Using low cost web cams

Introduction

Recently images taken with low cost "web cams" have appeared that are just as good, and in many cases better, than those taken with expensive conventional astronomical CCD cameras. These web cams are well suited to taking images of brighter objects such as the moon and planets. As the cost is quite low and many astronomers have high performance laptop computers, trying one of these web cams isn't going to hurt the bank balance too much. All the astro images shown here were taken with a Philips ToUcam Pro, which is shown in the right hand image together with an adapter to fit an 1.25" eyepiece holder. These web cams are available at prices from around 50 UK pounds for the Pro version. Beware that a standard ToUcam with 10 lux sensitivity and 352 x 288 pixel image size is also available but is not sensitive enough for astronomical use. These web cams are available from computer suppliers, such as eBuyer, Insight and Dabs (see links at bottom of page) and also telescope dealers such as True Technology and B, C & F. Threaded adapters are also available from the telescope dealers.

While there are other web cams on the market, the Philips ToUcam Pro seems to be the most popular, not least for the ease with which it can be adapted to fit a telescope. The lens simply unscrews and is replaced with a 1/25" adapter. Some of these adapters are also threaded to take an infra red blocking filter, this is recommended to improve the image sharpness, although I haven't tried one myself.

One problem with these low cost cameras is the plastic housing, removing the threaded adapter a few times will damage the threads in the camera body. Another problem is dust, the CCD chip is exposed to air when the original lens is removed. Neither of these problems occur with cameras such as the Starlight Xpress MX5C, however the MX5C is several times the price of a web cam and doesn't produce any better results for planetary work.

The live video output of a web cam can be a big advantage for centering and focusing a web cam. One the minus side, storing hundreds of video frames does require a lot of hard disk space! Typical video streams will be of the order of 200 frames or more, 200 frames at 640 x 480 pixels (the standard output of a ToUcam Pro) will produce a file approximately 100 MB in size and only take a few seconds to be created. There is some merit in taking longer sequences which allow programs such as Registax to automatically pick more good images for stacking, the problem is one of file size and processor speed on your computer. As in most things related to image taking, it's easy to experiment to see what suits your time, patience and hardware. It is often easier to take images with a laptop then transfer them via a 100 MB network to your main home PC for processing. Having a

PC with 512 MB of RAM and at least a 1500 MHz (1.5 GHz) processor speeds up processing significantly.
The software supplied with the ToUcam, especially the Microsoft Windows drivers, seems unstable to say the least. During installation I had several crashes of the "test" program, Philips VCheck, in the end I gave up with it. I just couldn't install the web cam on my new Fujitsu-Siemens C1020 notebook computer (running Windows XP Home) using the built-in USB ports, one solution was to buy a Cardbus USB2 card and use that instead. Much to my surprise, running the Cardbus card allowed the ToUcam drivers to install and work perfectly (VCheck still crashed every time). My colleague managed to install it first time on his HP notebook under Windows 98. I have heard several reports of difficulties with the software, most users seem to manage to install it eventually. I did contact both Philips and Fujitsu-Siemens about this problem, Philips were of little help, other than to point me to read their "XP installation" readme file... which didn't help and Fujitsu-Siemens didn't reply.

Equipment required for planetary images

1. Equatorially mounted telescope with a reasonably accurate clock drive on right ascension
2. Web cam, adapter, software and computer
3. Barlow lens to increase the focal length of the telescope. Eyepiece projection can be used but a Barlow lens is much simpler. The lightweight webcams don't introduce "sagging" of adapters that happens when using 1.25" push fit Barlows with heavy 35mm cameras or traditional CCD astro cameras

Example images from Mike Foulkes and Paul Carter

The Saturn image was taken on 23 January 2003 at 22:02 UT with a 254 mm Schmidt Cassegrain and a x2 Barlow. 200 frames stacked. Average seeing. Cassini's Division and the South Equatorial Belt visible plus a hint of Equatorial Band. South at the top.

Jupiter images: The one on the left was taken on 13 Feb 2003 at 21:03 UT with a 203 mm Schmidt Cassegrain and x 2 Barlow. South at the top. Seeing Good with hazy cloud. This shows Ganymede in transit on the planet (as a dark spot) and Europa to the left. 219 frames stacked.

The second Jupiter image (on the right) was taken on 27 March 2003 at 21:05 UT with a 254 mm Schmidt Cassegrain and 18mm eyepiece projection. 150 frames stacked. Average to good seeing. South at the top. The Red Spot is on the limb. To its right on the South Equatorial Belt is a small jet stream spot that collided with the Red Spot a few days later. The dark marking on the North Pole is a dust shadow. We didn't do a flat field!

Transit of Mercury taken with the Philips ToUcam attached to the prime focus of a 203 mm Schmidt Cassegrain (F10). A half aperture sun filter (Baader solar screen) was attached. This was extracted from a 4 minute plus web cam video stream (which was started at 10:28 UT) and comprises 16 frames stacked together at third contact. The frames were registered in Registax and final processing in Photoshop.

Mike and Paul have only been using the web cam for a few months. However they note that there are many experienced web cam users world- wide, such as Damian Peach in the UK, who are producing images of much higher resolution than the ones shown here.

Once a video stream has been stored, it can be processed in Registax. Full details are available from the Registax site. The resultant images from stacking hundreds of "mediocre" video frames is beyond belief, those blessed with steady seeing (not usually the case in the UK) can produce planetary images to rival the Hubble Space Telescope, see the image of Saturn and the Jovian moons showing surface detail on Damian Peach's web site for an incredible example. Damian uses a Philips ToUcam Pro, Barlow lens and Celestron C11 SCT on a Losmandy G-11 mount

Thoughts and suggestions

While I am no expert on using Registax and webcams, here are a few of my thoughts that may be of use:

Collimation and focusing are very important, don't assume that because you collimated your SCT a month ago it will still be OK.

Taking a large number of frames in a video stream (around 1000) will produce close to a 500 MB file, if you set pick the sharpest and set Registax to reject 95% of the images (2nd page of Registax, "Lower Quality" setting) you may get better results than taking 100 frames and setting the lower quality to a lower value. If the result is only stacking 10 frames then the final image may be grainy due to noise in the image (stacking more images averages out the noise). If your computer is too slow to deal with large files, you need a more powerful computer... my home PC has a 1.6 GHz processor and 512 MB of RAM, I would suggest this is the minimum specification

The down side to aligning on a central object and stacking many "wobbly" images is the edges of the final image will be blurred and the centre sharp.

Leaving the colour balance on auto may result in colour changes as the exposure is changed, often the resulting image appears monochromatic rather than coloured. Setting the colour balance manually isn't easy but can stop unexpected colour shifts.

The "QuickCam" progam seems easier to use and more stable, than the VRecord supplied with a Philips ToUcam Pro. The main advantage is to auto increment video file names (mars1.avi, mars2.avi, etc.), all you need to do is press the "record" button and the program does the rest. Settings are stored when you exit the program and it doesn't seem to crash either.

Connecting your home computer and laptop together with a network "crossover" cable is fairly easy, provided you either have built in networking in your laptop, or use a "Cardbus" 32 bit networking card. The data transfer rate should be 100 mega bits per second resulting in 1.3 GB of data being transferred in around 4 minutes. Some methods of transferring data can be incredibly slow and tedious.