

Image Evaluation Tips for StarTools

This is aimed at a relative novice like me - it is meant as a starting point and guide - and not a set of strict rules - add your own knowledge of your equipment and the conditions to guide in assessing the image and finding the best remedy for problems.

Thanks to Ivo Jager and others who provided input and feedback on these notes.

Checking sub-frames and stacking options

After an imaging session - as a minimum - start with a set of Lights, Darks, Flats & Bias (or Dark Flat) frames.

Exposure Length

- Check the exposure length of the sub-frames:
 - Only stack subs with the same exposure time and ISO setting - if necessary combine them later in StarTools using the Layer module- See [Creating a multi exposure length HDR composite](#).
 - If combining subs using median or sigma modes (anything but additive) the sub exposure must be long enough to catch some signal photons on most of the light frames so that the signal is not considered as noise by the stacking process.
 - Light pollution can tempt you to reduce the exposure time but often the signal is lost. Stacking and post-processing techniques can help to reduce the effect of light pollution, and compensate for saturated areas, but there is no way to make up for lack of signal.
 - If there are some over-exposed stars they can be improved by using the Magic module in post-processing.
- Look at the luminance histogram - See External Links [SNR and Histograms](#) and [Interpreting Histograms](#).
 - Is there a high count on left of the histogram and nothing on the right? If so, it may benefit from a longer exposure time.
 - Is there much saturation (a high count on the far right of histogram) showing the exposure time was perhaps too long?
 - If both left and right have high counts then the object has a high dynamic range (HDR) - consider collecting sets of subs with different exposure times - stack them separately and combine later in StarTools.

Inspect sub-frames

- Look at the light sub-frames:
 - If there is horizontal or vertical banding:
 - Stacking with a set of bias frames may help with banding.
 - If there are hot or stuck pixels or fixed pattern noise:
 - If you do dithering then these will be managed if you stack using a form of Sigma clipping with at least 10 subs. See this external [article on Dithering](#).
 - Without dithering, dark frames will get rid of the hot or stuck pixels.
 - If there are satellite trails, cosmic rays and other small blemishes in individual frames:
 - These will be managed if you stack using Median, or a form of Sigma clipping with at least 10 subs.
 - Otherwise remove the sub-frame with the defect - or, if you only have a few sub-frames, see if you can remove it using the Heal module during post-processing.
 - If there are any that are low grade or have any other individual artefacts that don't appear in the majority of images (e.g. focus issues, cloud, mist - etc. - etc.) discard these sub-frames.
 - Discarding the subs is better than introducing errors which will be difficult to remove later - however, if you only have a few subs leaving in subs with minor problems may improve the overall signal to noise ratio (SNR) more than leaving them out.

OSCs and DSLRs

For OSCs and DSLRs:

- Improve detail by avoiding debayering - if you have used spiral dithering during capture and have a large number of sub-frames you can stack using Bayer-drizzle (DSS) - See the topic [Using debayered integrated images](#).
- For noisy images - consider whether the image is sufficiently oversampled that you can afford to reduce the resolution by a factor of 4 - if so consider stacking using Super-pixels (DSS) or colour binning (Nebulosity) after reading this note by [Michael Covington](#).
- If using Deep Sky Stacker (DSS):
 - Consider preprocessing with DCRAW to remove the white balancing - as described [DSS vs Nebulosity vs ??](#) and [Eliminating white balancing when using DSS](#).
 - Consider saving the output as a FITS (32 bit/ch - integer) rather than a TIFF file (if not already) - see discussion [M13 Globular cluster](#).
 - You can also change the Autosave file format by setting Stacking Parameters - Intermediate Files - 'Intermediate and Final Image File Format' to FITS - See [Difference between TIFF and FITs files](#).
- For DSLRs, check whether the optimum ISO was used:
 - The optimum ISO for a camera is one where the sensor output is not artificially amplified to emulate improved sensitivity.
 - Above this setting you are not gaining any benefit in capturing detail and the dynamic range may be reduced.
 - See the external links: [DSLR Exposure](#), [Best ISO setting for Astrophotography](#), [DSLR Camera Data](#).
 - If necessary, make a note to change it for next time.

Now Stack the sub-frames based on what you now know.

Studying the stacked image

First, look for the problems:

White Balance

- Check if image has been white balanced:
 - RAW sub-frames will not be white balanced, JPEG will.
 - Stacking can introduce white balancing (Deep Sky Stacker (DSS) always white balances when using RAW subs, PixInsight and Regim do not).
 - White balanced images often show a red, brown or yellow bias. Non white-balanced images are teal or blue-green.

Opening in StarTools

- This will affect how you open the image in StarTools:
 - If it is a (stacked) RAW monochrome image - select 'Linear, was not Bayered or is white balanced'.
 - If it is a (stacked) RAW colour image that is white-balanced - select 'Linear, was not Bayered or is white balanced'.
 - If it is a (stacked) RAW colour image that is not white balanced - select 'Linear, was Bayered, is not white balanced'.
 - If it is a JPEG use 'Modified and not linear'.

Use AutoDev

- Use the [AutoDev module](#) and look at the initial image - this is specially designed to show up any colour casts, vignetting and artificial patterns such as banding. See [this example using M51](#).
 - Are the corners darker? This is a sign of vignetting – stacking using flats will help.
 - Can you see darker blotches? - These may be due to dust specks on the sensor - best way to remove these is to restack using flat frames flats. In the absence of flats try this method for [removing dust bunnies](#) using the Heal module.
 - Is there a Zipper or Checkerboard pattern - a possible indication of a debayering issue - see the topic [Checkerboard Pattern in image](#).
 - Look for stacking artefacts - be sure to Crop the image to remove these before using the [Wipe module](#).
 - Look for any banding - vertical or horizontal:
 - Ideally, if you can, restack using a set of bias frames.
 - Otherwise plan to try the Band module to fix this: - use as first step, turn tracking off - use Band module - turn tracking back on and continue - see this topic discussing the [Band module](#).
 - In the future stacking with bias frames, or dithering during capture, may help.

Skyglow

- Does the background have a colour bias (skyglow or light pollution)
 - Red or yellow/brown cast - skyglow that has been white balanced.
 - Teal, blue or green cast - skyglow that has not been white balanced.
 - Bright blue-green cast - skyglow filtered using a light pollution filter.
 - Missing yellow (e.g. no yellow stars) - indicates use of light pollution filter.
- Try the [Wipe Module](#) - if this doesn't work it may be that you need more subs to increase the total integration time - or your subs aren't long enough - to get a reasonable SNR. See CN discussion [Deep Sky Imaging, Aperture and Sky Fog Limits](#)

Look at the stars

- Is there saturation of some the stars:
 - Shrink stars using the Magic module or ...
 - Use HDR techniques to combine a stack of long exposures with a stack of short exposures - See [Creating a multi exposure length HDR composite](#)
- Look at the stars in the centre of the image:
 - Are the stars oval and all oriented in the same direction?
 - Look back at the sub-frames and see if some are worse than others - if so discard sub(s) and re-stack.
 - If all the same this may indicate guiding problems or the imaging plane is not perpendicular to the telescope axis. Plan to try the Repair module.
 - If round but blurred or doughnuts - see if some are worse than others - if so discard sub(s) and restack.
 - If all the same think about what might cause this (e.g. poor focus) and try and put it right for next time. For now plan to use the Decon module.
 - If there are some stars that are over-exposed then they can be improved by using the Magic module later.
- Look at the stars at the edge of the image :
 - Are the stars elongated on axis towards the centre of the image (Coma)?
 - Make a note to use the Lens module to reduce this before doing any cropping of the image. For the future a Coma Corrector will reduce this effect.
 - Are the stars at the edge more blurred than at the centre - or vice versa?
 - This is most likely caused by field curvature. For the future using a field flattener may help this.

Sampling

- Sampling - is the resolution better than the seeing? (over-sampled) - use the Bin module to reduce resolution and increase SNR.
 - To check if oversampled - if you zoom in to the image and the very smallest features look blurry (spread over multiple pixels) then the image is over-sampled.
 - When binning, reduce the resolution so this blurriness is gone. See [Bin module usage](#).
- Zoom in and look at the background - Look for shadows and marks that could indicate dust, scratches, cosmic rays or satellite trails - make a note to try the Heal module.
 - Remember to mask out dust specks (as well as the subject) when using the Wipe module.

Look for noise

- Zoom in to see the noise: -
 - Is there a lot of noise? –
 - For images with low signal to noise - increase the "Ignore Fine Detail" setting to stop AutoDev responding to the noise. See also later references to noise.
 - Try using the 'Isolate' preset in the Life module later using a full mask as described in the topic [First Astro Photograph](#)
 - Is the background quite uniform or are there coloured or darker single-pixel spots? If there are dark spots then consider increasing the Dark Anomaly Filter when using the Wipe module.
 - Are there signs hot pixels have not been eliminated by stacking? Go back and use Sigma or Kappa Sigma stacking to eliminate stuck pixels.
 - Is the noise level such that additional binning of the image would look better - in spite of the loss of resolution? See [Bin Module Use](#).
 - If noisy data then the deconvolution (Decon) module needs to be used with caution - it works best when the image has little noise.
 - Finally, the De-noise module (Wavelet De-Noise - when you switch Tracking off) will help eliminate noise - adjust the Grain Size until the noise grain can't be seen - don't worry about the signal - StarTools has been tracking it and will protect it.
 - If noise is predominantly colour blotches - set 'Brightness Detail Loss' to 0% when using the Wavelet De-Noise module.

Chromatic aberration

- Signs of Chromatic aberration?
 - Try using Lens or Filter module later - See the [Fringe and halo killer](#) - or
 - Make a synthetic Luminance channel from the green channel to reduce bloat from CA in the blue channel as described in the topic [Sh2-82 and reducing stars](#).
- Signs of purple fringing?
 - try using Lens or Filter module later - or
 - consider using one of the approaches for processing the blue channel separately as discussed in the topic [fringe killer filter add blue back to central star](#).
 - This may throw automatic colour calibration off - try using 'Max RGB' mode when colour correcting.

Histogram

- Look at the RGB histogram:
 - Is there saturation/clipping of colours (high count on far right of histogram)?
 - Is there much green? This will also show up in 'Max RGB' tool in the Color module - Plan to fix this using Color Module - See [Color module - colour balance](#).

Then look at the qualities of the image:

Are there any reasons to use something other than your 'standard' workflow?

Subject

- Subject - modify process depending on the subject.
 - Imaging Planets - perhaps from a video source or jpeg - try using the process described [Planetary Images and LRGB stacks](#).
 - Imaging Comets - remove the blurry stars in the background - either when stacking by using sigma clipping, or using the Heal module as described in the topic [Comet Lovejoy/2014 close up](#) or as described in the Background Notes in [Heal Module use](#).
 - Lunar imaging - when using the Decon module set 'Image Type' to 'Lunar/Planetary'
 - See the discussion in the topic [Colorful aristarchus](#).
- Object characteristics (high dynamic range, low dynamic range, faintness, etc.) :
 - Is it very high dynamic range - are there saturated areas? - merge 2 images with different exposure times using Layer Module (need to capture more data) - See [Creating a multi exposure length HDR composite](#).
 - Busy star field in background? - try using the Isolate preset in the Life Module to de-emphasise it.
- Image framing - does the image need to be cropped – either for framing or to get rid of edge effects?
- Are there special non-celestial elements in the image? - Trees, mountains, dust specks - Remember to mask out these object(s) when using the [Wipe](#) module.
- Atmospheric conditions - e.g. seeing is not good - Using Decon module will help here - see [Decon Module use](#).
- Details - are there specific features you want to bring out?
 - Some nebulosity for example - See [Using Heal to process stars and background independently](#)
 - Faint Detail - Try creating a synthetic luminance channel using [this approach](#) or [this alternative approach](#).
 - Small to medium structures - use the HDR module to locally adjust the stretch to bring out small to medium details.
 - Medium to large structures - use the Contrast module to locally adjust the stretch to bring out medium to large details.
 - Large Structures - Try using the Life module to emphasise large structures.

Colours

- Colours - what colours are there?
 - Are they real? - How to ensure they are preserved during processing? See [Colour balancing techniques](#) or
 - Are they wrong - like green in the wrong place? - For green use Cap Green in the Color module. For other colours try using the Filter module.
 - Are you using the Hubble Palette or similar? - You may want to adjust the channel balance in the Color module using the Bias Sliders.

Narrow Band

- HA and RGB
 - Combining RGB and Ha data - consider using the approach described in the topic [H,R,G,B data -> synthetic luminance](#).
 - HA and OIII etc. Consider using different mapping to bring out the detail you want.

Skyglow

- Shooting at different times (moon out) - try using the techniques described above to handle Skyglow.
- Shooting from a different location - do you have to work to control the effect of light pollution? Are you using a light pollution filter? - See [Colour Balancing using a light pollution filter](#) which is more fully described in the topic [Color balancing of data...](#)
- Equipment change or retuning (for example mount, flexure, insertion of filter in optical train, etc.).

Useful Image Analysis Tools

The following tools may help when analysing an image.

GIMP <https://www.gimp.org/>

AstrolImageJ [See this link to AstrolImageJ](#)

Description [See Description](#)
User Guide [See the User Guide](#)

DS9 [See this DS9 link](#)