QUICK LOOK: TWO NEW GUIDERS
CCD Labs Q-Guide and Fishcamp Starfish

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Disclaimer: Craig Stark operates Stark Labs and is the author of the PHD Guiding program (freeware) provided with both cameras described here. He is also the author of Nebulosity, one of the capture and processing programs provided with the Fishcamp Starfish. He served as a beta-tester for both cameras but has no financial interest in either Fishcamp Engineering or CCD-Labs.

As the author of PHD Guiding, I am often asked by users for my opinion on various guide camera solutions. My advice is typically to favor cameras that are a) capable of exposures of several seconds, b) monochrome, and c) have a reasonable sized chip. Unfortunately, webcams, the cameras may want to use for guiding don't fit the bill. Most are limited to about 30 ms exposures and almost all use small color chips. The short exposures and presence of color filters over each pixel conspire to limit the choice of guide stars to bright stars (e.g., mag 4-5). Given the small swath of sky covered by a small chip, makes finding a suitable guide star even more challenging. When standing out in either a freezing cold or hot and mosquito-infested field, the last thing I want to be doing is hunting around for a suitable guide star.

Here, we take a Quick Look at two relatively new entries into the market, the CCD Labs QGuide (http://www.ccd-labs.com/Qseries/qguide.htm) and the Fishcamp Starfish (http://www.fishcamp.com/starfish.html). Both cameras satisfy these requirements quite well and have performed admirably for me in the field. The two cameras are designed with two very different philosophies and aimed at two different markets, however as we'll see below.

Commonalities

Both cameras use the Micron MT9M001 black and white CMOS sensor and stream raw, uncompressed data from the camera over a USB2 interface. It is a 1/2" format (6.6 x 5.3 mm) sensor with 1.3 megapixels (1280

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Front view of the Starfish (left) and Q-Guide.

x 1024 array of 5.2? pixels). The sensor has a relatively high quantum efficiency (QE: Percent of photons captured and converted into electrons) of 56% with a broad spectral response (sensitivity falls to half of the peak at ~370 nm and ~780 nm). This contrasts quite favorably with another CMOS-based guider on the market, the Yankee Robotics Trifid Nugget ($495). It's Kodak KAC-9619 sensor is smaller (1/3" format of 4.9 x 3.7 mm), has fewer pixels (648 x 488 array of 7.5?), and a lower QE (27%). The Micron sensor is approximately the same size as the Kodak KAF-0402ME (765 x 510 array of 9? pixels) used in the SBIG ST-402ME ($1395), but it's 56% QE is clearly lower than the KAF-0402ME's QE of 85%.

The port connections on that back of the Starfish (left) and Q-Guide.

Both cameras have onboard ST-4 style autoguider output ports. These RJ-11 (telephone-style) ports allow you to send the guide commands to your mount's guider port (if present). As software running on your computer detects the star is beginning to move from the target location, signals can be sent out along this port to your mount's motors to bring the star back in line. This, therefore, provides the same manner of guiding your mount provided by the popular ShoeString adapters and is an alternative to sending guide commands to your mount via ASCOM and the serial (or USB) port on your computer. Both can attach to your telescope via either a provided 1.25" nosepiece or standard T-threads.

Both cameras also require a computer and software to actually collect and analyze the images and send the guide commands to your mount (the no-longer-available SBIG ST-V was the only guide setup that did not require this). Both cameras ship with PHD Guiding and have drivers available for guiding in other software (Maxim DL, CCD Soft and additionally for the QGuide, AstroArt).

Q-Guide

The CCD Labs Q-Guide is designed to do one thing, do it well and do it cost-effectively. It hits on all the recommendations noted above and costs $270. CCD Labs acts as a Value Added Reseller of the QHY CCD version of this camera, the QHY5. They provide USA distribution, support, and have pushed the development of the camera (addressing driver issues, providing support for PHD Guiding, etc.). They also provide the camera fully ready to go, complete with nosepiece, cables, instructions and a CD with drivers and Windows-based software .

The QGuide is very nicely put together and is a very compact (2.5" circle, 1.25" deep) and lightweight unit (4.2 oz). This latter aspect is not to be under-rated as flex in the guide scope mounting and focuser is a real cause for star trails and something often overlooked by imagers as they attempt to get autoguiding working well. Putting a heavy camera on the end of an inexpensive refractor's focuser is a recipe for differential flex between the image on the guide chip and the image on the main camera's chip. Guiding software may keep the star locked on the same position in the guide chip, but this flex makes the image still move on the main camera's chip. Fixing this flex alone in my personal rig let me move from 2 minute exposures to over 15 minute exposures.

The camera needs no power other than that provided by the USB port and has connections on the back for a USB cable and a guide command output. There is also a single red LED that flashes during camera activity. Over a USB2 connection, full frames are downloaded in

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about 70 ms. USB 1.1 is supported, but the ability to speed up image transfers by downloading only a regions of interest (ROI) is limited to 500 x 500 pixels or larger. On USB2 connections, this is a non-issue, but it does keep the camera from being highly responsive on older USB 1.1 connections.

Some may view this as potentially suitable for lunar or planetary imaging as well as guiding. CCD Labs is clear to note that this is designed as a guide camera only, however, and that it is not optimized for solar-system work. While the camera is specified to give exposures as fast as 1/10,000 s, this is done via a "rolling shutter". With this shutter scheme, each line may be exposed for a very short duration, but it still takes a fixed amount of time - 1/15 s in the case of the QGuide - to expose the entire chip. This limits the camera's ability to deal successfully with atmospheric turbulence and freeze a clear image during brief moments of steady seeing. Likewise, while the camera is capable of 1 minute exposures, its noise characteristics and the fact that data come off in 8-bit format do not make for a good DSO camera. It is designed to fill a specific need - the need to autoguide - and to do that well.

Starfish

The Fishcamp Starfish is also designed primarily as a guide camera, but where the QGuide cuts corners to provide a basic, highly-functional guider, the Starfish is designed to be the ultimate guide solution. Fishcamp has pulled out all the stops to get the most out of the Micron CMOS sensor and provide the cleanest possible image and the highest level of functionality. Where the QGuide consists internally largely of the sensor and a USB interface, the Starfish adds a temperature-regulated TEC (capable of -15º C from ambient, regulated to 0.2º C) and an on board CPU (processor) and memory. Where the QGuide has ST-4 output and basic "activity" LED, the Starfish has an ST4 output, an RS-232 serial output, and a full array of status LEDs. These features and more put it in a different league than the QGuide and provide a justification for the higher price tag ($995).

The Starfish is provided with software for both Windows and OS X. In Windows, PHD Guiding is provided for autoguiding and Nebulosity is provided for long-exposure image capture and processing (both from Stark Labs). In OS X, users have a choice of applications. Both PHD Guiding and Nebulosity are provided along with Fishcamp's own StarLink application. StarLink provides full guiding and image capture functions as well. As noted above, drivers are provided for Maxim and CCD Soft.

Physically, the Starfish exudes the feeling of a very well-built device. It is larger than the diminutive QGuide, measuring 2.75" in diameter and 3.125" long and weighing in at 10.9 oz. The rear of the camera starts showing off several of the added features. You get not only a basic "camera activity" LED, but separate LEDs indicating when each of the data lines on the onboard guide port are active (a very handy feature when troubleshooting). In addition to the ST-4 output and USB ports, the back also has an RS-232 serial port (to connect to your telescope or filter wheel) and a power plug. The power plug takes 12V input and is used to operate the TEC (the camera functions without power just fine). Here you'll note an example of Fishcamp's attention to detail - providing a coax socket that has a screw-on collar to lock the cable in place.

Inside the camera, the onboard CPU handles image processing, guider timing TEC cooler regulation, and camera diagnostics. Images come off the sensor in the full 10-bit format the Micron sensor is able to provide and are passed into an internal memory buffer. The CPU then takes care of bias correction (to remove fixed pattern noise) and additional processing tailored to the specific sensor and the current imaging parameters to reduce the noise. These all act to reduce the read noise of the Starfish to levels well below the QGuide and makes it very tolerant of issues with multiple devices sharing the same USB bus.

The Starfish can also act as a multi-purpose camera. While it still uses the rolling shutter (part of the Micron chip), it has several internal tricks up its sleeve to get better lunar and planetary images out of it. The pixel clock is continually adjusted based on the imaging demands up to the maximum rate of 48 MHz (twice the QGuide's fixed rate), dropping the time to read the data off the chip in half to 1/30 s. Full ROI control further drops this duration when cropping the frame during capture. In addition, the onboard image buffer and CPU let the camera's exposure duration be independent of the current load on the computer you're using. All timing is handled inside the camera, which makes for more consistent and accurate exposures. When combined with the reduced noise and 10-bit range, the Starfish takes on the appearance of a lunar and planetary camera as well.

While few would mistake it for a high-end DSO camera, the Starfish can actually do a very respectable job here as well. The TEC's cooling is regulated down to 0.2º C and the camera is capable of 5-minute exposures. When combined with the very low noise (the manufacturer has quoted me ~7 e- of read noise) and respectable QE, one starts to wonder "why not shoot DSOs"? Some will point to the 10-bit limitation on the data and this is certainly a shortcoming. However, uncooled 16-bit cameras waste many of the bits on thermal (and other) noise. In addition, since there is no such thing as a fraction of an electron, image sensors incapable of holding at least 65k electrons do not need 16 bits to digitize the image. Most amateur CCDs don't have full-well capacities nearly this high. Finally, as one stacks images, the error associated with limited bit depth - quantization error - is reduced and overall bit depth is increased (so long as one stacks with greater bit depth). Thus, while 10 bits is a bit lower than one would hope for in a DSO camera, it's not as bad as one might initially think. Having seen a number of very clean DSO shots from the Starfish, it's clear that it's up to the task.

Conclusions

I have used both cameras for several months now, with each getting a number of nights of guide-duty. Both have functioned as advertised and guided my mount well. The relatively large monochrome sensor used has made finding and locking onto guide stars a painless process using my 66 mm guide scope. Despite both using the same sensor and being both being designed as guiders, comparing them for the purpose of choosing between the two is an apples-and-oranges situation. The Starfish is cleaner and more versatile. Even when guiding, the effect of cooling and the onboard noise reduction show through to provide a cleaner image of the star field and to guide on slightly fainter stars. The Starfish also works perfectly on my Mac. While I've not tried DSO or planetary imaging with it, I've seen a number of very nice images in both categories. It's also nearly four times as expensive as the QGuide. If you're looking for a basic guider that is nicely up to the task of guiding your mount, the QGuide is hard to beat. It's compact, inexpensive, sensitive, has onboard guider outputs, and just plain works. It's an order of magnitude better as a guide camera than even long-exposure modified webcams or cameras like a Meade LPI or Celestron NexImage. The nice thing is, we've now got two more excellent choices when shopping around for cameras. ♦

By day, Craig Stark, Ph.D. is a professor of Cognitive Neuroscience at Johns Hopkins University. By night, he is an amateur astrophotographer and developer of software for astrophotography