

FOCUS STACKING: EXTENDING DEPTH OF FIELD IN CLOSE-UP PHOTOGRAPHY

by David Bryson



When taking close-up photographs, or indeed any photographs, there is a delicate balance of factors that allow us to limit or to maximise the parts of an image that are in focus. The three factors are lens, aperture, focal length and subject distance. Thus, widening the aperture (i.e. decreasing the f-number) results in a shallower depth of field and vice-versa; a wider-angle lens gives an apparent greater depth of field, as does a longer lens-to-subject distance.

The choice then depends on what you are trying to show. Do you go for a larger working distance with a telephoto lens versus smaller working distance with a wide angle lens to gain the detail and depth of field you need? Then how far do you stop down your aperture? If you use smaller apertures that may not be getting the best out of your lens.

This is where digital techniques to extend depth of field come into use with focus stacking. Using a wide aperture and taking a series of photographs through the subject it is possible to obtain a sequence where each image has part of your subject in focus. This used to be possible with film but was very complicated, termed light scanning photomicrography. Now with a tripod or stand, autofocus lens or a fixed lens and a focussing rail (<https://www.cognisysinc.com/products/stackshot/stackshot.php>), see Figure 1, a USB cable and a computer or tablet it is possible to take accurate series that can then be stacked using computer programs, for example HeliconFocus and Zere-neStacker.

The effect can be seen looking at the sequence of photographs of a Ten Pence coin set at an angle to the camera controlled by HeliconRemote or other tethering programs like CamRanger, Figure 2 which go to make the stacked photograph in Figure 3a. The computer program, in this instance HeliconFocus, aligns the in focus parts of the image using a depth map, see Figure 3b.

Figure 3 a) Left focus stacked photograph of coin b) Right: depth map developed as part of processing in HeliconFocus. Using lens focusing, photographs can be stacked for landscapes e.g. a wide angle lens very close to a fence can focus through to a far hillside and get all in focus. The limitation is anything that moves. At the close-up end the limit of your lens' close-up facility can be extended with auto bellows or extension tubes but for

even closer a focussing rail is needed, as Figure 1. These techniques are being applied in natural history (Cremona 2014), heritage for stereo recording (Gallo 2014) and alongside other digital techniques in archaeology (Watson 2013).

References

- Cremona J. (2014) Extreme close-up photography and focus stacking. The Crowood Press Ltd.
Gallo A, Muzzupappa M, Bruno F. (2014) 3D reconstruction of small sized objects from a sequence of multi-focused images. *Journal of Cultural Heritage*. 15(2):173-182.
Watson, J. T., & Weiland, J. (2013). Documenting Archaeological Mortuary Features using High Dynamic Range (HDR) Imaging. *International Journal of Osteoarchaeology*, 25(3), 366–373. <http://doi.org/10.1002/oa.2302>

Web resources

- <http://extreme-macro.co.uk/focus-stacking/>
<http://www.dpreview.com/articles/5717972844/focus-stacking-in-macro-photography>
Zerene Systems <http://zerenesystems.com/>
Heliconsoft <http://www.heliconsoft.com>
CamRanger <http://camranger.com>

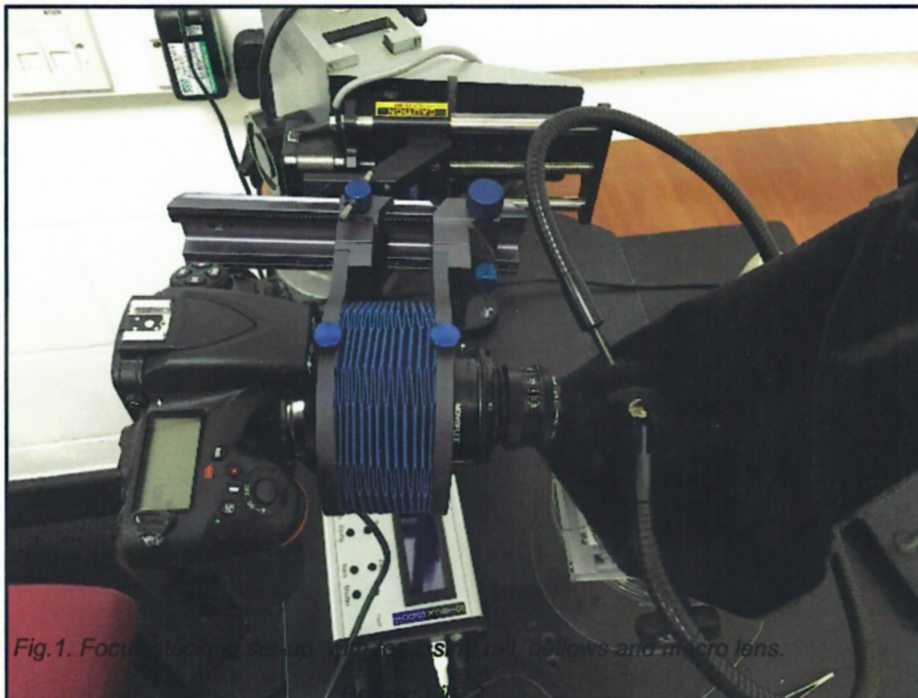
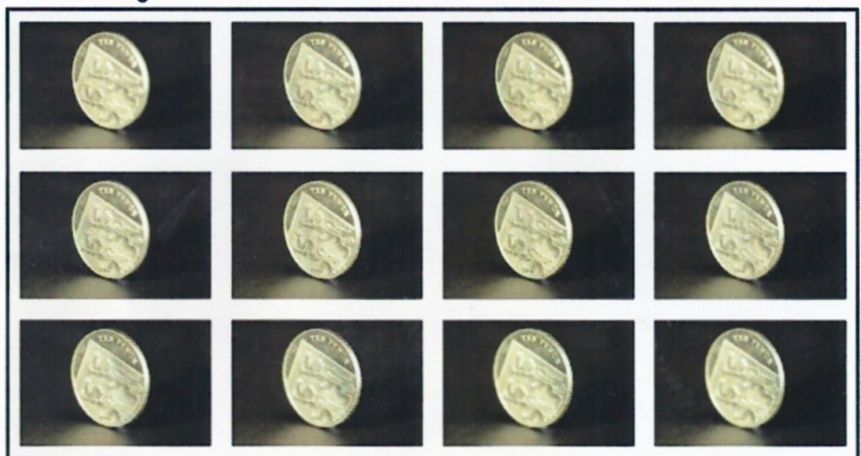


Fig. 1. Focus stacking setup showing camera and macro lens.





Above: Fig. 3a.

Right: Fig. 3b.

