

## IS VIDEO ASTRONOMY THE FUTURE OF OBSERVING?

*Amateur astronomy has seen a steady decline in popularity over the past few decades, due in large part to increases in man-made light pollution. Video astronomy may be just what our hobby needs to re-popularize it with the general public.*

My immediate response to the question posed by this article's title is: YES. I can say this with certainty, having been actively involved in video astronomy for almost two years. In this article I will try to explain how it is that I've come to be a video astronomer, and perhaps by the end you will agree with me when I say video IS the future of amateur astronomy.

### In The Beginning

I have been interested in astronomy since I was a young boy. For most of my childhood I lived in a small village north of Belleville, in south-central Ontario, Canada. The skies there in the 1970's were dark. Even better were the summers I spent with my grandparents at their trailer on Weslemkoon Lake, about 1.5 hours north of Belleville. There, away from the campfire light, the Milky Way was so bright that it cast a shadow. Under such conditions it was hard not to be inspired by the night sky and all that was in it. I spent countless hours staring at the heavens with my trusty hand built 60mm refractor. At the time my parents must have thought I was a little crazy, but luckily they encouraged my interest in astronomy and for that I am grateful.

Eventually my interests led me to university where I studied engineering. The time and effort I had to invest in my education didn't permit much opportunity for observing. After I graduated, my effort was spent on my career, and then eventually on getting married and starting a family. The many commitments of adult life had gradually pushed astronomy out of my mind, lost but not forgotten. It wasn't until my oldest child started to show interest in astronomy that my long lost love for it was reawakened. Very quickly I jumped back into the hobby, getting myself a nice 8" SCT like I used to dream about as a kid. I got myself some good books on the subject, and a reasonable assortment of accessories, and set to work recapturing the wonder and amazement I had when I was a boy. Unfortunately there was a problem: the skies today are nothing like what they were in the 1970's and 80's. I had been away from astronomy for twenty years, and in that time the skies had gone from an inspiring canvass of black velvet and sparkling diamonds to an orange-grey soup.

### A Fighting Chance

I tried hard to find the same enjoyment in observing that I had when I was younger. Very quickly I found that even with an 8" aperture telescope, I was limited to a short list of targets: the Moon, planets, open clusters, some globular clusters, double stars, and a handful of bright nebulae. This should have been enough to keep me busy for a while, but the severity of the light pollution made it hard to even find many of these objects. The prospect of only being able to observe in a dark local was worrisome; having a full time job and young kids, it simply was not practical for me to pack my gear in the car and drive one or two hours out of the city any time I wanted to observe.

There were other aspects of observing that did not end up the way I had hoped as well, for example the introduction of my kids to astronomy. I found it difficult to find good opportunities to include my family in my observing, and when I did it was difficult for them to really see what I saw in the eyepiece (through the grey murk) and begin to appreciate it. As a result almost all of my observing was done alone. It was impossible in practice to compete with the images that can be readily found on the internet, causing me to wonder what I was doing. After only a year of being back into astronomy, I was already starting to lose interest.



*Figure 1. A View Typical of Urban Skies: Only a handful of nebulae are visible through an eyepiece from my backyard. The view here of M42 is typical of what I can see using an O-III light pollution filter, with my accompanying attempt to sketch the object. (images by author)*

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### Same Old Story

My story is not a new one. Many amateur astronomers have lost interest in observing for the same reasons I had. The numbers of new people entering the hobby has also been dropping, due not only to the decline in observing conditions, but also due to a basic lack of astronomy awareness in the general public (see Bill Andrews' article "What happened to science education" in the August 2011 issue of Astronomy Magazine). Unfortunately there is an entire generation of people who may never see the Milky Way with their own eyes.

It is surprising in this so called "Golden Age" of astronomy, where incredible new images from robotic probes and space telescopes appear in the news every day, that more people are not getting involved in the hobby. Do people believe that the same feeling of inspiration you get from a space telescope image is unattainable by an amateur? One look through a telescope from an urban backyard and most people would say yes. Competing with other types of leisure activity today, especially amongst the younger generation, has become very challenging. It is difficult to draw people's attention away from flashy high-tech gadgets like smart phones and game consoles. If robot probes and space telescopes can't attract more people to astronomy, then what can?

### What About Astrophotography?

One area of amateur astronomy that has actually been growing in popularity is astrophotography. The technological advances in consumer electronics that have helped distract people from astronomy in general are actually helping to make imaging more popular. Good quality digital cameras and imaging telescopes have become significantly more affordable in the past five to ten years, making astrophotography accessible to a much wider audience. Amateur astrophotography has a number of appealing aspects, among them the ability to image under light polluted skies (using filters), and the ability to produce images that rival those from professional observatories. Using imaging it is also possible to make real contributions to science, through image based searches for new near Earth asteroids and comets. So is astrophotography the answer?

When I began to lose interest in observing, I seriously considered imaging as a way of keeping my involvement in astronomy alive. I liked the fact that I would have a visual record of my observations to share with others, and I am a bit of a tinkerer so fiddling with equipment seemed like it could be interesting as well. I researched the kinds of equipment and software that was required, and read through a number of "getting started" guides. I found that it is possible to get into astrophotography at a reasonably small cost, but to take the very best images requires a significant investment in a camera, mount, and telescope. Taking high quality images also requires a high level of technical ability and mental focus. For me the most important investment with astrophotography is time. The time required to properly setup the equipment, gather the image data, and post process it is far more than I am willing or able to commit to. I can only afford a couple hours the odd clear night to hop between a handful of celestial targets, not 10 to 20 hours of effort to get a single image. In addition, astrophotography did not really address my concern

about involving my family and friends into my hobby. Astrophotography would result in my spending even more time alone than when I was eyepiece observing. For me, astrophotography is not the answer.

### Video Saves The Day

Around the same time I was researching astrophotography I learned that numerous amateur astronomers were having good success recording images of planets using a common inexpensive webcam. The idea is to collect hundreds or even thousands of video frames and then let image processing software sort and "stack" the images. As I dug deeper I found a whole community of amateur astronomers dedicated to using video cameras for not only imaging but live observing as well. The results I saw other people achieving encouraged me to start playing with video astronomy myself. I began using an older model low light level net-cam that we had purchased as a "nanny-cam". I modified the camera to allow it to be installed prime focus on my telescope, as if it were an eyepiece. Adapters are readily available online to convert all natures of webcam for prime focus use. The first night I tried my home built contraption I was pleasantly surprised by the results. I was able to get nice sharp live video of the Moon and planets, and with very little effort. One benefit of video astronomy that immediately jumped out at me was that I could easily share what I was looking at with my wife and kids. How easy it was to simply point to the screen and discuss what it was we were looking at. I knew then that I was really onto something.



**Figure 2. First Steps Into Video Astronomy:** Even my early attempts with video showed the potential for this new area of amateur astronomy. The image here is a single raw video frame taken with my modified net-cam & 8" SCT. (image by author)

The extra effort required to use a video camera for my observing was not much more than simply using an eyepiece. Being able to control the exposure time of the camera, as well as video properties like brightness, contrast, saturation, and hue, gave an added capability to my observing. I soon found that I was not alone in my regard for video astronomy. In November 2010 I came across a website called NightSkiesNetwork.com (NSN). Through this website I was

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able to see live video streams from the telescopes of fellow video astronomers located all over the world. Not only could I see what they were seeing, but I could also chat with them as well, along with all the other people who were logged into the broadcast. The idea of being able to observe live and freely share views and ideas with people around the globe is very alluring. To me, this is what astronomy is supposed to be. At last I had found my calling!

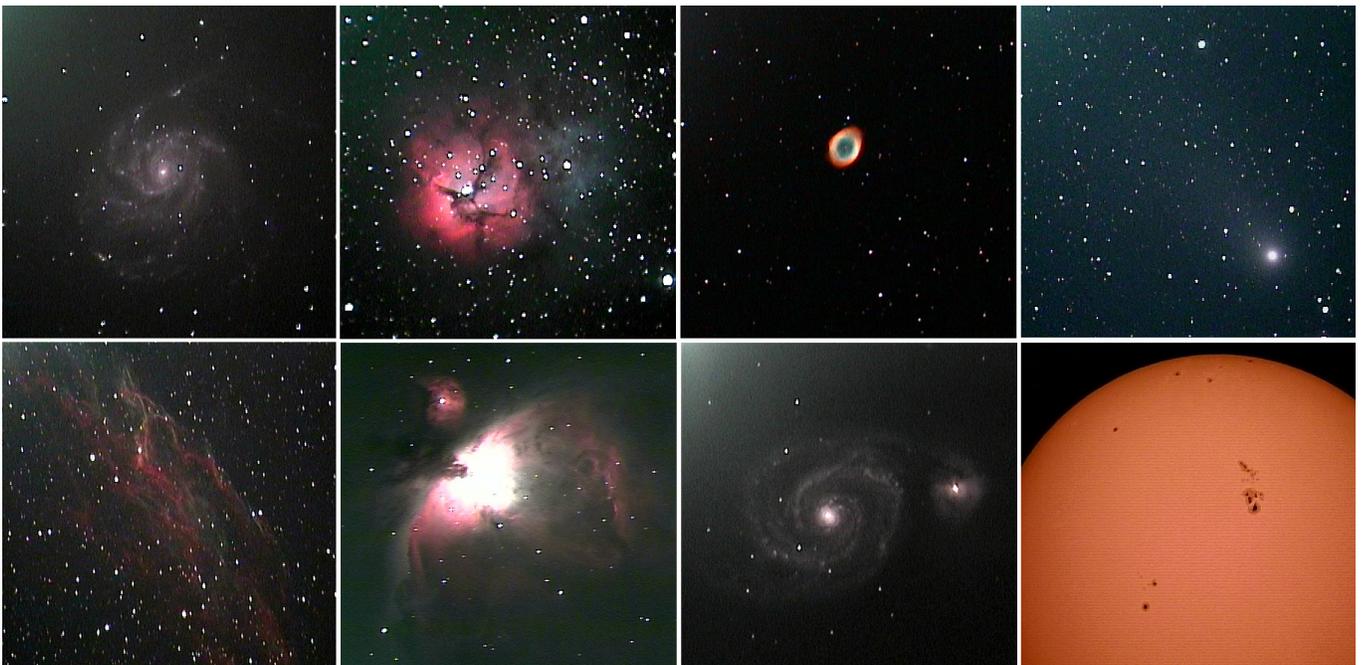
The final and most important observing problem to be resolved was what to do about light pollution. Webcams or modified security cameras are great for the Moon and planets, but they are simply not sensitive enough for observing DSO's. Luckily for us there are some pioneers in this field who have been working on the problem for many years now. My personal experience is with perhaps the most notable member of this vanguard group, fellow amateur astronomer and Canadian Rock Mallin. Through his own hard work and ingenuity he has developed a video camera specially designed for live astronomical observing, the Mallincam. Video cameras specially designed for live astronomical observing virtually eliminate the barriers amateur astronomers have. Here is a list of features an astro-video camera provides:

- you are observing a live video stream, as real and instantaneous as an eyepiece view;
- your view is in full colour, allowing you to see the sky as it truly is and not what our dark adapted eyes limit us to;
- the video can be displayed on a TV monitor or computer screen, right next to the telescope or inside your house where it is warm and dry;
- the video can be easily observed by many people simultaneously, making it perfect for outreach programs held by clubs, planetariums, museums, of just you and your family;
- the video can be streamed over the internet to allow anyone anywhere in the world to watch it live;

- the video can be saved for archival purposes or for image processing later;
- the camera works with whatever telescope you presently have, not just those specially designed for imaging;
- the camera installs just like a normal eyepiece, and is otherwise relatively easy to use;
- setup tasks like mount alignment, focusing, and scope collimation are much easier viewing a video screen;
- the camera uses a CCD sensor combined with sophisticated video processing circuitry, providing high levels of sensitivity including wavelengths not visible with the human eye;
- filters designed for visual and/or imaging applications can be used for effective reduction of light pollution.

An astro-video camera opens up an unlimited list of possibilities. They can be used for observing everything from the Sun and Moon to faint galaxies and nebulae. Cameras that have been carefully optimized for DSO observing such as the Mallincam are able to provide views of objects that you would never see through an eyepiece, whether you're under a dark sky or not. For example I routinely observe dim nebulae such as the North American (NGC7000), Horsehead (B33), and Pac-man (NGC281) from my backyard in downtown Ottawa. The Mallincam is also sensitive to near-infrared, permitting the viewing of remote galaxies and globular clusters. I personally have observed members of the Abell 426 galaxy cluster in Perseus down to  $M_V +16.5$ , also from my backyard. Simply amazing!

**Figure 3. Samples Of Astro-Video Camera Captures:** These images are single video frames that I have captured using my Mallincam Xtreme from the Ottawa area. (images by author)



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### How To Get Started

As you may have already guessed, I currently own a Mallincam (Xtreme) and simply love it. It is representative of the high end of the astro-video camera spectrum. As with amateur astronomy in general, you can choose to enter video astronomy at whatever price range you can afford. Many video astronomers use modified webcams costing around \$100 or less. From there you can find mid-level cameras in the \$500 price range which allow solar system work as well as some DSO's. The high end cameras are in the \$1500 range, which may seem like a lot but keep in mind that this single camera is replacing all of your eyepieces. There are a number of astro-video camera suppliers now including Mallincam and Orion to name a few. Make sure you visit the online user group for any camera you are considering buying so you can ask existing users questions and be sure you are making a good choice.

If you already have a telescope, then there is no need to run out and buy yourself another one just to use with your astro-video camera. There is a large amount of adjustability built into the camera and its video output that will allow you to work with whatever telescope you have. You need not even worry about your telescope's aperture as high-end astro-video cameras can give you the same effective aperture under light polluted skies as a telescope with 4 to 5 times the aperture under dark skies. A good mount is important, with progressively better tracking required the dimmer the objects are you wish to observe. I have my telescope on a German equatorial style mount, but many other users have (tracking) Alt-Az mounted scopes as well. An accessory that you probably should get if you don't have one already is a good focal reducer. A focal reducer will improve the light gathering capability of your scope as well as provide you with a wider field of view for observing a larger range of objects. If you have a light pollution filter already, there is a good chance it will work with your astro-video camera. Note however that using light pollution filters will also require better tracking capabilities as the camera will have to operate at longer exposure times.

The manner in which you view your video depends on the capabilities of the camera you have purchased. Webcams obviously require a computer to operate, but CCD based security cameras, camcorders or even DSLRs can often be viewed directly on a TV screen using an analog video out. High end astro-video cameras often give you a range of choices for how you can view the video. I capture the analog video output from my cameras to a computer for viewing and capture, as well as for streaming live to NSN.

The last thing you need to get started is curiosity and a willingness to try something new. There are so many different possible combinations of video camera, telescope, observing object, and environmental conditions, there can be no single recipe for how best to observe with a video camera. Luckily the video astronomy community is very open and friendly, and the asking of newbie questions is encouraged. It will be up to you to start from the advice of other users and explore, experiment, and hopefully enjoy.



**Figure 4. Author's Astro-Video Cameras:** The author owns three cameras for video astronomy (from left): Mallincam Junior, Toshiba IK-WB11A net-cam, and Mallincam Xtreme. (images by author)

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