Astrophotography and Digital Imaging:
Telescope Mounts

by Chris Patel

Last month I finished writing about mounts suitable for imaging. This month I am going to cover the primary types of cameras used for digital imaging and the next article will cover how to match a camera to a scope. All of these cameras use a CCD and they all need a PC to operate expect for one. Differentiation is based on the intended purpose and inclusion of features and software.

Let's start with the webcam. About 8 years ago the digital imaging landscape was very different. Specialized cameras for astrophotography were very expensive, the software was not feature rich and the chips were small compared to today's standards.

Like many hobbies, where there is a will there is a way, so you get folks stretching the envelope and using things in ways the inventors never imagined. Someone hooked up a webcam to the back of a scope and realized that they could capture the moon and planets. In doing so they opened up planetary imaging to the masses. Webcams were relatively cheap — I got mine new for $73 dollars — and soon, people were making a variety of modifications to them and writing software code. A webcam works very simply, it takes a movie for a desired amount of time and saves it on your computer. Software then takes that movie, breaks it into individual frames and stacks it together to get a "long" exposure. When you look at any individual frame you will not be impressed by the data, but add 600 or so good frames and you will be surprised by the level of detail.

The chips are small, they are not cooled and focusing can be a challenge, but look on the web and you will see some amazing work done with these types of cameras**.**

Modifications made allowed for longer single exposures instead of a movie, some even made modifications to cool the chip and others wrote software to allow the webcam to be used as an auto guider. Today we have mainstream scope makers using modified webcams and selling them with scopes or separately. The Meade Deep Sky Imager and Orion Star Shoot are some examples. Yes, some will argue that they are not really webcams, but they have more in common with a webcam than they do with specialized CCD cameras specifically designed for astrophotography. The latest versions use low noise chips or some method of cooling, the chip sizes go up to 1.4 megapixels compared to less than a third of a megapixel on my old webcam, they have filters that allow you to take color images or use single shot color CCD's and the software suite is very feature rich. Cost range goes from $100 up to $1,300.

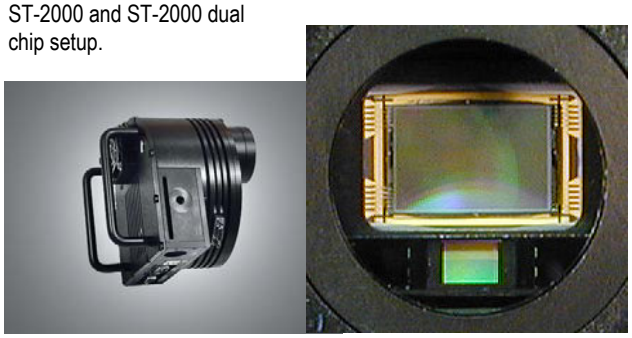
Here is a picture of my webcam and the adaptor that allows it to be mounted to the scope or diagonal.

Meade DSI

The next type of camera is basically a small light weight video camera with excellent low light sensitivity. Some folks like to use these real-time to project the view at the eyepiece to a group of people. While the chip sizes are larger than webcams, they can still be used just like a webcam to gather frames and stack them. Some are still relegated to the world of planetary imaging but others can show objects like nebulae and galaxies in real-time. Examples are the Lumenera SKYnyx2, Stella Cam and DMK Monochrome Firewire Camera (shown above). These range from $300 to $2,500 depending on chip size, format (monochrome or color) and the software package they come with.

Then we have specialized CCD cameras designed from the ground up for astrophotography. These cameras have monochrome or single shot color chips, the monochrome version requires color filter wheels to take images in color. The chips come in a large variety of sizes and you can also select the quality class of the chip. All have thermoelectric cooling and the ability to auto guide using an external guider or on board guide chip. The picture below shows the main chip and guiding chip on my camera. These cameras range in price from $500 used up to $15,000. Major manufacturers are Santa Barbara Instrument Group (SBIG), Apogee Instruments, Finger Lakes Instruments (FLI), and Starlight Express. I have two SBIG cameras currently, the ST-2000 is a dual chip, 2 megapixel camera and I use a ST-402 as a stand alone auto guider. The largest chip camera currently in the SBIG line is 11 megapixels and Apogee has a camera with a 16 megapixel sensor so mine is relatively small!

ST-2000 and ST-2000 dual chip setup.



Finally the last types are digital single lens reflex cameras, (DSLR). The two brands that dominate here are Canon and Nikon. These are stock large chip (6 megapixels or more) cameras meant for the consumer market that are being used on scopes much like film SLR's. This is a fairly new market and Canon has already exploited this niche by designing a camera specifically with astrophotography in mind, the Canon 20Da. Since these are stock cameras for the most part, some folks use them straight out of the box while others modify them by replacing the existing stock filter and modifying to allow additional filters of various types to be used, much like filters used at the eyepiece. None of these cameras are cooled but many are very low noise and there are a lot of folks doing some pretty good work with them. The price range is $1000 to $2000 which makes a good entry point if you do not want to go the cooled CCD route or already have one of these. They are also the only imaging option I have listed that does not require you to have a separate PC in the field with you to image.

So that's a rundown of the types of cameras used in digital astrophotography. As you think about the types of imaging you are interested in doing as well as targets you wish to image, you will want to do some exploring in depth on the web about the features and capabilities of the different types of cameras.

My next article will cover how to match the scope to the camera. There is some math involved but it boils down to the "seeing" conditions at your observing site and how much sky a pixel on your imaging sensor can see through your scope.

It's our club, let's continue to make it grow and diversify…Chris Patel