Image Stacking Software Comparisons

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Image stacking software programs are frequently used by photomicrographers to improve the depth of field of their images. Anyone who has attempted photographing micro-sized specimens through a scope is keenly aware of the difficulty of maintaining image sharpness over the boundaries of a tiny crystal. Image stacking programs combine multiple images captured at incremental focal points. This is accomplished by small steps in the distance between the microscope objective lens and the subject specimen. These steps are made by either adjustment of the microscope focus knob or adjustment of the vertical position of the specimen. The best results are obtained when the step increments are approximately equal and in linear increasing or decreasing order. A micrometer attached to your microscope, as described by article http://www.micromountersofnewengland.org/members/2010-oct.pdf , facilitates the small fine steps.

I have been using the Helicon Focus software stacking program for about three years now, (Lite Ver 5.1.29). Other popular stacking programs include CombineZP and Zerene. Web references and pricing for these are:

Helicon Focus $30 – one year, $115 lifetime license. http://www.heliconsoft.com/heliconfocus.html
CombineZP FREE http://www.hadleyweb.pwp.blueyonder.co.uk/CZP/Installation.htm
Zerene $89 http://zerenesystems.com/cms/stacker
(Zerene offers a free 30 day trial)

For a more complete listing of image stacking program offerings see:
http://www.micromountersofnewengland.org/pdfs/stacking-software.htm

For sometime I have had a desire to do a "head-to-head" comparison of these three programs, particularly using my own scope and camera. Could I get improved results with an alternate program? For reference, my equipment is as follows:

Scope:	MEIJI EMZ-5TR trinocular stereo microscope
Camera:	Cannon G9, 12 MP, with Meiji microscope MD lens and Canon LA-DC58H adapter
Light:	SOLUX, sun temperature 50 W lamp.
Computer:	Dell Intel quad-core i5 with 8GB RAM, Windows 7 64 bit OS.

My evaluation method was straightforward: acquire photo image stacks of several different specimens and stack-process these image sets with each of the programs. The stacking programs provide the user with a range of controls for the stacking parameters and styles. For this evaluation I used the default settings of each program. For image capture, I set my camera in MANUAL mode, (i.e. manual F stop selection, shutter speed, and focus). The ISO setting is set to 100. I use F8 for maximum camera depth of field and adjust the shutter speed for a satisfactory brightness on the camera display.
My computer is a moderately powerful one. My previous computer, (a single processor, 2GB RAM, 32 bit Windows XP, machine), would take upwards of 30 minutes to stack a dozen images with Helicon. My present desktop does this in less than 30 seconds.

Finally, some notes on the post-stacking image processing that I applied. Images were captured at full camera resolution: 4000 x 3000 pixels, jpg format. My process flow for the stacked image is:

Crop the image, maintaining 4:3 aspect. Typically I may crop away one-third to one-half the image area.
Level adjust the image to allocate the 8-bit jpg resolution optimally. (I use the Canon provided software for these first two steps.)
Photoshop Touch-up (Photoshop Elements 9)

- Adjust shadows and highlights to enhance detail.
- Occasionally reduce blue color saturation to reduce blue bloom reflections
- Apply clone tool to remove bright sparkle reflections.
- Occasionally apply a small sharpness adjustment.

Resize image to 1000 x 750 pixels (I use Microsoft PAINT for this)

When presented in the three inch by two inch format below, the comparative stacking differences are barely discernible. However, when shown on a full screen monitor, variations are apparent. Web links to these larger format images are provided below:

Whitmoreite – Helicon Focus	http://mindatnh.org/Stacking_Study/Whitmoreite_hf_ps_LR.jpg
Whitmoreite – CombineZP	http://mindatnh.org/Stacking_Study/Whitmoreite_cz_ps_LR.jpg
Whitmoreite – Zerene	http://mindatnh.org/Stacking_Study/Whitmoreite_zs_ps_LR.jpg
Whitlockite – Helicon Focus	http://mindatnh.org/Stacking_Study/Whitlockite_hf_ps_LR.jpg
Whitlockite – CombineZP	http://mindatnh.org/Stacking_Study/Whitlockite_cz_ps_LR.jpg
Whitlockite – Zerene	http://mindatnh.org/Stacking_Study/Whitlockite_zs_ps_LR.jpg
Laueite – Helicon Focus	http://mindatnh.org/Stacking_Study/Laueite2_HF_LR.jpg
Laueite – CombineZP	http://mindatnh.org/Stacking_Study/Laueite2_cz_LR.jpg
Laueite – Zerene	http://mindatnh.org/Stacking_Study/Laueite2_zs_LR.jpg
Laueite – G9 camera full auto	http://mindatnh.org/Stacking_Study/013_AUTO_LR.jpg
Laueite – G9 auto focus only	http://mindatnh.org/Stacking_Study/012_MAF_LR.jpg

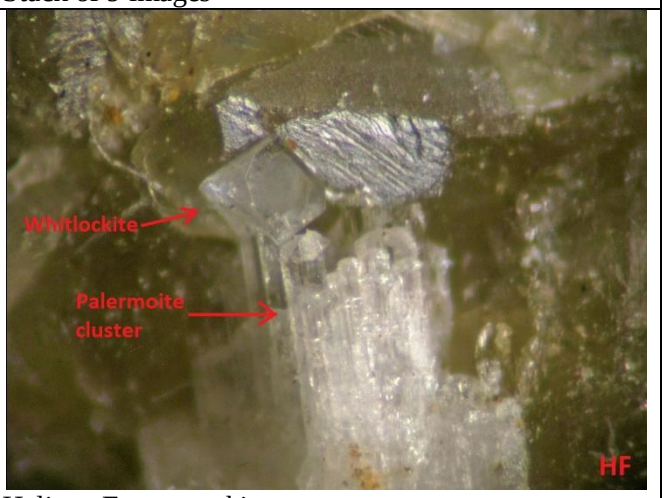
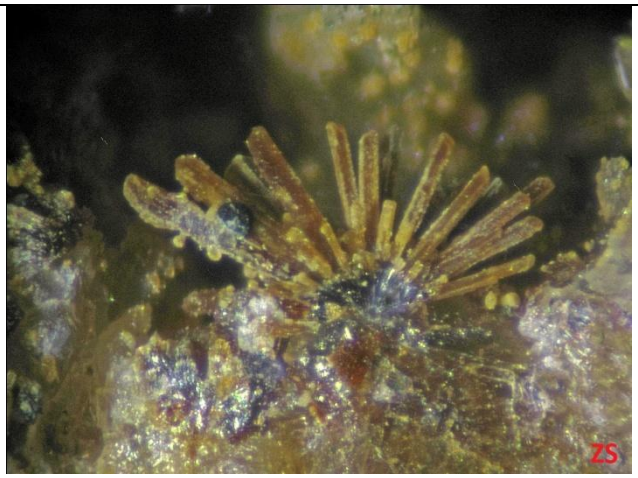
Observations and conclusions

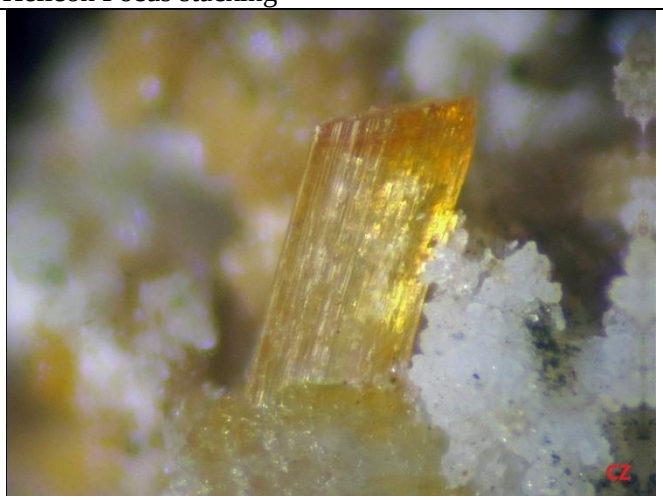
All three programs deliver a substantial improvement in photomicrograph depth of field. On my moderate horsepower PC, all programs stacked eight to a dozen images in well under a minute. Most web forums on stacking software rate the Helicon program as having the best user interface. I would agree with this. As to cost, it is hard to beat "free." So, CombineZP is definitely the winner here.

In my limited testing, the Zerene stacker images appeared to have the greatest final contrast, both in foreground and background. The enhanced contrast may, or may not, be appealing, it is user subjective. Here, the laueite image produced by the Zerene stacker, best illustrates the higher contrast of the Zerene stacker.

When photographing crystals that are relatively flat and have good contrast with the background matrix, satisfactory results can often be achieved without the aid of stacking, as shown by the un-stacked laueite photos here.

Going forward, having found no compelling reason to switch, I will continue to use Helicon as my primary stacking program. With many days remaining on my Zerene free trial, I will do further evaluation trials and perhaps purchase a license, adding it to my photo "tool-kit."

Whitmoreite, 1 mm "naval mine" spray Palermo Mine, N. Groton, NH Collected by Walter Lane Stack of 9 images spanning 0.32 mm depth	**Whitlockite** above, **Palermoite** below 1.5 mm FOV Palermo Mine, N. Groton, NH Collected by Walter Lane Stack of 9 images
 Helicon Focus stacking	 Helicon Focus stacking
 CombineZP stacking	 CombineZP stacking
 Zerene stacking	 Zerene stacking

Laueite, 0.8 mm color zoned crystal Palermo Mine, N. Groton, NH Collected by Walter Lane Stack of 9 images spanning 0.30 mm	**Laueite**, 0.8 mm color zoned crystal Palermo Mine, N. Groton, NH Collected by Walter Lane **NO Stacking – this column**
 Helicon Focus stacking	 Camera in full auto mode – no stacking
 CombineZP stacking	 Auto-focus, manual F stop & exposure -no stacking
 Zerene stacking	