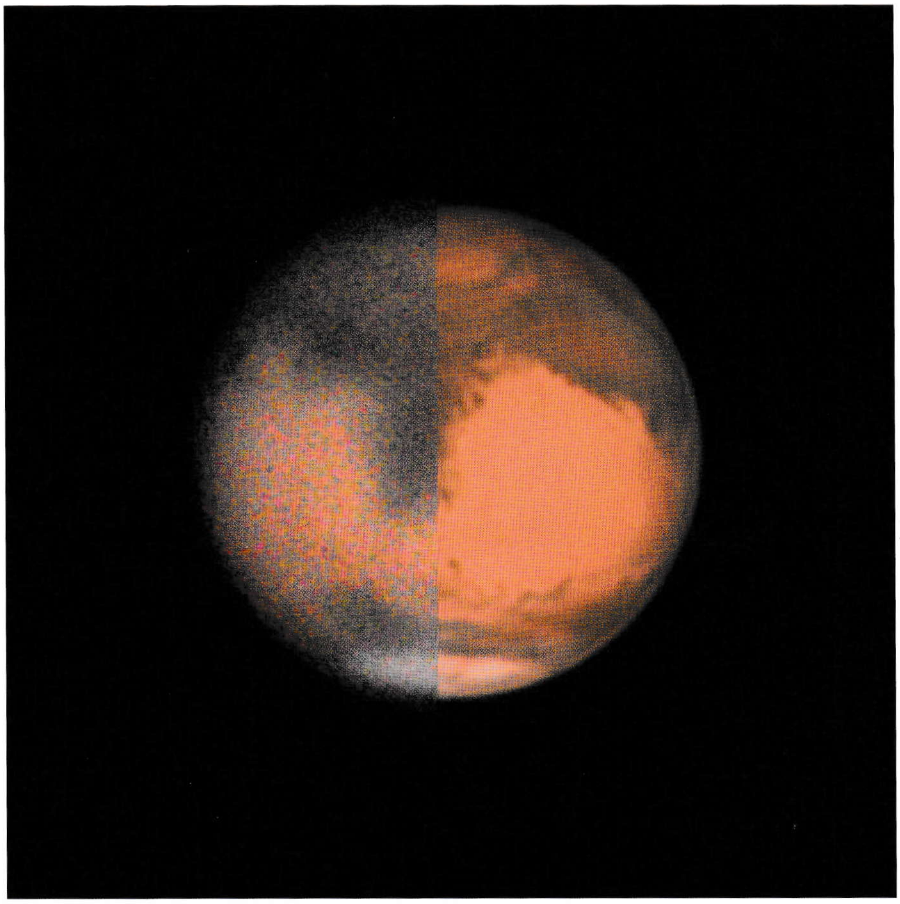


◀ The left half of this image of Mars is a single frame from a video stream recorded by Martin on 15 January 2025 with his 444 mm Dobsonian reflector. The right half shows the result of combining hundreds of such images and using wavelet processing as described in this article.
All photos credit: Martin Lewis.

Martin Lewis gives a step-by-step guide to those daunting screens you encounter when using planetary image processing software.

Planetary image processing made easy

This article is for those new to planetary imaging who have captured a video of a planet and want to know how to process it to draw out the detail.

Good planetary images have high levels of fine detail. The big challenge in planetary imaging comes from the fact that this fine detail is generally very small – in good conditions you may be operating close to the resolving power of the telescope. In these circumstances many things can have an impact on the level detail you are actually able to image.

Before talking about the nitty-gritty of planetary processing, I'll start by saying a little about the things that have an influence on the quality of the data captured, as this will have a strong bearing on the level of details seen in the final fully processed image.

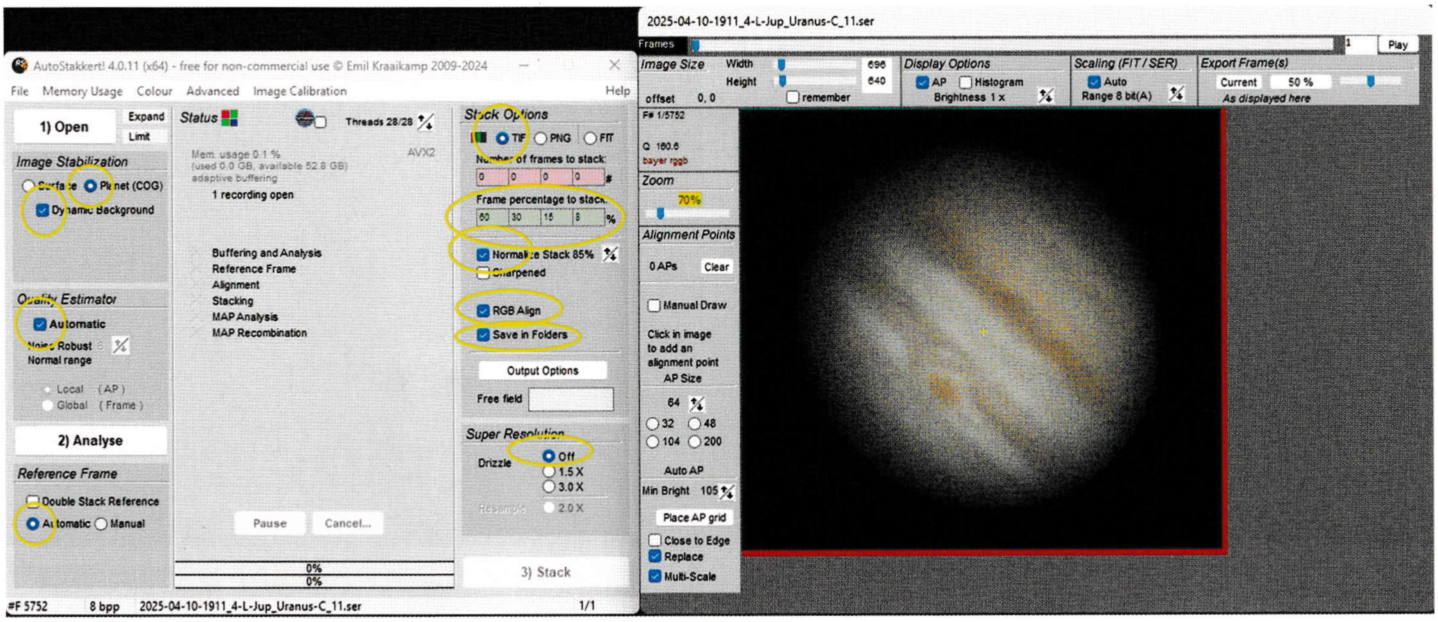
The biggest influences on the level of detail seen in planetary images are:

- The steadiness of the atmosphere – known as 'seeing'. Image on the steady nights when the atmosphere is calm and the seeing is good.
- The aperture of the telescope – increased aperture has the potential to reveal smaller details as the limiting resolution is better.
- The quality of the optics in the scope – for good images you need good and well-aligned optics.

Other significant influences include:

- Image scale - pick a Barlow magnification which gives an effective overall f-ratio of about 5× the pixel size in microns. For example, for a 2.9 micro pixel camera you'll need a Barlow which gives you an f-ratio of f/15.
- How cooled-down the scope is – store the telescope in an unheated garage or outdoors for a few hours before use, so that its components reach close to ambient temperature.
- Frame exposure time – for most planets pick a frame exposure time of 5 msec to 15 msec to avoid atmospheric smearing (exposure too long) or data loss (exposure too short).
- Pick a gain for that frame exposure where the maximum brightness of the planet is about 75 per cent of saturation.
- Pick a reduced area of the chip just containing the planet plus a bit of breathing space around it – too large an area will waste hard drive space and can severely reduce the number of frames you capture each second.
- Pick a video length where you will not get much rotation of the planet from start to end: about 2 minutes for Jupiter, about 4 minutes for Saturn and about 8 minutes for Mars.

I recommend capturing your video in SER format as this is a more well-


▲ Figure 1. Choose the highlighted options on the Autostakkert!4.0 home screen.

defined and less troublesome format than .avi. You can then later review your video with the excellent SER player (available from free-astro.org/index.php?title=SER_Player#SER_Player).

When using a colour camera don't record a full colour video as this would be slow and three times larger filesize than needed. Instead, capture a mono video. The Autostakkert! software knows which pixels are red which are blue and which are green, and is able to produce a full-colour stacked output image during the processing routine.

Note that the software described here only runs using Windows. However, those using Macs may run the software using a Windows emulator such as Wine, or obtain a secondhand Windows machine for the purpose. It will run on any recent version of Windows, but the faster the machine, the quicker you will get results.

Processing the sequences

This where the magic begins. I split the task into two sections: first, using stacking software to select the best frames from the video and stack them so as to reduce the noise that is obvious in individual frames, and then using wavelet processing software to enhance the detail in the stacked image.

Planetary imaging processing starts by opening Autostakkert!4, the latest version of which can be downloaded at autostakkert.com/wp/download/. Run the program and click on the *Open* button before selecting the video you want to process and then clicking *Close and Process Data.*

Following figure 1, set the Control Panel values to:

- *Planet (COG) & Dynamic Background* selected
- *Automatic* in Quality Estimator ticked
- *Double Stack Reference* unticked and *Automatic* ticked in Reference Frame

Now click on the Analyse button to get Autostakkert! to sort your video by quality. Once it is quality sorted, move the frames slider at the top of the Preview screen and check that the best frames are at the start (slider left) and the worst ones at the end (slider right). Assuming this is the case you can proceed to stacking. If not, untick *Automatic* in the Quality Estimator box and try higher or lower Noise Robust values and reanalysing until you get the best Noise Robust setting.

Once the video is optimally quality sorted set the remaining values in the Control Panel to:

- Stack Options – TIF
- Frames to stack values at 0 0 0 0
- Percentage to stack set to 60% 30% 15% 8%
- Normalise stack set to 85%
- *RGB Align* – ticked
- *Save in Folders* – ticked
- *Drizzle* set to Off

Now look at the Preview screen and move the slider fully to the left.

In the preview screen, seen in figure 2, set the following values:

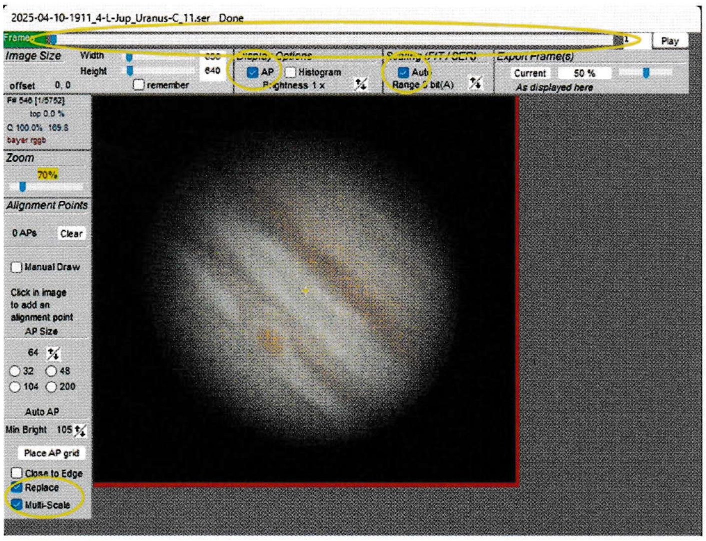
- Display Options to *AP*
- Scaling to *Auto*
- Alignment Points to *Replace* and *Multi-scale*

Now you need to choose an Alignment Point (AP) size. so that between 20 and 80 boxes will cover the planet after you hit the Place AP grid button (figure 3). If the AP size is too small there will be too many boxes. Conversely if too large there will be too few boxes. Hit *Clear* and try a larger or smaller size of AP until you get roughly the right number of alignment boxes generated. The boxes should cover the planet including the edges. If they spill over and cover all the background area too, increase the *Min Bright* value and retry.

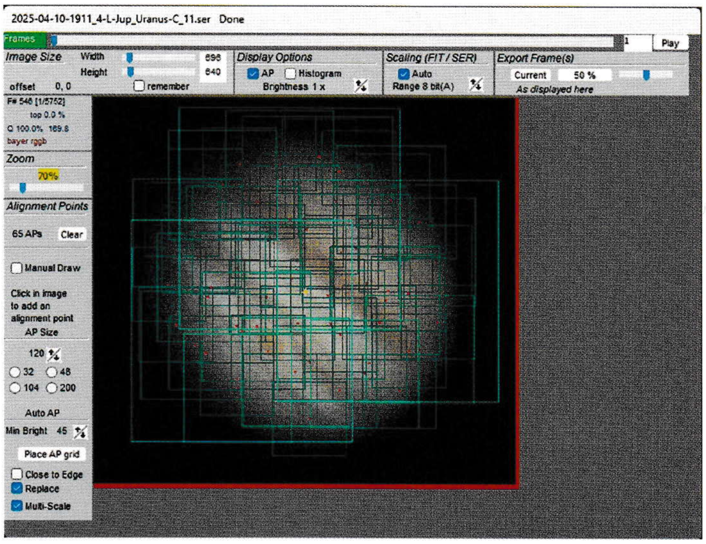
When your Noise Robust value is correct and the alignment boxes are correctly distributed you are ready to stack. Hit the Stack button to allow Autostakkert! to do its magic. With the settings chosen you will stack the best 60% as well as the best 30%, 15% and 8% of frames in the video, outputting four stacked TIFs, each based on a different percentage stack size. These will be stored in separate folders within the folder of your original file. You later process these picking the one that gives the best results. The larger the stack size the less the noise but the softer the image, as you are having to select more lower-quality frames to boost the total accumulated exposure time.

Wavelet processing

The last stage is to do the wavelet stretching to boost the details and the intention is to process all four



▲ Figure 2. Your choices for setting the Alignment Points in Autostakkert!4.0.



▲ FIgure 3. Autostakkert!'s automatic choice of Alignment Points on a large image.

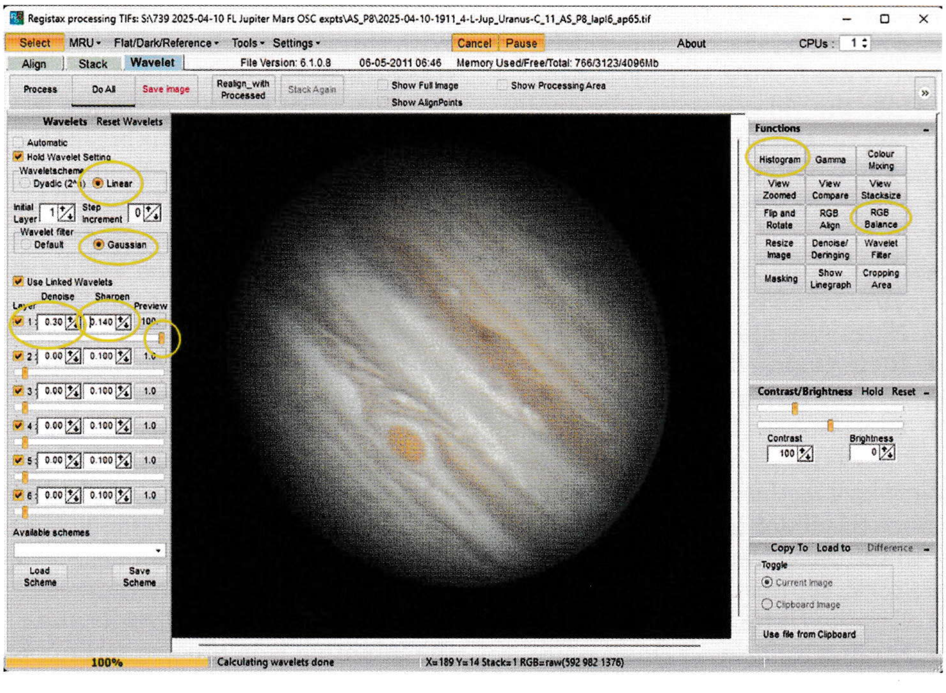
stacks, picking the one which is the best balance between noise and detail. To do the wavelet processing you will need to download the freeware program Registax6 at www.astronomie.be/registax/download.html. Download v 6.1.0.0. then update it to 6.1.0.8 to use the latest version. Once you are ready, run the program and use the *Select* button to click on one of the stacked tiffs from Autostakkert! Registax will open it and automatically move to the wavelet processing tab which is shown in figure 4. The wavelets setting page can look a bit overwhelming so keep it simple by just using the top slider and setting the Wavelets to *Linear* and *Gaussian*. Move the first slider fully to the right and increase the sharpen value with the associated up-arrow. As the detail is brought out by the sharpening process, the noise will increase too, so increase the denoise value to counteract this. Play around with denoise and sharpen settings until you get the best balance. Good data will show details with denoise of say 0.25 and sharpen of 0.16 but there is a wide variation in what will work – you will just have to develop a feel for this by experimenting. You can also experiment with ticking the *Use Linked Wavelets* box and reducing the sharpen value – again see what works.

The last step is to go to the Functions area of the Wavelets screen and adjust the image brightness and colour. For image brightness click on *Histogram*, adjust the max value down from 255 and hit *Stretch*. Make sure no part of your image is brighter than 255 after stretching, by checking the histogram chart. Change the max value and restretch if necessary.

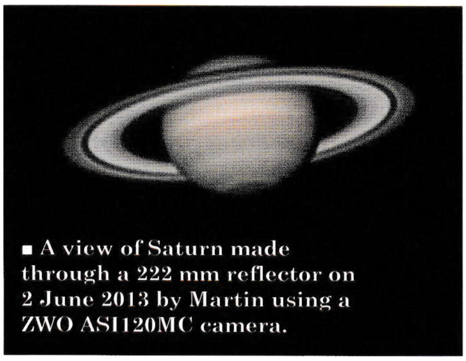
You can adjust the colour using the RGB balance button. Click on this and play around with the colour–weight values, balancing the different colours against each other or trying auto-balance. Match the colours of the planet against those in recent Hubble Images, as they are a good reference. When you are happy, hit the *Save Image* button.

The secret to planetary processing is to experiment and realise that planetary processing is often about balancing competing things. Strive to have your final image natural-looking, low in noise, and not over-processed, if you can – even if that means not pushing to bring out every bit of detail. As you become more experienced your data will improve and more planetary detail will show for the same level of processing.

▼ Fugure 4. Use these settings when using Registax 6 for wavelet processing.



***Martin Lewis** is a frequent section winner in the Astrophotographer of the Year contest for his superb planetary images made with his home-built 444 mm Dobsonian telescope.*



■ A view of Saturn made through a 222 mm reflector on 2 June 2013 by Martin using a ZWO ASI120MC camera.