DSLR Imaging in the field without needing a computer

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My imaging sessions see me in the field using a 'PC'less' setup This is not completely true as I do at times carry a netbook to aid in alignment and focusing; but this is only to expand my camera's LiveView output from the small on-camera LCD to a 10.1 inch display. This could be done as simply with my small 12v black and white TV but the netbook draws less power and is smaller.

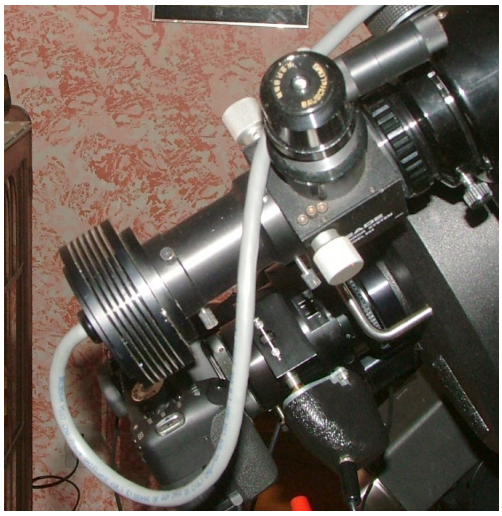
Hardware

To be able to perform all the tasks needed in a normal imaging session I had to gather together a suite of hardware that would do the jobs I required while running from the 12V batteries that I carry. I don't take an inverter as this would mean that I would lose efficiency. The hardware I have chosen is:

SBIG ST-4 Star Tracker

This small device is 'old technology' having been discontinued in 2001. It performs a single task, guiding a telescope, and does it extremely well. It is also built from 'automotive grade' components that will live nicely down to -40C. It plugs into my mount's auto-guider port only draws 1A while guiding.

The ST-4's guide-head is at the end of a long and very stiff cable (which can be a chore in cold weather). The camera itself uses a very small sensor but this is not an issue when using the flip mirror to acquire and centre a guide-star. The camera is also cooled which helps quite a bit, especially when it's hot outside. The unit allows the taking of a dark-frame which will keep hot-pixels and other thermal noise to a minimum. When used correctly the ST-4 can guide to within 1/5 of a pixel which is very accurate.



The ST-4 was available with a dedicated flip-mirror and reticule eyepiece that was very nice. The reticule showed a rectangle that equated to the field of view of the sensor which made things very simple.

As I mentioned above the ST-4 was discontinued in 2001 but many still show up in the used market for 300-500 dollars depending on the condition and what options ship with them. They draw MUCH less than a laptop and will guide just as well on stars down to 8-9 magnitude As a stand-alone replacement SBIG and others such as Orion and Celestron/SkyWatcher make stand-alone guiders that need no computer in the field.

Guide-scope

I use a Stellarvue 80mm NightHawk II refractor to guide my images. This is held quite solidly by a set of Ken's Rings guide-scope rings which have been modified to use 3/8-16 ADM thumbscrews instead of the nylon 1/4-20 screws they shipped with. A Ken's Rings style dovetail bar sits atop each of my OTAs and my side-by-side plate. This allows the guide-scope to be easily moved from OTA to OTA.

The NightHawk is very well built and weighs about 7lb. It incorporates a rotatable dual-speed focuser that displays no 'sag' when changing orientaion and is lockable. No provision for powered focusing is needed with this scope as the fine-focus knob and the 'brightness' readout on the ST-4 do a good job of quickly getting a guide-star into focus.

The NightHawk is a fine wide-field imager in it's own right. With a suitable minus-violet filter (it's not an ED or APO design) the 'blue-goo' is kept to a minimum and the field of view with a Canon DSLR easily encompasses the Andromeda Galaxy.

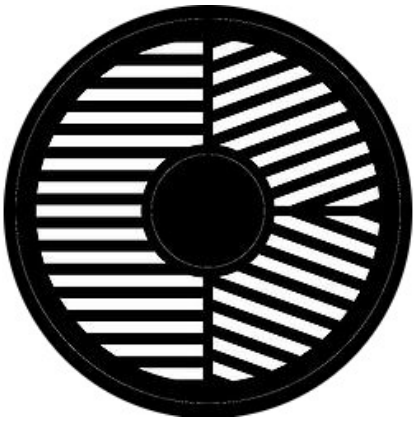
Powered Focuser

I have a powered focuser on both my C9.25 (seen below) and my AT8IN. The unit on the Celestron is a JMI NGF-S type that screws into the back of the telescope while the AT8's focuser is driven by a home-made setup that sits in the finder dovetail and turns the fine-focus knob with a large O-ring. Both can be controlled by either my home-made variable speed focus motor controller or with the JMI MotoFocus unit that came with the NGF-S.

While the NGF-S only has about ¾ of an inch of travel this is quite adequate as the Celestron's normal focusing knob can get things well within the range of the MotoFocus. The unit is quiet and can be

adjusted from VERY slow to just slow, which is fine for imaging.

Bahtinov Mask



These are a wonderful focusing aid and allow one to reach critical focus with none of the stress and strain that was part of focusing in the past. Available commercially or let your local laser cutting/etching business make you one. The only problem with using a mask is that you have to be at the telescope to put it in place and remove it. I may think about a remote mask device. I connect the camera to the ACER netbook viat a USB cable and open a LiveView window. A piece of freeware called Bahtinov Grabber runs on the netbook and will then tell me exactly when the diffraction pattern from the mask says that I'm in perfect focus.

Exposure Conrol

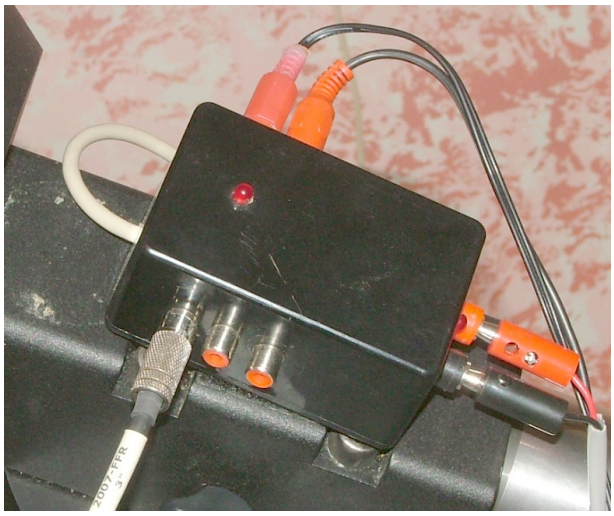
To keep the DSLR running on schedule I use a TOGA Intervalometer. This can be powered from my 12V source and will keep exposures correct to a high degree of accuracy. The red LCD display does get a bit sluggish in the winter but the timing doesn't suffer at all.

DSLR 8V Power

My Canon 500D is stated to need an 8.1v power supply. The battery produces a nominal 7.6v. I've built a small power supply that uses a Canon AC adapter's battery eliminator to connect my camera to the 12v booster pack. This keeps me imaging for a long time without changing batteries.

Anti-dew heat control

I use a home-made anti-dew heat unit and 12v power splitter. This sends power to the 8v supply that drives my DSLR, the above-mentioned Intervalometer and any other 12V source I need. I can control it from the TOGA Intervalometer or by using a small stand-alone 9v pulse-generator that I've built.



Computer

If I do use a computer in the field I take an Acer netbook. The only use that I make of it is as a remote display for the Canon camera's LiveView system for aligning and focusing. A small battery powered television would do as good a good a job.

Places to put things

To carry all of the gear I use efficiently I've built two shelves for my CGE mount that will carry the ST-4, netbook, booster pack and, along with the Starizona shelf already there, just about anything else that I need at the scope.

Setup and Imaging Workflow

I setup my CGE in the field before sunset with all of the power sub-systems,peripherals and polar alignment scope attached.

If I'm using the AT 8" f/4 newtonian (seen at the left) now is the time to use the Hotech SCA collimating laser to check and adjust the collimation of the optical system. This is a very good tool and, along with a Cheshire sight tube can bring the newtonian into collimation very accurately. If I'm imaging with the Celestron 9.25 SCT (seen below) I check the collimation on Polaris.

Next I swing the scope manually onto some terrestrial feature as far away as possible then move the scope up to a flat patch of sky to wait until after sunset. Once the sun is down about 10-20 minutes I shoot s series of five flat frames of the dusk sky, adjusting the shutter speed to make sure that the histogram is about 50%. Now I have to wait for Polaris.

Once Polaris and a few bright stars are visible (including the pointer stars in UMa) I adjust the polar scope to put Ursa Major and Cassiopeia in their correct positions and, using the altitude/azimuth adjustments put Polaris in its correct location and wait until the brightest stars are quite distinctive.

At this point it's time to power on the mount for the first time selecting 'Last Alignment' then manually slew the telescope to the brightest star I see and, looking through the viewfinder, roughly focus the telescope. At this time I power up the netbook if it is being used. When it is ready I power on the DSLR which starts EOS Utilities and I open the LiveView window. The bright star I selected should be in the field so I place the Bahtinov mask over the aperture and zoom in LiveView to make the diffraction pattern as large as possible.

With the Bahtinov diffraction pattern visible I start Bahtinov Grabber and select the area of the pattern in the LiveView window. Bahtinov Grabber will tell me which way to focus and then, when focus is reached, display this. The software is accurate to a fraction of a pixel. If I'm NOT using the netbook I shoot several 10 second exposures adjusting the focus after each until the Bahtinov pattern is symmetrical while zoomed in on the LCD display. The system is focused. Next the CGE is powered down and restarted; this time

selecting 'Two Star Alignment'. With the netbook and LiveView I just watch the screen. Each alignment and calibration star will show up in the field when the scope stops slewing allowing it to be centred quite accurately. When I'm done I check the polar alignment using the CGE's Polar Alignment display and if it's within 15 arcmin I leave it alone. If it is not I use the mount's AllStar Polar Alignment routine to dial it in. The telescope and mount are now ready for imaging and it's time to wait for dark. The netbook is now retired for the night.

Once 'shooting dark' has arrived I slew onto my first target for the night and shoot a 15 second framing test shot. This tells me whether I have to adjust the pointing to frame the target and either looking through the viewfinder I can 'move the stars' in the direction needed to re-frame. When the last test-shot is complete I program the TOGA Intervalometer for he exposure sequence desired and press the 'shoot' button. If a target like M42 is being shot I can program the intervalometer to shoot three separate sets of images to 'bracket' the target before starting. The IV will then shoot all of the programmed sessions one after the other.

All that is left to do for the remainder of the night is to wander about the dark-site getting on everyone's nerves or perhaps just sit back under the stars and nap. The setup I use runs pretty much on auto-pilot.

At the end of all of the imaging sequences for the night I disconnect the camera, intervalometer and battery and move it aside. Then I can program in up two 3 sets of dark frames into the intervalometer and, with the cap over the camera, start shooting darks while I tear down. All of my flats, lights and darks are on the SD card in the camera waiting for transfer to the computer at home for processing... which is another story altogether.