A Photo Stacking Aid - Tom Mortimer

Mineral stacking software has been in use by micro-mineral photographers for several years (reference past MMNE newsletter article). My personal choice for image stacking is the Helicon Focus product (http://www.heliconsoft.com). I have found it quite easy to use. Stacking software combines multiple images (taken at a sequence of specimen focal planes) to produce a final photo with greatly enhanced depth of field. The procedure is to start at one specimen focal limit (e.g. the top-most area to be in sharp focus) and take a sequence of photos until the other focal point limit is reached. The sequence of digital camera images from the different focal points is called a "stack." A micro-mineral photo stack may span a specimen depth range of less than a millimeter to several millimeters. My stacks typically contain three to a dozen separate images. I often shoot and process several of these stacks to get a satisfactory final photo.

It is desirable to shoot a stack in equal focus steps; for example covering a 1 mm depth of field in five 0.2 mm steps or ten 0.1 mm steps. Changing a stereo scope focal point by one or two mm typically requires rotating the focus knob less than one-eighth of a turn. Accurately performing this knob rotation span in five or ten equal steps is difficult.

A solution to this difficulty was inspired by a note I read on the web, perhaps on a mindat.org message thread (I have since been unable to relocate it.) The essence of the solution was to raise/lower the specimen on a small platform attached to a digital read-out caliper. The read-out would accurately indicate the focus displacement, allowing the photographer to accurately take a photo at each increment step. A satisfactory quality digital read-out caliper may be purchased on the web for $25.00 and up (Figure 1). These calipers provide a read-out in either millimeters or inches. The read-out on mine has a resolution of 0.01 mm.

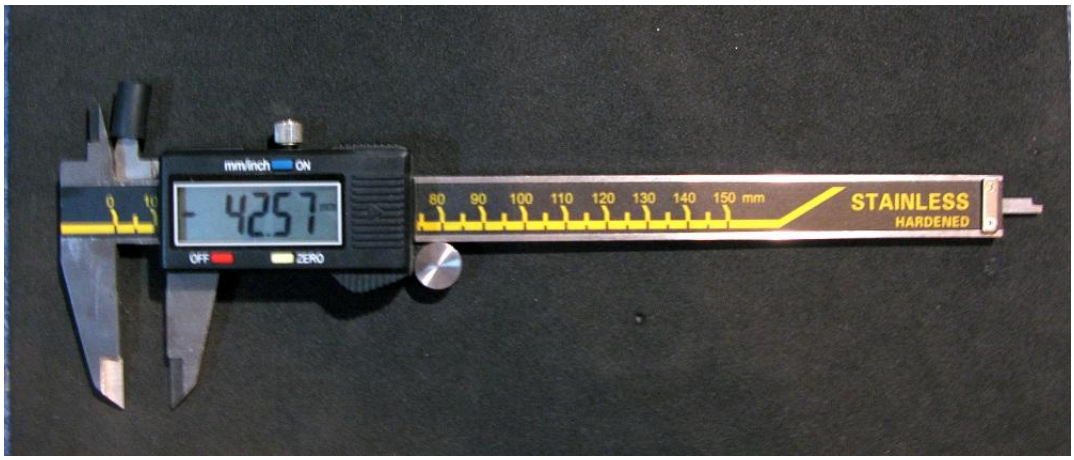


Figure 1: Digital caliper, purchased on the web.

After considering the difficulties of building a stable, independent z-axis, specimen platform that could be affixed to the base of my scope, I conceived a simpler alternative: the fixed end of the caliper could be attached to the stereo scope base and the slider end of the caliper attached to movable optics end of the scope. When the caliper is thus constrained, the read-out would accurately indicate the scope z-axis displacement as the scope focus knob is adjusted. The design detailed below works with my Meiji EMZ-5TR model scope. No modification, (e.g. drill holes), were required to my scope or the caliper. As every scope is different, another make/model may require a somewhat different approach.

My Meiji scope has holes in the base for a pair of specimen holder spring clips (Figure 2).

Figure 2: Slide holder clamps – typical of many stereo scopes.

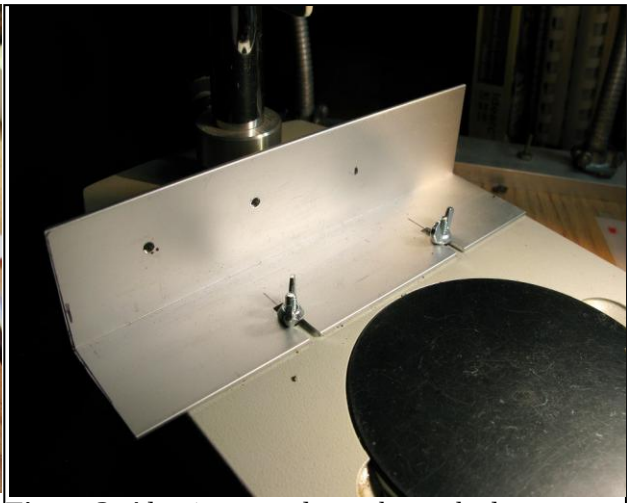


Figure 3: Aluminum angle stock attached to microscope base with a pair of machine screws and wing nuts.

These holes provide a means of attachment for a length of 1½ inch aluminum angle stock (Figure 3). A piece of ½ inch thick Teflon cutting board, (- a favorite hobby construction material of mine - -you could substitute a piece of wood), plus a pair of machine screws, (Figure 4) are assembled to form a clamp to hold the caliper fixed end in a vertical position (Figure 5).

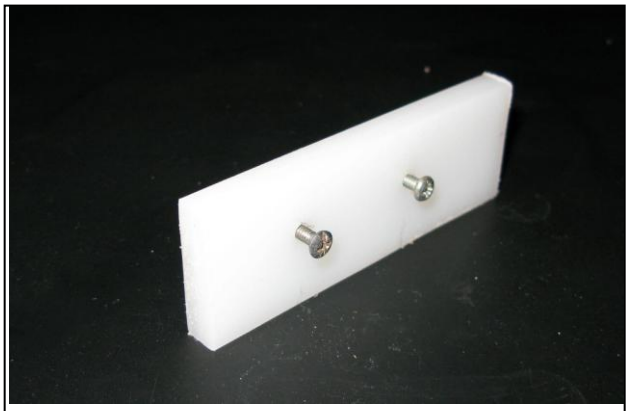
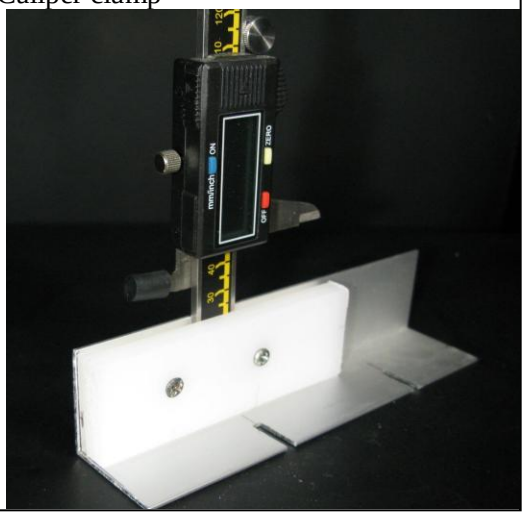


Figure 4: ½ inch thick Teflon cutting board, plus a pair of machine screws.

Figure 5: Caliper clamp



I used 6:32 screws and tapped the holes in the angle aluminum - - you could just as well use a pair of 6:32 nuts here. Note the hole slots in the angle aluminum and the vice clamp nature of the of the caliper attachment allow two degrees movement freedom for alignment of the caliper with the movable scope optics.

What now remains is to attach the movable end of the caliper to the movable scope optics. Here, the Meiji fortuitously has a convenient tapped hole in the vertical mobile stage. (Figure 6) (The Meiji, being of Japanese manufacture, has metric hardware, and thus metric threads. A trip to my local hardware store quickly located the correct machine screw for 15¢.) A slotted piece of Teflon board (3" x ½" x ½") was cut out (Figure 7).

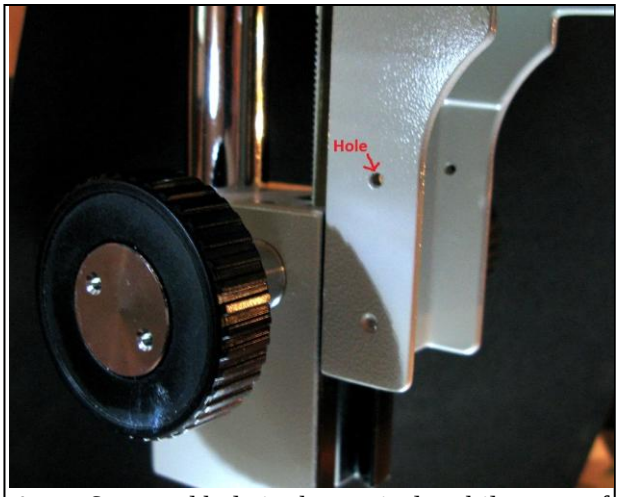


Figure 6: tapped hole in the vertical mobile stage of Meiji scope.

Figure 7: A slotted piece of Teflon board (3" x ½" x ½")

A machine screw was inserted across the lower end of the slot to function as a squeeze vice. A hole was drilled in the upper end of the piece for my metric screw attachment to the scope, (Figure 8). Assembling all the pieces together provides the configuration illustrated in figure 9.

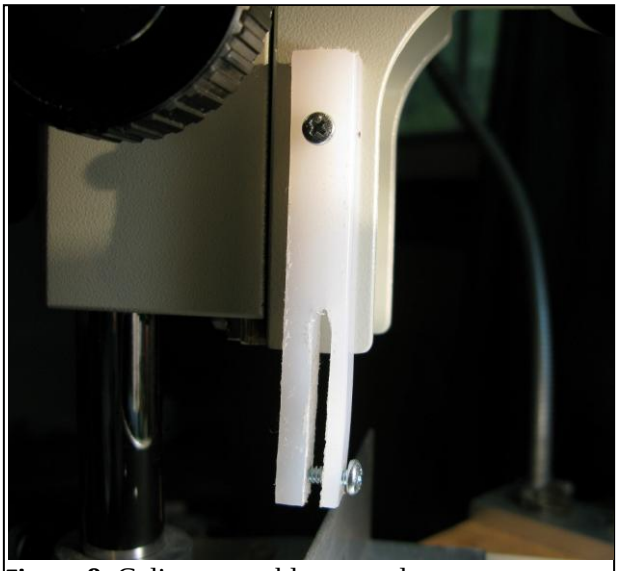


Figure 8: Caliper movable stage clamp.

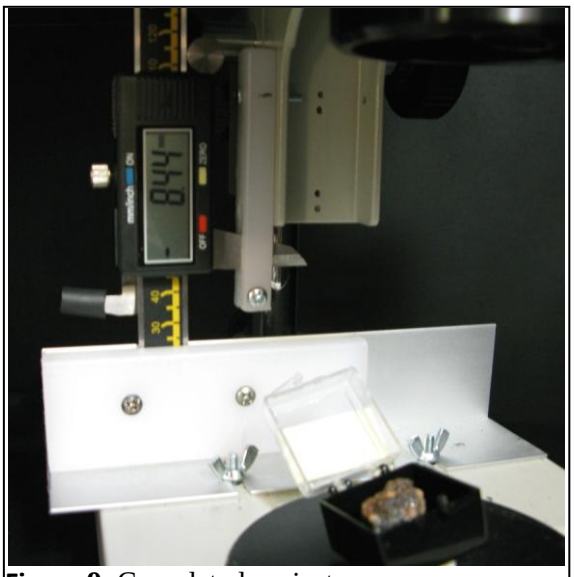


Figure 9: Completed project

Using the set-up:

1. Position the specimen to be photographed on the scope base and arrange the lighting for your photo.
2. Adjust the scope focus so that the top-most zone of the crystal (or specimen zone) to be photographed is in focus.
3. Turn on the caliper display (a push-button) and zero the display (another caliper button). I work in the caliper mm mode (vs. inch mode). Check the caliper is in the mm mode.
4. Adjust the scope focus to the lowest zone of the crystal that is desired for image focus. The caliper now reads the depth of field to be traversed for your photo. For example the caliper might read 1.20 mm for a typical micro crystal.
5. Decide how many images you would like for your stack. You might try six. The 1.20 mm depth of field in the example could be covered in six 0.20 mm steps or twelve 0.10 mm steps.
6. Return the scope to focus on the top-most part of your crystal (the caliper readout should again read 0.00 mm) and take your first photo.
7. For the six 0.20 mm step case, drop your scope focus until the caliper read-out indicates 0.20 mm and take the next photo.
8. Continue dropping the scope focus, taking photos at 0.40 mm, 0.60 mm … 1.20 mm.
9. Import your six image stack to your PC/mac and apply your stacking software.

Some final notes

Set your camera to the manual focus mode, otherwise the camera auto focus will (partially) defeat your effort to define the focal plane. Also, use the shutter delay feature of the camera (I use a two second delay) so the action of depressing the shutter does not induce vibration to your set-up.