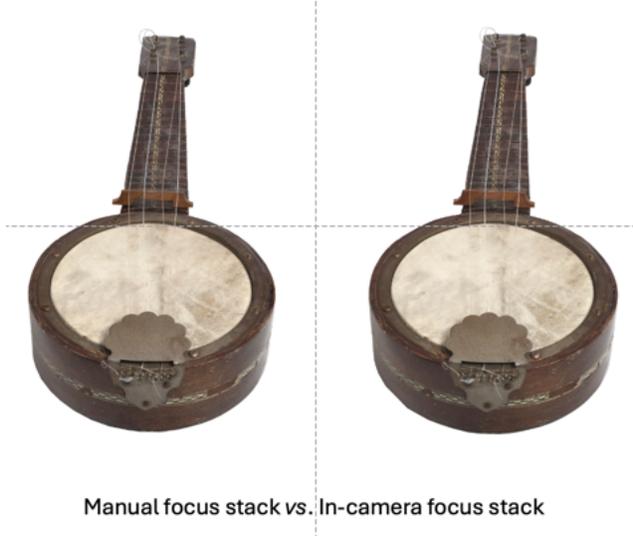
6. File types: JPEG rendered quickly, TIFF gives higher quality. Destructive operations like colour balance and highlights clipping can redone afterwards if the program handles RAW files (but may be slower); many vendors prefer DNG file format for consistency.



In this example, blown highlights/colour balance could be adjusted first?

Technical advances:

In-camera focus stacking is now available, comparable to dedicated software...may be difficult to distinguish between them!



Manual focus stack vs. In-camera focus stack

To manually do a focus stack using Photoshop.

Take all the images into Lightroom and highlight them all - and then press sync (bottom right corner _ this will bring all the images into the same exposure / temp etc) . Once this is done export these to your hard drive and open them in Photoshop If you want to miss the Lightroom move this is fine. It just makes sure they are all the same in terms of exposure etc etc

In Photoshop open up the above images (make sure there are no other images open in PS that are not being used) and do the following -

With images in PS - go to File ... Scripts - load files into stack ... now so long as there are no other files open in PS you can press open all files. You should now see all the individual images loaded on right hand side

Now go to Edit - auto align layers and select auto This may take a few minutes ... depending on the number of images you are stacking and aligning

Now go to Edit - auto blend layers and select Stacked images - this should produce the final image as a stacked imaged - you can then go on and edit it as you would any other normal image.