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Webcam Imaging

Amazing Lunar and Planetary Images
from Small Telescopes



June 2, 2012



Sky and Telescope - June 2003

The image shows a double-page spread from the June 2003 issue of *Sky & Telescope*. The left page features a large, bold title "Shooting the Planets with Webcams". Below the title is a short lead paragraph followed by the author's names, Michael Davis and David Staub. The main article begins with a large, bold letter "M" and discusses Mars, Jupiter, and Saturn. The right page contains three images of the planets: Mars, Jupiter, and Saturn. Mars is shown as a reddish-orange sphere, Jupiter as a large, light-colored sphere with prominent horizontal bands and a bright spot (Io), and Saturn as a yellow sphere with its iconic ring system.

astro imaging

Shooting the Planets with Webcams

for less than the price of a good eyepiece and a few hours' work at the computer, astro imagers can capture stunning views of Mars and the other planets. | By Michael Davis and David Staub

MARS HAS ALWAYS INTRIGUED backyard observers and astro imagers alike, offering them a wealth of surface details during favorable oppositions. This summer the red planet will make its closest approach to Earth in tens of thousands of years. On the night of August 27th it will reach its greatest apparent size of a little more than 25° (see page 39). This is a golden opportunity for close-up views of Mars's dusky markings, its brilliant white south polar cap, atmospheric clouds and hazes, and, perhaps, its globe-girding dust storms.

You can record this once-in-a-lifetime event much longer than just one night. In fact, now is a good time to start trying out your equipment and practicing your imaging techniques. At the beginning of late Mars gets higher each day in the eastern sky at dawn, while Jupiter is still visible in the west at nightfall.

Photographic film, CCD cameras, digital cameras, and video have been the media of choice of astro imagers for recording the planets. In recent years, however, an increasing number of imagers have begun to use inexpensive consumer webcams to obtain stunningly detailed color portraits of the Moon and planets that rival — or even surpass — those obtained with far more costly and sophisticated CCD cameras. In fact, some accomplished imagers equipped with state-of-the-art CCDs find that they actually prefer webcams for high-resolution lunar and planetary imaging.

More and more astro imagers are now using webcams to obtain high-resolution portraits of the Moon and planets. These views of Mars, Jupiter, and Saturn (shown not at the same scale) were made by Michael Davis, Damian Peach, and Eric Ng, respectively. Davis used an 11-inch Celestron Schmidt-Cassegrain telescope, a 2.5× Tele Vue Powermate, and a 3Com Home Connect webcam; Peach used an 11-inch Celestron, a 2× Barlow lens, and a Philips PCV740K Webcam Pro; and Ng used a 10-inch Newtonian reflector, a 5× Powermate, and a TtUcam Pro. South is up in all images.

Sky & Telescope | June 2003 117

The article that caught the wider attention of the amateur community.

Popular Webcams



Philips Vesta Pro



Philips ToUcam Pro



Logitech QC 4000

Comprehensive List of Webcams: <http://homepage.ntlworld.com/molyned/web-cameras.htm>.

Current Cameras



Philips SPC900NC

ImagingSource Color Camera

Advantages



- High Sensitivity of Sony ICX098BQ CCD.
 - < 1 lux.
- Pixel and Chip Size.
 - 1/4 inch chip (659 x 494 pixel).
 - 5.6x5.6 micron pixels.
- Lots of Frames.
 - High signal to noise ratio.
- Expensive Mounts Unnecessary.

Advantages

Side by side comparison of film and webcam technologies.

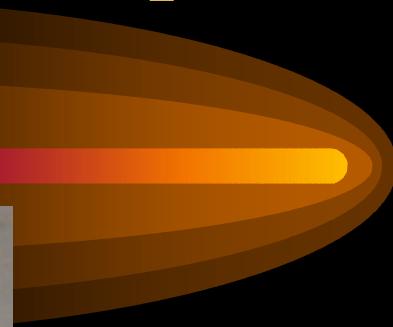


800 ASA Film - 1/4 sec



ToUcam Pro webcam - 1/25 sec
350 frame stack

The Mogg Adapter



<http://www.webcaddy.com.au/astro/adapter.htm>

Near IR Blocking Filter



Near infrared sensitivity of the CCDs in webcams reduces image contrast and affects color balance. Factory lenses have IR filters, but removing the lens requires finding a suitable replacement.

Webcam, Mogg Adapter, and IR Filter



Barlow Lenses

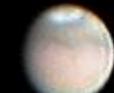


Telescope

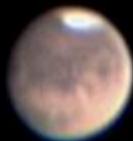


Early Mars Images

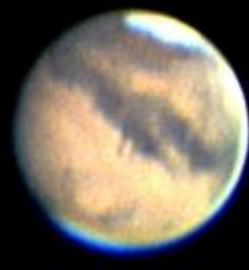
* 3X and 5X barlows



July 13, 2003



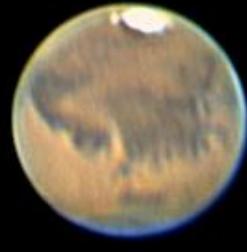
July 26, 2003



Aug. 12, 2003



Aug. 24, 2003

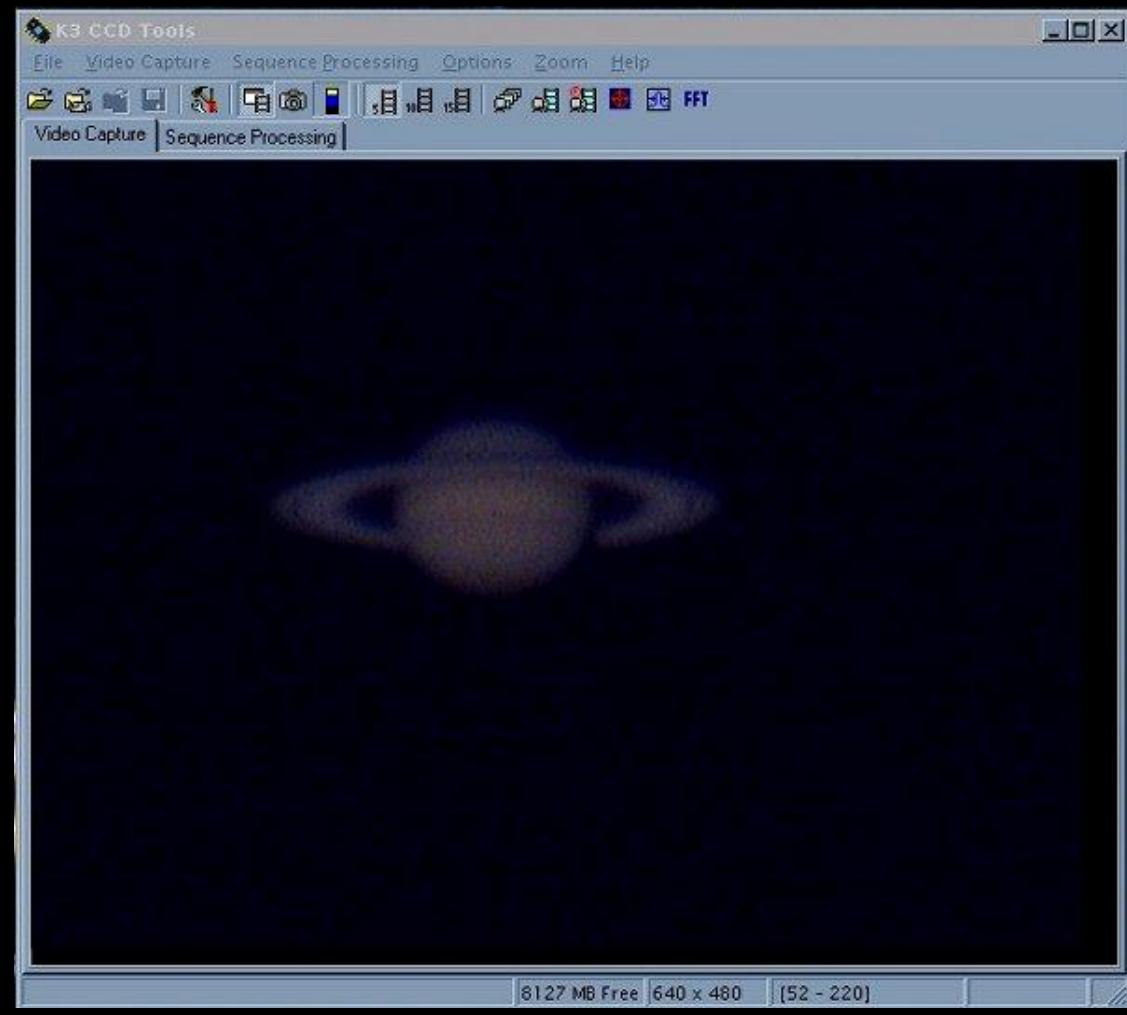


Sept. 3, 2003



Sept. 7, 2003

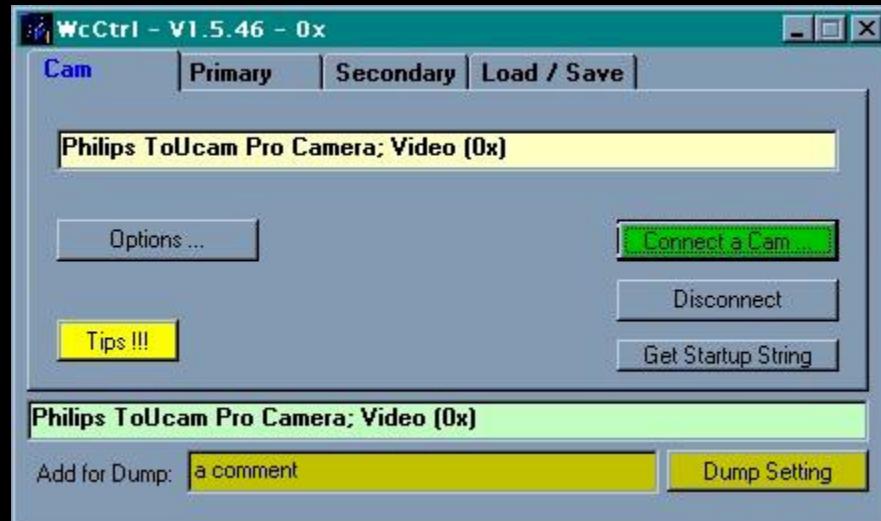
Video Capture



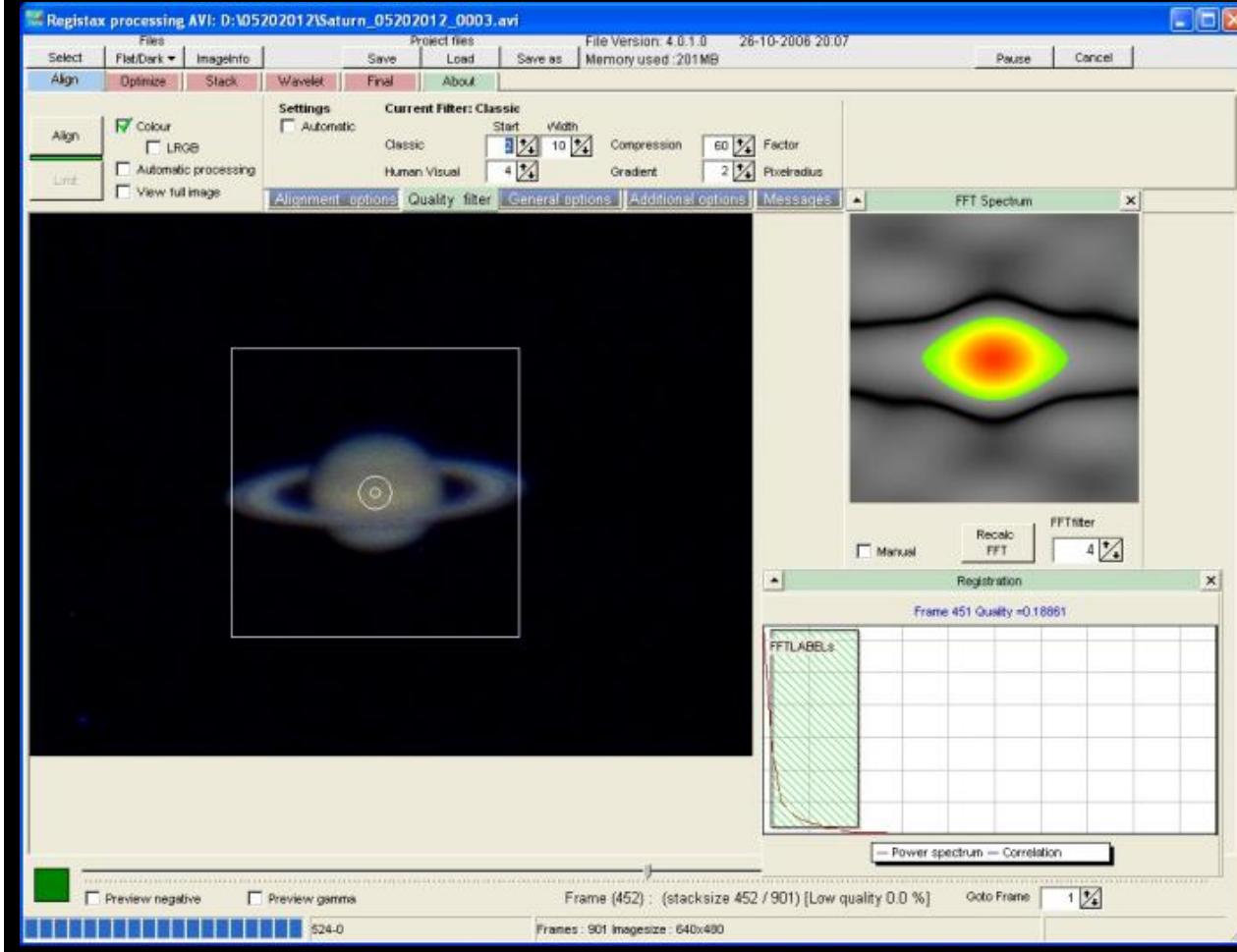
- K3CCDTools.
[\(http://www.pk3.org/Astro/\)](http://www.pk3.org/Astro/)
- Record at 5 fps.
- Turn compression off.
- Set the level meter around 80 to 85%.
- Turn all other applications off - especially antivirus.

Video Capture

- Record Camera Settings.
 - WcCtrl captures camera settings to the clipboard.
(<http://www.burri-web.org/bm98/soft/wcctrl/>)
 - Save settings in NotePad.

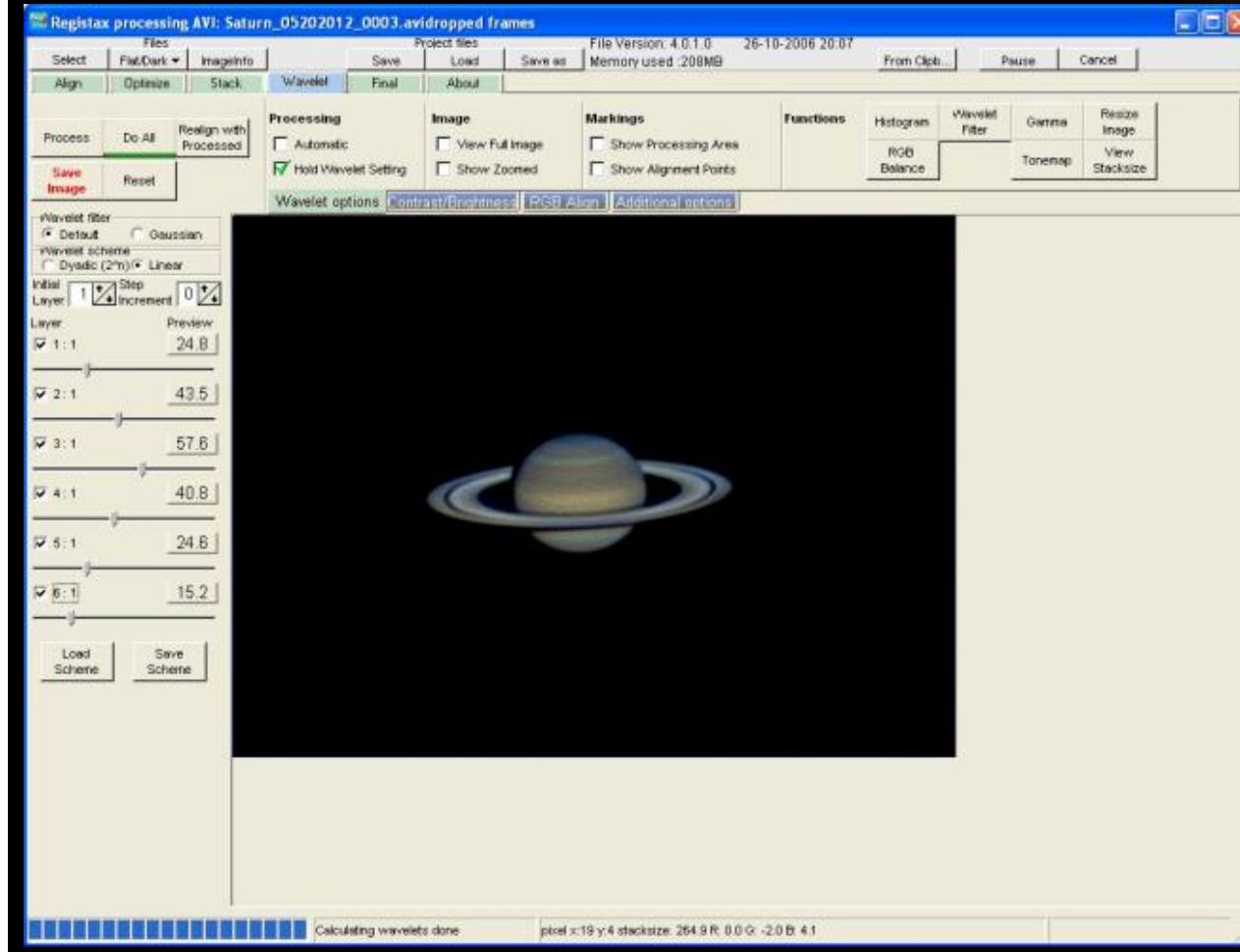


Registax

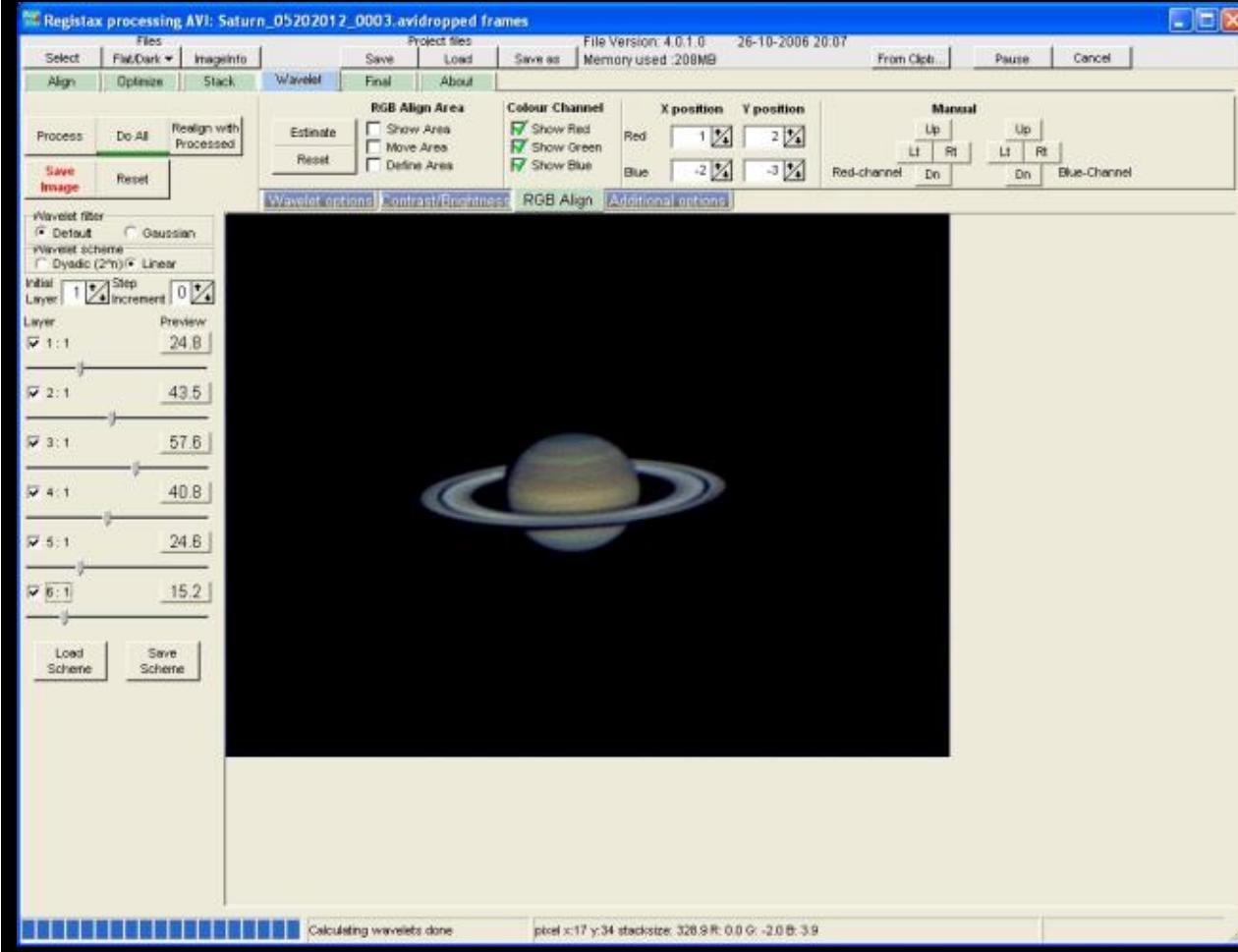


- Freeware written by Cor Berrevoets.
- Sorts frames by quality and performs alignment, stacking of individual frames.
- Applies wavelets to the final image as well as basic image enhancements.

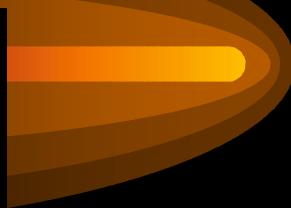
Registax - Wavelets



Registax - RGB Shift

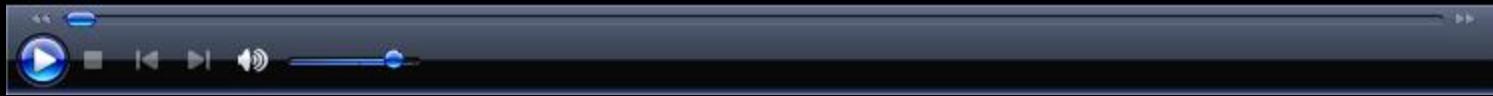


Registax - Demo

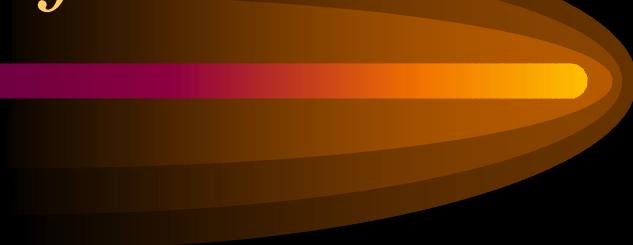


Registax Demo

Ready

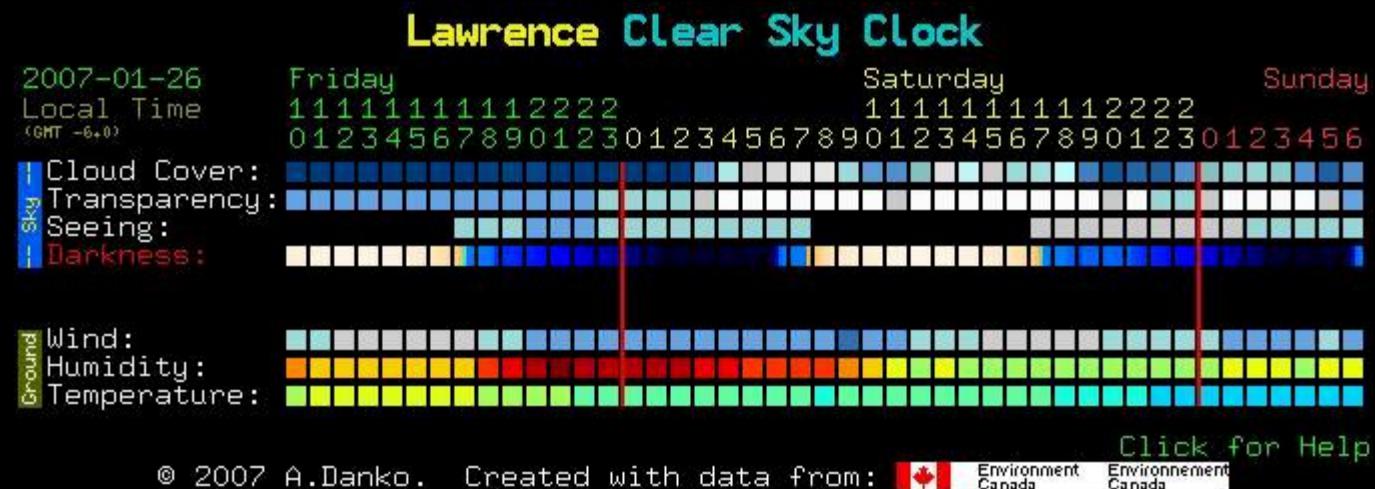


Techniques for Success



- Good Seeing.
 - Clear Sky Clock.
 - Best seeing is often just before dawn.
- Good Collimation.
 - ***Collimate often!***
- Focus, Focus, Focus!
- Thermal Equilibrium.
- Choose Appropriate Video Capture Lengths.
 - Jupiter (~2 min), Mars (~4 min).
- Synchronize PC Clock with Atomic Clock.

Clear Sky Clock



<http://www.cleardarksky.com/csk/>

Collimation

- Collimate on a Star.
- Laser Collimator.
- Artificial Stars - shame to waste good seeing on collimating.
 - Sunlight reflecting off from a
 - Mechanical Pin Holes.
 - Fiber Optic “Pin Holes”.

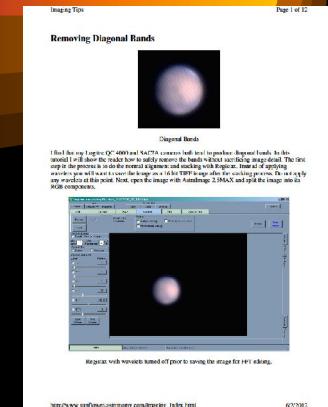


Focus Aids

- Hartmann Mask.
- High Contrast Planetary Features.
 - Cassini Division.
 - Jupiter's moons or their shadows (transits).
- Focus Software.
 - AstroSnap (<http://www.astrosnap.com>).
- Electric Focusers (must have).
 - JMI Telescopes (<http://www.jimsmobile.com/>).

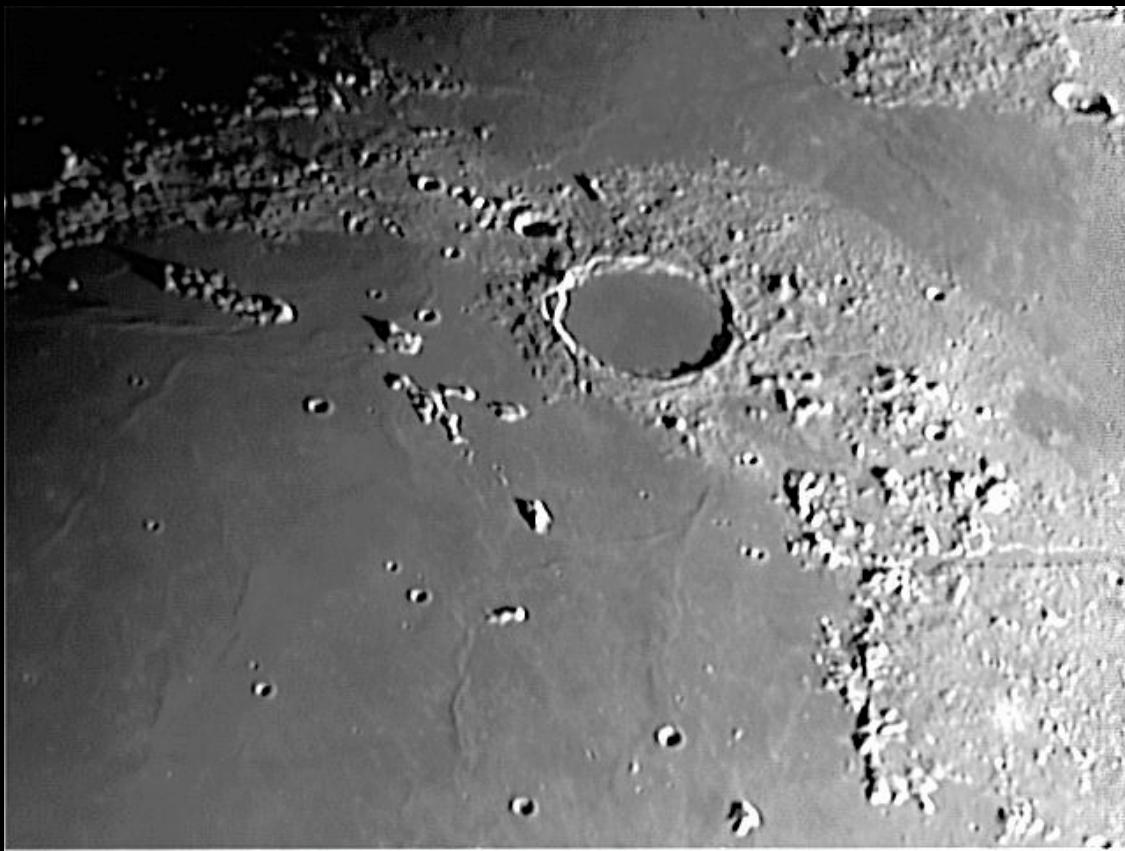
Final Processing Techniques

- ImageJ (<http://rsbweb.nih.gov/ij/>).
 - FFT Editor.
 - Removal of pattern noise.
- Astra Image (<http://www.phasespace.com.au/>)
 - Deconvolution.
 - Maximum Entropy - best for planets.
 - Lucy-Richardson.
 - Van-Cittert.
- Neat Image (<http://www.neatimage.com/>).
 - Digital Noise Filtering.
- Photoshop, Paint Shop Pro or The Gimp.
 - Histogram and Color Balance.
 - Unsharp Mask.

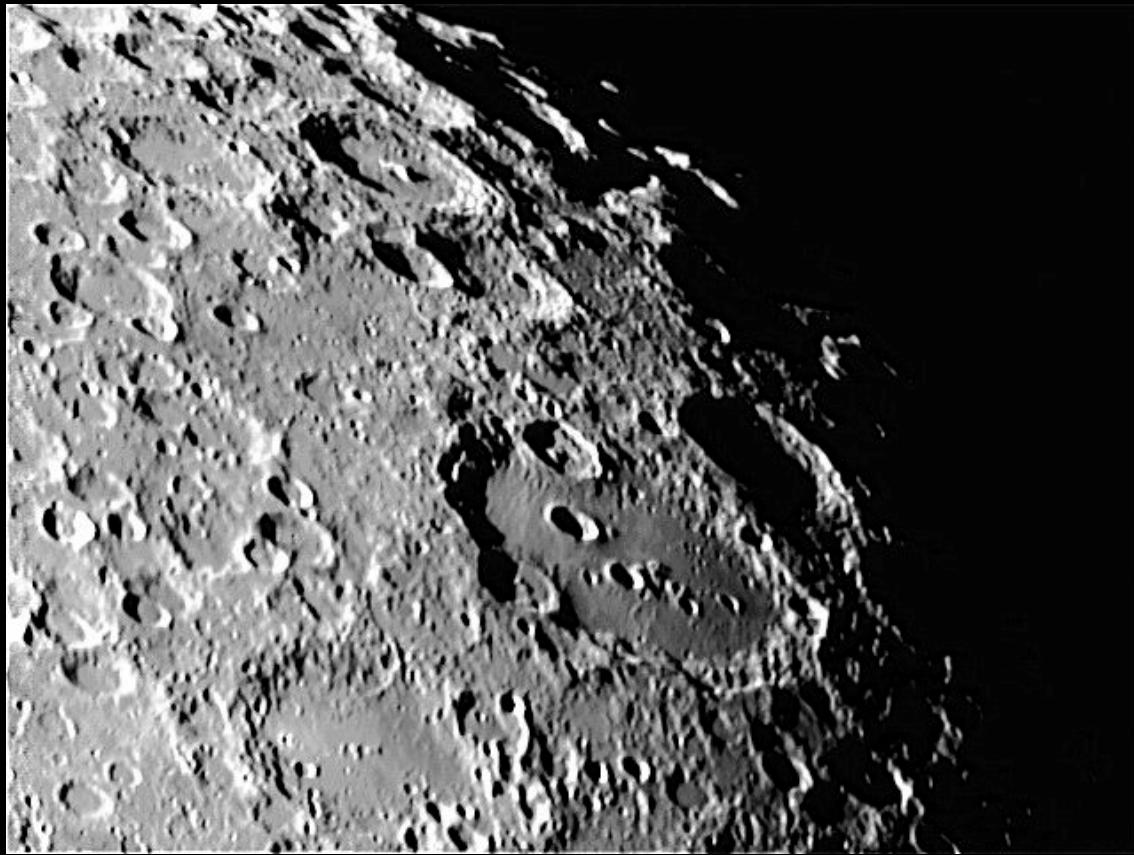


Step-by-step
Example

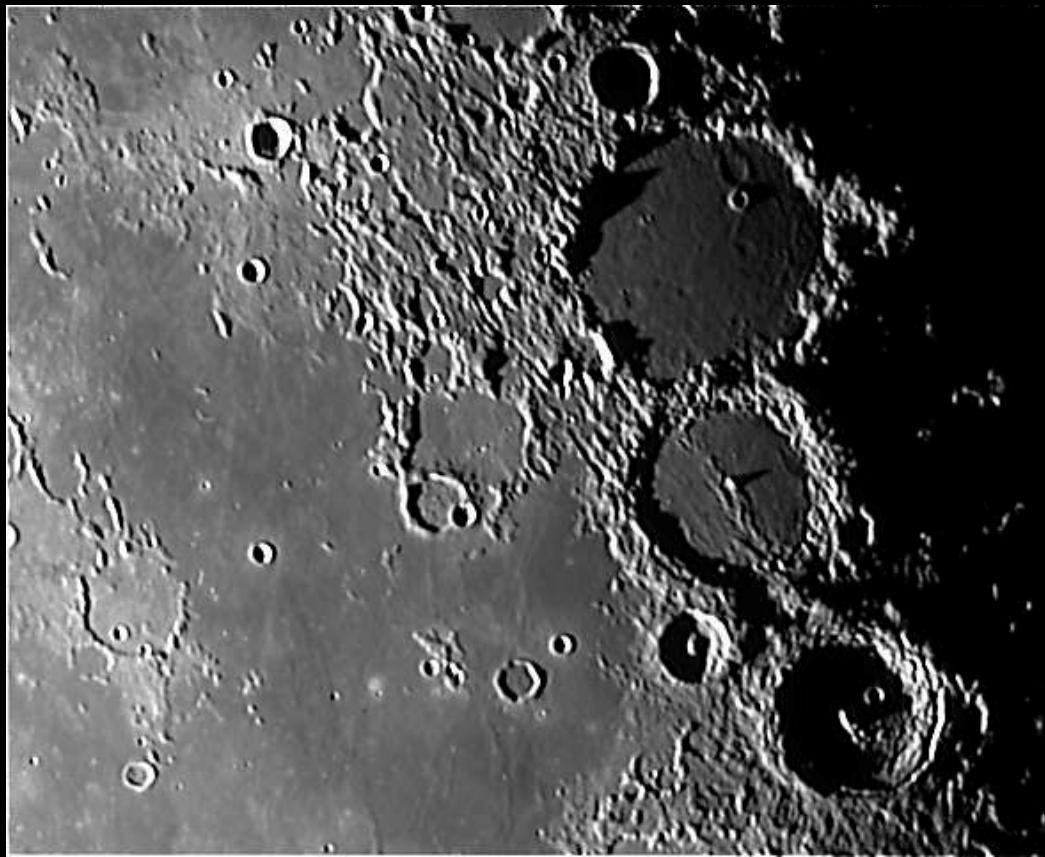
Lunar Images



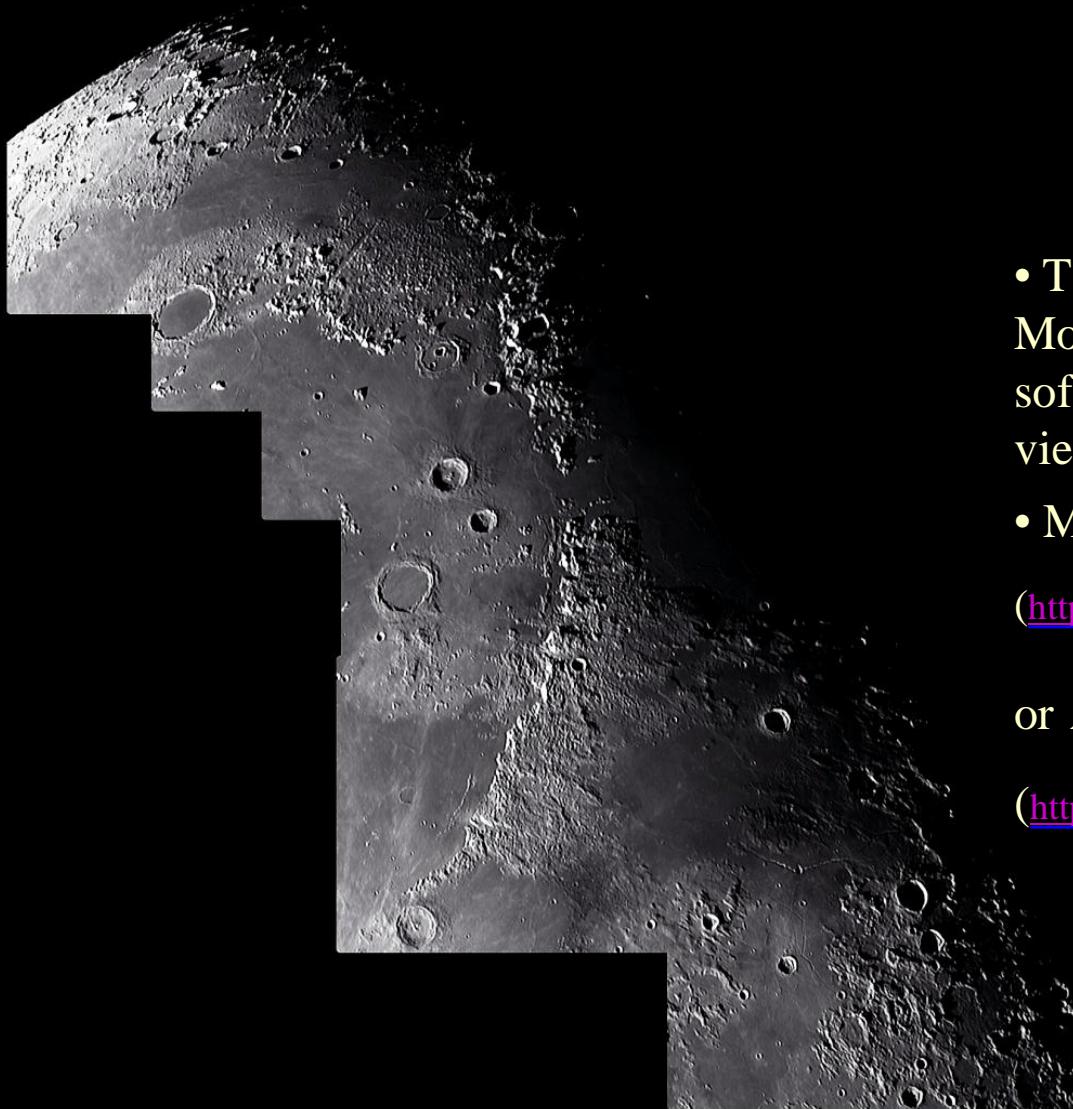
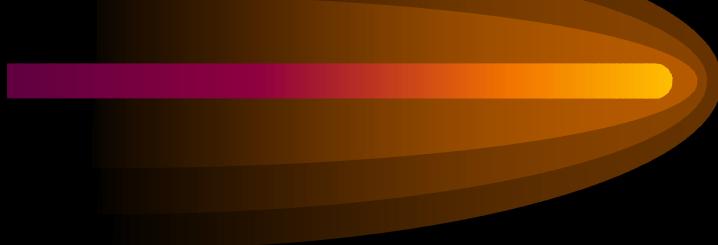
Lunar Images



Lunar Images



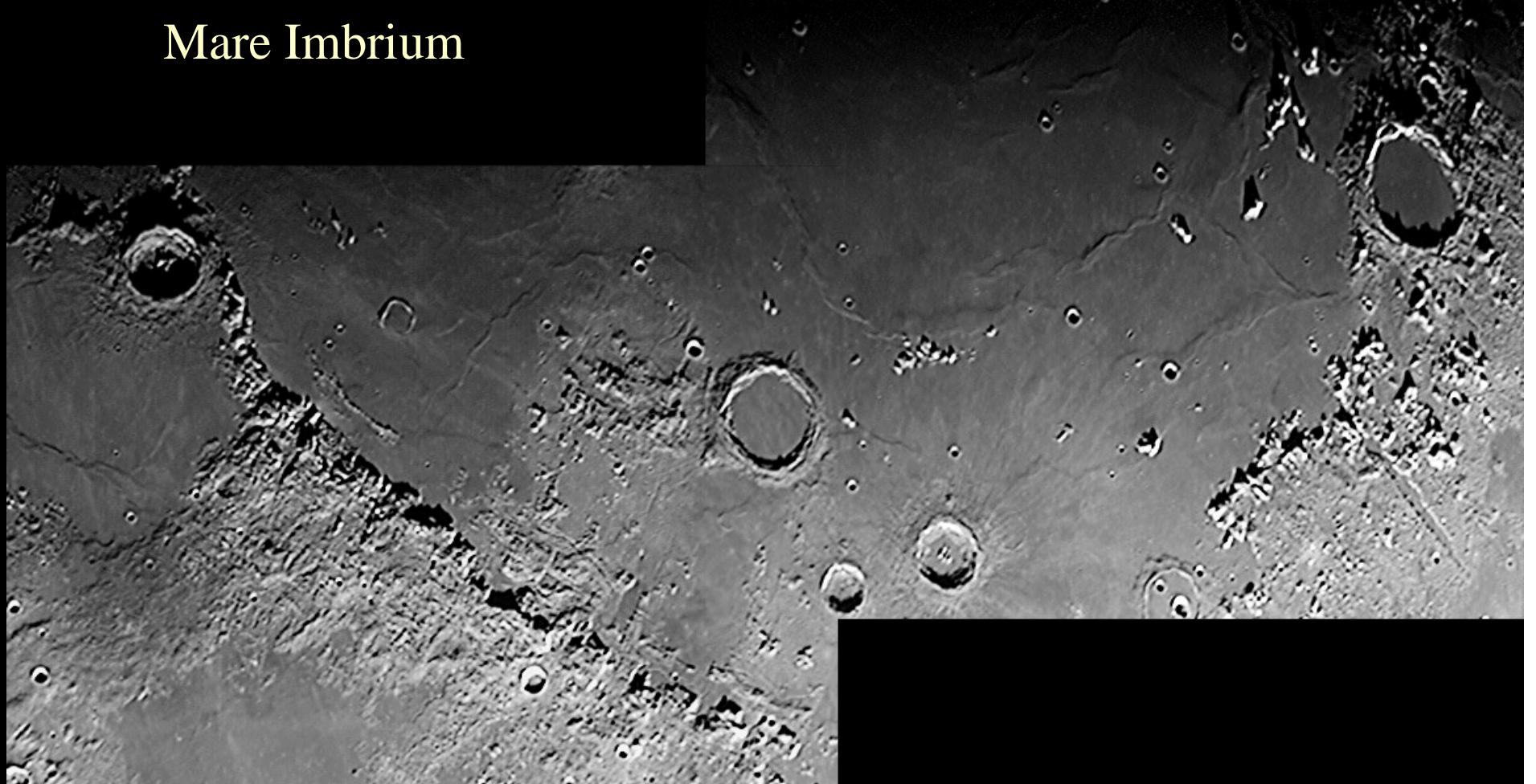
Lunar Mosaics



- To build a high resolution image of the Moon with a webcam requires the use of software that can assemble the small fields of view that are delivered by a webcam.
 - Mosaics can be assembled using iMerge (<http://jaggedplanet.com>) or AutoStitch (<http://www.autostitch.net>).

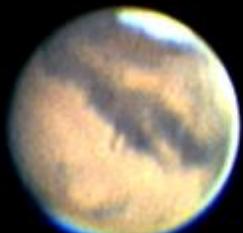
Lunar Mosaics

Mare Imbrium

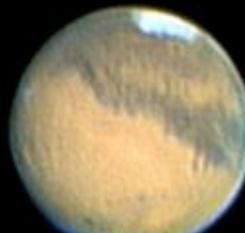


Mars Images

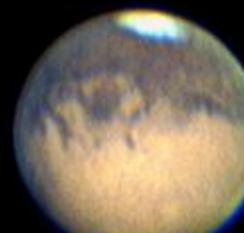
Mars Opposition 2003



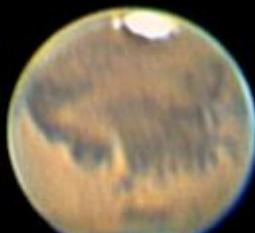
8/12/2003
7:29 UT



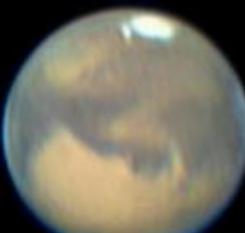
8/17/2003
8:04 UT



8/24/2003
7:08 UT



9/03/2003
6:57 UT



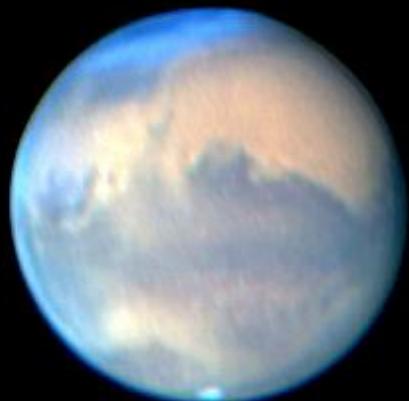
9/05/2003
5:59 UT



9/07/2003
6:12 UT

Mars Images

Changes in the Martian Dust Storms of Oct. 2005



Oct. 26, 2005
7:14 UT
CM 359.8 °



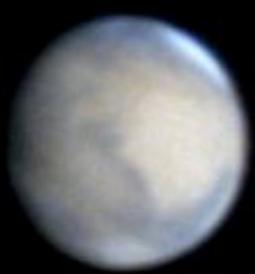
Oct. 28, 2005
7:53 UT
CM 341.9 °

Mars Images



Dec. 19, 2007

15.9"



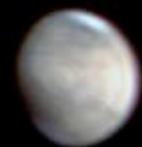
Jan. 27, 2008

12.6"



Mar. 1, 2008

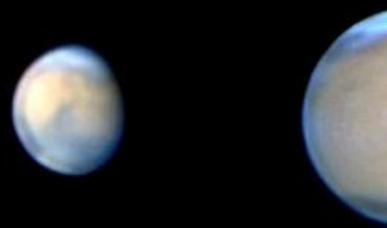
9.0"



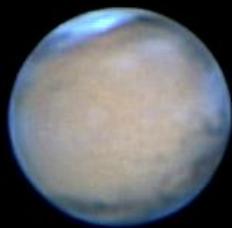
Apr. 5, 2008

6.7"

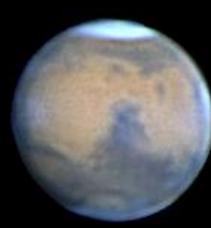
Mars Images



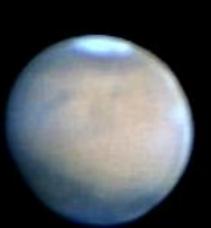
11/5/2009
8.15"



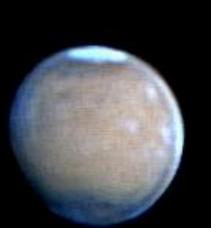
1/31/2010
14.07"



2/17/2010
13.10"



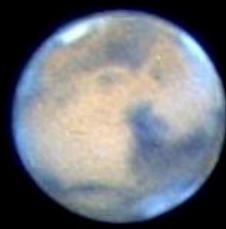
2/28/2010
12.18"



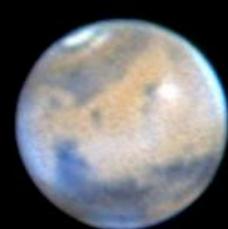
3/4/2010
11.69"



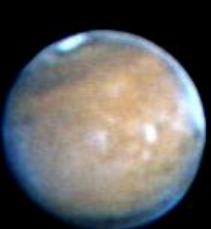
5/30/2012
6.06"



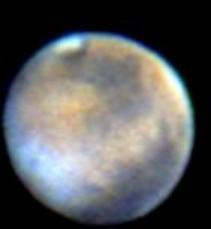
3/10/2012
13.84"



3/13/2012
13.76"



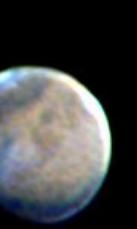
3/25/2012
13.10"



4/1/2012
12.54"



4/6/2012
12.11"



4/22/2012
10.67"

Jupiter Images



Io and shadow in
transit - Jan. 10, 2004



Io and shadow in transit with Ganymede
emerging from occultation - Jun. 19, 2005



Ganymede's shadow in
transit - Jul. 29, 2006



Europa and shadow in
transit - Aug. 26, 2008

Jupiter Images - with impact scar



Jul. 18, 2009



Jul. 26, 2009



Aug. 2, 2009



Aug. 12, 2009

Jupiter Images



Aug. 1, 2010



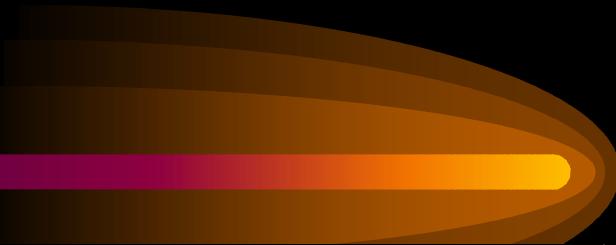
Aug. 22, 2010



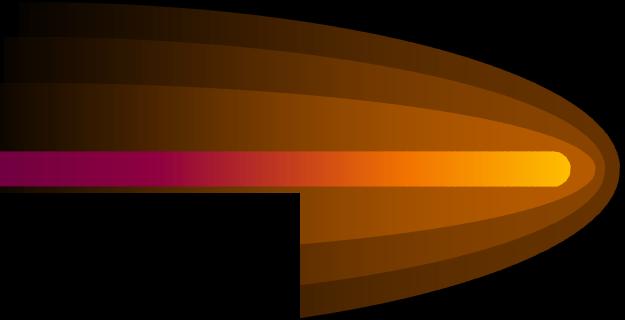
Oct. 4, 2010



Nov. 14, 2010



Jupiter Images



Oct. 25, 2010

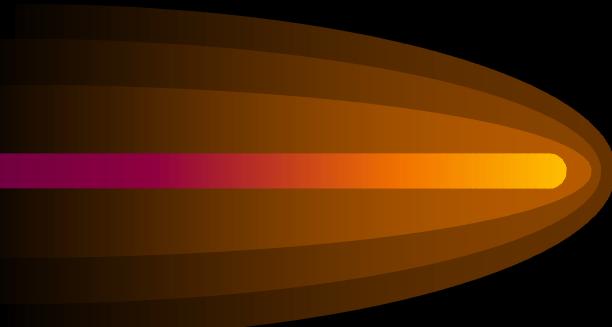
Jupiter Images



Sept 28, 2011



Sept 29, 2011



Jupiter Animations



[Play 6/19/2005 Video](#)

[Play 8/02/2009 Video](#)



Saturn Images



3X Barlow



Jan. 25, 2005



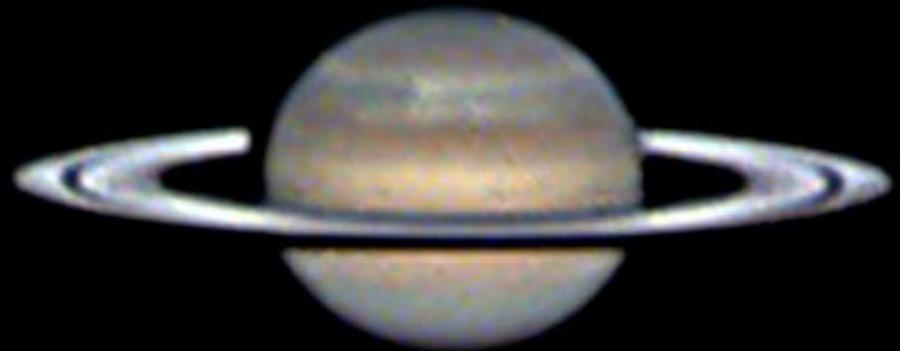
Dec. 24, 2006

Saturn Images



5X Barlow

Saturn Images



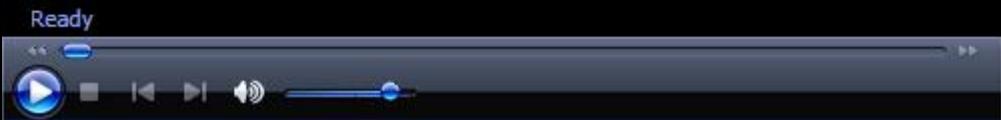
May 8, 2011



May 20, 2012

Saturn Animation

[Saturn Video](#)

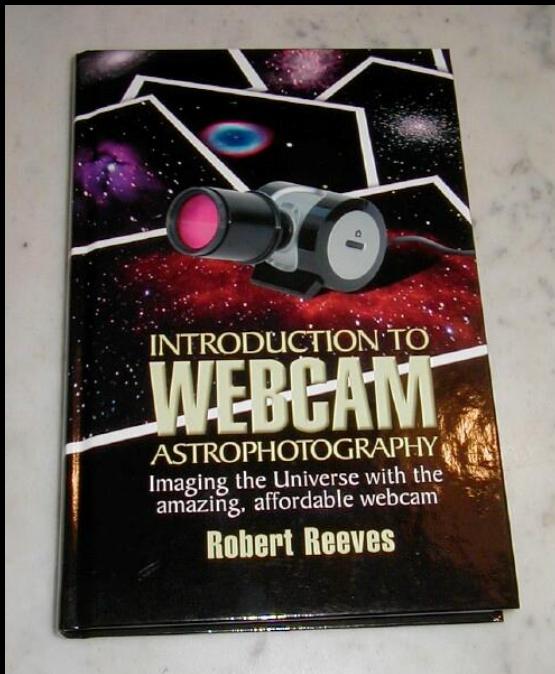


Resources



Quick**C**am and **U**nconventional **I**maging
Astronomy **G**roup

<http://www.qcuiag.co.uk/>



“Introduction to Webcam
Astrophotography” by Robert Reeves

Published by Willmann-Bell, Inc.

<http://www.willbell.com>

Resources

“How to Process Planetary Images”

by Don C. Parker,

Sky & Telescope, Jan. 2007, p. 129

The screenshot shows the beginning of an article titled "How to Process Planetary Images". It includes several small images of planets (Jupiter, Saturn, Mars) and a screenshot of the RegiStax software interface.

How to Process Planetary Images
A premier planetary photographer shares his secrets for capturing the finest details on our neighbor worlds. By Donald C. Parker

OVER THE PAST FIVE YEARS, a tremendous resurgence in amateur planetary astronomy has taken place. This is due in large part to the wide, inexpensive webcams, which has opened up a new area of amateur planetary imaging. The amateur images of the planets that most often capture with large professional instruments (S&T, October 2005, page 101). These images are often taken with long exposure times, perhaps one-tenth of the durations required with astronomical cameras. One of the key differences between the two is that the amateur “beat the sensor”—capture sharp images during fleeting moments of atmospheric transparency.

It typically takes hours to process a single planetary frame, or many when compared to those from cooled astronomical CCD cameras. But because signal increases, noise decreases, and the noise-to-signal ratio is small, as the square root of exposure, you can stack lots of frames to produce an image with a much higher signal-to-noise ratio.

It typically takes hundreds or thousands of software images stacked together to achieve an acceptable result. That’s where the time savings come in. Instead of stacking images one by one, you need to load the binary files, sorting and stacking thousands of images manually would take days. Instead, you can use a computer program to do the work for you. That’s what this column is all about. These programs are called “stacking” or “processing” programs, and they’re designed to reduce the time it takes to process images from a few hours down to near zero.

Selecting and Stacking
RegiStax (<http://registax.astromatic.net>), available as a free download from the Internet, is one of the most powerful and easiest-to-use stacking programs for capturing, processing, and sharpening planetary images. Sean Walker describes its key functions in his review of version 3 (in the December 2005 issue of S&T). The program can stack individual images by using the program’s default settings, but even better results will be had by using manual control.

RegiStax is a great program, but it is not the only one. I first selected RegiStax because it is a great reference for average quality, as this tends to produce the best alignment compared to using an exception tool. I find it very

Capturing the planets has become relatively easy. Thanks to modern cameras, capturing the most detail from the raw images produced by the telescope takes just a few minutes. The latest versions of RegiStax are available today for year digital cameras. Author Don C. Parker reviews the latest version of RegiStax, which adds support for Canon EOS 20D and 30D cameras, and Mars using webcams, a 13-inch Newtonian telescope, and a 10-inch refractor to describe here. All images are courtesy the author.

Sky & Telescope January 2007 129

The screenshot shows the beginning of an article titled "Planetary Processing with RegiStax 3". It includes a screenshot of the RegiStax software interface showing processed planetary images.

Planetary Processing with RegiStax 3
The latest release of this popular image-processing program incorporates new tools to enhance your solar-system photography. By Sean Walker

LEIAK AND PLANETARY astrophotography has undergone a resurgence in recent years. And much of it is driven by the change from film to digital cameras and by the general software tools available to amateur astronomers, whether or not the images are mounted. In years past, photographs of solar-system objects had to be taken with a telescope and camera, then sliced and spliced out of dozens, sometimes hundreds, of images, then stacking and averaging them. Using a cutting-edge would use complex deblurring procedures to combine one or more good pictures into an even better final image. Processing images this way is a slow and difficult task. But now there are programs that streamline this tedious task more than ever before, and it’s a whole lot easier.

RegiStax (<http://astromatic.net/registax/>) takes the annoyance out of processing planetary images. It automatically stacks images, aligns them, and averages the images in input batches or even thousands of images, then stacking and averaging the sharpest individual frames to create a final planetary processed image in a single step. The image improves the quality of a single picture.

Putting RegiStax to Work
The latest release of RegiStax 3 changes the whole

look and feel of previous versions (S&T, April 2004, page 130)—every step now has interactive menus, and there are some new additions.

One of the most useful additions is the ability to choose the files you wish to sort and stack. RegiStax supports AVI movie files (including Lazarus camera movies) or groups of BMP, JPEG, TIFF, and EPS files. When RegiStax imports any of these formats, the images need to be saved under the BMP or JPEG color or TIFF and EPS grayscale formats. RegiStax can also import 16-bit grayscale images. A new feature of the latest version of RegiStax is its ability to register multiple images taken with different cameras if the edges were recorded close together in time to avoid changes in planetary features between the images—but both Mars and Jupiter must be roughly aligned in the same orientation after a few steps.

The next step is to select a single image for RegiStax to use as a reference, and to identify an alignment marker. The registration window in RegiStax allows a 512 by 512-pixel alignment box, which is particularly useful on large areas of detail, such as mountains or craters on planets recorded with multi-megapixel cameras.

Another change I found useful is that many of the program’s menus are context sensitive. The “dataset” menu is only visible in the PPF alignment window, which calculates the estimated shift for

the reader of planetary imaging. RegiStax is one of the most popular programs for writing, stacking, and sharpening large groups of images. Version 3 is a major improvement over previous versions, including multiple AVI imports, RGB24, and image rotation. Last September, 14th-year Sean Walker reviewed RegiStax (<http://astromatic.net/registax/>). He found the latest version to be the best 13 megapixel planetary processor (176 x 176 pixels). Multi-image processing is included. Plus, RegiStax 3 has some tools included in RegiStax 3 to process

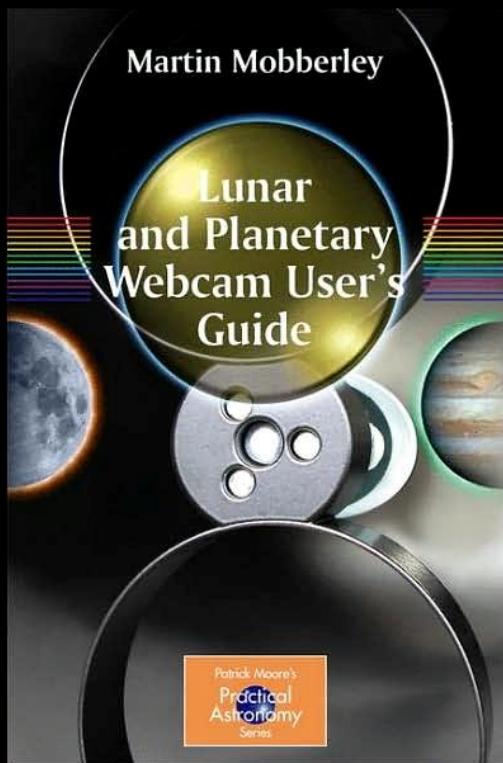
Sky & Telescope December 2005 94

“Planetary Processing with Registax 3”

by Sean Walker,

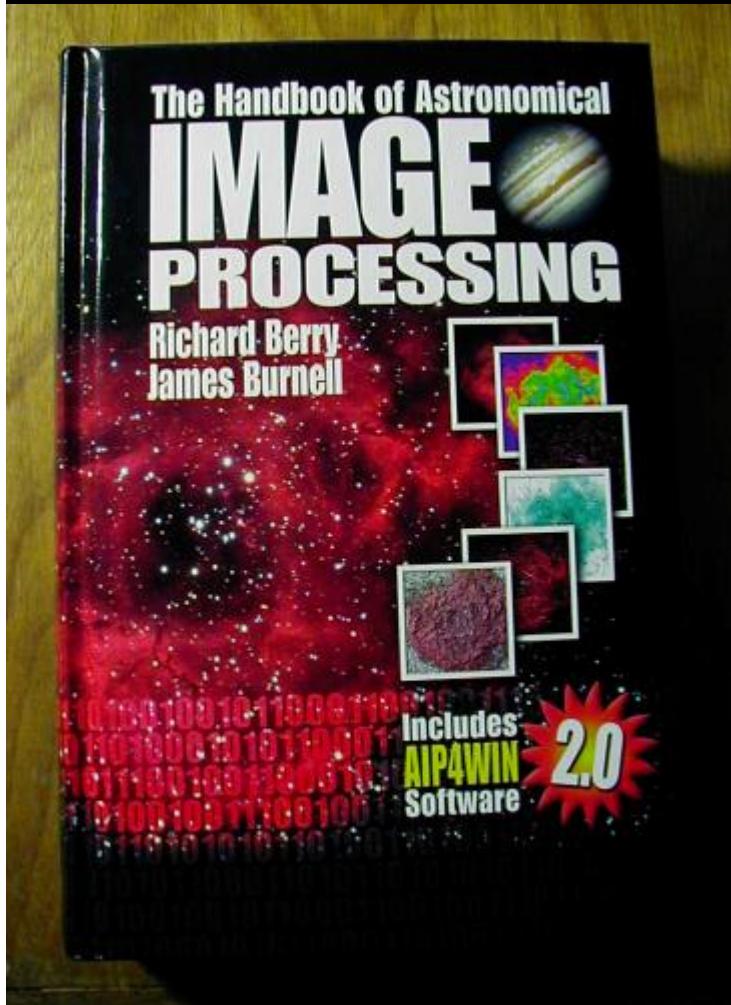
Sky & Telescope, Dec. 2005, p. 94

Resources



“Lunar and Planetary Webcam User’s Guide”
by Martin Mobberley, Springer, 2006

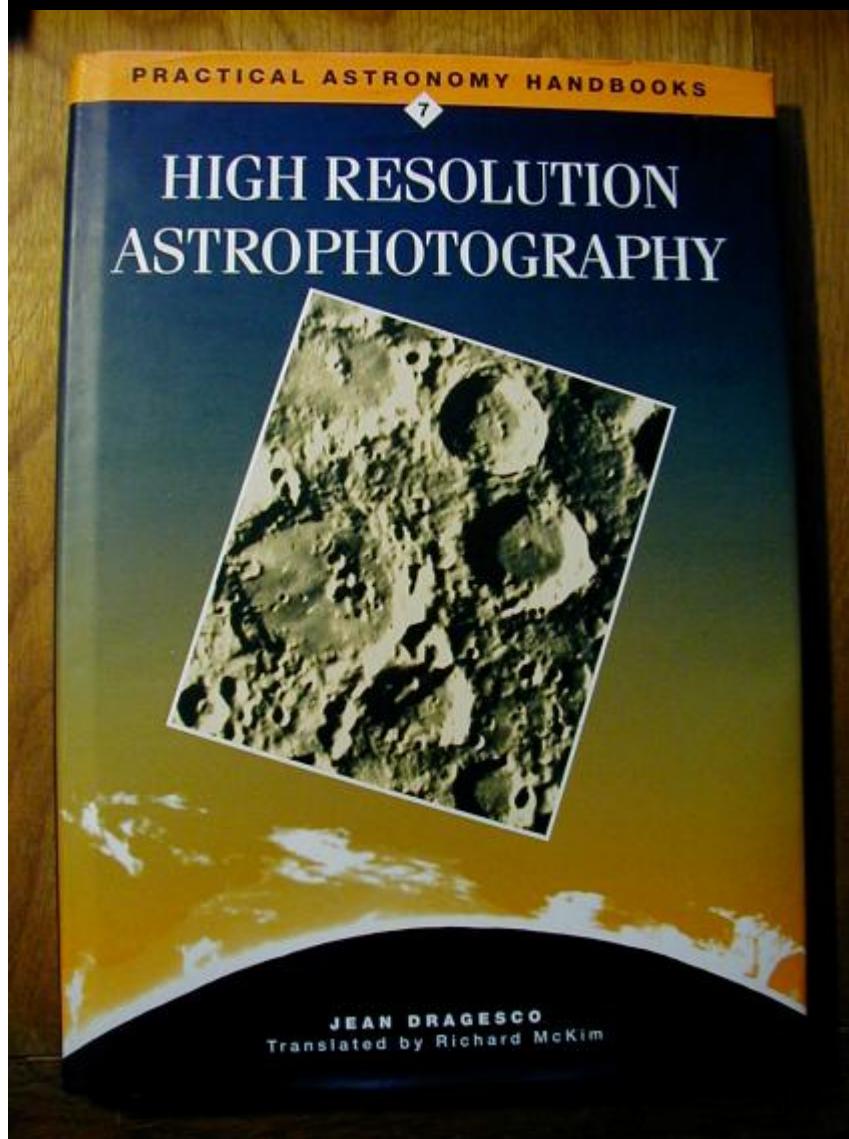
Resources



“The Handbook of Astronomical
Image Processing”

by Richard Berry and James Burnell,
Willmann-Bell, 2nd ed., 2005

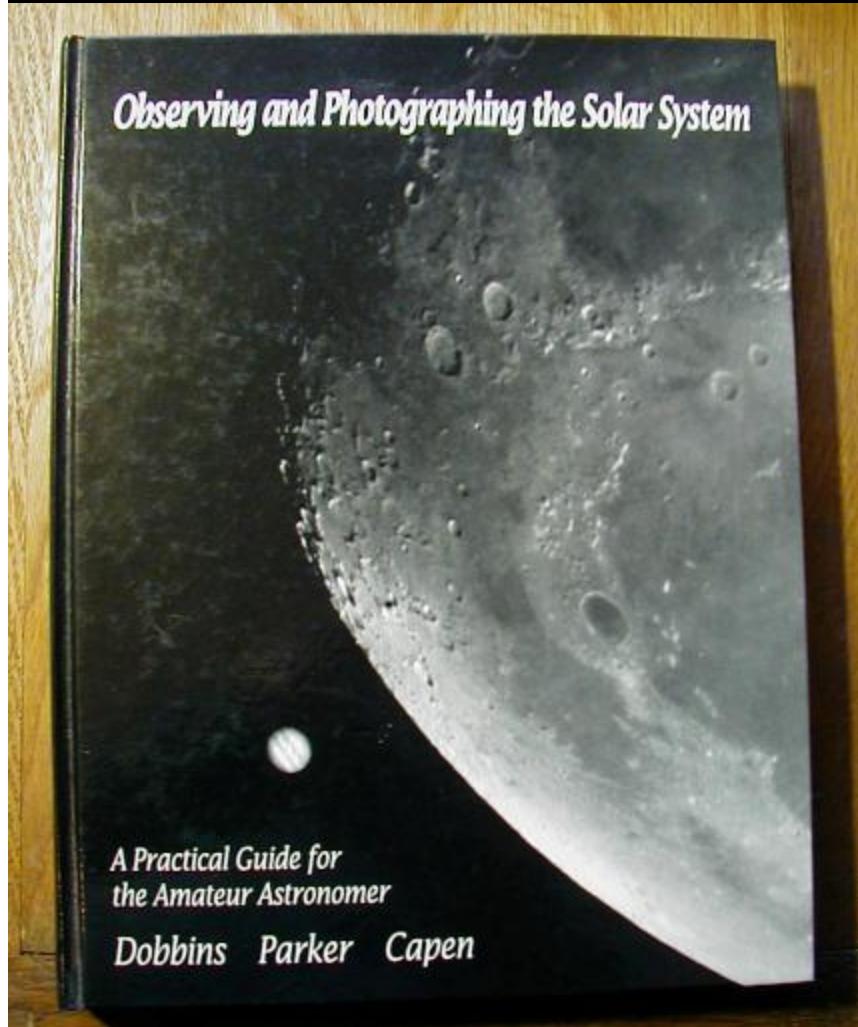
Resources



“High Resolution Astrophotography”
by Jean Dragesco, Cambridge
University Press, 1995

Covers film techniques and early CCD techniques.

Resources



“Observing and Photographing the
Solar System”
by Thomas Dobbins, Don Parker, and
Charles Reinhart, Willmann-Bell, 1992

Covers film techniques.