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Meade LPI vs. Philips TouCam Pro Webcam Comparo

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Many thanks to the wonderful folks at Digitec Optical for the loan of the Meade LPI unit.

Webcam planetary astrophotography is hot!

Unless you've been living under a rock, disconnected from the Internet, you know that amateurs are taking planetary pictures with inexpensive webcams that were completely unthinkable ten years ago. The Philips TouCam Pro (recently replaced with the TouCam Pro II which has a new body but is otherwise internally identical to its progenitor) was the consensus imaging king. In 2003 Meade came out with their Lunar Planetary Imager, so a comparison for Cloudy Nights between the de-facto King and the new kid on the block was inevitable!

(Note: in addition to its imaging capabilities, the LPI can be used as an autoguider for Meade telescopes, and Autostar Suite enables additional telescope automation capabilities. As I do not have a Meade telescope these features were not reviewed)



What's in the box?

The LPI comes with (clockwise from top left):

- USB cable
- 4 wire RJ cable
- 6 wire RJ cable
- Quickstart instructions + errata sheet
- camera body itself
- Autostar Suite CDROM
- RJ to DB9 adapter
- parfocalizing ring

The Philips TouCam Pro comes with:

- webcam
- tabletop stand
- monitor top stand
- CDROM
- Philips "VLounge" CDROM
- cool orange storage "egg"

As supplied the TouCam Pro is not astrophotography ready. You have to buy a webcam to 1.25" adapter and optionally an IR block filter (the IR block for the TouCam Pro is built into the little lens you twist off - on the Meade an IR filter appears to be built into the camera body itself). Also, the software that comes with the TouCam Pro isn't designed for astro-imaging or image processing - for those functions I use [QCfocus](#) and [Registax](#), both freeware.

Clearly you get a LOT of stuff with the LPI, particularly considering its price, and it is ready to go "out of the box". Looking forward to the imaging portion of this review, an advertised differentiating feature of the LPI is that it can take long (for a webcam) exposures of up to 15 seconds, far longer than a standard webcam.

Advantage: LPI



Comparing the camera bodies

Both webcams are *tiny*, not much bigger than the average 20mm Plossl (the TouCam Pro is shown with a Mogg 1.25" nosepiece attached), so neither is going to strain even the smallest telescope. The LPI has a nice feature that the 1.25" nosepiece is actually a screw-on sleeve. Unscrewing it reveals a 0.965" sleeve, a thoughtful touch. Additionally, the 1.25" nosepiece is threaded for standard 1.25" filters.



Both cameras have lights to show that they're powered up, the one on the Meade is appropriately astro-dim, the one on the TouCam Pro, while red, is a little on the bright side.

Unscrewing the lens from the TouCam Pro (necessary to put on the Mogg adapter) enables you to compare the sensors on the LPI and the TouCam Pro:



In both cases the sensors are literally smaller than a thumbnail. Note that the LPI sensor is appreciably larger than the TouCam Pro sensor. That can be either good or bad depending on what you want to shoot. For the same number of pixels, a smaller sensor is actually an advantage for planetary imaging where you want a tremendous amount of magnification. Conversely the larger the sensor the larger the FOV for a given telescope, which can be an advantage when imaging the moon.

Due to the design of the TouCam Pro, where the lens is designed to be screwed in and out for focus, the body allows for very easy access to the surface of the sensor. This makes cleaning (with a Q-tip and pure isopropyl alcohol - NOT rubbing alcohol which has menthol oil in it) very straightforward with the TouCam Pro. The 0.965" nosepiece on the LPI is actually another sleeve on a non-removable nosepiece molded onto the front of the camera (don't try to pull off the 0.956" sleeve – it's glued onto the nosepiece). This will make cleaning awkward. It looks like the body can be taken apart by removing two screws, but as this was a dealer loan I didn't try disassembling the body.

Despite the cleaning issue the LPI is obviously designed with the imager in mind, so it's

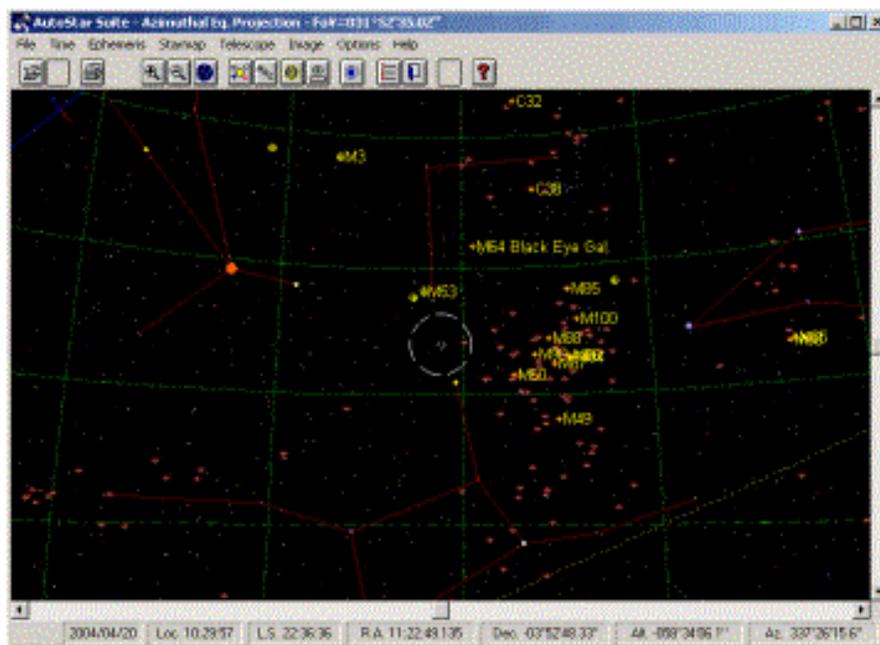
Advantage: LPI

Autostar Suite Overview

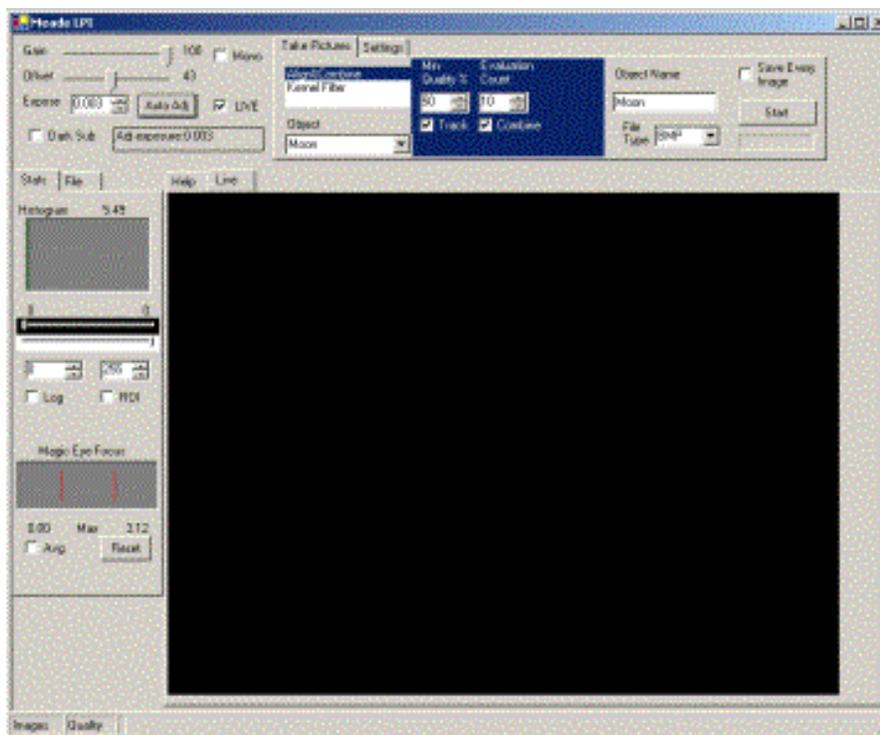
The Autostar Suite software package that comes with the LPI is a combination Planetarium/ Telescope Control/Imaging Acquisition/Image Processing system. As I do not have a Meade telescope, I only evaluated Autostar Suite's image acquisition and processing capabilities.

Software installation is straightforward. Pay attention to the numerous warnings not to re-boot your computer until the very end of the installation. On my Windows 2000 Pro system no requests for a reboot happened at all.

After installation of the software you attach the camera to your USB port with the supplied cable (which is a little on the short side) to complete the hardware driver install process. Launching the software brings up the following screen:



Clicking on Image -> LPI Imaging brings up the image acquisition window:



Going clockwise from upper left the major functional areas are:

- raw camera controls for exposure and gain control
- image acquisition control area controlling how pictures are acquired and initially processed
- image preview/viewing screen

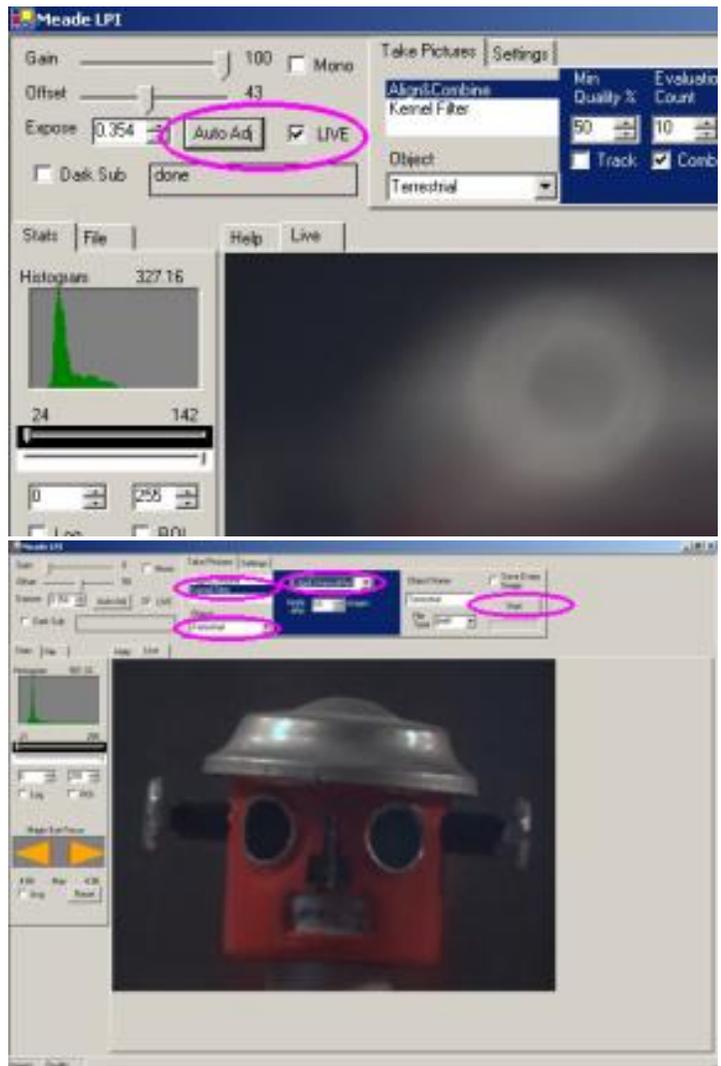
- Magic Eye Focus assist window
- image contrast/brightness & histogram window

Autostar Suite - Capturing your first terrestrial image

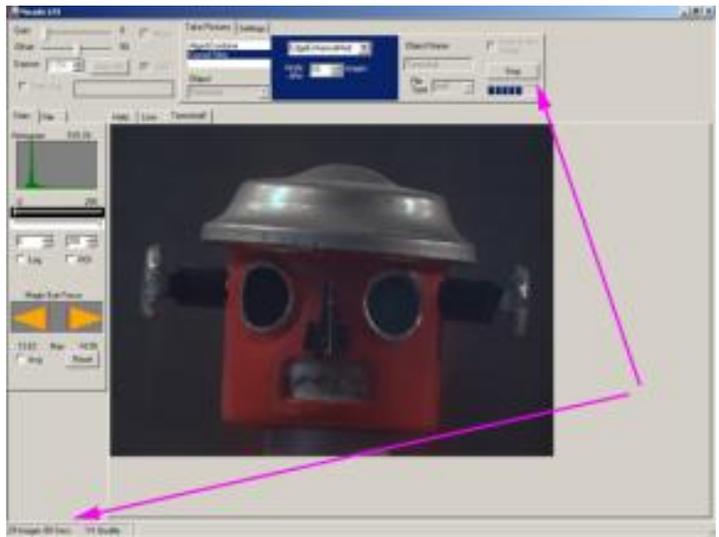
Acquainting yourself with the LPI and Autostar Suite is easiest in the daytime where you have a bright stationary object. Select a terrestrial object far away enough from your scope that you can reach focus and select an object that has a bright glint on it. A reflection off of a street lamp, for example, is perfect. Focus with your eyepiece then remove the eyepiece and insert the LPI. They likely will not be parfocal so expect to have to refocus. The purpose of selecting an object with a bright glint is to be able to see something to focus on.

Make sure "LIVE" is selected and click on "Auto Adj" to get the camera rolling. Autostar Suite will set the exposure to 1 millisecond then gradually increase exposure until you have a reasonable image and then stop. This can take a little time so be patient. You will see "done" in the box below the "Auto Adj" button when the sequence is finished.

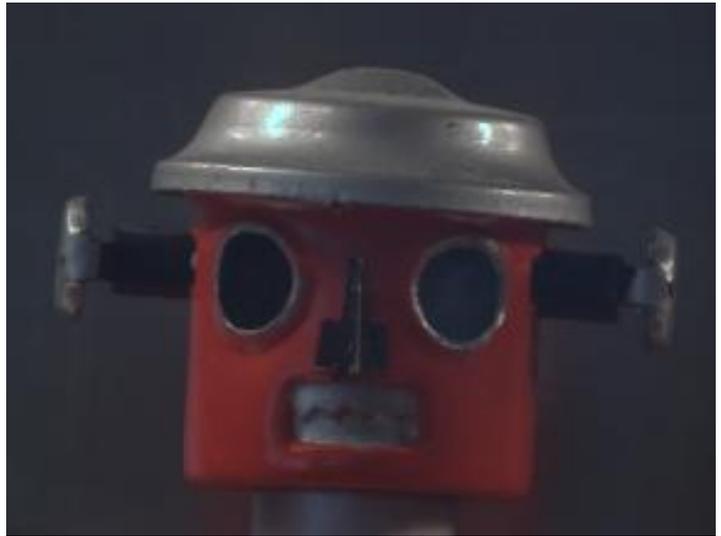
Ignore the "Magic Eye" at this point and manually focus until you have a crisp image. At this point you haven't acquired anything yet, you've been using the preview "Live" window (see the tab above the image). Now you're ready to actually capture that image. Under the "Take Pictures" tab, select "Kernal Filter", below that select the Object to be "Terrestrial", select "EdgeEnhanceMed" and when you're ready, click on "Start" at the right hand side.



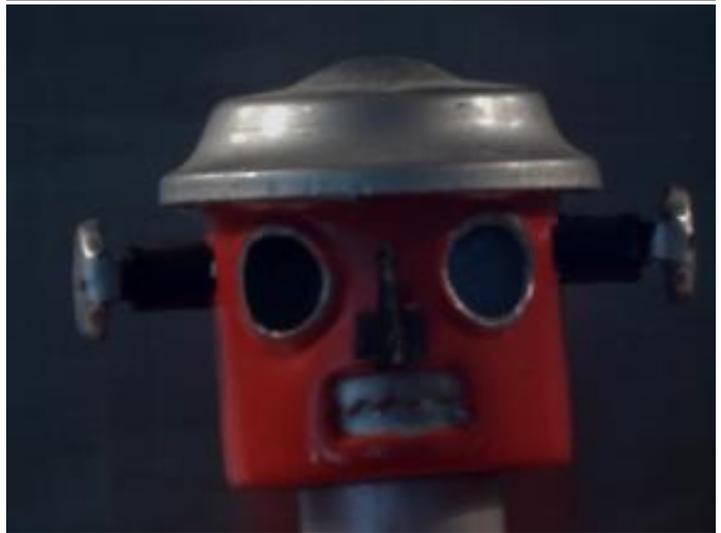
Once you click on "Start" Autostar Suite starts continuously taking images. Using the default values it first takes 10 images to generate a "baseline" level of quality, then starts some kind of compositing algorithm to improve the picture. Image acquisition happens continuously: the "Start" button changes into a "Stop" button, a progress bar appears below, and at the bottom of the window you can see the total number of frames acquired and total elapsed time.



You can specify the type of processing that takes place in real-time - in this case I've selected medium edge enhancement. Here's the shot straight out of the program with no further processing.



The result is very good, a close match to what was seen visually through the scope. Here's the same subject with edge enhancement processing turned off.



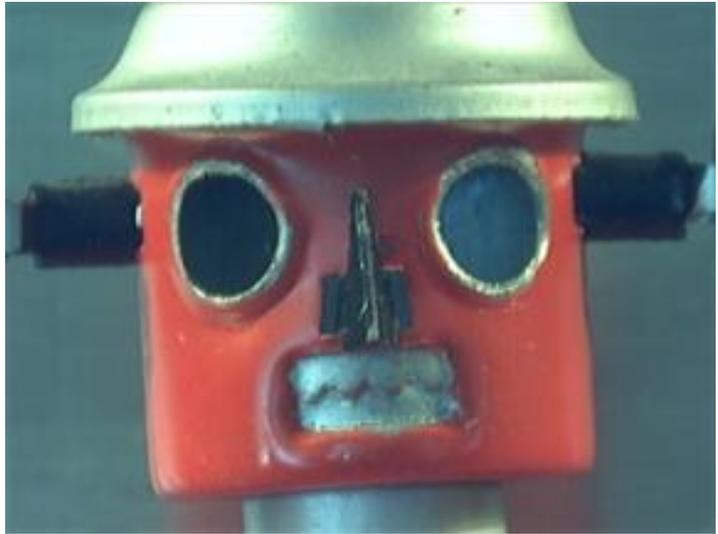
As expected the image is a little "soft" - it's in focus but edge contrast is low. The natural colors indicate that the camera DOES have a built in IR block filter.

Initial TouCam Pro/QCFocus/Registax comparison

Unlike the Meade LPI/Autostar Suite combo QCFocus only captures video to disk. The resulting

AVI must then be post-processed in Registax (or some other equivalent video stacking program): you can't see the processed results in realtime.

Using auto-exposure in QCFocus, and a moderate amount of wavelet processing (visually similar to the amount of processing done by Autostar Suite in medium edge enhance mode) here is the same subject with the TouCam Pro. To keep the comparison fair this is a straight stack of 45 frames.



As with the LPI example above here's the un-enhanced, but stacked, version. Again it's in focus but a little soft.

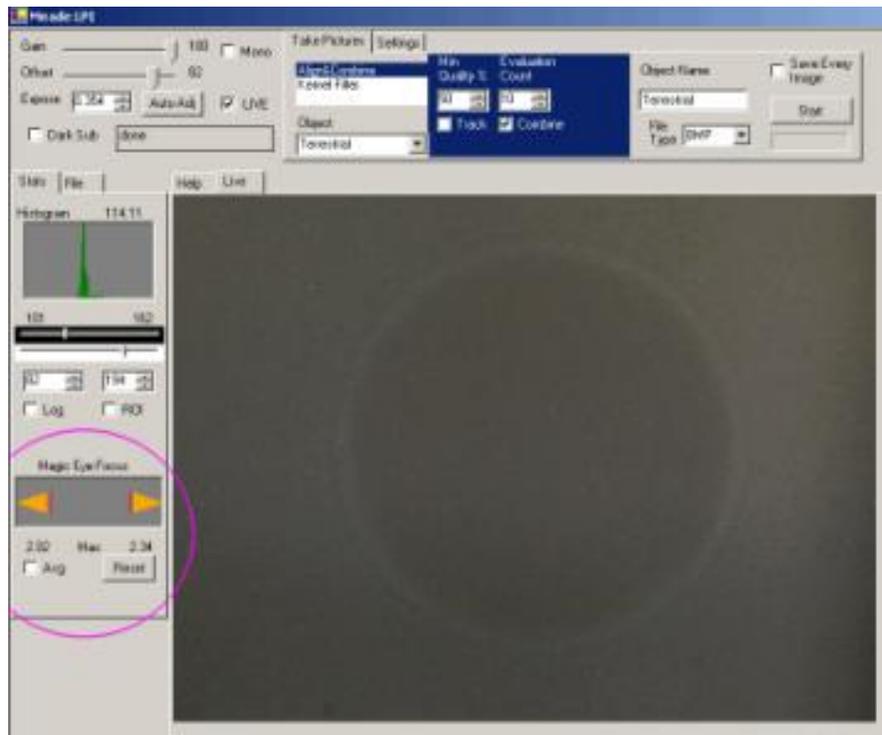


Vagaries of color balance, exposure, and image scale aside, the results are comparable. It's time to move onto actual astro-imaging.

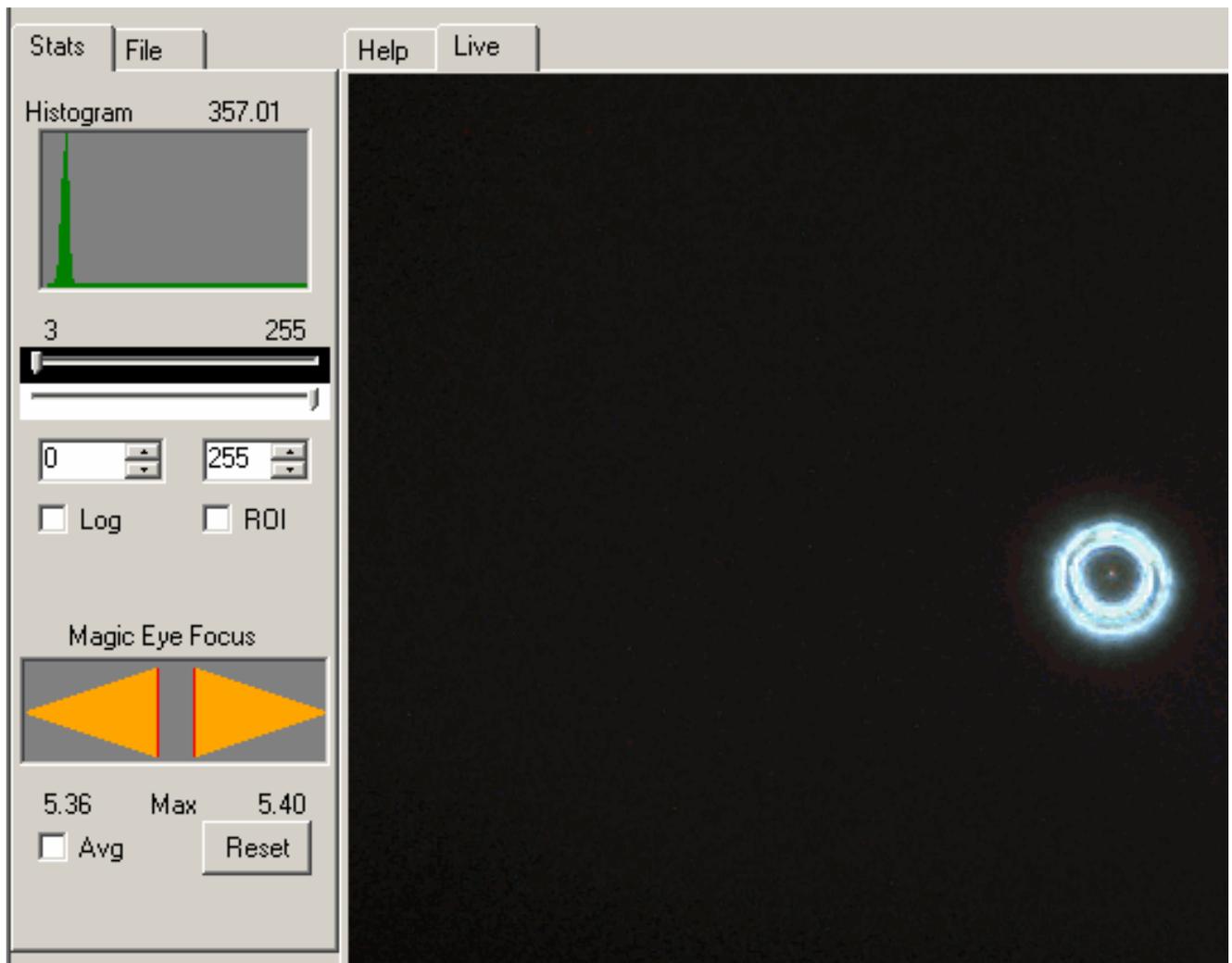
Advantage: Tie

Autostar Suite Magic Eye focus assist

Autostar Suite has a focus assist mode called "Magic Eye". In the picture below you can see the donut (the telescope used was for this portion of the review was a 3.5" Questar Mak) created by the out-of-focus star.

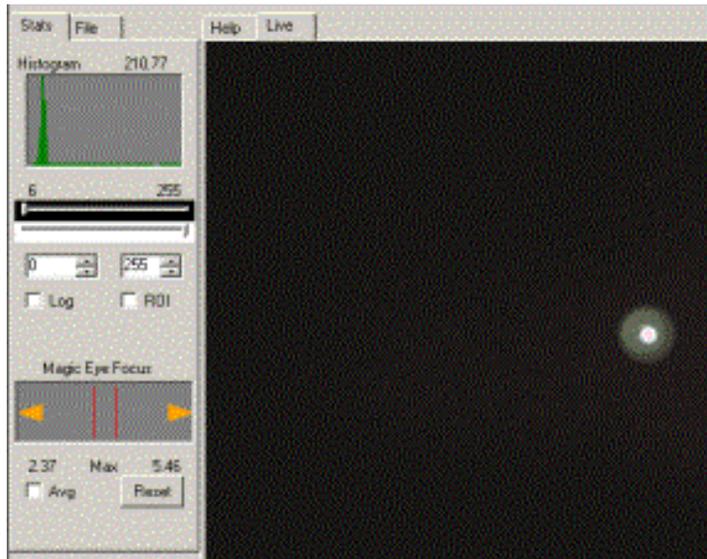


The way Magic Eye is supposed to work is that as focus gets closer the yellow triangles enlarge to meet the red lines of maximum focus. In this shot we're much closer to focus but the triangles have touched the red lines, seemingly indicating that focus has been reached.

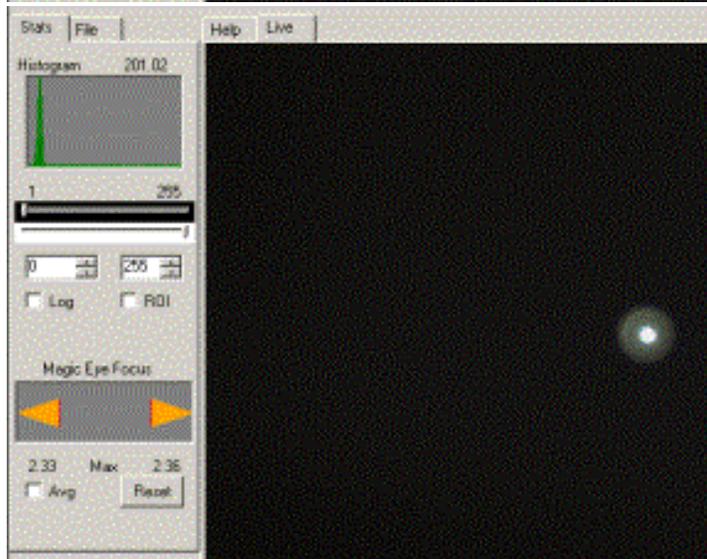


(No, collimation isn't off, the image is a little off-axis)

Here focus has been reached (checked using the method described below) but the triangles don't touch the red lines:



Clicking on "Reset" puts the lines in the right place, but the software is supposed to be helping the user, not the other way around:



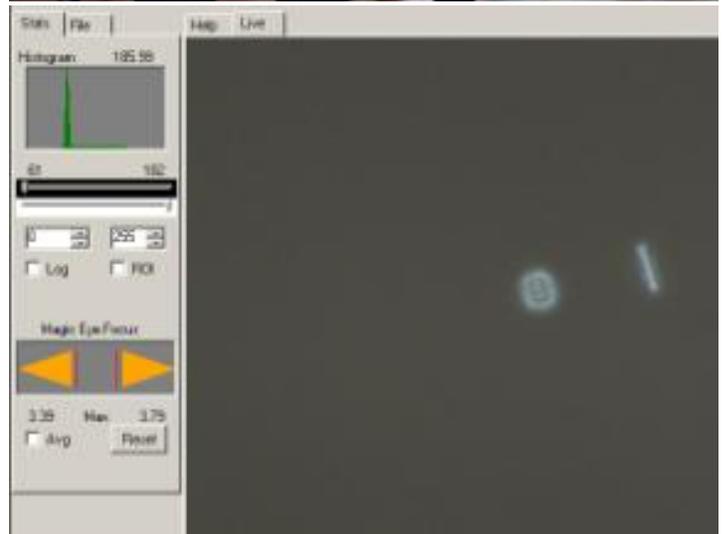
The manual is extremely brief in its description, so unless I've misunderstood something, I don't find Magic Eye to be reliable or helpful.

Here's a more precise way to get to focus.

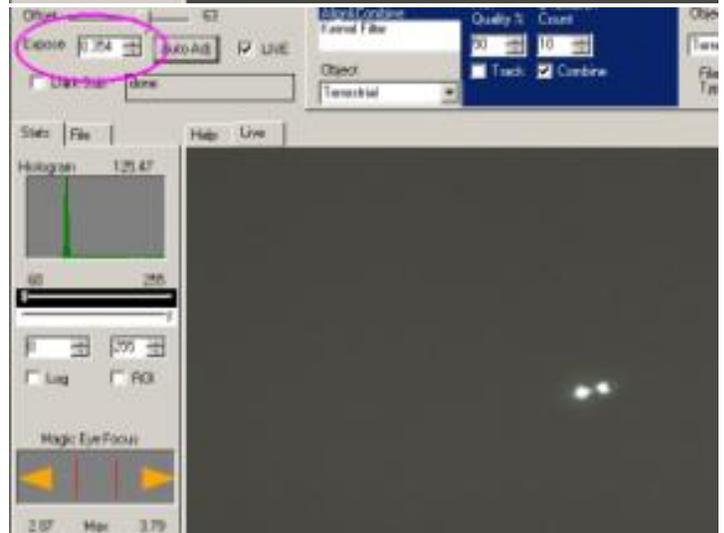
Make a Hartmann mask, basically an aperture cover with two holes cut in it. As you can see from the picture it doesn't have to be particularly precise or pretty. For my larger telescopes I've made permanent masks out of foamcore.



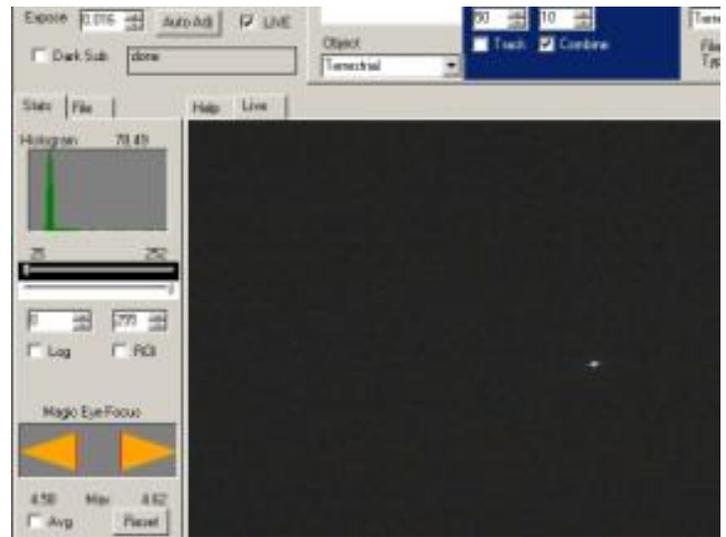
Start up Autostar Suite and get close to focus and then put the mask on your telescope. Instead of one star you now have two. As you get closer to focus the images will approach each other.



As you get closer to focus the images will also get brighter, making it hard to judge exactly when they overlap.



Manually reduce exposure to reduce the brightness of the images and then bring them into overlap. You are in focus.



Once you've achieve critical focus on a star you can swing over to a planet or the moon.

QCFocus has a fast focus mode with its own methods of helping you achieve focus, but similarly, the Hartmann mask method is still the most accurate and most unambiguous way to focus so,

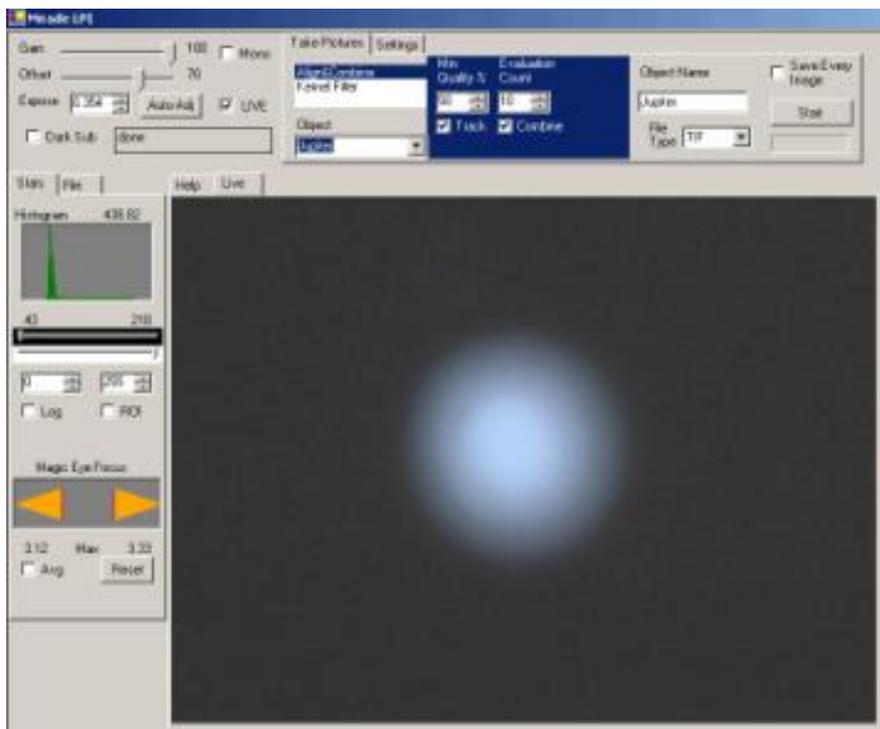
Advantage: Tie

Short Exposure Planetary imaging – Round 1, terrible seeing conditions

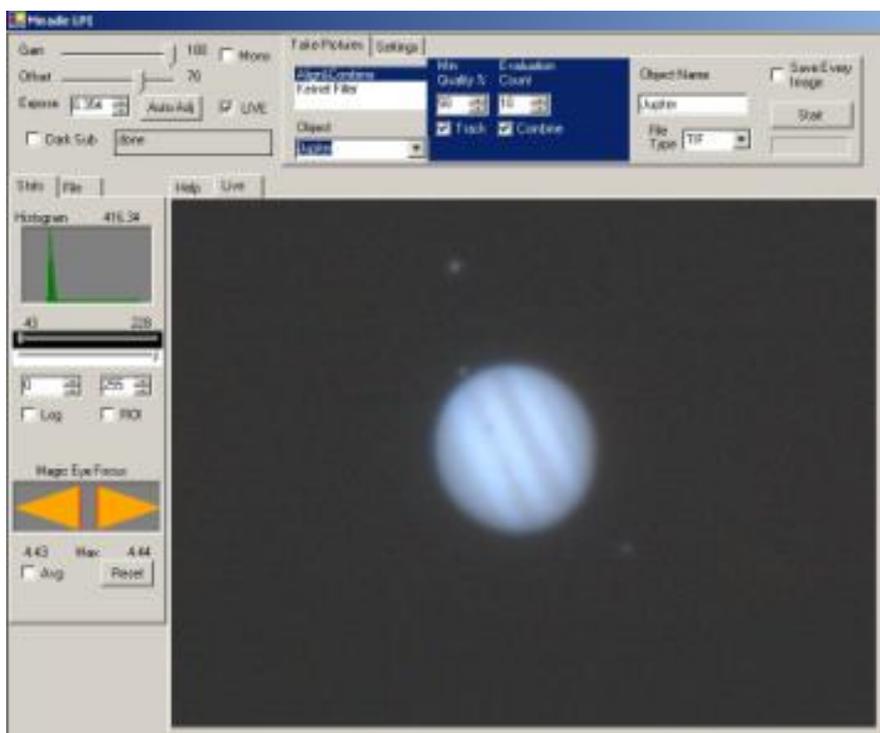
The first real test of planetary imaging was carried out on a night of terrible conditions. Clear but gusty and windy, causing the image to bounce around and pop in and out of focus. Why bother? Because under these conditions you can assess the absolute limits of the software's ability to handle tracking and seeing problems.

Both the LPI and TouCam Pro were evaluated by imaging Jupiter with a Takahashi Mewlon 250 and Televue 2X Powermate, giving a focal length of 6000mm.

The first challenge is always finding the planet and focusing. At 6000mm it's hard just to find the planet! Center and focus the planet using a high power eyepiece, around 12mm, then remove the eyepiece and put in the LPI. Start up Autostar Suite and hit the "Auto Adj" button and wait for the software to set the exposure. Hopefully you'll get something that looks like this:



Now bring Jupiter into approximate focus:

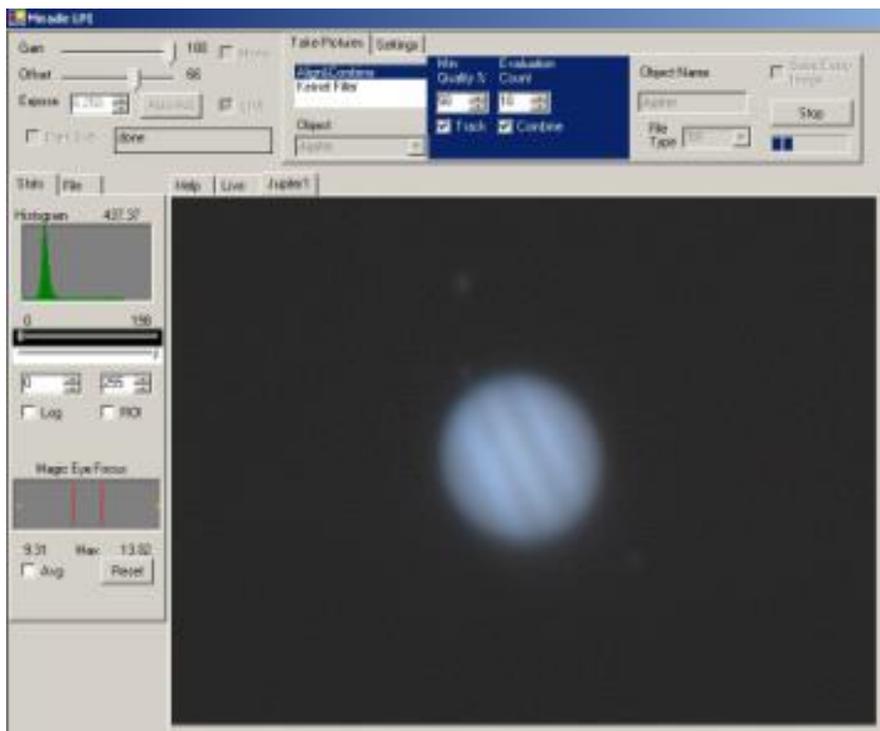


Here's where the parfocalizing ring Meade thoughtfully provided comes in handy. Put the ring onto your eyepiece, and pull out the LPI. Put the eyepiece in and **WITHOUT ADJUSTING FOCUS**, slide the eyepiece back and forth until you can see Jupiter in focus. Slide the parfocalizing ring up against the focus drawtube and lock it down. You can now use the eyepiece to get to approximate focus, and **FIND** Jupiter again.

You'll need to find Jupiter again because you'll now swing away from Jupiter and use a star and your Hartmann mask to focus your telescope.

Keeping the eyepiece in place, swing over to a bright star and center. Take out the eyepiece and put the LPI back in. Now focus using the Hartmann mask method described above. If you have a GOTO scope, just GOTO back to Jupiter. If you don't take out the LPI and put the eyepiece in. You'll be close enough to focus to see what you're doing. **DON'T TOUCH FOCUS**, and swing your telescope back to Jupiter and center again. Put the LPI back in. You're in focus and ready to start capturing images.

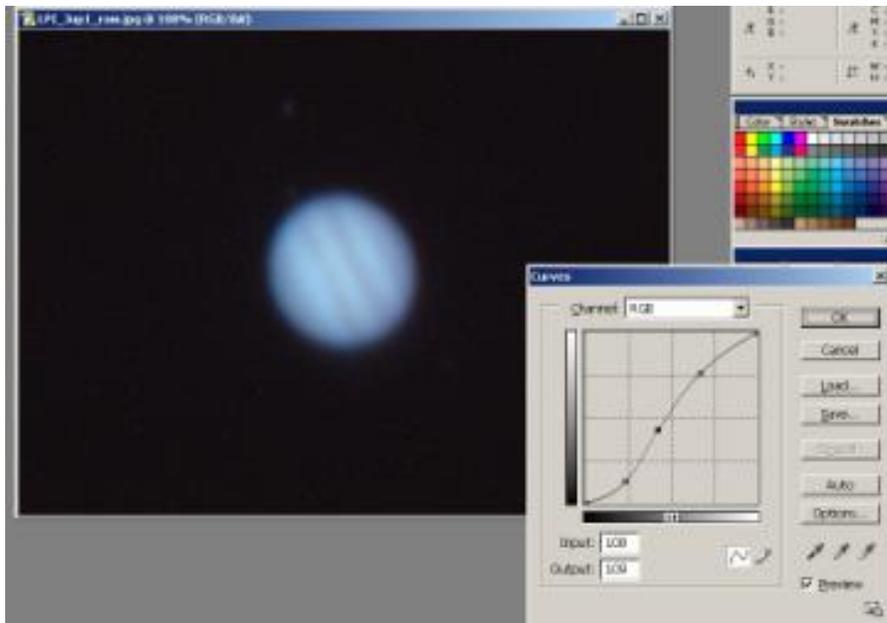
The "Auto Adj" routine seems to measure average brightness instead of peak brightness (a common auto-exposure method), so for a small bright object like Jupiter it overexposes a little. In the picture above you can see that the bright bands between the equatorial belts is overexposed and burned out. Manually adjust exposure to get rid of the overexposure. In this case exposure was manually reduced to 0.25s:



Make sure the "Object type" is selected appropriately ("Jupiter" in this case) and click "Start" to start image acquisition and processing. As described above, the first 10 exposures are used to set a baseline, then Autostar Suite continuously tries to improve the picture. Because of the quick rotation of Jupiter I let Autostar Suite acquire images for 2 minutes then stopped it. This resulted in the following image:



In Photoshop I “curved” the image to reduce the background noise and bring up the contrast in Jupiter (which unfortunately lost the moons – not unusual):



Applying the “Dust and Scratches” filter got rid of the remaining electronic noise:

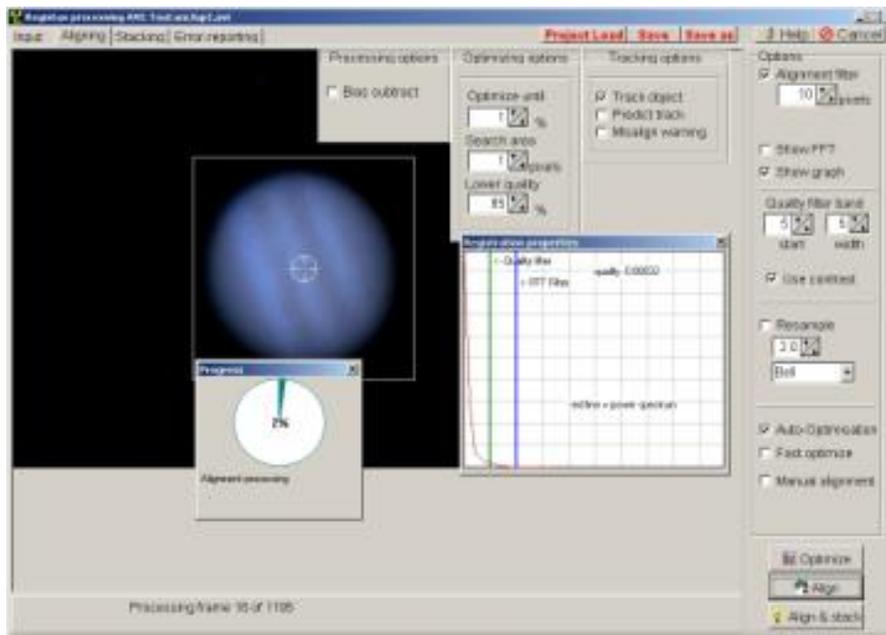


It's not great, but nonetheless pretty good considering the terrible shooting conditions (if you turn up the contrast on your monitor you can see that the moons are still there).

How does this compare to the TouCam Pro under the same conditions?

First off, the TouCam Pro is noticeably more sensitive than the LPI: the LPI needed an exposure of 0.25 seconds while the TouCam Pro only needed an exposure of 0.04 seconds. Secondly, the TouCam Pro could capture images much more quickly than the LPI. In the same 2 minute period I was able to capture 1195 frames at 10 frames/second. The advantage here is that the shorter shutter speed and greater number of frames increases the chances of catching Jupiter "frozen" during a moment of good seeing.

In Registax I used a typical set of parameters to extract and align the best 15% of the frames out of the 1195, about 100 frames:

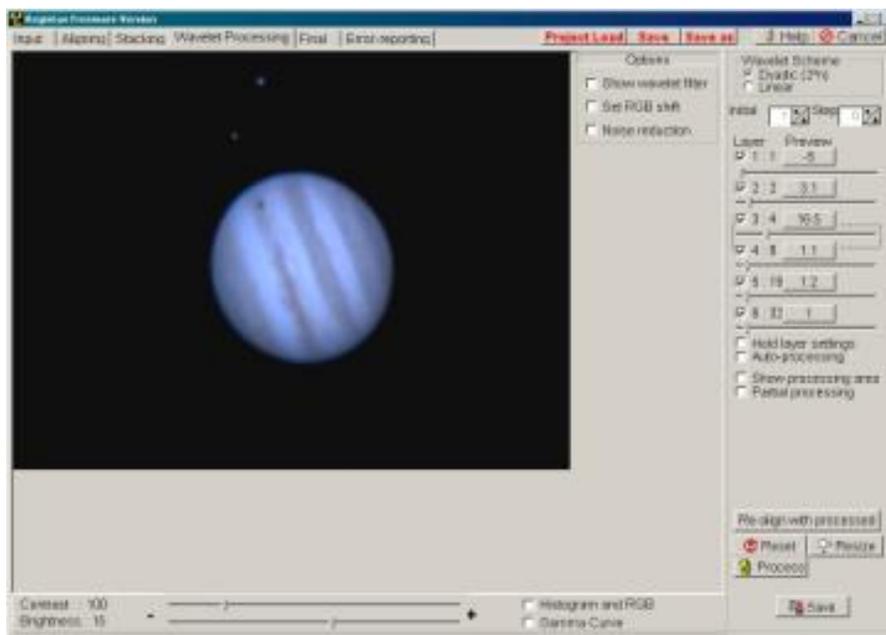


After stacking, but no further processing, here's the initial result:



Image scale is obviously larger because the TouCam Pro sensor is smaller than the LPI's, but also note the lack of noise as a result of the stacking process.

Registax has a very powerful set of post-processing filters called wavelet filters. With practice, an astonishing amount of detail can be extracted from an otherwise "soft" looking image:

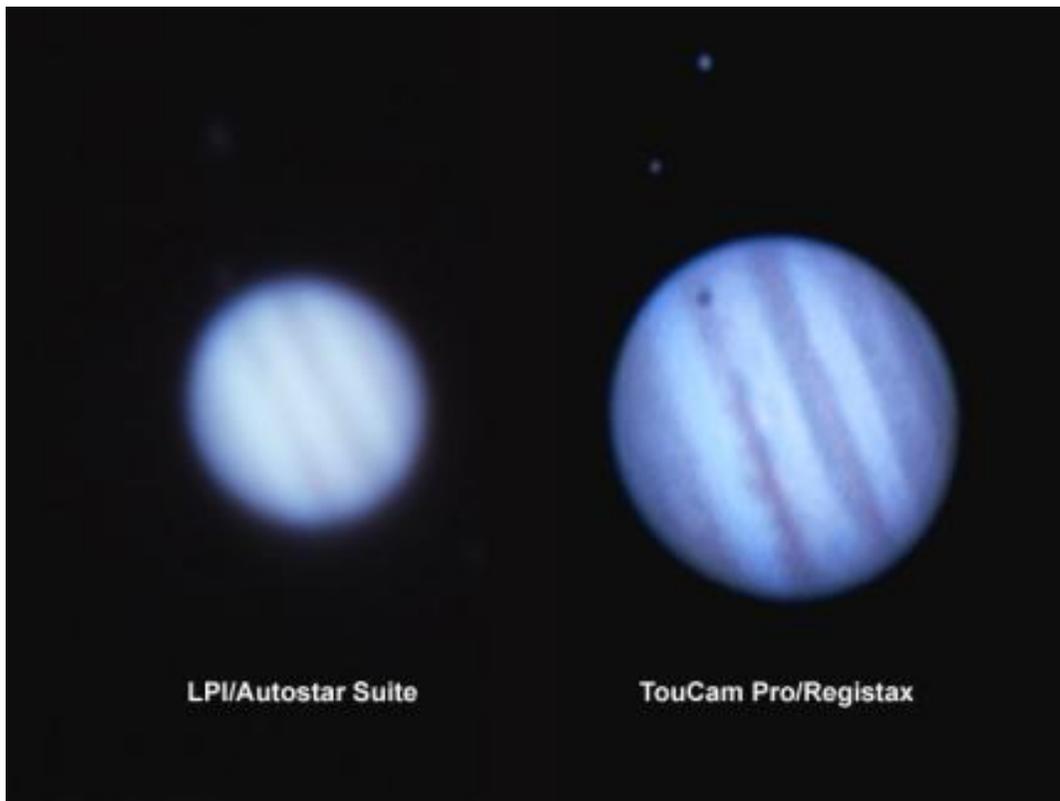


Here's the output of the wavelet processing stage:



No further processing was done on this image i.e. no curving in Photoshop to bring back the moons. Again, a pretty good result considering the terrible imaging conditions.

Clearly, the combination of fast acquisition and the processing power in Registax puts the TouCam Pro ahead of the LPI under less than ideal conditions.



Advantage: TouCam Pro

Short Exposure Planetary imaging – Round 2, good conditions

Under better seeing conditions both cameras should give better results. The following images were shot and processed as above during a night of unusually good, almost exceptional, seeing. Both represent 2 minutes of image acquisition. In the case of the LPI this was 149 frames, in the case of the TouCam Pro this was 1200 frames

LPI/Autostar Suite:



TouCam Pro/Registax (150 of 1200 frames):



Frankly, I expected the LPI to give a much better result under the vastly improved seeing conditions. However, even though seeing was tremendously improved, 149 frames @ 0.25s for the LPI versus 1200/0.04s for the TouCam Pro was the determining factor. Even at 0.25s, there's enough atmospheric turbulence to blur fine detail, while the fast frame rate of the TouCam Pro allowed it to freeze and capture the few moments of exceptional steadiness.



Advantage: TouCam Pro

Long Exposure DSO imaging

On this topic, right off the bat, it's:

Advantage: LPI

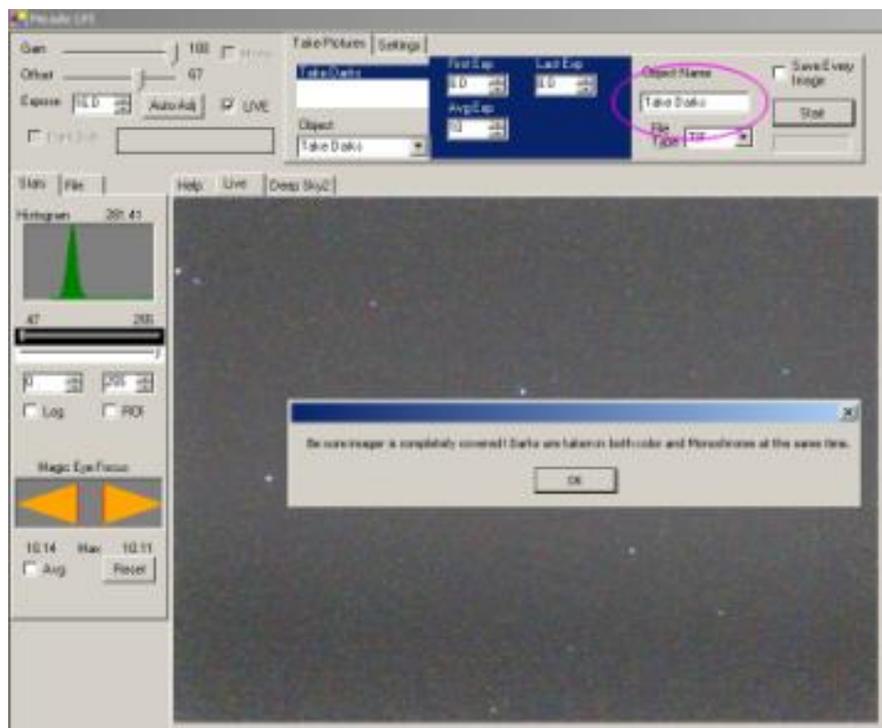
because the LPI can take a 15 second exposure, unlike the TouCam Pro which is limited to 0.04s maximum.

For this test the telescope was switched to a William Optics Megrez 80 semi-apo refractor. The shorter focal length is needed for non-planetary imaging due to the small size of the CCD. With such as small CCD, a shorter focal length is required to give a reasonably wide FOV. With this combination FOV is about $1/3 \times 1/2$ degree.

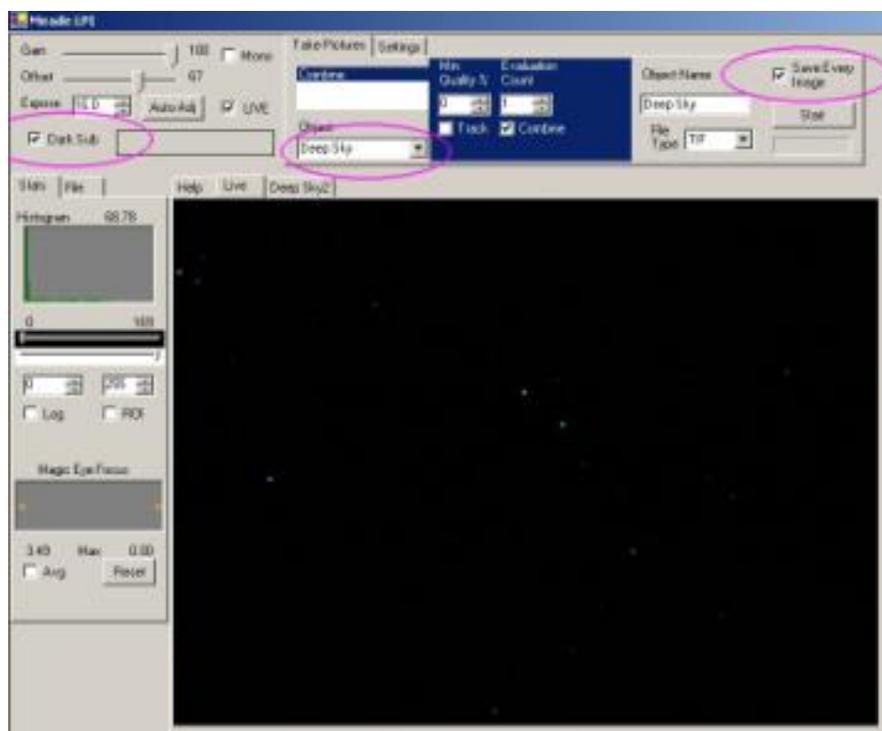
Taking a long exposure with the LPI or any electronic camera, CCD or CMOS, is going to create electronic noise in the image. The way this is usually managed is to take a picture of just the electronic noise. Dark frames are images of the same length at the same camera temperature as your image, but with the camera covered. These dark frames are then subtracted from the image frames. In an un-cooled camera like the LPI you are depending on the camera temperature staying pretty constant as you image.

To take a set of dark frames (normally multiple are taken and averaged together), select "Take Darks" in Autostar Suite. It reminds you to cover the camera then starts taking dark frames.

After 10 frames it automatically stops and stores the resulting dark frame.



To acquire DSO images set the Object type to "Deep Sky" and click on "Dark Sub". It's also a good idea to "Save Every Image":



Here is a single 16 second, unprocessed image of M44 (Beehive cluster):



16 seconds, while long for a webcam, is short for astrophotography. Since the “Save Every Image” option was selected, I had 10 images to work with. I added them in Registrar (NOT Registax) to create an effective 160 second exposure:



Since the exposures are short, guiding is not required so long as your mount is fairly smooth and your polar alignment is good. Registrar will align the pictures so that they can be summed (this mode of image acquisition is often called track-and-accumulate).

Despite the dark frame subtraction that was automatically carried out by Autostar Suite, summing the images makes the residual noise visible. In Photoshop I applied a “Dust and Scratches” filter with a radius of 2 pixels then slightly stretched the histogram to bring up the

stars some more:



It's not Hubble, but for the price it's an extremely inexpensive way to get in and dabble with deep sky imaging. By the way, the color balance is off, there are no green stars...

Comparing Costs

Meade Solution

Meade LPI & Autostar Suite \$149.00

QCFocus \$0.00

Registax \$0.00

\$149.00

TouCam Solution

TouCam Pro II + adapter \$160.00
combo

Baader UV/IR filter \$50.00

QCFocus \$0.00

Registax \$0.00

\$210.00

Advantage: LPI

Summary

	Meade LPI/Autostar Suite	TouCam Pro/QCFocus/Registax
What's in the box?	Advantage	
Comparing camera bodies	Advantage	
Terrestrial image quality	Tie	
Ease of Focus	Tie	
Planetary imaging – poor seeing		Advantage
Planetary imaging – good seeing		Advantage
DSO imaging	Advantage	
Comparing costs	Advantage	

LPI Pros:

- Very complete package, comes with everything needed to start imaging
- Very simple to get a planetary image – just a couple of key clicks to capture an image
- Capable of imaging brighter DSOs (with additional stacking software)

LPI Cons:

- Low sensitivity and low image capture rate limits the quality of planetary images
- Image processing software not as powerful as available freeware
- DSO imaging capability limited – should be approached with realistic expectations

TouCam Pro Pros:

- Currently most sensitive webcam available
- High sensitivity and high image capture rate enables “freezing” seeing for best planetary images
- An inexpensive and the best way to do planetary astrophotography

TouCam Pro Cons:

- Not specifically designed for astrophotography – must procure additional items
- Not capable of DSO imaging (although user modification is possible)
- Slightly more expensive than LPI

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