

SharpCap User Manual

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This version describes SharpCap 3.2.

This is a pre-release copy of the User Manual and may contain errors.



SharpCap is an image capture application designed primarily for Astrophotography and Video Astronomy.

Support can be obtained via the SharpCap forum at <http://forums.sharpcap.co.uk>.

You can download this manual in [PDF format](#).

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Foreword

SharpCap was born in frustration in February 2010. The frustration was with the typical applications used for webcam capture in Astrophotography at the time. AMCAP was a prime example – it made it very hard to adjust the settings on your camera and very easy to do silly things like write over the previous capture file. These shortcomings were brought even more obvious when you were trying to use the program in the dark, on a laptop and while wearing gloves.

My response to this – a standard one for a software developer who has just encountered a poorly designed application – was to think to myself ‘I can do better than that’. Perhaps more unusually I actually decided that I *would* do better than that and I started to write SharpCap over the next few days. One of the hard parts of a software project is often deciding on a name, but the name SharpCap was easy to arrive at – it comes from the programming language it is written in – C# (pronounced C-sharp).

Through its first year, SharpCap remained a fairly simple webcam capture application that was designed to be easy to use, to use standard, familiar Windows UI elements and to show the controls for the camera to the user at all times. This seemed to be enough of an improvement over the available alternatives to persuade a large number of people to start using SharpCap.

About a year after SharpCap’s first release something unexpected (to me) happened – I was approached out of the blue by an astronomy retailer selling Basler cameras asking if it would be possible to make SharpCap work with those cameras and offering to provide a sample camera to work with. This chance event changed SharpCap’s direction from a webcam only application to one that today supports a wide range of dedicated astro-imaging hardware.

Over the years as well as adding support for more cameras, SharpCap has also added many more features to the extent that this user manual is now necessary as the application is sadly no longer simple enough to ‘just use’. The primary aim throughout has been to try to make things that are difficult simpler – finding objects can be hard so the various image boost effects help find faint or out-of-focus targets; focusing can be hard so there are six focus assistance tools; DSO imaging is hard so live stacking makes it easier and of course polar alignment can be hard, but it is made simpler with SharpCap’s easy to use polar alignment tool.

I hope that you enjoy using SharpCap and that it indeed makes your astro-imaging easier.

Clear Skies!

Robin Glover, April 2018

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Introduction

SharpCap is an image capture application designed primarily for astrophotography and video astronomy.

Support can be obtained via the SharpCap forum at <http://forums.sharpcap.co.uk>.

This manual describes SharpCap 3.2.

Requirements

Supported Cameras

SharpCap supports a wide range of cameras. These can be divided into 3 basic categories:

1. Cameras supported directly by SharpCap – these include many brands of dedicated astronomy cameras including models by Altair, Basler, Celestron, Imaging Source, iNova, QHY and ZWO.
2. Cameras supported via a Windows Webcam driver – includes most webcams (modified and unmodified), USB frame grabbers and is also an option for many specialised cameras where the manufacturer provides a webcam driver (sometimes called a WDM or DirectShow driver).
3. Cameras supported via an ASCOM driver – many astronomy camera manufacturers provide ASCOM drivers for their products and SharpCap can use these to communicate with the camera.

Sometimes a camera can be accessed by two (or even all three) of the options above. If that happens, it is usually best to prefer to use the direct support for the camera as this will give the most control over the camera's functionality.

Altair Cameras

A UK based supplier of a wide range of CMOS cameras for guiding, solar, planetary, lunar and deep sky imaging. Altair cameras can also be purchased from a range of dealers in the UK and other countries. Altair's website can be found at <https://www.altairastro.com/>.

Basler Cameras

A German manufacturer of a wide range of industrial cameras, some of which are suitable for astro imaging. SharpCap supports Basler cameras, including those with Gigabit Ethernet connectivity. On some models of Basler cameras, SharpCap is capable of supporting exposures longer than the camera's normal maximum limit by clever software control of the camera's manual exposure triggers. Basler's website can be found at <http://www.baslerweb.com/en>.

Celestron/Imaging Source Cameras

The Imaging Source provide a wide range of industrial cameras which have been used for astro imaging for some time. Imaging Source manufactured cameras are now sold under the Celestron brand. SharpCap should be able to control the full range of The Imaging Source and Celestron cameras, although testing has covered the more common USB cameras only. The Imaging Source's website can be found at <https://www.theimagingsource.com/>.

iNova Cameras

iNova sell a range of small sensor CMOS/CCD cameras aimed primarily at the astro imaging market, primarily suitable for solar/lunar/planetary imaging and auto-guiding. iNova's website can be found at <http://inovaccdusa.com/>.

Point Grey Cameras (now FLIR)

Point Grey (now owned by FLIR) sell a wide range of industrial cameras that can also be used for astro imaging and scientific imaging. SharpCap supports most Point Grey cameras and provides full control over their functionality. More details on Point Grey cameras can be found at <https://www.ptgrey.com/>.

QHY Cameras

QHY sell a wide range of CCD and CMOS cameras with sensor sizes ranging from webcam size to full frame SLR and beyond. These cameras are primarily designed for the astro imaging and Scientific markets. SharpCap supports the full range of QHY cameras and includes support for advanced features such as built-in filter wheels, GPS timing modules and Peltier cooler control. QHY's website can be found at <http://www.qhyccd.com/> .

StarlightXpress Cameras

StarlightXpress produce a range of CCD based cameras designed specifically for astronomy use. SharpCap can control the full range of StarlightXpress cameras including the popular Lodestar family of highly sensitive guiding cameras. More details of StarlightXpress cameras can be found at <https://www.sxccd.com/> .

ZWO Cameras

ZWO sell a range of CMOS cameras with low noise, high sensitivity sensors, ranging from webcam size to full frame SLR. Their cameras are primarily designed for the astro imaging market, including useful features such as built in USB hubs on some models. SharpCap supports the full range of ZWO cameras including control of advanced features such as Peltier cooler control and USB bandwidth adjustment. ZWO's website can be found at <https://astronomy-imaging-camera.com/> .

ASCOM Cameras

Many astro cameras have ASCOM drivers and SharpCap can use these drivers to control such cameras. This can be a good fall back option when SharpCap does not have direct support for a camera. The ASCOM Standards website can be found at <http://www.ascom-standards.org/Downloads/CameraDrivers.htm> .

DirectShow Cameras

Microsoft DirectShow is an architecture for streaming media on the Microsoft Windows platform. There are a vast number of webcams and frame grabbers on the market. The controls available in SharpCap are determined by the driver – SharpCap just shows the controls the driver makes available.

Virtual Camera

SharpCap 3.2 adds support for a 'Virtual' camera. This works by reading image files from a selected folder and treating the images as if they were frames received from a camera. SharpCap will read all existing images in the folder in date order and then wait for any new images that are created. You can use the virtual camera to use SharpCap features such as live stacking with previously captured images or with an unsupported camera if you have a program that will capture images from the camera and save them to disk.

Choosing Between ASCOM and DirectShow

If a camera appears as ASCOM and DirectShow – which should be chosen?

If a camera not directly supported by SharpCap is to be used, there are two options when connecting to it – *ASCOM drivers* or *DirectShow drivers*. Each have their pros and cons.

ASCOM	DirectShow
Pros: <ul style="list-style-type: none"> • Direct control of exposure (continuously variable) in the SharpCap panel. 	Pros: <ul style="list-style-type: none"> • A better selection of camera controls available in the panel (gamma, brightness, contrast, etc.).

<ul style="list-style-type: none"> • Binning may be available. • ROI may be available (2.10 and up). • Bit depths of >8 and RAW modes may be available. • Long exposures likely to be available. <p>Cons:</p> <ul style="list-style-type: none"> • Few other controls in the SharpCap panel as ASCOM doesn't allow for many except exposure and gain. • ASCOM is relatively slow, so frame rates will be slower. • ASCOM can be unreliable because each manufacturer interprets the standard in their own way, which can lead to some ASCOM drivers being incompatible with SharpCap. 	<ul style="list-style-type: none"> • Long exposures may be available (i.e. 1s, 2s, 4s, 8s, 16s, etc.). • Region of Interest (ROI) may be available. • Extra controls may be available in the camera's DirectShow config dialog. • High frame rates possible. • Less likely to have compatibility issues than ASCOM. <p>Cons:</p> <ul style="list-style-type: none"> • Exposure only changeable in multiples of 2. • Bit depths limited to 8 bits and RAW modes unlikely to be available. • Can only save videos to AVI and images to PNG (2.9 only, this restriction removed in 2.10). • Using an astro camera via DirectShow isn't as good as using it directly (less controls, less control over exposure), but it is better than nothing.
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Software

SharpCap runs on Microsoft Windows. The minimum version requirement is:

- SharpCap 2.9 (or older versions) – Windows XP, Vista, 7, 8, 8.1, 10
- SharpCap 3.0 – Windows Vista, 7, 8, 8.1, 10
- SharpCap 3.1 and 3.2 – Windows 7 with SP1, 8.1, 10

SharpCap is a 32-bit application and will install and run on both the 32-bit and 64-bit versions of Windows.

Multiple major versions can co-exist, for example 2.8, 2.9 and 2.10 can be installed together on the same machine. Only one minor version can be installed, for example only one of 2.9.3055 and 2.9.3011 can be installed at any one time.

Windows XP, although now out of Microsoft support, will work with older cameras. The problem with this version of the operating system is manufacturer driver support for XP will dwindle, therefore newer cameras will be unable to run on the platform.

Windows 7, 8.1 and 10 are well supported by manufacturers. Windows 7 will go end of life in 2020 and at this point, Microsoft support will cease.

Hardware

The minimum hardware requirement is dependent on the type of camera being used. When purchasing a camera, look closely at the manufacturer/vendor recommended minimum PC specification.

The following areas need to be considered to achieve the best frame rates:

- Processor, i5 or i7 is better.
- Memory, 3Gb maximum for 32-bit Windows, 64-bit needs at least 4Gb.

- Disk, SSD is faster than conventional drive.
- USB, USB3 (5Gb/s) is 10x faster than USB2 (480Mb/s).
- Windows 32/64-bit, 64-bit supports > 3Gb memory.

SharpCap is designed to take advantage of the multiple CPU cores available on most modern computers and will perform better for fast cameras if more than one CPU core is available.

Consider the hardware demands when purchasing high frame rate cameras.

Minimum Hardware Specification

A 640x480 resolution webcam will work well on a low specification PC. A ThinkPad X61 (used to produce the examples in this manual) satisfies this requirement. The following specification can achieve 30fps at 640 x 480 with a USB2 webcam.

- Core 2Duo 1.86Ghz processor
- 4Gb (3Gb usable with 32-bit Windows)
- 120Gb SATA2 drive
- Windows 10 32-bit

Recommended Hardware Specification

A dedicated astronomy camera capable of 3000x2000 pixels at 50fps will require a fast processor, more memory, an SSD and a USB3 port to achieve maximum performance.

If intending to use high resolution cameras (10 Megapixels or more), ensure the capture PC/laptop has:

- A minimum of i5 processor.
- A large capacity hard drive (500Gb or more) with SSD preferred.
- At least 4Gb (preferably 8Gb or more) of memory.
- A 64-bit version of the Windows operating system.

This configuration allows SharpCap to access more memory, thus reducing the likelihood of memory exhaustion while capturing. This applies when working in RGB mode or at bit depths of 12 or 16 bits per pixel.

SharpCap Pro

A number of the more advanced features of SharpCap now require the purchase of a SharpCap Pro license. SharpCap Pro licenses are reasonably priced, can be purchased for 1 or 5 years or a lifetime license and are available from <http://store.astrosharp.co.uk/>.

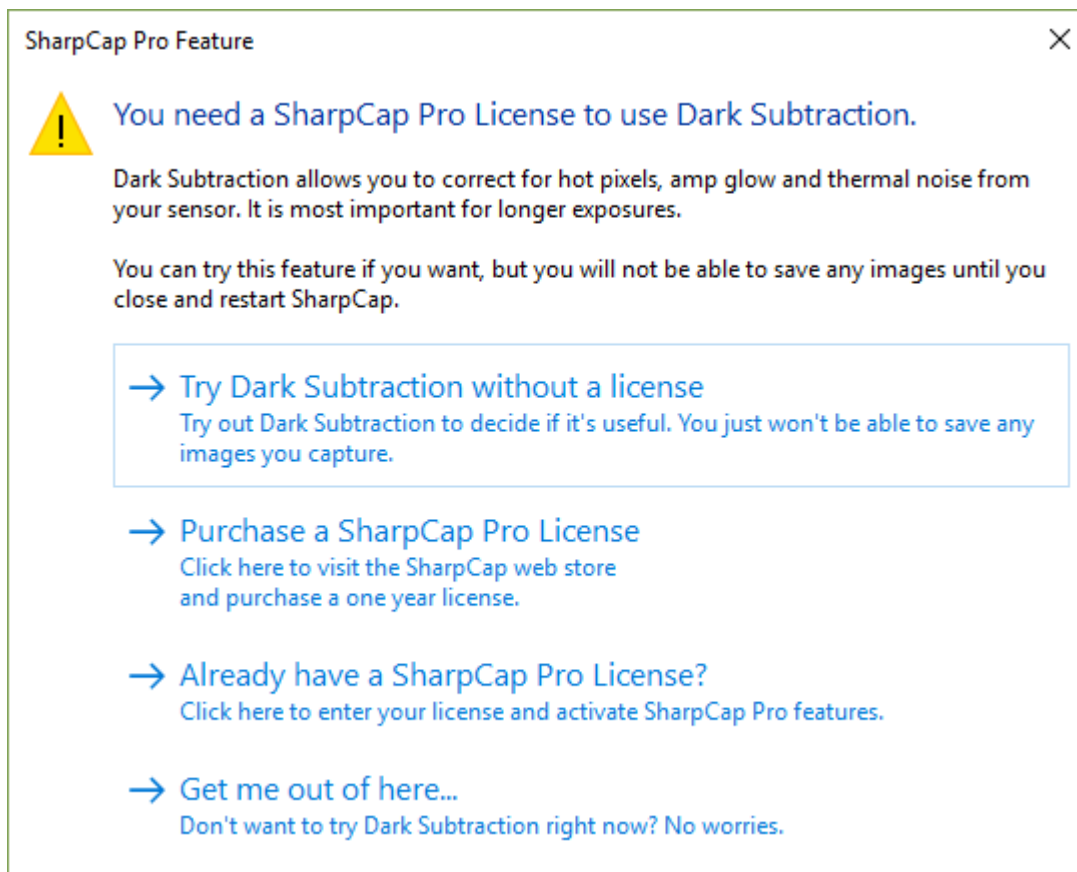
Installing SharpCap Pro

You do not need to install a separate version of SharpCap if you wish to use SharpCap Pro features – the SharpCap Pro features are already in the normal installed version of SharpCap – they become available to you when you enter a SharpCap Pro license key.

Trying out SharpCap Pro

You can try out most SharpCap Pro features before purchasing a license. If you decide to try out one or more SharpCap Pro features without entering a license then SharpCap enters an evaluation mode where you cannot save any images until you close and then re-start the application. Evaluation mode allows you to see the effects of SharpCap Pro features on screen but not save the resulting images.

When you try to use a SharpCap Pro feature without a license installed you will see a message like this



which allows you to choose whether to use the feature in evaluation mode, purchase a new license or enter an already purchased one or you can choose not to use the feature after all.

SharpCap Pro Features

The table below shows the list of features that require a SharpCap Pro license. These features are also highlighted with the text '[PRO]' where they are mentioned in the remainder of this user guide.

Feature	Notes
Dark Subtraction	
Live Flat Correction	
Polar Alignment	You can measure your polar alignment error without needing a license. Guidance on adjusting to correct any error requires a license.
Python Scripting Language	
Live Stacking Colour Adjustments	
Live Stacking and Display Histogram Autostretch	
Feature Tracking	
Seeing Monitor	Seeing Triggered capture and Seeing Filtered capture can only be activated with a license.
Smart Histogram	
Advanced Focus Score Features	Automatic focus scans via ASCOM focuser require a license
Live Stack Image Enhancements	
Live Stack Sigma Clipped Stacking	
Live Stack Dithering via PHD2	
Two Monitor View	Image view on second monitor is watermarked if you do not have a license

Buying a SharpCap Pro License

SharpCap Pro licenses can be bought by visiting <https://store.astrosharp.co.uk> . Payment is accepted via PayPal. If you do not have a PayPal account then you can either choose to create one or choose to buy without creating an account using your credit or debit card (just follow the PayPal link anyway and you should see the option to buy using a credit or debit card).

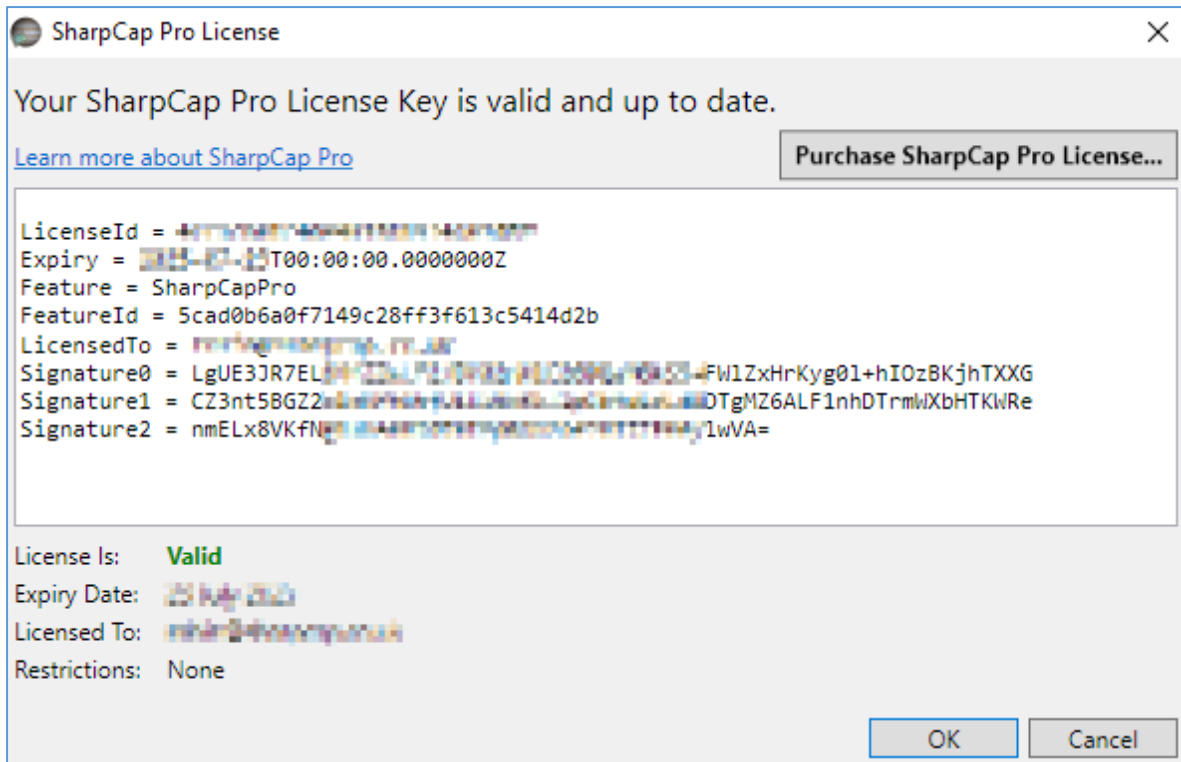
Once you have paid, your license will be sent to the email address that you used on the PayPal site, so please make sure that it is correct. Sometimes license emails can get caught in your 'Junk' email folder so be sure to check if the license email does not arrive promptly. You will also see your new license in your web browser – just let your browser return automatically to the AstroSharp website after completing your PayPal payment.

Installing your SharpCap Pro License

To install your new SharpCap Pro license, run SharpCap, go to the 'Help' menu and select 'SharpCap Pro License'. Copy the license text from your web browser or email and paste it into the license box. Be careful to include all of the license text.

Once entered, your license should look like the example shown below (without the blurring!). Every line of text should start with a field name (like LicenseId or Expiry), followed by an equals sign ('=') followed by the field value. Don't include any other text and make sure you include all the lines shown.

If your license is entered correctly then you will see the license status change to 'Valid' below the license entry box.



License Expiry and Renewal

SharpCap Pro licenses are sold on a subscription basis – that means that if you buy a one-year license, it will allow you to use SharpCap Pro features for one year from the date of purchase. If your license has expired then you will no longer be able to access SharpCap Pro features (but you will be able to continue using the many non-Pro features in SharpCap). Subscription based licensing allows the annual cost to be kept very low.

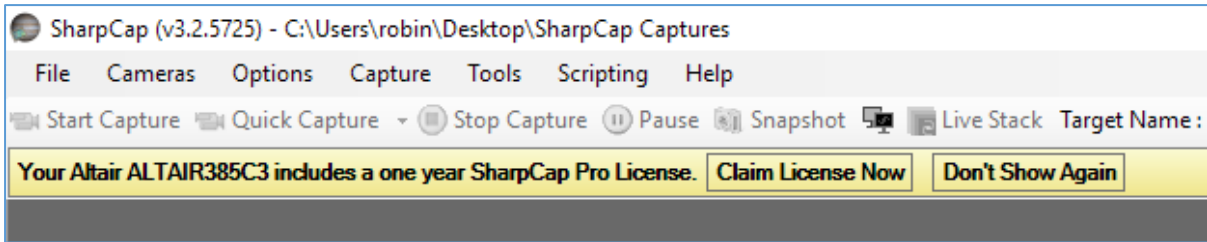
You should receive two reminder emails in the weeks before your SharpCap Pro license expires to let you know that will soon be time to renew your license. You will also see notifications inside SharpCap itself warning you when your license will expire soon.

If you choose to renew your SharpCap Pro license then you will receive a new license key. You will need to replace the existing license key in SharpCap with the new key, following the steps in [Installing your SharpCap Pro License](#). The new key will be valid immediately, so there is no need to wait until your old key expires before making the change.

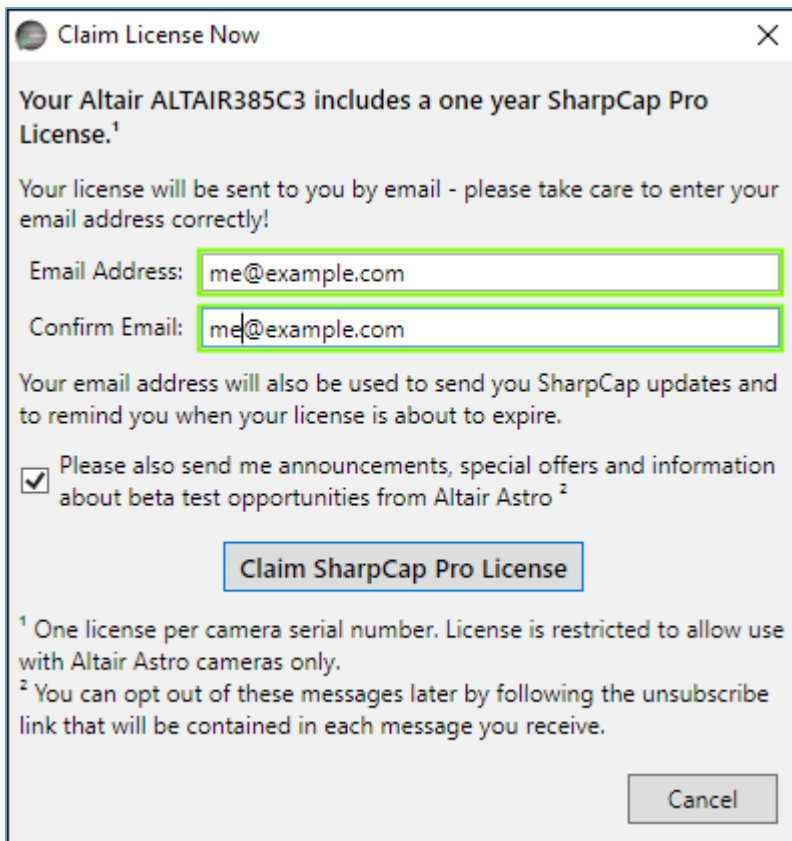
Claiming a SharpCap Pro license bundled with a new Camera

Some cameras are sold with an offer of a 1-year SharpCap Pro license included with the camera. If you have purchased one of these cameras then follow the steps below to claim the license.

- Install any drivers necessary to allow your PC to detect the camera properly (for Altair cameras, this means you **must** install AltairCapture, even if you do not intend to use it)
- Install the latest version of SharpCap
- Ensure you are connected to the internet – the license claim procedure requires a working internet connection.
- Plug in your camera to a suitable USB port
- Run SharpCap. If you do not have a SharpCap Pro license already, then a notification should appear at the top of the screen soon after SharpCap starts.



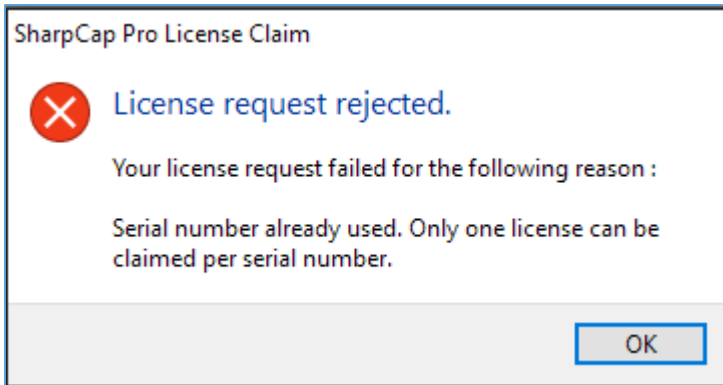
- Click on the 'Claim License Now' button
- In the license claim window, enter your email address. Take care to enter your email address correctly, as you will receive a copy of your license by email. You can choose to share your email address with the camera manufacturer to receive updates and special offers if you want (this is entirely optional – if you choose not to share your email address with the manufacturer then your email address will only be used to send you your licence key and remind you when it is about to expire).



- Press the *Claim SharpCap Pro License* button – after a few moments your claim will be processed and you should see a message confirming the license claim has been successful. Your license email should usually arrive within a few minutes.

Note: Licenses included with purchases cameras are only valid for use with the specific brand of camera they were claimed against.

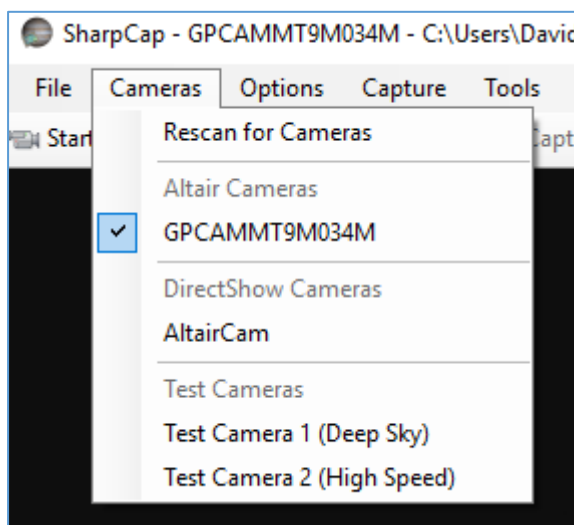
Note: If you have purchased your camera second-hand then the previous owner may have already claimed the license for that camera – in that case you will not be able to claim a SharpCap Pro license and will see this message if you do try to claim:



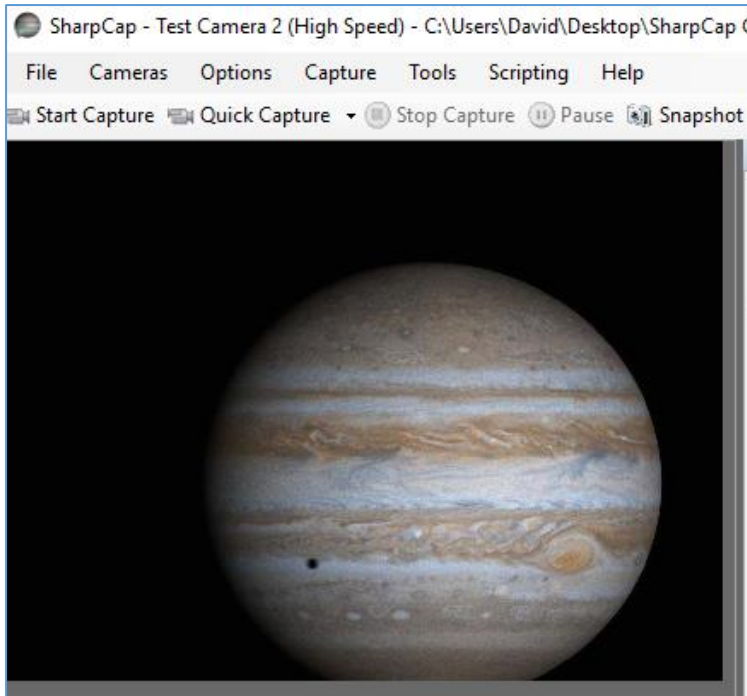
Quick Start

This section describes getting started quickly and is intended for the experienced or impatient user.

1. Download the latest camera driver from the manufacturer's website.
2. Install the camera driver – there may be a need to approve an administrator prompt or run the installer as administrator.
3. Restart the PC/laptop.
4. Attach the camera.
5. Download the latest SharpCap from <http://www.sharpcap.co.uk/sharpcap/downloads>.
6. Install SharpCap – there may be a need to approve an administrator prompt or run the installer as administrator.
7. Go to the camera menu and select the camera from the list of devices.



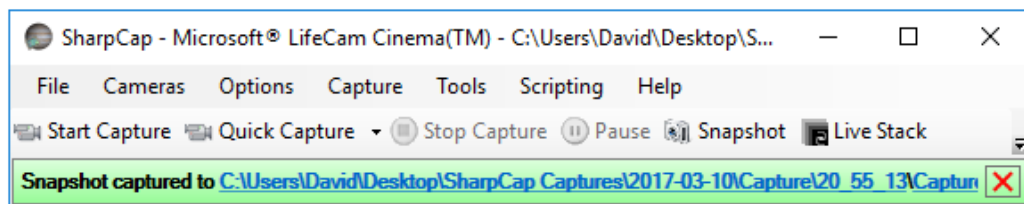
8. If the camera is attached to a telescope or lens, a picture from the camera should be seen in the display area.



9. Use the *Camera Control Panel* at the right-hand side of the screen to control settings such as exposure and gain. The image should change in response to the controls being adjusted.
10. Use the *Start Capture* (or *Quick Capture*) buttons to start a video capture to a new file or the *Snapshot* button to capture a single frame to a file.



Once the capture has completed, a *Notification Bar* will appear directly below the *Tool Bar*. Click the highlighted link to go directly to the folder holding the captured image.



11. The installation and testing of SharpCap is now complete.

Installation and First Steps

This section is a step by step getting started guide.

Installing the Camera Driver

Do not connect a camera until its drivers have been installed. Drivers are best installed from a Windows user account which has administrative privileges. The drivers can be obtained in three ways, depending on the camera:

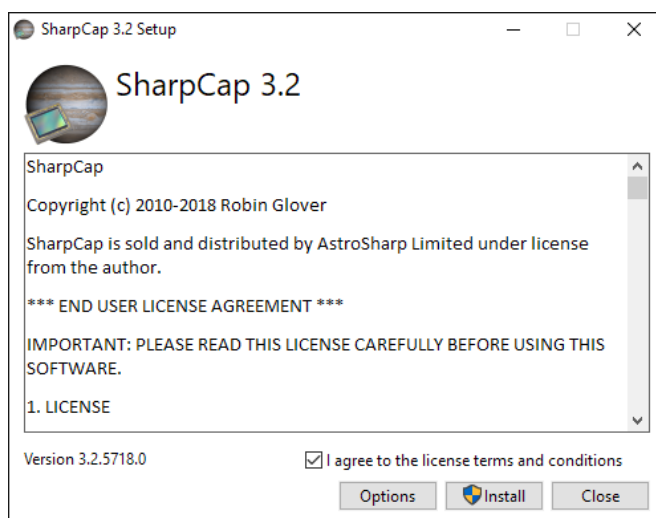
1. Drivers delivered on a CD-ROM provided with the camera. These might not be the latest version, so consider option 2.
2. Links to camera manufacturers' websites can be found at <http://www.sharpcap.co.uk/>, in the [Supported Devices](#) section or in [Camera Controls](#) in this document under the appropriate manufacturer.
3. Microsoft supported webcams (which work with DirectShow) may download a driver automatically once the camera is plugged in. This certainly works, for example, with the Microsoft LifeCam under Windows 10. However, earlier versions of Windows require the [LifeCam drivers](#) to be downloaded from Microsoft.

Once the camera drivers are installed, restart Windows, plug in the camera and check via *Control Panel > Devices* to see if the device (camera) is working properly.

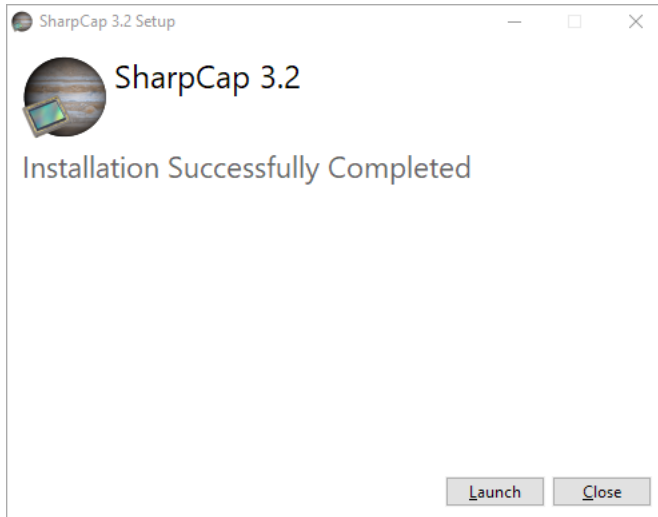
Installing SharpCap

The download and installation of SharpCap is described here.

1. Download SharpCap from <http://www.sharpcap.co.uk/downloads>. The single download is suitable for both 32-bit and 64-bit versions of Windows.
2. Navigate to the folder where SharpCap has been loaded. Double click on the file *SharpcapInstall-version-number.exe* to install.
3. Tick the box to agree to the license terms and conditions and press the Install button.



4. Supply an administrator account name and password if requested.
5. When the *Installation Successfully Completed* message appears, click *Close* to close the installer or *Launch* to run SharpCap straight away.

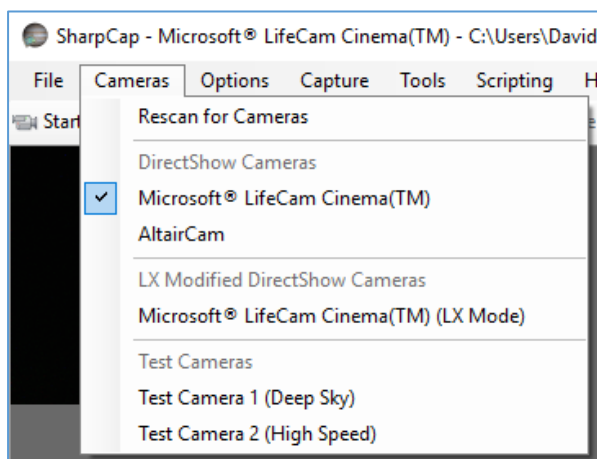


6. SharpCap is now installed.

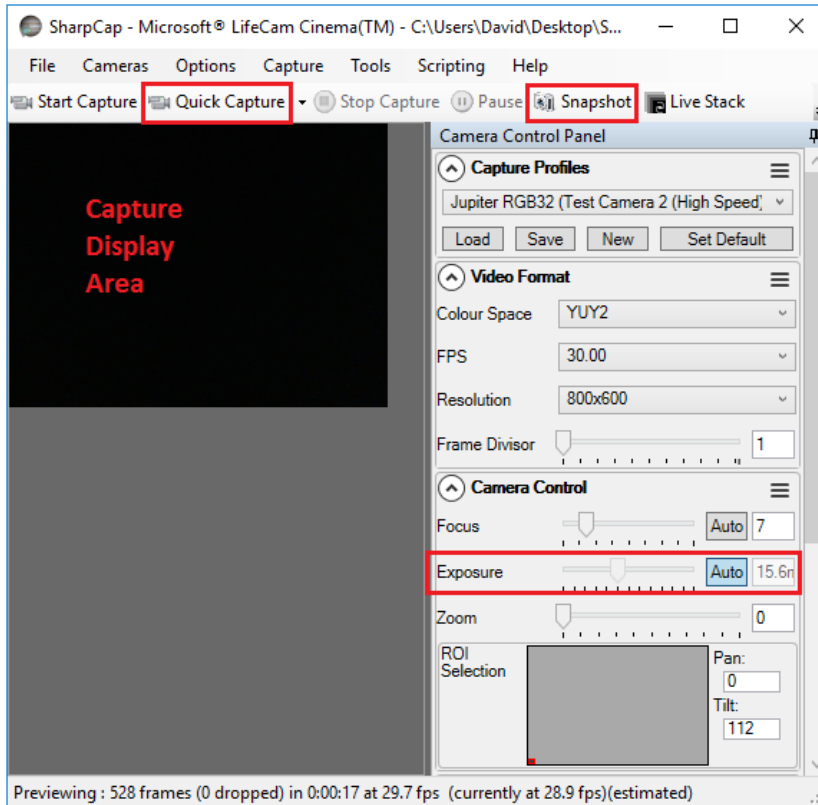
Testing SharpCap

Consider carrying out the initial testing from inside with the telescope and camera pointing at an object such as a tree, chimney, lamp or mast. Choose a large object.

12. Connect the camera to the telescope.
13. Connect the camera to the PC.
14. Start SharpCap. From the main menu, select *Cameras*. Ensure the camera is selected (ticked) – in this example, the camera is a *Microsoft LifeCam*. If the camera name appears twice, select the highest one on the list.



15. This is SharpCap's *Main Screen*.

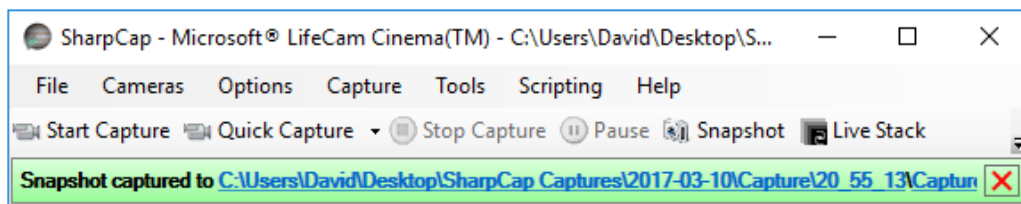


Key areas are:

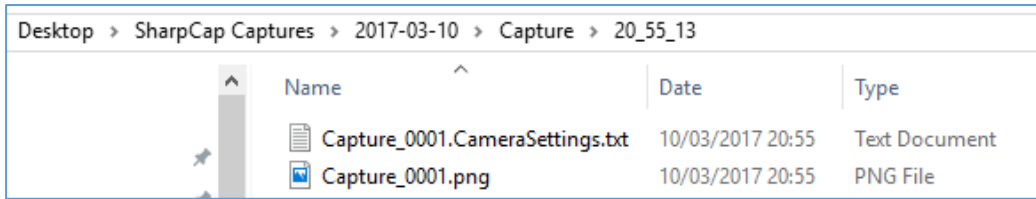
- Capture Display Area* – the image the camera sees is displayed here.
- Quick Capture Button* – will start a video capture to a new file.
- Snapshot Button* – will capture a single frame to a PNG file.
- Exposure* – controls the camera exposure.

If focusing of the telescope cannot be reached, try removing diagonals or adding extensions.

16. Try the *Snapshot* button. A *Notification Bar* will appear directly below the *Tool Bar*. Click the highlighted link to go directly to the folder holding the captured image.



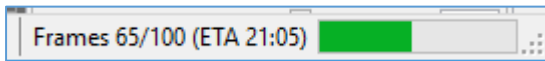
17. This folder (*SharpCap Captures\YYY-MM-DD*) which is on the desktop, will contain 2 files. One is the image, the other is a text file containing the camera settings.



18. The camera settings file looks like this:

```
[[Microsoft® LifeCam Cinema (TM) ]
Frame Divisor=1
Resolution=800x600
FPS=30.00
Colour Space=YUY2
Pan=0
Tilt=0
Zoom=0
Exposure=15.6ms (Auto)
Focus=7
Contrast=7
Saturation=97
Sharpness=21
White Balance=3758 (Auto)
Backlight Compensation=5
```

19. Try the *Quick Capture* button. At the bottom-right of the main screen, a progress bar should appear.



20. When this video capture has completed, click the link in the *Notification Bar*. The capture folder should contain a video file and a camera settings file. Double click the video to play it.

21. If all the above has worked, the SharpCap and camera installation has been successfully tested.

Removing SharpCap

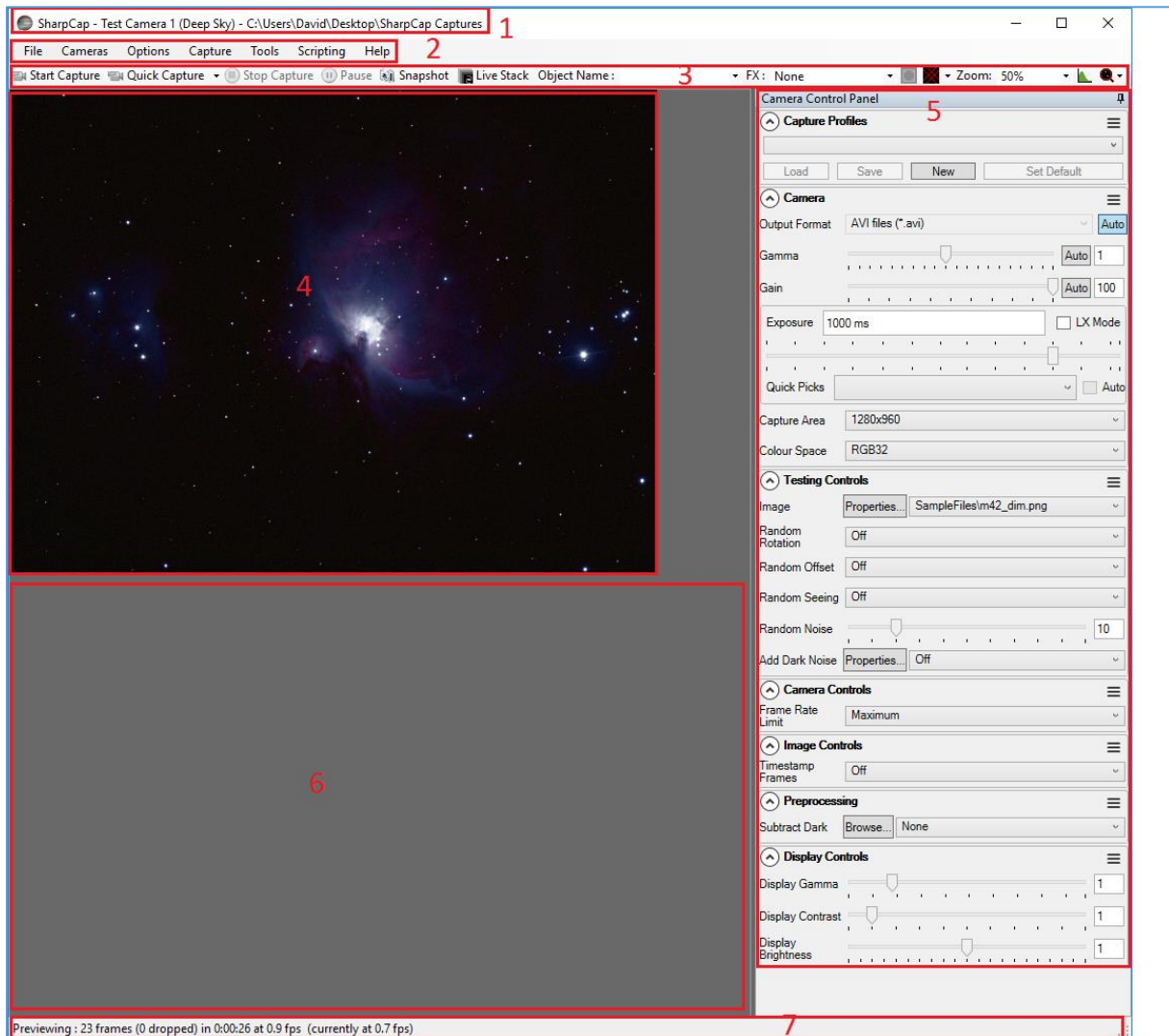
This section describes the complete removal of SharpCap and all its ancillary settings. This action might be required to perform a clean install with all old settings removed. This work is best carried out with an account with administrator privileges

Uninstall SharpCap – either from Control Panel or via the Start button, go to Programs and Features, highlight SharpCap and Uninstall. [Note: there may be multiple versions to choose from.]

See the Appendix for additional (non-essential) clean-up actions.

Introduction to the SharpCap User Interface

Upon starting SharpCap and dismissing the *Tip of the Day* message, the following screen appears:



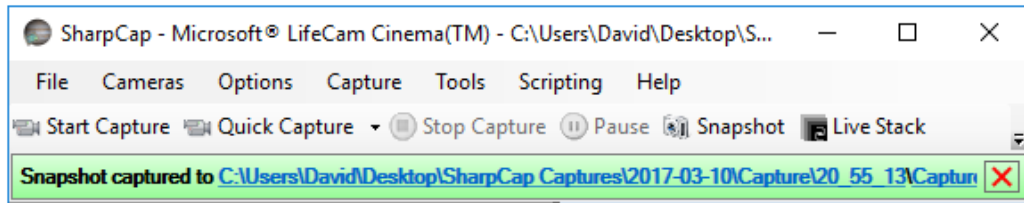
The SharpCap main screen consists of seven permanent areas and one temporary area.

The permanent areas are:

1. **Title Bar** – shows the selected (active) camera (if any) and the default capture folder.
2. **Menu Bar** – gives access to SharpCap functions.
3. **Tool Bar** – gives quick access to tools frequently used for image capture. When an image capture has completed a *Notification Bar*, giving save details, will appear below the *Tool Bar*.
4. **Capture Display Area** – shows the image currently being captured by the selected camera.
5. **Camera Control Panel** – gives access to all available controls for the selected camera. Items displayed in this panel will vary depending on the type, model and level of support of the connected camera.
6. **Work Area** – used as a display area by tools such as *Image Histogram*, *Calculate Focus Score* and *Live Stack*.
7. **Status Bar** – gives ongoing information about frames captured/dropped and frame rate. During a capture, a progress bar will appear at the right-hand end of the status bar.

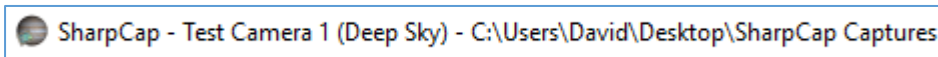
The temporary area is:

1. **Notification Bar** – appears below the *Tool Bar* upon completion of a *Capture* or *Snapshot* and provides a clickable link to go directly to the appropriate folder where the file has been stored. The notification bar is also used to provide other information – a green notification bar indicates success; a yellow bar indicates a warning and an orange bar indicates an error has occurred.

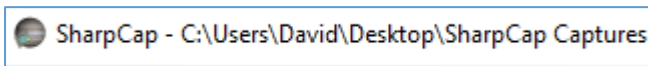


Title Bar

The *Title Bar* shows the selected (active) camera and the default folder for saving image captures.

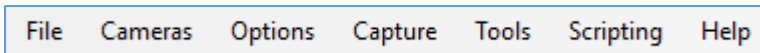


If no camera is active, only the default folder for saving image captures is shown.



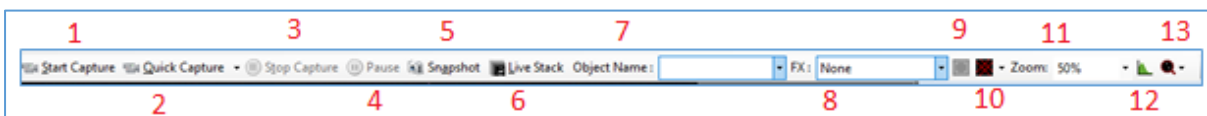
Menu Bar

The *Menu Bar* gives structured access to many aspects of SharpCap functionality.



Tool Bar

The *Tool Bar* gives easy access to a collection of facilities commonly used when performing an image capture.

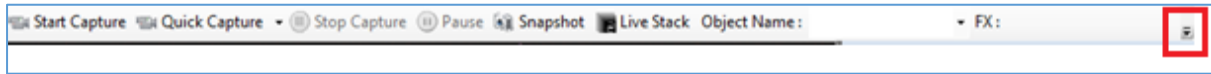


From left to right, these are:

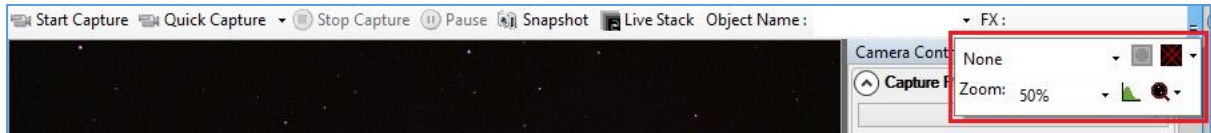
1. [Start Capture](#)
2. [Quick Capture](#)
3. [Stop Capture](#)
4. [Pause](#)
5. [Snapshot](#)
6. [Live Stack](#)
7. [Object Name](#)
8. [Preview Effects \(FX\)](#)
9. [FX Selection Area](#)
10. [Reticule Overlays](#)
11. [Zoom](#)
12. [Image Histogram](#)

13. [Calculate Focus Score](#)

If the SharpCap window is not wide enough to accommodate all the tool icons, the *Tool Bar* will look like this with a down arrow at the right-hand end:

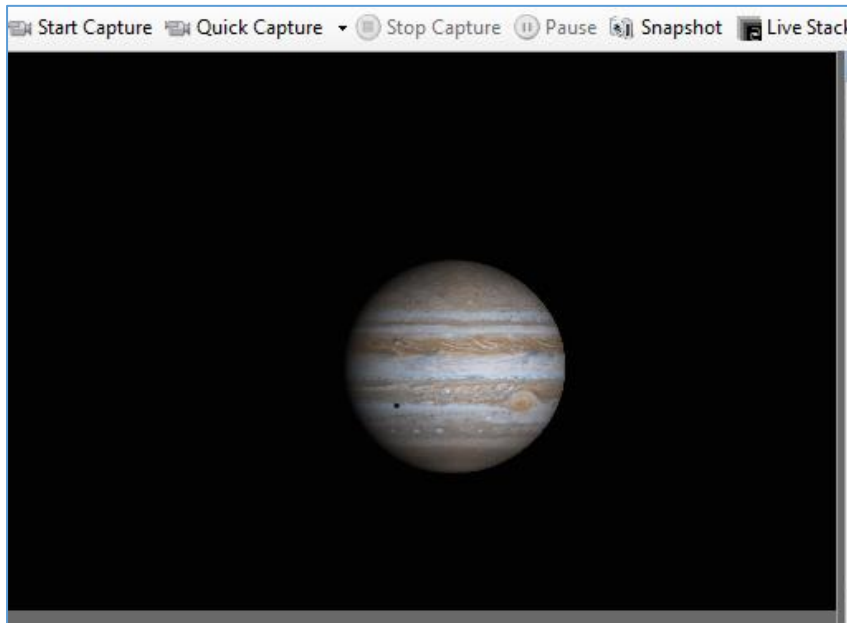


Click the down arrow to access the rest of the tool icons:



[Capture Display Area](#)

The *Capture Display Area* shows the view currently being seen by the active camera.



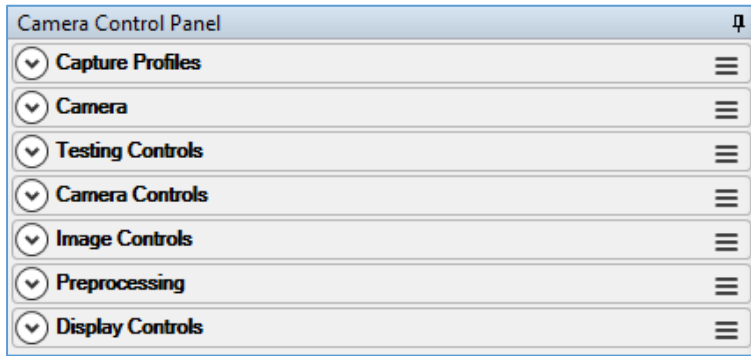
When a camera is selected in SharpCap (or SharpCap automatically selects a camera when it is started), SharpCap starts grabbing and displaying frames straight away. SharpCap isn't saving these frames, just showing them on the screen. Depending on the exposure length being used, the image may update many times per second or only once every few seconds (or even less frequently). SharpCap will only save images after use of the *Start Capture* or *Snapshot* buttons.

[Camera Control Panel](#)

The capabilities and available controls of the active camera are displayed in the *Camera Control Panel*. These controls are used to adjust camera settings such as exposure, resolution, colour balance and others. The groups and controls displayed can vary depending on:

- The manufacturer of the attached camera.
- The model of camera (even from the same manufacturer)

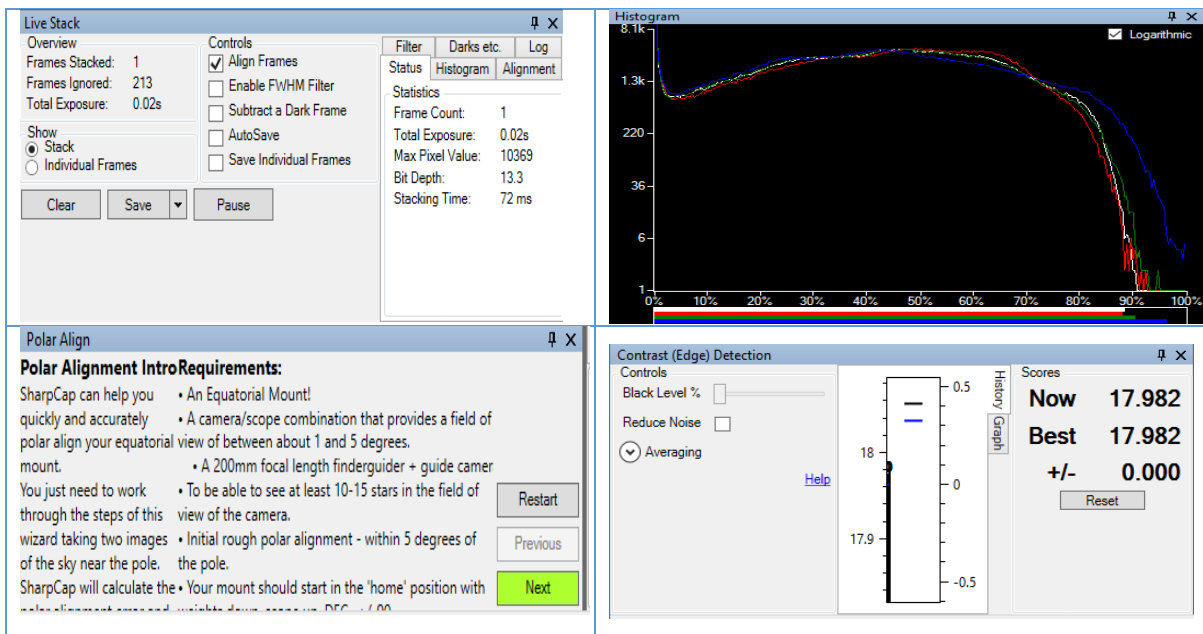
See [Camera Controls](#) for a full description. The controls are grouped logically and each group can be expanded/closed as required.



Work Area

The *Work Area* is the display area for the following tools:

- Live Stack
- Histogram
- Polar Align
- Focus Score



For each tool, the title bar of the panel can be used to drag the panel out of the main SharpCap form, for example to place it on a second monitor.

Status Bar

The Status bar at the bottom of the screen gives a constantly updated report on:


- Frames captured
- Frames dropped
- Duration of capture
- Capture speed, frames per second (fps)
- Memory available and in use
- Cooler Status (for cooled cameras)

- GPS Status (for GPS enabled cameras)

Previewing : 1770 frames (0 dropped) in 0:02:12, 13.3 fps | Memory: 2 of 466 frames in use. | Cooler: 28%, Temp -0.1C, Target 0.0C | GPS: ***Locked***

Frame Progress

When the exposure is set to 1s or longer, a progress bar will show on the right giving the progress of each frame

Frame:  00:04/00:12

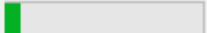
The numbers to the right of the progress bar are the time elapsed so far in the frame and the time left to go in the frame (both in MM:SS).

Some cameras take a considerable time to download a completed frame to the computer – while the download is happening, the time remaining in the frame may show a negative value. A negative value may also show if the camera has stopped responding properly and SharpCap is stuck waiting for a frame that has not arrived.

Capture Progress

When an image capture has been initiated, a progress bar is displayed at the right showing:

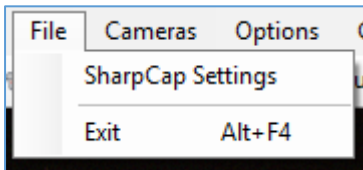
- Frames completed
- Frames remaining
- Estimated finishing time

Frames 8/100 (ETA 16:42) 

The Menu Bar

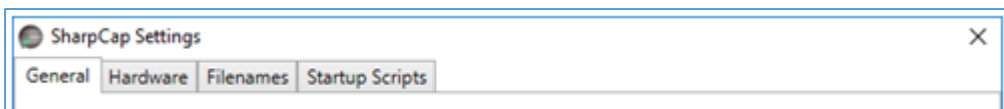
File

The *File* menu item has the following options.



SharpCap Settings

The *SharpCap Settings* defaults have been chosen to enable ease of use of the application with minimal configuration required after installation, however adjustment to the settings can be made here when necessary.



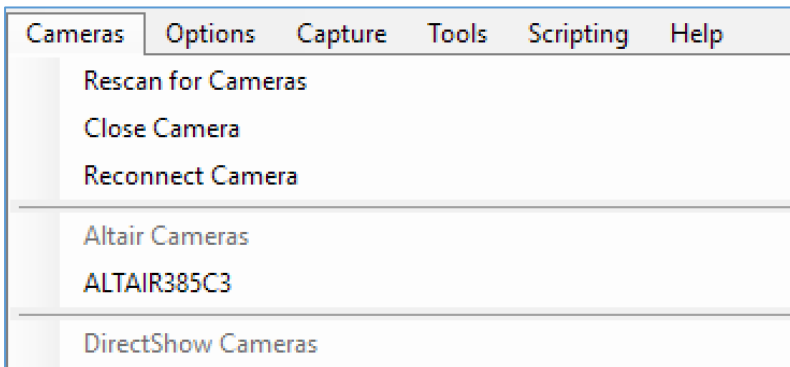
See [Configuring SharpCap](#) for a detailed description of the four tabs *General*, *Hardware*, *Filenames*, and *Startup Scripts*.

Exit

Selecting *Exit* or *Alt+F4* will perform an orderly shutdown of SharpCap.

Cameras

The *Cameras* menu item allows selection and de-selection of attached imaging devices. These may be cameras or video capture devices (frame grabbers).



Different types of camera are grouped into different sections of the menu – each section is headed by the description of the type of camera in that section – i.e. ‘Altair Cameras’, ‘DirectShow Cameras’, ‘ZWO Cameras’, etc.

Normally a new camera will be detected automatically when you plug it into your computer, but in some cases you may need to use the *Rescan for Cameras* option to detect a newly added camera.

Two ‘built-in’ cameras are provided:

1. Test Camera 1 (Deep Sky), a simulation of a capture of the M42 Nebula in the Constellation of Orion.

2. Test Camera 2 (High Speed), a simulation of a capture of Jupiter (the dark spot to the lower left being the shadow of a moon).

These two test cameras can be used to learn the functionality of SharpCap without requiring a telescope and camera.

[Note: some cameras (particularly ASCOM and DirectShow cameras) may show in the device list even when they are not connected to the computer – selecting one of these cameras not currently available will give an error message.]

Rescan for Cameras

If a camera connection is lost or a camera plugged in while SharpCap is open, use the *Rescan* option to find the device.

SharpCap automatically rescans after a USB device is added to or removed from the computer. The rescan button is mainly useful to detect network connected cameras (i.e. Basler or Point Grey Gig-E cameras) as SharpCap cannot detect these being added to the network.

Close Camera

This will close the currently open camera. A camera can also be closed by selecting the active camera a second time in the Cameras menu. Cameras are also closed automatically if a different camera is selected.

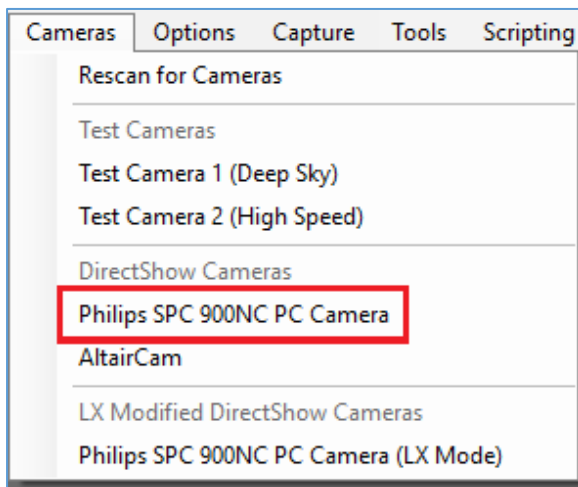
Reconnect Camera

This will stop then restart the currently connected camera. Under some circumstances this may help recover correct operation if a camera has become stuck or is not responding. If reconnecting the camera does not cure the problem then you may need to close and re-open SharpCap or disconnect and re-connect the camera.

Available Cameras

Select the camera to use from the dropdown list.

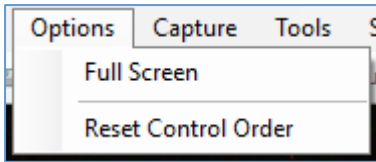
There may be occasion when a camera appears twice in the available cameras list. If in doubt which one to select, use the one highest in the list (because SharpCap tries to put the cameras it has the best control over at the top of the list). See the Philips SPC 900NC in the graphic below.



Sometimes it is useful to close the camera currently in use without opening a different camera. This can be achieved by returning to the *Cameras* menu and choosing the selected camera from the menu again.

Options

The *Options* menu item has the following items.

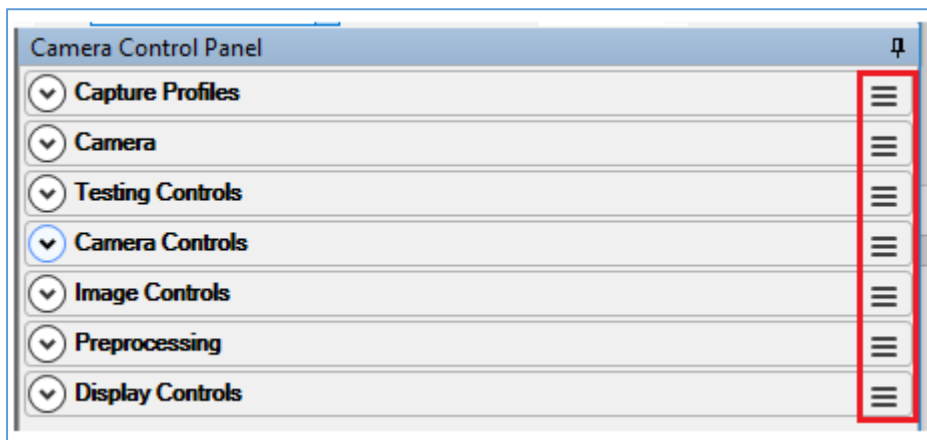


Full Screen

The *Full Screen* option forces SharpCap to switch to full screen mode. This leaves only the *Capture Display Area* and *Camera Control Panel* visible – there are no menu or tool bars available. To reverse this situation, move the mouse pointer to the top of the screen and the menu will appear. The *Full Screen* option can be unchecked. You can also switch in/out of full-screen view by pressing the F11 key.

Reset Control Order

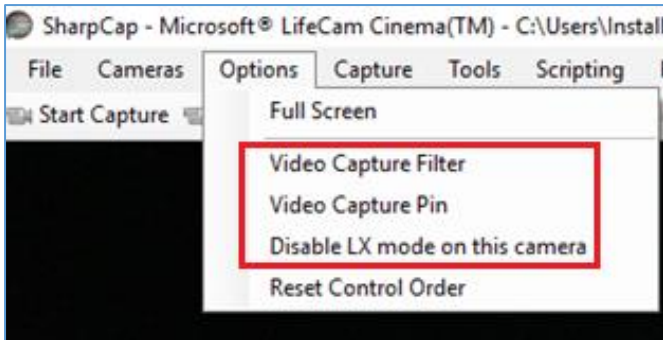
In the *Camera Control Panel*, each control group has a handle at the top right corner. This handle can be grabbed with a mouse and the control moved elsewhere in the *Camera Control Panel* to suit individual preferences. By choosing *Reset Control Order*, the control groups can be returned to their default order.



Other Options

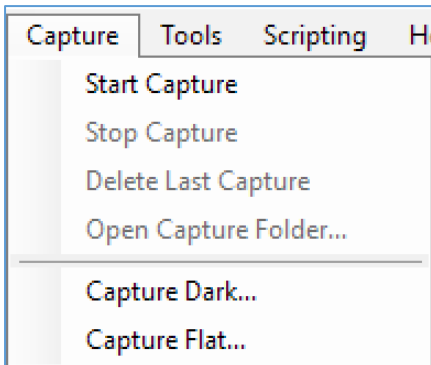
Depending on the manufacturer/model of camera connected and selected in SharpCap, other menu items may appear in the *Options* menu.

These are the additional menu items available when a Microsoft LifeCam (webcam) is connected and selected.



Capture

The *Capture* menu item has the following options.



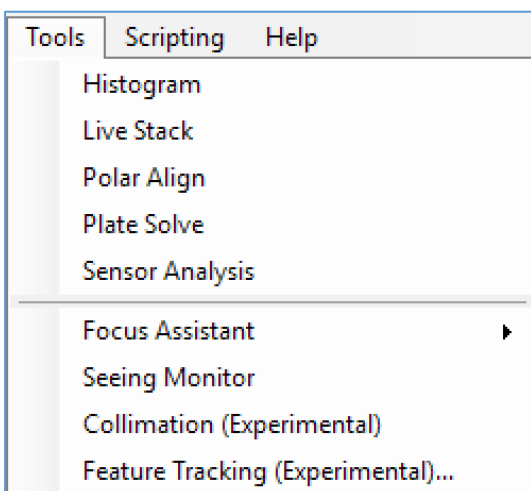
Capture allows control of:

- The capture process.
- The production of dark frames.
- The creation of flat frames.

See [Capturing Videos and Images](#) for a detailed description of these menu items.

Tools

The *Tools* menu item provides access to specific functions which can assist in capturing images or ensuring alignment of the telescope.



Histogram

This option provides access to the main SharpCap histogram functionality. See [The Histogram](#) for a full description of this tool.

Live Stack

This option provides the same functionality as the Live Stack button located on the Tool Bar. See [Live Stacking](#) for a full description of the tool.

<ALT> <L> can be used as a hot key combination to initiate *Live Stack*.

Polar Align

Selecting Polar Align will produce a set of screens to manage the alignment process. See [Polar Alignment](#) for a detailed description.

Plate Solve

This tool initiates a “blind” plate solving search to determine the celestial co-ordinates of the current image. The option will only be enabled if a compatible plate solving tool has been auto-detected or configured in the SharpCap settings. The progress and result of the plate solve operation will be shown in the notification bar. See [Plate Solving Tab](#) for more details on compatible plate solving tools and configuration.

Sensor Analysis

This tool launches the SharpCap sensor analysis routine which can measure the characteristics of your camera sensor. Once measured, the sensor data is stored and can be used in future to provide SharpCap smart histogram functionality. See [Sensor Analysis](#) and [Smart Histogram](#) for more details. Note that Smart Histogram is a SharpCap Pro feature.

Focus Assistant

The sub-options here allow the various [Focusing](#) tools to be selected.

Seeing Monitor

This launches the [Seeing Monitor](#) which can help you capture Lunar/Solar/Planetary images when the seeing is at its best.

Collimation (Experimental)

This launches the experimental [Collimation](#) assistant which may help with collimation of Newtonian telescopes.

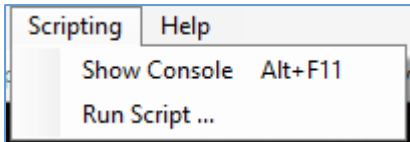
Feature Tracking (Experimental)

This launches the experimental [Feature Tracking](#) tool, which can guide your mount during Lunar/Solar/Planetary imaging to keep the target from drifting out of view.

Scripting

The *Scripting* menu item allows access to the *Scripting Console* and gives the ability to run existing scripts and write new scripts. The scripts are based on Python. The functionality of SharpCap can be extended by using scripting as a built-in programming language.

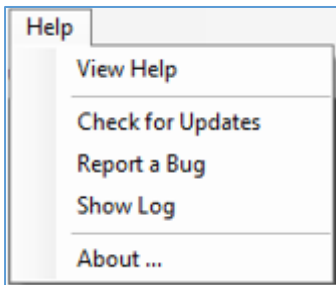
Scripting is an advanced topic and knowledge of it is not essential to be able to use SharpCap effectively.



See [Scripting](#) for a full description.

Help

The *Help* menu item has the following options.



View Help

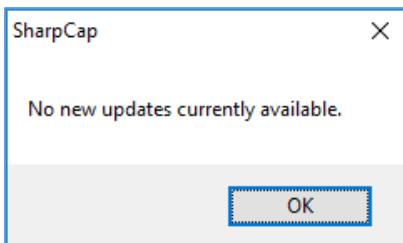
View Help will display a manual, in Windows help file format, installed as part of the of the SharpCap software.

SharpCap Pro License

Allows you to enter or check your [SharpCap Pro](#) license.

Check for Updates

Selecting *Check for Updates* will initiate a version check against the SharpCap website of the installed versus latest version. If no updates are available, the message below is displayed.



If an update is available, a download and installation is offered.

Report a Bug

This option provides direct link to the 'Bug Reports' area of the SharpCap forums. Before posting a new bug report in the forums, please check to see if the problem you are having has already been discussed – there may even already be a fix or workaround for the problem!

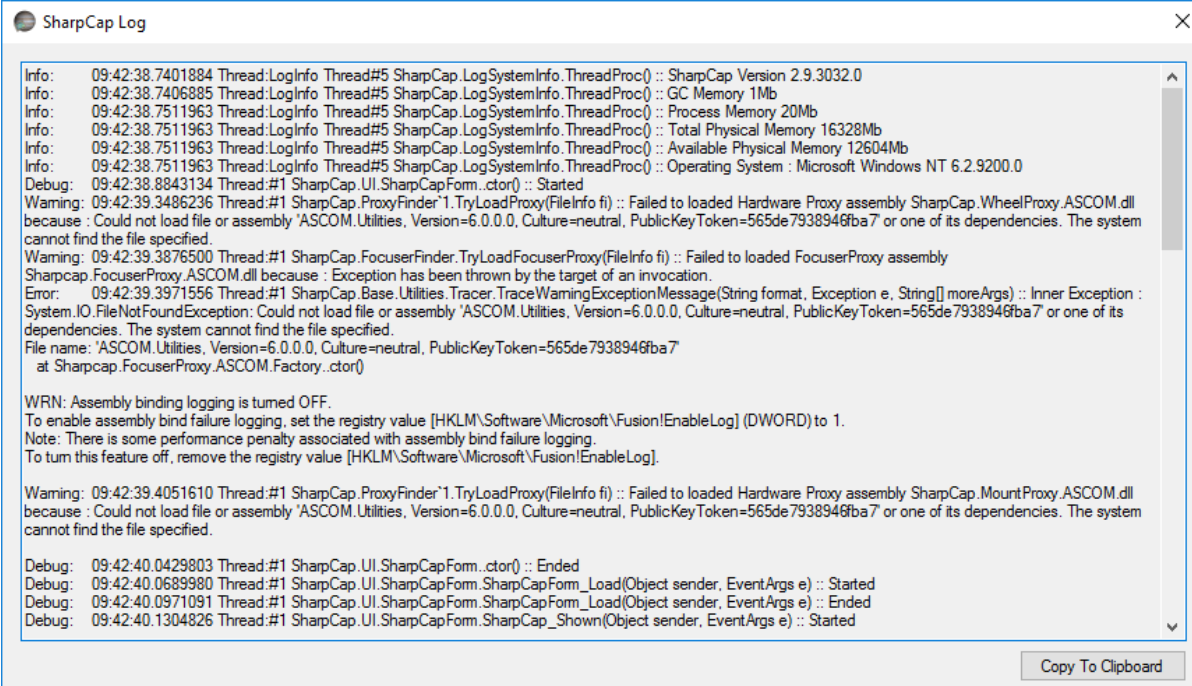
Support Forum

This will launch the SharpCap forums in your web browser. You will find hints, tips, guides, and discussion of the use of SharpCap and general astronomy on the forums.

Show Log

SharpCap shows ASCOM focuser positions on the Focus score graphs

SharpCap, in the background, is constantly logging events relating to the program.



```

SharpCap Log
Info: 09:42:38.7401884 Thread:LogInfo Thread#5 SharpCap.LogSystemInfo.ThreadProc() :: SharpCap Version 2.9.3032.0
Info: 09:42:38.7406885 Thread:LogInfo Thread#5 SharpCap.LogSystemInfo.ThreadProc() :: GC Memory 1Mb
Info: 09:42:38.7511963 Thread:LogInfo Thread#5 SharpCap.LogSystemInfo.ThreadProc() :: Process Memory 20Mb
Info: 09:42:38.7511963 Thread:LogInfo Thread#5 SharpCap.LogSystemInfo.ThreadProc() :: Total Physical Memory 16328Mb
Info: 09:42:38.7511963 Thread:LogInfo Thread#5 SharpCap.LogSystemInfo.ThreadProc() :: Available Physical Memory 12604Mb
Info: 09:42:38.7511963 Thread:LogInfo Thread#5 SharpCap.LogSystemInfo.ThreadProc() :: Operating System : Microsoft Windows NT 6.2.9200.0
Debug: 09:42:38.8843134 Thread:#1 SharpCap.UI.SharpCapForm..ctor() :: Started
Warning: 09:42:39.3486236 Thread:#1 SharpCap.ProxyFinder`1.TryLoadProxy(FileInfo fi) :: Failed to loaded Hardware Proxy assembly SharpCap.WheelProxy.ASCOM.dll because : Could not load file or assembly 'ASCOM.Utilities, Version=6.0.0.0, Culture=neutral, PublicKeyToken=565de7938946fba7' or one of its dependencies. The system cannot find the file specified.
Warning: 09:42:39.3876500 Thread:#1 SharpCap.FocuserFinder.TryLoadFocuserProxy(FileInfo fi) :: Failed to loaded FocuserProxy assembly SharpCap.FocuserProxy.ASCOM.dll because : Exception has been thrown by the target of an invocation.
Error: 09:42:39.3971556 Thread:#1 SharpCap.Base.Utilities.Tracer.TraceWarningExceptionMessage(String format, Exception e, String[] moreArgs) :: Inner Exception : System.IO.FileNotFoundException: Could not load file or assembly 'ASCOM.Utilities, Version=6.0.0.0, Culture=neutral, PublicKeyToken=565de7938946fba7' or one of its dependencies. The system cannot find the file specified.
File name: 'ASCOM.Utilities, Version=6.0.0.0, Culture=neutral, PublicKeyToken=565de7938946fba7'
at SharpCap.FocuserProxy.ASCOM.Factory..ctor()

WRN: Assembly binding logging is turned OFF.
To enable assembly bind failure logging, set the registry value [HKLM\Software\Microsoft\Fusion!EnableLog] (DWORD) to 1.
Note: There is some performance penalty associated with assembly bind failure logging.
To turn this feature off, remove the registry value [HKLM\Software\Microsoft\Fusion!EnableLog].

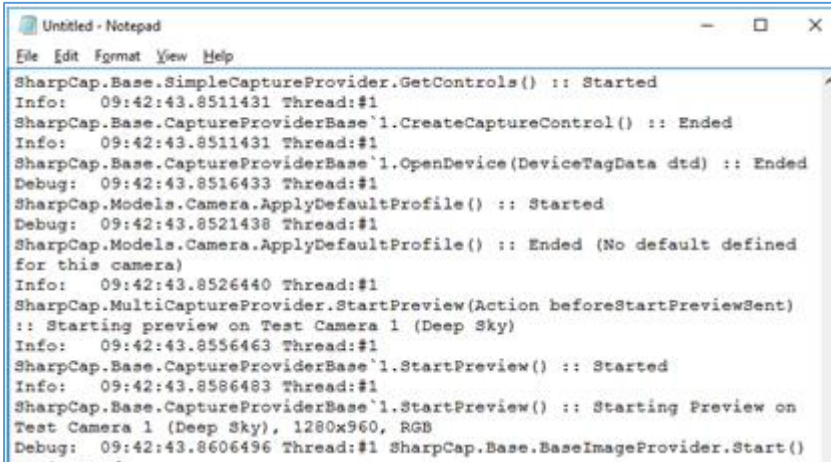
Warning: 09:42:39.4051610 Thread:#1 SharpCap.ProxyFinder`1.TryLoadProxy(FileInfo fi) :: Failed to loaded Hardware Proxy assembly SharpCap.MountProxy.ASCOM.dll because : Could not load file or assembly 'ASCOM.Utilities, Version=6.0.0.0, Culture=neutral, PublicKeyToken=565de7938946fba7' or one of its dependencies. The system cannot find the file specified.

Debug: 09:42:40.0429803 Thread:#1 SharpCap.UI.SharpCapForm..ctor() :: Ended
Debug: 09:42:40.0689980 Thread:#1 SharpCap.UI.SharpCapForm.SharpCapForm_Load(Object sender, EventArgs e) :: Started
Debug: 09:42:40.0971091 Thread:#1 SharpCap.UI.SharpCapForm.SharpCapForm_Load(Object sender, EventArgs e) :: Ended
Debug: 09:42:40.1304826 Thread:#1 SharpCap.UI.SharpCapForm.SharpCap_Shown(Object sender, EventArgs e) :: Started

```

Copy To Clipboard

Click the *Copy to Clipboard* button to copy the contents of the log. By opening Notepad (or other text editor) the contents of the log can be pasted and a file saved. The information on how to send the log file can be found at <http://forums.sharpcap.co.uk/>.

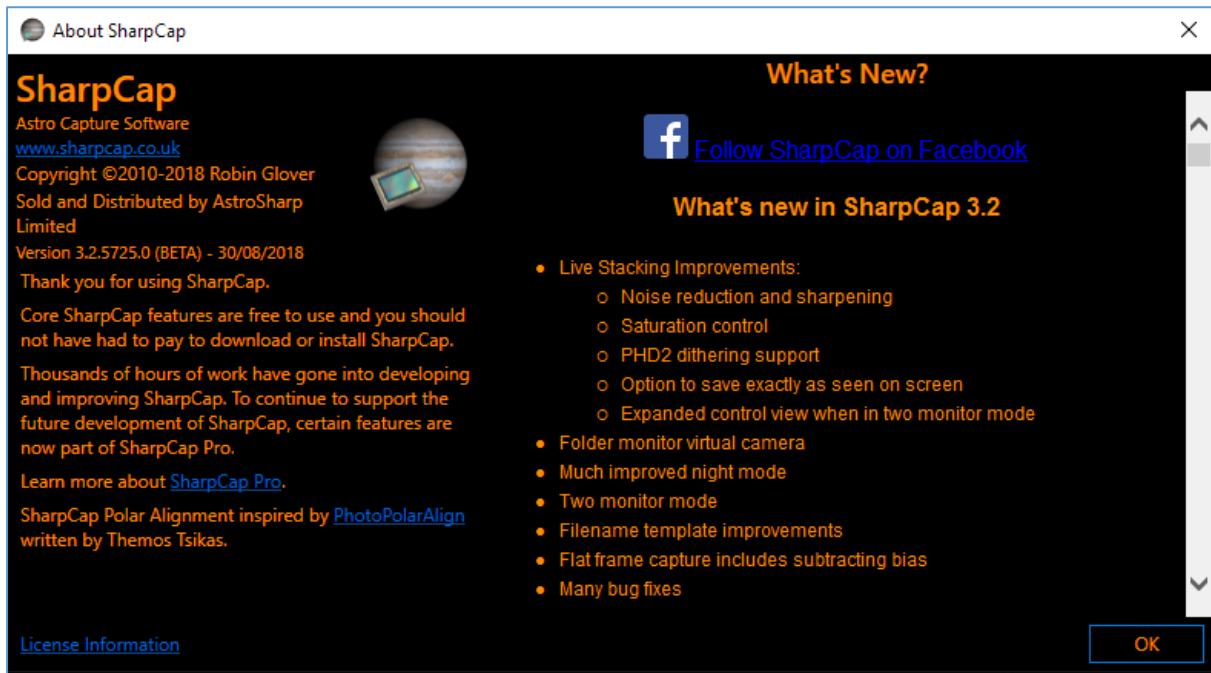


```

Untitled - Notepad
File Edit Format View Help
SharpCap.Base.SimpleCaptureProvider.GetControls() :: Started
Info: 09:42:43.8511431 Thread:#1
SharpCap.Base.CaptureProviderBase`1.CreateCaptureControl() :: Ended
Info: 09:42:43.8511431 Thread:#1
SharpCap.Base.CaptureProviderBase`1.OpenDevice(DeviceTagData dtd) :: Ended
Debug: 09:42:43.8516433 Thread:#1
SharpCap.Models.Camera.ApplyDefaultProfile() :: Started
Debug: 09:42:43.8521438 Thread:#1
SharpCap.Models.Camera.ApplyDefaultProfile() :: Ended (No default defined for this camera)
Info: 09:42:43.8526440 Thread:#1
SharpCap.MultiCaptureProvider.StartPreview(Action beforeStartPreviewSent) :: Starting preview on Test Camera 1 (Deep Sky)
Info: 09:42:43.8556463 Thread:#1
SharpCap.Base.CaptureProviderBase`1.StartPreview() :: Started
Info: 09:42:43.8586483 Thread:#1
SharpCap.Base.CaptureProviderBase`1.StartPreview() :: Starting Preview on Test Camera 1 (Deep Sky), 1280x960, RGB
Debug: 09:42:43.8606496 Thread:#1 SharpCap.Base.BaseImageProvider.Start() :: Started

```

About

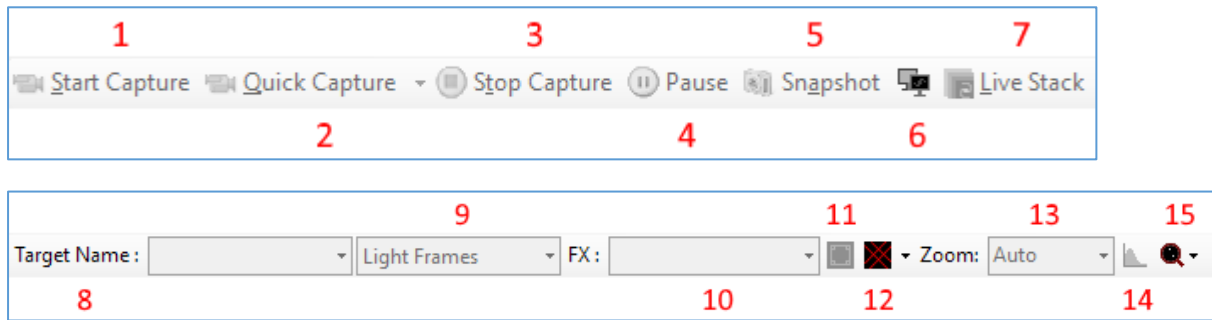


The *About* window provides:

- A link to the SharpCap website.
- A message informing an upgrade to a SharpCap Pro License is available.
- Acknowledgements.
- A link to License Information.
- A link to the SharpCap Facebook page.
- Version and Change history. The currently installed version shown here is 3.2.5725.

The *About Window* is shown here in the dark colour scheme.

The Tool Bar



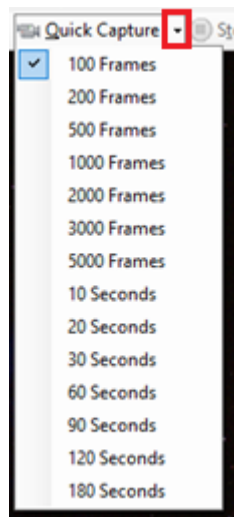
Start Capture

The *Start Capture* button will start a video capture to a new file. The functionality is identical to choosing *Capture > Start Capture* from the menu. See [Capturing Videos and Images](#) for a full description.

Quick Capture

Clicking the *Quick Capture* button will initiate a video capture to a new file but use a pre-selected number of frames or seconds.

To modify the pre-selected value, click the down arrow and select a new value. This value will be 'remembered' for future quick captures.



<ALT> <Q> can be used as a hot key combination to initiate a *Quick Capture*.

Stop Capture

When a capture is in-progress, the *Stop Capture* button will be available and will stop the current capture.

Pause

When a capture is in-progress, the *Pause* button will be available and will pause capture. This is useful if a cloud is passing over the object of interest. Pausing capture only stops frames from being saved to file – the image shown on screen will continue to update.

Snapshot

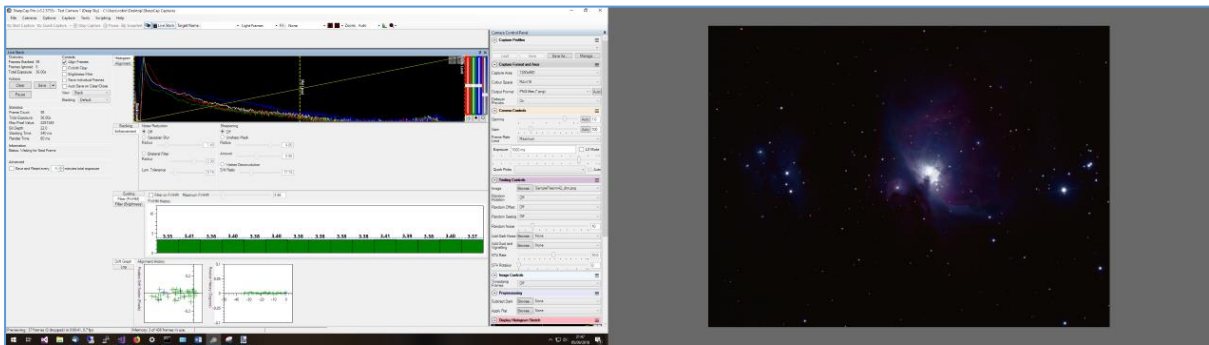
The *Snapshot* button will capture the current image as seen in the display area to a PNG or FITS file. The location of the captured file appears in the *Notification Bar* below the *Tool Bar*, for example:

Snapshot captured to C:\Users\David\Desktop\SharpCap Captures\2017-01-25\Capture\00_38_24\Capture_0001.fits

<ALT> <A> can be used as a hot key combination to initiate a *Snapshot*.

Two Monitor View

This button will only appear on a PC with two or more monitors connected (the monitors must also be used to 'Extend' the display rather than 'Mirror' it). When pressed SharpCap will switch between the normal view on one monitor and a two-monitor view where the camera image is transferred to the second monitor and all controls remain on the initial monitor. This is particularly useful when *Live Stacking* as the live stacking controls can be allocated much more space on the first monitor.



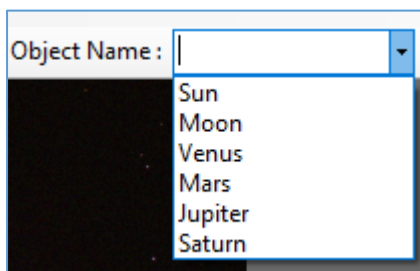
Live Stack

This button initiates the *Live Stack* process. The functionality is identical to choosing *Tools > Live Stack*. See [Live Stacking](#) for a full description of the tool.

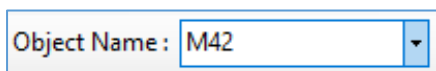
<ALT> <L> can be used as a hot key combination to initiate *Live Stack*.

Object Name

Selecting *Object Name* in the main toolbar allows a pre-defined object to be selected and used as part of the capture folder hierarchy.



A new name can also be typed here to represent the current object of interest – such as *M42* or *Orion Nebula*.



Subsequent captures would be saved in a sub-folder called *M42* (or *Orion Nebula*) under the default capture folder. Objects added here will not persist across SharpCap restarts. To become permanent, the object must be added via *File > SharpCap Settings > General tab*.

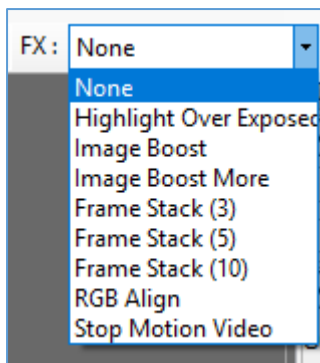
This tool is convenient for self-documentation purposes (in the capture folder name hierarchy) during an imaging session. For example, names such as 'M42 CLS filter' and 'M42 f6.3 reducer' can be created to identify equipment used for a capture.

Frame Type

This dropdown only shows if the *Filename Settings* are set to the advanced [Filename Templates](#) mode. You can select the type of frame you are capturing here and the type will be substituted into the filename template for any saved files.

Preview FX (effects)

The *Preview Effects, FX*, dropdown contains the options shown below.



When an FX option is chosen, the *FX Selection* tool from the tool bar becomes active.



A red rectangle, which can be dragged and re-sized, appears on the image. In this way, the special effect can be applied only to the selected area.



Preview Effects (FX) will apply only to the display and not affect the captured data.

This tool can also be used with the *Image Histogram* and *Calculate Focus Score* tools to limit an action to a section of the image.

None

No effects are applied to the image.

Highlight Over Exposed

Any part of the image which is deemed to be over exposed is highlighted in red. In this graphic, notice the red highlighted areas.



This is a more extreme example using the moon – the camera exposure setting needs to be reduced to remove the red highlighted area.

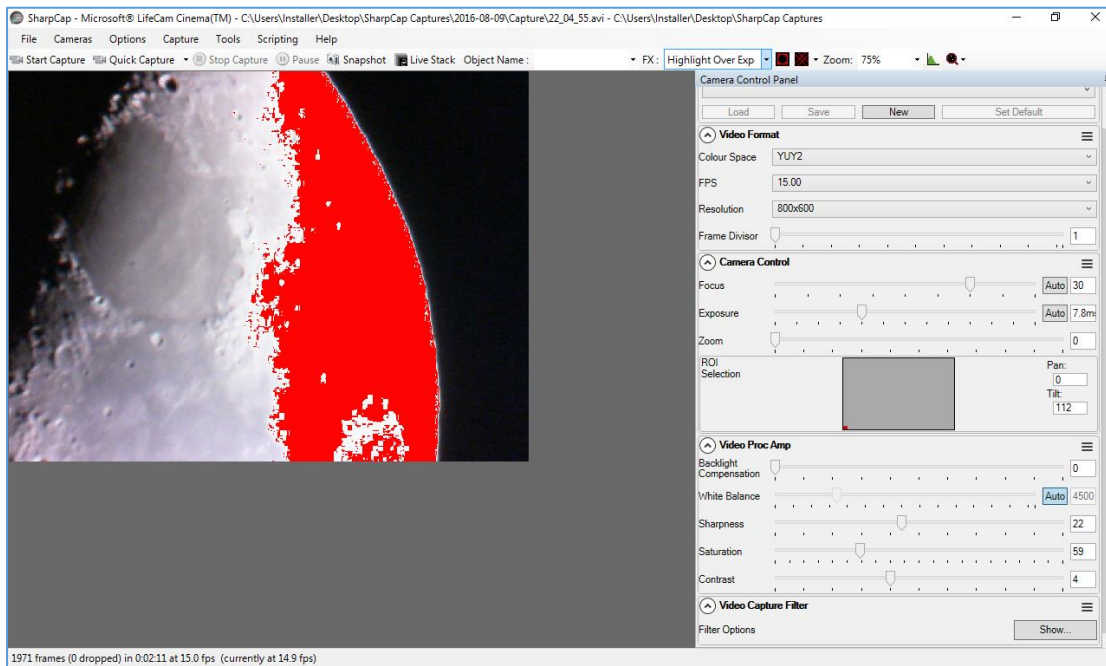


Image Boost

Image Boost is useful when trying to find fainter objects. The image will appear slightly grainy as noise is introduced.



Image Boost More

Image Boost More applies a greater boost to the image, allowing even fainter objects to be revealed. An increase in graininess is to be expected.



Frame Stack (3)

With *Frame Stack (3)*, 3 images are stacked. This effect can assist when looking for fainter objects. Stacking when this option is applied does not attempt to align new images with previous images in the stack.



Frame Stack (5)

With *Frame Stack (5)*, 5 images are stacked. This provides a further boost to brightness when trying to locate faint objects.



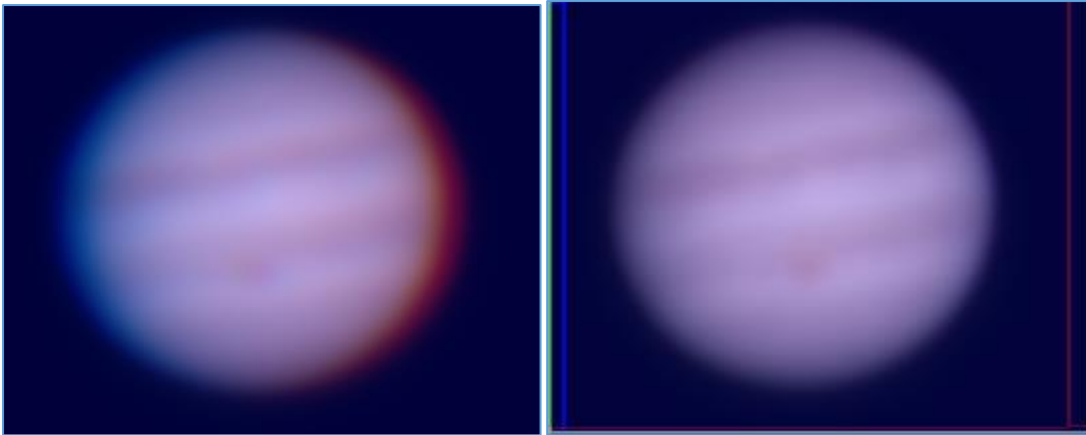
Frame Stack (10)

With *Frame Stack (10)*, 10 images are stacked.

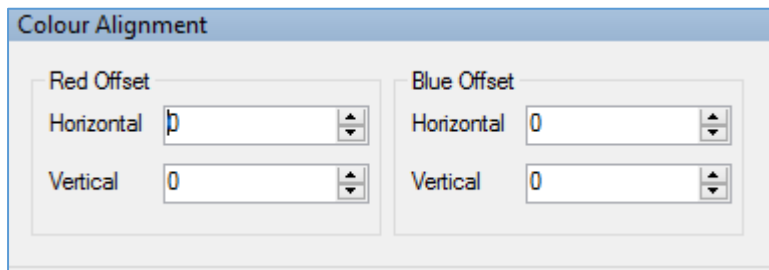


RGB Align

RGB Align can be used for planetary imaging when, due to atmospheric conditions, the object being imaged has colour distortion at the edge. In this *extreme* example, note the red on one side and the blue on the other, caused by the varying refraction of colours of light as they enter the atmosphere.



Use this option to adjust the red/blue values to obtain a good image on screen to ensure best focus when preparing to capture. The right-hand image shows the same view of Jupiter with the colour channels aligned.



RGB Align applies only to the previewed image, it does not affect the captured data. Other programs, such as Registax, allow re-alignment of RGB channels in the final captured images.

Since the RGB align only affects the image as displayed on screen, its main use is to correct for RGB misalignment to allow a better judge of focus quality to be obtained, or for live broadcasting of planetary imaging.

Stop Motion Video

This option will terminate an in-progress video capture. A basic tool to allow stop motion frames to be captured from any camera supported by SharpCap.

FX Selection Area

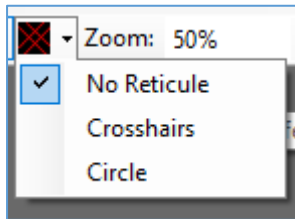
The *FX Selection Area* tool creates a red selection rectangle on the image which can be dragged and re-sized. This selected area is used when applying special effects (*FX*) or when using the *Calculate Focus Score* tool.



The *FX Selection Area* tool can also be used to investigate the histogram of a reduced area when using the *Image Histogram* tool and specify the area of the image to be processed for other operations such as the sensor analysis tool.

Reticule Overlays

The *Reticule Overlay* tool has 4 options.



By repeatedly clicking the icon located in the Tool Bar, the display area will cycle through the reticule options. The reticule can be selected directly by using the drop-down menu to the right of the button.

- The reticule can be 'grabbed' by the mouse and moved around in the display area.
- When the reticule is displayed, the centre point can be moved by clicking anywhere on the preview display.
- Dragging or clicking with the right mouse button instead will adjust the orientation or size of the reticule.

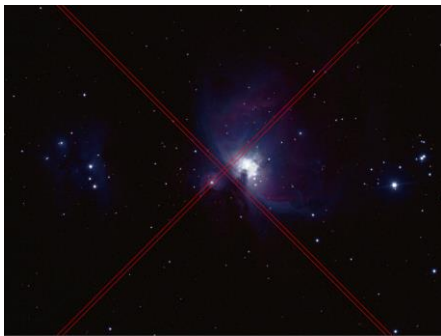
The rotation angle of each reticule is also shown near the center of the reticule.

No Reticule

The graphic is cleared from the image. This is the default.

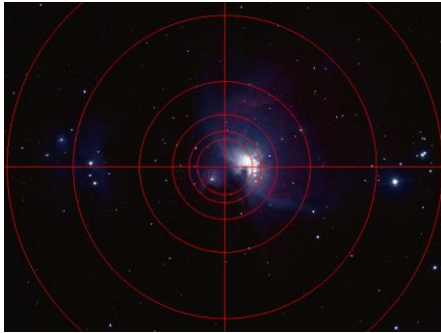
Crosshairs

A crosshair graphic is imposed over the image in the display area. This can be used to facilitate accurate mount alignment using a camera rather than an eyepiece.



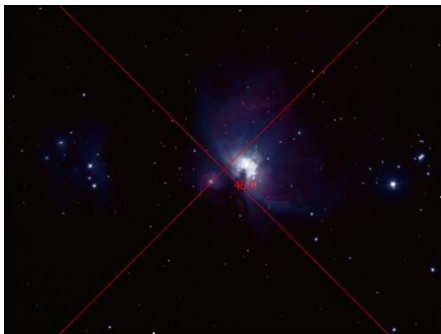
Circle

A circular graphic is imposed over the image in the display area. This can be used to facilitate accurate mount alignment using a camera rather than an eyepiece. The rings can also be used to assist with collimation.



Single Crosshair

A simple single crosshair (one line only in each direction).



Zoom

The *Zoom* tool gives the ability to zoom in or out of the image in the *Capture Display Area*. You can also adjust the zoom by using the mouse wheel while holding the down the <Control> key. If you are using a laptop with a touch panel, you may also be able to adjust the zoom using 'pinch' gestures.

This feature can be used to:

- Zoom in when searching for fainter objects.
- Zoom in when trying to place the *FX Selection Area* over a single-star when using the *Calculate Focus Score* tool.
- Zoom in when trying to accurately set the *Black Level %* when using the *Calculate Focus Score* tool.
- Zoom out to reduce the image when *Live Stack* or *Image Histogram* are in use.
- Zoom out to reduce the image size displayed when capturing at higher camera resolutions.
- Zoom has a range of 16% - 800%.
- *Auto* zoom is a sensible working setting for most purposes – it will fit the image to the screen space available.

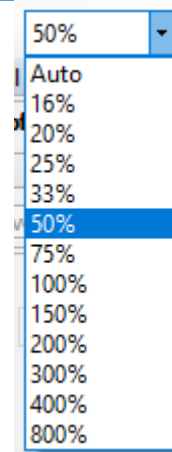


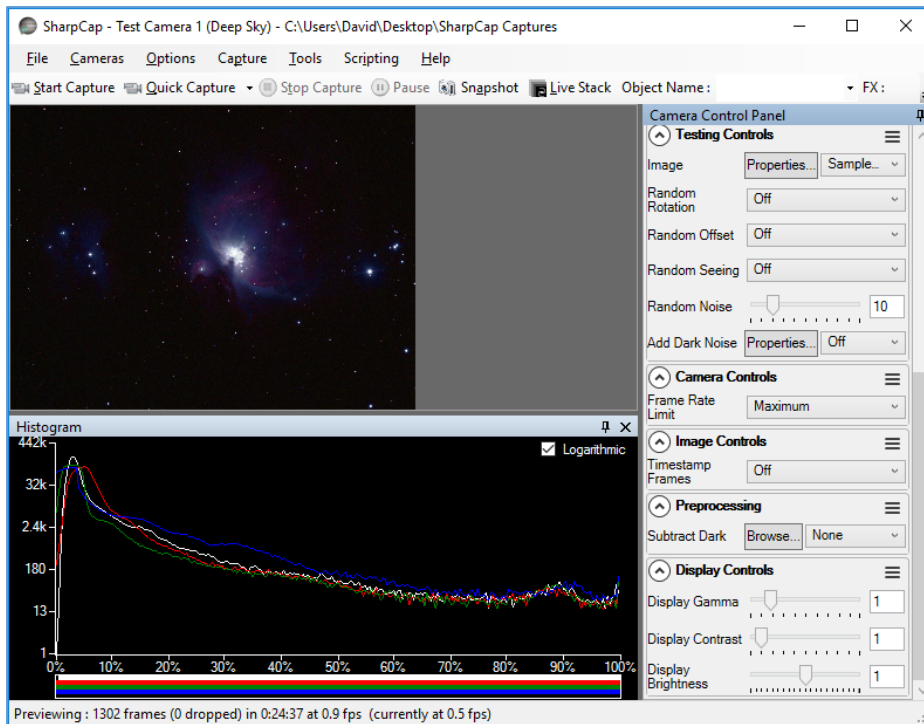
Image Histogram

A correctly shaped *Histogram* is a key requirement to producing quality images.

Clicking the *Image Histogram* icon in the *Tool Bar*:



will display the *Image Histogram* in the *Work Area* of the *Main Screen*.

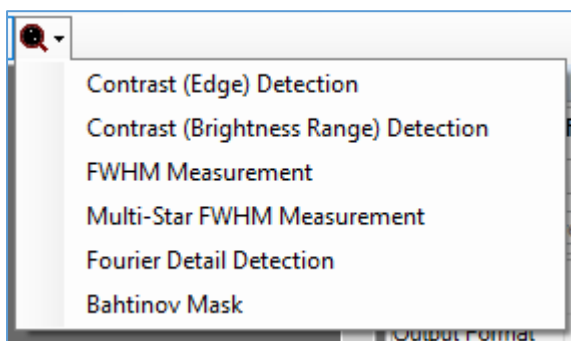


See [The Histogram](#) for a full description and examples including information on logarithmic versus linear scales and the impact of solar/lunar/planetary/deep sky/ROI on the shape of a histogram.

Calculate Focus Score

SharpCap has a several options to help acquire focus on targets (possibly one of the most challenging aspects of astrophotography). The tools are particularly powerful if an ASCOM focuser is configured in SharpCap.

Focus assistance is started by selecting the *Calculate Focus Score* icon from the *Tool Bar*.



Focus tools for planetary or surface targets:

- Contrast (Edge) Detection
- Contrast (Brightness Range) Detection
- Fourier Detail Detection

Focus tools for stars or other point sources:

- FWHM Measurement
- Multi-Star FWHM Measurement
- Bahtinov Mask

See [Focusing](#) for a full description including introductory materials and examples.

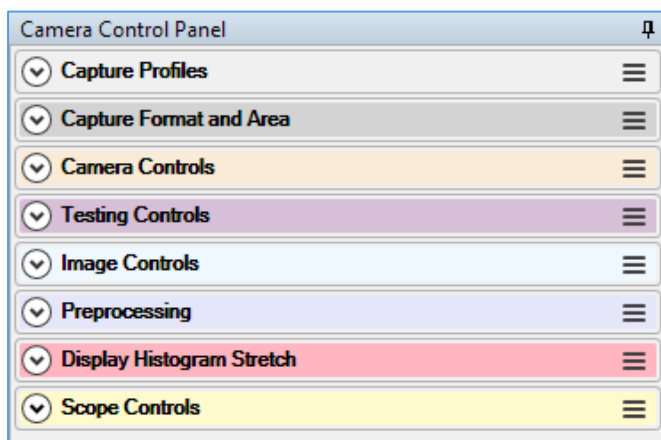
Camera Control Panel

The capabilities and available controls of the active camera are displayed in the *Camera Control Panel*. The groups and controls displayed can vary depending on:

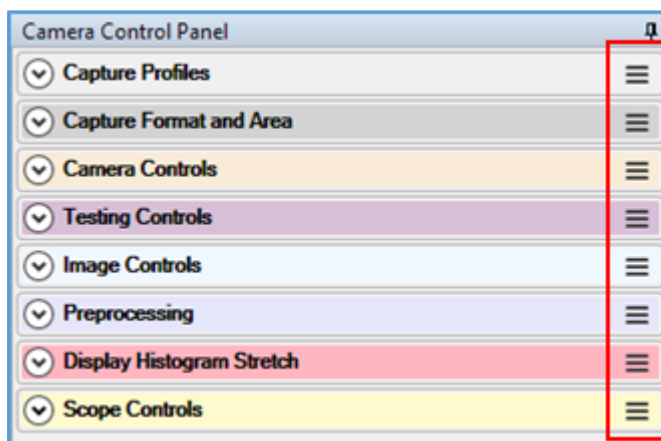
- The manufacturer of the attached camera.
- The model of camera (even from the same manufacturer)

See [Camera Controls](#) for a full description. Common camera controls are described first followed by descriptions of manufacturer specific camera controls.

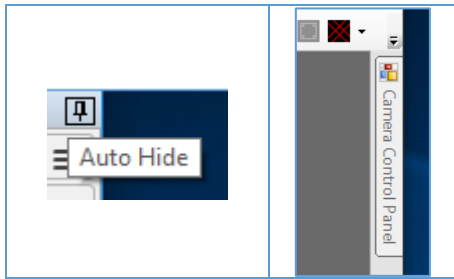
- The controls are grouped logically and each group can be expanded/closed as required. Each group has its own heading colour which helps you quickly identify the correct group when looking for a particular control.



- The control groups can be grabbed with a mouse and the order re-arranged to suit user preferences. To reset the order to default, use *Options > Reset Control Order* from the main menu.



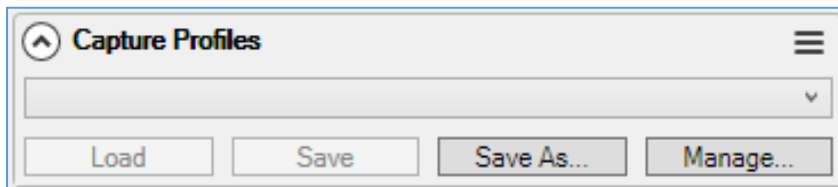
- The title bar of the panel can be used to drag the panel out of the main SharpCap form, for example to place it on a second monitor.
- The pin icon can be used to Auto Hide the Camera Control Panel, leaving it docked at the side.



- A new value can be typed in for many controls. Any camera controls showing a numeric value (gain, exposure, brightness and many others) can be changed by typing a new value into the display box and pressing <Enter> or <Tab>. If a value typed in is out of range, the value will be ignored.

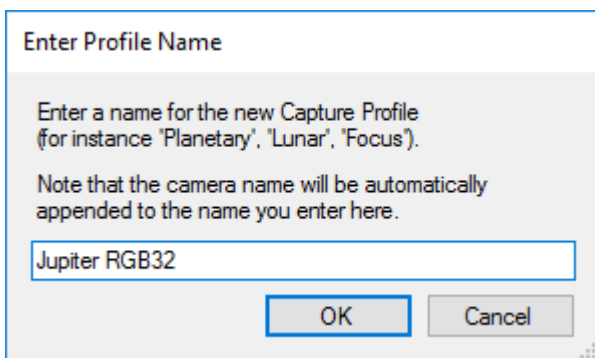
Capture Profiles

A *Capture Profile* is a collection of camera settings stored in a text file. Various profiles can be loaded to have instant access to known collections of settings for different targets and cameras.

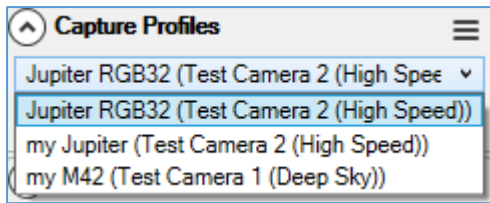


- *Load* – loads the values from the capture profile currently selected in the drop down and applies them to the camera controls.
- *Save* – takes the current values of the camera controls and writes them to the profile currently selected in the dropdown (overwrites the profile).
- *Save As* – creates a new profile from the current camera control values.
- *Manage* – shows the Capture Profile management screen, which allows you to rename, delete and set capture profiles as default.

A new *Capture Profile* can be created by clicking *Save As*, entering a meaningful profile name, followed by *OK*.



The available stored *Capture Profiles* can be accessed from the drop down:

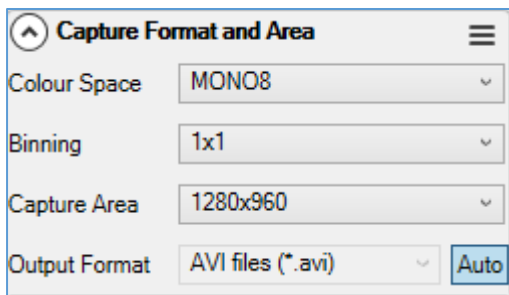


Note, changing the selected item in the drop down of profile names doesn't do anything by itself, it just changes the profile used if *Save* or *Load* is pressed.

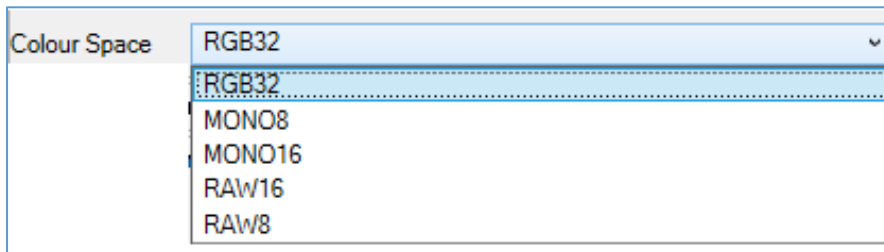
If a default profile is set for a camera then that profile is automatically loaded each time the camera is opened.

Capture Format and Area

The controls in this section allow management of the resolution, bit depth, colour space and binning of the camera as well as the save format for any captured images.



An alternate *Colour Space* can be chosen if required.



When the output format is set to *Auto*, SharpCap will chose the most appropriate save format for capture files depending on the colour mode chosen and the exposure length.

- Exposures of less than 5s will be saved into a video format.
- Exposures of 5s or more will be saved as individual frames.
- RGB and Mono at 8 bits per pixel will be saved to AVI or PNG.
- 16 bit per pixel or RAW modes will be saved to SER or FITS.

Camera Controls

The controls in this section allow management of the exposure, gain and other mostly hardware related features of the camera.

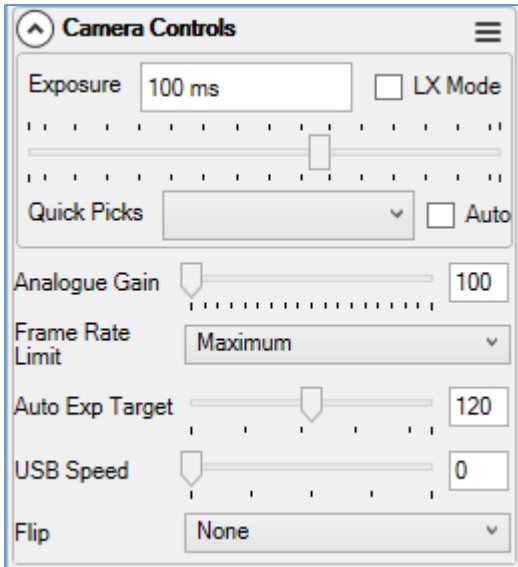
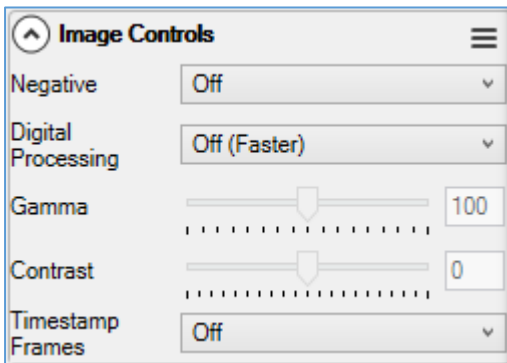


Image Controls

The controls in this section allow application of basic image processing such as brightness, gamma and contrast to the images being captured by the camera. The range of controls available is determined by the camera manufacturer/camera driver author.

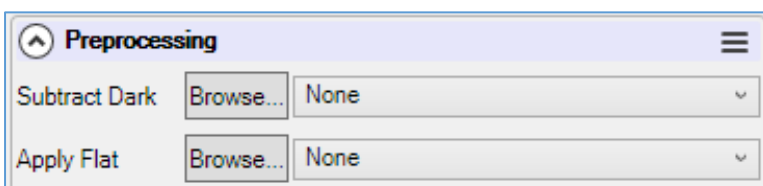


SharpCap can add a timestamp showing the date and time to captured frames from many cameras. Supported cameras include ZWO, QHY, Altair and iNova cameras, and DirectShow cameras when capturing in MONO8 or RGB24 format.

Adding a timestamp to DirectShow cameras capturing in compressed formats (such as I420, MJPG, YUY2) is not currently supported as SharpCap would need to decompress, alter and recompress each frame.

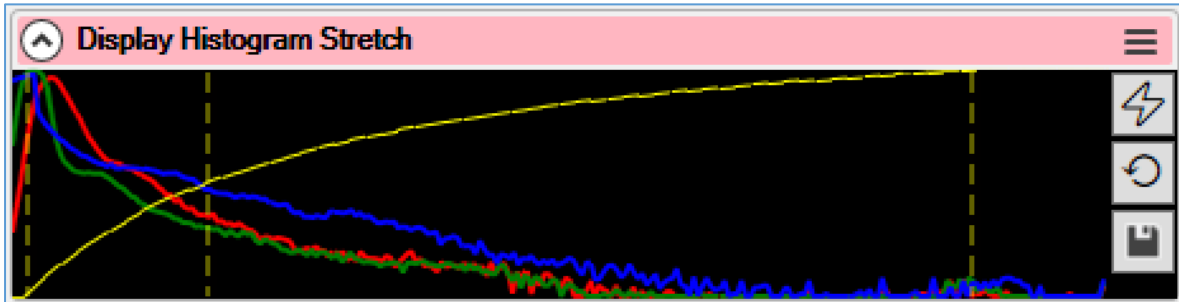
Pre-processing

You can configure dark subtraction and flat frame correction here. SharpCap's flat frame correction code has been designed to allow it to process images at high speed from USB3 cameras, allowing the live removal of artifacts such as dust shadows will capturing lunar/solar/planetary imaging videos. See [Capturing and Using Dark Frames](#) and [Capturing and Using Flat Frames](#) for more details.



Mini Histogram and Display Stretch

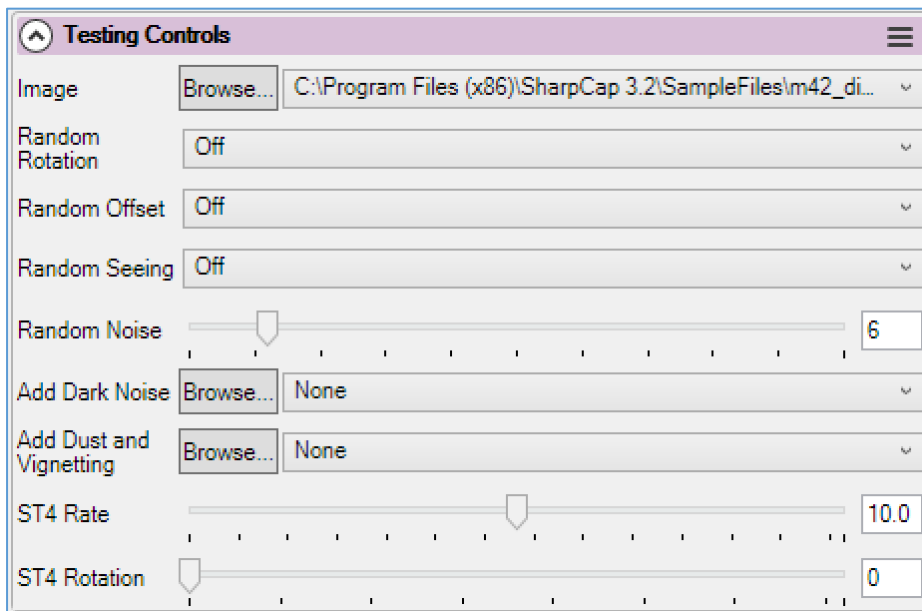
This control shows an always-on mini histogram of the current image and allows the image displayed on screen to be 'stretched' without affecting the data saved to file when capturing. Stretching the displayed image means that the brightness and/or contrast can be enhanced, or faint detail can be brightened easily. The stretch function provides similar effects to the *Image Boost* options in the FX dropdown but with finer control.



See [Mini Histogram and Display Stretch](#) for more details.

Testing Controls

The testing Controls group is specific to the two test cameras included with SharpCap. The controls allow for the simulation of atmospheric conditions, addition of simulated dark noise or dust specks and a simulated ST4 guiding port.



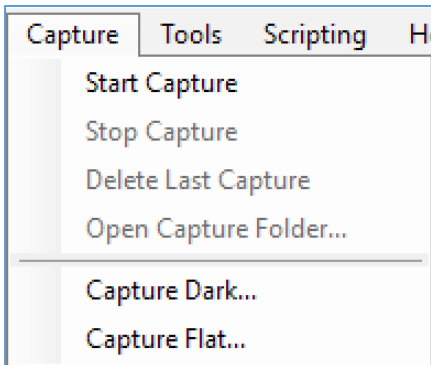
Other Controls

These are manufacturer dependent, examples include:

- Telescope controls.
- Thermal controls such as fan on/off.
- GPS settings.

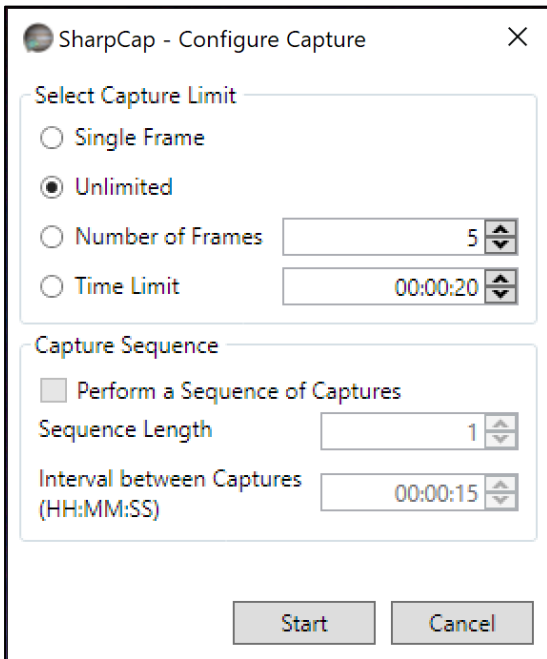
Capturing Videos and Images

Video and image capture can be started from the Capture menu or the equivalent buttons in the toolbar.

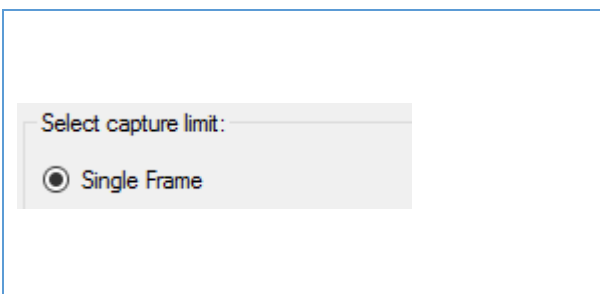


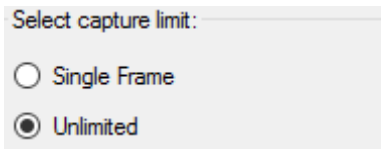
Start Capture

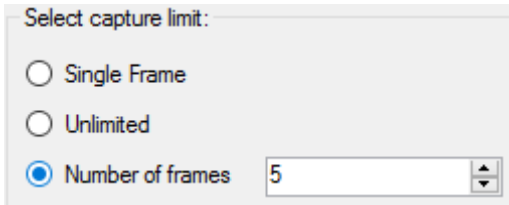
The *Start Capture* menu item or toolbar button allows a custom capture limited either by number of frames or time to be started.

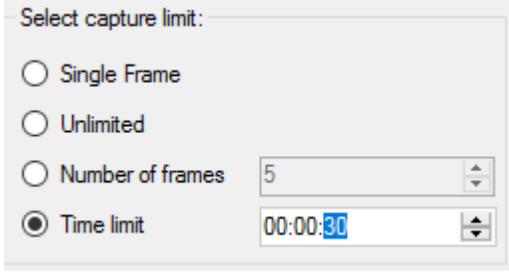


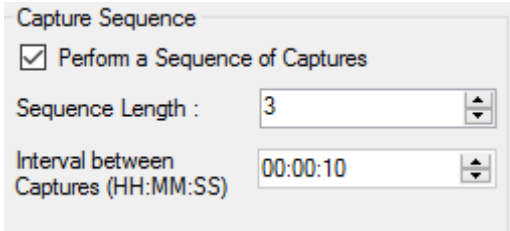
Capture Limits Explained

	<ul style="list-style-type: none"> • Two files will be created – a single frame PNG or FITS, together with the camera settings TXT. • Upon completion of the capture, information will be displayed in the <i>Notification Bar</i>. • The files will be stored in the default capture folder.
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 <p>Select capture limit:</p> <p><input type="radio"/> Single Frame</p> <p><input checked="" type="radio"/> Unlimited</p>	<ul style="list-style-type: none"> • Two files will be created – an AVI or SER, together with the camera settings TXT. • Note if a still file format is selected in the 'Output Format' control, multiple still image files will be created in a single folder instead of a single video file. • Upon completion of the capture, information will be displayed in the <i>Notification Bar</i>. • The files will be stored in the default capture folder. • The capture will continue until the <i>Stop Capture</i> button in the tool bar is clicked.
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 <p>Select capture limit:</p> <p><input type="radio"/> Single Frame</p> <p><input type="radio"/> Unlimited</p> <p><input checked="" type="radio"/> Number of frames <input type="text" value="5"/></p>	<ul style="list-style-type: none"> • Two files will be created – an AVI or SER, together with the camera settings TXT. • Note if a still file format is selected in the 'Output Format' control, multiple still image files will be created in a single folder instead of a single video file. • Upon completion of the capture, information will be displayed in the <i>Notification Bar</i>. • In this example, the capture file will contain 5 frames. • The files will be stored in the default capture folder.
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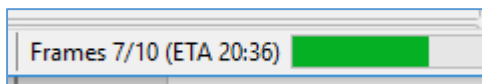
 <p>Select capture limit:</p> <p><input type="radio"/> Single Frame</p> <p><input type="radio"/> Unlimited</p> <p><input type="radio"/> Number of frames <input type="text" value="5"/></p> <p><input checked="" type="radio"/> Time limit <input type="text" value="00:00:30"/></p>	<ul style="list-style-type: none"> • A time limit can be set using HH:MM:SS. In this example 30 seconds is the limit set for the capture. • Two files will be created – an AVI or SER, together with the camera settings TXT. • Note if a still file format is selected in the 'Output Format' control, multiple still image files will be created in a single folder instead of a single video file. • Upon completion of the capture, information will be displayed in the <i>Notification Bar</i>. • In this example, the capture file will be a 30 second video. • The files will be stored in the default capture folder.
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	<ul style="list-style-type: none"> • This repeats the capture defined in the <i>capture limit</i> section above. • Note this option cannot be activated when the capture limit set above is 'Unlimited'. • A sequence of captures, with an interval between them, can be initiated. • In this example, 3 captures will be taken, with an interval of 10 seconds between them. • Six files will be created – 3 AVI or SER, together with 3 camera settings TXT. • Upon completion of the capture, information will be displayed in the <i>Notification Bar</i>. • In this example, the capture files will be a 3 x 10 second videos. • The files will be stored in the default capture folder.
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Once the capture options have been set, press the *Start* button to begin the capture or press the *Cancel* button to abort.

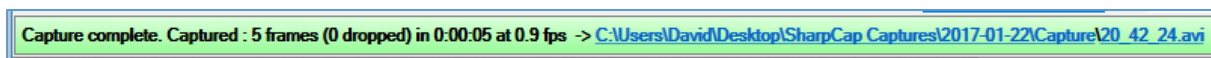
With large numbers of frames or extended time sequences it is advisable to use a guided telescope.

During a capture, the progress will be shown at the right-hand end of the *Status Bar* (bottom right of the screen).



Actual/Total frames and an estimated finishing time are displayed for the duration of the capture.

When the capture is complete, information about the status, location and name of the captured file is displayed in the *Notification Bar* below the *Tool Bar*.



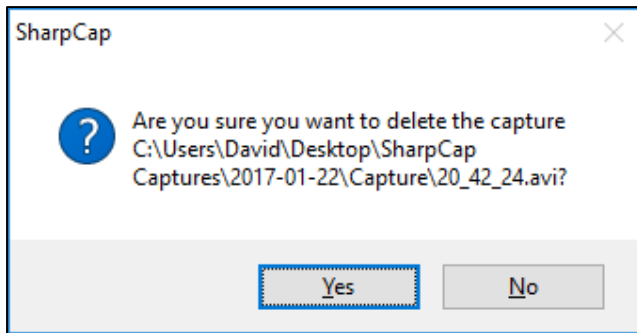
The blue text in the *Notification Bar* is clickable and will go directly to the capture file/folder.

Stop Capture

Once a capture has been initiated, the *Stop Capture* option becomes available – this will stop the current capture immediately. Note if a sequence of captures is in progress it will only stop the current capture, not cancel the sequence. The whole sequence can be cancelled using the button in the notification bar that appears while waiting for the next capture in the sequence.

Delete Last Capture

Once a capture has been completed, the option to *Delete Last Capture* becomes available. A confirmation dialogue window is shown, which is useful if a capture is taken accidentally or if something goes wrong during a capture.



Open Capture Folder

Open Capture Folder opens a File Explorer window at the location where captures are currently being saved. In a default configuration, this would normally be:

Desktop\SharpCap Captures\YYYY-MM-DD

Capture Dark

This menu item launches the SharpCap dark frame capture assistant – see [Capturing and Using Dark Frames](#).

Capture Flat

This menu item launches the SharpCap flat frame capture assistant – see [Capturing and Using Flat Frames](#).

Camera Basics

Colour Spaces Explained

A colour space describes how the image data is stored for each frame captured from a camera. The details of a colour space indicate:

- Whether the image data is colour or monochrome.
- How many levels of brightness are measured.
- Whether the image data is compressed or not.

The number of brightness levels that are available in an image is often described using the term 'bit depth'. The bit depth is the number of bits needed to store the full range of brightness levels in the image. For instance, an image that has:

- 256 brightness levels will have a bit depth of 8
- 1024 brightness levels will have a bit depth of 10
- 4096 brightness levels will have a bit depth of 12
- 65536 brightness levels will have a bit depth of 16.

Uncompressed Colour Spaces

The colour spaces listed in this section are uncompressed and lossless – meaning that they do not reduce the quality of any images being captured. All specialist astronomy cameras and some webcams will offer the option of uncompressed colour spaces.

RGB24

This is the default colour space for a colour image – 3 bytes are used for each pixel (one for each of the red, green and blue channels). The one byte used for each channel means that there are 256 possible values for each colour (from 0 to 255).

Pros:	<ul style="list-style-type: none"> • Simple to use and simple post-processing. • Images should look correct when viewed in any application. • Camera based adjustments such as white balance, gamma, brightness and contrast are available (although these are usually performed in software on the PC).
Cons:	<ul style="list-style-type: none"> • Files are large as they are typically 3 bytes per pixel. • Bit depth limited to 8 bits. • Debayering (turning the raw image to full colour) is performed by the camera driver typically using a simple but fast algorithm. • Adjustments like gamma, brightness and contrast lead to data loss when performed as they happen in digital space.

RGB32

This is an alternative option for a standard colour image. Instead of 3 bytes, 4 bytes of space are used per pixel, although one of the bytes is unused. Files saved in this format will be larger than the same file saved in RGB24, but will have absolutely no difference in image quality.

Pros:	<ul style="list-style-type: none"> • Simple to use and simple post-processing. • Images should look correct when viewed in any application. • Camera based adjustments such as white balance, gamma, brightness and contrast are available (although these are usually performed in software on the PC).
Cons:	<ul style="list-style-type: none"> • Files are large as they are typically 4 bytes per pixel.

	<ul style="list-style-type: none"> • Bit depth limited to 8 bits. • Debayering (turning the raw image to full colour) is performed by the camera driver typically using a simple but fast algorithm. • Adjustments like gamma, brightness and contrast lead to data loss when performed as they happen in digital space.
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MONO8 (also Y800)

This is the basic monochrome colour space, using one byte per pixel, storing a single brightness value between 0 and 255.

Pros:	<ul style="list-style-type: none"> • Smaller file size (1 byte per pixel), ideal for monochrome targets (narrowband filters, moon).
Cons:	<p>The following cons apply only when capturing in MONO on a colour camera.</p> <ul style="list-style-type: none"> • Processing to produce mono on a colour camera involves a debayer process to produce a colour image and then that is made monochrome, so the following cons for RGB apply: <ul style="list-style-type: none"> ○ Debayering (turning the raw image to full colour) is performed by the camera driver typically using a simple but fast algorithm. ○ Adjustments like gamma, brightness and contrast lead to data loss when they are performed as they happen in digital space. It may be better to capture as RAW8/12 and then make the final processed image monochrome.

MONO16

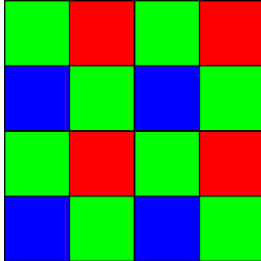
This is a monochrome colour space which uses 2 bytes per pixel, allowing for 65536 different brightness values per pixel. Note that many cameras that offer this colour space do not have the ability to create the full range of 65536 values – for instance some cameras may have the ability to create only 1024 different values (10 bit) or 4096 different values (12 bit). In these cases, the values the camera produces are stretched to fill the entire range.

Pros:	<ul style="list-style-type: none"> • Larger range of levels in the output, so a bigger range of brightness can be represented in a single image
Cons:	<ul style="list-style-type: none"> • Larger file size (2 bytes per pixel) • No gain in actual image quality if the frames being captured are visibly noisy (just recording the noise in more detail) <p>The following cons apply only when capturing in MONO on a colour camera.</p> <ul style="list-style-type: none"> • Processing to produce mono involves a debayer to produce a colour image and then that is made monochrome, so the following cons for RGB apply: <ul style="list-style-type: none"> ○ Debayering (turning the raw image to full colour) is performed by the camera driver typically using a simple but fast algorithm. ○ Adjustments like gamma, brightness and contrast lead to data loss when they are performed as they happen in digital space. It may be better to capture as RAW8/12 and then make the final processed image

	monochrome.
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RAW8

Colour cameras do not detect all three colour channels (red, green and blue) at each pixel – in fact each pixel only detects light of a single colour. The colours are arranged in a grid fashion – usually called a Bayer matrix – which looks like this (the graphic is a GRBG Bayer matrix):



Almost all colour cameras capture their colour data in this way. A technique called ‘debayering’ is used to generate a full set of red, green and blue values at each pixel to give a full colour image. When using an RGB colour space, this debayering process occurs either on the camera or in its driver software.

When capturing in a raw colour space such as RAW8, the original values of the individual red, green and blue pixels are captured by SharpCap. SharpCap has its own debayering code, so the image as seen on the screen will still be in colour, but saved files will appear to be monochrome with a slight grid pattern visible at the pixel level unless they are opened in software that is capable of debayering. Suitable software for this includes PIPP, Registax, AutoStakkert and Deep Sky Stacker.

Saved files captured in RAW8 format will consume only 1 byte per pixel, so they have the great advantage over RGB files of being much smaller. Additionally, a file that is saved in RAW format can be debayered by appropriate processing software using a slower but higher quality algorithm than those typically used in camera drivers.

There are four varieties of the RAW8 colour space, depending on where in the green/red/blue grid the top-left pixel of the camera sensor starts. These variations are named after the top left four pixels on the camera sensor

- RGGB
- BGGR
- GRBG
- GBRG

For instance, RGGB means that the left hand two pixels of the top row are red and green and the left two pixels on the second row are green and blue respectively.

In general, SharpCap knows which pattern a camera uses in RAW mode and will select the correct pattern automatically, however if the wrong pattern is selected automatically then manually choose the correct pattern by adjusting the value of the ‘Debayer Preview’ control. This control can be used to turn off the debayering function if desired. The easiest way to find the correct pattern is to view a red object or light with the camera – only the correct pattern will show a red image.

Note that even when SharpCap is debayering the image being viewed on screen, images saved to any capture files are still in RAW format.

Pros:	<ul style="list-style-type: none"> • Exact data that comes off the camera sensor with no post-processing. • Post-processing (including debayering) can be done later at a higher quality. • File size is small (1 byte per pixel)
Cons:	<ul style="list-style-type: none"> • Smaller range of applications that can work with the output files. • Post-processing is more complex. • Output files may appear to have 'chessboard' effect if opened in applications that don't understand raw formats. • Bit depth limited to 8 bits.

RAW16

The RAW16 colour space is a raw colour space for bit depths of up to 16 bits per pixel. On some cameras, this will be labelled as RAW10 or RAW12 to give a more accurate description of the true bit depth available from the camera. Saved files in the RAW 16 colour space use 2 bytes per pixel.

Pros:	<ul style="list-style-type: none"> • Exact data that comes off the camera sensor with no post-processing. • Post-processing (including debayering) can be done later at a higher quality. • Higher bit depth may give more information and more dynamic range if images are low noise.
Cons:	<ul style="list-style-type: none"> • Smaller range of applications that can work with the output files. • Post-processing is more complex. • Output files may appear to have 'chessboard' effect if opened in applications that don't understand raw formats. • Files are larger (2 bytes per pixel).

Compressed Colour Spaces

Many webcams only offer compressed colour spaces. While these reduce the size of capture files they also mean that some detail of the image is lost. Unless creating small capture files it is very important compressed colour spaces should be avoided if possible.

YUY2 / YUV

These are just two names for the same colour space. In these colour spaces, brightness information is stored at every pixel, but colour information is shared between two adjacent horizontal pixels. Since the colour information consists of two bytes of information (hue and saturation), this means that overall 2 bytes are used per pixel in this colour space. (<http://www.fourcc.org/yuv.php>)

I420

In this colour space, brightness is still stored at every single pixel, but colour information is shared between a block of 4 pixels (2x2). This means a total of 1.5 bytes are used per pixel in this colour space.

MJPEG

In this colour space, each frame is stored as a compressed JPEG image. This leads to a much smaller capture file than any other colour space, but can lead to significant compression artefacts in the images. The level of compression is set by the camera or camera driver and cannot be adjusted.

Choosing the Correct Colour Space

In general, the following guidelines will help choose the correct colour space:

- For a colour camera prefer RAW colour spaces if available to RGB colour spaces.
- If no RAW colour spaces, prefer uncompressed RGB to compressed colour spaces unless small output files are very important.

If having the option of choosing a higher bit depth (RAW10,12,16 or MONO16), only do so if there can be seen no noise that changes from frame to frame in the corresponding 8-bit mode. If there is visible noise in 8 bit, then all that a higher bit depth will do is measure and store more detail of the noise (and make output files twice as big). This means that higher bit depths are only useful at low gains.

Capture Formats Explained

AVI

The AVI file format is a video file format. While the AVI file format is commonly used, and can be read by many different applications, it is unfortunately a complex file format which can store video data in many ways. This means that sometimes certain applications may have difficulty reading certain AVI files, while the same files work correctly with other applications or on other computers. In general, however, AVI files in either MONO or RGB colour spaces will work correctly on any software on any system.

AVI files can only save video format at a bit depth of up to 8 bits per colour channel, so capture to AVI is not available when using a camera in a higher bit depth mode.

While AVI files can be used to save captures in RAW format, processing software will not recognize this automatically and will generally show a monochrome image with a pixel grid visible if the appropriate Bayer pattern is not specified manually.

[PIPP - Planetary Imaging PreProcessor](#) (commonly referred to as PIPP) is useful software for dealing with troublesome AVI files and to stabilise the frames of a video that are too jumpy for stacking software to handle.

Pros:	<ul style="list-style-type: none"> • Can be viewed in almost any video playback software.
Cons:	<ul style="list-style-type: none"> • File format is complex and has many sub formats. • Correct playback may depend on other software and codecs installed on the machine. • Errors may be subtle and difficult to solve. • 8-bit only. • Mono and RAW saved in AVI may appear upside down due to limitations of the file format.

SER

The SER file format is another video file format that has been designed specifically for astronomy capture. SER files cannot be read, viewed or processed by as many different applications as AVI files but there tend to be far fewer seemingly random issues caused by incompatibilities as the file format is far simpler than the AVI file format.

The SER format can be used to save videos in the RGB, Mono and RAW formats and can be used to capture at both 8 bits per pixel and up to 16 bits per pixel bit depth.

When capturing in a RAW format, the details of the sensor Bayer pattern is stored in the SER file, meaning that most processing and viewing software will automatically read this information and correctly debayer the raw image data to a colour image.

Additionally, a timestamp for each captured frame is stored in the SER file, which is often useful for later image processing.

A [SER Player](#) application can be downloaded from the PIPP website.

Pros:	<ul style="list-style-type: none"> • Simple file format with few variations - applications tend to work correctly with it or not at all. • SER file is written with the Bayer pattern of the camera which simplifies post-processing for RAW captures. • Supports bit depths of 8 bits per pixel and up to 16 bits per pixel. • Each frame in the file is timestamped exactly. • Supports Mono, RAW and RGB captures.
Cons:	<ul style="list-style-type: none"> • Less post-processing applications support SER format but the ones which are most used, listed below, all accept SER format: <ul style="list-style-type: none"> ○ AutoStakkert AS2 (stacking). ○ Registax 5 and 6 (stacking and wavelet sharpening). ○ PIPP (preparing the video files for processing). • Interpretation of the SER standard is somewhat different so sometimes the program needs help to select the correct colour space if not automatically recognized.

PNG

PNG files are standard image files for capture of single frames. Almost any image processing or viewing software will be able to open a PNG file, making them easy to work with.

Still images in any format (a bit depth of 8 or 16 bits, colour, monochrome or RAW) can be stored in a PNG file. It is worth noting however that many image processing applications do not deal correctly with PNG files with a bit depth of 16 bits – often they will drop the bit depth to 8 bits as they load the file, throwing away detail.

When saving RAW images to a PNG file they are saved as monochrome PNG files and image processing and viewing software will display them as monochrome showing a pixel grid pattern unless correctly set up to debayer the images.

Pros:	<ul style="list-style-type: none"> • Can be loaded into almost any graphics application • Handles 8-bit to 16-bit depths and mono or colour images.
Cons:	<ul style="list-style-type: none"> • Many imaging applications may discard detail from 16 bit PNG files when loading them. • RAW images saved in PNG will appear monochrome with a checkerboard pattern and may need additional manual settings in post-processing to ensure correct debayering. • SharpCap can only re-load 8 bits of data from PNG files, even when loading 16 bit saved files.

FITS

The FITS file format is a highly flexible but specialised format that is often used for storing high bit depth still images. While the FITS format can store images at a bit depth of 8 bits, it is usually better to choose PNG for that case.

Since FITS is a specialised file format, there are less applications that can process FITS files to choose between – certainly most image viewing and editing applications which can quite happily work with PNG files will not be able to open FITS files. There are however applications such as [Deep Sky Stacker](#) or [FITS Liberator](#) that can be used to process and view FITS files.

Pros:	<ul style="list-style-type: none"> • Supports 8 bit and greater bit depths. • Supports mono, colour and raw images. • Image data, such as exposure, is stored in the file and some applications will read this data. • SharpCap can load 16 bits of data from FITS files when loading dark frames.
Cons:	<ul style="list-style-type: none"> • Can only be opened by a limited number of applications. • Some applications require additional plugins to open this file type. • File format is very complex and flexible, so files may display incorrectly in some applications and correctly in others. • Slower to save to than other file formats, so not suitable for high frame rates.

TIFF

The TIFF file format is a widely supported imaging file format that can be opened in most image processing applications. TIFF files are typically large as they are not heavily compressed, although they may be smaller than FITS files for the same image.

Pros:	<ul style="list-style-type: none"> • Supports 8 bit and greater bit depths. • Supports mono, colour and raw images. • SharpCap can load 16 bits of data from TIFF files when loading dark frames.
Cons:	<ul style="list-style-type: none"> • Files may be larger than other file formats such as PNG • Less information stored in the file headers than FITS • Slower to save to than other file formats, so not suitable for high frame rates.

JPEG

The JPEG file format is a very widely used image format for digital images. Almost all imaging applications can load, manipulate and save JPEG files. The JPEG file format can store still images at a bit depth of 8 bits.

It is important to note that the JPEG format uses a type of compression that means that fine image detail is lost in the saving process and cannot be recovered later. The reason that this fine detail in brightness and colour (that would not be easily noticed by the human eye) is discarded is because it allows the file size to be much smaller than for other file types.

Given the limitations of the JPEG file type, it is probably only suitable for certain use cases – such as all sky cameras where a very large number of frames will be captured automatically and having perfect image quality for each frame is less important than having a small file size.

Pros:	<ul style="list-style-type: none"> • Small file size. • Can be opened by almost all imaging applications
Cons:	<ul style="list-style-type: none"> • Image detail lost when saving • Limited depths of 8-bits only

Camera Controls

Generic camera controls are described below in *Common Camera Controls*.

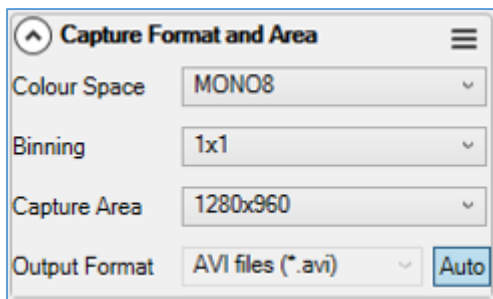
Subsequent subsections describe features specific to individual camera manufacturers. The same functionality may have different names across manufacturers. Different models from the same manufacturer may have differing features. The manufacturers are described in alphabetic order.

Common Camera Controls

The controls listed below are generally expected to be available across a wide range of cameras from different manufacturers, although not all cameras will have every control listed in this section.

These controls are to be found in the *Camera Control Panel* (which by default is shown to the right of the main camera image).

Capture Format and Area



Capture Format and Area	
Colour Space	<ul style="list-style-type: none"> The colour space control determines the image format each frame is captured in. In general, there are four categories of colour spaces <ul style="list-style-type: none"> Monochrome Colour Raw Compressed See Colour Spaces Explained for more detail on the colour space to choose and the implications of each choice.
Capture Area	<ul style="list-style-type: none"> This controls the size (in pixels) of each frame captured. For most cameras, the choice of a smaller capture area selects capture of a subarea of the full sensor area – this is often termed ROI (region of interest) capture. As well as giving smaller saved files, selecting a smaller capture area often gives a higher frame rate.
ROI Position (pan/tilt)	<ul style="list-style-type: none"> When a smaller capture area is selected, it is usually also possible to choose which region of the sensor is used – selecting the appropriate <i>Region of Interest</i> (ROI). <div style="text-align: center;"> </div>

	<ul style="list-style-type: none"> Only shows if the selected ROI is smaller than the maximum.
Binning	See Binning below further information.
Output Format	<ul style="list-style-type: none"> Output format allows the choice of the format any captured files will be saved in. The options for capture format can be found in Capture Formats Explained. The following rules apply: <ul style="list-style-type: none"> For 'Snapshot' (single frame) captures, one of the still capture formats (PNG, FITS, TIFF and JPEG) are always used, even if the selected output format is a video format (AVI or SER). If the output format is a still file format the selected format is used. For video captures, the selected format is always used. If a still file format is selected each frame will be saved to a separate file. <p>When the output format is set to 'Auto', a compatible video format is selected if the current exposure is less than 5 seconds and a compatible still format is selected if the current exposure is greater than 5 seconds. The preferred output formats specified in the settings dialog are used (providing the preferred format is compatible with the type of image being captured – for instance 16-bit depth images cannot be saved to AVI format).</p> <p>[Note: If the 'Start Cameras with Auto Output Format' option is checked in the General Tab of the settings then cameras will always start with this control in 'Auto' mode.]</p>
Debayer Preview	<ul style="list-style-type: none"> Only shows for RAW colour spaces. Allows the user to choose to debayer (convert to colour) or not the raw image for display. Does not affect the data saved to file. As well as switching the debayer function on and off it is possible to override the Bayer pattern used if, for some reason, the wrong pattern is selected automatically.

Binning

Binning is a technique used to improve the signal-to-noise ratio of an image at the expense of reducing the resolution. Binning works by taking the value of 2 or more neighbouring pixels on the sensor and either adding or averaging them to produce the value for a single output pixel. Binning is usually 'symmetric' - meaning that the same number of pixels are averaged over in each direction. For instance, a binning value of '2x2' or just '2' means that a 2 by 2 block of sensor pixels are used to make each pixel in the final image – this will reduce the resolution of the final image by a factor of 2, but also increase the signal-to-noise ratio (S/N ratio) of the image by a factor of 2.

As an example, with a 1280x960 sensor, using 2x2 binning will give an output image of 640x480. Using 4x4 binning will give an output image of 320x240.

A binning value of '1' or '1x1' means that no binning is being applied.

It is important to note that some cameras add pixel values when binning (meaning that the image will get brighter when binning is turned on), while other cameras average the values (meaning that


the image doesn't get brighter, but the noise reduces instead). In both cases, the same increase in S/N ratio is achieved in the final image – if a brighter image is required and the camera averages then just turn up the gain – the result being the same as if the camera had added pixels.

Additive Binning

	
Unbinned (width 2x, height 2y)	Binned 2x2 (width x, height y)

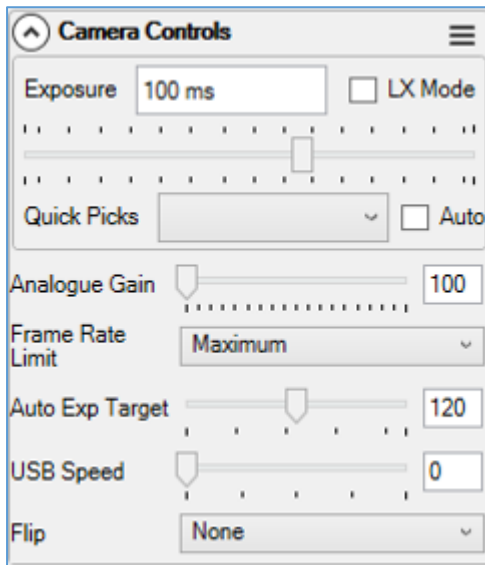
Additive binning – no other changes were made to camera settings between the unbinned and binned images. Applying the 2x2 binning halves the size of the captured image and brightens the image by a factor of four. Note that a considerable level of noise is visible in the brighter right hand section of the image in both frames.

Averaging Binning

		
Unbinned (width 2x, height 2y)	Binned 2x2 (width x, height y)	Binned 2x2 with extra gain (width x, height y)

Averaging binning – no other changes were made to camera settings between the unbinned and binned images. Applying the 2x2 binning halves the size of the captured image but does not brighten the image in this case. However, looking closely at the bright area on the right-hand side of the image shows that applying the binning has significantly reduced the noise in this area (and across the rest of the frame). Increasing the gain further does brighten the binned image producing a similar image to the additive binning result both in terms of image brightness and noise level.

Camera Controls



Camera Controls	
Exposure	<ul style="list-style-type: none"> Exposure controls the length of time that the camera collects photons for each frame. Longer exposures allow more photons to be collected and will therefore give brighter images. For most cameras, the selection of a longer exposure can limit the frame rate. For instance, setting an exposure of 100ms (1/10s) will limit most cameras to a frame rate of 10 frames per second. Each camera will have its own limits for the length of exposure it allows. Some cameras (particularly webcams) may report incorrect ranges of allowable exposures to SharpCap. The LX checkbox in the exposure control has only one effect – it changes the range of the exposure slider from minimum exposure to 5s (LX unticked) to 0.5s to maximum exposure (LX ticked). This is necessary because for cameras with a very wide possible exposure range it becomes difficult to adjust the exposure accurately if the slider range runs all the way from 0.01ms to 1000s.
Gain	<ul style="list-style-type: none"> The gain control acts as an amplifier for the signal received by the sensor. Turning up the gain will increase the brightness of an image without needing to increase the exposure duration, but at the cost of the making the image noisier.
Frame Rate Limit	<ul style="list-style-type: none"> Limits the rate at which frames are processed by SharpCap, even if the camera is creating frames at a higher rate. This affects the rate at which frames are saved to any capture file and the rate at which the UI is updated.
Flip	<ul style="list-style-type: none"> Apply a horizontal or vertical (or both) flip to an image to correct its orientation.
Temperature [Read Only]	<ul style="list-style-type: none"> The current temperature of the camera sensor. Note that if the camera has more complicated thermal controls (for instance a

	Peltier cooler), the current temperature will appear with those controls in the Thermal Controls section.
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Image Controls

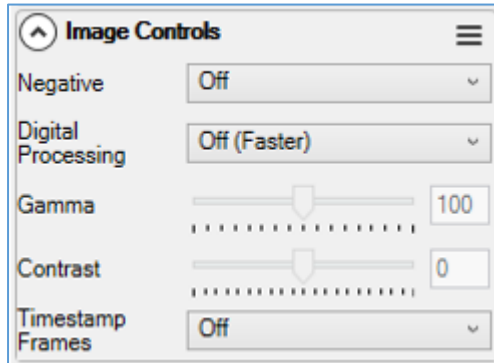


Image Controls	
Gamma	<ul style="list-style-type: none"> • <i>Neutral</i> gamma is 1. • Correctly interpreted, gamma of less than 1 will boost the shadows and mid tones, gamma greater than 1 will lower the mid tones and highlights. • Some applications and cameras treat gamma the opposite way around – increasing gamma boosts the shadows. • See http://www.orpalis.com/blog/color-adjustments-brightness-contrast-and-gamma/ for more details on gamma, contrast and brightness.
Contrast	<ul style="list-style-type: none"> • Increasing contrast will typically make the dark parts of the image darker and the bright parts brighter. • Sometimes this can help pull out detail in the image.
Brightness	<ul style="list-style-type: none"> • Increasing brightness will typically make the image brighter by the same amount. • This can help pull out detail in the darker regions of the image.
Timestamp Frames	<ul style="list-style-type: none"> • Applies a UTC timestamp in the top left corner of the frame. • As well as the visible timestamp a machine-readable timestamp is embedded into the first 8 bytes of the pixel data of the frame. <p>The machine-readable timestamp is a 64-bit integer that is the number of 100ns intervals since midnight on 1st Jan 0001 (see https://msdn.microsoft.com/enus/library/system.datetime.ticks(v=vs.110).aspx for defaults)</p>
White balance	See <i>White Balance</i> below.

White Balance – Images shown from colour cameras can frequently show incorrect colours. This can be due to a range of reasons, such as:

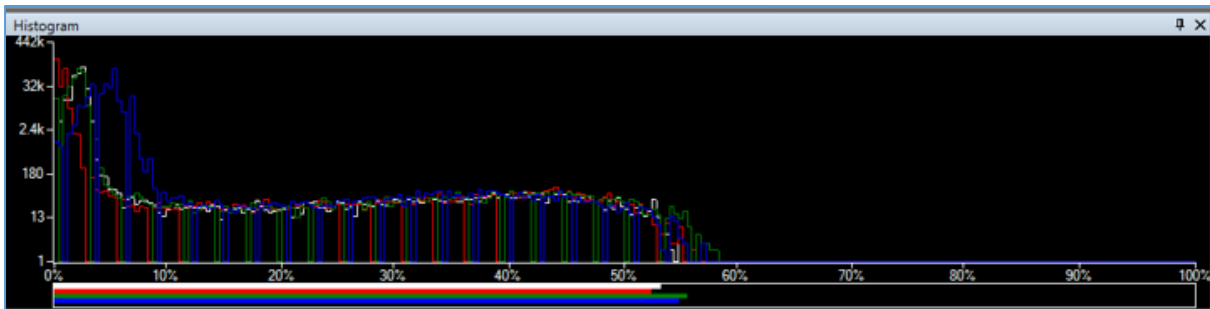
- One colour (often green or red) being more sensitive to light than the other colours.
- The type of illumination the image is being taken under – for instance tungsten, LED or fluorescent lights for non-astro images.

Different cameras have different controls to enable colour balance to be adjusted to give images showing the correct colours.

Although these controls differ in detail they all effectively allow the brightness of the colour channels to be adjusted relative to each other to correct the colour cast in the image.

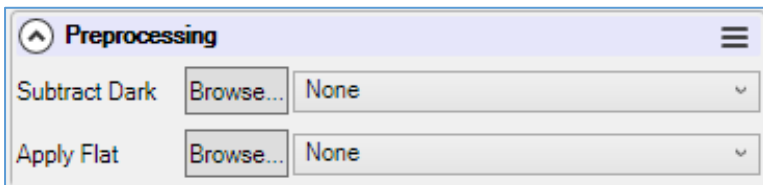
Some cameras offer an auto white balance option – these often work well for ordinary images but can sometimes be confused by astro images, so should be used with caution.

Use the histogram control while adjusting the white balance and other image controls such as gamma, contrast and brightness – if it is noticed the histogram trace for any of the colour channels has gaps (i.e. levels with zero count appear in the middle of the histogram – see graphic below), it probably means the white balance (or other) adjustment is being done in software on the PC rather than in hardware on the camera. Histograms such as the one below indicate data is being lost.



In this case, it is best to set the white balance back to default (remove the gaps in the histogram) and to correct the colour balance after stacking. This will avoid the data loss caused by applying digital white balance correction in SharpCap.

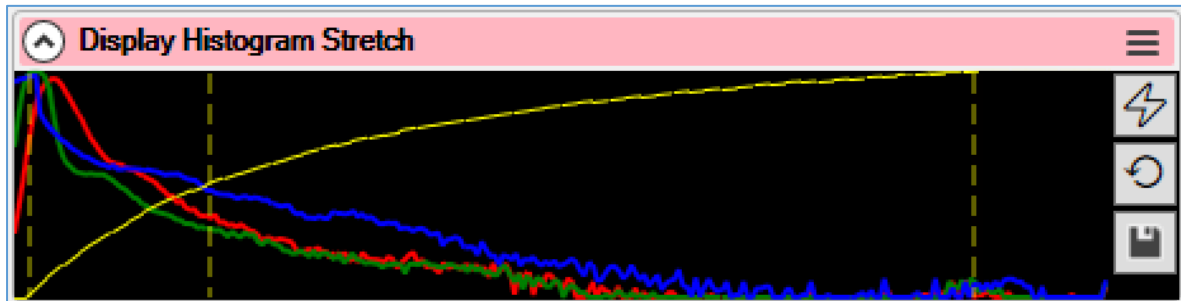
Pre-processing



Preprocessing	
Subtract Dark	<ul style="list-style-type: none"> Subtracts the selected dark frame image from each frame captured by SharpCap, allowing artefacts such as amp glow and dark noise to be reduced. See Capturing and Using Dark Frames for more details. <p>[Note: the dark frame is subtracted before any other processing of the frame (such as live stacking or any FX effects) and <i>the subtraction of a dark frame affects the saved file.</i>]</p>
Apply Flat	<ul style="list-style-type: none"> Corrects each frame for brightness variations caused by vignetting or dust spots. The flat frame correction code has been highly optimized so that on a fast PC it can run on every frame even when high speed imaging using a USB3 camera. See Capturing and Using Flat Frames for more details. <p>[Note: the flat frame correction is applied after dark subtraction but before any other processing of the frame (such as live stacking or any FX effects) and <i>the application of a flat frame affects the saved file.</i>]</p>

Mini Histogram and Display Stretch

This control shows an always-on mini histogram of the current image and allows the image displayed on screen to be 'stretched' without affecting the data saved to file when capturing. Stretching the displayed image means that the brightness and/or contrast can be enhanced, or faint detail can be brightened easily. The stretch function provides similar effects to the *Image Boost* options in the FX dropdown but with finer control.



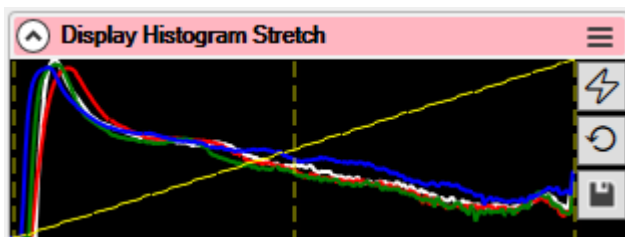
Adjusting the Display Histogram Stretch

Basic operation of the stretch adjustments involves dragging the position of the three vertical dashed yellow lines using the mouse. These three lines represent the histogram levels that will be displayed as black, mid grey and white respectively.

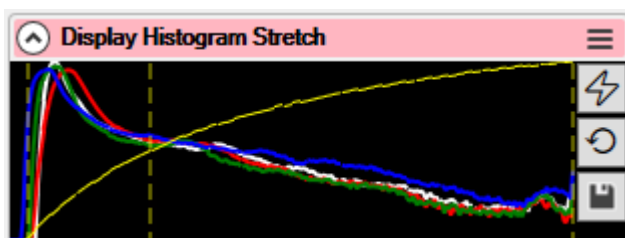
It is usually most useful to adjust the black and mid-level lines. Adjusting the mid-level line so that it is no-longer half way between the black and white level lines will create a transfer curve, shown as a yellow curve on the histogram that controls how the image pixel values are converted to displayed screen brightness.

Moving the mid-level line to the left will create a curve that initially rises rapidly then flattens out. This will have the effect of boosting the brightness of the darker areas of the image, making it easier to see faint detail. Moving the mid-level line to the right will create a curve that is initially relatively flat before rising more sharply near the white level. This has the effect of darkening the brighter areas of the image, perhaps making more detail visible in those regions.

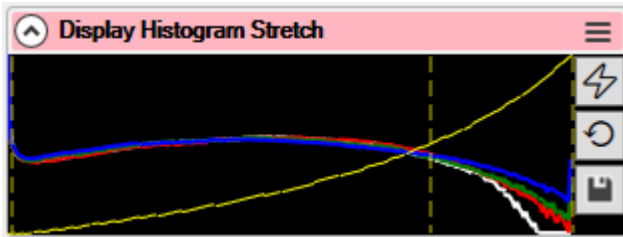
The default settings of the Display Histogram Stretch (image displayed without adjustment):



The mid-level line moved to the left, enhancing the brightness of faint detail:



The mid-level line moved to the right, enhancing contrast in bright areas of the image:



Moving the black-level line to the right will effectively darken the whole image. This can be useful to give a blacker background – making background noise and light pollution less noticeable.

Display Histogram Stretch Buttons



The top, lightning bolt, button will perform an auto-stretch designed to pull out faint detail in the current image. This will adjust the black, mid and white level lines automatically based on an analysis of the brightness levels in the image. You can adjust how strong a stretch will be applied when using this button in the [General Tab](#) of the SharpCap settings. Using the auto-stretch feature requires a SharpCap Pro license.



The middle, circular arrow, button will reset the black, mid and white level lines back to their default positions, removing any display stretch currently in effect.



The bottom, save, button will save the current image exactly as seen onscreen as a PNG file. Unlike the normal SharpCap image saving functionality, this saved file *will* include the effects of any display stretch currently in effect. Note that the saved image file will have a bit depth of 8 bits regardless of the bit depth setting of the current camera.

Any changes made in the Display Histogram Stretch section only affect how the images are displayed on screen – there will not be any changes made to the images saved to capture files (except those saved using the 'Save Exactly as Seen' button in the display histogram stretch control).

Camera Specific Controls

The controls listed below will appear *in addition to* the common controls listed above.

Altair Camera Controls

SharpCap supports all current models of camera produced by Altair Astro. If the camera is a new model and not in the *Cameras* list, please check for an updated version of SharpCap which may include changes needed to support the camera.

Further information can be found at the [Altair Astro](#) website. Drivers, software and technical notes can be found at the [Altair Support](#) website.

Image Controls

White Balance Adjust	Performs a single auto adjustment of the image white balance.
Negative	Converts the image to a negative representation (black becomes white, white becomes black, colours are reversed).
Colour Tint	Adjust the green/magenta colour balance of the image – lower values give a magenta tint to the image, higher values a green tint.
Colour Temperature	Adjusts the red/blue colour balance of the image – setting this value higher will make the image appear redder, setting it lower will make it appear bluer.
Digital Processing (On/Off)	Enables/Disables the digital adjustments to the image in the Altair Driver. <ul style="list-style-type: none"> • When this is switched to 'On', controls like Gamma, Brightness, Colour Tint, etc. are active. • When switched off, these controls are disabled. Switching this to Off may give a small performance boost.

Camera Controls	
Auto Exposure Target	Controls the how bright a frame the auto exposure will aim for (when enabled). When this is set to a low value the auto exposure will tend to give an under exposed frame with few highlights. When set to a high value the auto exposure will tend to give an over exposed frame.
USB Speed	Controls how much of the USB bus speed the camera will try to use. Higher values will usually lead to higher frame rates, but setting this value too high may lead to very low frame rates, irregular frames or no frames at all.
Flip	Allows the orientation of the image to be flipped either in the horizontal, vertical or both. Not available in RAW modes.
Fan	Allows the Fan to be turned on/off on cameras that have a fan.

ASCOM Camera Controls

ASCOM cameras have relatively few controls available in SharpCap. Drivers and further information can be found at the [ASCOM Standards](#) website.

There is no guarantee all ASCOM cameras will offer all the controls listed below. For instance, some ASCOM cameras have no cooler at all and of those with coolers some may offer direct control of cooler power while others may not.

Camera Controls	
Options	Allows the ASCOM configuration dialog for the camera to be shown. May have additional camera options that can be configured. The camera is temporarily closed while the dialog is displayed and will restart when it is closed.

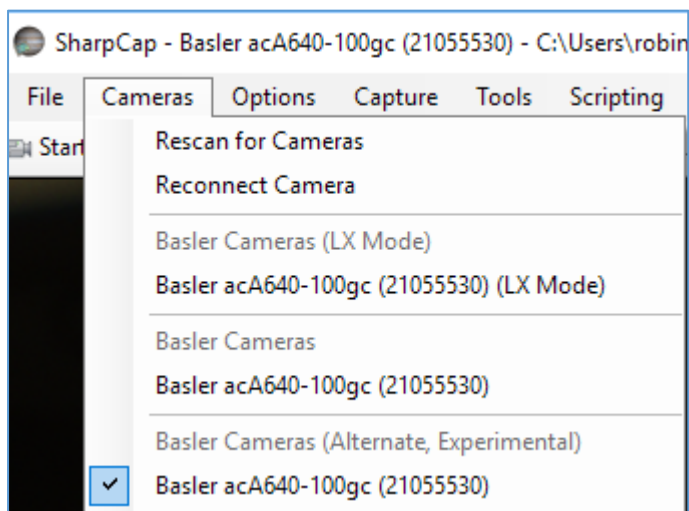
Thermal Controls	
Actual Temperature	The current temperature of the camera sensor (read only).

Heat Sink Temperature	The current temperature of the heat sink (if any) in the camera (read only).
Cooler (on/off)	Allows any cooler present on the camera to be turned on or off. If the cooler is turned on, then the cooling level may be controllable using one of the two controls listed below.
Cooler Power	Allows the percentage power that the cooler runs at to be set.
Target Temperature	The temperature that the camera will attempt to cool to (adjusting the cooler power automatically to achieve this temperature).

Basler Camera Controls

Drivers and further information can be found at the [Basler](#) website.

Basler cameras may appear more than once in the *Cameras* menu:



SharpCap has three separate options for working with Basler Cameras:

1. *(LX Mode) suffix* – uses the camera's trigger functionality (if present) to take longer exposures than the camera would normally allow. Only use this mode if taking longer exposures than those available from the other two options.
2. *No suffix* – the old code to support Basler cameras. Some functions such as pre-processing and display controls available with other cameras will not be available. This option is deprecated and will be removed in a future version. Do not use this option unless having problems with the Experimental option (below).
3. *(Alternate, Experimental) suffix* – a newer implementation of the Basler camera that should have all the modern SharpCap features. This should be the preferred way of working with Basler cameras if long-exposure functionality is not required. This will become the default method of working with a Basler camera in a future version.

Basler Specific Controls

Capture Format and Area

Colour Space	<p>Basler cameras use non-standard colour space names for RAW modes.</p> <ul style="list-style-type: none"> • <i>BayerBG8</i> – equivalent to RAW8 with BGGR Bayer pattern. • <i>BayerRG12</i> – equivalent to RAW12 with RGGB Bayer pattern. • <i>Bayer GB12Packed</i> – equivalent to RAW12 with GBBR Bayer pattern. In packed 12 bit modes, 2 adjacent pixels are packed into 3 bytes (1.5 bytes each) rather than requiring 2 bytes each in unpacked mode. This may increase frame rates in some circumstances as it reduces the amount of data that needs to be transferred from the camera to the computer.
FPS	<p>The number of frames per second that the camera will attempt to deliver to the computer. When left on auto it will aim for the maximum possible rate. Note that the frame rate set in manual mode may not actually be achieved due to factors such as the exposure being too long or the data rate between the camera and the computer being insufficient to cover the desired frame rate.</p> <p>If aiming for a limited frame rate, then setting this to a low value is better than leaving this at a high value and setting the 'Frame Rate Limit' control as it should reduce the CPU load on the capture computer.</p>

Camera Controls	
Black Level	Allows the black level to be adjusted. This control should be adjusted with the camera covered to ensure that both sides of the black level peak in the histogram are visible and distinct from the zero level to ensure that black level noise can be averaged out correctly in stacking. Called offset or brightness on some other cameras.
Digital Gain	An additional gain that can be applied to the image. Each step above zero doubles the image brightness but also doubles the noise levels

Processing Controls (should be Image controls for consistency with other cameras)	
Auto White Balance	Automatically adjust the white balance of the image when the 'Adjust' button is pressed.
White Bal (R) [Colour Modes only]	Controls the relative intensity of the red channel of a colour image.
White Bal (B) [Colour Modes only]	Controls the relative intensity of the blue channel of a colour image.
White Bal (G) [Colour Modes only]	Controls the relative intensity of the green channel of a colour image.

Celestron/Imaging Source Camera Controls

SharpCap should support all Celestron branded Skyris and NexImage cameras (manufactured by The Imaging Source) as well as Imaging Source branded DMK and DFK cameras.

Drivers and further information can be found at the [Imaging Source](#) website and the [Celestron](#) website.

Camera Controls	
Focus	Controls the focus of the built-in camera lens (if available).
Iris	Controls the aperture of the built-in camera lens (if available).
Pan, Tilt and Roll	Physical controls to pan, tilt and roll the camera if it has motor drive to allow it to be controlled remotely.
IR Cut Filter	Turn on/off the IR cut filter on cameras equipped with a controllable filter.

Image Controls	
Colour Enhancement	Enhance colours in the image.
Highlight Reduction	Reduce the relative brightness of the highlights in the image.
Denoise	Apply a noise reduction filter to each frame (will also tend to reduce detail).
Colour Enable	Switch colour cameras between colour and monochrome mode.
Sharpness	Apply a sharpening filter to each frame to enhance detail (will also tend to increase noise).

White Balance	
White Bal (R)	Controls the relative intensity of the red channel of a colour image.
White Bal (B)	As for White Bal(R) above, but controls blue.
White Bal (G)	As for White Bal(R) and (B) above, but controls green channel.

iNova Camera Controls

SharpCap supports a range of iNova cameras.

Drivers and further information can be found at the [iNova](#) website.

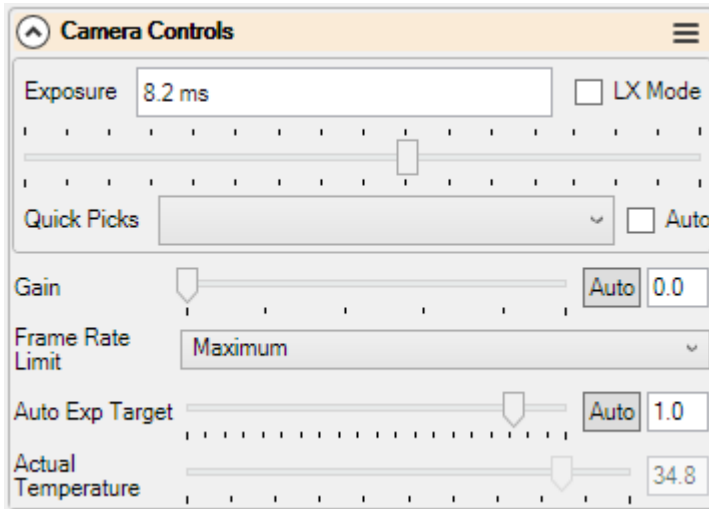
Camera Controls	
Black level	In theory, the same as the black level control documented for other makes (copy from QHY?), in practice does nothing due to a bug in the iNova SDK.
Pixel Clock	How fast the internal CPU of the camera runs. Higher speeds can give higher frame rates but sometimes too high a speed will lead to no frames at all.
Horizontal Blank	How long a delay the camera should apply between reading one scan line of the image and the next. Usually best left on auto, but manual tweaking can sometimes improve frame rates, with lower values giving faster frame rates. As with many of these speed controls, going too far can cause the frame rate to collapse to zero.

Point Grey Camera Controls

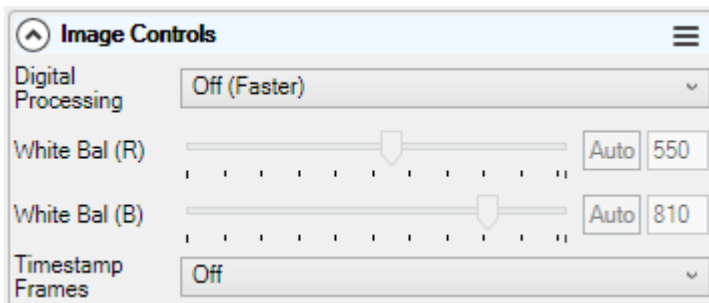
SharpCap supports FlyCapture based Point Grey cameras. Spinnaker based cameras are not supported. USB, GigE and Firewire models are all supported.

Drivers and further information can be found at the [Point Grey](#) website.

Note that you may need to restart SharpCap to detect GigE cameras if they are connected after SharpCap has been run.



Camera Controls	
Auto Exp Target	This indicates the brightness that the <i>Auto</i> options for <i>Exposure</i> and <i>Gain</i> will aim for when enabled. Higher values (above zero) indicate brighter exposure, negative values indicate lower exposure.
Actual Temperature	This indicates the temperature of the sensor in Celcius



Depending on the colour space chosen (i.e. RAW, MONO or RGB), different *Image Controls* from the list below will be available.

Image Controls	
Digital Processing	Turning this control on will enable the other image controls listed below but may reduce frame rate slightly. Turning this control off will disable the other image controls but ensure that image data viewed and saved will match the data read from the camera sensor without any processing in software.
Gamma	Adjusts the gamma of the image
Brightness	Adjusts the brightness of the image. Warning: This is not a simple Brightness control that merely adds a constant offset to the values of all pixels. The exact implementation of this control is unclear, but in RGB mode it appears to affect the relative strength of the colour channels.

Sharpness	Applies a simple sharpening to the image (note that this will also increase noise in a noisy image)
Hue	Adjusts the colour tint of the image
Saturation	Controls the strength of colour in an RGB image
White Bal (Red)	Controls the relative intensity of the red component of a colour image
White Bal (Blue)	Controls the relative intensity of the blue component of a colour image

QHY Camera Controls

SharpCap supports a wide range of QHY CMOS cameras, including QHY5L-II, QHY5-III, QHY174, 178, 224, 290, 163 and 183. The cooling features of the QHY ColdMOS cameras are supported as well as the GPS features of the QHY174-GPS.

Drivers and further information can be found at the [QHY](#) website.

Camera Controls	
Amp Noise Reduction	<p>This control is available for some cameras and when activated will reduce the amount of amp glow created by the camera for long exposures.</p> <p>In general, it is best to leave this control on the 'Auto' setting as it will apply the amp glow reduction when appropriate. If amp glow reduction is enabled manually, this may result in incorrect images for certain exposure and gain combinations.</p>
Row Noise Reduction	This control is available for some cameras and can be adjusted to reduce banding effects between camera rows.
Offset	Allows the black level to be adjusted. This control should be adjusted with the camera covered to ensure that both sides of the black level peak in the histogram are visible and distinct from the zero level. This ensures that black level noise can be averaged out correctly in stacking.
Speed	Control the transfer speed being used by the camera. May increase frame rate in some circumstances.
USB Traffic	<p>This controls how fast the camera will try to push data over the USB bus. Setting a <i>lower</i> value will try to move data faster and give higher frame rates. Setting a value that is too low can cause:</p> <ul style="list-style-type: none"> • dropped frames • a collapse in frame rate • or even no frames at all
Use DDR Buffer	Available on some cameras. Turns on/off the use of the internal DDR buffer on the camera. Using the DDR buffer may improve frame rate and reduce problems with dropped frames.
Optimize Light Level	Allows the sensor on the camera to be optimized for low or bright light levels.
Filter Wheel	Allows a QHY filter wheel connected via the camera port to be controlled. Note that a connected filter wheel may not be detected if it is still initializing when the camera is opened in SharpCap.
Enable Live Broadcast	Enable live broadcast of the images being shown in SharpCap via the QHY video broadcast application.

GPS Controls	
GPS	Enable or disable the built-in GPS functionality on cameras that support it. The GPS feature allows frames to be timestamped precisely to microsecond precision. GPS may require the camera to be supplied with 12V power. When GPS is enabled and has a satellite lock the timestamp for each frame taken from the GPS system is used for the timestamp in capture settings files and SER file frame timestamps. Without further adjustment, frame times will be accurate to millisecond levels, but to get microsecond precision the following controls must be adjusted correctly.
GPS Calibration LED	The GPS calibration LED must be turned on to be able to correctly adjust the following two controls. The camera must also be covered so that the light from the LED can be seen in the image. Turn up the gain so that the light can be seen easily.
Calibration Start Pos	With the GPS LED on, turn the calibration Start Pos down to zero and then turn it up until the calibration light appears as a glow at one side of the image. Then turn the value down a small amount until the light vanishes again. Setting this control allows the GPS frame start time to be corrected for the time difference between the camera circuitry requesting the frame starts and the actual exposure starting.
Calibration End Pos	With the GPS LED on, set this to a value just above the calibration Start Pos value and then turn up the value until the LED light vanishes again. Turn the value down a small amount until the light re-appears. This allows the end of frame time to be adjusted for the time difference between the camera circuitry requesting the frame to stop and the frame having finished. After calibrating the Start and End Pos, don't forget to turn the calibration LED off again. Also, note that the calibration needs to be repeated after having changed the camera exposure or the camera colour space.

Image Controls	
White Bal (R) [Colour Modes only]	Controls the relative intensity of the red channel of a colour image.
White Bal (B) [Colour Modes only]	As for White Bal(R) above, but controls blue.
White Bal (G) [Colour Modes only]	As for White Bal(R) and (B) above, but controls green channel.

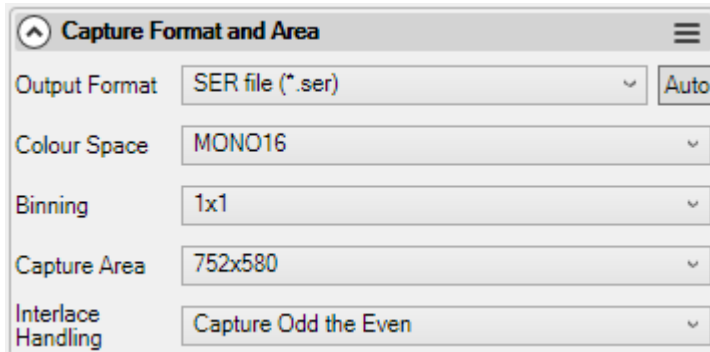
Thermal Controls	
Cooler Power	Allows the percentage power that the cooler runs at to be set. If set to Auto, then the cooler will automatically attempt to cool the sensor to the temperature given by the Target Temperature control.
Target Temperature	Sets the sensor target temperature for use when the cooler power is set to Auto.

Starlight Xpress Camera Controls

SharpCap supports the full range of Starlight tXpress CCD cameras. Drivers and further information can be found at the [Starlight Xpress](#) web site.

Capture Format and Area

Some Starlight Xpress cameras have interlaced sensors, meaning that only half of the lines on the sensor can be read at a time. When a camera with an interlaced sensor is in use, SharpCap adds an *Interlace Handling* control to allow various ways of dealing with the interlaced camera to be chosen.



The options for *Interlace Handling* are

- *Capture Odd then Even Rows* - this option will expose the camera twice for each frame shown in SharpCap, first capturing the odd lines of the sensor, then the even. This is the only option that gives full sensor resolution, but frame rate is halved (for instance with a 2s exposure selected, the image will only update once every 4s)
- *Interpolate from Odd Rows* – this option will only expose the odd rows of the sensor, but will generate a full-size image by generating data for the even rows by averaging (interpolating) the data of the odd rows on either side. Frame rate will be normal, but there will be less detail in the image
- *Interpolate from Even Rows* – as *Interpolate from Odd Rows*, but exposes only the even rows of the sensor, with the odd rows being generated by averaging
- *Capture Odd Rows* – exposes the odd rows of the sensor and forms an image only half the normal height (290 pixels for the camera shown above). Frame rate will be normal, but images will be distorted due to halving the height of the image
- *Capture Even Rows* – as *Capture Odd Rows*, but captures only the even rows.
- *Capture All Rows (2x vertical bin)* – this option exposes all pixels on the sensor, with a 2x vertical binning being applied before reading the sensor. As for *Capture Odd Rows* and *Capture Even Rows*, the image will be distorted due to being half normal height, but the sensitivity of the sensor is maximised as all pixels are exposed and measured in each frame.

Image Controls

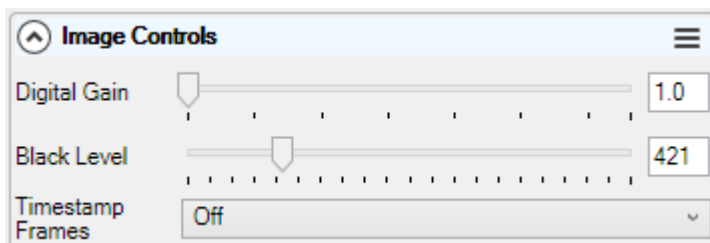


Image Controls	
Digital Gain	Starlight Xpress CCD cameras do not have an analogue gain adjustment option, but the deep well depth means that a usable image can be generated even at relatively low saturation levels.

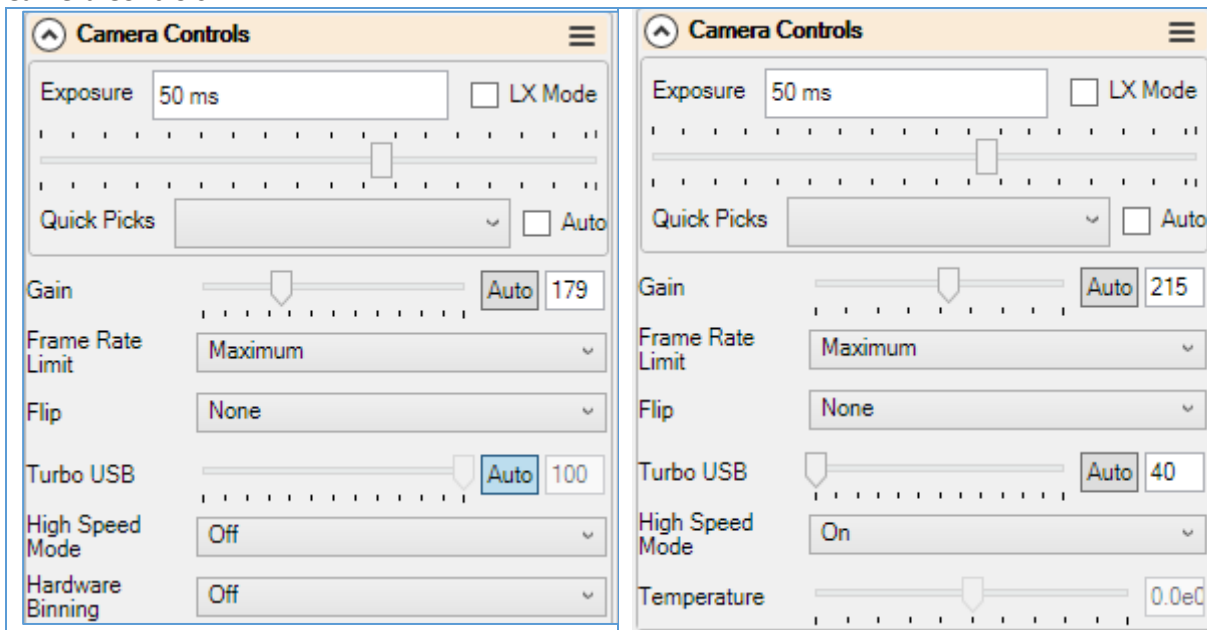
	<p>Unfortunately, such images are very dark due to the signal on each pixel being low compared to the maximum signal. The digital gain option provides a way to compensate for this problem by boosting the whole image after it is read from the sensor, by a factor of up to 100x.</p> <p>The use of <i>Digital Gain</i> is particularly helpful when focussing or using the <i>Polar Alignment</i> tool.</p>
<p>Black Level</p>	<p>This is a software black level adjustment. It should only be necessary to adjust this control when using the <i>Digital Gain</i> option (to keep the black level of the histogram down to a reasonable range).</p>

ZWO Camera Controls

SharpCap supports the full range of ZWO cameras, including support for high resolution ASI1600 cameras and cooled cameras.

Drivers and further information can be found at the [ZWO](#) website.

Camera Controls



Camera Controls	
<p>Turbo USB</p>	<p>Controls how fast the camera will try to push data over the USB bus. Setting a higher value will try to move data faster and give higher frame rates, but setting a value too high can cause:</p> <ul style="list-style-type: none"> • Dropped frames. • A collapse in frame rate. • Or even no frames at all.

	In general, leaving this setting on Auto will work well in most circumstances, but if there are issues with no frames, stuttering frames or low frame rates then try adjusting this option.
High Speed Mode	May improve the frame rate under some circumstances. Changes from using the 12bit ADC on the camera to using a 10bit ADC. Enabling high speed mode may increase image noise when the gain is set to a low value.
Hardware Binning	Only applies when binning is enabled. Calculates binning on the camera itself rather than in software in the camera driver. Increases gain and noise and increases frame rate.

Image Controls

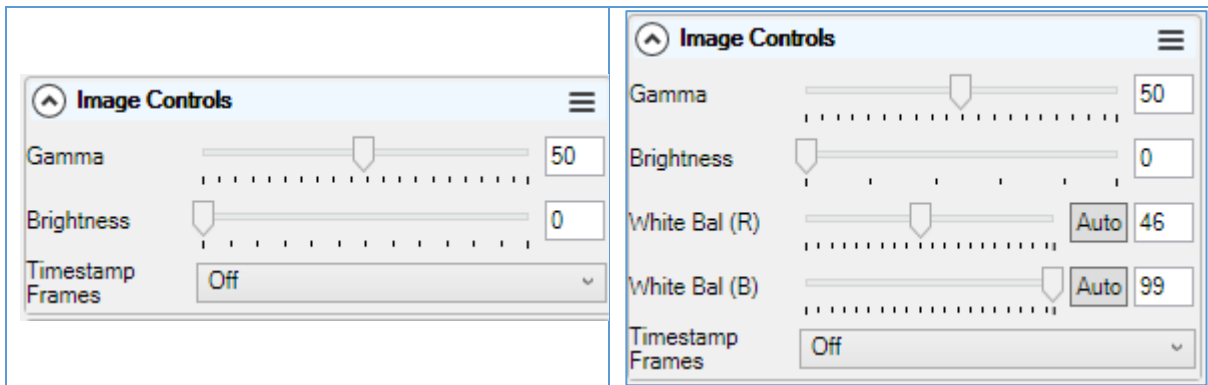
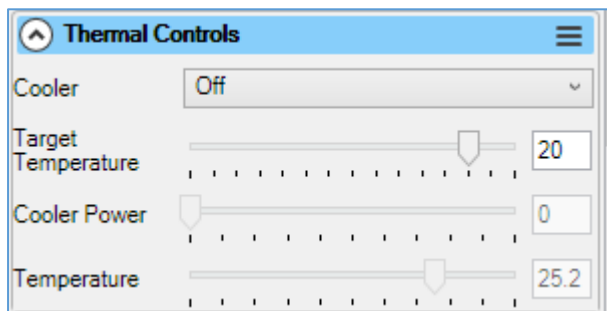


Image Controls	
White Bal (R) [Colour Modes only]	Controls the relative intensity of the red channel of a colour image. Along with White Bal (B) this can be used to correct the white balance of an image. Note that setting either of the two ZWO white balance controls to auto sets them both to auto.
White Bal (B) [Colour Modes only]	As for White Bal(R) above, but controls blue. Note that there is no control for the green channel, but that isn't needed as the relative strength of the green channel can be increased or decreased by making the opposite change to both red and blue.
Mono Bin [Colour Cameras only]	Only applies when binning is selected. Creates a monochrome binned image rather than a colour binned image.

Thermal Controls

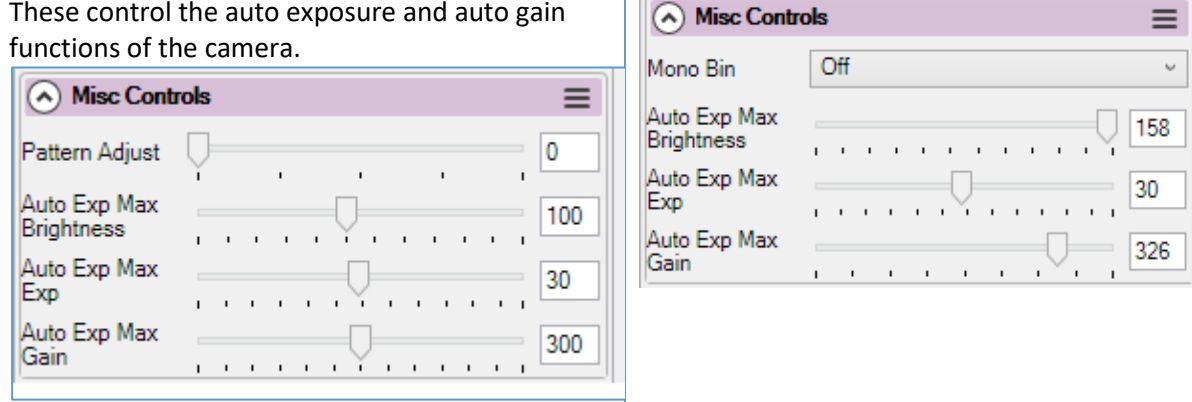


Thermal Controls

Cooler On/Off	Turns the camera cooler on or off. The camera must be connected to 12V power to allow the cooler to operate.
Target Temperature	The temperature the camera will try to achieve if the cooler is turned on.
Cooler Power [Read only]	The current power percentage that the cooler is running at.

Miscellaneous Controls

These control the auto exposure and auto gain functions of the camera.



Miscellaneous Controls	
Auto Exp Max Brightness	Auto Exp Max Brightness sets the target level for the maximum brightness point in the histogram in the range 50 (targets a histogram peak at about the 20% level) to 150 (targets a histogram peak at about the 60% level).
Auto Exp Max Exp	Auto Exp Max Exp is the maximum exposure (in seconds) that can be used when auto exposure is enabled.
Auto Exp Max Gain	Sets the max allowable gain in the same way.

[DirectShow Cameras](#)

Microsoft DirectShow is an architecture for streaming media on the Microsoft Windows platform.

There are a vast number of webcams and frame grabbers on the market. In general, SharpCap should work with any of them but some cameras/grabbers have buggy drivers which may prevent them from working correctly with SharpCap. The controls available in SharpCap are determined by the driver – SharpCap just shows the controls the driver makes available. Sometimes more controls are available in the *Video Capture Pin* and *Video Capture Filter* dialogs provided by the device driver.

Additionally, SharpCap allows the images being captured from a webcam to be processed by sophisticated features available to dedicated astro cam users – for instance *Live Stacking* and *Polar Alignment* are both usable with images coming from a webcam or frame grabber provided a long enough exposure can be set to start seeing details and/or stars.

[Webcams](#)

Many budget webcams usually need some adaptation to be used for imaging. This usually involves removal of lenses, auto-focusers (which includes the infra-red filter) and addition of a webcam 1.25" adapter and IR cut filter.

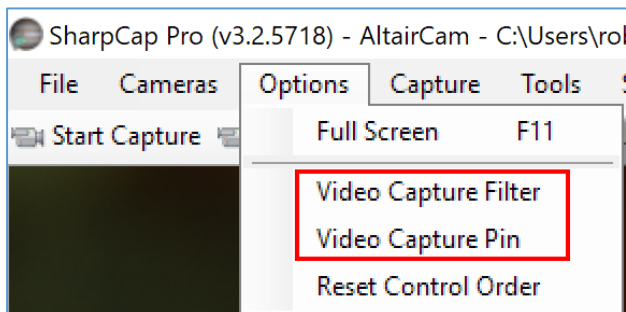
Microsoft LifeCam (webcam)

The Microsoft LifeCam HD is a common web cam which can be modified for astro use – it would typically be used for lunar/planetary image capture but not deep sky objects. Its capability can be seen in the Jupiter images at the [SharpCap gallery](#) .

These webcams can be found on eBay for around £15 and would need an IR cut filter (around £10 on eBay). Modification details can be found at <http://dslrmodifications.com/lifecam/lifecam1.html>, showing the camera being fitted into a disused or low cost telescope eyepiece.



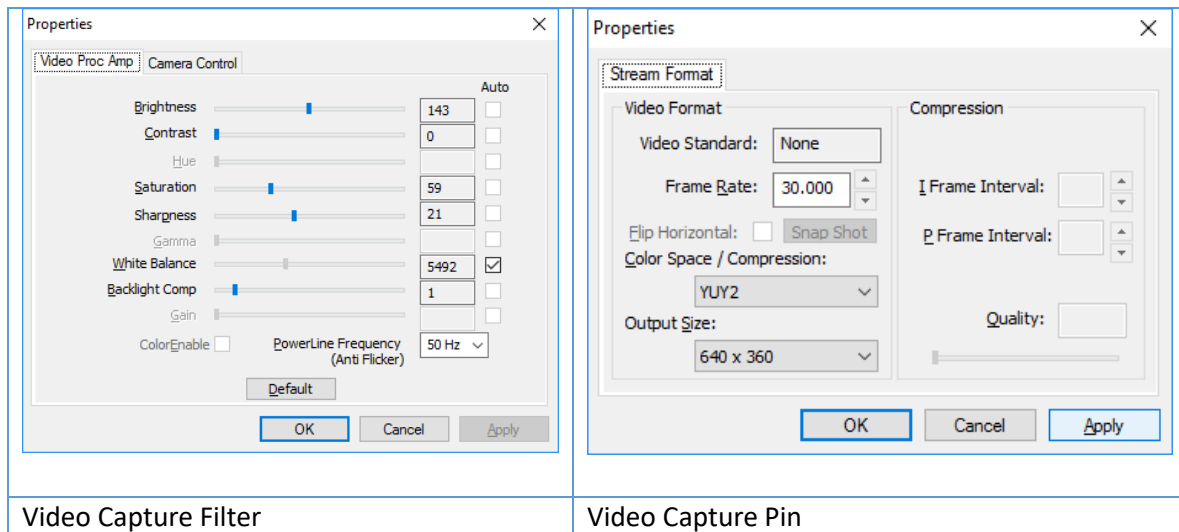
When a Microsoft LifeCam is the active camera, additional menu *Options* appear in SharpCap.



With the Microsoft LifeCam, the useful extra options are:

- Video Capture Filter
- Video Capture Pin

Video Capture Filter and *Video Capture Pin* are options which show setup dialogs created by the camera's manufacturer. The Video Capture Filter dialog can also be accessed via the [Camera Control Panel](#) by pressing the 'Show' buttons next to the options control.



Note that the controls available in, and the design of, the Video Capture Filter and Video Capture Pin dialogs is determined by the camera driver for the camera being used, not by SharpCap.

Frame Grabbers

A frame grabber is an electronic device able to capture frames from an analogue video signal. The frame grabber is a USB device. The analogue video signal is commonly supplied by a day/night CCTV style security camera. This type of camera, generically called an astro video camera, is commonly based on the LN300 style CCTV body, usually with enhanced firmware or electronics which allow for internal stacking of video frames. Camera output can be to a frame grabber or an analogue screen. This arrangement is commonly used for live image display and internet video broadcasting of astronomical objects particularly in outreach type scenarios. This arrangement has proved to give satisfactory results under heavily light-polluted skies.

A typical video capture device is the EzGrabber from <http://www.ezcap.tv/>. [Note: there are lots of clone devices that look the same as the ezcap but may contain completely different hardware and have different drivers – sometimes these drivers have compatibility problems.]

Well known manufacturers of the astro video type cameras are Revolution Imager and Mallincam.

A typical setup comprising frame grabber and astro video camera is shown below.



Analogue video camera with Bluetooth adapter for accessing the camera's internal menu. Video/power balun (left hand side) used to connect ethernet cable.



USB2 video frame capture device. Shows in SharpCap as a *USB 2861 device*.



From left to right – video frame grabber, balun, ethernet cable, balun, analogue video camera.

SharpCap will see this USB frame grabber as a USB 2861 (typically 28xx) device. The details of the camera connected to the frame grabbing device will not be detected by SharpCap. The camera is controlled by its own internal menu system and is usually accessed via a USB or Bluetooth connection. This type of camera typically has a maximum resolution of 720 x 576 and will be NTSC or PAL.

<table border="1"> <thead> <tr> <th>Cameras</th> <th>Options</th> <th>Capture</th> <th>Tool</th> </tr> </thead> <tbody> <tr> <td colspan="4">Rescan for Cameras</td> </tr> <tr> <td colspan="4">DirectShow Cameras</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td colspan="3">USB 2861 Device</td> </tr> <tr> <td></td> <td colspan="3">AltairCam</td> </tr> <tr> <td colspan="4">Test Cameras</td> </tr> <tr> <td></td> <td colspan="3">Test Camera 1 (Deep Sky)</td> </tr> <tr> <td></td> <td colspan="3">Test Camera 2 (High Speed)</td> </tr> </tbody> </table>	Cameras	Options	Capture	Tool	Rescan for Cameras				DirectShow Cameras				<input checked="" type="checkbox"/>	USB 2861 Device				AltairCam			Test Cameras					Test Camera 1 (Deep Sky)				Test Camera 2 (High Speed)			
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<p>SharpCap view of a frame grabber</p>	<p>Astro video camera internal menu</p>																																

Modified Webcams

Modified webcams are those which have been electronically modified. Typical modifications are long-exposure (LX) and amp glow removal. SharpCap 3.1 and above no longer support LX modified webcams - you should use an earlier version of SharpCap (3.0 or earlier) to control these cameras. Details on their use can be found in an earlier version of this user manual.

DirectShow Controls

DirectShow cameras have a fixed set of available controls defined by Microsoft, however not all cameras will offer all these controls.

Format & area (Video format)	Camera controls	Image controls
<ul style="list-style-type: none"> • Colour space • FPS • Resolution • Frame divisor 	<ul style="list-style-type: none"> • Pan • Tilt • Roll • Zoom • Exposure • Iris • Focus 	<ul style="list-style-type: none"> • Brightness • Contrast • Hue • Saturation • Sharpness • Gamma • Color Enable • White Balance • Backlight Compensation • Gain

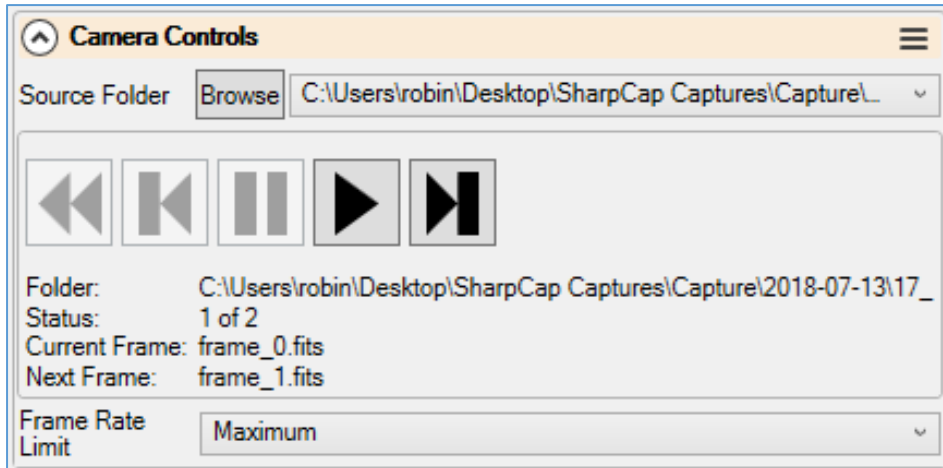
Virtual Cameras

SharpCap can talk to a wide range of cameras directly and even more via either an ASCOM or DirectShow driver. It also has a pair of testing (simulated) cameras that can be used to try out the features of the program on cloudy nights. The Virtual Folder Monitor Camera adds another way to get images into SharpCap – it can read existing or newly added image files from a directory opening up new ways to use SharpCap. As a couple of examples:

- You have a camera that isn't supported by SharpCap, even using a DirectShow or ASCOM driver, but you have an application that will capture frames from that camera and save them to a folder. You can use the folder monitor virtual camera to load each new frame saved to the folder into SharpCap, allowing you to access SharpCap tools like focus measurements, live stacking, etc.
- You have a series of image frames of a target captured with either SharpCap or another capture application. You can use the folder monitor virtual camera to live stack these frames in SharpCap (or repeat the live stacking with different parameters if these were frames originally saved in SharpCap).

The virtual folder monitor camera only has a limited set of controls available – it's obviously not possible to adjust camera controls like exposure, gain or colour balance when the images are being read from saved files! The resolution and colour space values are also determined by the contents of the image files being loaded and cannot be changed.

You do have the ability to browse for the folder that contains the files you want to work with and move through the list of files in the folder either automatically (in play mode) or stepping forward/back manually in pause mode. Additionally, dark subtraction and flat frame correction can be applied and the frame rate limit can be set.



To select the folder source, press the 'Browse' button and either select a folder (which will process all image files in that folder) or select a single image file (PNG, TIF, FITS and JPG supported), which will process all image files of that type in the same folder. When you select a new folder:

- If the folder contains image files then the first image file of the selected file type is loaded into the camera and displayed, then the camera is paused automatically, allowing you to make any adjustments necessary or select tools such as live stacking before pressing the 'Play' button to begin processing the other images in the folder
- If the folder does not contain any image files then the camera will enter play mode automatically, which means that the first image will be processed and appear on screen soon after it is saved into the selected folder.

The playback controls (Rewind, Step back, pause, play, step forward) provide a way to move through the image files present in the folder.

Image files are always processed in date order (starting with the oldest first). The resolution and colour space values are selected from the first frame processed, and files that have different resolutions or colour space settings will be skipped. If SharpCap runs out of files in the folder (or if there are no image files in the folder initially) then it will wait for new image files to be added and load them when they appear.

If multiple image files are present in a folder and the 'Play' function is selected then they will be rapidly displayed in turn with no pause between images unless

- The frame rate limit control is set to limit the rate at which frames are displayed or
- Live Stacking is selected, in which case a new frame will be loaded only after the previous frame has completed any live stacking calculations, ensuring that no frames will be skipped by the live stacking.

The Virtual Folder Monitor Camera is a SharpCap Pro feature.

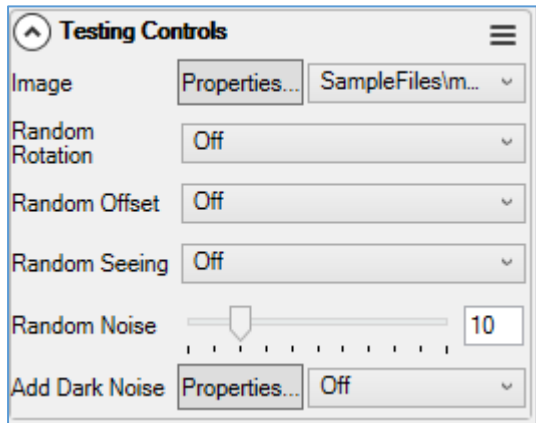
[Test Cameras](#)

The *Test Cameras* are useful to experiment with and understand settings and their effect. Much of the material in this manual has been derived from the *Test Cameras*. Hence this document can be used as a learning aid without having a telescope or camera attached to the PC/laptop or when the

sky is cloudy. The use of a suitable lens (which can be purchased for a few pounds) will allow astro cameras to be tested without waiting for clear skies.

Test Camera 1 (Deep Sky)

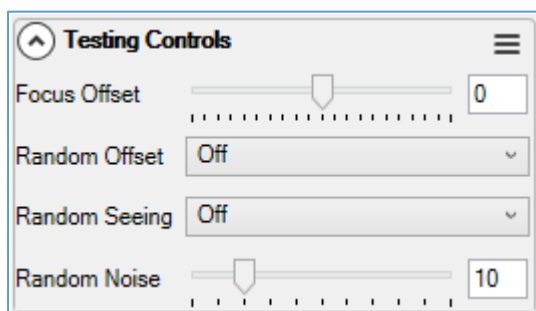
See [Common Camera Controls](#) for a description of generic camera/image/display controls. [Note: some of the common controls currently have no effect, for example gain.]



- *Image* – click the *Properties* button to load a PNG file stored in the *SampleFiles* folder. Other user created PNG, JPG or FITS files can be stored here for access via the test camera.
- *Random Rotation* – applies a random small rotation to each frame shown in the capture display area. On/Off, default = Off.
- *Random Offset* – applies a random offset effect to the image shown in the capture display area. On/Off, default = Off.
- *Random Seeing* – applies a random seeing effect to the image shown in the capture display area. The seeing effect is a blurring of the image. On/Off, default = Off.
- *Random Noise(On/Off)* – applies a random noise effect to the image shown in the capture display area. Default = 10, range 0..50.
- *Add Dark Noise* – will, by default, apply the file *SampleFiles\1280x960x32RGB_dark.png* to the image shown in the capture image. The image used for dark noise can be changed by pressing *Properties* – the image must be the same size as the main image.

Test Camera 2 (High Speed)

See [Common Camera Controls](#) for a description of generic camera/image/display controls. [Note: some of the common controls currently have no effect i.e. gain, exposure, gamma.]



- *Focus Offset* – simulate focuser movement and can be used in *Focus Score > Graph*. Default = 0, range -10..+10. Note that this Focus Offset control is only available if the selected focuser in the Hardware Settings is set to *None*.

- *Random Offset* – applies a random offset effect to the image shown in the capture display area. On/Off, default = Off.
- *Random Seeing* – applies a random seeing effect to the image shown in the capture display area. The seeing effect is a blurring of the image. On/Off, default = Off.
- *Random Noise* – applies a random noise effect to the image shown in the capture display area. Default = 10, range 0..50.

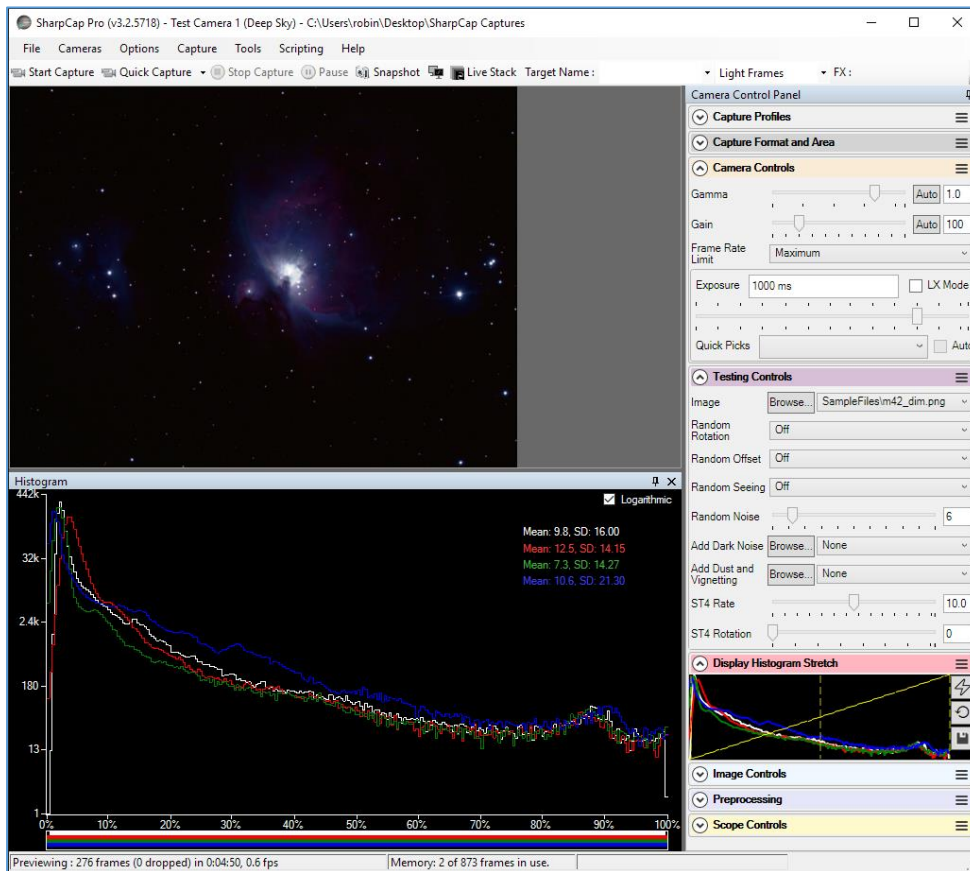
The Histogram

The image histogram acts as a graphical representation of the tonal distribution in a digital image. It plots the number of pixels for each tonal value. The histogram will quickly highlight problems with an image including under exposure, over exposure or colour balance issues and is used to help capture the highest quality data possible.

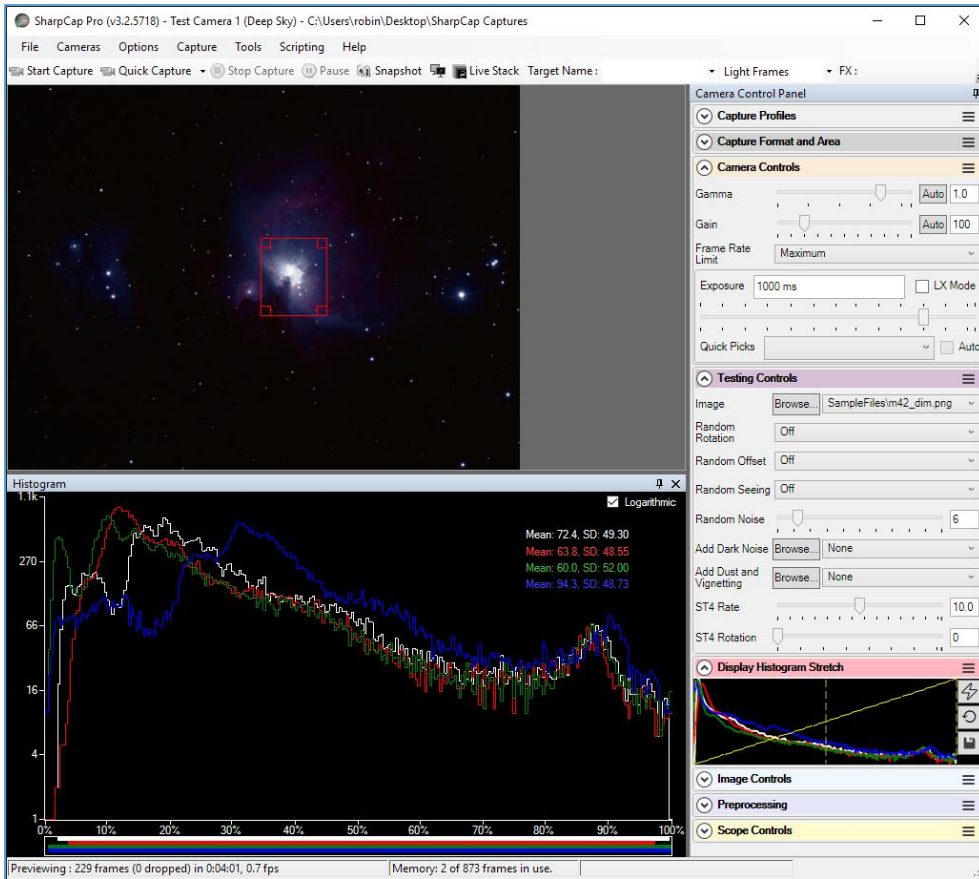
The histogram can be shown by clicking the *Image Histogram* icon in the *Tool Bar*:



which will display the *Image Histogram* in the *Work Area* of the *Main Screen*, as shown below.

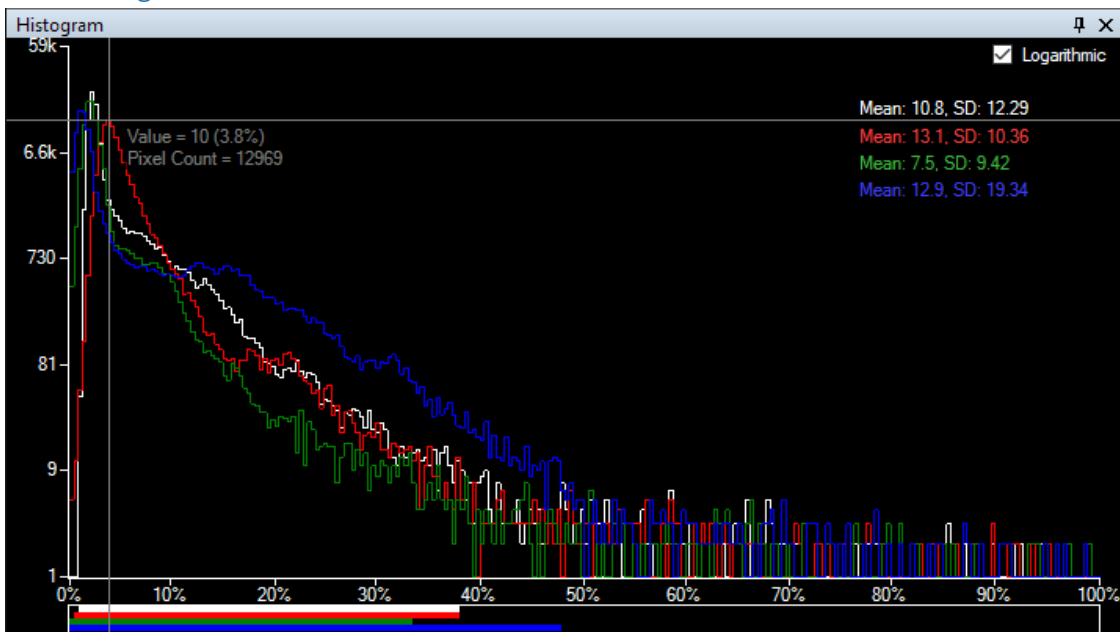


Clicking the *FX Selection Area* icon in the *Tool Bar* shows a red rectangle on the image which can be dragged and re-sized. While this selection area rectangle is enabled, the histogram is only calculated for the parts of the image within the rectangle. This allows for more detailed scrutiny of a restricted region of the image and of how the histogram in the region appears.



Notice the two histograms above are different but no camera settings have been changed.

The Histogram in Detail



Auto Hide – at the top right, the ‘pin’ icon can be used to auto hide the histogram when the mouse is moved away from it. Moving the mouse back over the collapsed histogram tab will re-show it.

Logarithmic/linear selection – the checkbox will switch between a logarithmic display and a linear display.

Mean and Standard Deviation (SD) – statistical information for each colour channel giving the mean and standard deviation of the pixel values for that channel. These are measured in ADU (Analogue to Digital Units) with a maximum value of 255 at 100% for 8-bit images and 65535 at 100% for 10/12/14/16-bit images.

Crosshairs – these show when the mouse is moved over the histogram area and allow you to read off the ADU value and pixel count for any point on the histogram graph easily.

Horizontal axis – the % of maximum pixel brightness (in 8 bit modes the pixel brightness is 0 to 255, in 16 bit modes 0 to 65535). This is scaled as 0 – 100 and caters for 8-bit, 12-bit, 14-bit and 16-bit cameras in a uniform presentation.

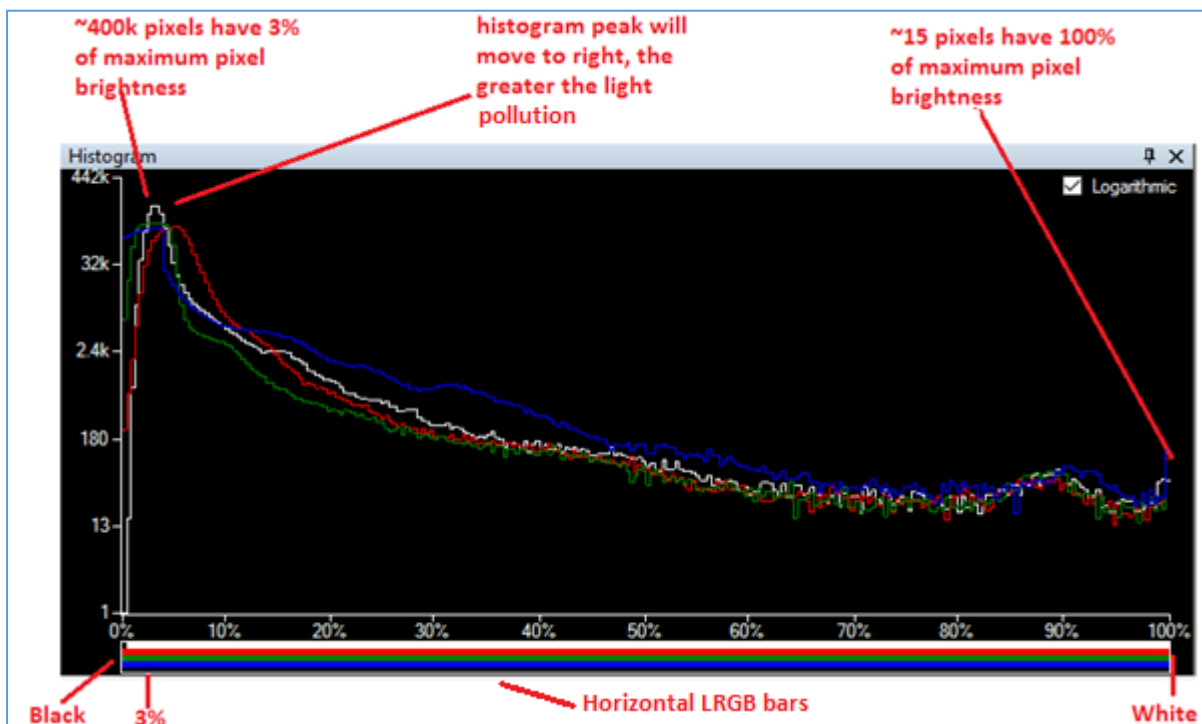
Vertical axis – the number of pixels at that brightness.

The Histogram Lines – The four lines on the histogram graph showing the brightness distribution of each of the three primary colour channels (Red, Green and Blue) and the distribution of the total brightness of each pixel (often referred to as Luminance).

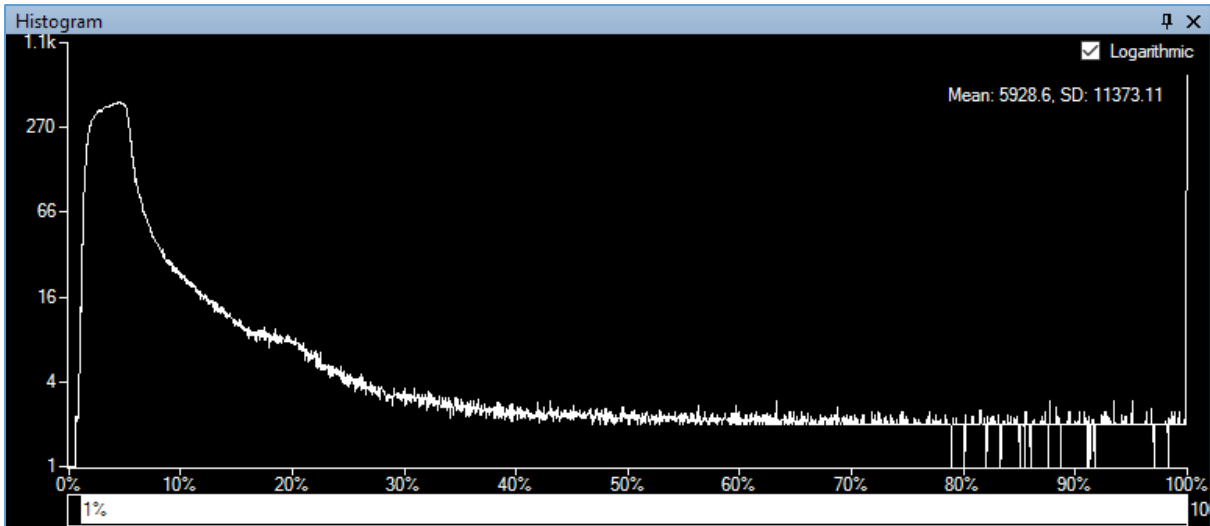
Horizontal Colour Bars – these bars below the horizontal axis represent the ranges of the Luminance, Red, Green and Blue channels (commonly referred to as LRGB).

This histogram below conveys the following information:

- Approximately 400k pixels have 3% of maximum pixel brightness. This is the histogram peak.
- Approximately 15 pixels have 100% of maximum pixel brightness”, that is, are saturated in this case. This is a very small number of pixels compared to the total number in the image, so the clipping at the right-hand side is of little significance.

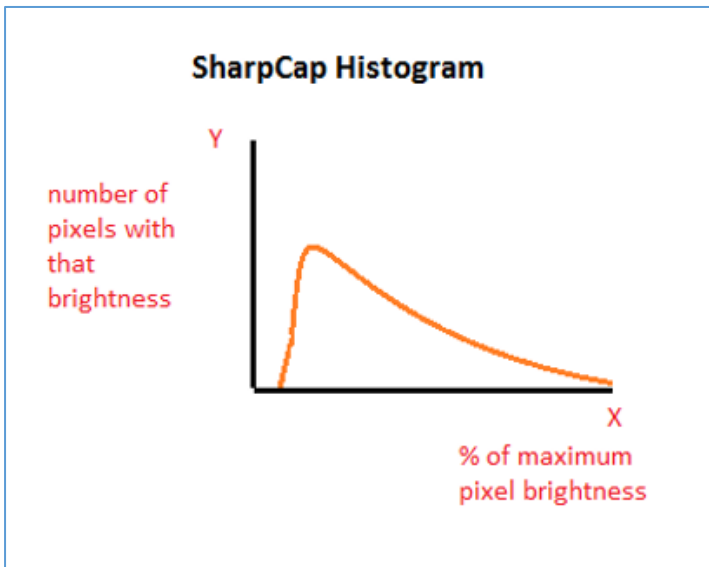


Note when using a *Mono* colour space, there is only a single white horizontal bar (Luminance) and single line on the graph.



Understanding the Histogram Axes

The diagram below defines the units of the horizontal and vertical axes.



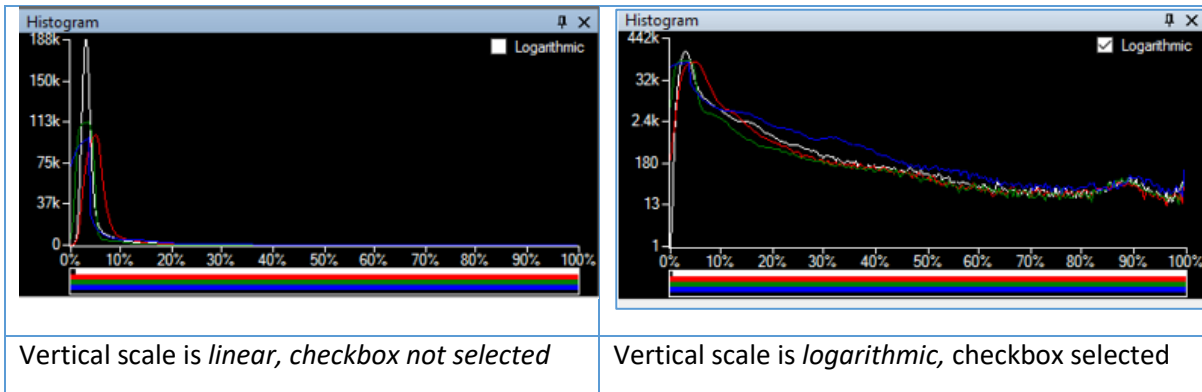
Note SharpCap shows the horizontal scale as a %, giving a uniform method of labelling to cover 8, 12, 14 and 16-bit cameras.

The horizontal scales can be found on the internet using a representation of the bit depth capability of the camera. The table indicates alternate horizontal scales that may be encountered, the numbers being derived as $2^n - 1$, where n = bit depth of camera.

Camera bit depth	Histogram horizontal scale
8	0..255
12	0..4095
14	0..16383
16	0..65535

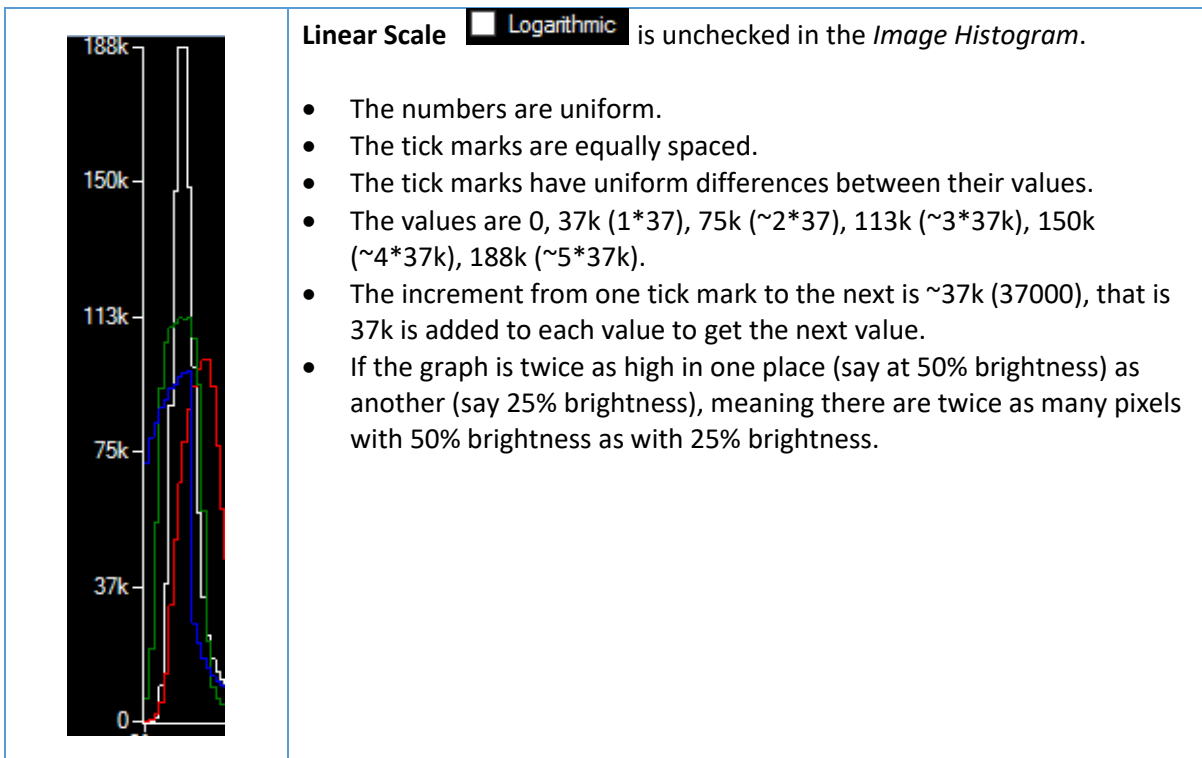
Linear and Logarithmic Scales

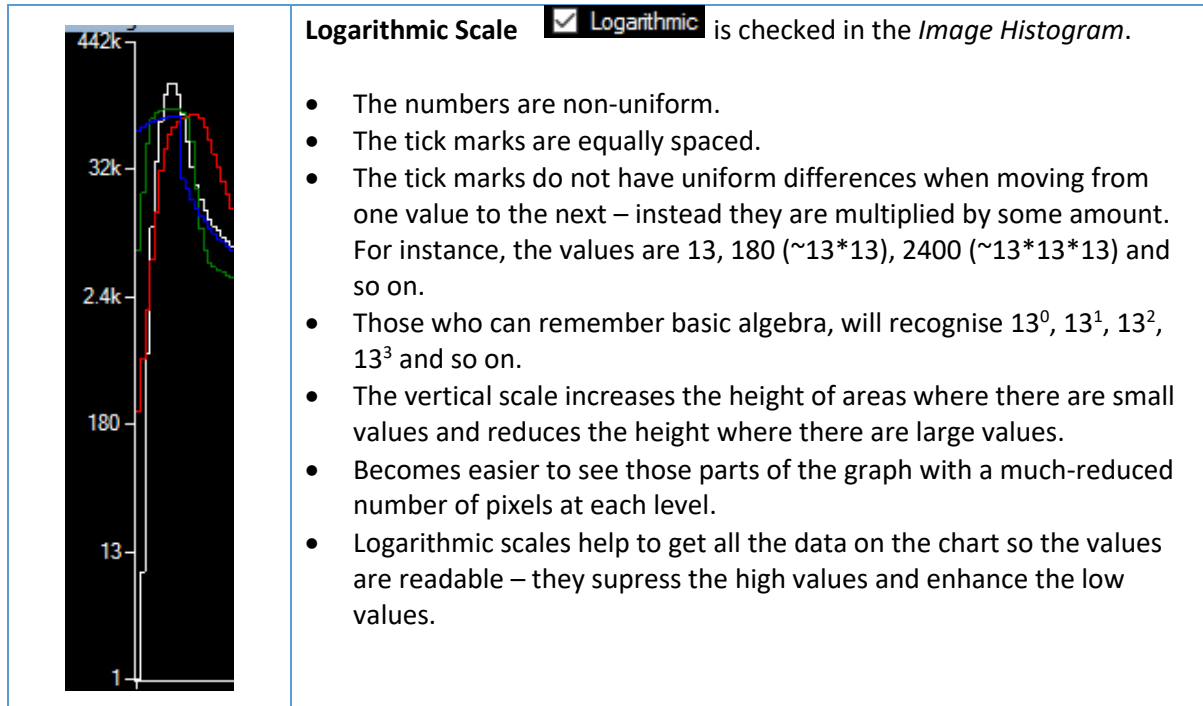
By deselecting or selecting the *Logarithmic* checkbox at the top right, the shape of the SharpCap histogram can be changed.



In the graphics above, notice the vertical scales are different. The following is a description of the difference between *Linear* and *Logarithmic* scales.

Note: ~ means **approximately** in the calculations. The slight inaccuracies are due to rounding errors when scaling to fit the screen.





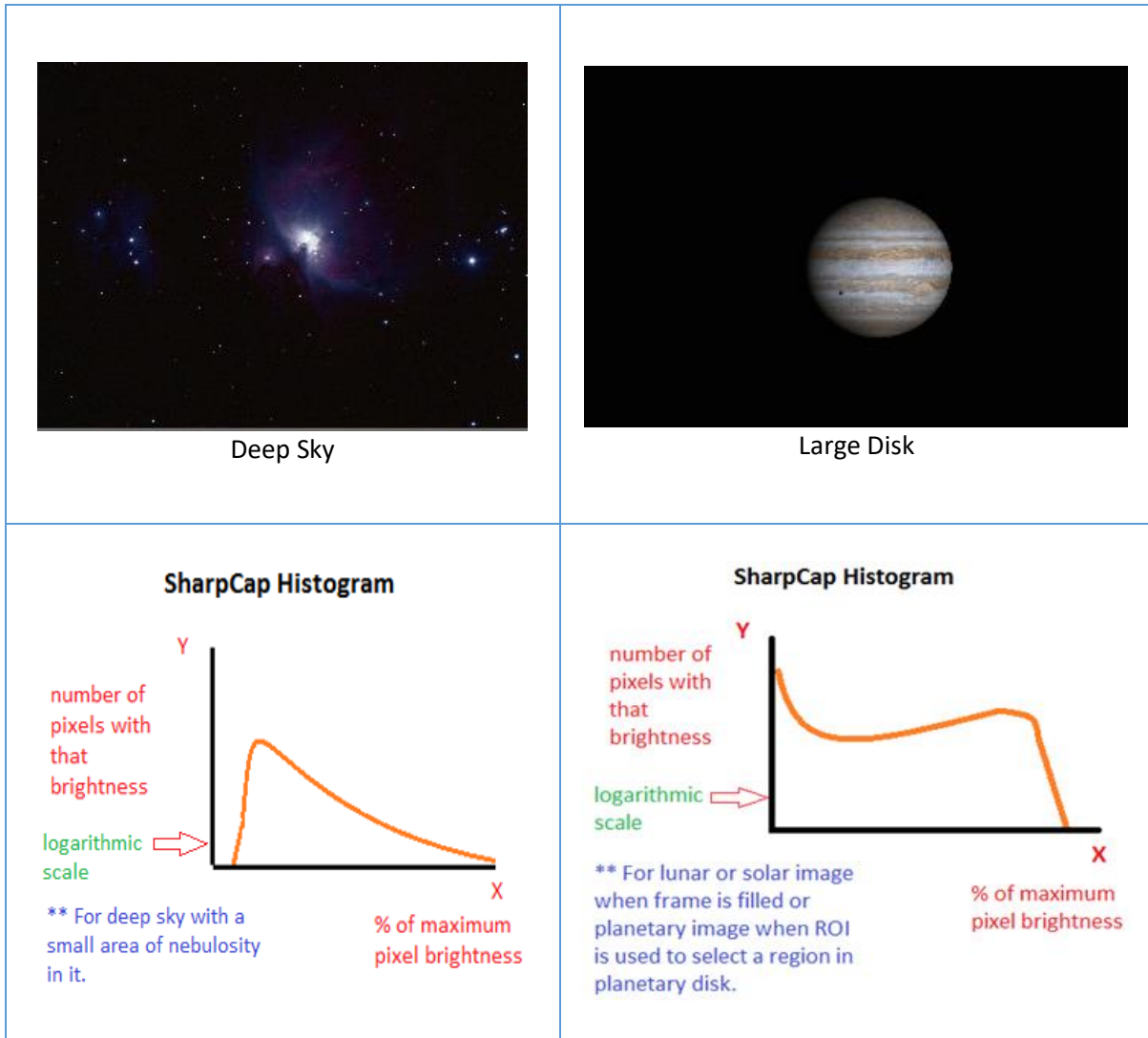
After reading the above, the question is “Should a *Logarithmic* scale or a *Linear* scale be chosen when using the *Image Histogram*?”

The answer is “think about the type of object being imaged and use whichever obtains the best images” but, bear in mind the following:

- *Linear* makes most sense when the area the histogram is being applied to is roughly uniform in brightness, for instance:
 - A lunar or solar image when the frame is filled.
 - A planetary image when the ROI is used to select a region inside the planetary disk.
- *Logarithmic* makes sense when there are distinct different regions inside the histogram area, for instance:
 - A deep sky full frame containing a small area of nebulosity.

If the deep sky was looked at with a linear histogram, the peaks from the nebulosity and stars would be swamped by the vast black level peak and therefore invisible. However, the logarithmic scale gets around this.

The following two examples both use a *logarithmic* scale but depending on the type of object being imaged (deep sky or large disk) the *desired histogram shape is totally different*.



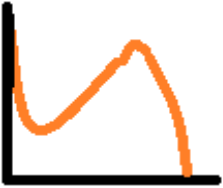



Using the Histogram to Improve Image Quality

The shape of a 'good' Histogram can vary depending on:

- A *logarithmic* or *linear* vertical scale being selected.
- The object being viewed:
 - Deep Sky.
 - Solar/Lunar/Planetary.
 - Solar/Lunar/Planetary when ROI (Region of Interest) is used to select an area inside the disk.

Guidelines for 'good' histogram shapes for linear/logarithmic vertical scales and object types are summarised below. Following these guidelines will help ensure images are correctly exposed.

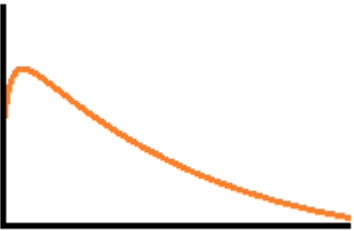


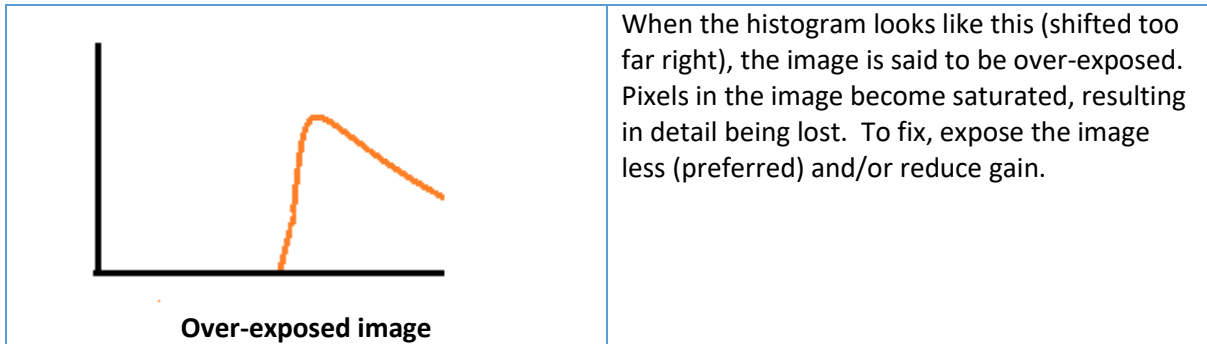
Deep sky - linear	Deep sky - logarithmic
 <p data-bbox="317 562 676 591">Solar/lunar/planetary – linear</p>	 <p data-bbox="895 562 1315 591">Solar/lunar/planetary - logarithmic</p>
 <p data-bbox="217 927 775 1025">Solar/lunar/planetary with ROI or when target is filling frame (i.e. no black background) – linear</p>	 <p data-bbox="836 909 1362 938">Solar/lunar/planetary with ROI - logarithmic</p>

It is helpful to consider the following information to understand why these shapes of histogram are associated with the given types of image:

- Deep sky histograms have a peak at low intensity levels due to the dark background and typical low brightness of any nebulosity.
- Solar/lunar/planetary histograms usually have a peak near the black level due to the dark background and another peak for the (relatively) large and bright image.
- Solar and Lunar histograms where an ROI is used or the sun/moon fill the entire frame will not have a peak near the black level as there is no black background.

The following two diagrams show the type of problems (plus suggested fixes) encountered with a histogram.

 <p data-bbox="360 1895 632 1924">Under-exposed image</p>	<p data-bbox="810 1585 1390 1901">When the histogram looks like this (shifted too far left), the image is said to be under-exposed or black level clipped. This will result in an image with a grainy background. The grainy background is difficult to remove with post-processing software. Faint detail will be hard to bring out. To fix, expose the image for longer (preferred) and/or increase gain and/or increase brightness or offset.</p>
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Worked Examples

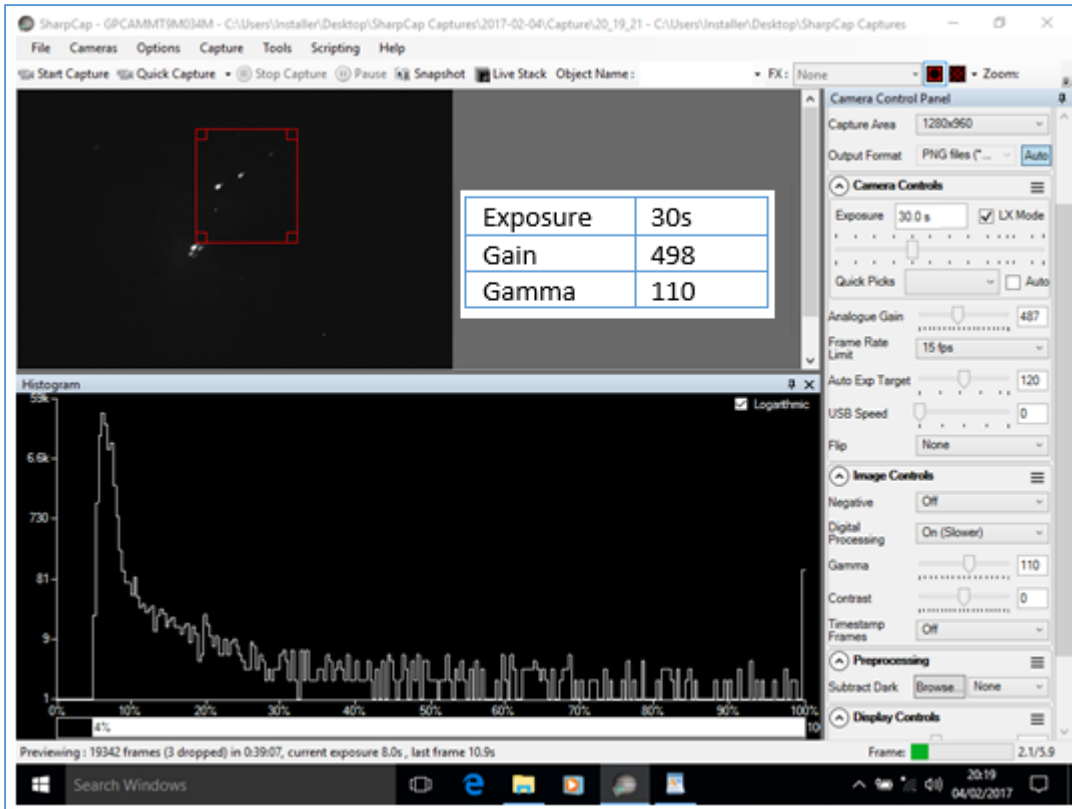
The following two examples use these *guidelines (not rules)* for a 'reasonable' histogram for a **deep sky object with the vertical axis set to use a logarithmic scale**:

- Horizontal LRGB bars not touching left axis (otherwise black clipped).
- Horizontal LRGB bars not touching right axis (otherwise white saturated).
- Red and blue horizontal bars approximately level at each end (colour balance).
- LRGB histograms very close together in the graph.
- Histogram peak at around 20% on horizontal axis. The peak can move depending on light pollution.
- Sharp gradient at left of peak.
- Gentle gradient to right of peak.

A Monochrome Deep Sky Example

The example below documents the preparation to image M42. The equipment used was:

- Celestron C8 SCT.
- Celestron CG5 Equatorial Mount.
- Altair Astro GPCAM MONO V1 set to MONO8 colour space.
- A 0.5x focal reducer and Astronomik CLS filter.
- Imaging laptop was a Lenovo X61 ThinkPad, with 1.8GHz Core 2 Duo CPU, 4Gb RAM, 120Gb SSD & Windows 10 Pro 32-bit.

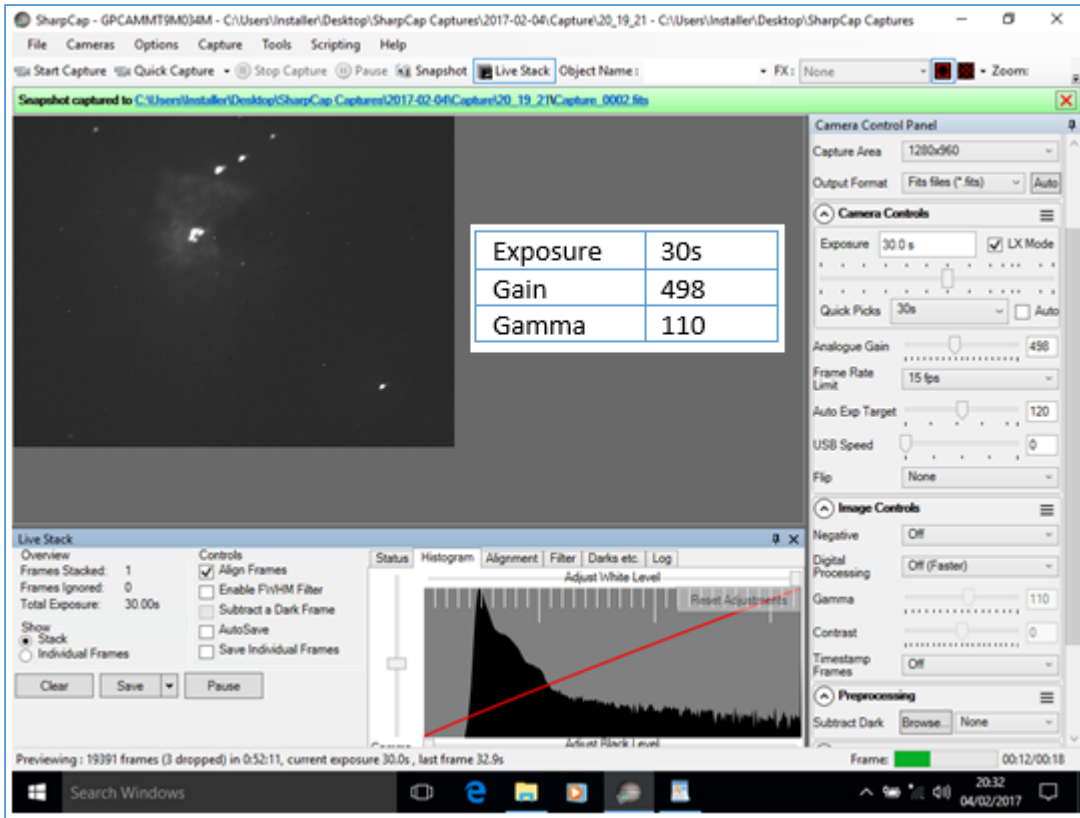


The M42 object has a wide range of brightness. Rather than try to set exposure and gain for the whole image, the *FX Area Selection tool* was used to set the histogram for a restricted area, effectively excluding the bright core of M42 from the calculations. This choice led to the core being over exposed but gave a chance of capturing the nebulosity – a trade-off.

Checking against the guidelines listed above for a **deep sky object with the vertical axis set to use a logarithmic scale**:

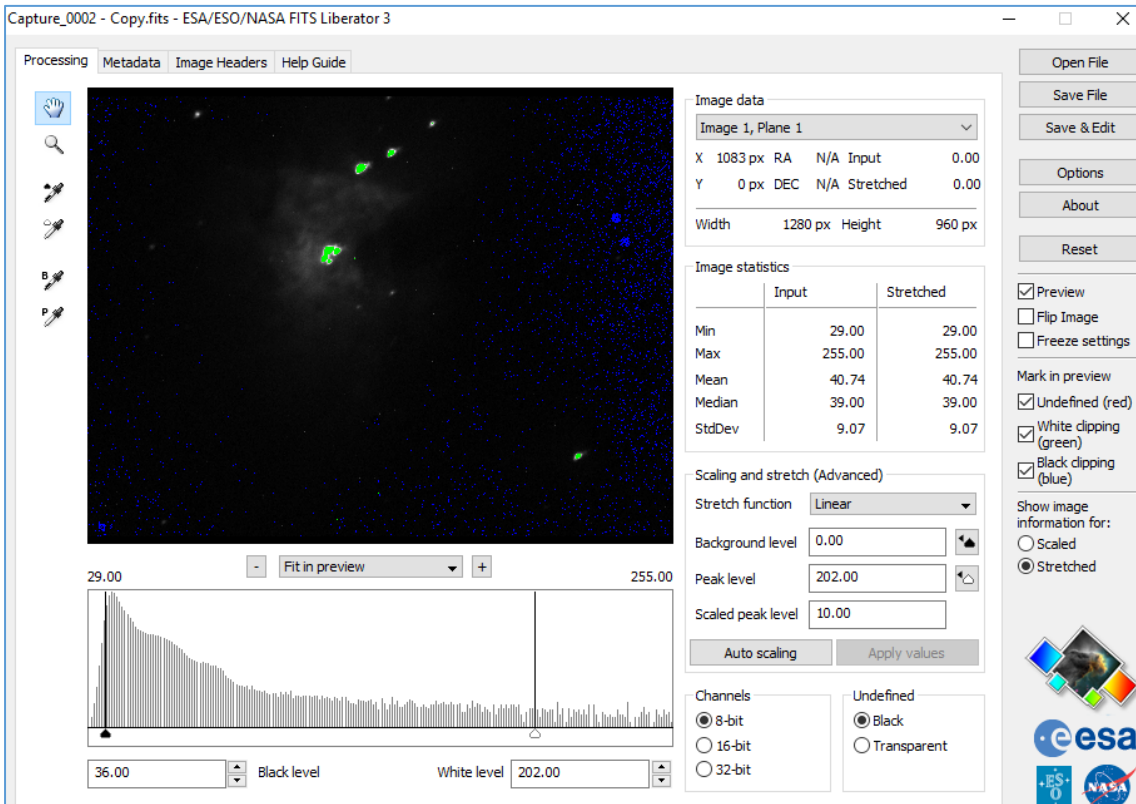
Guideline	Whether satisfied
Horizontal LRGB bars not touching left axis (otherwise black clipped).	Yes, mono therefore no RGB.
Horizontal LRGB bars not touching right axis (otherwise white saturated).	Touching, but looking at the log scale, ~80 pixels saturated.
Red and blue horizontal bars approximately level at each end (colour balance).	Not applicable, as mono.
LRGB histograms very close together in the graph.	Not applicable, as mono.
Histogram peak at around 20% on horizontal axis.	At 10% but shape is good.
Sharp gradient at left of peak.	Yes.
Gentle gradient to right of peak.	Yes.

The stack was cleared and stacking restarted, the histogram was still reasonable, nebulosity was starting to build after 1 x 30s frame.



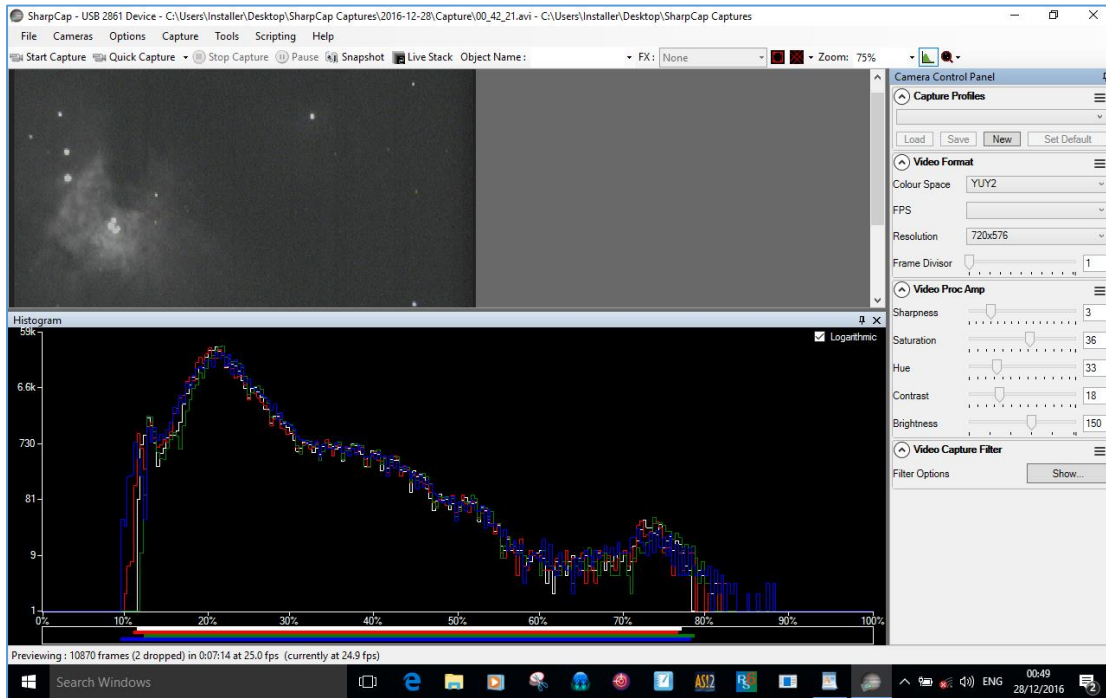
At each stage, most attention was paid to the histogram in the *Work Area*.

Here is a **copy** of the FITS capture file loaded into FITS Liberator – with no post-processing. The histogram had kept ‘reasonable’ shape suggesting worthwhile data was being captured for subsequent processing.



A Colour Deep Sky Example

This capture was taken using an AVS DSO-1 analogue video camera with USB2 video capture device (frame grabber). The video grabber is classed as a DirectShow device, no camera controls are exposed in SharpCap, so adjustments are made using the camera's internal menu.



Checking against the guidelines listed above:

Guideline	Whether satisfied
Horizontal LRGB bars not touching left axis (otherwise black clipped).	Yes.
Horizontal LRGB bars not touching right axis (otherwise white saturated).	Yes.
Red and blue horizontal bars approximately level at each end (colour balance).	Reasonable.
LRGB histograms very close together in the graph.	Yes.
Histogram peak at around 20% on horizontal axis.	Yes.
Sharp gradient at left of peak.	Yes.
Gentle gradient to right of peak.	Yes.

The four Trapezium stars at the core of M42 can be seen. Improvements here would be to try to extend the histogram more to the right, by adjusting exposure, gain and brightness.

The resultant *Save as Viewed* PNG file when the *Live Stack* count was 293 is shown below (*Save as Viewed* = no post-processing). The core was blown out but some nebulosity was captured.



Smart Histogram

Have you ever wondered whether you are using the right gain or exposure when deep sky imaging? Whether 6x ten-minute exposures really do give you more detail than 12x five-minute exposures? No more guesswork is required with the SharpCap Pro Smart Histogram feature. In combination with the results of [Sensor Analysis](#), SharpCap can measure the sky background brightness for you and then perform a mathematical simulation of the impact on final stacked image quality of using different gain and exposure combinations. You can also see graphs showing the impact of using longer or shorter exposures (or lower or higher gain) than suggested.

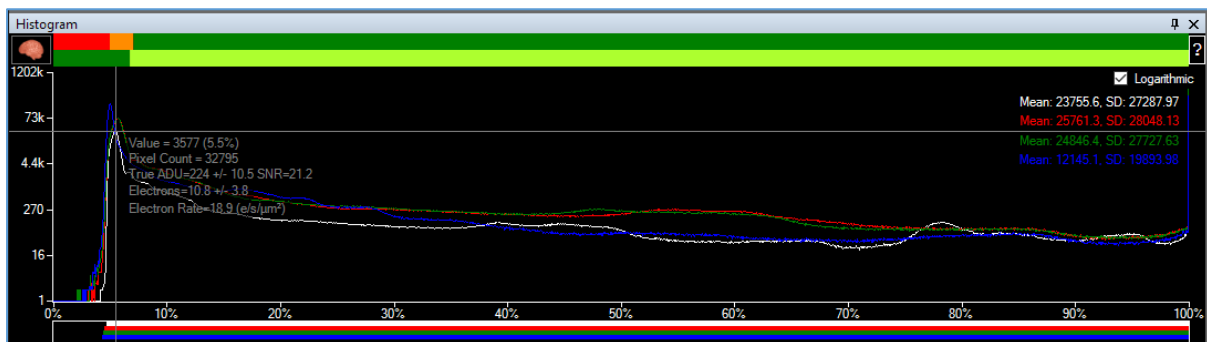
If you try this using a modern, low noise, CMOS sensor you might be pleasantly surprised to find out that the optimal exposure length isn't nearly as long as you imagine and that maybe the complexities of guiding will become a thing of the past (The use of long – 5 to 10 minute or even longer – exposures in traditional deep sky imaging is not required to see faint targets, it's actually required to deal with the high typical read noise of CCD sensors. Since the optimal exposure length is proportional to the square of the read noise and CMOS read noises can be 1-3 electrons instead of 8-10 electrons, exposures can often be much shorter with no loss of quality).

Note that Smart Histogram functionality is only available for certain cameras:

- Smart Histogram is not available for any Cameras used via a DirectShow (Webcam) driver.
- Smart Histogram is only available for cameras that have been analysed using the [Sensor Analysis](#) tool. SharpCap ships with a selection of camera analysis data for the most popular Astronomy cameras, but you may need to run *Sensor Analysis* on each of your cameras to make the Smart Histogram features available.

The Smart Histogram Bars

The basic form of Smart Histogram takes the form of a pair of coloured bars along the top of the histogram area:

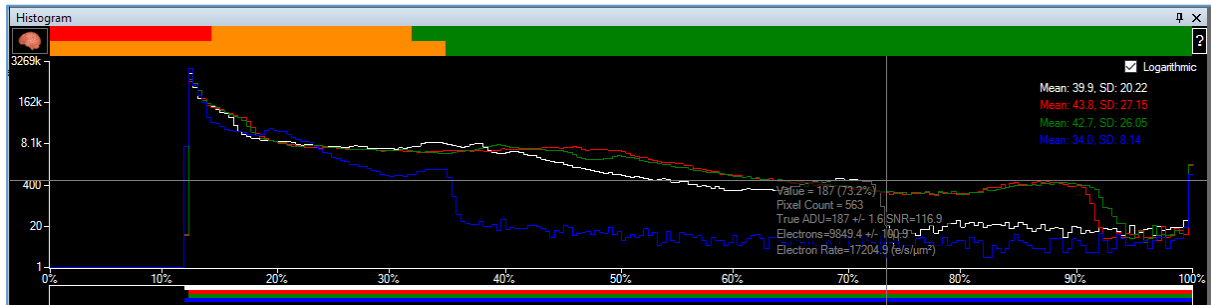


The top bar with the red, amber and green sections shows the impact of the camera's read noise on the total image noise at that brightness level. For areas of the image in the red highlighted region of the histogram, the camera read noise dominates the total noise (>50% of total noise). In the amber region, the read noise contributes significantly to the total noise (10% to 50%). In the green region, the contribution from read noise is small (<10%).

The size of the red and orange zones will vary as you vary the gain and offset controls of your camera. Once you have picked values for those controls, you should adjust the exposure so that the histogram peak corresponding to the sky background is just to the right of the orange zone – this will give you optimum image quality without entering the zone where increased exposure time has diminishing (to zero) returns.

The lower bar indicates the effect of bit depth on the quality of captured image. In high bit depth modes (12, 14, 16 bit), the bar is green and light green (as seen above) – the light green section shows the range where the increased bit depth is not helping you because the total pixel noise equals or exceeds the distance between ADU levels in 8-bit mode. In the light green region, the use of high bit depth simply means that you are recording the pixel noise in greater detail!

In 8-bit modes, the lower bar is amber and green:

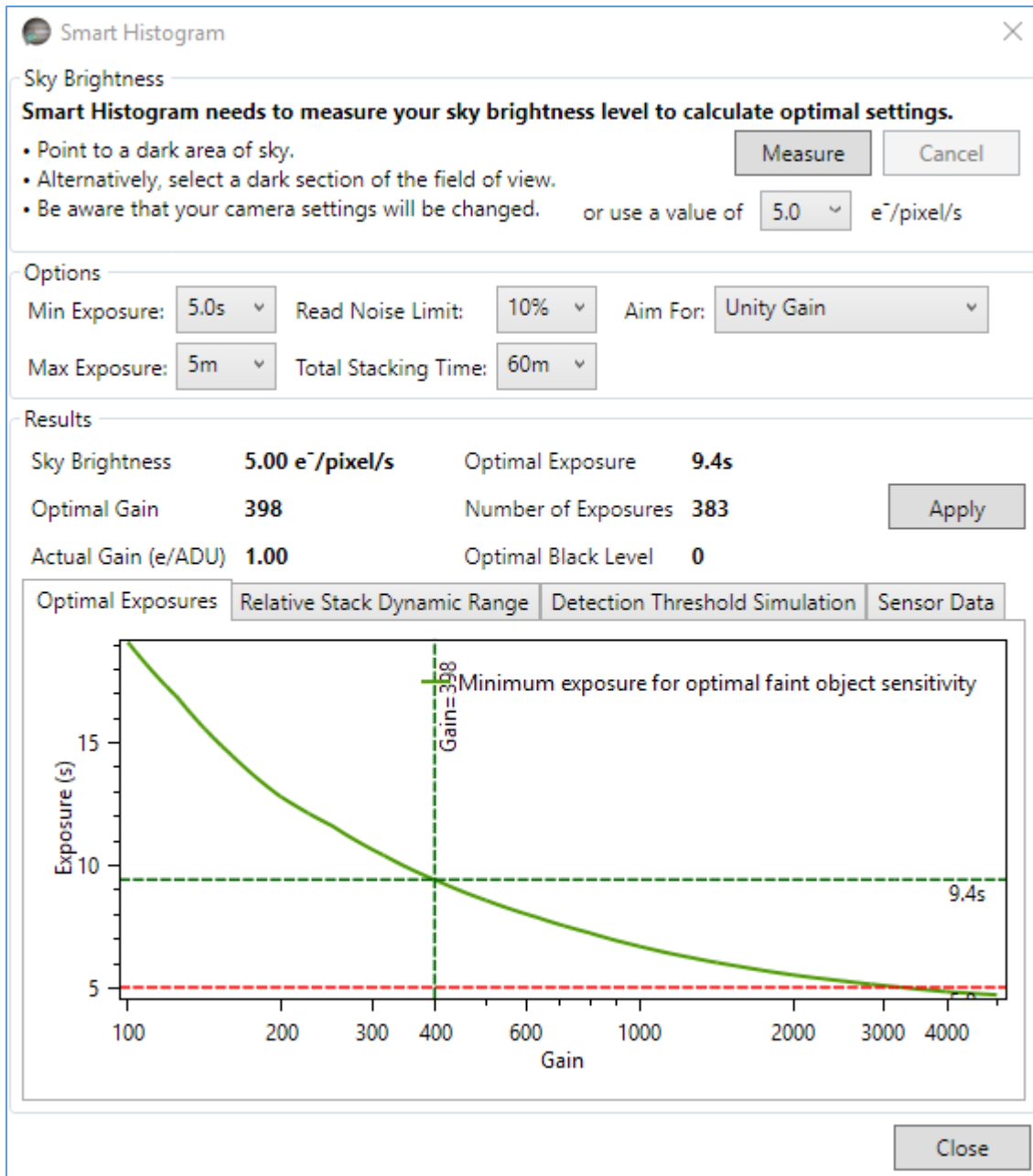


The amber region indicates the part of the histogram where you are throwing away data by using 8-bit mode (i.e. you would get more image quality by switching to 10/12/14/16 bits for parts of the image in this histogram region). The amber region will shrink to the left as you increase the camera gain level, and at the high gains used in planetary imaging it may not be visible at all – this shows why there is no need to use high bit depth modes for planetary ‘lucky’ imaging (and also that the Smart Histogram isn’t only useful for deep sky!).

The coloured bars at the top of the histogram are just the quick way to use the Smart Histogram features, giving you some basic guidance on exposure times and bit depths. For a more in-depth calculation that gives recommendations on gain, offset, exposure and bit depth, press the ‘Brain’ button next to the coloured bars to bring up the Brain window.

The Smart Histogram Brain Window

The ‘Brain’ window looks quite complicated, but if you follow it from top to bottom it should not be too hard to use.



The goal of the Brain is to help you pick the right camera settings to get the best deep sky images. Note that the Brain is **not** aiming to give you fabulous quality sub-exposure images, it is calculating how to get the best final image when you stack all frames taken in a set period of time (1 hour by default). The calculations will work out for you whether it is better to take 360 x 10 second images or 10 x 360 second images or some other combination. Note that the primary results (suggested exposure length and gain) do not change if you select longer or shorter total stacking times than the default value of 60 minutes.

Measuring Sky Brightness

The first step is to measure (or enter) your sky brightness – this is measured in electrons per pixel per second and is a measure of how much signal is arriving at every pixel on your camera every second from sources that we don't really want – light pollution and thermal noise being the main culprits. If you press the 'Measure' button then SharpCap will set the gain to maximum and take a

number of increasing length exposures to measure this value – you should point the telescope at an area of sky without nebulosity or many stars to get a good measurement.

Note that the sky brightness will vary depending on a number of factors such as the altitude of your target, sky transparency, proximity of a bright moon, etc.

After using the *Brain Window* a number of times, you may become familiar with typical values for sky brightness at your observing location and be able to enter the value directly by using the dropdown to specify an approximate sky brightness in e/pixel/s.

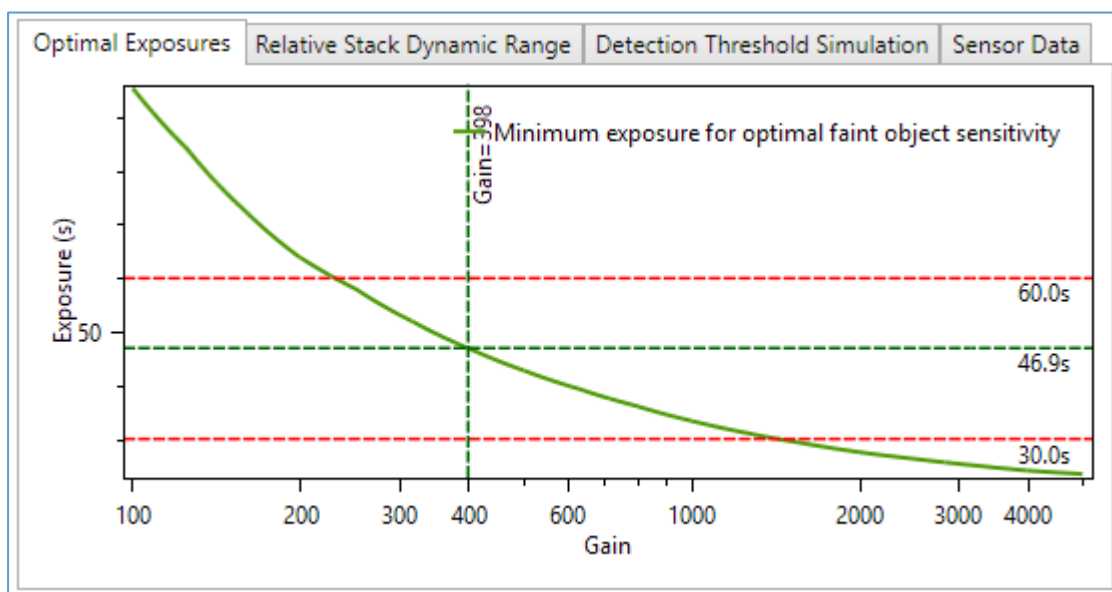
Setting Limits and Targets

The next step is to set limits and targets for the calculation – you can set a minimum and maximum exposure to consider (typically maximum exposure is determined by mount tracking/guiding quality and minimum by how much data you have to save with very short frames or stacking speed for live stacking). You can also set the time you intend to image for (setting this value is not critical, changing this will *not* change the suggested values) and the contribution you are prepared to tolerate from the sensor read noise in the final image noise level. If you select a ‘Read Noise Limit’ of 10%, that means that the calculations will allow the total noise level in the final stacked image to increase by 10% above the minimum achievable noise level (i.e. to go from 10 to 11 on some arbitrary scale).

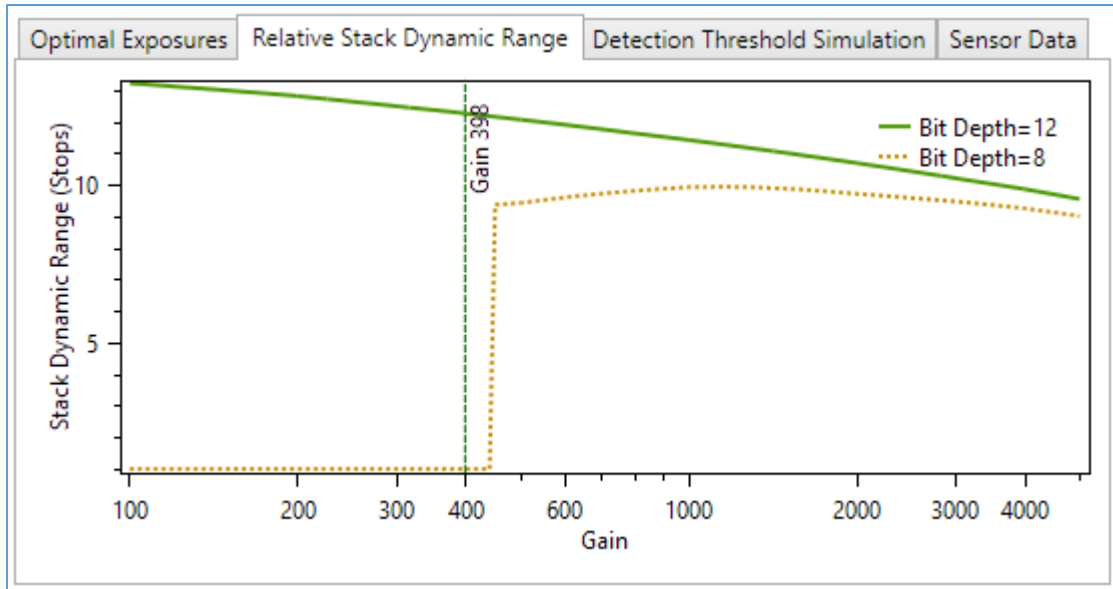
The last choice in this section determines how the gain is chosen – the two options are ‘Unity Gain’ which aims for 1 electron per ADU (or as close as possible) and ‘Max Dynamic Range’. ‘Max Dynamic Range’ finds the gain where the final stacked image will have the maximum ratio between the brightest thing that is not quite saturated and the noise level. Max Dynamic Range will often (but not always) choose the minimum gain value.

The Results

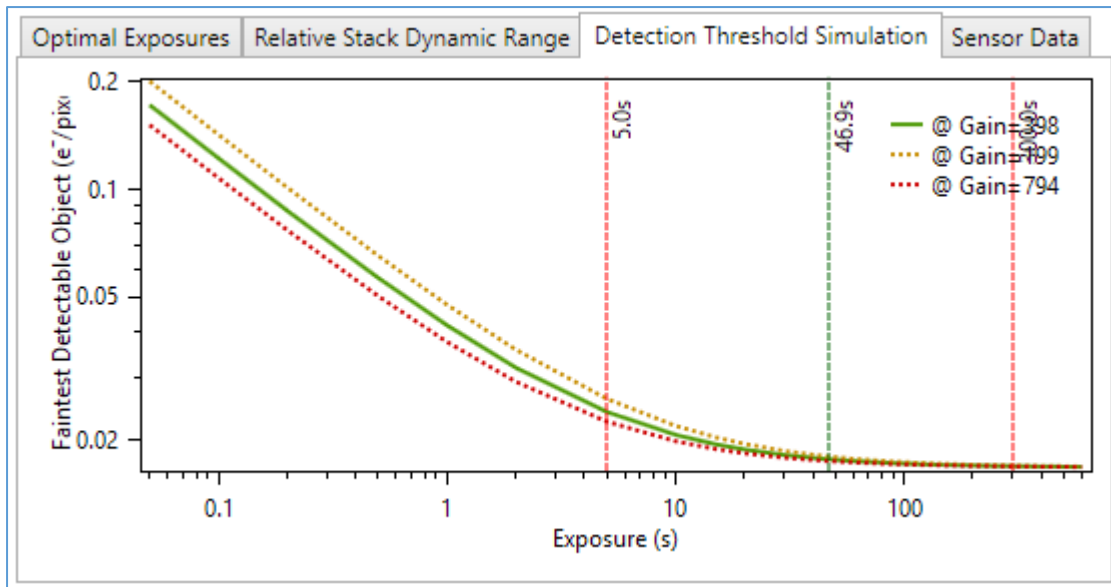
Once the sky background is measured and the limits and targets are set you can examine the results. In the image above, you can see that with a 5e/pixel/s sky brightness (quite bad light pollution), the calculation is recommending a gain value of 398, an exposure of 9.4s and a black level of zero (because the sky brightness will be enough to pull the histogram clear of the left-hand side). The graphs below show useful detail on the calculations that help you understand the result and if necessary tweak the values.



The optimal exposure chart shows you the exposure time you need to use to hit your 'Read Noise Limit' criteria for different gains – it also shows your minimum and maximum exposure limits as horizontal red lines if they fall within the range of the graph. From this graph we can see that in this case the recommended exposure is 46.9s at 398 gain, but an exposure of 60s could be used at 230 gain or 30s at about 1400 gain to get very similar results. You aim for at least the exposure time shown on this graph, although selecting a longer exposure won't improve things much as we will see in the detection threshold simulation chart.



The relative stack dynamic range chart shows how the dynamic range of the final stacked image will be affected by changing the gain (assuming you follow the suggested exposure time for each gain value). This chart shows information for different bit depths if the required sensor analysis data is available. In this case the stack dynamic range for the 8-bit line drops to zero at gains below about 450. This happens when there are no valid solutions for the exposure time that fit all the limits you have chosen – for instance in this case a read noise limit of 10% would require exposures longer than the maximum exposure value of 5 minutes when in 8-bit mode with a gain < 450. In this case (in common with many cameras), you can get a slight increase in the dynamic range of the final stacked image by moving to lower gain values.



The third chart shows how the faintest visible object in the final stacked image varies with different exposure times. This chart makes it very clear how little extra final sensitivity you will achieve by exceeding the recommended exposure times. In this case at the recommended values (Gain=398, Exposure=47s), the expected faintest detectable object would be 0.0176 e/pixel/s. Increasing the exposure from ~47s to 300s drops that to 0.0168 e/pixel/s, an improvement of about 5%. You can also see that by this point the curves are basically flat – further increases in exposure bring practically no improvement to visibility of faint objects in the final stacked image.

You should use the figures recommended by the Smart Histogram feature as a starting point for fine-tuning the optimal settings for your imaging. For instance if you have good guiding and Smart Histogram recommends 30s exposures, you may wish to use somewhat longer exposures.

The Detection Threshold Simulation assumes that the faintest object you will be able to see in the final stacked image is equal in brightness to the noise level in that image. In fact, for objects that cover a large number of pixels, you might do a bit better than that as it is easier to see a large faint object than a small one, but this does not change the shape of the curve, in particular the fact that beyond the recommended exposure level there is practically no improvement in final image sensitivity to faint detail with further exposure increases.

In summary, when you use the Brain window, SharpCap simulates in a fraction of a second all the possible combinations of gain and exposure that you might use to image and calculates what the effect of each set of parameters would be on the final stacked image. This is possible because the results of the Sensor Analysis allow SharpCap to calculate the behaviour of the sensor for any combination of gain and exposure.

Smart Histogram requires a SharpCap Pro license and you must perform sensor analysis on each model of camera you intend to use. For best results perform sensor analysis in both 8-bit and high bit depth (12/14/16) modes.

Live Stacking

Live stacking is a feature that enables the capture of deep sky images within SharpCap without the traditional requirements of a high accuracy, guided, equatorial mount and long sub-frame exposures. The capture of a larger number of shorter exposures and software correction within SharpCap for any drift or rotation of the field of view between frames makes deep sky astrophotography accessible to a much wider audience at much lower cost.

The traditional requirements of long exposures and accurately guided mounts arise from traditional CCD cameras used for deep sky astrophotography have a high-level of read noise. If there is a high read noise every time that a frame is captured, long exposures are required to allow faint deep sky objects to be seen above the read noise level. Long exposures mean that an equatorial mount which tracks accurately and is typically auto-guided is required.

This all changes when modern low noise CMOS cameras are used instead of CCD cameras. The low level of read noise means that faint objects can be detected in far shorter exposures (and can be enhanced by stacking many short exposures – something that would not be possible without low read noise). If exposures are short enough (often 30s or less), mount accuracy is less important as the amount of drift during a 30s exposure is far smaller than the drift during a 300s exposure. Away from the zenith, field rotation due to the use of an ALT/AZ mount is also not usually going to be significant during a single 30s exposure. SharpCap corrects for any gradual drift or rotation between successive frames by tracking the movement of the brightest stars in the image. As the number of frames captured increases the noise level visible initially visible in the stacked image will reduce giving astounding deep sky images with the minimum of fuss.

Because of the simple satisfaction of watching deep sky images appear in real time without the need to use a separate stacking program, Live Stacking is particularly well suited to outreach uses.

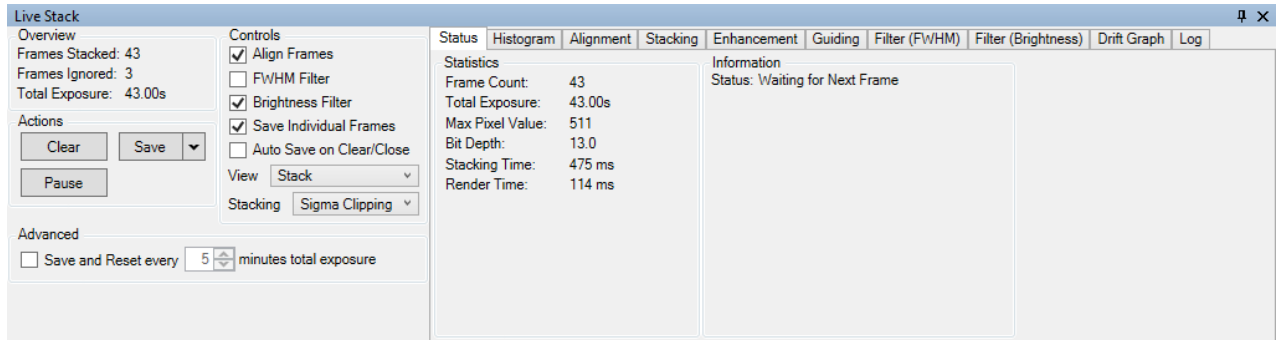
Live Stacking is started by choosing the 'Live Stack' option from the Tools menu or by selecting the *Live Stack* toolbar button.

Once selected, Live Stacking will immediately begin capturing, aligning and stacking frames. A minimum of 3 stars must be detected in each frame for alignment to be possible (see the following sections for further details on alignment and how to customize star detection). It is possible to save the stacked image at any point using the *Save* button that appears in the Live Stack work area – the *Save* can be repeated as required – for instance after 50 frames and again after 100 frames and so on.

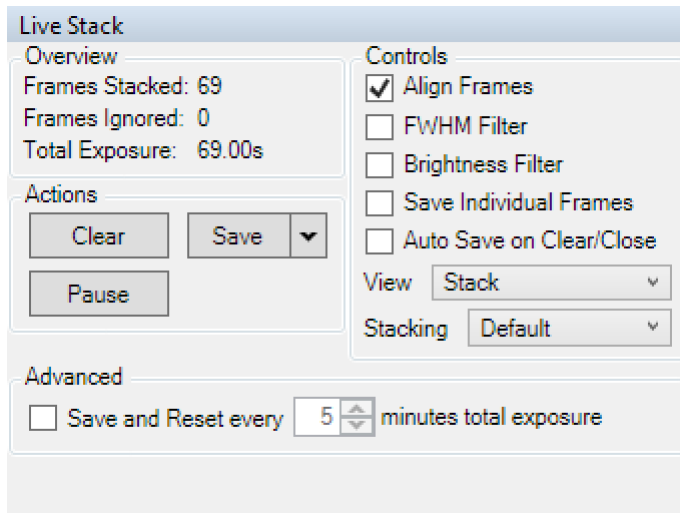
The Live Stacking User Interface

The UI to control Live Stacking appears in the work area below the camera image, and is divided into an always visible left panel and a series of tabs to the right.

The left panel controls and reports on the most important aspects of the stacking process and is always visible during Live Stack. The right panel has six tabs to allow the monitoring and control of the details of the Live Stack process.



Left Panel



Overview Group

- *Frames Stacked* – the current number of frames on the stack.
- *Frames Ignored* – the number of frames ignored (not stacked). This can happen because of alignment problems, SharpCap not seeing enough stars, frame failing to achieve a focus score criteria or other reasons.
- *Total Exposure* – the length of time the current stack has been running. Some cameras cannot report their exposure value to SharpCap (for instance DirectShow Frame Grabbers). In those cases, SharpCap estimates the exposure based on the time between subsequent frames.

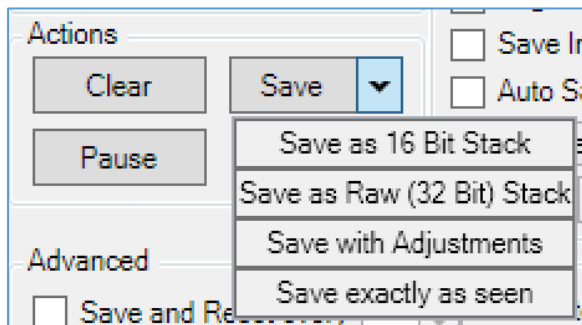
Controls Group

- *Align Frames* – turn alignment and de-rotation on/off (default on). See *Alignment* tab on right panel for more details.
- *Enable FWHM Filter* – enable/disable filtering of each frame by the average FWHM (focus quality) value. High FWHM value frames are discarded as indicating poor focus/seeing/transparency/cloud. See *Filter* tab.
- *Brightness Filter* – enable/disable filtering of each frame by the brightness of the stars detected in the frame. A reduction in star brightness is often caused by thin cloud.
- *Save Individual Frames* – when enabled save each frame as a separate file (FITS/PNG). Note, that only the stacked frames are saved. The individual frames will be found in a folder like YYYY-MM-DD\Capture\HH_MM_SS\rawframes.
- *AutoSave* – enable/disable saving the stack automatically when the clear button is pressed or another action causes the stack to be reset.

- *View* – you can choose to view either
 - Stack (show the stack so far – the default)
 - Individual Frames (show the individual frames being captured by the camera)
- *Stacking* – Allows you to choose the stacking algorithm between the default algorithm and the sigma-clipping algorithm. See <<<Stacking Tab>>> for more details. Note that changing the stacking algorithm will reset the stack.

The *Clear* button will reset the stack to start from scratch. Note, other actions can cause the stack to be reset; for instance, changing camera, resolution, colour space. Changes to exposure, gain, brightness or applying a dark/flat will not cause the stack to be reset.

The *Save* button has 4 sub options:



- *Save as 16 Bit Stack* will rescale the stacked data linearly between the 0 and the maximum pixel value into the range 0 to 65535 and save this as a 16-bit FITS file. The 16-bit FITS option is the default as it gives a high bit depth image with the full range of the image used (i.e. brightest pixel is 65535).
- *Save as Raw (32-bit) Stack* will save the full 32-bit stack data without any scaling as a 32-bit FITS file. The maximum value in it will depend on the number of frames stacked, meaning more adjustments will be needed when viewing (without further adjustment this FITS file will probably appear black when opened into a FITS viewing application).
- *Save with Adjustments* will save the image with the Live Stacking adjustments applied (i.e. after histogram adjustments and colour adjustments have been applied) as an 8 or 16-bit PNG file (depending on bit depth of camera being used).
- *Save Exactly as Seen* will save the image exactly as shown on screen as an 8-bit PNG file. This will include the effects of both the live stacking histogram and colour adjustments and the display stretch if one is applied.

The *Pause/Resume* button will temporarily stop or resume stacking. Stacking will automatically be paused if the *Live Stack* window is closed or if the user switches to another tool such as *Histogram*. Switching back to Live Stack will allow stacking to be resumed in these circumstances if another action would cause the stack to reset has not been carried out (for instance changing resolution or colour space).

Finally, in the *Advanced* section, you can choose to automatically save and reset the stack after a selectable interval. This can be useful if you live in an area with heavy aircraft traffic as taking a large number of shorter stacks may avoid a single set of aircraft lights spoiling a long stack.

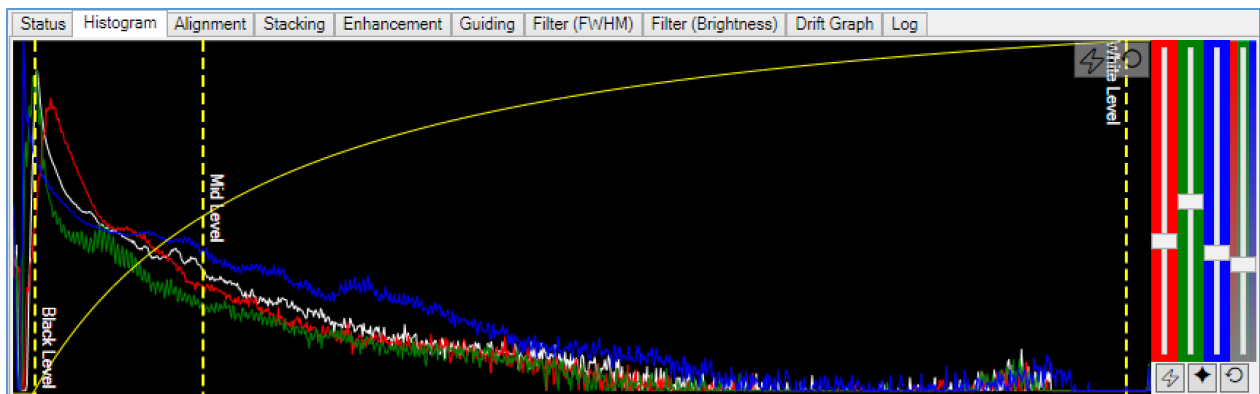
Status Tab

Status	Histogram	Alignment	Stacking	Enhancement	Guiding	Filter (FWHM)	Filter (t	
Statistics Frame Count: 891 Total Exposure: 14m 51s Max Pixel Value: 226524 Bit Depth: 25.0 Stacking Time: 300 ms Render Time: 162 ms		Information Status: Waiting for Next Frame						

The Status tab shows some more detailed information about the stacking process and the stack so far. Of interest is the stacking time, which is the amount of time taken to process the alignment and stacking calculations needed for each frame. If this time is longer than the exposure length, frames will be dropped from the stack (due to the previous frame still being stacked when the next frame arrives). The *Render Time* indicates how long the calculations to redraw the image on screen take to complete. Certain Live Stacking features such as noise reduction and sharpening can increase the render time. If the render time is large then the program will only respond slowly to changes in the Live Stack histogram or colour settings.

The right-hand information panel shows the current status or warning or error messages if stacking errors are occurring.

Histogram Tab



The *Histogram* tab shows not only the image histogram but allows the image levels to be stretched by moving the three vertical dashed yellow lines which represent the *White Level*, *Black Level*, and *Mid-Level*. The yellow curve shows the *Transfer Curve* which determines how bright the viewed image is for a given histogram level. For pixels at the *Black Level* point (and below) the viewed image will be black. For pixels at the *Mid-Level* point the viewed image will be mid (50%) grey. For pixels at (or above) the *White Level* point, the viewed image will be at maximum (100%) intensity.

- Tweaks to the *Black Level*, *White Level* and *Mid-Level* affect how the image is shown on screen **and** how it is saved if choosing *Save with Adjustments* or *Save Exactly as Seen*.
- The changes **do not** affect the actual values in the stack or the result if *Saving As 16 or 32 bit* stacks.

- Changes made to the levels here do not affect the shape or position of the histogram shown in the Live Stacking panel, but will show in the Mini Histogram in the *Camera Control Panel* on the right.
- *Additionally, the Histogram Stretch Controls on the right, in the Camera Control Panel, affect only how the image is viewed on screen and do not affect saved data except when using the 'Save Exactly as Seen' option.*

Adjust White Level

- The white level applies to the horizontal axis of the histogram, so left is 0% and right is 100%. It is not usually necessary to adjust this line.

Adjust Black Level

- The black level applies to the horizontal axis of the histogram, so left is 0% and right is 100%.
- Turn up the *Black Level* slightly (move slider to right) to suppress sky glow/chip noise and give a dark background to an image. Turning the black level up too far can give the image an unnatural look.

Adjust Mid-Level

- The mid-level line also applies to the horizontal axis of the histogram and specifies the level on the histogram that will be displayed as a mid (50%) grey level. The mid-level is restricted to be between the black level and the white level.
- Moving the mid-level control to the left towards will enhance the brightness of dim areas of the image. Moving the mid-level control to the right towards the white level will darken dim areas of the image but enhance contrast in the brighter areas of the image.

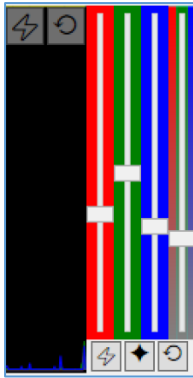
Transfer Curve

- The yellow transfer curve shows how the levels between the black and white points are going to be displayed on screen. The shape of this line is determined by the positions of the black level, white level and mid-level controls, and the line acts in a way similar to the 'Curves' adjustment found in many image processing applications. For this line the vertical axis of the graph is the display brightness from black (bottom) to white (top). The brightness of a pixel in the viewed image is calculated by taking its horizontal position of the pixel on the histogram, moving up to the red transfer curve line and taking the vertical position of the line at that point as the displayed brightness for that pixel.

Auto-Stretch and Reset Buttons

These buttons are located at the top-right of the main histogram area. The *Auto-Stretch* button (with the lightning bolt) will automatically set the black, mid and white levels to appropriate values to enhance the view of the image being stacked. The *Reset* button (with the circular arrow) will set the levels back to their default values. Note that the use of the *Auto-Stretch* button requires a SharpCap Pro license.

Colour Adjustment



The colour adjustment sliders can be found to the right of the main histogram area and only show for colour cameras. The four sliders are, in order from left to right:

- Red Adjustment
- Green Adjustment
- Blue Adjustment
- Saturation Adjustment

The three colour sliders can be used to adjust the colour balance of the image. The saturation slider can be used to increase or decrease the amount of colour seen.

Adjustments made here affect the image as viewed on screen and the saved images when choosing either *'Save With Adjustments'* or *'Save Exactly as Seen'*.

The colour adjustment sliders can apply an adjustment of between -10db (0.32x) and +10db (3.2x) to each colour channel.

Below the colour sliders are three buttons – from left to right:

- Auto colour balance based on aligning image histogram peaks
- Auto colour balance based on star colours
- Colour adjustments reset button

Alignment Tab

Status	Histogram	Alignment	Stacking	Enhancement	Guiding	Filter (FWHM)	Filter (Brightness)	Drift Graph	Log	
Alignment <input checked="" type="checkbox"/> Align Frames Align using <input type="text" value="15"/> stars		Star Detection Noise Reduction <input type="text" value="0.5"/> Minimum star width <input type="text" value="0"/> Maximum star width <input type="text" value="4"/> <input type="checkbox"/> Highlight Detected Stars		Black Level Threshold <input type="text" value="20"/> Digital Gain <input type="text" value="Off"/> Hot Pixel Warning! <input type="button" value="More..."/> <input type="button" value="Reset All"/>		Alignment Status Offset: dx=0.4px, dy=0.0px Rotation: 0.0 degrees		Star Detection Status Stack: 209 stars, FWHM: 3.41 Frame: 211 stars, FWHM: 3.43		

The *Alignment* tab controls the alignment process which, along with the FWHM filter, depends on the detection of stars in each image. SharpCap can only align images in which it can detect stars (**do not use Live Stack for planetary or lunar images**).

- A minimum of 3 stars is required for *Live Stack* with alignment to work. However, for reliability and good alignment a star count of 10-15 or more is to be preferred.

Alignment Group

- *Align Frames* – enable or disable the alignment of frames. The first frame in any stack becomes the reference frame – all other frames are aligned with that frame when alignment is enabled. SharpCap uses the stars it detected in the first frame to align all subsequent frames with the stack. Stars in the stack **are re-detected** if any of the star detection parameters are changed. The absolute minimum requirement is 3 stars detected, although having 3 stars is no guarantee of alignment working if too close together or close to being in a straight line for instance. Ideally, aim for 10-20 or more stars detected with a good distribution across the frame.
- *Align using* – to select number of stars. It can be 10, 15, 20 or 25 stars. Using a larger number of stars may slow down the stacking process, but may give better alignment results. Only increase this value if detecting plenty of stars but still having difficulty aligning.

Star Detection Group

- *Reduce Noise* – when enabled applies a Gaussian blur to help SharpCap to ignore low level noise and hot pixels. Selecting *Reduce Noise* is recommended.
- *Black Level Threshold* – anything under this level is treated as black and can help to ignore low level noise. The default is 50, the range 1..254 in steps of 2 by pressing the up/down arrows. Any value required (in the range) can be typed directly into the box.
- *Digital Gain* – can be used to apply a gain during the star detection process if stars are faint and are not being detected. Values can be Off, 2x, 4x, 8x. Enabling this may help if SharpCap is not detecting enough stars.
- *Minimum star width* – increase this to help stop hot pixels being detected as stars. The default is 2, range 2..32 in steps of 2 by pressing the up/down arrows. Any value required (in the range) can be typed directly into the box.
- *Maximum star width* – reduce this to limit detection of very bright bloated stars. The default is 16, range 4..32 in steps of 2 by pressing the up/down arrows. Any value required (in the range) can be typed directly into the box.
- *Highlight Detected Stars* – checking this will put boxes around the detected stars – yellow stars are used for alignment, red are not used for alignment. This can be very helpful to determine and understand the causes of problems with star detection and alignment.



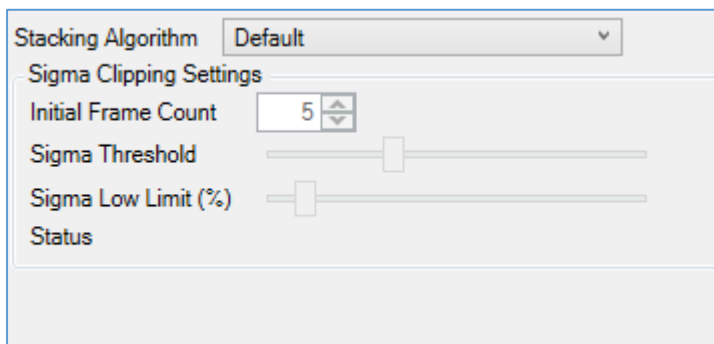
- *Hot Pixel Warning* – this shows when the combination of settings chosen for star detection combine to allow a single hot pixel to be detected as a star. If your camera tends to produce large numbers of hot pixels then this can be a problem as the hot pixels detected as stars may prevent correct alignment. You can prevent hot pixels being detected as stars by
 - Increasing the Noise Reduction setting
 - Increasing the Minimum Star Width Setting
 - Reducing or turning off the Digital Gain Setting
- *Reset All* – this button resets all star detection related options to their default values.

Status Groups

- Shows various data including offset of the frame from the stack, rotation and number of stars detected.

Stacking Tab

The *Stacking* tab allows the selection of either the *Default* or *Sigma Clipped* stacking algorithm and also allows adjustments to be made to the settings for the *Sigma Clipped* algorithm.



Default Stacking

The *Default Stacking Algorithm* adds the pixel values from each frame to the stack data. All frame data from stacked frames is included in the stack. The default stacking algorithm does not have any adjustable controls.

Sigma Clipped Stacking

The *Sigma Clipped Stacking Algorithm* averages stacked frames together to create the stack data. The algorithm tracks fractional pixel values, so stack quality is maintained. The algorithm also compares the value of each pixel in a new frame to the value of that pixel so far in the stack – if the two differ too much the data from that pixel is ignored for that frame.

The advantage of *Sigma Clipped* stacking is that anomalous features in individual frames – for example satellite or aeroplane trails do not end up in the stack data, since the anomalously bright pixels are rejected by the algorithm.

SharpCap keeps track of the mean value of each pixel in the stack as well as the amount of variability in the pixel value for each pixel. The amount of variability for each pixel is known as the standard deviation or *Sigma* value for each pixel.

The decision on whether to include the data for a particular pixel from a particular frame in the stack is made on the basis of the difference between the pixel value in the frame and the mean pixel value in the stack so far for that pixel. The size of this difference is compared to the sigma value for that pixel multiplied by the *Sigma Threshold* value. If the difference is larger then the pixel data is ignored.

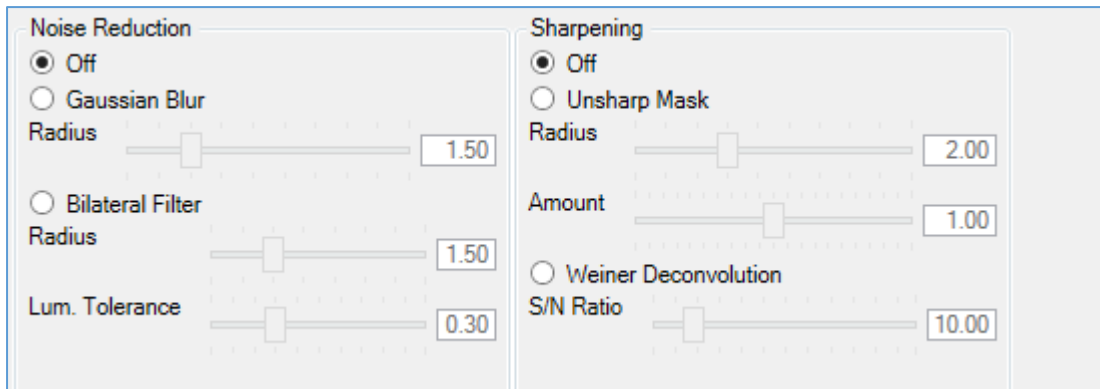
The following controls are available to adjust the behaviour of the *Sigma Clipped Algorithm*:

- *Initial Frame Count* – this controls the number of initial frames during which the algorithm learns what values are expected for each pixel without rejecting any potentially unusual values. A value in the range 5 to 10 is usually sufficient.
- *Sigma Threshold* – this controls how different from the current stack pixel value a frame pixel value must be to be rejected. Setting a higher value here will mean that less pixel data is discarded but will reduce the effectiveness of the algorithm at excluding anomalous pixel data. This control should be adjusted while watching the *Status* information which shows the fraction of pixels being rejected in each frame.
- *Sigma Low Limit (%)* – this control specifies a lower limit on the value of sigma calculated for any pixel in the stack. This is required to prevent incorrect rejection of image data when the individual frames have very little noise.

Note that *Sigma Clipped Stacking* requires a SharpCap Pro license.

Enhancement Tab

The controls in the *Enhancement* tab provide a way to improve the live stack image by either reducing the noise in the image, sharpening the image or both. All tools in the enhancement tab, except for the simple *Gaussian Blur* noise reduction require a SharpCap Pro license.



Gaussian Blur is a simple noise reduction tool which blurs each pixel in the image with its neighbours. This helps reduce the noise in the image but also has the effect of blurring the image somewhat. The *Radius* control determines how large an area each pixel is blurred over, increasing this value will strengthen the noise reduction effect but also blur the image more.

Bilateral Filter is a more sophisticated noise reduction tool which can reduce noise in areas of similar colour without blurring detail as much as the *Gaussian Blur* noise reduction tool. Once again, the *Radius* control determines the area over which the noise reduction operates. The *Luminance Tolerance* control determines how big a change in brightness is required to be regarded as a feature that will be preserved. The *Bilateral Filter* algorithm requires much more calculation than the *Gaussian Blur* algorithm and may slow down live stacking when using high resolution cameras or on slower computers.

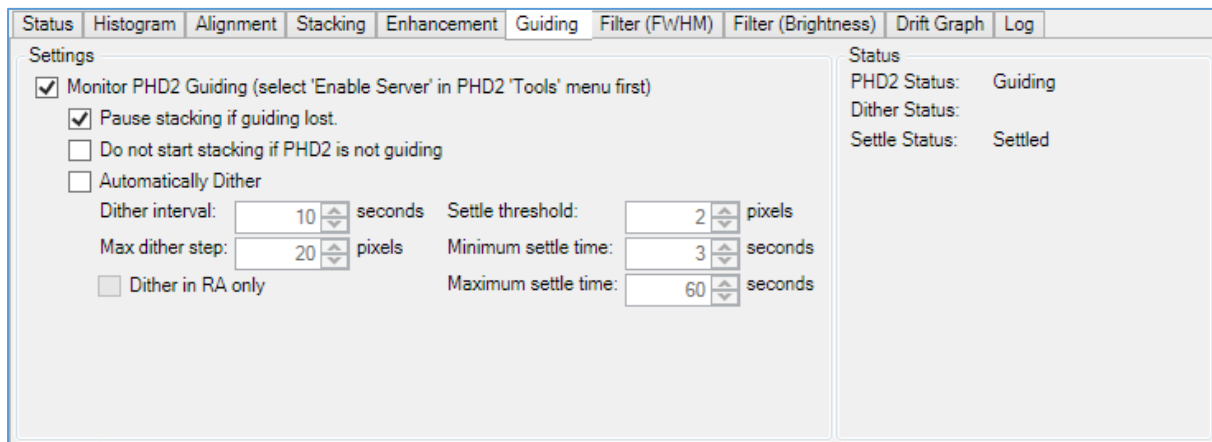
Unsharp Mask is a simple image sharpening tool which strengthens the sharper components of the image relative to the less sharp components, producing a sharper looking image. The *Radius* control adjusts the split between the 'sharp' and 'less sharp' components of the image – the higher the value set the larger the scales of details that will be considered part of the 'sharp' component. The *Amount* control determines how much boosting is applied to the 'sharp' components of the image. Applying the *Unsharp Mask* sharpening unfortunately has the side effect of increasing image noise in the image. Setting the *Amount* control to too high a value may lead to an unnatural look to the image.

Weiner Deconvolution is a sophisticated image sharpening tool based on determining the shape of stars in the stacked image as an indication of the nature of blurring in the stacked image, then attempting to undo this blurring to the image to produce a sharpened image. The only control to adjust for this sharpening algorithm is the *Signal to Noise Ratio*. This is an estimate of how much brighter the image signal is in the stack than the noise. The *Signal to Noise Ratio* control should be set to the highest value that gives a natural look to the image (setting the value too high will give the image an unnatural, 'orange peel' look). The *Weiner Deconvolution* algorithm requires a significant amount of calculation and may slow down live stacking when using high resolution cameras or on slower computers.

The sharpening and noise reduction algorithms affect both the image as shown on screen and the image saved when using *Save with Adjustments* or *Save Exactly as Seen*. Since the sharpening and noise reduction is applied every time the image on screen is updated, using these tools may reduce the responsiveness of the live stacking to changes in other controls such as colour adjustment or histogram changes.

Guiding Tab

SharpCap can work with the popular freeware guiding application [PHD2](#) to monitor and control guiding and dithering while live stacking.



In order to enable integration between SharpCap and PHD2, ensure the following:

- PHD2 is a recent version and running on the same computer as SharpCap
- the *Enable Server* menu item must be selected in PHD2
- the *Monitor PHD2 Guiding* checkbox must be checked.

If SharpCap has successfully connected to PHD2 then a status such as 'Guiding', 'Calibrating' or 'Stopped' will be shown in the *Status* box on the right. If PHD2 monitoring is disabled or SharpCap cannot connect to PHD2 then 'Not connected to PHD2' will be shown.

Monitoring Guiding

Basic guiding monitoring is managed by the two options:

Pause stacking if guiding lost – if enabled then SharpCap will pause any live stack in progress if the PHD2 status changes from 'Guiding' to any other status. Note that with this option set you can still start stacking with PHD2 not guiding (or not connected). Also note that if you manually resume the paused stack, SharpCap will not re-pause it unless PHD2 again changes from the 'Guiding' to non-guiding state.

Do not start stacking if PHD2 is not guiding – if enabled then SharpCap will pause any new stack that is started if PHD2 is not in the 'Guiding' state (or is not running or not connected).

Notification messages will be shown in the SharpCap notification bar when PHD2 guiding starts or stops.

Dithering

SharpCap Pro users can also enable dithering using PHD2 while live stacking. In order to enable dithering, tick the *Automatically Dither* checkbox and set the options to choose dithering parameters.

SharpCap will send instructions to PHD2 to dither at regular intervals. If the dither time arrives while a frame is being captured, SharpCap will wait until the frame ends before starting dithering. During the dither operation, SharpCap will pause the live stack so that frames that may be blurred due to the dithering movement are not included in the stack. The stack will be resumed after the end of the first frame to finish after the dither has finished settling.

Dither Interval – this is the minimum time that SharpCap will wait between the end of one dither starting the next dither. As noted above, dither operations are delayed until the end of any frame in progress. The *Dither Interval* should be set to a time considerably longer than the camera exposure time, otherwise an unacceptably high fraction of frames will be lost due to dithering.

Max Dither Step – this specifies the maximum distance that any dither movement can be, measured in guide camera pixels (i.e. pixels in PHD2, not in SharpCap)

Settle Threshold – when the movement between two guide camera frames drops below this number of pixels then the dither is considered to have ‘settled’ – i.e. the mount movement is complete and images taken should no longer be blurred by movement.

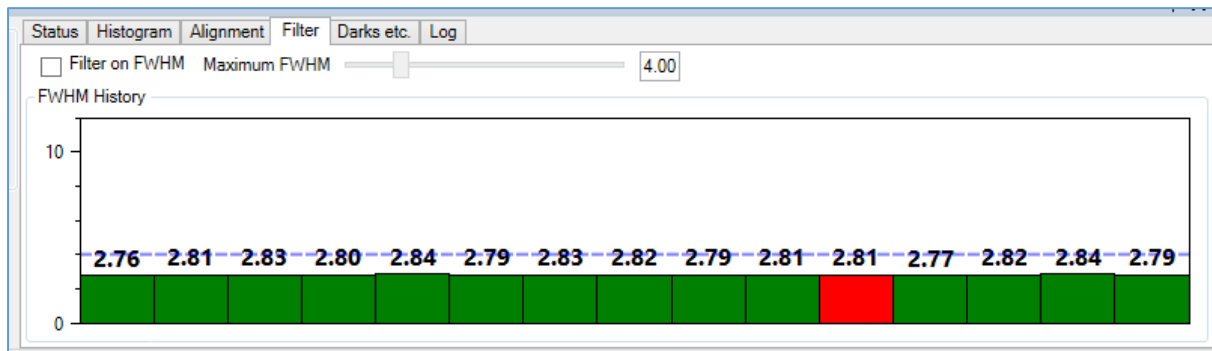
Minimum Settle Time – a dither will not be considered to be settled until this amount of time has elapsed after the end of the movement, even if the *Settle Threshold* is met before this time has elapsed.

Maximum Settle Time – a dither will always be considered to be settled after this amount of time has elapsed, even if the settle threshold has not been met.

Dither in RA only – restrict dithering to the Right Ascension axis only.

See the [PHD2 Documentation](#) for more information on dithering using PHD2.

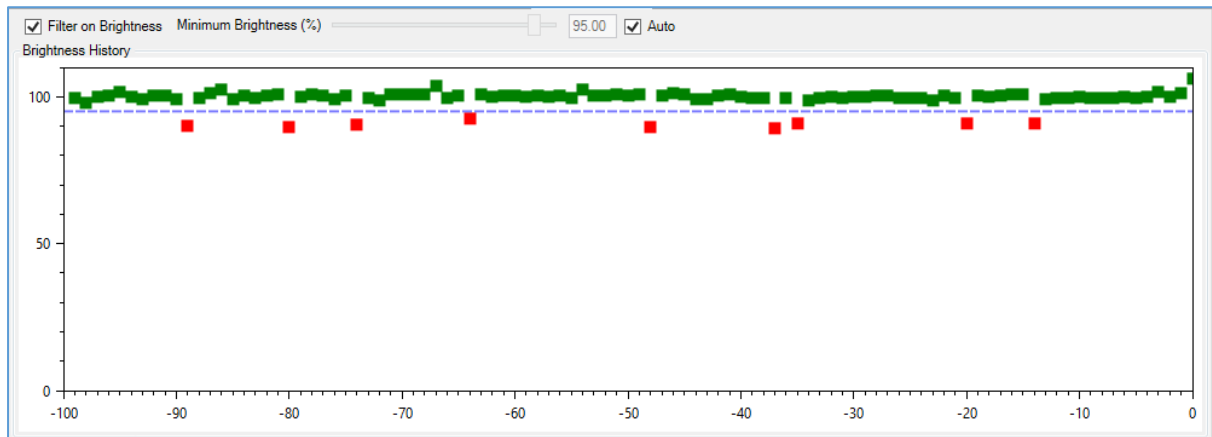
Filter (FWHM) Tab



This filter allows poor-quality frames (poor atmospheric conditions or clouds) to be excluded from the stack. Frame quality is judged only by the FWHM (full-width-half-maximum) estimate of the quality of focus in the frame.

- *Filter on FWHM* – check to enable FWHM (focus score) filtering.
- *Maximum FWHM* – use the slider to specify a maximum FWHM value for frames to be used. It shows a history of recent frames. Used frames are green, frames discarded by filtering are red.
- Filtering does not apply to the first frame in any stack.

Filter (Brightness) Tab



This filter can help detect reductions in frame brightness caused by passing cloud, stopping frames spoiled by cloud from being added to the stack. The frame brightness is judged based on the brightness of stars detected in the frame, so this filter can only operate correctly when sufficient stars are detected in the frame.

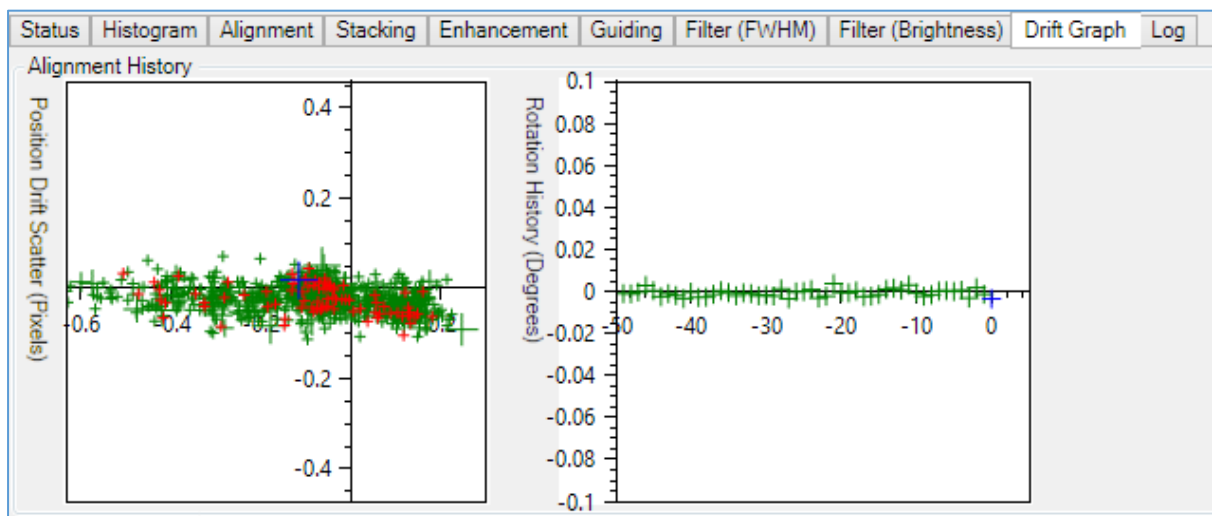
The graph shows the brightness of recent frames with the most recent frames on the right-hand side and the oldest frames on the left. Frames that are rejected are shown as red squares, frames that are stacked are shown as green squares.

The controls available are:

- *Filter on Brightness* – check to enable brightness filtering
- *Minimum Brightness* – adjust the level of brightness below which frames will be rejected. The level is measured relative to the average brightness of recently stacked frames.
- *Auto* – check this box to allow SharpCap to set the *Minimum Brightness* threshold automatically based on the statistics of recent frames. Uncheck this box to allow the *Minimum Brightness* to be set manually.

Drift Graph Tab

The drift graphs show the history of movement and rotation of the image during the current live stack.



The left-hand graph shows the amount of movement of the image on a scatter (X,Y) graph. Green crosses represent frames that were added to the stack, red crosses represent frames that were not added to the stack for some reason (filtering, stacking paused, etc). More recent frames have larger crosses and the most recent frame is a blue cross.

The right-hand graph shows the history of rotation of the stack with the amount of rotation measured on the vertical axis and time (with the most recent frames on the right) measured on the horizontal axis. Rotation will be very low for equatorial mounts, but may be significant for Alt-Az mounts.

Hovering the mouse over either graph will display a larger version.

Log Tab

Shows some log information of Live Stacking in more detail than is saved in the main SharpCap log. If something is not working, this is the place to look.

Status	Histogram	Alignment	Filter	Darks etc.	Log
00:51:04		ERROR			Failed to calculate alignment.
00:51:05		INFO			Detected 69 in the stacked image, mean FWHM is 3.323106
00:51:05		INFO			Detected 78 stars in the frame image, mean FWHM is 3.0960
00:51:05		ERROR			No potential transforms remaining after filtering for scale
00:51:05		WARN			Failed to align with the reference frame.
00:51:05		ERROR			Failed to calculate alignment.
00:51:05		NOTE			Processed 620 frames, stacked 261
00:51:06		INFO			Detected 69 in the stacked image, mean FWHM is 3.323106
00:51:06		INFO			Detected 73 stars in the frame image, mean FWHM is 3.097
00:51:06		ERROR			No potential transforms remaining after filtering for scale
00:51:06		WARN			Failed to align with the reference frame.
00:51:06		ERROR			Failed to calculate alignment.

Live Stack Reference

In the background, SharpCap maintains a 32-bit integer value for each pixel of the stack with the value from each frame being added to the pixel value.

- For a 16-bit camera it is possible to stack up to 32768 (2^{15}) frames before running out of values in the stack.
- For an 8-bit camera it is possible to stack up to 16 million frames (2^{24}) before running out of values in the stack.

All files saved during a stack will be saved in a single folder (raw frames and processed stack images saved in subfolders). This helps keep the saves from the stack together. The folder is named after normal file naming rules based on the time stacking was started and the name of the target object selected.

Desktop > SharpCap Captures > 2017-02-03 > Capture > 13_47_30			
Name	Date modified	Type	
processed	03/02/2017 13:47	File folder	
rawframes	03/02/2017 13:48	File folder	
Stack_7.fits	03/02/2017 13:47	FITS File	
Stack_7.fits.CameraSettings.txt	03/02/2017 13:47	Text Document	

If the name of the target in the toolbar is changed during Live Stacking, SharpCap will rename the output folder.

Using Live Stacking

A useful video demonstration of using the *Live Stack* function in SharpCap can be found, courtesy of Charles Copeland, at <https://www.youtube.com/watch?v=zllJHyVWei4>.

Although the video shows SharpCap 2.7, it is still valid for SharpCap 2.9 and beyond. This is a good demonstration of what can be achieved with video stacking software using a NexStar 6SE telescope, [analogue video camera](#) and 0.5x focal reducer. Be aware of the comment “if using v2.9 be sure to set *Digital Gain* to 2X in the *Alignment* tab” on the web page, below the video. This may be helpful if it is difficult to detect enough stars, however turning on the *Digital Gain* when it is not required will reduce alignment accuracy slightly.

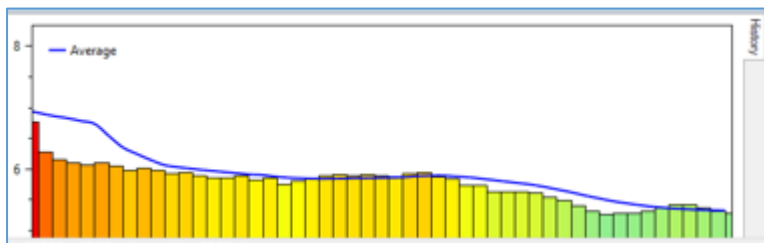
The video is worth watching again and again

Focusing

SharpCap has a several options to help acquire focus on targets (possibly one of the most challenging aspects of astrophotography). The tools are particularly powerful if an ASCOM focuser is configured in SharpCap (An ASCOM focuser is a device which uses a stepper motor or DC motor to move the telescope focuser and can be controlled from a computer via a USB cable).

Introduction

There are six Focus Score tools, the appropriate one must be chosen for the target. Each tool attempts to measure the quality of focus of the image (the different tools measure the quality of focus by different methods) and displays the measurement in the work area as both figures and a graph. The graph may look something like this:



Green bars always indicate better focus while red bars always indicate poorer focus. The most recent measurements are shown at the right-hand side of the graph with older measurements to the left. Note, for some tools the best focus is associated with low scores (short bars in the graph), while for others it is associated with high scores (tall bars in the graph).

It is possible to just select one of the focus tools and adjust the focuser until obtaining the best score such that the score can no longer be improved by moving the focuser in either direction, but better results can be obtained with a full understanding of how the process works and the adjustments available.

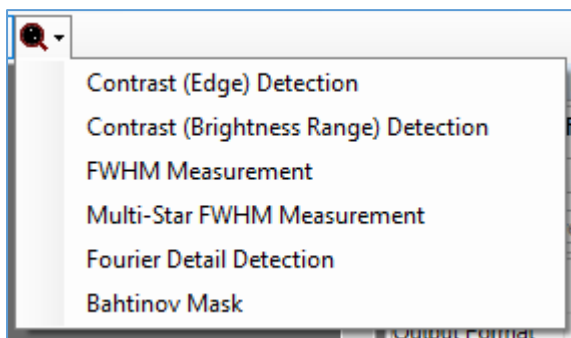
Don't try to use the focus tools if the image is a long way out of focus. The tools are to be used to go from being *close to focus* to *perfectly in focus*. If focus is a long way out and there are problems getting anywhere near focus, try one of the following:

- Focus on a terrestrial object at least 200m away in daylight (the further the better), which will get close to the focus point for astronomical objects.
- Use the moon, if it is visible, as it is easy to find and bright. This helps because it can be hard to find any objects when the telescope is a long way out of focus. However, the moon is bright enough to be hard to miss even when the focus is very bad.
- With high gain and exposure of 2s or so, aim at a bright star or planet. Increase the brightness of the displayed image by one of the following:
 - Selecting 'Image Boost' from the FX dropdown.
 - Selecting 'Image Boost More' from the FX dropdown.
 - Reducing the 'Display Gamma' control to a smaller value.

If the bright object is either in or near the field of view, all or part of a bright donut (reflector/SCT) or bright disk (refractor) of light will be seen – this is the very out-of-focus view of the object, made visible by the high gain and brightness boost. Adjust the focuser of the telescope to make the disk/donut smaller, which will bring the telescope nearer to correct focus.

The Focusing Tools

The six available focusing tools can all be found under the *Calculate Focus Score* icon from the *Tool Bar*. Select the desired tool to begin measuring focus.



Which Focus Tool Should Be Used?

For a single-star (or sparse) field use either *FWHM* or *Bahtinov Mask*.

For a multi-star field use *Multi-Star FWHM*.

For planetary or surface targets, there are three tools to choose from:

- Contrast (Edge) Detection
- Contrast (Brightness Range) Detection
- Fourier Detail Detection

When trying to focus a planetary or surface target consider the following:

- The different focus score algorithms are attempts to find a better balance between two opposing factors – sensitivity to being in good focus and insensitivity to noise.
- There are trade-offs involved in the various approaches. Which to use is going to be a matter of trial and error and/or personal preference. The *Contrast (Edge) Detection* tool is (probably) a good starting point in most circumstances.

In more detail, the focus tools available are:

Tool	Description	Best Focus
Contrast (Edge) Detection	<i>Suitable for planetary or surface targets.</i> Measures the total amount of contrast in the image - better focus gives more contrast which gives higher scores.	Tall green bars (high values) are best. Red is worst.
Contrast (Brightness Range) Detection	<i>Suitable for planetary or surface targets (especially high noise).</i> Measures the range between the brightest and dimmest parts of the image - better focus should give higher scores.	Tall green bars (high values) are best. Red is worst.
FWHM Measurement	<i>Suitable for stars or other point sources.</i> Measures the width (FWHM) of a sole star – which must be selected using the selection area tool. Better focus gives narrower stars and a lower FWHM score	Short green bars (low values) are best. Red is worst.
Multi-Star FWHM Measurement	<i>Suitable for stars and point sources.</i> Measures the FWM of all suitable stars in the frame, giving an average score. Once again, lower scores mean better focus.	Short green bars (low values) are best. Red is worst.
Fourier Detail Detection	<i>Suitable for planetary or surface targets.</i> Measures focus by examining amount of detail in small scales in the image as determined by a Fourier Transform. Good focus leads to higher scores. May be less sensitive to noise than contrast detection options.	Tall green bars (high values) are best. Red is worst.
Bahtinov Mask	<i>Suitable for stars or other point sources.</i> Requires a Bahtinov mask to be placed over the aperture of the scope and the area around the star and lines to be selected using the selection tool. Best focus is achieved when all three lines intersect at the same point which gives scores (positive or negative) closest to zero.	Short green bars (low values) are best – values can be positive, negative or zero. Zero equals perfect focus. Red is worst.

Notes

1. Which is the best focusing method for planets and surfaces? All three see noise as detail to some extent so picking the right one is a case of trial and error and personal preference.
2. A Bahtinov mask of suitable diameter must be placed over the end of the telescope to use the *Bahtinov Focus Score* tool. Negative values are possible, values nearest zero are best, so -0.1 and 0.1 are equally good, 0.0 is perfect and +3.9 and -3.9 are equally bad.
3. Remember – tall green bars for Planets and Surfaces, short green bars for Stars.
4. *Multi-Star FWHM* is usually better than single-star because it takes 10s or 100s of FWHM measurements and averages them, so there should be less noise and less systematic error in the reading.

Focusing Procedure

The table details the various steps to be followed to achieve good focus of the telescope.

Telescope (no ASCOM focuser)	Telescope (with ASCOM focuser)
<p><i>Preparation Phase</i></p> <ul style="list-style-type: none"> Initial visual focus with telescope against a distant object. 	
<p><i>Setup Phase</i></p> <ul style="list-style-type: none"> Check target not over exposed using <i>Image Histogram tool</i>. Select appropriate <i>Calculate Focus Score</i> tool – adjust black level, target detection parameters, ROI box – to obtain best focus score. Reset the graph to wipe the score history. 	
<p><i>Focusing Phase</i></p> <ul style="list-style-type: none"> Adjust telescope focuser manually, watch focus scores. Stop when best score obtained. Telescope now in focus. 	<p><i>Focusing Phase</i></p> <ul style="list-style-type: none"> Adjust telescope focuser using the Focuser controls in the camera control panel, watch focus scores. Use the <i>Graph</i> tab. Stop when best score obtained. Telescope now in focus.

During the Setup Phase, the scores being shown are meaningless as they are changing because of changing the software parameters, not changing the focus of the telescope.

*At the end of the Setup Phase, **Reset the Graph** to wipe the score history.*

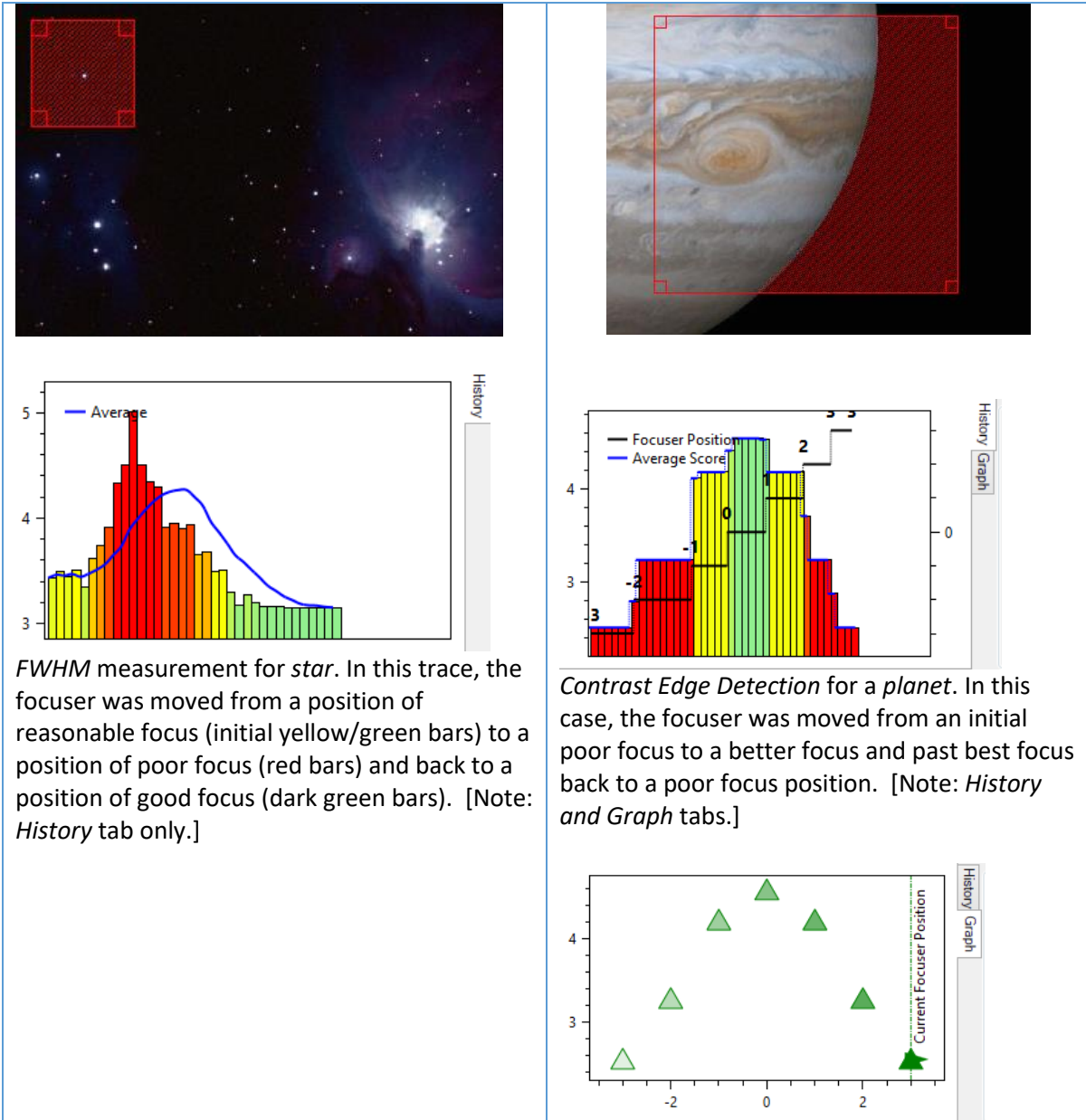
During the Focusing Phase, only adjust the telescope's focuser, not any of the settings within SharpCap – this is to ensure the changes seen in the focus score are only a result of the changes in focus of the telescope and are not influenced by anything else. If any SharpCap settings are changed during the focusing stage (for instance because a planetary target has shifted in the field of view and there is a need to update the ROI), reset the graph after making the adjustment – effectively starting the focusing phase again.

Focus will need to be checked throughout a session as it could change because of one or more of the following factors:

- Thin cloud over target.
- Changing atmospheric conditions.
- Change in temperature affecting telescope tube.
- Change in temperature affecting optics.

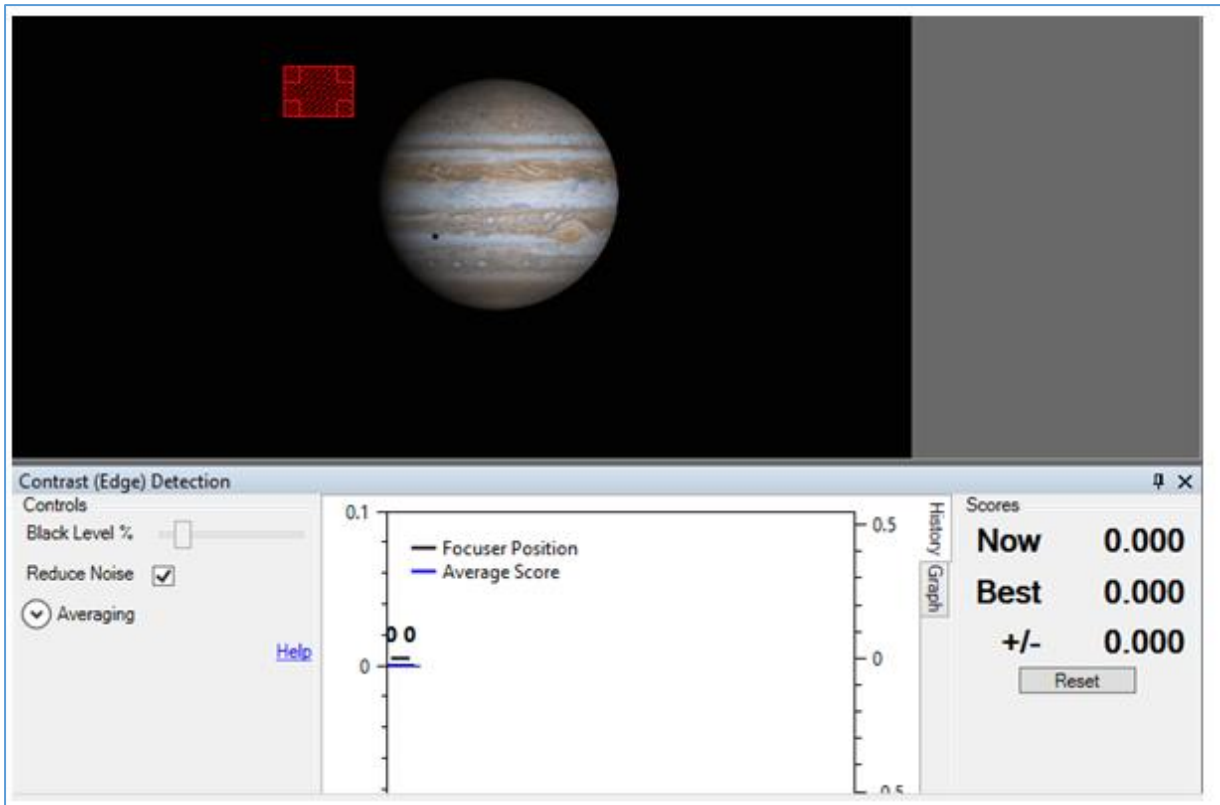
The table below shows what would be seen in SharpCap when using the appropriate *Calculate Focus Score* tool for a telescope both without and with an ASCOM focuser.

Telescope (no ASCOM focuser)	Telescope (with ASCOM focuser)
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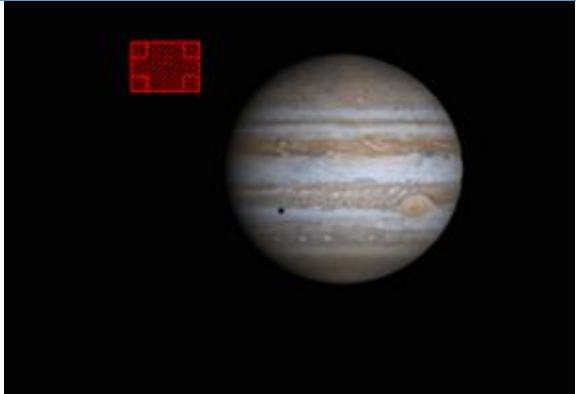
Overview of Display

When selecting one of the *Focus Score* tools, *Contrast (Edge) Detection* in this case, the following screen appears. This screen layout is the same for all six *Focus Score* tools.



There are four distinct regions when a *Contrast Focus Score* tool is in use.

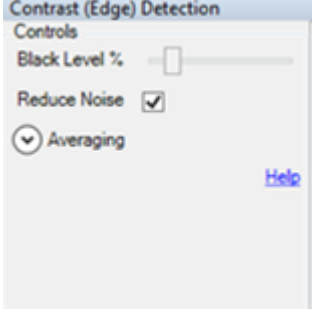
The Capture Display Area




In the *Capture Display Area*, a red *Selection Area* rectangle appears. The rectangle can be dragged with the mouse and resized. It would be moved over the edge of the object, completely onto the surface, or expanded to surround the complete object.

- Any area **outside the red rectangle** will be **excluded** from focus score calculations.
- Any area within the rectangle which **is not shaded** (above the black level) will be included for focus score calculations.
- Any area within the rectangle which **is shaded** (below the black level), will be excluded from focus score calculations.

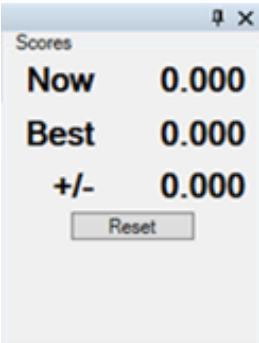
The Controls Pane

	<ul style="list-style-type: none"> The following Controls are available: <ul style="list-style-type: none"> <i>Black Level %</i>, a slider <i>Reduce Noise</i>, a checkbox <i>Averaging</i>, see description below Context sensitive <i>Help</i> is available.
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The Graphs Pane

	<ul style="list-style-type: none"> The graph region will display a graphic for: <ul style="list-style-type: none"> <i>Focus Score</i> history (<i>History</i> tab) <i>Focus Score v Focuser Position</i> graph (<i>Graph</i> tab). [Note: This only shows if there is an ASCOM focuser connected.] The black line is used to indicate Focuser Position (explained later). The blue line is <i>Average Score</i> – an average of the 10 previous focus scores. The left hand vertical axis shows focus scores. The right hand vertical axis shows focuser position.
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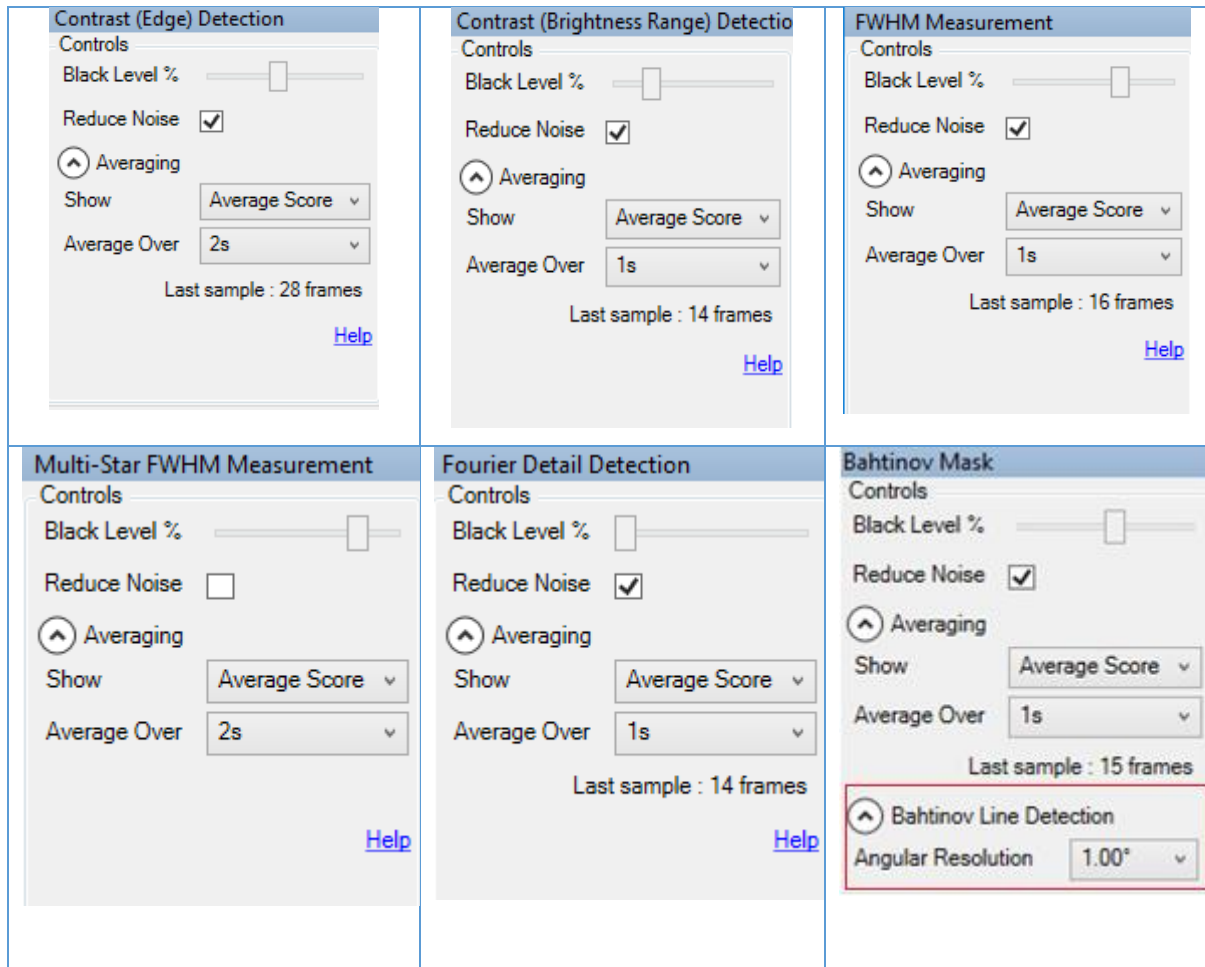
The Scores Pane

	<ul style="list-style-type: none"> The title bar of the panel can be used to drag the panel out of the main SharpCap form, for example to place it on a second monitor The <i>Pin</i> icon can autohide the focus tool displayed in the Work Area. Current score (<i>Now</i>) and Best score recorded so far (<i>Best</i>) are shown. The <i>Reset</i> button clears the history and the best score. If the <i>Selection Area</i> is enabled, disabled or moved, or the <i>Black Level</i> changed, the <i>Reset</i> button should be used.
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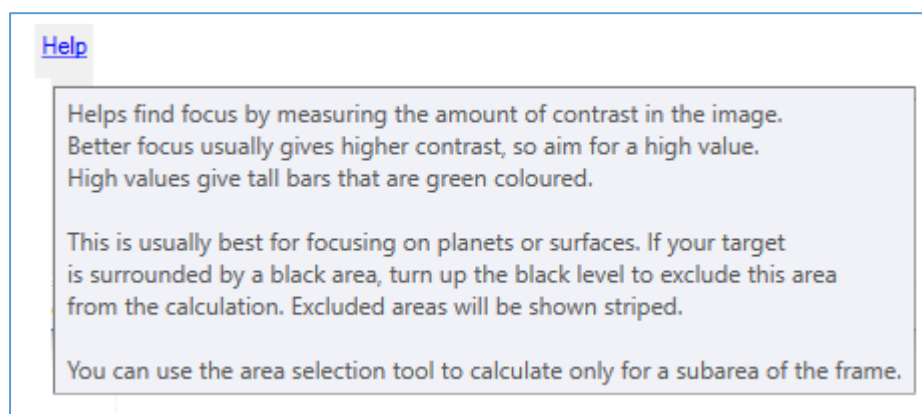
Focus Tools Controls

This section describes the focus tools controls. At first use, a set of sensible defaults is offered. As these settings are changed, SharpCap will retain them for subsequent use.

This is a summary of the control group for all six focus score methods. The first five are identical, with the *Bahtinov mask* having two additional fields.

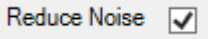
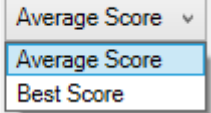
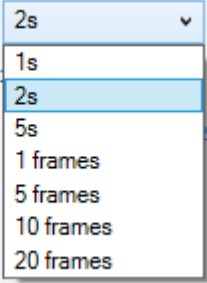



Context sensitive help is available with all six focus score tools – click the *Help* link to see the help onscreen. For example, this is the *Help* for *Contrast (Edge) Detection*:

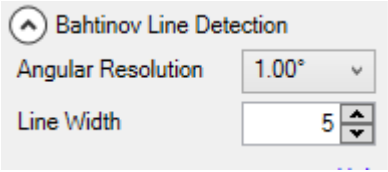


The controls in the next table are common to all six focus score methods.

	<p><i>Black level</i> – anything below that level is excluded from the calculation, avoids including dark level noise in the calculation.</p>
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	<p><i>Reduce noise</i> – applies a <i>weak</i> Gaussian blur to the image to cut down on pixel noise before performing the measurement.</p>
	<p><i>Averaging</i> – choose either average or best score from an averaging period to be the value recorded.</p>
	<p><i>Average Over</i> – the period can be specified as either number of frames or a time-period by the settings offered.</p>
	<p><i>Scores</i> – <i>Now</i> and <i>Best</i> are shown. Understand which focus score methods need high/low values.</p> <p>The score can be Reset and should be if the <i>Selection Area</i> is enabled, disabled or moved, or the <i>Black Level</i> changed.</p>

Angular Resolution and *Line Width* are controls found only in the *Bahtinov* focus score.

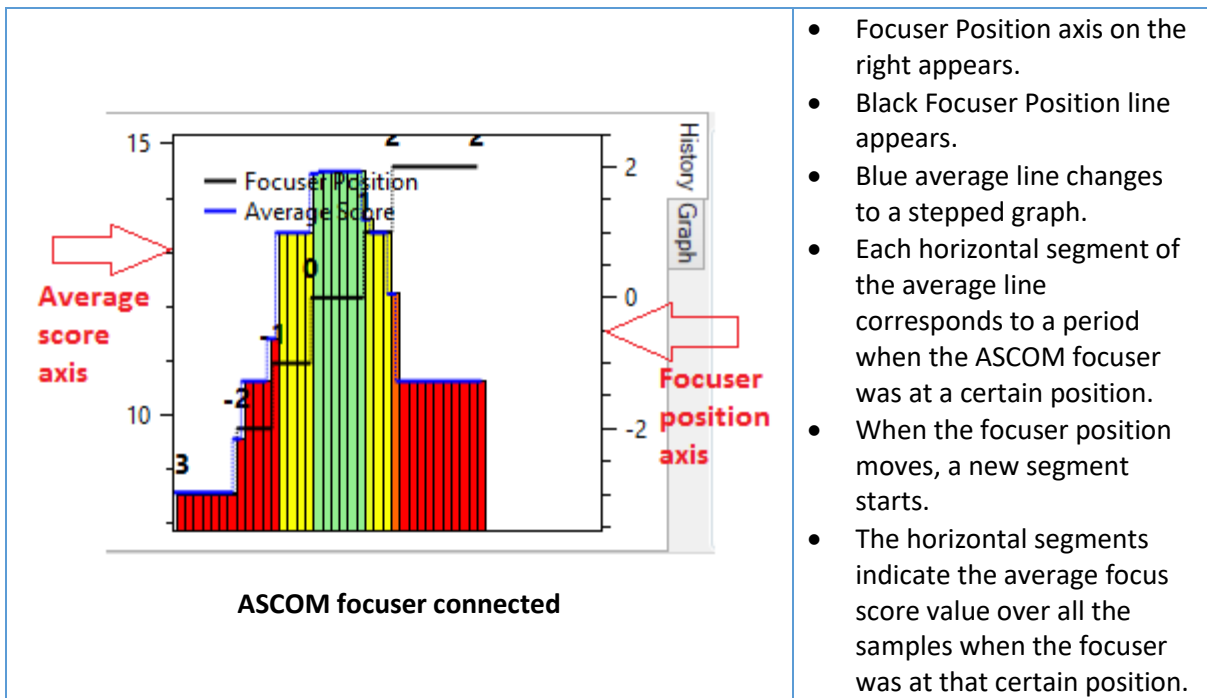
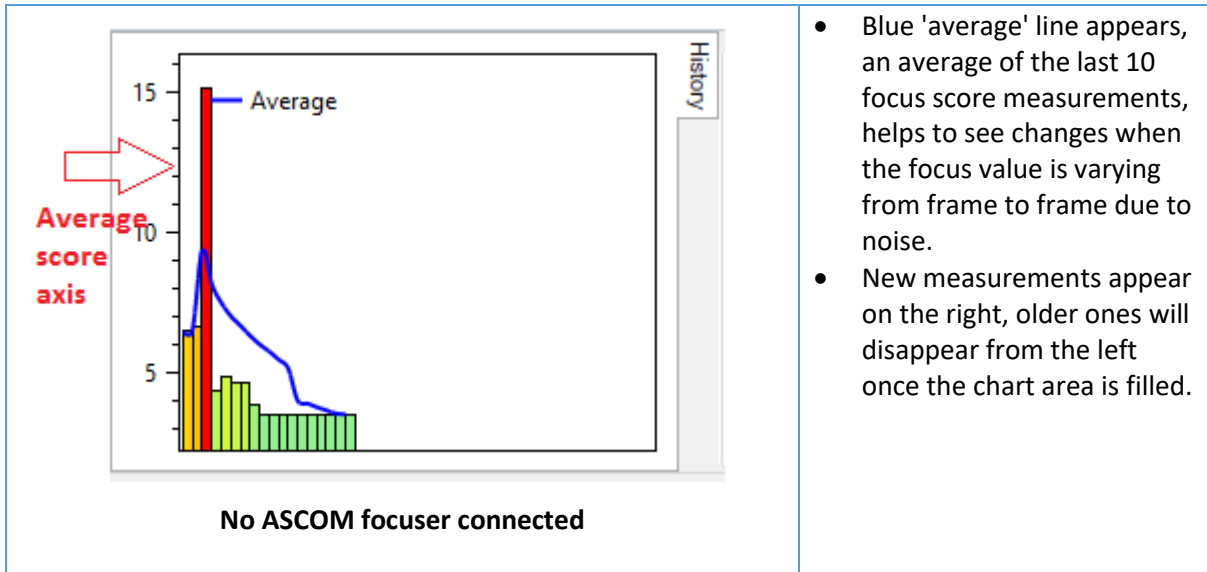
	<p><i>Angular Resolution</i> – measured in degrees and defines how finely to scan the full 360 degrees when looking for Bahtinov lines – the default scans once per degree, but it can be made finer. Possible values are 0.20°, 0.25°, 0.33°, 0.5°, 1.0°</p> <p><i>Line width</i> – measured in pixels and should be set to roughly the width of the Bahtinov spikes seen on the screen – the correct value here helps SharpCap separate the spikes from the noise. Possible values are 1..40 in increments of 5.</p>
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The Graph Pane

The History tab always appears (1st diagram below). The additional Graph tab will only appear when an ASCOM focuser is connected (2nd diagram below).

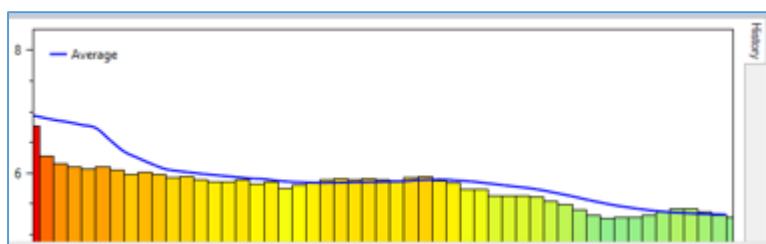
History Tab

The *History* tab provides more functionality when there is an ASCOM focuser, although it is best to switch to the *Graph* tab when a focuser is connected.



This is the range of colours that can be displayed – from red (poor focus) to green (good focus).

Red > Orange > Yellow > Light Green > Dark Green



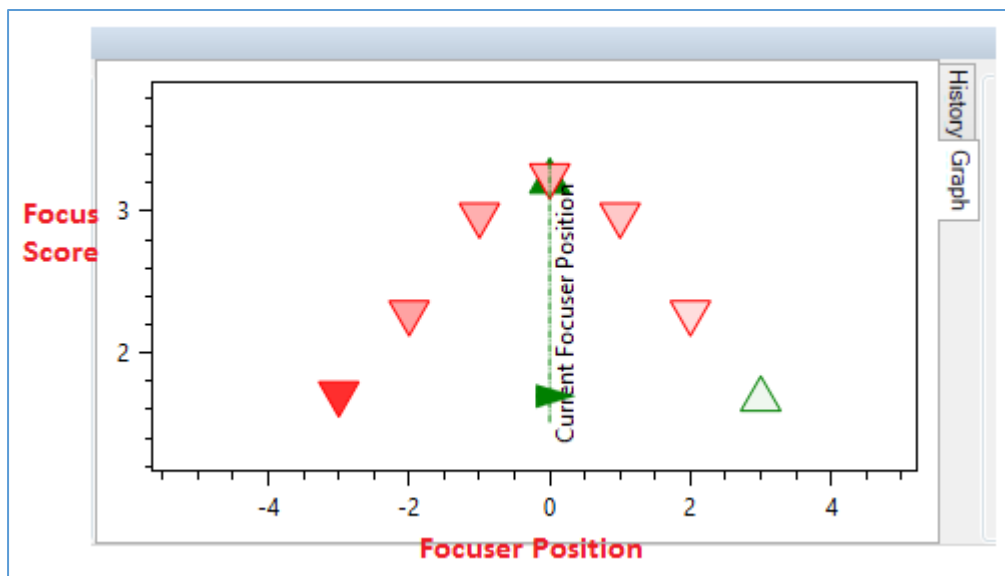
Colours and heights of focus graph bars are not an absolute measure of 'good focus', they are a measure relative to the other recent focus measurements made. The best focus score recently obtained will always get a vivid green bar and will be the highest (lowest for FWHM) one in the graph. This doesn't mean perfect focus, it means the best focus achieved since the focus tool was opened (or since last reset). The exception to this is the Bahtinov mask tool - there the value of zero is an absolute measure of perfect focus.

Graph Tab

This graph only appears if an ASCOM focuser has been configured in SharpCap.

The graphic shows the focuser position was stepped from -3 to +3 in the following sequence:

-3 -2 -1 0 1 2 3



This graph shows the focuser position along the horizontal axis and the focus score on the vertical axis.

- The green upward pointing triangles show data points collected when the focuser was moving in the positive (outward) direction.
- The red downward pointing triangles show data points collected while the focuser was moving in the negative (inward) direction.
- Stronger colours indicate more recent data points.
- Faded colours indicate older data points.

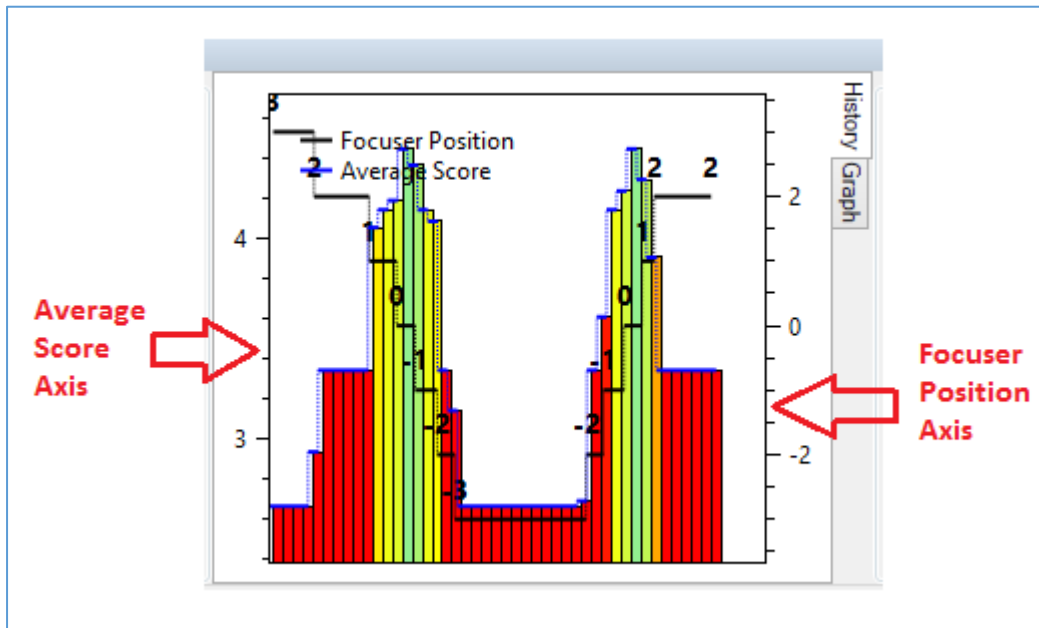
The black lines and numbers on the *History* graph below correspond to the focuser positions shown in the *Graph* above.

With an ASCOM focuser installed, work from the *Graph* tab rather than the *Histogram* tab. To find the point of best focus using the focus score axis (at the left of the graph) look for:

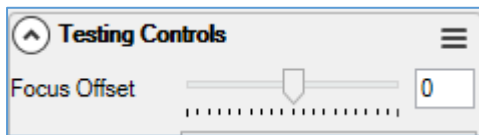
- The peak value (Contrast Detection/Fourier options).
- Minimum value (FWHM options).
- Zero (Bahtinov option).

Backlash in the focuser mechanism will be present in all real focusers and shows itself as the best focus point appearing in differing positions depending on which direction the focuser is moving. So,

if the peak focus score is at focuser position 20100 when the focuser is moving in the positive (+ve) direction, it could be at 19900 when moving in the negative (-ve) direction. If trying to return the focuser to the position where the score was at its best, always approach from the same direction used when measuring the focus to avoid errors caused by backlash.

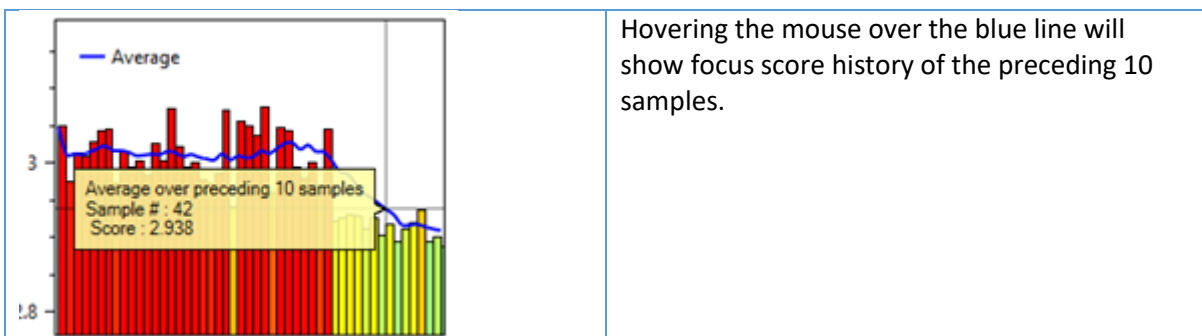


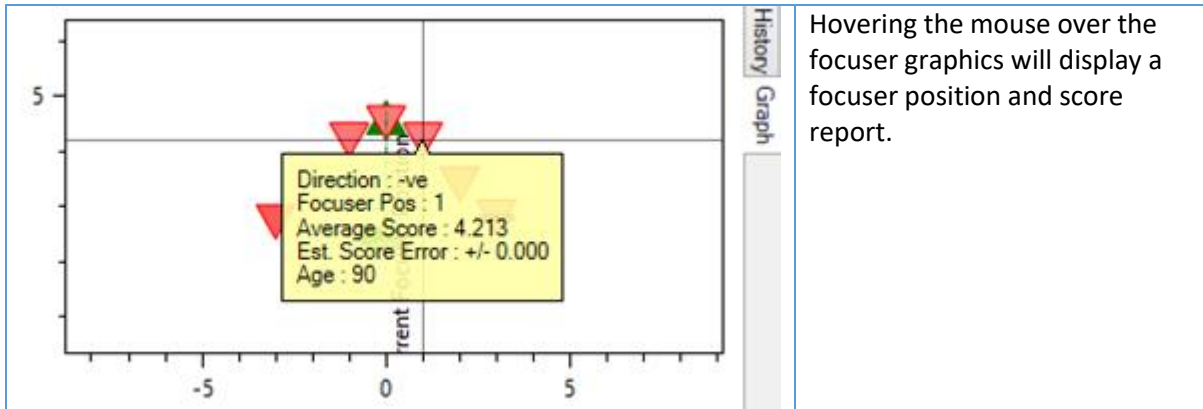
This functionality can be experimented with using the *Focus Offset* control available in *Test Camera 2 (High Speed)* which can be found in the *Camera Control Panel*.



History and Graph Manipulation

- Drag with left mouse button to move around.
- Mouse wheel to zoom.
- Select an area with middle or right mouse button to zoom to that area.
- Double click to return to default view if lost.





Setting the Correct Black Level

Before setting the black level, ensure the object is not over-exposed by viewing with the *Image Histogram* – avoid the *Image Histogram* hitting the right-hand side.

For a large planetary target, the optimum black level is when there is a thin black area between the object and the dark area. This can be difficult to see, so use the *Zoom* tool from the tool bar to improve the detail.

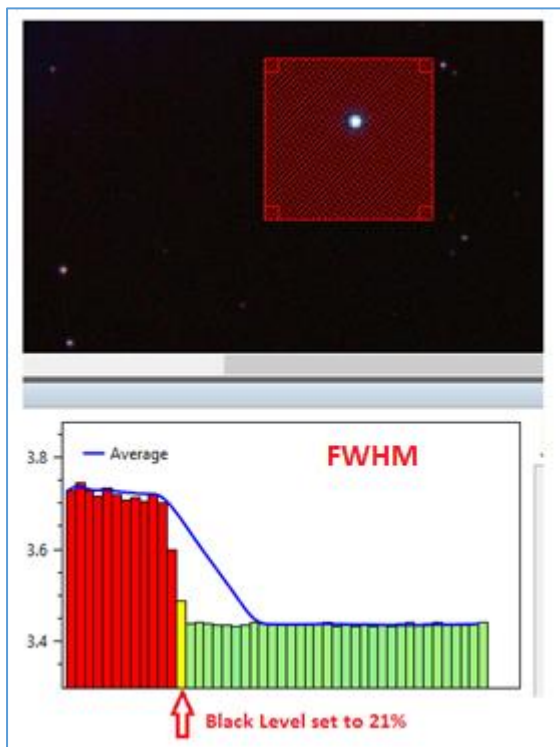
	<p><i>Contrast (Edge) Detection</i> focus score used.</p> <p>Here the <i>Zoom</i> is 100%. The black level happened to be 6.5% in this case.</p> <p>The actual optimum percentage black level will vary depending on camera and settings. The picture illustrates how the black level shading should look when the black level is set correctly.</p>
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When the ROI is over the planet, and everything within the ROI is part of the desired image. The requirement is to measure the focus of all of it. Hence in this case, the black level is set to low or zero.

For a star as target, the optimum black level is when there is a thin black area between the object and the dark area. This can be difficult to see, so use the *Zoom* tool from the tool bar.

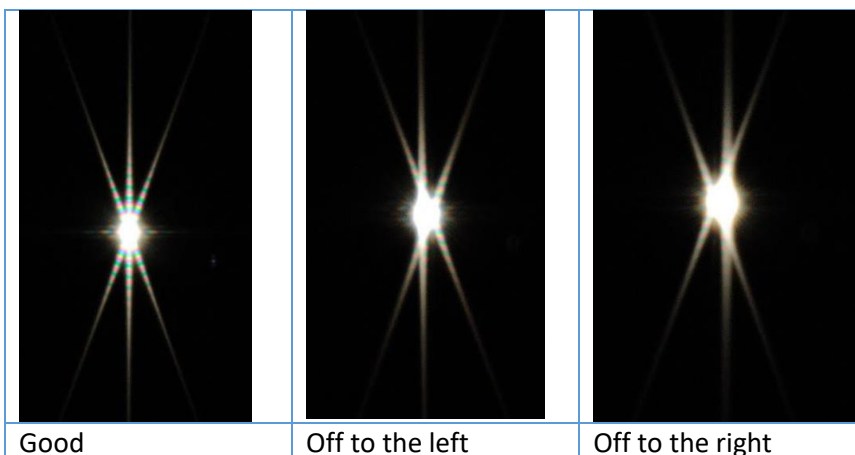
	<p><i>FWHM</i> focus score used.</p> <p>Here the <i>Zoom</i> is 150%. The black level happened to be 21% in this case.</p> <p>The actual optimum percentage black level will vary depending on camera and settings. The picture illustrates how the black level shading should look when the black level is set correctly.</p>
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This is the effect of the correct black level on the focus score, making it clear the graph should always be reset after adjusting the black level or other parameters to avoid confusing the results of these adjustments with actual changes in the quality of focus.



Using a Bahtinov Mask

A Bahtinov mask must be fitted to the telescope for the Bahtinov mask focus score tool to work. Here are examples of diffraction patterns obtained using a Bahtinov mask in the conventional way, where the intersection of all three diffraction spikes at a single point indicates good focus.

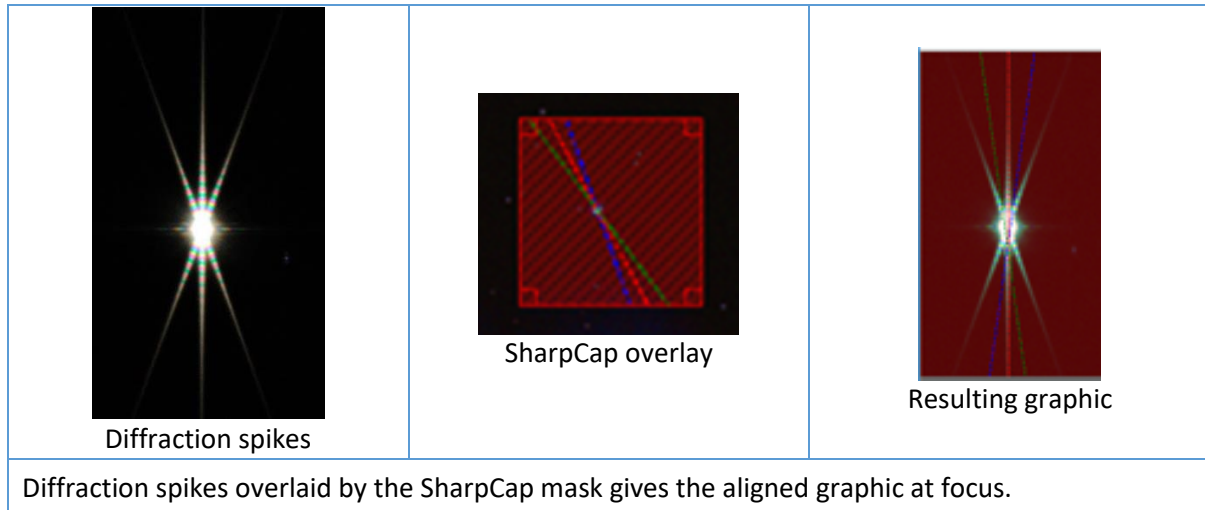


The Bahtinov Mask is used for single stars, which must be selected with the region selection area. Good focus is indicated by short green bars. No bars, or a score of 0, indicated perfect focus.

When using the Bahtinov mask tool, ensure the *Black Level* control is set to a value that excludes the background area around the diffraction spikes from the focus score calculation but includes the entire visible diffraction spike area.

SharpCap attempts to detect the diffraction lines created by the Bahtinov mask and calculate whether they all meet at a single point (in focus) or not – SharpCap will draw coloured lines over the diffraction spikes as can be seen in the diagrams below.

Check the lines really are following the diffraction spikes, as sometimes the wrong lines will be detected and if this happens (as shown in the diagram on the right) the focus score will not be accurate. When the lines are detected incorrectly, it is usually possible to correct the problem by adjusting the black level or camera parameters such as gain or exposure.

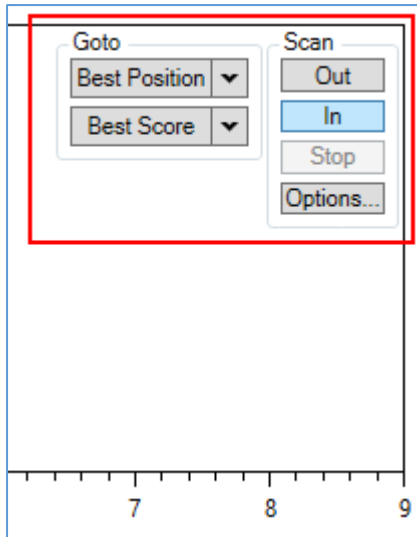


(Nearly) Automatic Focusing

When using an ASCOM focuser, SharpCap Pro users can activate additional features that allow many of the steps outlined above to be automated. The actions that can be automated are

- Scanning over a range of focuser positions, measuring the focus score at each position to produce a focus quality graph automatically.
- Returning automatically to the position at which the best focus score was measured
- Automatically re-scanning over the same range of focus positions and stopping automatically when the highest measured focus score is reached

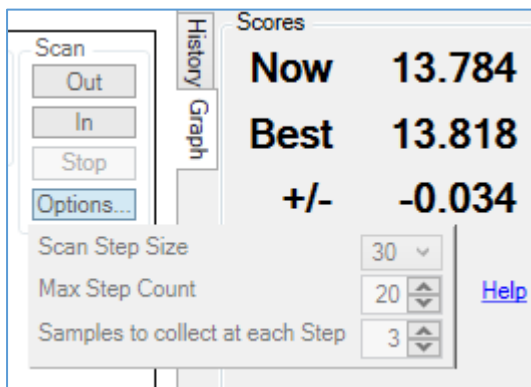
All of these functions can be activated using the controls which are available in the top-right corner of the *Focus Graph*



Note that the buttons in the *Goto* and *Scan* groups will appear slightly transparent until you move your mouse over them – this allows graph detail behind the buttons to be seen.

Automatic Focus Scanning

The *Scan In* and *Scan Out* buttons can be used to initiate an automatic scan over a range of focuser positions, measuring the quality of focus at each position. This is best started one side of the point of best focus so that the scan will pass through the expected position of best focus.



The details of the focus scan can be configured by pressing the *Options...* button and setting

- *Scan Step Size* – this is the amount of focuser movement between each focus measurement
- *Max Step Count* – this is the total number of steps of *Scan Step Size* to make during the focus scan
- *Samples to collect at each Step* – the number of frames to use to measure the focus score at each step. Note that SharpCap will wait at least one frame to allow movement to settle at each step before starting measurement.

The scan will continue, building up data in the *Focus Graph* until either

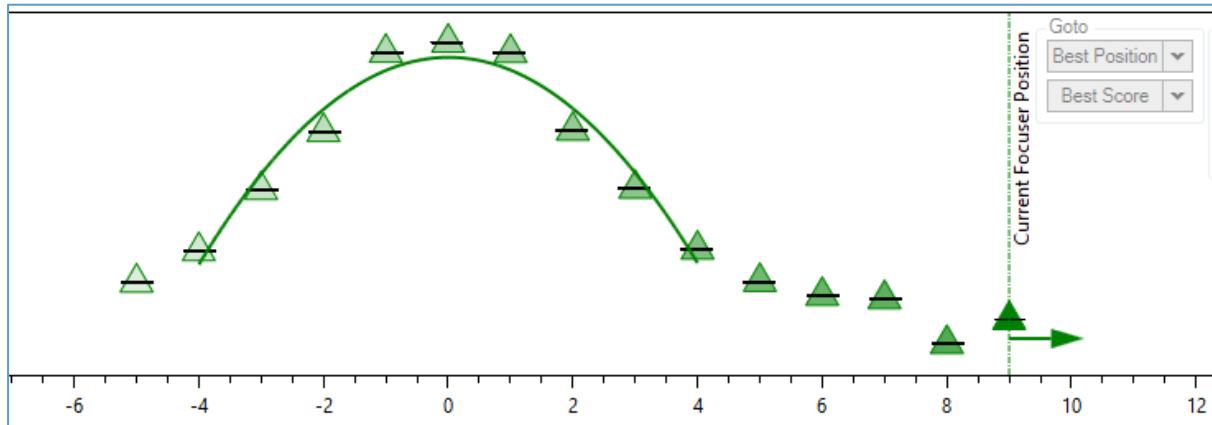
- The *Stop* button is pressed
- The focuser reaches its maximum or minimum possible position or
- The number of steps configured in the options has been completed

During the scanning process, information on progress will be shown in the notification bar.

Focuser scan in progress - step 9 of 20. Waiting for 3 focus score samples.

Point of Best Focus Detection

SharpCap will monitor the focus data being accumulated during both automatic and manual focus movements and try to find a pattern in the data. In particular SharpCap is looking for the point of best focus, which will be indicated by a best-fit curve with either a peak (as shown below) or a valley. A valley shaped best-fit curve should be expected for focus scores where the lowest values are best (i.e. star FWHM measurements), a peak should be expected for scores where the highest values are best (i.e. contrast measurements).



The best-fit curve will indicate the position where best focus is expected to be found, even if it occurs between two measurement positions.

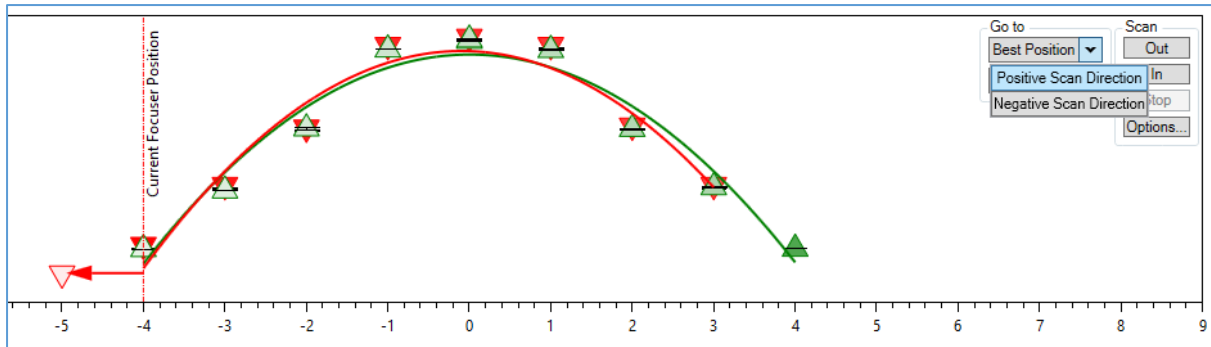
Note that the focus measurements must include at least two or three measurements each side of the point of best focus for the focus best-fit curve to be detected properly. If a focus scan stops at or before this point (i.e. the stopping point has the best score so far) then press the scan button again to continue the scan past the point of best focus.

Once the best-fit curve is shown and has a clear peak or valley, the *Go To Best Position* or *Go to Best Score* options can be used to return the focuser to the point where the best focus was achieved.

Returning to Best Focus

SharpCap can return to either the focuser position where the best focus score was obtained, or attempt to return the focuser to a position where the score matches the best score obtained so far via the two 'Go To ...' buttons.

Each of these buttons has a dropdown to allow choice of which direction of movement to use the best data from – positive (outward) or negative (inward). The *Focus Graph* can show two best fit lines (green for movement in the outward direction, red for movement in the inward direction). If the focuser hardware has any significant backlash then these lines may not peak in the same position, making it important to be able to choose between them.



The default action of the *Go To* buttons (if you do not choose from the dropdown but just press the button) is to choose the direction that was scanned most recently.

Whichever direction of scan is chosen, and regardless of the choice between using *Go to Best Position* and *Go to Best Score*, SharpCap will always move the focuser so as to approach the best focus position in the same direction as the scan data being used, moving the focuser past the best focus region if necessary first to allow approach from the correct direction. This is necessary to keep the effect of any focuser mechanism backlash to a minimum

Go to Best Focus Position

The *Go to Best Position* button is the best option if your focuser has minimal backlash and can accurately return to a previous focus position. Focusers based on stepper motors generally fall into this category.

When this button is pressed, SharpCap will calculate the focuser position for the optimum point on the *best-fit curve* and then move the focuser to that position (from the same direction as the curve measurements were made to minimize backlash). This should place your telescope into best focus.

Go to Best Focus Score

The *Go to Best Score* button is the best option if your focuser is less accurate and has trouble returning to exactly the same physical position when the same focuser position number is selected. Focusers based on DC motors generally fall into this category.

When this button is pressed, SharpCap will attempt to find a position where the focus score matches (or is close to matching) the peak value measured in the previous focus scan. The target score that SharpCap will try to achieve is the average of the two best scores measured in the previous focus scan. This procedure will involve making a second focus scan in the same direction and stopping when the target focus value is reached, and will therefore take longer than the alternative of using the *Goto Best Focus Position* button.

Automatic focussing with a Bahtinov Mask

The discussions of automatic focussing above concentrate on focus score methods such as *Contrast Detection* and *FWHM Measurement* which give either a maximum value or minimum value at the point of best focus. When using the Bahtinov Mask focus tool, the best focus is at the point where the focus score is zero.

The automatic focussing routines described are capable of working with the Bahtinov mask tool and will properly return to the point where the focus score is zero.

Polar Alignment

SharpCap *Polar Alignment* is designed to help astronomers achieve excellent polar alignment quickly, easily and reliably. The idea was inspired by the [PhotoPolarAlign](#) application created by Themos Tsikas. Themos has been kind enough to help with testing and suggestions during the development of the polar alignment feature in SharpCap.

The *Polar Alignment* procedure can be started from the *Tools* menu.

How does it Work?

The polar alignment works by analysing two pictures taken of the area near the pole. Take one picture, let SharpCap analyse it, rotate the mount by about 90 degrees about the RA axis and take the second picture. By recognizing the stars in each of the pictures, SharpCap can work out two things:

1. The exact area of sky represented in each image - this process is called Plate Solving. SharpCap has a built-in plate solving algorithm that doesn't need an internet connection or any other program or database to be installed. SharpCap's plate solving only works within 5 degrees of the pole though (N or S).
2. The centre of rotation about which the stars seem to rotate when going from the first to the second image.

Since SharpCap has worked out exactly what RA & Dec the telescope was pointing at in each image, it knows where in the image (or perhaps how far off the image) the celestial pole is. SharpCap also knows the point about which the stars seem to rotate - that's where the mount's RA axis is currently pointing. If those two points are the same, the polar alignment is perfect. If they are not the same, all that is required is to adjust the Altitude and Azimuth adjusters of the mount until they are the same point and that will complete polar alignment.

SharpCap will guide through this process with on-screen instructions, including a live update of how far is still needed to move the mount in each direction to get perfect alignment.

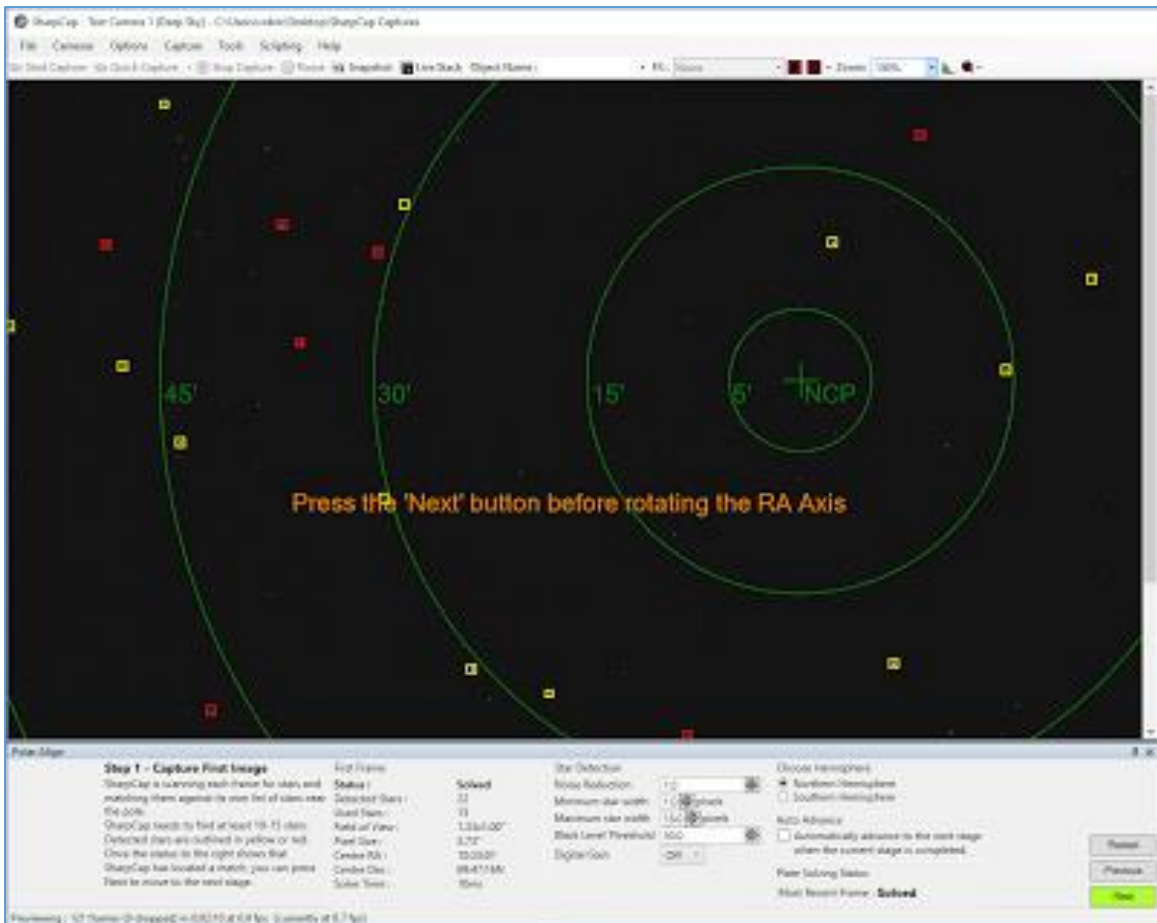
What is required?

- An equatorial mount.
- A camera supported by SharpCap combined with a telescope/finder-scope on the mount.
- A field of view in the camera of between 0.5 degrees and about 2.5 degrees.
- Able to see at least 15 stars in the field of view.
- To already be aligned within about 5 degrees of the pole

It is **not** required to have perfectly aligned the guider scope or main scope as the polar alignment process is not affected by this sort of misalignment.

Step-By-Step

When first selecting the Polar Alignment tool, SharpCap will try to plate solve each frame coming from the camera. If enough stars are detected and the field-of-view is the right size and close enough to the pole something like this should be seen:



The stars SharpCap is using to perform the plate solving are highlighted in yellow, other stars are highlighted in red. The North (or South) celestial pole is shown and circles of different radii are shown around it. Note that the pole may be out of view - don't worry if it is, carry on to the next stage.

[Note: the 'Next' button will turn green when SharpCap is ready to advance to the next stage and that the user needs to press the button.]

If the plate solving fails, there are three likely causes:

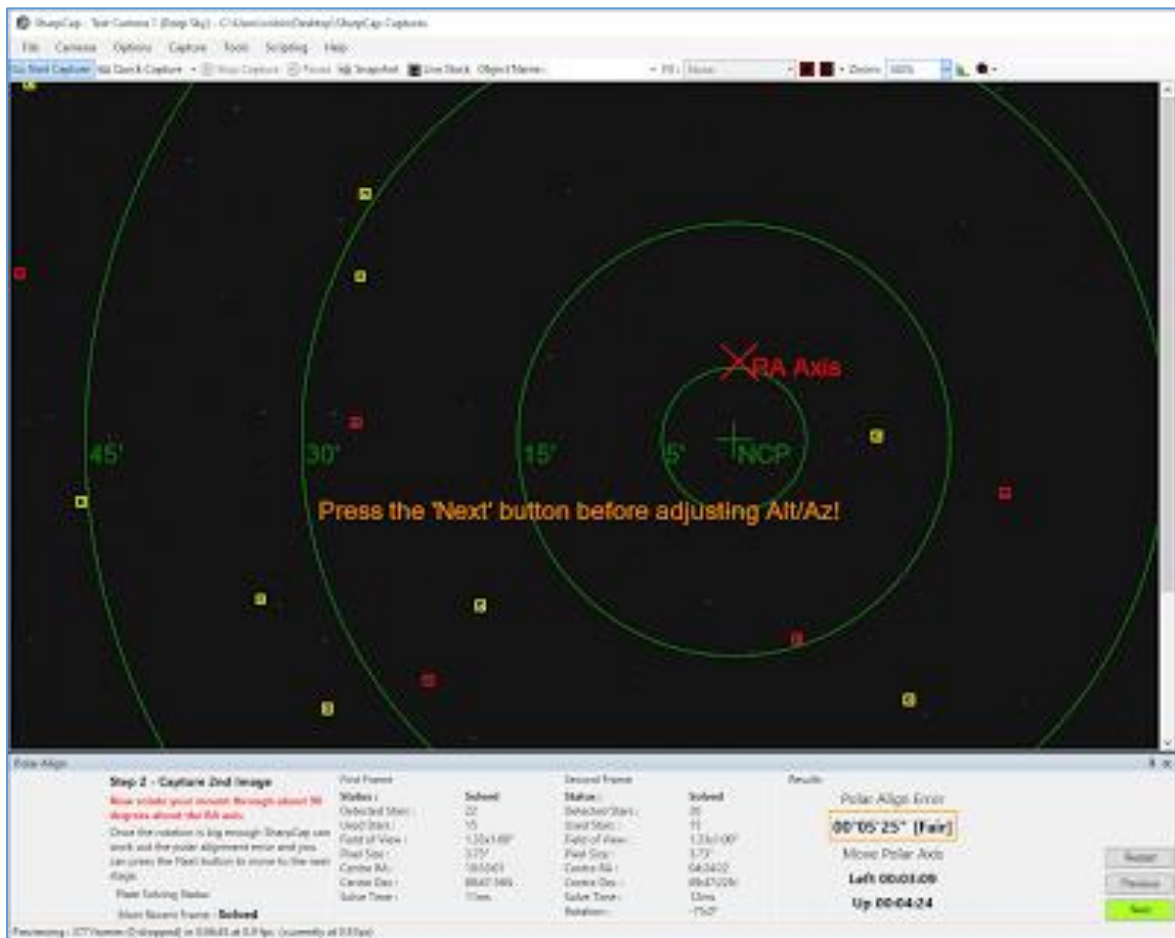
1. Not enough stars detected.
2. Too far from pole.
3. Field of view too large or too small.

The last two require physical changes to be made to the setup, but the first might be fixable by adjusting the star detection parameters at the bottom of the screen or by adjusting the exposure or gain of the camera in use. If the stars are too faint, try turning up the exposure, gain or digital gain. If hot pixels or noise are being picked up as stars, try turning up the noise reduction control.

Once the first frame is solved, press the *NEXT* button to move to the next stage.

After pressing *NEXT*, rotate the RA axis through about 90 degrees. Do this either by unlocking the RA clutch or by using the mount's GOTO system if it has one.

SharpCap will continue attempting to plate solve each frame - once it manages to solve a frame that has rotated far enough it will offer the option to move on to the adjustment phase - looking a bit like this:

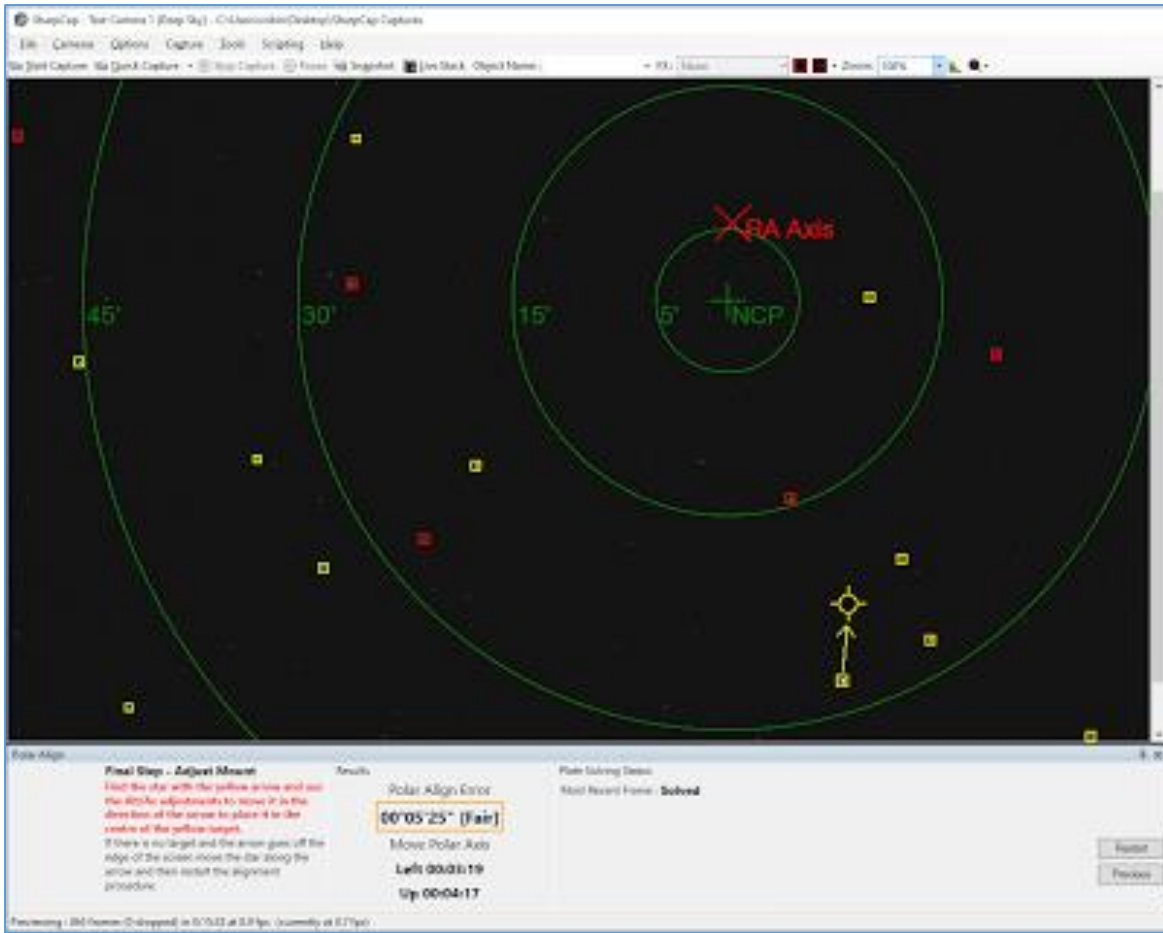


At this point, SharpCap has calculated the position in the image that the RA axis is pointing at - this is the point around which the image appeared to rotate. The RA axis point might be out of view, so don't worry if it doesn't show up, so long as the 'NEXT' button becomes enabled.

If the 'NEXT' button is not enabled, try different amounts of rotation (or rotating in the opposite direction). If that still fails, it is likely that not enough stars are being picked up in the rotated position - the best way to fix this is to leave the mount in the rotated position and press the 'Restart' button to go back to the start of the alignment process. This leaves a view of the rotated position with the star detection controls available to play with until a plate solve can be achieved in that orientation.

DO NOT ADJUST THE ALTITUDE OR AZIMUTH UNTIL **NEXT** HAS PRESSED TO MOVE TO THE FINAL STAGE.

Once the button is pressed to move to the adjustment stage, one of the brighter stars on screen will be highlighted with an arrow pointing to a target, like this:



All that is required to get good polar alignment is to move the indicated star into the target - doing this will also line up the NCP with the RA axis and polar alignment done. At the bottom of the screen, below the Polar Align Error figure are some guidelines indicating which direction the mount needs to be moved. These are calculated based on the estimated longitude which is calculated from the offset between the local time and GMT, so they are not exact.

During the adjustment phase the highlighted star might switch to a different one - no need to worry, just keep adjusting. As this gets closer the arrow and target changes to a pair of parallel lines that need to be brought together to finalise the alignment process.

If it is found that the length of the arrow isn't updating, or is only updating now and then, it is likely that the plate solving isn't working for every frame - either ignore the problem and just get the star into the target or alternatively try further tweaks to the gain or exposure to get the star detection and plate solving working more reliably. That an alignment error of under 2 minutes of arc is considered good and under 1 minute of arc is excellent. Do not waste time trying to get the alignment error all the way down to zero.

Tips

- Try using a guiding camera (such as ZWO120MC, QHY5LII, Altair GPCAM and others) with a ~200mm focal length finder-guider - this will give the correct field of view.
- Read the on-screen instructions - they will walk through the procedure.
- Select a high gain and an exposure of 4-8s - this should let SharpCap see enough stars.
- If the mount is on a pier, the pier mounting plate bolts can often give finer adjustment than the mounts own alt/azimuth adjusters.

- Don't worry if the scope or finder is aligned with the mount correctly - misalignment won't affect the result.
- SharpCap needs to know the approximate longitude to work out which direction (up/down/left/right) the mount needs to be moved. If the time zone is set incorrectly, the wrong directions may be suggested.

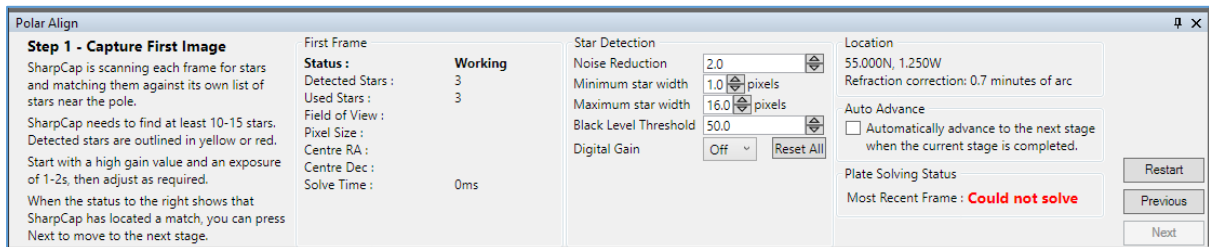
Troubleshooting Polar Alignment

The information below should help you resolve a number of commonly encountered problems with the polar alignment tool.

[No matter how much I adjust I can't get the error down to zero!](#)

STOP!!! You don't need to get the polar align error down to exactly zero and you are wasting clear sky time if you try! A polar alignment within 1 arc minute of the pole is usually considered to be excellent and good enough for long exposure imaging.

[Stuck at the first Step? The 'Next' button never becomes enabled?](#)



Getting stuck at this stage means that SharpCap can't plate solve the view from the camera and work out where near the pole the camera is pointing. The most recent frame status will be 'Could Not Solve' in red all the time and the First Frame Status will be 'Working'. Sometimes you will find that you will eventually get past this stage if a frame from the camera happens to be a bit better than the others and plate solves – don't be tempted to move on if that happens as you will get stuck further on – fix the problem by running through the troubleshooting steps below instead.

The likely causes for this problem are:

[Not enough stars being detected](#)

if the number of detected stars is low (less than 10) then this is the most likely cause. Here are some suggestions to fix the problem

- Increase camera exposure up to 2-4s
- Increase camera gain if the camera has a gain control. Start at about 1/2 gain and work up towards maximum
- Try a digital gain of 2x or 4x if your camera has no gain control
- Reset the Star Detection settings to default if you have adjusted them

[The camera/telescope is pointed more than 5-6 degrees away from the pole](#)

If plenty of stars are being detected, but the plate solving still fails, you could be starting from too far away from the pole

SharpCap has a star database out to 5 degrees away from the pole (7 degrees in SharpCap 3.1). If the image is taken of an area further from the pole than this then plate solving will fail. If you have a network connection, you can check how far you are from the pole by saving a frame (press the 'Snapshot' button) and uploading it to nova.astrometry.net for plate solving. If you have a plate solving tool installed on your PC you could use that instead.

Hot pixels are being detected as stars

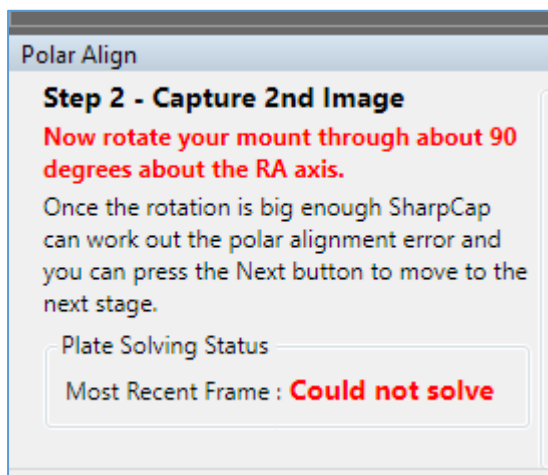
Some cameras suffer from hot pixels (pixels which have maximum value even though no light falls on them). With some star detection settings, single hot pixels may be detected as stars. If enough of these hot pixels exist and are detected, they may confuse the plate solving algorithm.

SharpCap 3.1 and above will show a warning below the star detection options if the combination of options mean that hot pixels would be detected as stars. You only need to worry about this if your camera is prone to hot pixels at the exposure/gain settings you are using. You can stop hot pixels from being detected by increasing the noise reduction setting, increasing the minimum star width or reducing the digital gain.

Stuck in Step 2 or Step 3, nothing updates or everything takes a very long time

Once you have made adjustments to your telescope or moved SharpCap on to a new step in the polar alignment process, you shouldn't have a long wait to see the results or for SharpCap to find a solution – a few seconds or so is typical. If you find yourself waiting more than 15 seconds then something isn't right and the most common cause is that SharpCap is not able to plate solve every frame that is coming from the camera – in fact it might only be solving one frame in 10 or even one in 100.

This problem is easy to spot because the 'Most Recent Frame' status will be 'Could not solve' in red most of the time, but will change to a green 'Solved' every now and then.



This problem has exactly the same causes as the problem of being stuck at step 1 above. The best solution to this problem is to restart the alignment process and follow the suggestions above until the 'Most Recent Frame' status is showing as 'Solved' for every frame.

Note that sometimes you find this problem occurs for Step 2 even though you had a good solution straight away for Step 1 – this could be because the rotation around the RA axis has moved the camera to point to an area of sky that is harder to plate solve (perhaps fewer bright stars). A good trick for this problem is to leave the RA axis rotated but reset the SharpCap Polar Align routine back to Step 1 – then adjust the camera settings and star detection settings to get good plate solve in the rotated position before continuing the process by rotating back to the home position.

I get the wrong results – SharpCap says my Polar Alignment is great after adjustment, but it isn't!

The first thing to check is that you have pressed the 'Next' button to move to the adjustment stage before you started tweaking the Alt/Az of your mount. If you don't move to the adjustment stage

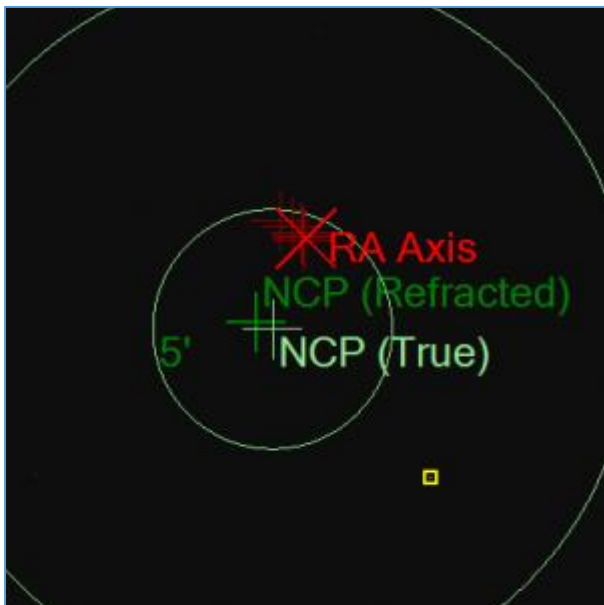
then you will get incorrect polar alignment. Update to SharpCap 3.1 which improves polar align to make this common slip up much harder to make.

The next most common cause of this is that something is shifting as the mount is being rotated around the RA axis. If you are using a guide scope/camera it could be that the scope is not mounted firmly or that a cable is pulling (or just hanging loose) which can shift the camera slightly. This problem has also been experienced by people who have a problem with their RA axis bearings!

The first thing to do if you suspect this problem is to confirm you have an issue. Run a SharpCap polar align normally (starting in the home position and rotating 90 degrees), and adjust as usual. Once you are finished, leave the scope at the 90 degree position and re-run polar alignment in SharpCap (this time rotating back to the home position when prompted to rotate). If the measurement from the second PA run matches the first then you probably don't have this issue. If it doesn't match by a big margin then flexure/movement as you rotate is the likely cause.

In SharpCap 3.1 you can test for this problem quite easily by rotating the mount in stages of about 15 degrees. SharpCap plots a dark red cross at the point it calculates to be the center of rotation (where the RA axis is pointing) for each stage of the rotation – these should form a tight group on screen if there is no flexure. In the screenshots below I deliberately let the cable to the guide camera hang loose for the polar alignment run shown on the left. Here you can see that the measured RA axis positions have drifted as I have rotated further due to the weight of the cable pulling on the camera. Once the cable was properly secured the RA axis positions form a much tighter group.

Loose Cable



Secured Cable



If you discover that you have problems with flexure when rotating you can obviously try the usual hardware fixes of tightening all connections and securing all cables. Another possible trick that can help is to run the two steps of the polar alignment at about 30-40 degrees left of home and 30-40 degrees right of the home position. Depending on how your equipment is configured there may be less flexure when using this approach because the scope is largely 'up' during the hole procedure rather than going from 'up' to 'sideways' after rotation.

[The directions that SharpCap says I should move my mount are wrong](#)

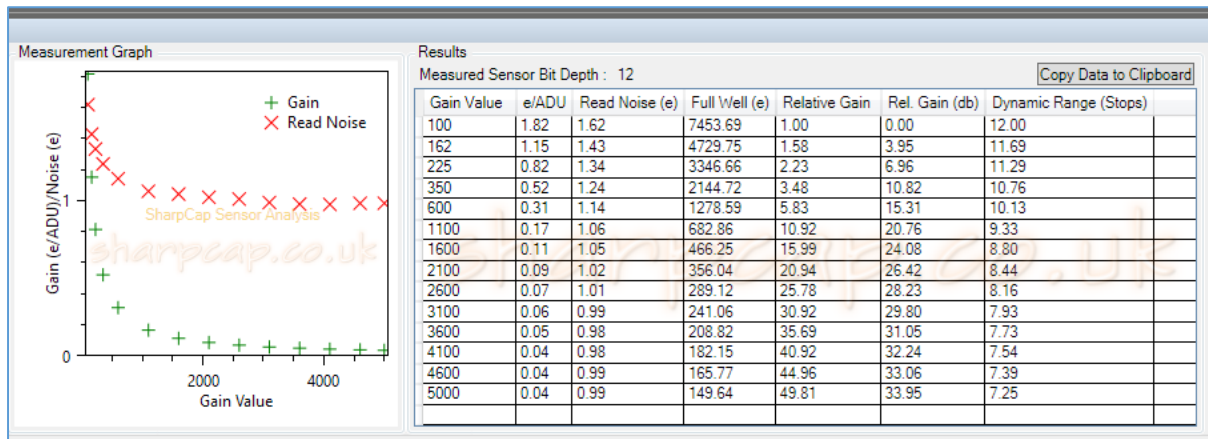
Firstly, make sure that you have pressed the 'Next' button to move onto the adjustment stage before adjusting the mount Alt/Az. If you start adjusting before pressing the 'Next' button then your final alignment result will be incorrect and the direction indications (up/down/left/right) will not appear to work correctly. If you are using SharpCap 3.0, update to SharpCap 3.1 which only shows the direction guides after pressing next to avoid this problem.

Secondly, remember that the directions given are assuming that you are looking at your mount and you are facing in the direction of the pole (ie the telescope is pointing away from you at the pole). An instruction to move up means 'move the mount altitude so that the objective end of the telescope is pointing higher up', while right means 'move the mount azimuth so that the objective end of the telescope points further to the right (east for NH. west for SH)'.

Sensor Analysis

Camera manufacturers frequently produce charts of sensor gain, read noise and dynamic range for their cameras. Such charts are useful for comparing the characteristics of one sensor with another and also for helping choose the optimum camera settings for a particular imaging situation. However, until now, creating these charts was outside the reach of all but the most dedicated amateur astronomer, requiring as it did dozens of careful measurements and careful calculation.

SharpCap now automates the measurements and calculations required to perform this analysis on almost any camera (DirectShow cameras cannot be analysed because they do not have a fine-grained exposure control that SharpCap can adjust).



The results of the SharpCap *Sensor Analysis* procedure are used to support the [Smart Histogram](#) functionality that helps guide the choice of gain, exposure and bit depth when imaging.

Preparing to run a Sensor Analysis

These are the steps you need to carry out before running SharpCap's *Sensor Analysis* tool.

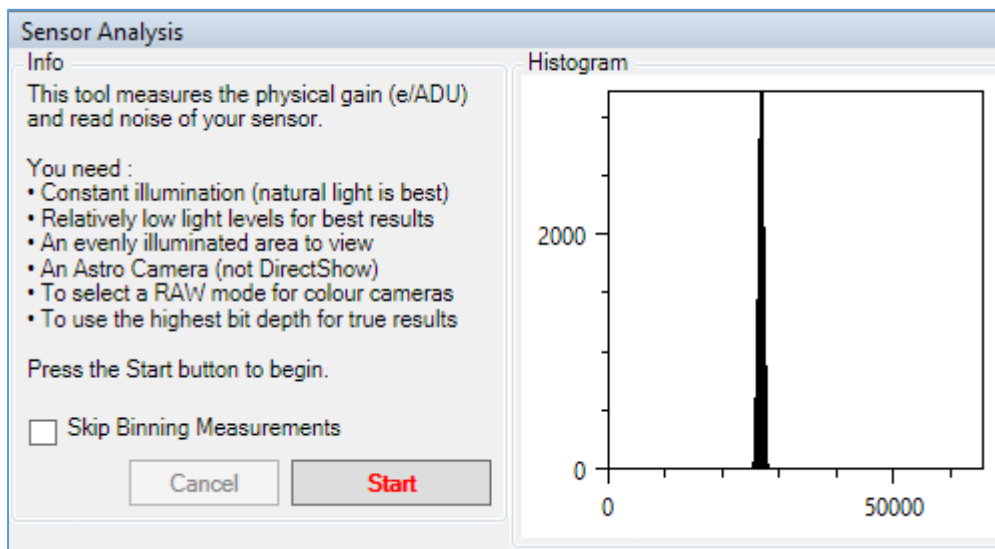
- Ensure your camera is working well with SharpCap
- Set your camera into it's highest bit depth mode, and if it is a colour camera, set it into RAW mode rather than RGB mode
- Find a source of constant illumination.
 - Natural daylight on a clear or overcast day is ideal, but not on a day with scattered clouds as the brightness changes.
 - Artificial light can work well but you may see lines in the image at short exposures due to the 50/60Hz flicker of many artificial lights – if this is the case then select a tall, thin area for measurement to include multiple flicker bands in the area
- Arrange for an evenly illuminated area to show in the camera field of view. Note that the whole field of view does not need to be evenly illuminated, just an area of at least 100x100 pixels. You can do this by
 - Using your telescope, putting it out of focus and pointing it at the cloudy or blue sky or putting a white T-shirt or similar over the lens.
 - Using a translucent 1.25" dust cap over the nosepiece of the camera
 - Using a CS or C thread lens and pointing the camera at an evenly illuminated featureless object (like a sheet of paper)
 - Using the camera with no lens or cover (but beware getting dust on the sensor).
- Arrange to be able to vary the brightness of the illumination of the sensor. You may need to do this to get the process to run to completion successfully

- Arrange to be able to cover the sensor so that dark measurements can be made
- Set any colour balance, gamma or contrast controls for the camera to their 'Neutral' state.

Running Sensor Analysis

To begin the process, select *Sensor Analysis* from the *Tools* menu. Any existing tool (such as the *Histogram* or *Live Stacking*) will close and the *Sensor Analysis* will open. The selection area rectangle will also appear in the image preview area.

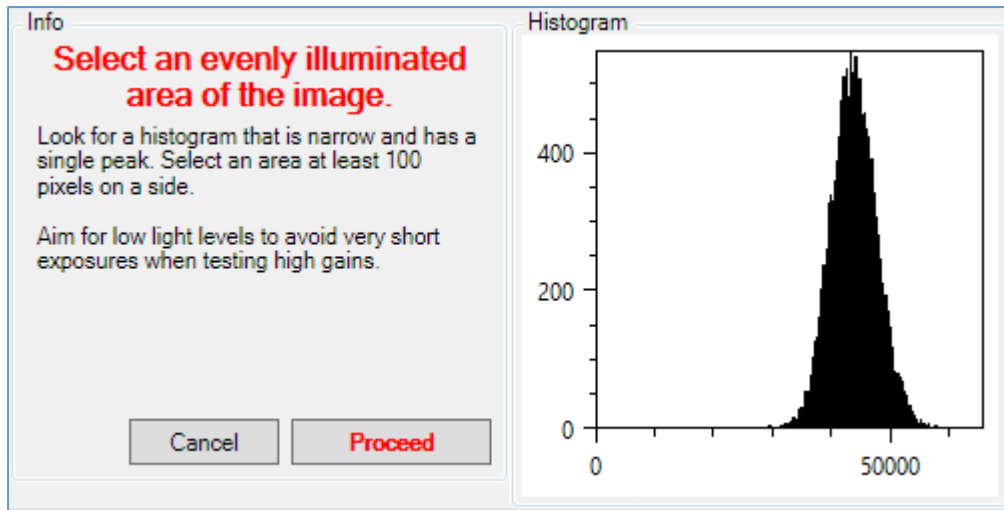
Some basic instructions and a small image histogram will show in the *Sensor Analysis* tool window. Only check the *Skip Binning Measurements* checkbox if sensor analysis has failed or become stuck at the final stage of measuring the effects of binning in a previous run. Once you have checked you are ready, press the *Start* button.



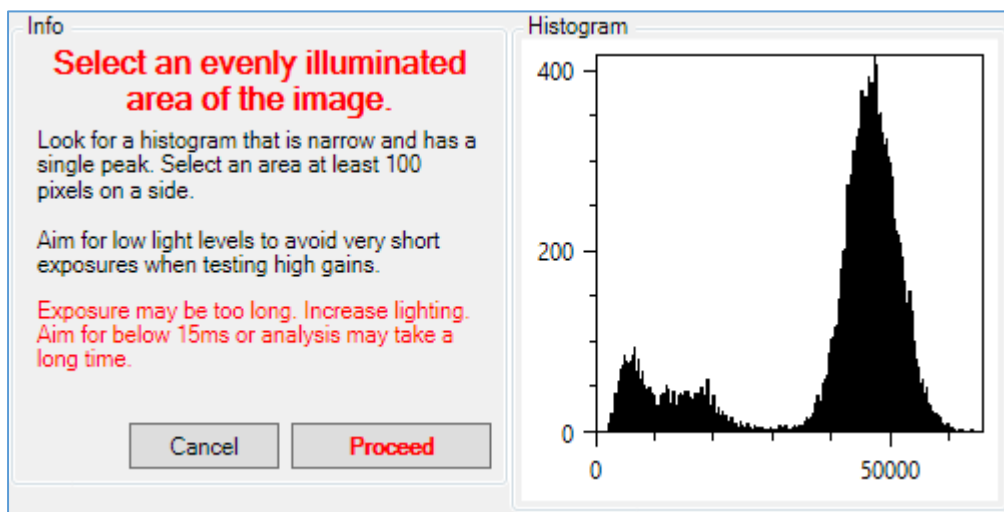
Selecting the Measurement Area

Once the *Start* button is pressed, SharpCap will automatically select the highest gain level that will be tested during the sensor analysis (this may not be the highest gain that your camera supports – some cameras have a very wide range of gains, in which case the highest gains will be excluded from analysis to make the process more reliable). SharpCap will also automatically adjust the camera exposure to correctly expose the region inside the *Selection Rectangle*.

At this point you should adjust the move and/or resize the *Selection Rectangle* to select a region of the image that is of uniform brightness and colour. A suitable area of image will show a histogram similar to the one below with a single, symmetric peak towards the right-hand side. You should also adjust the brightness of illumination to give an exposure time just over 1ms (unless SharpCap recommends a higher value). Do not adjust the exposure value yourself – it will be automatically adjusted as you change the illumination levels or adjust the selection area.



If the selected area is not uniform then the histogram will have more than one peak or an asymmetric peak. If the exposure time is too long or too short then a warning message will be shown in red giving instructions on what changes need to be made. Both of these situations are shown in the image below.



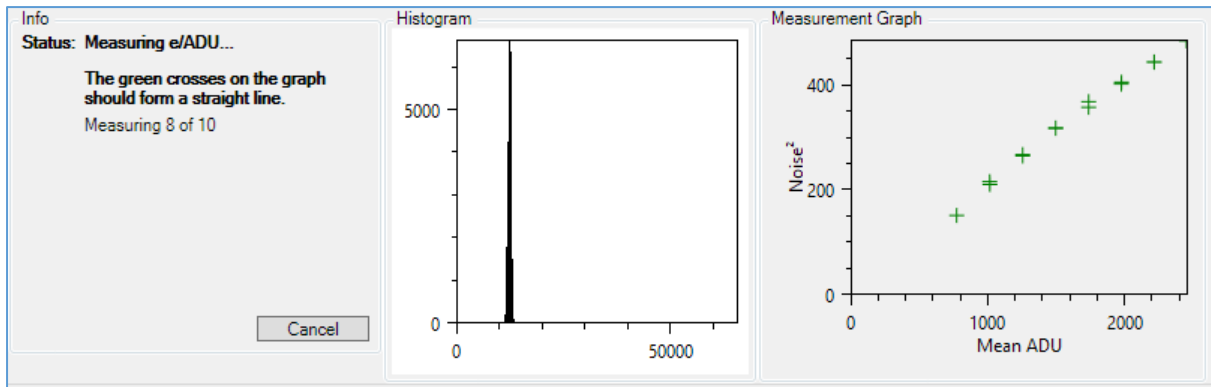
Once the light levels have been adjusted correctly and the selection area chosen, press the *Proceed* button to start the actual measurements.

During the measurement period, be careful not to

- Disturb the camera while measurements are being taken
- Move in front of the camera (which will change the light levels being measured)
- Allow the light level reaching the camera to change (except when asked to cover/uncover the sensor).

Bit Depth and e/ADU Measurements

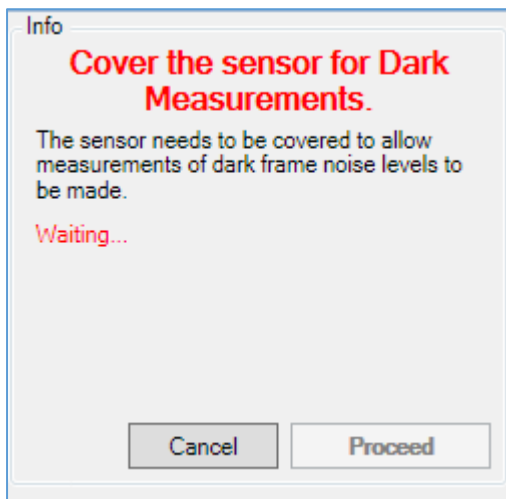
The first stages of sensor measurement involve measuring the true bit depth of the images that the camera produces and the e/ADU (electrons per ADU) of the camera at minimum gain. While the e/ADU measurements are being made a scatter graph will draw to the right of the histogram which shows the relationship between measured frame noise and measured mean ADU at various exposures. The green crosses should be close to a straight line.



After this stage is complete, the sensor must be covered so that no light can reach it to allow dark measurements to be made.

Dark Measurements

SharpCap will prompt you to cover the sensor to allow dark measurements to proceed.



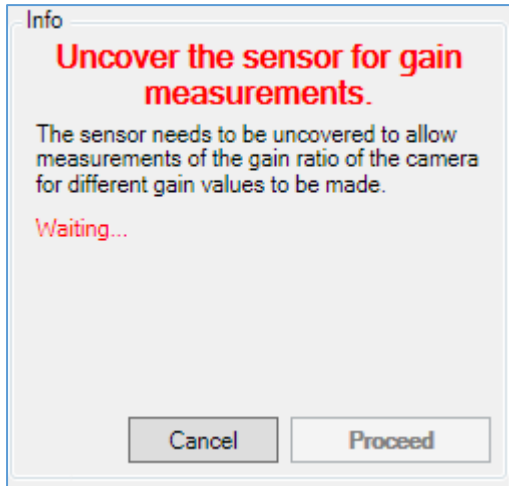
SharpCap will set a high gain and a 100ms exposure which will most likely lead to a white image showing on screen at this point. When you cover the sensor, the camera image will go dark and the *Proceed* button will become enabled. Press the *Proceed* button when it becomes enabled and the sensor is fully covered.

A large number of dark measurements need to be made, but they typically proceed fairly quickly unless the frame rate is very low. The initial measurements are of the brightness of the image with different values set for the Gain and Offset controls (Offset is also known as Black Level or Brightness). These are followed by measurements of the amount of noise present in dark frames at various gain values.

When the dark measurements are complete, the sensor must be uncovered to allow the final Gain and Binning measurements to take place.

Gain and Binning Measurements

SharpCap will prompt you to uncover the sensor.

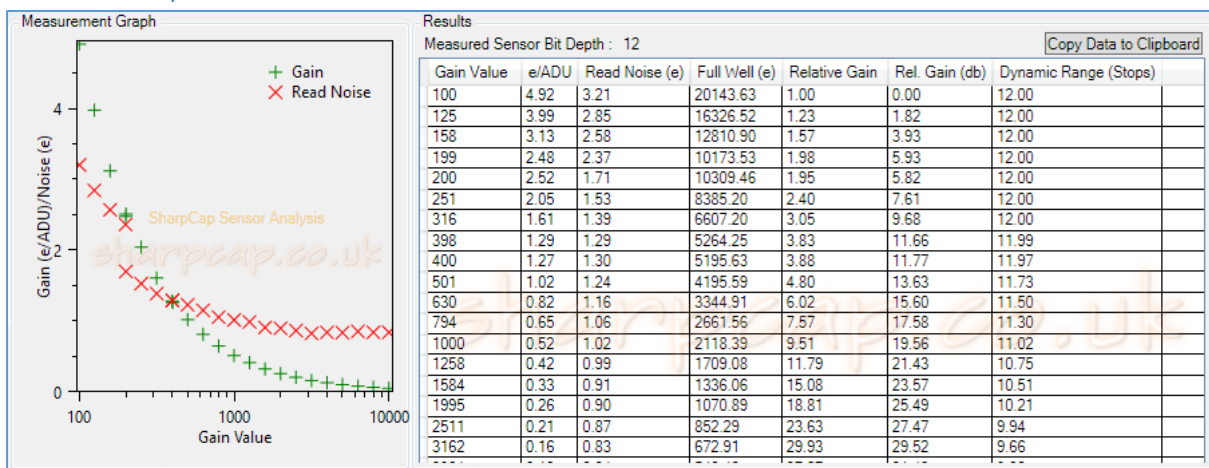


Once you uncover the sensor, SharpCap will begin to adjust the exposure to correctly exposure the selection area. At this point, you may (if required) adjust the brightness of illumination and the selection area as you did initially to ensure the area being measured is uniform and the exposure is in the recommended range. Once any necessary adjustments have been made, press the *Proceed* button, which will become enabled when the sensor is uncovered.

After you press the *Proceed* button, the final stages of sensor measurements will commence, which involve gradually adjusting the camera gain and measuring how much the exposure must be changed to counteract each change in gain. **It is vitally important that the brightness of illumination of the camera does not alter during this part of the measurement process, otherwise incorrect results will be produced.**

The final step is to briefly adjust the *Binning* setting of the camera to determine how the camera deals with binning, after which the results will be shown.

Sensor Analysis Results



The primary results of the measurement process are

- The sensor bit depth, shown above the results table, here 12 bits meaning that the sensor can produce 2^{12} (4096) different ADU values (different brightness levels).
- The e/ADU values for different gain settings, shown as the green crosses on the graph and in the table. This figure is the number of electrons required per pixel to increase the brightness measured by the camera by 1 ADU

- The Read noise of the camera for different gain settings, shown as the red crosses on the graph and in the results table. This is the amount of noise (in electron equivalents) that is added to each image due to the camera electronics not being perfect at reading the brightness of each pixel.

The other results, shown in the table are

- The *Full Well* capacity of a pixel – that is the number of electrons that it can hold before it becomes saturated (gives a 100% white signal).
- The *Relative Gain* for each gain setting, measured as a multiplier of the minimum gain or in dB
- The *Dynamic Range* for each gain setting – this is the ratio between the brightest signal that can be properly measured (the full well signal) and the dimmest (the read noise). This value is measured in photographic stops (effectively powers of two).

Usually, the graphs will show two smooth curves, with the highest values for both e/ADU gain and read noise at the left-hand side. The example above shows a sharp drop in the read noise at a gain value of approximately 200. In this case, the camera sensor switches to a more sensitive and lower noise mode when the gain is higher than 200 and this is reflected in the measurements.

SharpCap stores the results of completed Sensor Analyses on your computer and will use them later to provide [Smart Histogram](#) functionality on analysed cameras. If you re-run the analysis then the previous saved version will be overwritten. Note that previously saved sensor data will not be shown when you re-select the *Sensor Analysis* tool. It can however be viewed in one of the tabs of [The Smart Histogram Brain Window](#).

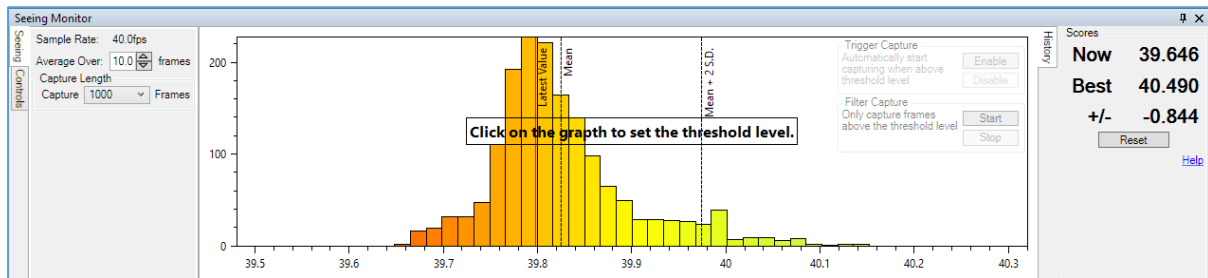
To gain full *Smart Histogram* functionality, you should analyse your camera at both it's maximum bit depth (i.e. in RAW12/RAW16/MONO16 mode) and at a bit depth of 8 bits (i.e. in RAW8/MONO8 mode).

Sensor analysis is a free feature and does not require a SharpCap Pro license, however users with a SharpCap Pro license can copy the table of values from the results if they wish.

Seeing Monitor

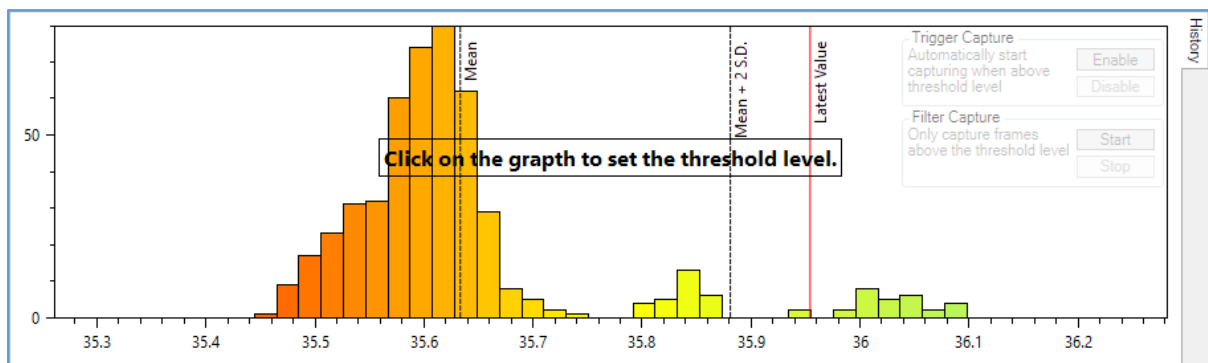
The Seeing Monitor is a new application of the image quality measurement techniques that SharpCap has provided to assist focusing for some time. Instead of helping you find the point of best focus, you can now use the image sharpness measurements to help you capture the moments of clearest seeing without the eyestrain and fatigue usually associated with carefully watching the image to pick out seeing improvements.

Seeing Monitor is launched from the Tools Menu, and shows a chart of the recent range of image quality with the most recent values highlighted. This gives an objective measurement of when the seeing is at its best.



Every new frame is analysed for sharpness (contrast) and the results are added to the graph that will build up below the image. The quality of the results can be improved by selecting the area of interest using the selection area tool (for instance sunspots, prominences, craters). Using the standard colour scheme for focus measurements, sharp frames build the graph in green on the right hand side of the graph, poor frames build the left hand side in red.

If the seeing is relatively constant then the graph will be like the one above with a single peak. If the seeing improves or worsens then a new peak will begin to build (to the right for improved seeing, to the left for worse seeing), like the image below. Note that other factors can also change the score and cause a new peak – for instance brightening or dimming caused by passing thin clouds.



In both graphs you can see a number of vertical lines:

- Dashed line labelled *Mean* - The mean image quality value for all samples measured so far
- Dashed line labelled *Mean + 2S.D.* – The image quality value that corresponds to the mean plus two standard deviations. If the seeing is steady then you would only expect to see about 2% of frames exceed this level due to small random fluctuations.
- Solid red line labelled *Latest Value* – This shows the quality of the most recent frame recorded. If this line moves to the right of the *Mean + 2SD* line for any significant length of time then it is likely that the seeing has improved.

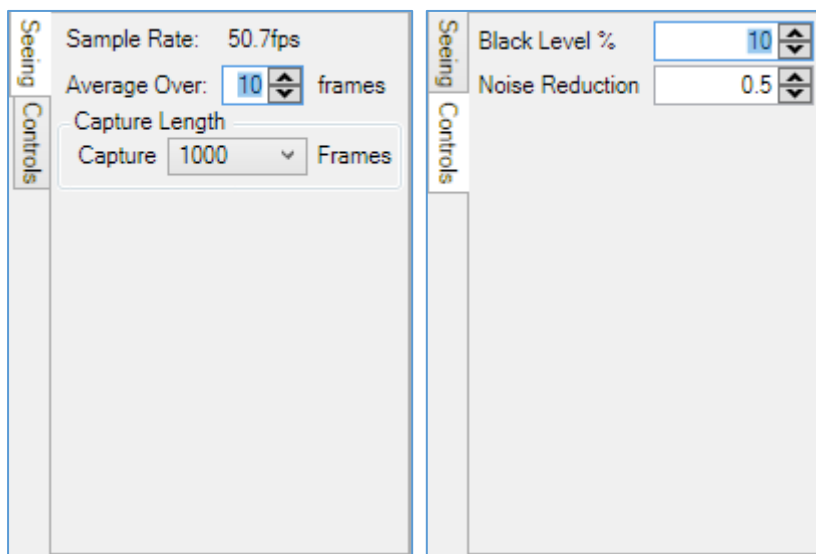
It is important to remember that other actions can cause the quality of the image to change – for instance

- Adjusting Focus
- Adjusting camera parameters such as gain or exposure
- Moving the selection area rectangle
- The image moving due for some reason (poor tracking, mount adjustments)

When any of these occur, press the *Reset* button to clear the graph and start accumulating new seeing data, otherwise the data may be misleading.

Configuring Seeing Monitor

On the left-hand side you will see a selection of controls allowing adjustments to be made to the *Seeing Monitor* settings.



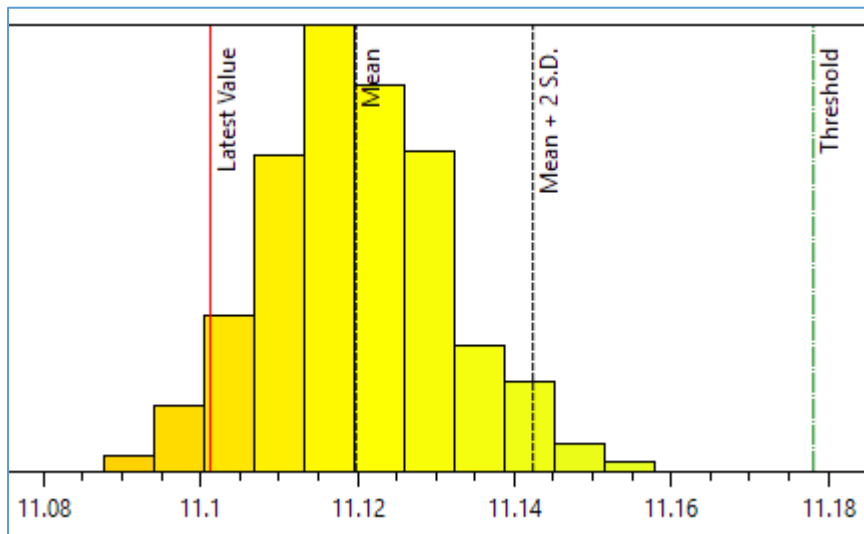
- *Sample Rate* – shows how often SharpCap is measuring the frame quality
- *Average Over <X> frames* – controls how many frame measurements are averaged together before plotting a new data point on the graph. Typically this should be set to a value between one half and one fifth of the sample rate to give a few new data points being added each second
- *Black Level* – selects a brightness level in the image below which all detail will be ignored. Setting this appropriately ensures that noise in dark areas does not contribute to the image quality measurement
- *Noise Reduction* – allows the fine scale noise in the frames to be suppressed to prevent it from affecting the image quality measurement.

Finally, the *Capture Length* setting controls how many frames will be captured when a *Seeing Triggered Capture* begins – see below for more details.

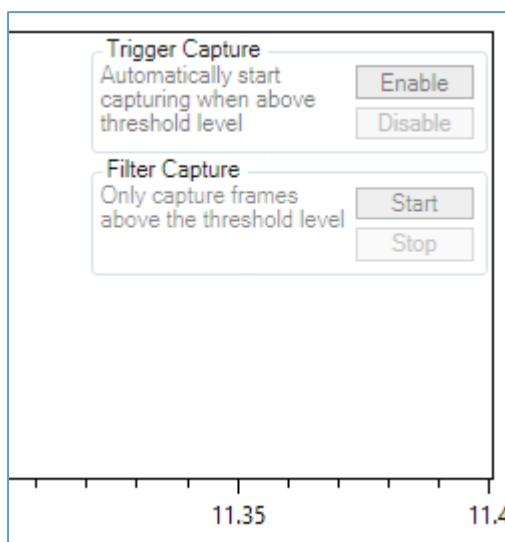
Seeing Triggered and Seeing Filtered Capture

With a SharpCap Pro license, two additional functions become available – *Seeing Triggered Capture* and *Seeing Filtered Capture*. These functions help capture images when the seeing improves without the need to constantly watch the *Seeing Monitor* graph.

Both functions rely on setting a *Threshold* level in the seeing monitor graph, which can be set and adjusted by clicking on any point in the graph.



Both modes can be activated using the buttons found on the right-hand side of the graph.



Seeing Triggered Capture will automatically start capturing when the *Latest Value* exceeds the *Threshold Value* and will then capture the number of frames given by the *Capture Length* setting in the left-hand controls region. Note that the specified number of frames will be captured even if the image quality then falls back below the *Threshold* level.

Seeing Filtered Capture works in a different way – when the *Start* button is pressed, SharpCap will immediately begin capturing, but will deliberately discard all frames where the frame image quality is below the *Threshold Level*. This will be reflected by the dropped frames count rising rapidly in the *Status Bar*. Only frames that meet or exceed the *Threshold Level* will be saved to the capture file. Capture will continue until the *Stop Capture* button on the toolbar or the *Stop button* is pressed.

Note: While *Seeing Filtered Capture* is active, the captured frame count shown in the status bar may seem to fluctuate slightly at times when all frames are being discarded. This behaviour is normal.

Note: Some frames may be saved to the output file even at times where the *Latest Value* line on the graph is below the *Threshold* line. This is because the position of the *Latest Value* line is an average

of the image quality of a number of frames. The average value may be below the threshold, but a number of the individual frames that make up the average may have an image quality above the threshold.

Feature Tracking

Feature tracking is a tool designed to assist with solar/lunar/planetary imaging, where it can help stop the target from drifting out of view even if the telescope is not tracking perfectly. Guiding during longer exposure deep sky imaging can be achieved using tools such as PHD2 guiding.

Hardware Requirements

In order to use *Feature Tracking*, you need to be using either

- An ASCOM compatible GOTO mount – the mount must be selected in the [Hardware Tab](#) of the SharpCap settings and connected.

Or

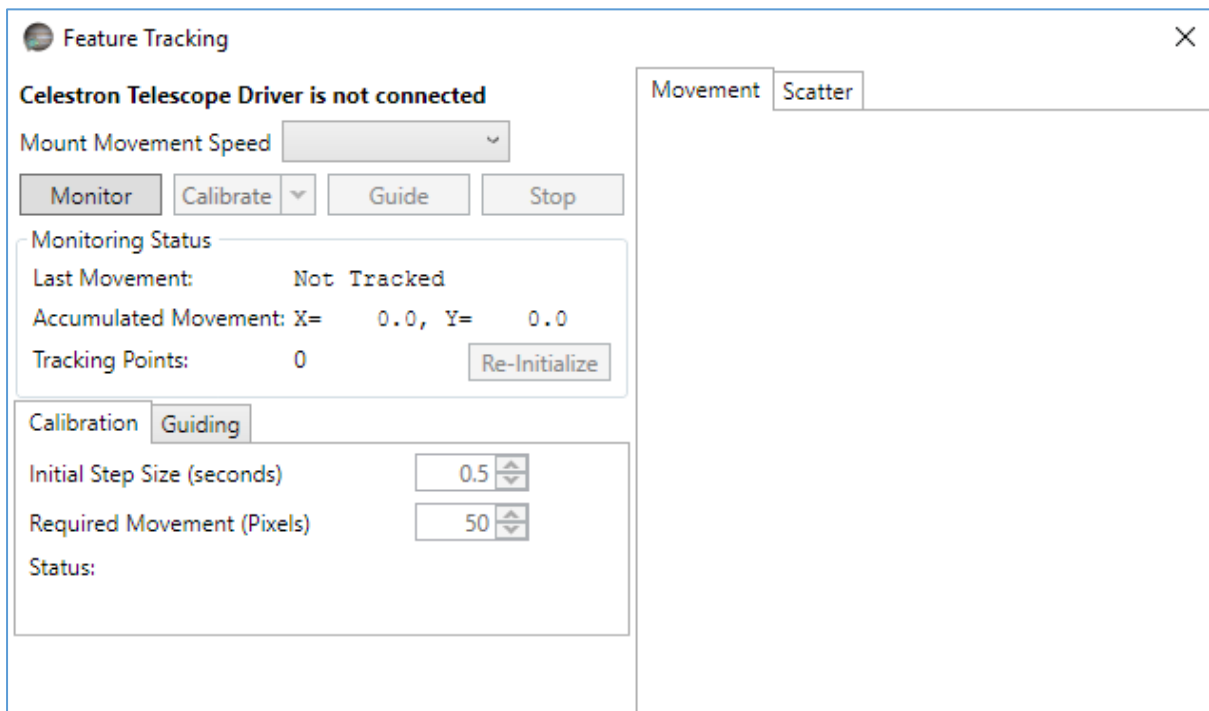
- A supported camera with an ST4 pulse guiding port that is connected to a pulse guide-capable mount. Select 'On Camera ST4' as the mount option in the [Hardware Tab](#) to use this option.

Either of these will allow SharpCap to move the mount in all four directions, although the ST4 option only allows a single movement rate, so the ASCOM option should be preferred if available.

There is no need to have a separate guide scope or guide camera for this functionality. SharpCap will use images from the main imaging camera to track any movement without affecting normal imaging functionality.

Setting up Feature Tracking

Feature Tracking is launched by selecting it from the *Tools* menu, which will show the *Feature Tracking Window*. This is a separate window meaning that *Feature Tracking* can be used at the same time as other features such as *Focus Assistance*, *Seeing Monitor* or *Histogram*.

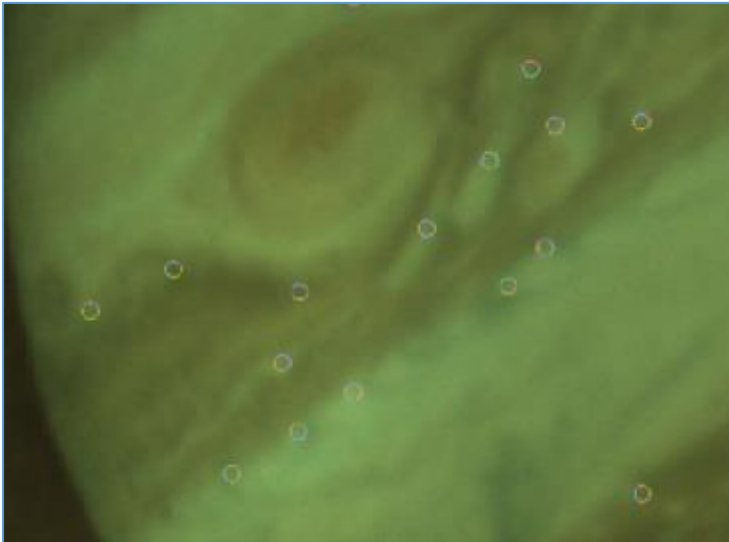


The top left of the *Feature Tracking Window* shows the hardware that will be used for guiding and allows the mount movement speed to be chosen if an ASCOM GOTO mount is being used. If

appropriate guiding hardware is not selected, or not connected, a warning will be shown here and guiding functions will be unavailable.

Starting Monitoring Image Drift

Press the *Monitor* button to begin monitoring the image for drift. SharpCap will automatically find a range of identifiable feature points on the image and highlight them on-screen with small circles. As the image moves, these points will follow the feature on the image, allowing SharpCap to track how far the image has moved and in what direction.

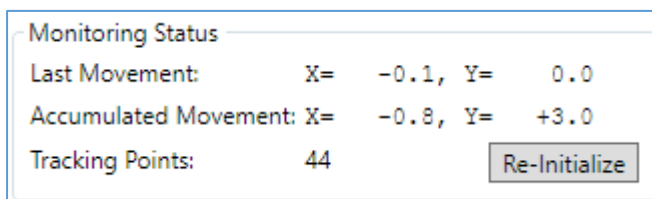


If the image is very low contrast or very out-of-focus then SharpCap may not be able to find sufficient image features to track accurately.

Tracking may be lost if

- The image moves very rapidly
- The image moves such a long way that most of the tracked features move out of view
- The image brightness is increased or decreased drastically

When image monitoring is active, the *Monitoring Status* area will be updated regularly.



The *Last Movement* values show how far the image has moved between the most recent frame measured and the previous measured frame. The *Accumulated Movement* shows the total amount of image movement detected since monitoring was started. These measurements are in pixels.

The *Tracking Points* value shows how many features on the image SharpCap is currently tracking. If the number of tracked features falls then the *Re-Initialize* button can be used to find a new set of features to track while monitoring is still active.

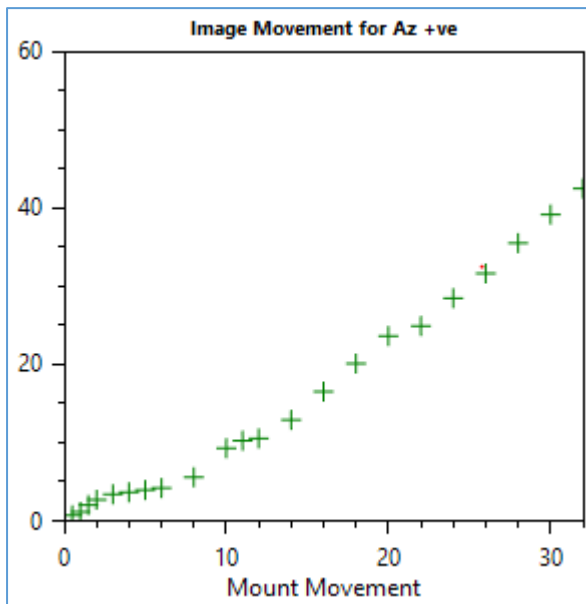
You may wish to test if the tracking is working correctly by moving your mount slightly – this should be detected and lead to changes in the *Accumulated Movement* figures.

Calibration

SharpCap needs to work out which direction (and how far) the image moves when the mount is moved in the four different directions (RA +/-, Dec +/- or Alt +/-, Az +/-). This is affected by a wide range of factors such as camera orientation, telescope focal length, optical configuration of telescope, reducers or Barlow lenses being used, etc. In order to avoid having to enter all of the above information (which would be tedious and prone to error), SharpCap works out this information by moving the mount in each direction and measuring how the image moves – this process is known as *Calibration*.

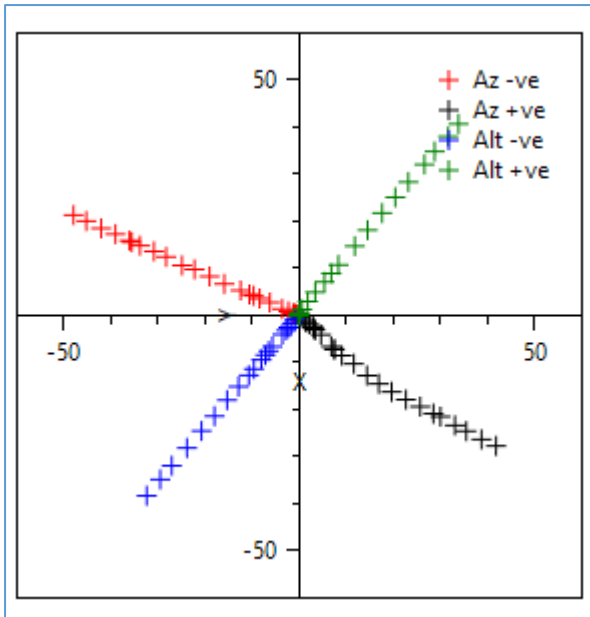
Once image monitoring is running successfully with a suitable number of tracking points, press the *Calibration* button to begin the calibration process.

During the calibration process, SharpCap will move the mount in each of the four directions, starting with small movements and gradually increasing the size until the image shift is detected. SharpCap will continue moving the mount until a total image shift of 50 pixels is measured (this value can be configured in the calibration settings). During the calibration process for each direction, a graph showing the measured image movement on the Y axis against the total mount movement on the X axis is drawn.



The graph should generally be a straight line, although as shown here it is common for the image not to move as much for the initial mount movements – this is due to backlash in the mount mechanism and should not normally cause a problem unless the amount of backlash is excessive.

During the four phases of the calibration process, a graph will build up in the *Scatter* tab showing how the image moved in response to each of the four mount movement directions. This graph should form the shape of an 'X' or cross. The two arms should be roughly straight, and close to being at right angles with each other.



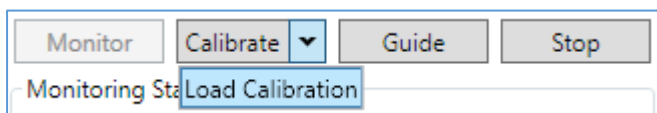
If the scatter plot does not resemble the one shown above then the calibration process may fail. Possible causes of calibration failure include:

- The image does not move in response to SharpCap moving the mount in one of the four directions
- The image moves at significantly different rates when the mount is moved in opposite directions
- When moving the mount in opposite directions the image does not move in opposite directions
- The direction the image moves when the mount is moved in the RA (or Az) axis is not roughly at right-angles to the direction the image moves when the mount is moved in Dec (or Alt)

The most likely cause of all of the above is excessive backlash in the mount movements. It may help to select a higher movement rate (if possible) to reduce the influence of backlash. Setting a higher *Initial Step Size* or *Required Movement* value may also help. The reason for any calibration failure will be shown in the *Status* area of the Calibration controls and more information may be available in the SharpCap guiding log, which can be found in the same folder as the [normal SharpCap log files](#).

Once calibration has completed successfully, the *Guide* button will become enabled.

Note: After a successful calibration, SharpCap saves the calibration results so that they can be re-used later. If you return to *Feature Tracking* after re-starting SharpCap, you can choose to load the saved calibration by using the dropdown at the right-hand side of the *Calibrate* button.

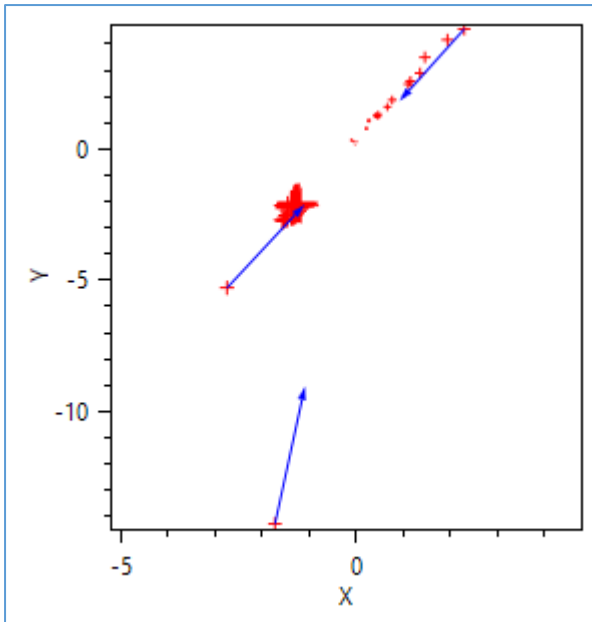


The saved calibration will only be valid if you have not adjusted or rotated the camera and are still imaging in the same region of sky.

Guiding in Action

After calibrating or loading a previously saved calibration, press the *Guide* button to begin guiding. SharpCap will then attempt to move your mount so as to keep the target roughly stationary in image. Note that SharpCap does not attempt to keep the target stationary to 'pixel perfect' levels – just to keep it from slowly drifting out of view.

The status of the guiding process can be monitored by checking the *Accumulated Movement* information, which should stay close to X=0 and Y=0 when guiding as active and also by viewing the *Movement Graph*, which shows both the history of image movement and corrections made



Red crosses on the *Movement Graph* represent measurements of the image position relative to the target position (the X and Y axes are measured in pixels). The most recent measurements are shown as larger red crosses while older measurements are smaller. Blue arrows represent guiding corrections made to bring the image back to the target position.

There are three adjustments that can be made to control the guiding procedure:

Calibration	Guiding
Dead Zone Size (Pixels)	<input type="text" value="5"/>
Max Move Duration (s)	<input type="text" value="3.0"/>
Correction Scaling (%)	<input type="text" value="60.0"/>
Status:	Within dead zone

- *Dead Zone Size* – this is the size of the zone (in pixels) around the target position in which no guiding corrections at all will be made. The default is 5 pixels.
- *Max Move Duration* – the maximum length of a move command that will be issued (in seconds) as part of a guiding correction. The actual amount moved will depend on both this and the guiding rate chosen.
- *Correction Scaling* – the percentage of the calculated correction to apply when issuing a guiding command. Typically setting this between 50 and 70% ensures that there are no

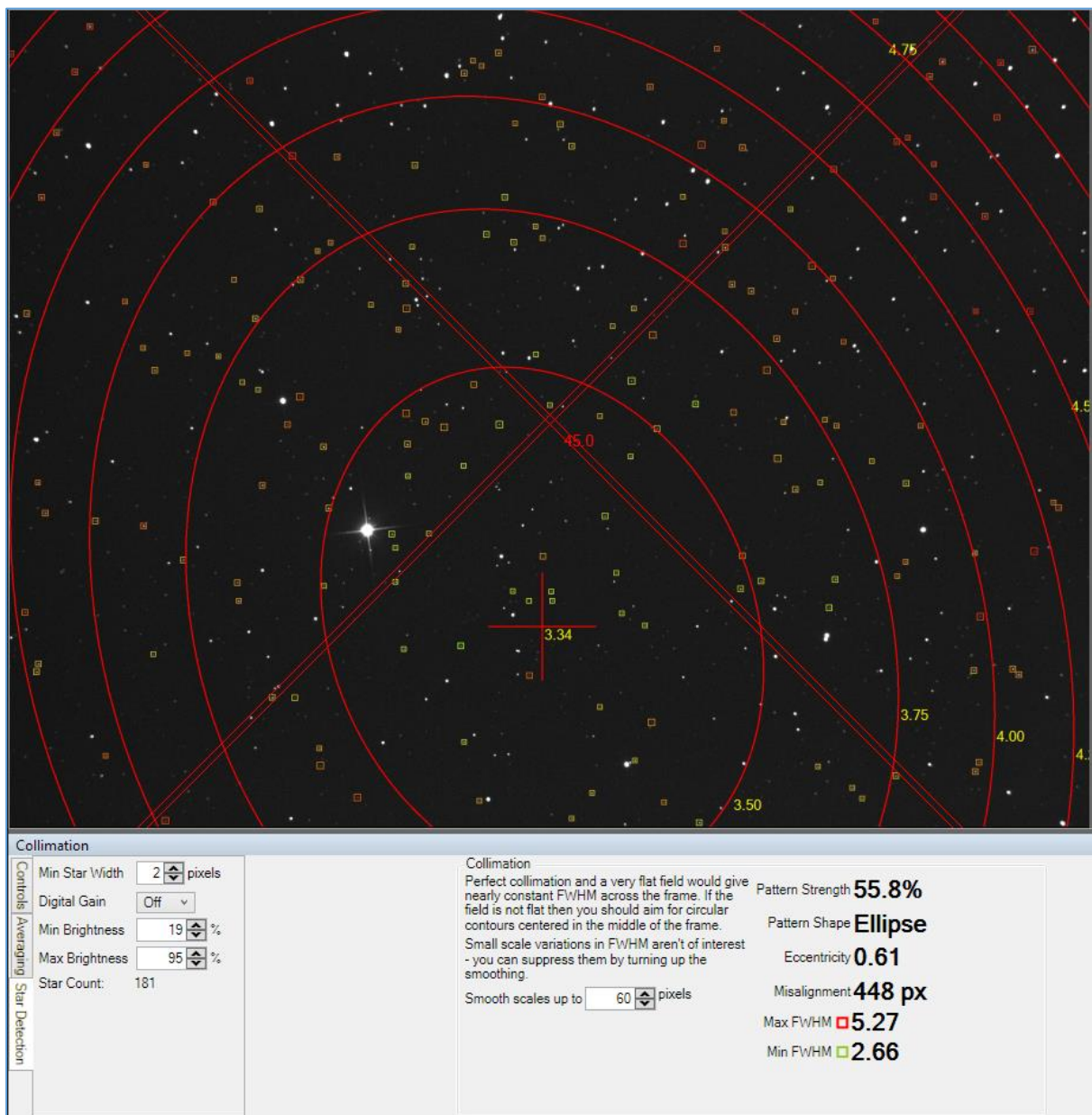
problems with over-correction or oscillation from one side of the target to the other, even if the calibration data is not 100% accurate.

Collimation

SharpCap's experimental collimation tool is designed to help spot collimation problems on Newtonian telescopes by measuring star size across the field of view.

If you take images of a well-focussed star field with little nebulosity then in a correctly collimated Newtonian telescope the sharpest stars should be in the centre of the frame while stars towards the edges and particularly in the corners will be larger due to the effects of coma and (potentially) other aberrations.

When the collimation tool is activated, SharpCap will detect and measure the sizes of stars across the frame and highlight each detected star. SharpCap will also try to find a pattern in the sizes of stars across the frame and draw a contour plot of star sizes over the image.



Small, well-focussed stars will be highlighted in green to yellow colours, larger, less well-focussed stars in orange to red colours. In the example above you can see that there is indeed an area with smaller stars surrounded by regions with less well-defined stars, but that centre of the pattern is just below the centre of the frame and is slightly elliptical rather than circular. This offset indicates that the collimation is not quite correct.

Offsets of the pattern from the centre are largely caused by incorrect collimation of the primary mirror. Elliptical patterns (ie non-circular) are largely caused by incorrect secondary collimation or camera tilt. A circular (or very nearly circular) pattern centred in the middle of the frame represents good collimation.

The normal *Star Detection* and other controls are available to the left-hand side – these are described in detail in the documentation on the [Focus Tools Controls](#). The collimation tool additionally offers the ability to ignore star size variation on small spatial scales across the frame – sometimes this can help bring out the pattern of star size variation on the larger scale.

The collimation status information shows

- *Pattern Strength* – this is an indication of how much of the variation in star size is explained by the pattern. High strength patterns are more reliable than low strength patterns.
- *Pattern Shape* – this must be 'Ellipse' or 'Circle' for the tool to be useful – other patterns do not have a centre point and cannot be used to guide collimation
- *Eccentricity* – this shows how far from circular an elliptical pattern is. An eccentricity of zero means circular.
- *Misalignment* – this shows how far from the centre of the frame the centre of an elliptical or circular pattern is
- *Max/Min FWHM* – these figures show the minimum and maximum star widths measured in the frame

Note: while this tool can detect collimation errors, it is still difficult to make adjustments successfully based on the measurements shown

Note: using a coma corrector dramatically reduces the coma of stars away from the centre of the field of view. While this improves images dramatically, it also makes it very hard or impossible for this tool to make accurate readings of collimation.

Keyboard Shortcuts

The following keyboard shortcuts can be used to control SharpCap

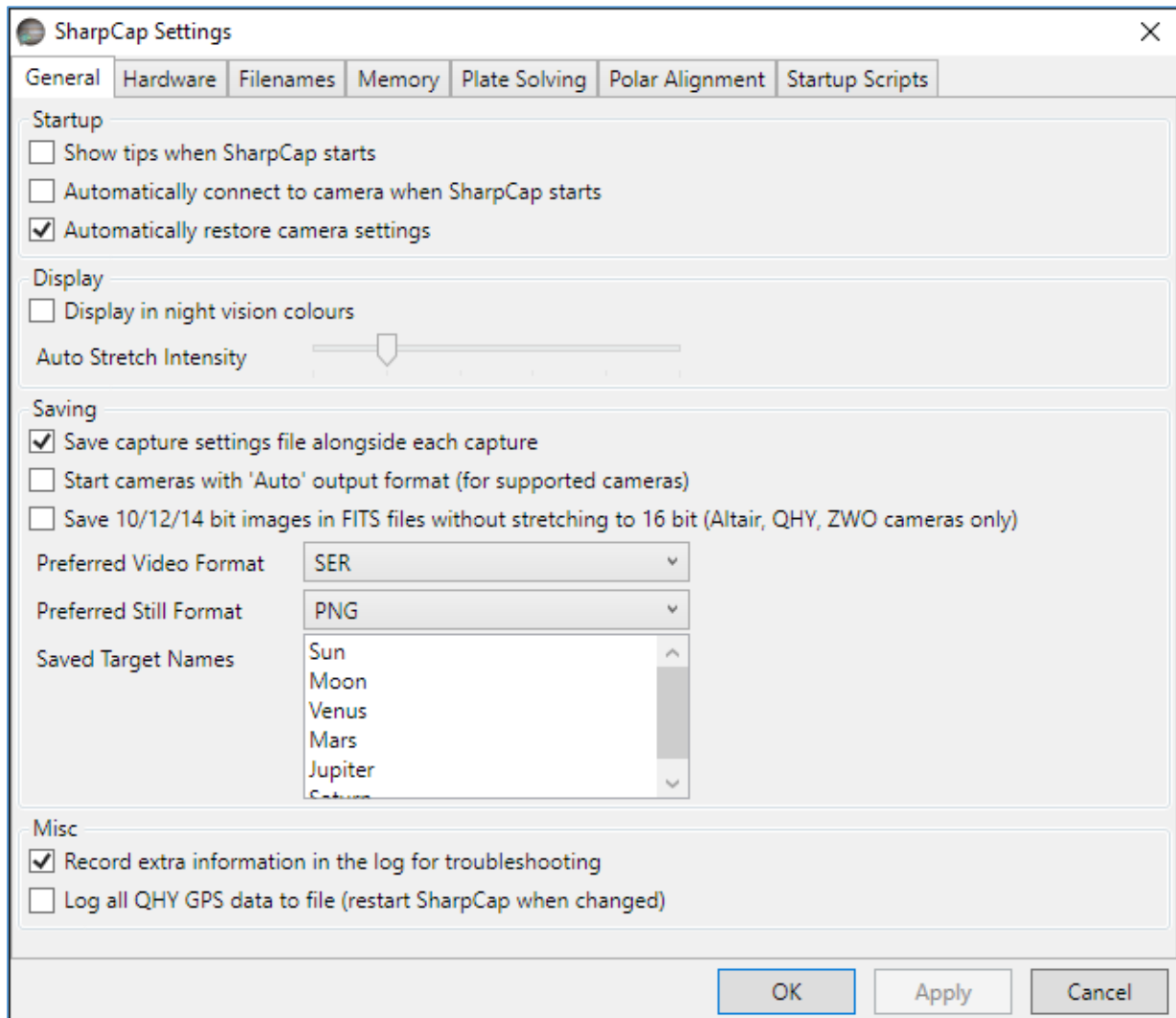
<CONTROL> while opening SharpCap	Do not open a camera at startup
<SHIFT> while opening SharpCap	Show SharpCap log immediately
<CONTROL> while opening a camera	Do not load any saved default capture profile for the camera
<SHIFT> while adjusting histogram stretch levels	Move the histogram stretch level 10 times more slowly than mouse movement for fine control
<CONTROL> + Mouse Wheel over image	Zoom in/out
Mouse Wheel over image	Scroll up/down
<SHIFT> + Mouse Wheel over Image	Scroll left/right
F1	Reduce Exposure
F2	Increase Exposure
F3	Reduce Gain
F4	Increase Gain
F5	Reduce Black Level/Offset/Brightness
F6	Increase Black Level/Offset/Brightness
F7	Move focuser in negative direction
F8	Move focuser in positive direction
<ALT+F11>	Show Scripting Console
F11	Toggle full screen mode
F12	Toggle night mode
<CONTROL>+F12	Toggle two monitor mode
<ALT>+S	Start Capture
<ALT>+Q	Quick Capture (most recently used length)
<ALT>+T or <ESCAPE> while Capturing	Stop Capture
<ALT>+A	Snapshot single frame
<ALT>+L	Activate Live Stacking
<ALT>+F4	Exit SharpCap

Configuring SharpCap

SharpCap configuration is carried out in the Settings dialog, which can be accessed from the File menu.

General Tab

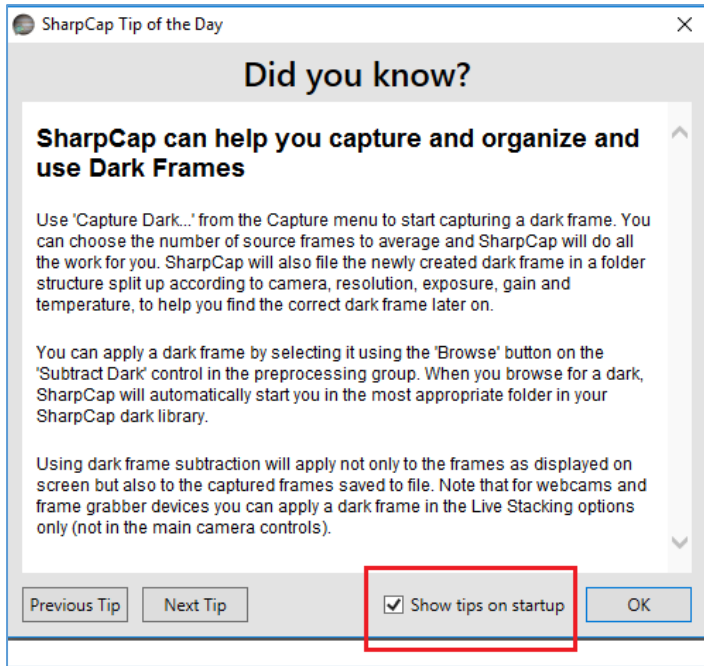
The General tab contains a variety of settings that are divided into four groups – Startup, Display, Saving and Misc.



Startup Settings

Show tips when SharpCap starts

This option is checked by default. The *Tip of the Day* appears when SharpCap is started but can be disabled for future start-ups here or when SharpCap starts.



Automatically connect to camera when SharpCap starts

When set, SharpCap will automatically reconnect to the last used camera at start-up. If set, this setting can be overridden by holding down the *Control* key when starting SharpCap, which will skip opening a camera at start-up. This setting is enabled by default.

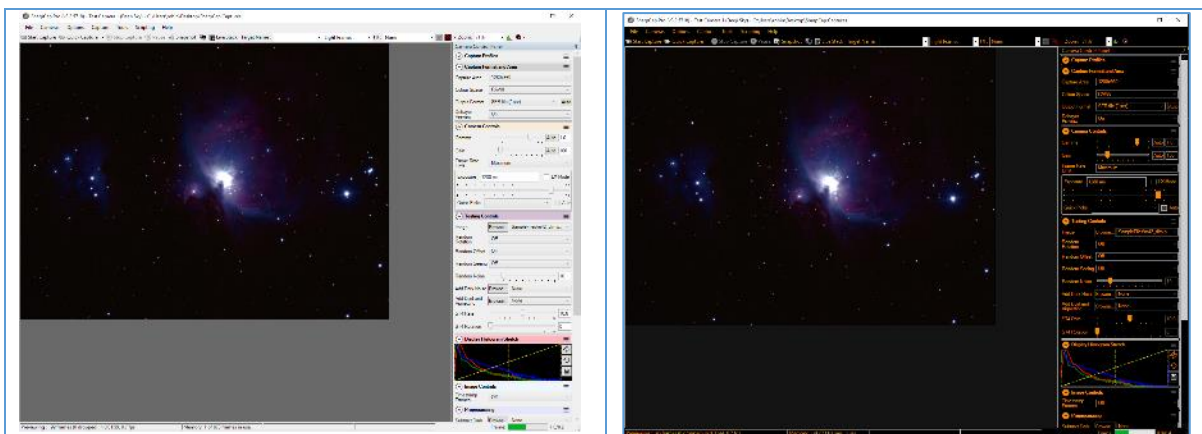
Automatically restore camera settings

When set, SharpCap will save the current settings of each camera when you close the camera (or close SharpCap) and restore those settings the next time the camera is opened. The saved settings are stored in a hidden capture profile called ‘_autosave’ (this profile may be visible in older versions of SharpCap used on the same PC). If you do not wish to reload the previous settings then hold down the <CONTROL> key while the camera is opening. This setting is checked by default.

Display Settings

Display in night vision colours

Selecting this option causes SharpCap to display in a dark colour scheme which is better for night-time use. You can also switch between the two colour-schemes by pressing the <F12> key. This option is unchecked by default.



Normal vision (day) colours	Night vision colours
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Use night vision to preserve dark adaptation of the eyes during a capture session if intending to observe visually.

Auto Stretch Intensity

This setting controls how aggressive the *Auto Stretch* functionality in the *Mini Histogram* and *Live Stacking* is. Setting this option to a larger value will result in the *Auto Stretch* buttons brightening the darker regions of the image more strongly. You can adjust this option until the *Auto Stretch* buttons give results that suit your tastes.

Saving Options

Save capture settings file alongside each capture

When this option is checked, SharpCap will save a text file containing all the camera settings alongside the capture file each time a new capture is started. This file is useful to check the settings used for particular images at a later date. This option is enabled by default.

Start cameras with 'Auto' output format

This option is checked by default. This option will set the Output Format control into Auto mode when a camera is opened. When the Output Format is in Auto mode a compatible video format will be chosen automatically for exposure times of less than 5s and a compatible still file format for exposure times of more than 5s. If possible, the preferred formats will be used (providing they are compatible with the camera settings in use).

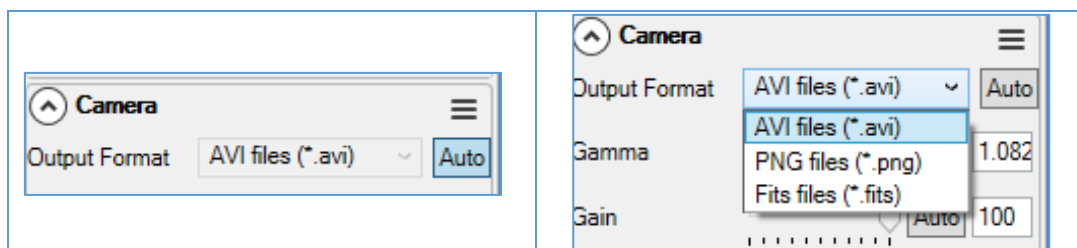
Save 10/12/14 bit images in FITS files without stretching to 16 bit

This option is off by default and should only be enabled for special use cases where post-processing software has issues with pre-stretched images. If in doubt, do not turn this option on.

By default, SharpCap will stretch 10,12 and 14-bit images up to use the full 16-bit range (0 to 65535) when saving those images to file (FITS, TIFF, PNG or SER formats). This is desirable because without applying this stretch the saved images would appear very dark and would all require brightening before the image could be seen properly. However, some image processing software (particularly photometry software) cannot process such pre-stretched images correctly. If you encounter this situation then you can turn this option on to make SharpCap save unstretched FITS files.

Preferred Video Format

AVI is the default video format. This determines the auto selected format in the camera section of the *Camera Control Panel*.

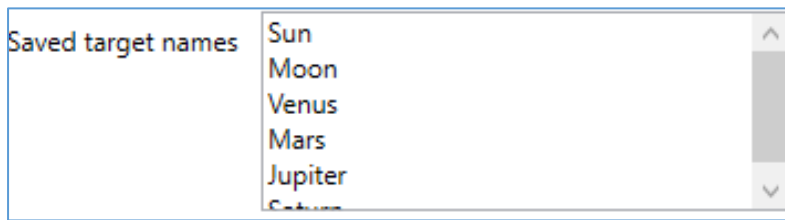


Preferred Still Format

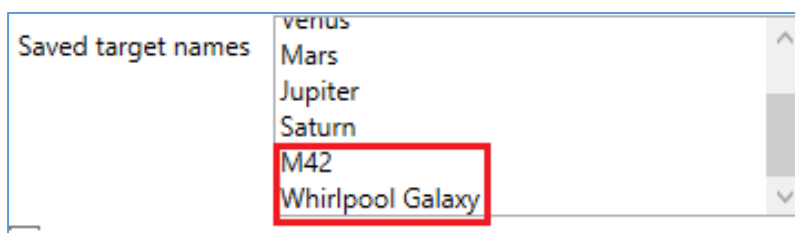
PNG is the default still format. This determines the auto selected format in the camera section of the *Camera Control Panel*.

Saved target names

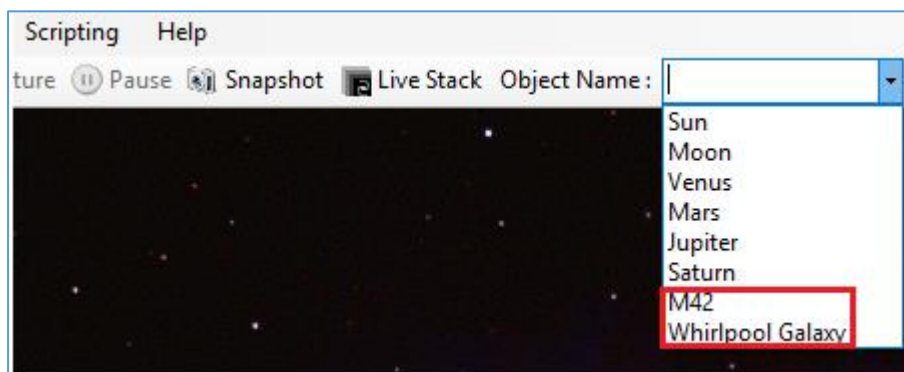
This option is a pre-configured list of object names. Objects can be added to the list or removed from the list and the list re-ordered.



To add a new object, for example *M42* or *Whirlpool Galaxy*, type the name *anywhere* into the *Saved target names* list. Click *Apply* to save the amended list. The amended list will be available the next time SharpCap is started.



The list also appears in the *Tool Bar* near the top of the screen under *Object Name*. Objects added in *Saved target names* will also appear in the *Tool Bar* dropdown list.



Examples:

- *Object Name* undefined (the default), captures saved in folder: **YYYY-MM-DD\Capture**
- *Object Name* defined, captures saved in folder: **YYYY-MM-DD\Object**
- *Moon* selected as *Object Name*, captures saved in folder: **YYYY-MM-DD\Moon**

Misc Settings

Record extra information in the log for troubleshooting

This option is off by default. When turned on, SharpCap will write significantly more information to its log – in some cases this extra information may help track down issues. Turning this option on may result in SharpCap running more slowly or becoming less responsive due to the extra information being logged, so it is not recommended that you turn this option on unless asked to by SharpCap support.

[Log all QHY GPS data to file](#)

SharpCap supports QHY cameras with built in GPS. When the GPS is activated on such cameras, the default behaviour is to store the GPS data (time, date, location) in FITS headers or in the capture settings file. However sometimes it is desirable to keep a more detailed record of the GPS information – enabling this option will create such a log file in CSV format in the root capture directory each time a GPS enabled camera is used.

This option is disabled by default and you should restart SharpCap after changing this option to be sure that it takes effect.

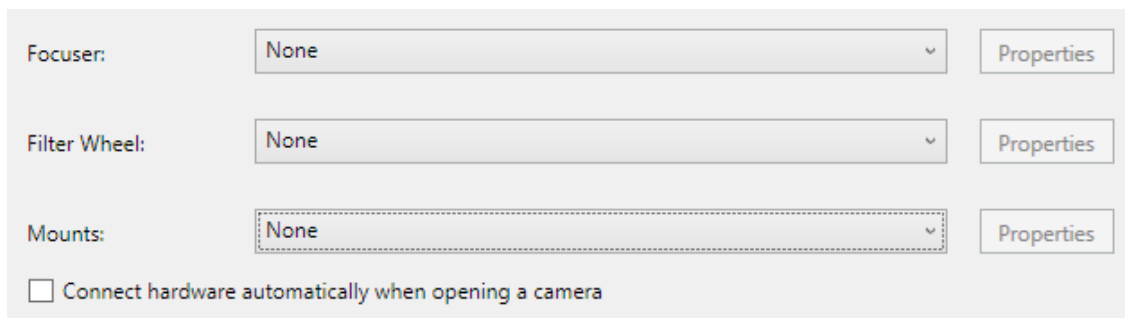
The format of each line of the log file is

<PC Clock Time>, <GPS Status>, <Frame Number>, <Frame Start Time from GPS>, <Frame End Time from GPS>, <Latitude>, <Longitude>, <RawLatitude>, <RawLongitude>

The RawLatitude and RawLongitude are the un-decoded values received from the camera. Contact QHY for the steps necessary to decode these values if you wish to decode them separately.

[Hardware Tab](#)

This is the hardware screen for a default SharpCap installation. The fields Focuser, Filter Wheel and Mounts all show as None.

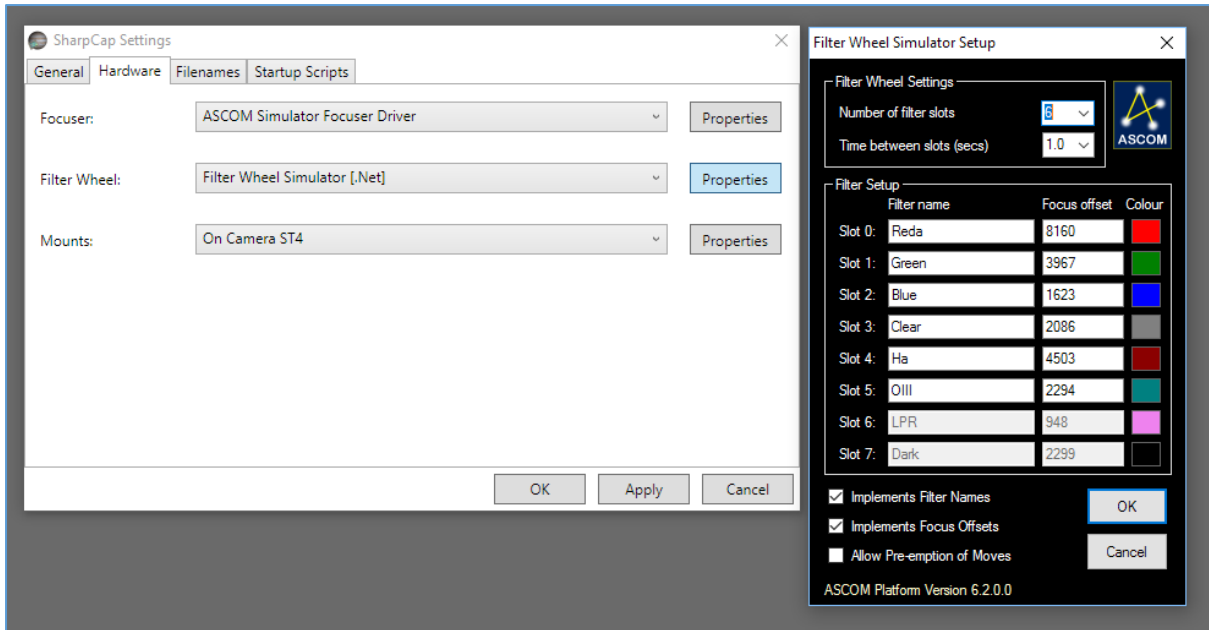


The screenshot shows the hardware configuration interface. It contains three rows of controls:

- Focuser:** A dropdown menu showing 'None' and a 'Properties' button.
- Filter Wheel:** A dropdown menu showing 'None' and a 'Properties' button.
- Mounts:** A dropdown menu showing 'None' and a 'Properties' button.

At the bottom of the interface, there is a checkbox with the label 'Connect hardware automatically when opening a camera', which is currently unchecked.

This is the hardware screen when various [ASCUM](#) compliant hardware has been configured.



- This section will only need to be configured if a computer-controlled focuser, mount or filter wheel is to be used from within SharpCap.
- The ASCOM platform must be installed to be able to select any hardware in this section.
- Ensure ASCOM drivers for the hardware are installed and configured.
- The ASCOM platform comes with a range of simulated hardware drivers that can be used for testing and experimentation.

Note that there is an option to choose whether SharpCap automatically connects to the selected ASCOM hardware each time a camera is opened or not. If this option is checked then SharpCap will attempt to connect to all selected hardware automatically when a camera is opened. While convenient, if the hardware does not respond (perhaps it has not been switched on) then you may see an error. If you prefer you can uncheck this option and then manually connect each item of hardware when needed. This option is checked by default.

Filename Tab

This tab allows fine control over how captured images and videos are named and organised.

Save captured files to

This allows the top-level capture folder to be selected. All captured files will be saved into this folder or subfolders created within this folder.

The capture folder in a default installation will be on the logged-in user's desktop and is called *SharpCap Captures*. Note that SharpCap will check that the top-level capture folder exists and that it is not full each time SharpCap starts. If the top-level capture folder is found to be missing, full or read-only then the folder will be reset to the default of *Desktop\SharpCap Captures*.

The *browse* button allows other capture folders to be selected or created.

Speed Test

This button will carry out a hardware performance test of disk write speed. Running this test will discover if the camera's capture rates are being degraded by disk write speeds.

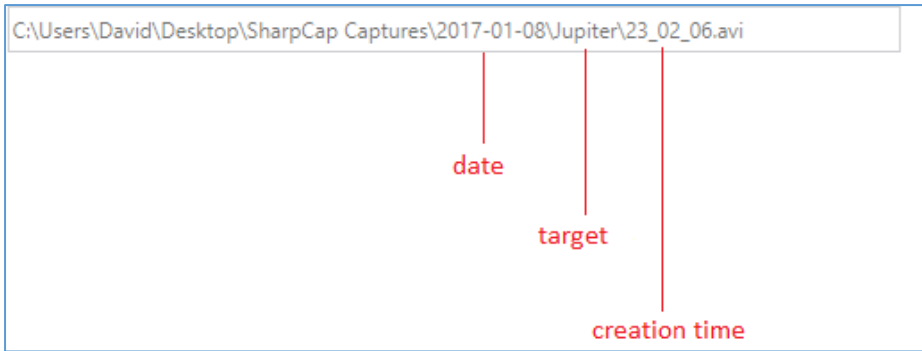
Organise captured files into subfolders

If this is unchecked, all captures will be saved in the top-level capture folder. When checked, captured files will be saved into subfolders according to the rules selected below.

Options and combinations for *folder and file names* are available. Sensible defaults are offered in the initial, default installation. Examples of using the options are given below.

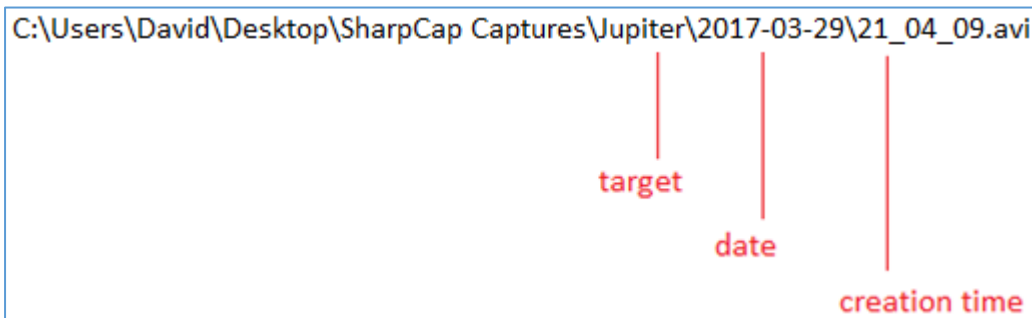
Date and then Target Name

Below is an example of a saved file organised by date then target name. File names are derived from the creation time of the capture and are in the format HH_MM_SS. Note the higher-level directory is named after the date and the inner directory named after the target.



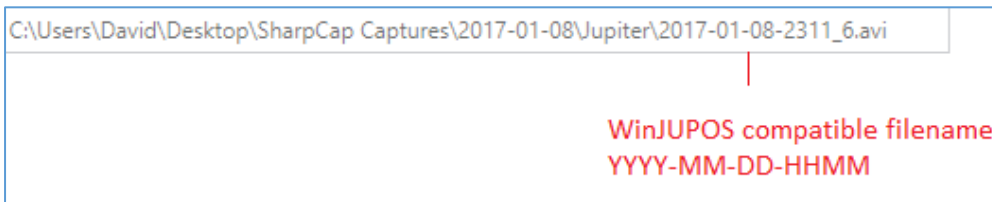
Target Name and then Date

Below is an example of a saved file organised by target name then date as seen in the *Notification Bar* (green = success). Note the higher-level directory is named after the target and the inner directory named after the date.



Create WinJUPOS Compatible File Names

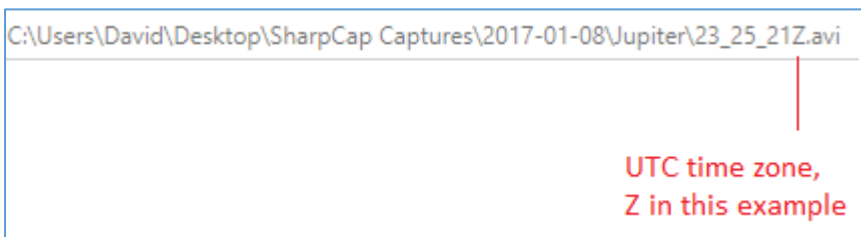
Below is an example of a saved file using a [WinJUPOS](#) compatible name – a combination of date and time. This uses mid-point time in the capture for the WinJUPOS name. Using this option will make loading video files into WinJUPOS for de-rotation easier.



Use UTC times in files and folder names

When this option is checked, all dates and times used for filename generation will be UTC times. When it is unchecked, local times will be used.

Below is an example of a saved file using the [UTC](#) time format.





The letter designates time zone, Z = United Kingdom.


Use sortable date format (YYYY-MM-DD)

When checked, the date format YYYY-MM-DD will be used for all dates, making it easy to sort file and folder names in Windows Explorer. When unchecked, the date formatting rules appropriate to the PC's regional settings will be used. This option is checked by default.

Save capture settings file alongside each capture

When checked, each capture file will, have an associated settings file saved with it.

Name	Date	Type	Size	Length
 22_06_22.avi	08/01/2017 22:06	AVI File	480,116 KB	00:00:03
 22_06_22.CameraSe...	08/01/2017 22:06	Text Document	1 KB	

<p>22_06_22.avi & 22_06_22.CameraSettings.txt</p> <p>The text file to the right contains capture settings from the <i>Camera Control Panel</i> – useful for reference in future observing sessions or analysis during a post-processing session.</p> <p>The name of the text file reflects the time of creation.</p> <p>The captured data (video or still) and the CameraSettings.txt file will have the same timestamp in their filenames.</p>	<p> 22_06_22.CameraSettings.txt - Notepad</p> <p>File Edit Format View Help</p> <pre>[[Test Camera 1 (Deep Sky)] Colour Space=RGB32 Capture Area=1280x960 Exposure=1000 Gain=100 Gamma=1 Output Format=AVI files (*.avi) Add Dark Noise=Off Random Noise=10 Random Seeing=Off Random Offset=Off Random Rotation=Off Image=SampleFiles\m42_dim.png Frame Rate Limit=Maximum Timestamp Frames=Off Subtract Dark=None Display Brightness=1 Display Contrast=1 Display Gamma=1</pre>
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Sequences

This section provides extra options for filenames generated as part of a sequence of files (for instance when capturing frames to PNG or FITS format a file will be created for each captured frame).

Include time in filenames will put the current time (the time at which the frame was captured) in the filename for each captured frame.

Create subfolder for each sequence is enabled by default. When enabled, each new sequence of files will be stored in a separate subfolder. When disabled, many sequences may be saved in the same folder, depending on higher level folder naming choices.

Extras

Append Filter Name will add the name of the current filter to the file name. For this option to be effective, you must have selected a filter wheel in the [Hardware Tab](#) and ensured that it is connected correctly.

Sample Filenames

This section shows sample filenames that would be generated based on your choices for file and folder naming above. The first sample shows how a filename will be generated for a single file capture (where multiple frames are saved into a single video file in AVI or SER format). The second sample shows how filenames will be generated for a sequence of files capture (where each saved frame is stored in a separate image file in a format such as PNG, FITS or TIFF).

If Filename Templates are in use then these samples show the filenames that would be generated by the *Single File* and *Sequence* templates.

Filename Templates

All capture file names in SharpCap are generated through a system of filename templates. When you adjust the various check boxes and options for file naming, SharpCap automatically generates filename templates that represent your choices. These templates are then used later to generate the actual file names. In fact, as you change the various options in for file and folder naming you can see the *Filename Templates* shown in the lower portion of the tab updating to represent your choices.

Sometimes you may find that you cannot obtain the file naming that you wish to achieve using the various file and folder naming options available. In this case you can choose to *Edit Filename Templates Manually* rather than have the templates created automatically based on your file/folder naming selections.

Editing the filename templates manually requires some care, but provides ultimate control over how your saved files are named. Each filename template consists of text containing one or more tags. A tag consists of a tag name surrounded by curly braces ('{' and '}'). Tags are replaced by values when a filename is needed, so the tag '{Date}' is replaced by the current date and '{Time}' is replaced by the current time. The available tags are:

{DateTime}	The date and time that the capture was started
{Date}	The date that the capture was started
{Time}	The time that the capture was started
{TargetName}	The name of the target object entered (or 'Capture' if no name entered)

{Camera}	The name of the camera being used
{Filter}	The name of the currently selected filter
{Extension}	The extension of the file (ie AVI or PNG). There is no need to put '{Extension}' at the end of a template.
{Index}	Sequence captures only. The index of the current frame in the sequence.
{FrameDate}	Sequence captures only. The date on which the current frame was captured
{FrameTime}	Sequence captures only. The time at which the current frame was captured
{BitDepth}	
{StackedFrames}	Live Stacking only. The total number of stacked frames so far
{TotalExposure}	Live Stacking only. The total exposure of stacked frames so far
{AutoSave}	Live Stacking only. Is the current save an autosave?
{Exposure}	Sequence captures only. The exposure of the current frame.
{Gain}	Sequence captures only. The gain of the current frame.
{BlackLevel}	Sequence captures only. The black level (offset/brightness) of the current frame.
{FrameType}	The type of frame (ie light/dark/flat) as selected from the toolbar dropdown.

Some Tags can have an optional format string to change the way they are used in the filename:

Format	Applies To	Meaning	Example
:S	Date, DateTime, FrameDate	Use a sortable format for dates	{DateTime:S}
:Z	Any time or date tag	Use UTC times and dates	{FrameTime:Z}
:J	DateTime, FrameTime	Use WinJupos compatible format	{DateTime:J}

When you make changes to the filename templates you will see typical filenames updated in the *Sample Filenames* area described above, helping you understand how your filename templates would work.

It is important to take care when customizing filename templates as you may accidentally set up templates that have undesirable results (for instance writing over previous capture files). You should always test manual changes to filename templates before embarking on an observing session.

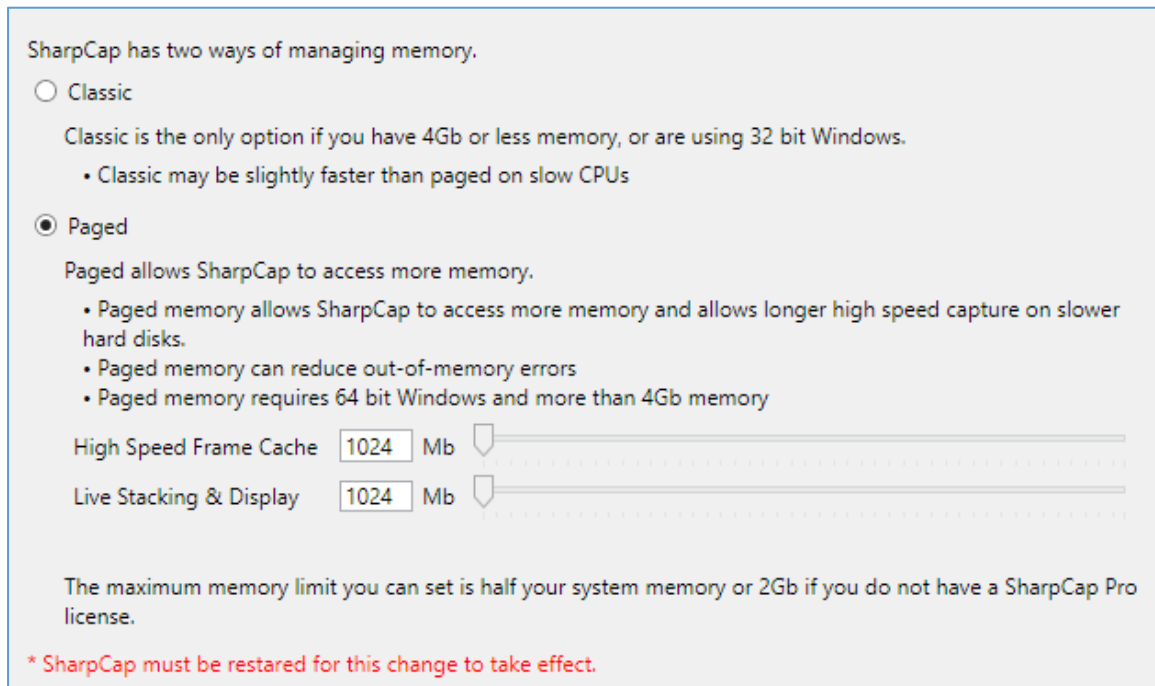
[Note: The toolbar dropdown for Frame Type is only visible if the *Edit Filename Templates Manually* option is selected]

Memory Tab

On 64-bit versions of Microsoft Windows, SharpCap can access additional memory to improve performance and help handle the large amounts of memory needed to perform certain functions like running Live Stacking on very high resolution cameras.

If you have only have 4Gb or less of memory, or you are using a 32-bit version of Windows then your only option here is to remain on the *Classic* option for memory management.

If you have more than 4Gb of memory and are using a 64-bit version of Windows then *Paged* will be the default option for memory management (although you can switch back to *Classic* if you prefer).



Choosing *Paged* memory allows SharpCap to access more memory in total. *Paged* memory is divided into two categories:

- High Speed Frame Cache – this memory is used to store frames captured from the camera before they are written to disk. If you are using a high speed USB3 camera and have a trouble with dropped frames when capturing because your disk drive or SSD cannot keep up then a large high speed frame cache will help.
- Live Stacking and Display – this memory is used to support live stacking operations and also to support the transformation and processing of images prior to display on screen. If you are Live Stacking with a high resolution camera then having a large amount of memory allocated to this category will help avoid out-of-memory errors.

By default, 1Gb of paged memory is allocated to each category, for a total of 2Gb. If you have a SharpCap Pro license then you can increase the amount of memory allocated to each category, up to a total of 50% of your physical memory.

If you change the settings on the Memory tab then you should restart SharpCap to ensure that they take effect correctly.

Plate Solving Tab

Plate Solving is a technique to work out the location in the sky of a particular image by recognizing the pattern of stars it contains against an index of known stars. If this technique is applied to an image just captured from your telescope then the calculated location will be the point in the sky that your telescope is pointing at.

SharpCap can integrate with a number of plate solving tools based on the astrometry.net plate solving engine. This engine is found inside plate solving tools such as [AstroTortilla](#), [Ansvr](#) and [All Sky Plate Solver](#). In order to plate solve images you must first install and configure one of these tools.

Remember that you must also install plate solving index files – please see documentation for the plate solving tool which will guide you on how to install index files and which index files to install.

SharpCap will automatically detect the installation of the three plate solving tools mentioned above if they have been installed into their default locations. However, if you have installed to a custom location or installed a different astrometry.net based tool, you will need to configure the location of the 'solve-field' command which performs the actual plate solving process.

The screenshot shows the 'Plate Solver' configuration window. It includes a section for the 'solve-field' tool path, with 'Detect Automatically' selected and the path 'C:\Users\robin\AppData\Local\Astrometry\bin\solve-field' entered. Below this is an 'Options' section with a 'Star Detection Noise Threshold (--sigma)' set to 50 and a checked checkbox for 'Automatically downsample large images when solving'. The 'Actions' section at the bottom has 'Sync mount only' selected.

Further options to configure and fine tune the plate solving process are available as follows:

The *Star Noise Detection Threshold* can be configured by adjusting the numeric value of the '—sigma' parameter. Higher values will tend to detect fewer stars, lower values will mean that more stars are detected. If too few stars are detected (less than 20-3) then plate solving is more likely to fail. If too many stars are detected (more than 200) then plate solving may take a very long time to complete. You may need to adjust this parameter depending on the camera/telescope combination in use.

When *Automatically downsample large images when solving* is enabled, images that are wider than 2000 pixels will automatically be downsampled (binned) to make them smaller before attempting to plate solve them. This option tends to dramatically improve the speed and reliability of plate solving large images with large numbers of stars visible in them.

Finally, it is possible to choose the action taken when plate solving is launched from the ASCOM mount controls. The default action is to sync the mount to the solved position and then re-centre on the target. You can change this to performing the sync only if you want.

Polar Alignment Tab

SharpCap's Polar Alignment routine can become more accurate and easier to use if SharpCap knows your latitude and longitude. By default, SharpCap estimates your longitude from your computer's time zone settings and estimates your latitude to be 45 degrees North or South. This is sufficient for Polar Alignment to work, but setting your correct latitude will allow SharpCap to correct for atmospheric refraction giving a more accurate result. Setting your correct longitude will ensure that up/down/left/right movement instructions are accurate.

Polar Alignment

Correct for Atmospheric Refraction (requires accurate location)

Observing Location:

Estimate automatically from time zone

Use location from ASCOM mount

Use this location:

Longitude: Latitude:

You can choose to leave the observing location as the default setting (Estimate automatically from time zone) or choose either of the two accurate location options – using the location from your ASCOM mount or specifying a location manually. If you choose an accurate location option then you can enable the option to correct for atmospheric refraction.

The location provided does not need to be perfectly accurate – latitude and longitude correct to the nearest degree are accurate enough.

Finally, you can use the ‘Geolocate’ button to find your current location automatically if you are connected to the internet. This will send your IP address to an internet server which will respond with your approximate location. This approach may not work for all internet providers and will probably not work well if you are connected to the internet via a mobile device.

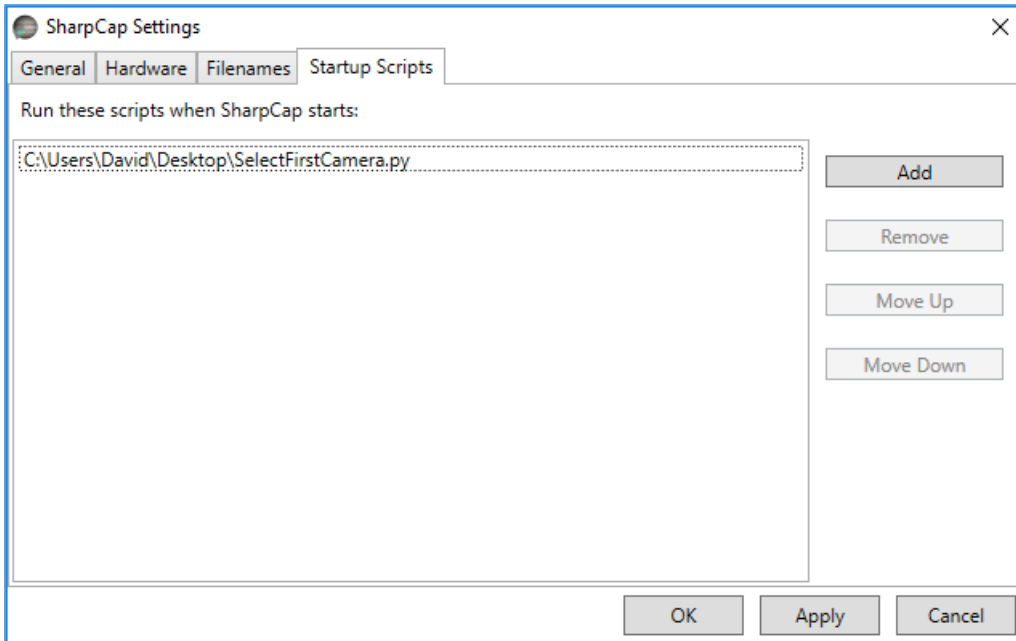
Start-up Scripts Tab

This tab allows a list of Python scripts, to be run at SharpCap start-up, to be configured. Such scripts can be used to add additional features or customizations to SharpCap every time it is started. Use the Add, Remove, Move Up and Move Down buttons to manage the list of start-up scripts.

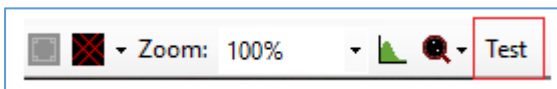
For example, the following Script will create a button on the toolbar that selects the first camera when pressed. The code can be created and saved by following the information in [Scripting](#).

```
def selectFirstCamera():
    SharpCap.SelectedCamera=SharpCap.Cameras[0]
SharpCap.AddCustomButton("Test", None, "Select the first camera", selectFirstCamera)
```

Save the script somewhere (call it *SelectFirstCamera.py* for example), say on the desktop and configure *File > SharpCap Settings > Startup Scripts* accordingly.



Deselect the camera, restart SharpCap and the button *Test* should be added to the right-hand end of the *Tool Bar*, together with the camera having been selected.



This technique is good to use for the start-up script as it allows creation of custom toolbar buttons and have them load every time SharpCap is started.

The Test button can be removed via *File > SharpCap Settings > Startup Scripts*, highlighting the script *SelectFirstCamera.py*, selecting *Remove* and restarting SharpCap.




Capturing and Using Dark Frames

Images taken with digital cameras can suffer from noise caused by the camera sensor and electronics. Dark frames can be used to counteract the effect of this noise on image quality. A dark frame is taken with the camera lens (or telescope) covered to ensure there is no light – this means any signal in the dark frame is due to noise. Once a dark frame has been created, it can be subtracted from each image frame to remove much of the noise. The dark frame must be captured under identical conditions (such as exposure, gain, resolution, temperature) as the image frames for the noise to cancel correctly.

Some cameras have a Peltier thermoelectric cooler attached (a fridge on the back of the camera) to combat noise generated by heat from long exposures.

Camera Noise

Below are examples of camera noise.

	<p>Amp glow in bottom right-hand corner – image produced with a webcam. This amp glow can be removed from an image by using dark frame subtraction.</p>
	<p>Thermal noise – image produced with a colour astro video camera. This thermal noise can be removed from an image by using dark frame subtraction.</p>
	<p>The brightest dots are hot pixels – produced with a monochrome camera and a high gain setting. With a colour camera, the hot pixels would appear as differing colours. These hot pixels can be removed from an image by using dark frame subtraction.</p>





A dark frame is captured to subtract it from later frames, to remove as much of the camera noise as possible.

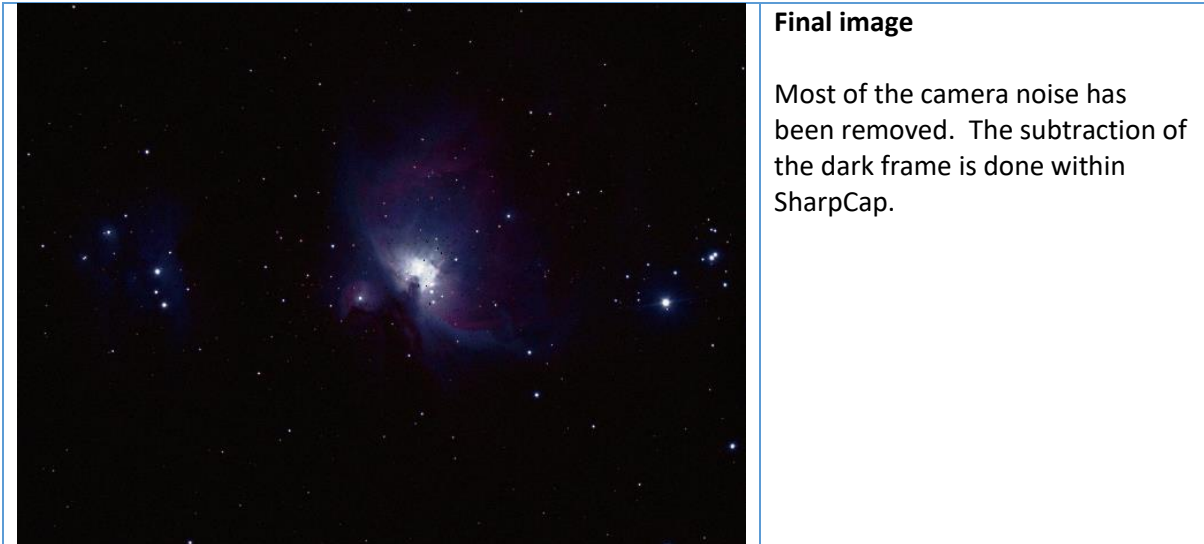
Dark Frames Explained

SharpCap can capture a dark frame – the result being stored in the default capture folder under *darks*.

The dark frames must be captured using the same resolution and colour space as the image about to be captured. The same exposure and gain values should be used for the darks as for the captured images and ideally the temperature of the camera sensor should be the same to ensure the noise in the dark frame is as far as possible the same as the noise in the light frames

SharpCap can subtract dark frames for DirectShow cameras within Live Stack, for other cameras this subtraction is carried out in the Camera Control Panel or with post-processing software. Below is an example of the dark frame subtraction process and how it impacts the final image.

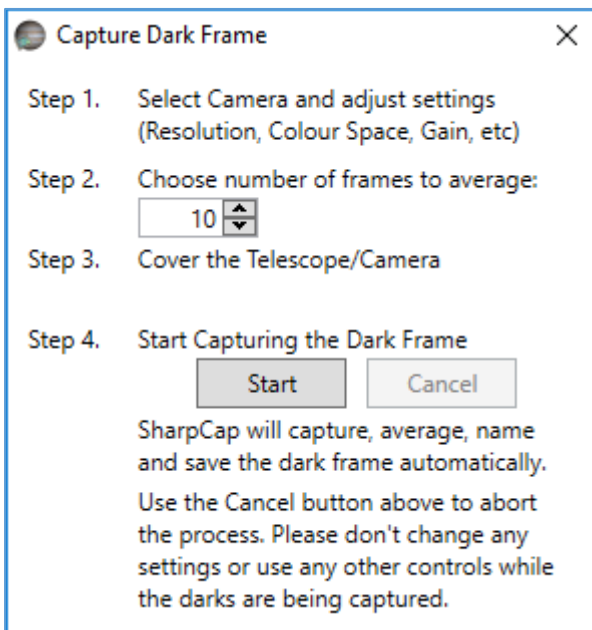
	<p>Captured frame</p> <p>Initial image from the camera, showing noise (magnify document to see the noise more clearly).</p>
	<p>Subtract</p>
	<p>Dark frame</p> <p>Dark frame image generated by SharpCap. The camera must be capped off or the cover put on the telescope to generate this.</p>
	<p>Equals</p>

**Final image**

Most of the camera noise has been removed. The subtraction of the dark frame is done within SharpCap.

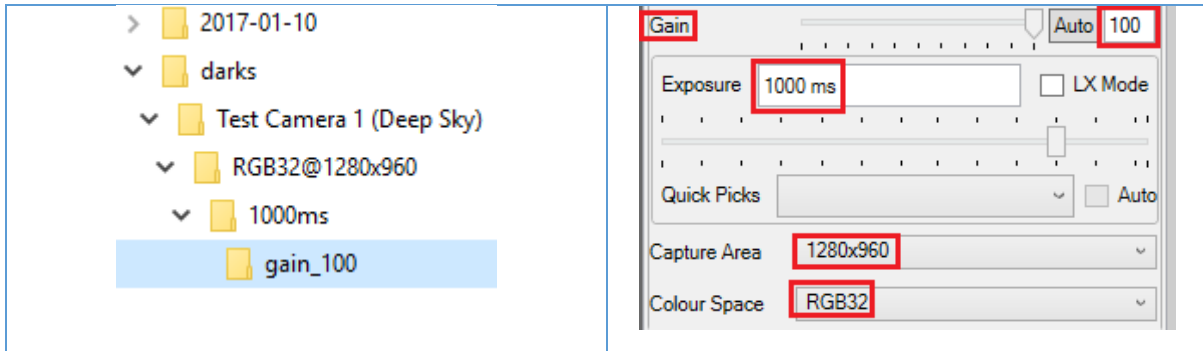
Capture Dark Dialogue

This subsection explains the process for capturing and saving a dark frame. The process is started from the main menu via *Capture > Capture Dark*. The telescope or camera must be covered to exclude any light before commencing the dark frame capture.



While the *Capture Dark Frame* window is open, do not use any SharpCap functions. Additionally, while the darks are being captured (after pressing the *Start* button), do not adjust any camera controls. Once the window closes, the dark frame capture process has completed.

Using the *Test Camera 1 (Deep Sky)* and the settings above (10 frames), a folder structure is created. The folder structure represents the camera settings in the *Camera Control Panel*.



In the folder *gain_100* the following dark frame set is stored:

<code>dark_10_frames_2017-01-10T00_18_07.fits</code>	10/01/2017 00:18	FITS File
------------------------------------------------------	------------------	-----------

This is an example of a dark frame. The white points are hot pixels and notice the green-blue mottled background – to best see this, magnify the document to at least 150%.



The dark frame should be applied against a capture (light) which has the same properties as the dark. Ideally, the dark frames should be captured at the same time as the image is captured to ensure settings and camera temperature are matched.

The [FITS](#) file produced can be opened by suitable software – an example of which is *FITS Liberator*.

Capturing and Using Flat Frames

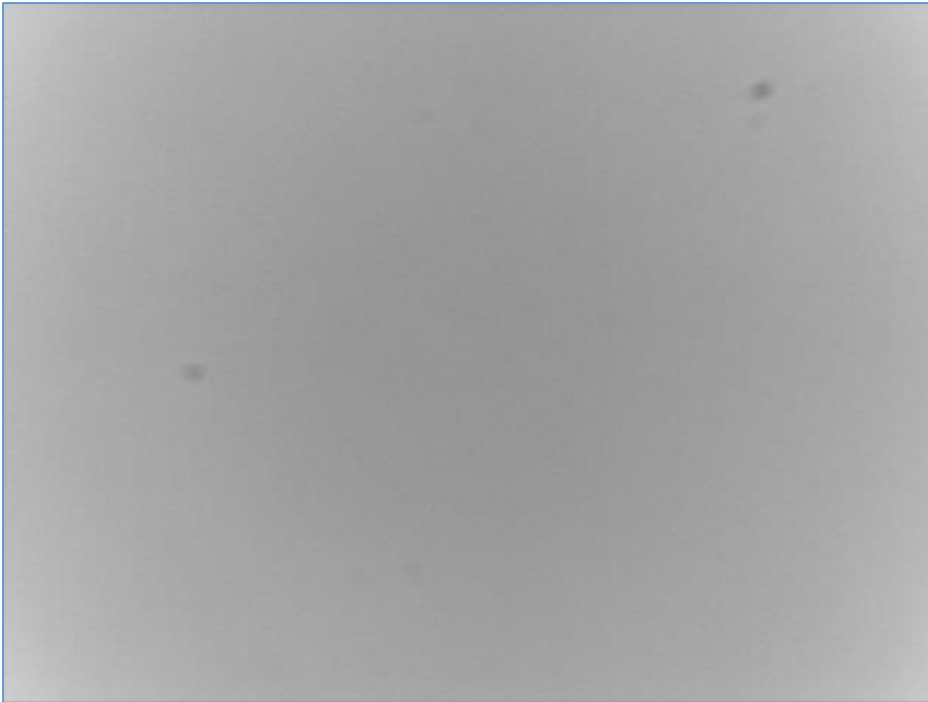
Introduction to Flat Frames

Flat frames are used to correct images for unwanted brightness variations across the frame. This brightness variation might be caused by the optical configuration of a lens or telescope meaning that less light reaches the edges and corners of the frame, making them darker (known as vignetting), or by the presence of dust or dirt specks on the sensor, sensor glass or filters. Dust specks cause dark patches on the image which may be simple spots (as seen in the image below) or small dark donut shapes when using telescopes with a central obstruction.



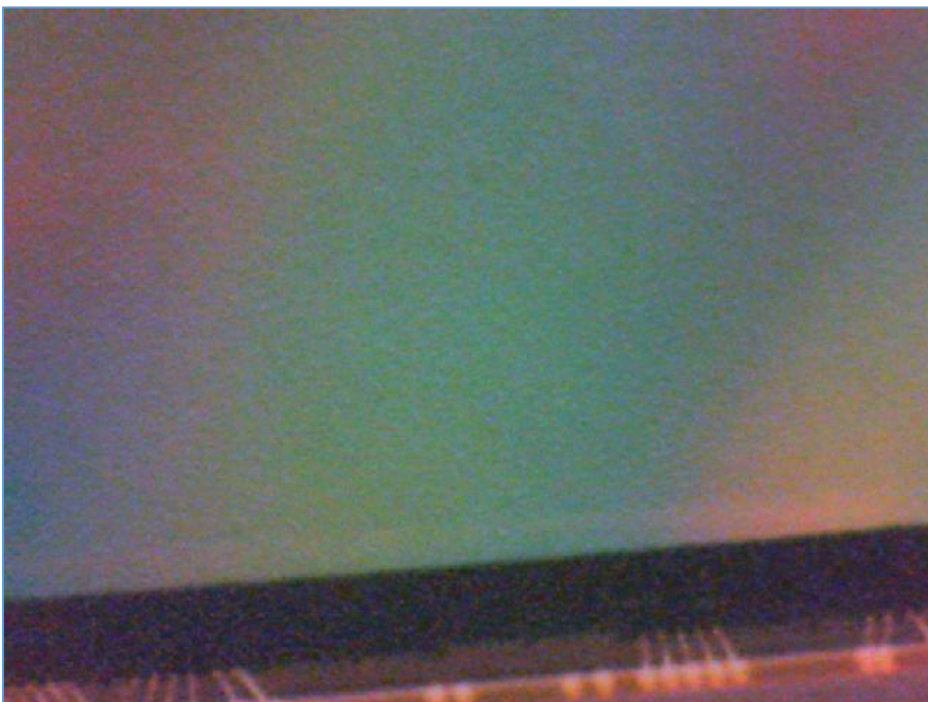
Dust spots and vignetting need to be corrected before images are stacked as the differing alignment of frames during stacking will spread them out in an unknown manner, making them impossible to fully correct after stacking.

In order to correct for these types of defects in the image, a flat frame is captured – that is an image of a perfectly uniformly illuminated surface, meaning that the only variations in brightness of the flat frame are due to the effects of vignetting and/or dust. The image below shows a flat frame taken with the same (rather dirty) camera sensor used above – the dust specks are clearly visible in the flat frame.



It is actually good practice to capture many flat frames and then to average them to produce a 'master flat' which will have less noise than any individual flat frame. The flat frame image shown above is actually a master flat created from 30 individual flat frames and is noticeably less noisy than the light frames shown.

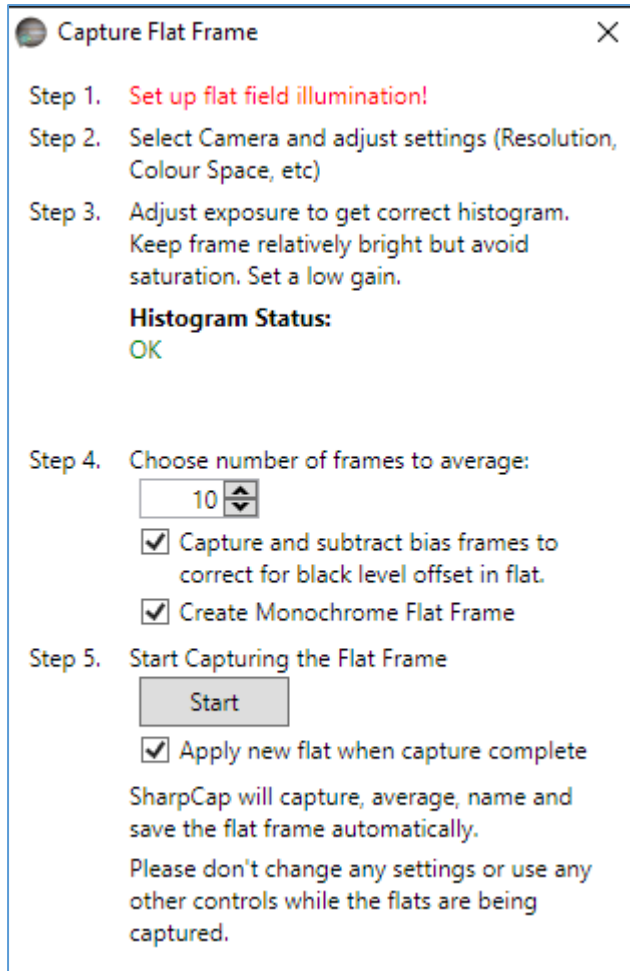
Flat frame correction itself involves brightening the captured image in areas where the flat frame is dimmer than average to correct for the reduction in light reaching the camera sensor in that area. Taking the image and flat frame shown above, the corrected image can be seen below – it is basically impossible to see the effects of the dust spots in the corrected image.



Note: Flat frame correction can also help remove the effects of optical interference patterns from images, such as the 'Newton's Rings' which may cause issues in solar imaging.

Creating Flat Frames

Select *Capture Flat* from the *Capture* menu. This will automatically enable the histogram and show the *Capture Flat Frame* window.



The steps required for creating the flat frame can now be followed

Setup Flat Field Illumination

This involves arranging for the objective or primary mirror of the telescope or camera to be illuminated evenly, ensuring that the only variations in brightness of the captured image will be due to dust specks, vignetting etc.

This is perhaps the trickiest part of using flat frames. Many discussions of different ways to achieve this can be found online, but to give a brief summary, some options are

- Covering the end of the telescope with a white t-shirt and using any light source
- Pointing the telescope at clear blue sky
- Pointing the telescope at uniform, overcast sky
- Using an electroluminescent panel

Note that you should ensure that orientation and arrangement of the imaging system is not changed between capturing flat frames and capturing the actual target images – this means that you should not

- Rotate the camera
- Remove and re-insert the camera
- Add/remove or change filters, reducers, barlows, etc
- Adjust focus more than absolutely necessary (small tweaks are OK)

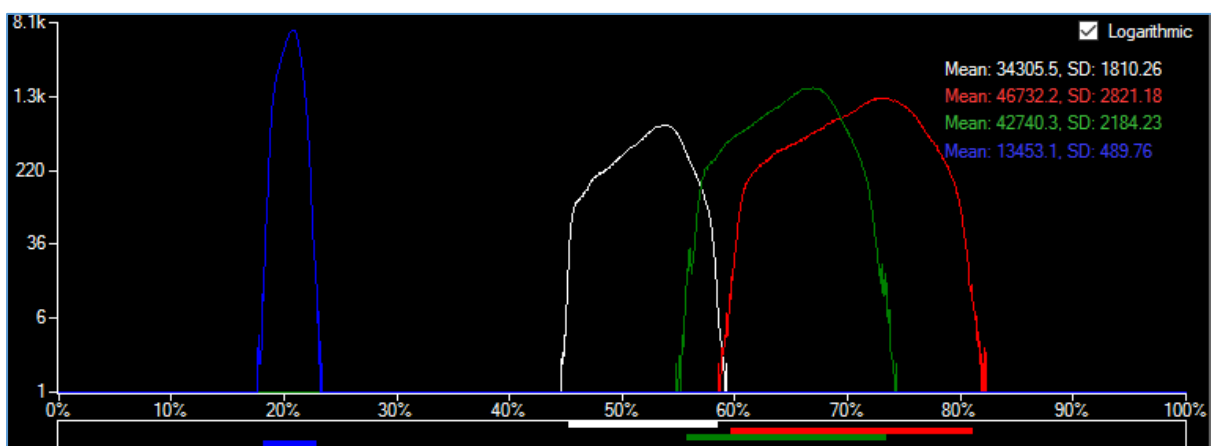
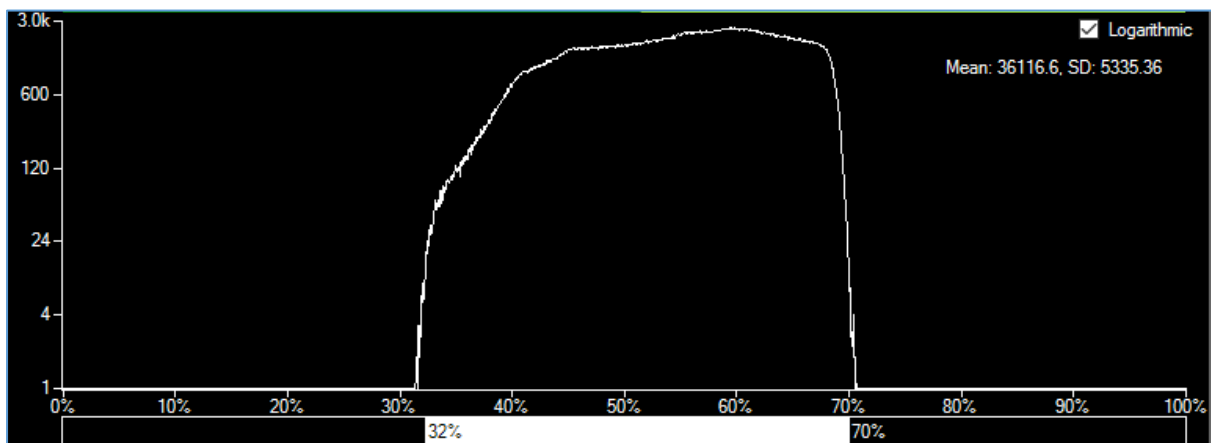
Setup Camera Settings

Ensure that the camera is set to the correct settings at this stage. If you intend to image at 1600x1200, bin 1, RAW12 then set the camera to those settings before capturing flat frames. There is no need to use the same exposure or gain for flat frames (in fact this would not normally work). Since flat frames should have as little noise as possible, it is usually a good idea to set a low gain value.

Adjust Exposure to get correct Histogram Shape

Correct exposure is critical for creating good flat frames. The text under in the *Histogram Status* area of the *Capture Flat Frame* window will provide guidance on how to achieve this.

An ideal flat frame histogram would have a peak at about the 50-60% level and have all the histogram between the 20% and 80% levels. This is shown below for monochrome and colour cameras



Note the use of the *Logarithmic* histogram style in both cases which makes it easier to see the extent of the histogram. Also note that for the colour camera the difference in brightness between the blue and red pixels means that it proved impossible to keep all the histogram for both of those colours in the 20-80% range, but the white channel histogram is well confined to the 45-60% region.

Choose Options

The *Capture Flat Frame* window allows you to customize the flat frame creation procedure by changing the following options

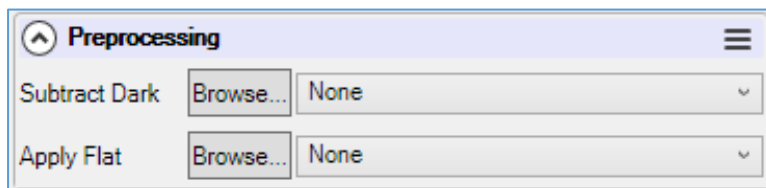
- *Number of Frames to Average* - SharpCap will capture this number of frames and then create a master flat frame by averaging the captured frames. The higher the number chosen here, the less noise will be apparent in the final master flat frame, which ensure help final image quality.
- *Capture and Subtract Bias Frames* – If selected, SharpCap will set the camera exposure to minimum after capturing the flat frames and then capture an equal number of bias frames. The master flat frame will then be made up of the average of all the bias frames subtracted from the average of all the flat frames. Selecting this option should give better flat correction across a wide range of image brightness, but requires that the Black Level/Offset/Brightness controls of the camera are not modified between capturing the flat frame and capturing the target image frames.
- *Create Monochrome Flat Frame* – Selected by default and only relevant for colour cameras, this option will make the created flat frame monochrome even on a colour camera. Monochrome flat frames will only affect the brightness of the image when used. When unselected, a colour flat frame will be created which will have the effect of altering the white-balance of captured images when used.

Start Capturing Flat Frames

Press the *Start* button to begin capturing flat frames (and bias frames if that option is selected). If the *Apply New Flat when capture complete* option is checked then the newly created master flat frame will be automatically selected when it is ready.

Using Flat Frame Correction

Flat frames can be selected by using the *Apply Flat* control in the *Pre-processing* group.



Press the *Browse* button to select a flat frame that has already been saved to disk or use the drop down to select a recently used flat frame. To disable flat frame correction, select *None* from the drop down.

Note: Flat frames must match the resolution of the camera currently in use.

Note: Flat frames created by other software can be used by SharpCap providing they are saved in a compatible format (PNG, FITS, TIFF)

Applying flat frame correction will affect both the image shown on screen and the image data saved to any capture file, so there is no need to apply flat frame correction in later processing if you have used flat frame correction in SharpCap.

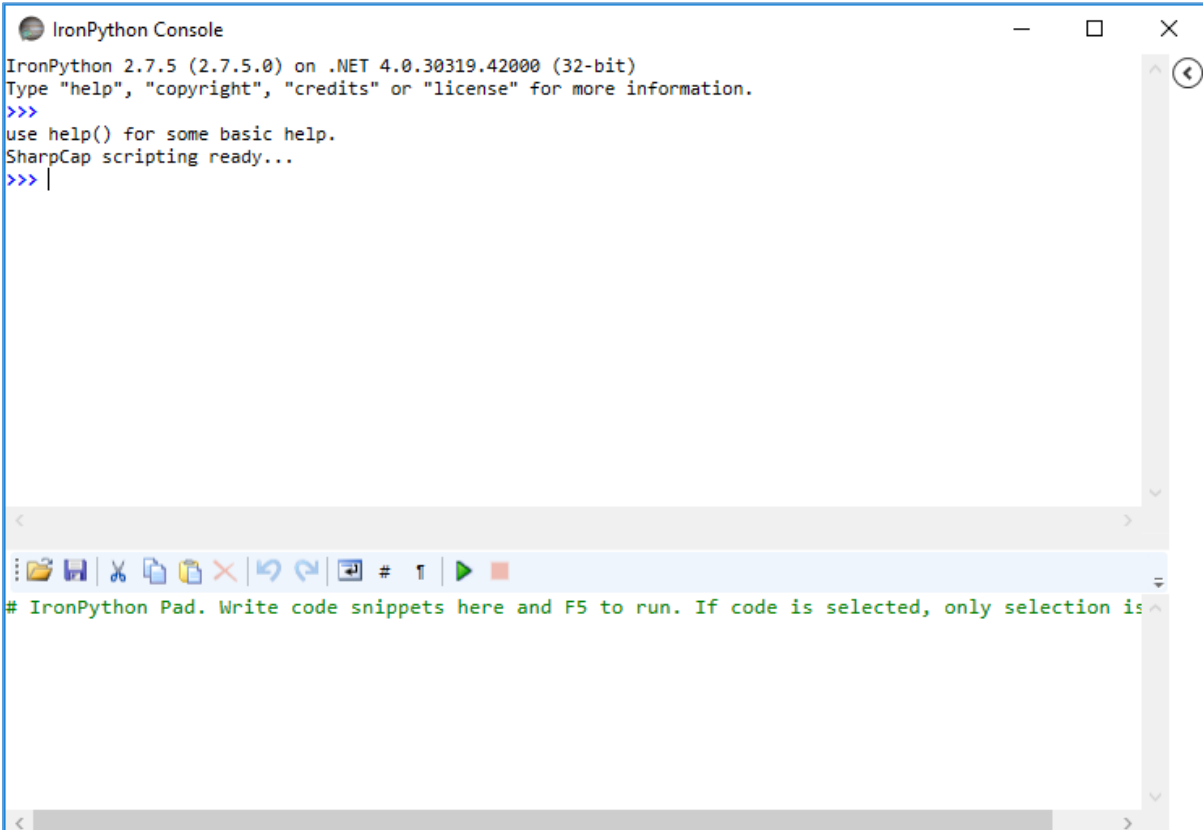
Flat frame correction in SharpCap is possible even with high speed cameras – with the LifeCam Cinema running at 1280x720x30fps, applying a flat frame only increases the CPU usage by 1% – SharpCap uses the special video processing instructions in modern CPUs to apply flat frames incredibly efficiently. With a fast CPU you can apply a flat frame to a USB3 camera running at 1920x1080x150fps!

Scripting

SharpCap has a scripting language built in that allows simple programs to be written that can perform just about any action that can be performed when controlling SharpCap with the keyboard and mouse. The scripting language is based on a language called IronPython which is a Microsoft port of the [Python Programming Language](#) to the .NET framework.

The Scripting Console

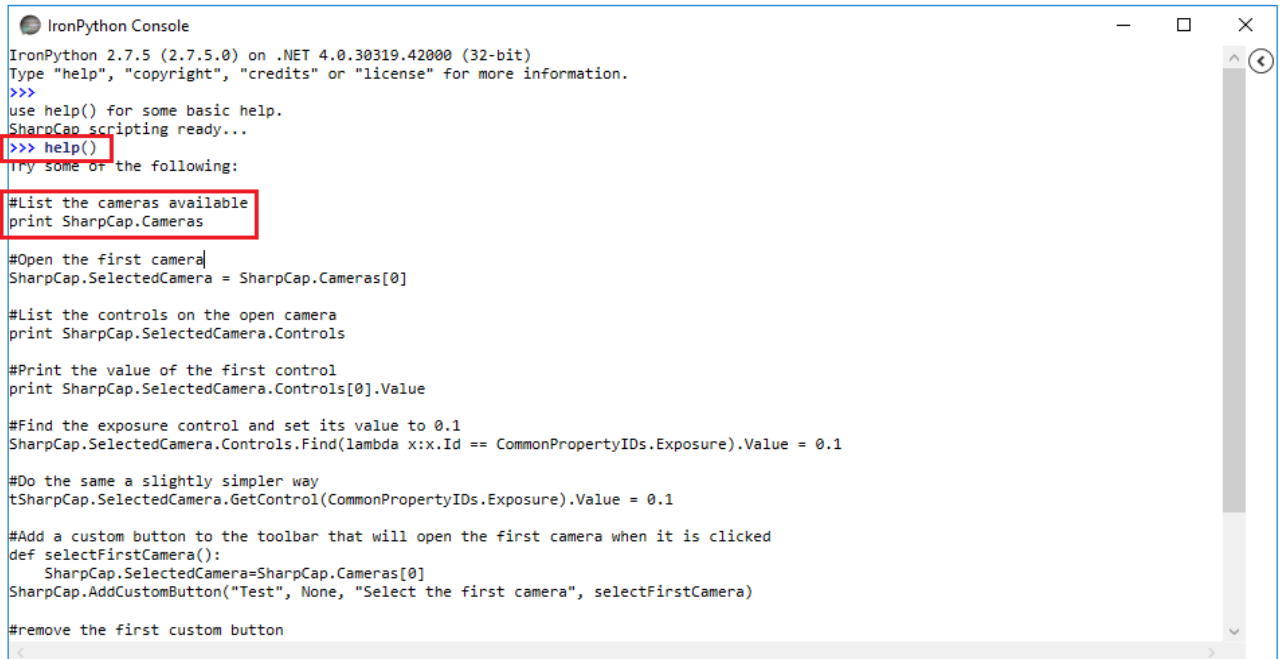
The Scripting console can be shown by selecting *Show Console from the scripting menu*. The scripting console is an Integrated Development Environment (IDE). This allows for the creation, execution and debugging of code using the IronPython programming language and its integration into SharpCap.



```
IronPython Console
IronPython 2.7.5 (2.7.5.0) on .NET 4.0.30319.42000 (32-bit)
Type "help", "copyright", "credits" or "license" for more information.
>>>
use help() for some basic help.
SharpCap scripting ready...
>>> |

# IronPython Pad. Write code snippets here and F5 to run. If code is selected, only selection is
```

Typing `help()` and `<ENTER>` into the IronPython Console window gives the following basic help output:



```

IronPython Console
IronPython 2.7.5 (2.7.5.0) on .NET 4.0.30319.42000 (32-bit)
Type "help", "copyright", "credits" or "license" for more information.
>>>
use help() for some basic help.
SharpCap scripting ready...
>>> help()
Try some of the following:
#List the cameras available
print SharpCap.Cameras

#Open the first camera|
SharpCap.SelectedCamera = SharpCap.Cameras[0]

#List the controls on the open camera
print SharpCap.SelectedCamera.Controls

#Print the value of the first control
print SharpCap.SelectedCamera.Controls[0].Value

#Find the exposure control and set its value to 0.1
SharpCap.SelectedCamera.Controls.Find(lambda x:x.Id == CommonPropertyIDs.Exposure).Value = 0.1

#Do the same a slightly simpler way
SharpCap.SelectedCamera.GetControl(CommonPropertyIDs.Exposure).Value = 0.1

#Add a custom button to the toolbar that will open the first camera when it is clicked
def selectFirstCamera():
    SharpCap.SelectedCamera=SharpCap.Cameras[0]
    SharpCap.AddCustomButton("Test", None, "Select the first camera", selectFirstCamera)

#remove the first custom button

```

Some examples are displayed. One of these is code to list the cameras available to SharpCap.

```
#List the cameras available
print SharpCap.Cameras
```

Lines beginning with `#` are comment lines, meaning they are ignored by the computer.

Code can be typed directly into the console or pasted into the IronPython Pad in the lower part of the console window. If code is typed into the upper part of the window, it will be run when the `<Enter>` key is pressed. Longer sections of code should be typed into the lower editor area where they are not run until the 'Run' button is pressed.

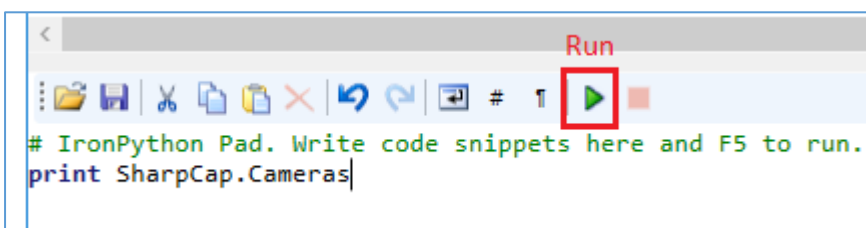
Controlling SharpCap is handled using the SharpCap object which is automatically loaded into each script session. Some simple commands would be...

```
SharpCap.SelectedCamera = None # Close the camera that is currently active
SharpCap.SelectedCamera = SharpCap.Cameras[0] # Open the first camera in the Cameras menu and start previewing it
```

Once a camera is running, adjust its properties like this

```
SharpCap.SelectedCamera.Controls.Exposure.Value = 1000 # Set the exposure to 1000ms (1s)
```

In the IronPython Pad, type in the code `print SharpCap.Cameras` and press the Run button.



The following output appears in the IronPython Console.

```
>>>
List[Camera]([<SharpCap.Models.Camera object at 0x000000000000002B [Test Cameras::Test Camera 1 (Deep Sky)]>, <SharpCap.Models.Camera obj
>>>
```

Click the floppy disk icon and save the file as *cameras.py* for use in the Run Script menu item below.

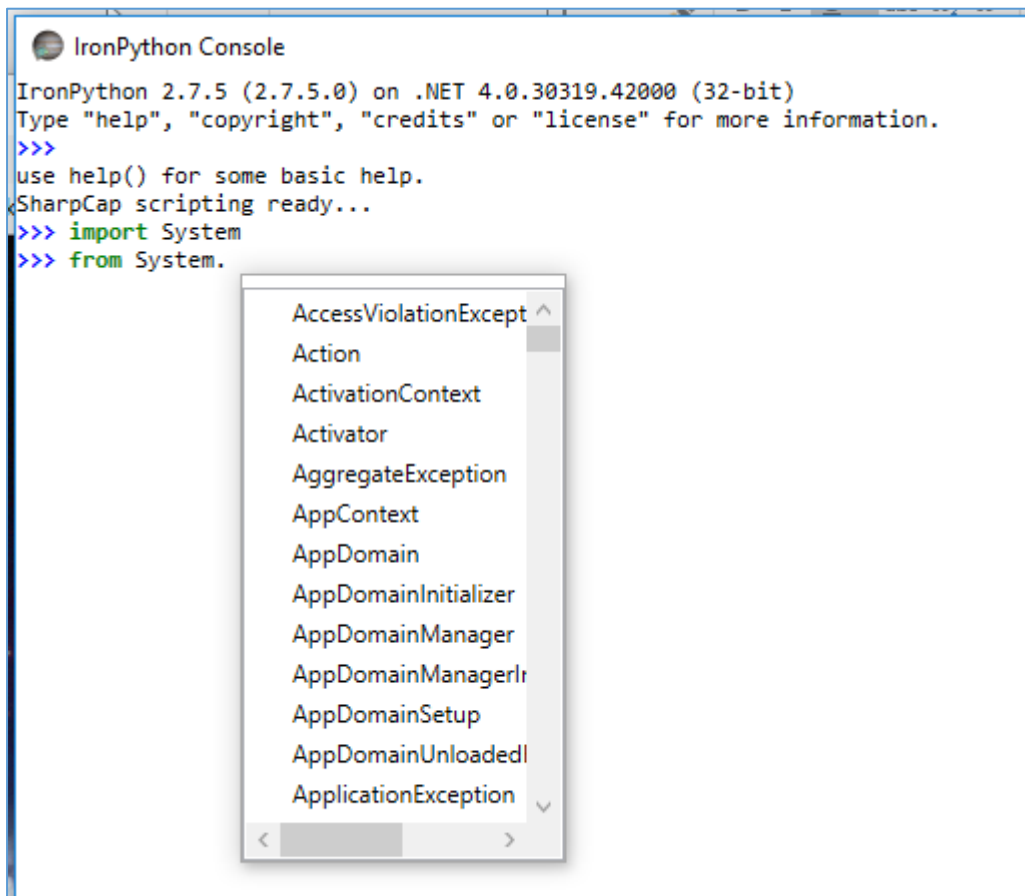
Exploring the API

The editor automatically shows the possible methods and properties for an object upon typing the '.' – this helps explore the available API.

In the *IronPython Console*, type the following two lines (**the case of the text matters and the '.' matters**):

```
import System
from System.
```

As soon as the '.' is typed, a list appears allowing selection. This trick can be applied to many parts of the SharpCap API to allow discovery of the methods available and what parameters they require.

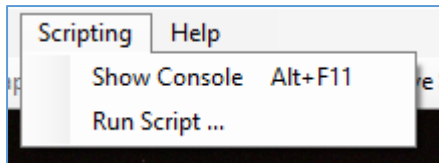


Run a Script

The *Run Script* menu item opens a File Explorer window to allow selection of a previously created Python script.

Scripts (programs) can also be created from within Windows using any text editor. The scripts must be saved with a `.py` extension.

From the *Menu* select *Scripting > Run Script*.



Browse to the file *something.py* and click the *Open button*. The script should execute.

Example

1. From the Menu select *Scripting > Show Console*.
2. Drag the Iron Python Console to one side using the mouse.
3. From the *Menu* select *Scripting > Run Script*.
4. Navigate to the file *cameras.py*, created in the previous section, and select it.
5. The script executes and the result (the available cameras) is shown in the IronPython Console.

```

IronPython Console
IronPython 2.7.5 (2.7.5.0) on .NET 4.0.30319.42000 (32-bit)
Type "help", "copyright", "credits" or "license" for more information.
>>>
use help() for some basic help.
SharpCap scripting ready...
>>>
Running script from C:\Users\David\Desktop\cameras.py
List[Camera][[<SharpCap.Models.Camera object at 0x000000000000002B [DirectShow Cameras::AltairCam]>, <
>>>

```

The above example has no practical use but serves to demonstrate how to use SharpCap functionality.

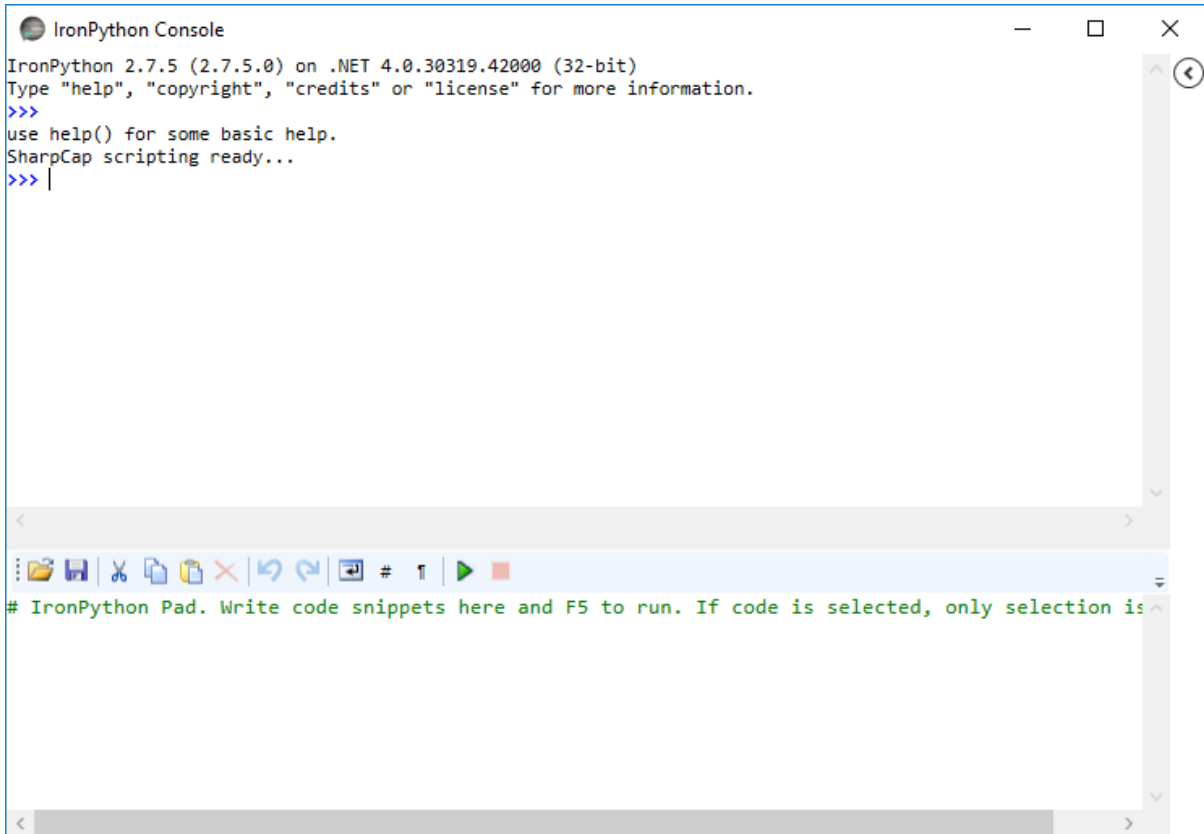
Scripting Tutorial

Create a Script

This section shows how to:

- Create a simple script using the IronPython Console.
- Save the script.
- Run the script from within the console.
- Run the saved script directly from the Run Script menu option.

Upon selecting *Show Console*, an Integrated Development Environment (IDE) is displayed. This allows for the creation, execution and debugging of code using the IronPython programming language.

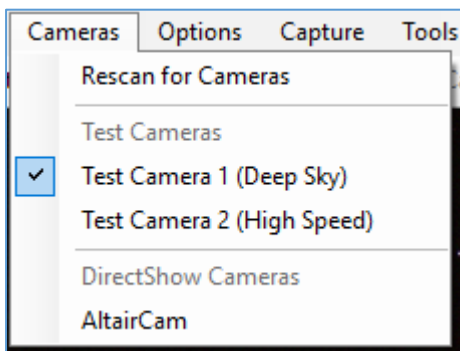


The code below will capture a single PNG image and save it to a file. The destination `d:\capture.png` will need to be changed to somewhere convenient on the computer being used.

```
SharpCap.SelectedCamera.CaptureSingleFrameTo("d:\capture.png")
```

Complete the following steps to test the scripting functionality:

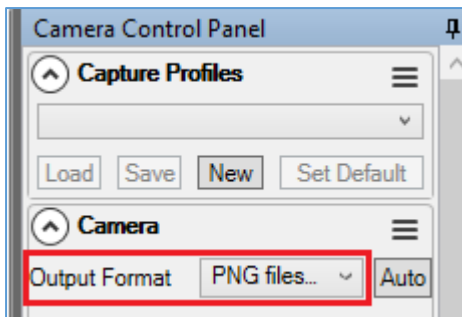
1. Start SharpCap and from the *Menu* select *Cameras > Test Camera 1 (Deep Sky)*.



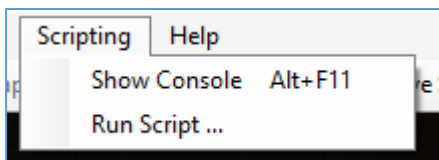
The M42 image should be shown in the Capture Display Area.



2. In the *Camera Control Panel*, change the *Output Format* to be *PNG files...*



3. From the *Menu* select *Scripting > Show Console*.

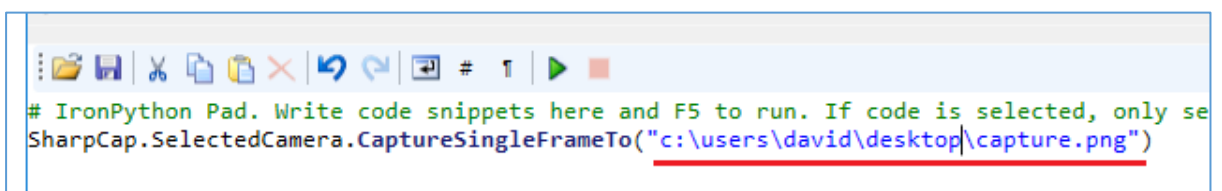


The IronPython Console will open.

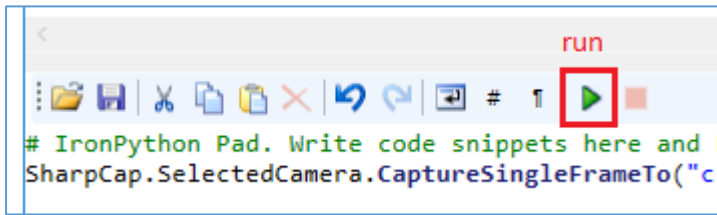
4. Copy the following code:

```
SharpCap.SelectedCamera.CaptureSingleFrameTo("d:\capture.png")
```

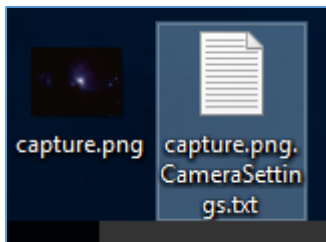
and paste it with Ctrl+V (or type directly) into the IronPython Pad (bottom part of the IronPython Console). Edit the destination (underlined in red) to be something appropriate on the PC in use.



5. Press the Run icon (or F5).



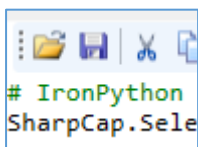
6. Check the destination which, all being well, should now contain 2 new files called *capture.png* and *capture.png.CameraSettings.txt*.



7. Edit the code to change the capture file name to be *capture2.png*.

```
# IronPython Pad. Write code snippets here and F5 to run. If code is selected, only SharpCap.SelectedCamera.CaptureSingleFrameTo("c:\users\ david\desktop\capture2.png")
```

8. Click on the floppy disk icon and a file explorer window opens.



Save the file as *capture2.py* (the **.py** extension is important).

9. Close the IronPython Console.

[Note: Of course, the point of scripting is to automate the use of SharpCap, and all of the above steps could be automated by a more complex script – for example:

```
SharpCap.SelectedCamera = SharpCap.Cameras.Find( lambda x:x.DeviceName == "Test Camera 1 (Deep Sky)")
SharpCap.SelectedCamera.Controls.OutputFormat.Value = "PNG Files (*.png)"
SharpCap.SelectedCamera.CaptureSingleFrameTo("d:\capture.png")
```

SharpCap Scripting Object Model Reference

The major objects available to control the application are:

SharpCap	The main application object, all other objects are accessed via this object.
----------	------------------------------------------------------------------------------

SharpCap.Cameras	A collection of available cameras (as shown in the Cameras menu)
SharpCap.SelectedCamera	The camera that is currently open (or 'None' if no camera open)
SharpCap.SelectedCamera.Controls	The controls available on the currently open camera. Many common controls can be access directly, but others will need a check of each item in the array to find the control needed.
SharpCap.Focusers	A collection of (ASCOM) focusers detected by SharpCap. SharpCap.Focusers.SelectedFocuser can be used to connect to a specific focuser and then access it via the SelectedCamera.Controls collection.
SharpCap.Mounts, SharpCap.Wheels	Collections of ASCOM mounts and filter wheels, work in the same way as Focusers.
SharpCap.Transforms	A collection of frame transforms that can be applied to the preview window by setting the SharpCap.Transforms.SelectedTransform property (buggy at the moment)
SharpCap.MainWindow	The main application window of SharpCap. Take care changing properties or calling methods on this as it may break things.
SharpCap.Reticules	Collection of reticule overlays that may be selected for drawing on the screen (like the transforms, also currently buggy)
SharpCap.Settings	All application settings, alter with care and call 'Save()' after any changes to make them take effect

In general, the most used objects will be [SharpCap.SelectCamera](#) and [SharpCap.SelectCamera.Controls](#).

The Camera Object

The most important methods and properties on the [SelectedCamera](#) object are (informational properties will work on other non-selected cameras):

CanCapture, CanStillCapture	Indicate whether the camera can capture video and still frames, respectively
CanPause	Can the camera pause a video capture without stopping it?
CaptureConfig	Settings controlling the type of capture to be performed, including frame limit, etc
PrepareToCapture()	Must be called to set up a video capture before calling RunCapture()
RunCapture()	Begins a prepared video capture. The capture will run until any limit is reached or StopCapture() is called. The output file(s) will be named according to the selected naming scheme.

CancelCapture()	Cancel a capture that has been prepared (instead of running it using RunCapture).
CaptureSingleFrame()	Capture a single frame snapshot (the output file will be named according to the selected naming scheme)
CaptureSingleFrameTo(string filePath)	Capture a single frame and save it to the specified output file name. The path will need to be a full path and the extension specified should match that selected in <code>SharpCap.SelectedCameras.Controls.OutputFormat.Value</code>
Name	The name of the camera used in the application UI
VideoDeviceId	Internal identifier for the camera (may be empty or rather geeky)
StartPreview() , StopPreview()	Start and Stop previewing frames on the camera respectively
RestartPreview()	Stop then re-start previewing frames on the camera
GetStatus(booleen allStats)	Returns an object describing the status of the camera including frames captured, average frame rate, etc.
IsOpen , IsPreviewing , CanCountFrames , Capturing	Informational properties, as named
CapturedFrameCount	The number of frames processed by the camera (including preview frames) since the last time preview was started or capture was started or stopped.
ApplySelectedTransform()	Reserved, internal use only

The following controls may be available directly on the Controls object for the SelectedCamera:

[Binning](#), [ColourSpace](#), [Exposure](#), [FilterWheel](#), [Focus](#), [Gain](#), [OutputFormat](#), [Resolution](#)

Other controls are likely to be available within the Controls collection and must be searched for by name, for example:

```
cooler = SharpCap.SelectedCamera.Controls.Find(lambda x: x.Name == "Cooler")
```

Note that the available controls vary from camera to camera, and only [ColourSpace](#), [Exposure](#), [Resolution](#) and [OutputFormat](#) are always available.

The Control Object

The following properties are available on each [Control](#):

Available	True if the control is actually available to read or write values.
---------------------------	--------------------------------------------------------------------

ReadOnly	True if the control can only be read from (for instance a sensor temperature readout)												
AutoAvailable	True if the control can be set into Auto mode												
Auto	Switch the control between Auto and Manual mode												
Name	The name of the control as displayed in the UI												
Id	An enumeration of common property types, currently including: Other, Exposure, FrameRate, Pan, Tilt, Resolution, ColourSpace, OutputFormat, Focus, FilterWheel, FrameFilter, Binning, Gain												
Minimum, Maximum	Retrieve the minimum and maximum values of numeric controls												
Step	Integer controls may have a step value defined - they can only be changed in multiples of this value. This is very rarely encountered.												
Value	The value of the control, which can be retrieved and (if not ReadOnly) changed.												
Type	<p>The type of value that the control has.</p> <table border="1"> <tr> <td>Integer</td> <td>Numeric, whole number values</td> </tr> <tr> <td>Double</td> <td>Numeric, whole or decimal values</td> </tr> <tr> <td>Boolean</td> <td>On/Off value (checkbox)</td> </tr> <tr> <td>Command</td> <td>A single action, launched by a button in the UI</td> </tr> <tr> <td>MultipleChoice</td> <td>A list of options, shown as a drop down control in the UI</td> </tr> <tr> <td>Custom</td> <td>Any other type of control.</td> </tr> </table>	Integer	Numeric, whole number values	Double	Numeric, whole or decimal values	Boolean	On/Off value (checkbox)	Command	A single action, launched by a button in the UI	MultipleChoice	A list of options, shown as a drop down control in the UI	Custom	Any other type of control.
Integer	Numeric, whole number values												
Double	Numeric, whole or decimal values												
Boolean	On/Off value (checkbox)												
Command	A single action, launched by a button in the UI												
MultipleChoice	A list of options, shown as a drop down control in the UI												
Custom	Any other type of control.												
AvailableValues	In the case of a MultipleChoice control, a list of the choices available.												

Scripting Samples

Examples of scripting tasks are shown below.

Periodic Capture and Timestamp Image

The code below will capture a single PNG image approximately every 15 seconds and write a timestamp into the image itself before saving it. It would be simple to modify the code to save each timestamped image under a different filename or to remove the timestamping step.

The code relies on a camera already being selected and previewing and that the camera can output to PNG files (i.e. will not work if the camera is in a 12/16-bit mode).

```
import time
clr.AddReference("System.Drawing")
```

```

import System.Drawing

SharpCap.SelectedCamera.Controls.OutputFormat.Value = 'PNG files (*.png)'
if (SharpCap.SelectedCamera.Controls.Exposure.AutoAvailable):
    SharpCap.SelectedCamera.Controls.Exposure.Automatic = True

while True:
    SharpCap.SelectedCamera.CaptureSingleFrameTo("d:\capture.png")
    time.sleep(1)
    bm = System.Drawing.Bitmap("d:\capture.png")
    g = System.Drawing.Graphics.FromImage(bm)
    f = System.Drawing.Font("Arial", 12)
    g.DrawString(System.DateTime.Now.ToString(), f, System.Drawing.Brushes.Red, System.Drawing.Point(0,0))
    g.Dispose()
    f.Dispose()
    bm.Save("d:\\timestamped.png")
    bm.Dispose()
# do more with png file here
time.sleep(15)

```

Controlling the Selection Rectangle

Before starting this example, select either a suitable *Focus Score* method or the *Image Histogram* to enable the *Selection Area* generated by the program to be shown. The *Selection Area* needs to be turned off via its *Tool Bar* icon

From *Scripting > Show Console*, type the following code into the *IronPython Console*. Do not copy and paste as this negates the purpose of the exercise. At certain places, when '.' is typed a dropdown will appear showing possible methods and properties. Select the appropriate text.

```

import clr
clr.AddReference("System.Drawing")
from System.Drawing import Rectangle
SharpCap.Transforms.AreaSelection = True # turn on selection area
SharpCap.Transforms.SelectionRect = Rectangle(100,200,300,400) # adjust selection rectangle, parameters are
(x, y, width, height)

```

The typed in code should look like this. When run, nothing will appear to happen except an additional >>> will appear in the console. No errors messages is a good sign.

```

import clr
clr.AddReference("System.Drawing")
from System.Drawing import Rectangle
SharpCap.Transforms.AreaSelection = True # turn on selection area
SharpCap.Transforms.SelectionRect = Rectangle(100,200,300,400) # adjust selection rectangle, parameters are (x, y, width, height)

```

This enables use of the .NET type `System.Drawing.Rectangle` which is required to specify the selection area - the first 3 lines, which allow access to the .NET type, are the important ones here as they can be used for other .NET types too.

Example Task to Script

Consider the following non-trivial task.

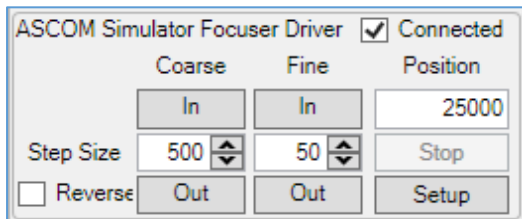
- Control a USB filter wheel containing LRGB filters
- Capture 10x5 minute exposures using L filter
- Switch to R filter

- Capture 10x5 minute exposures using R filter
- Switch to G filter
- Capture 10x5 minute exposures using G filter
- Switch to B filter
- Capture 10x5 minute exposures using B filter

Total capture time = 3h 20m but no intervention is needed if the capture is managed by a script.

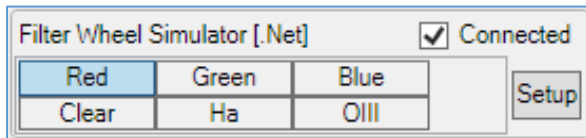
ASCOM Hardware Control

Focuser Control



The focuser can be controlled by using the *In* and *Out* buttons. Between each pair of buttons (coarse and fine) are the step size adjustment controls which allow the amount of movement per button press to be adjusted. The current position of the focuser is shown and it is also possible to directly type a new position value into this control (after typing a new value press <Tab> or <Enter> to move the focuser to the typed value). The *Reverse* checkbox swaps the meaning of the *In* and *Out* buttons - handy if the focuser moves in when pressing *Out*.

Filter Wheel Control

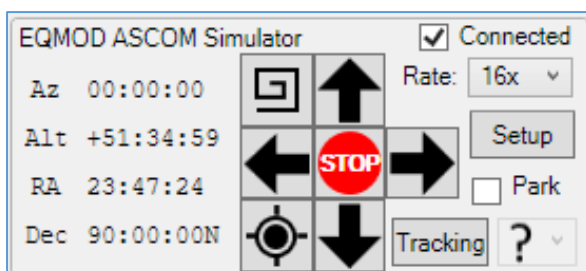


ASCOM *Filter Wheels* are simple to control in SharpCap – the buttons show a list of filters available and all that is necessary is to select the desired filter by pressing the appropriate button. It is best to avoid trying to change the filter again while the wheel is still moving. The names of the filters shown by SharpCap can usually be configured in the ASCOM driver configuration dialog for the filter wheel.

As with all ASCOM hardware in SharpCap it is possible to temporarily disconnect from the device by unchecking the *Connected* checkbox and the ASCOM driver configuration can be shown by pressing the *Setup* button.

SharpCap also contains the option to configure and show controls for a manually operated filter wheel. When using a manually operated wheel you can select the currently chosen filter in SharpCap, allowing the filter name to be used in custom filename templates.

Mount Control



SharpCap can connect to and control most ASCOM mounts (unfortunately, if the mount does not support the ASCOM *MoveAxis* functionality SharpCap will not be able to use it).

On the left-hand side of the control, the current *Azimuth*, *Altitude*, *RA* and *Dec* are shown – these are updated from the mount on a regular basis, so should update if the mount is moved using another application such as a planetarium program.

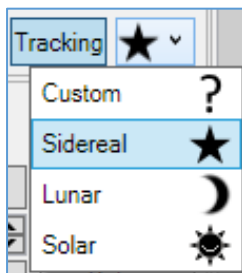
The centre section of the control is home to the movement buttons which allow the mount to be moved from within SharpCap. The *up*, *down*, *left* and *right* buttons will move the mount in the given direction while they are pressed. If the mount is an equatorial mount, *Up/Down* will move the mount in *Declination* and *Left/Right* will move the mount in *RA*. The mount will be moved at a speed that can be selected using the *Rate* drop down in the top-right of the control. This lists the movement rates that the mount makes available (this drop down shows slower movement rates in multiples of Sidereal rate – i.e. 1x, 2x, 8x – and faster rates in degrees per second). The *STOP* button between the direction buttons will stop any current movement of the mount but is not normally needed as movement is stopped when the direction buttons are released.

The *Spiral Search* button (top left of the button group) moves the mount in a growing square spiral around the starting point while it is held down. This is useful when trying to locate an object such as a planet that may be just out of frame. Note that like the movement buttons, the speed of movement of the *Spiral Search* is governed by the *Rate* dropdown. If the *Spiral Search* button is released the spiral movement will stop. Pressing it again will begin a new spiral around the current location – it will not resume the previous spiral pattern.

The *Plate Solve* button (bottom left of the button group) will perform a plate solve on the current image, re-synchronize the mount's location to the plate solve result and will GOTO the original target co-ordinates. This has the effect of putting the target into the centre of the field of view even if it is off-centre or out of view entirely. This button only becomes enabled if a compatible plate solver is detected or configured. See [Plate Solving Tab](#) for more details. Note that when plate solving is launched from this button, it will restrict its search to sky locations within 15 degrees of the current location as reported by your ASCOM mount. This dramatically improves the speed of plate solving, but does mean that if the current mount location is highly inaccurate, plate solving will fail.

The *Park* checkbox can be used to park or un-park your mount.

Finally, the *Tracking* button (bottom right) can be used to turn sidereal rate tracking of the mount on or off. If tracking is turned off, stars and other objects will appear to drift across the field of view. To the right of the *Tracking* button is a drop down that shows (and allows you to change) the current tracking rate. You can select sidereal, solar or lunar tracking rates. The '?' icon shows when the selected tracking rate is a custom rate.



As with all ASCOM hardware in SharpCap it is possible to temporarily disconnect from the device by unchecking the *Connected* checkbox and the ASCOM driver configuration can be shown by pressing the *Setup* button.

Bugs & Crashes

Before reporting a bug or other issue make sure the latest version of SharpCap is being used as the bug could have been fixed already. Also, search the forums for other users reporting the same issue as there may already be a workaround available.

Forums for reporting Bugs and Crashes and other discussions of SharpCap can be found at <http://forums.sharpcap.co.uk>.

How to Report a Bug

If discovering a bug in SharpCap that doesn't involve SharpCap crashing, post the following details in a new thread in the forum:

- A thread subject briefly describing the problem.
- A description of what was trying to be done.
- A list of the steps needed to make the bug happen.
- The contents of the SharpCap log collected after the problem has occurred.

Since the log text can be rather long, post it as an attachment rather than including it in the body of the post.

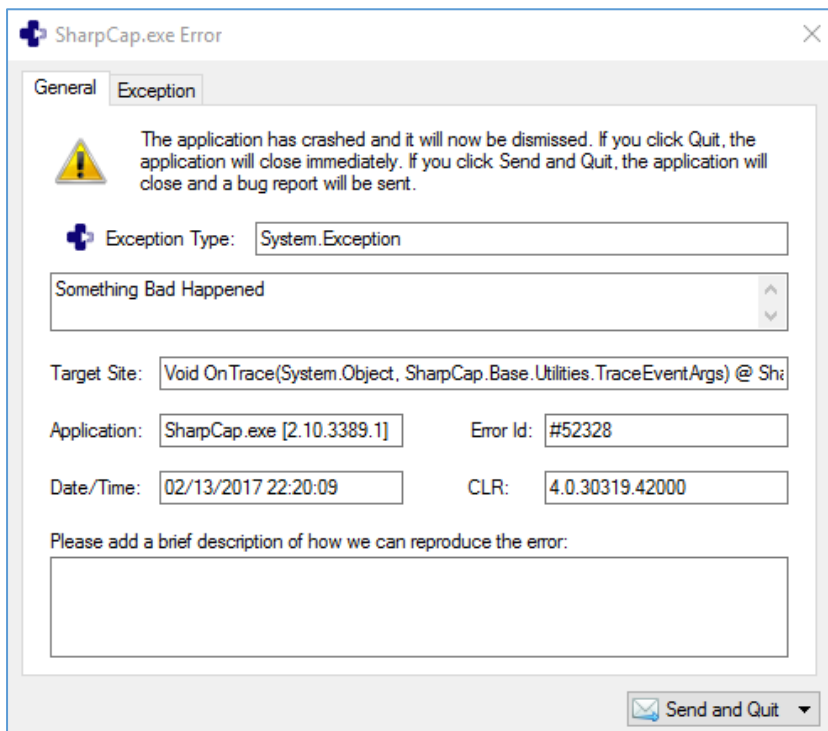
While SharpCap is running, the log text can be obtained via *File > Help > Show Log*. Logs are also saved in the folder `%LOCALAPPDATA%\SharpCap\logs`.

Alternatively, access the folder `C:\Users\<user name>\AppData\Local\SharpCap\logs` to find the log file after SharpCap has been closed.

How to Report a Crash

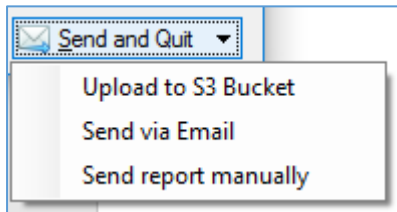
Submitting a Crash Report

If SharpCap crashes, it is most likely a message will be displayed requesting a bug report to be submitted.



If connected to the internet, press the *Send and Quit* button and the bug report will automatically be uploaded to the SharpCap bug archive. Optionally, add a description of what was taking place when the crash happened.

If not connected to the internet, press the down arrow next to *Send and Quit* which shows extra options including sending the bug report by email and saving it as a file which can be shared on the forums.



- *Upload to S3 Bucket* – the default action when pressing Send and Quit, report is uploaded to the internet.
- *Send via Email* – when connected to internet.
- *Send report manually* – the generated report will be saved as a zip file ready for manual submission to the forums.

The bug report contains a description of the problem causing SharpCap to crash and the contents of the SharpCap log, both of which help track down the problem causing the crash.

No Crash Report?

On rare occasions SharpCap may crash without showing the error report message. If this happens, tracking down the bug requires SharpCap to be re-run from a command prompt with a */dump* option added to the command line like this:

```
"c:\Program Files (x86)\SharpCap 2.9\SharpCap.exe" /dump
```

Once SharpCap has been run this way, try to make the crash happen again. If the crash happens, a file called *SharpCap.dmp* will be created on the desktop. Post on the forums including a link to the *SharpCap.dmp* file and a description of what was being done when the crash occurred. Dump files can be large, so provide a link to the upload – Dropbox, Google Drive and Microsoft's One Drive are useful technologies here, there may be others.

Trouble Shooting

This section is inspired by problems encountered.

Hardware

A common source of hardware problems relating to image capture can be attributed to a lack of understanding of the USB standards. See <https://en.wikipedia.org/wiki/USB> for further information and maximum cable lengths.

Some definitions:

- The USB 2.0 standard defines a High Speed (HS) of 480 Mbits/s.
- The USB 3.0 standard defines a SuperSpeed (SS) of 5 Gbits/s, although because of timing overheads, a data throughput of 3.2 Gbits/s is deemed reasonable.
- A passive USB extension cable is a simple cable without electronics.
- An active USB extension cable contains electronics to regenerate the USB signal. It is basically a hub and cable combined.
- An unpowered USB hub draws its power from the computer's USB port.
- A powered USB hub has its own external power supply.
- Black USB ports on a PC/laptop indicate a USB2 connection is available.
- Blue USB ports on a PC/laptop indicate a USB3 connection is available.

Things to consider:

- A camera will draw its power from the computer's USB port.
- A camera with a cooling fan will draw even more power from the computer's USB port.
- Lack of power can cause a USB3 device to fall back to USB2 speeds.
- A low quality (or damaged) USB cable can cause problems.
- A copper clad aluminium (CCA) USB cable can cause problems.
- Not all USB ports are equal; think here of front USB ports on micro/mini PCs or laptops running off battery. In case of unexplained difficulty, try different ports on the same computer.
- If an internal PCI USB card has a power connector, ensure an internal power lead is connected.

[USBTreeView](#) is a useful utility for discovering the speed at which a USB connected device is performing. The utility will show speeds as HS (High Speed = USB2) or SS (SuperSpeed = USB3).

For trouble free running, consider the following:

- Use the camera manufacturer's supplied USB cable. If problems arise always test with at least two different short USB cables to rule out USB cable/hub issues.
- If extra length is required, good-quality passive extension cables are usually sufficient up to 3.5m total length for USB3 speeds and 4.5m for USB2 speeds.
- Beyond these lengths, the use of hubs or active cables are required.
- If running two or more devices from a USB hub consider a powered hub rather than an unpowered hub.

Software

- Ensure correct hardware drivers are installed and are up-to-date. Not having the correct drivers for the installed graphics card installed can lead to the card running in low performance 'compatibility mode' and to slow frame rates or crashes.
- Windows 'N' variants (which do not have media features installed by default) may require the 'Windows Media Feature Pack' to be installed before SharpCap will work correctly for certain cameras.

Imaging

Image Too Bright

Problem – some moons of Jupiter are in my image but the planet has no features.

Solution – the exposure setting on the camera is too high. Reduce the value of *Exposure* in the *Camera Control Panel* until the features of the planet can be seen (the moons might not be visible).

Capture a video of say 1,000 frames. Stack this, for example with AutoStakkert, so hopefully the moons re-appear on the stacked final image. This is also an argument against cropping too early in the process as the moons, although not visible in the video, will appear in the processed image.



Jumpy AVI Will Not Stack

Follow these instructions to attempt to rescue a jumpy video created during windy conditions.

The problem – a jumpy surface video (lunar/solar) will not stack.

The solution – have a look at the [image stabilisation process](#) at the PIPP website.

Grainy Image

The problem – a very grainy image.

The solution – turn down the *Gain* in the *Camera Control Panel*.



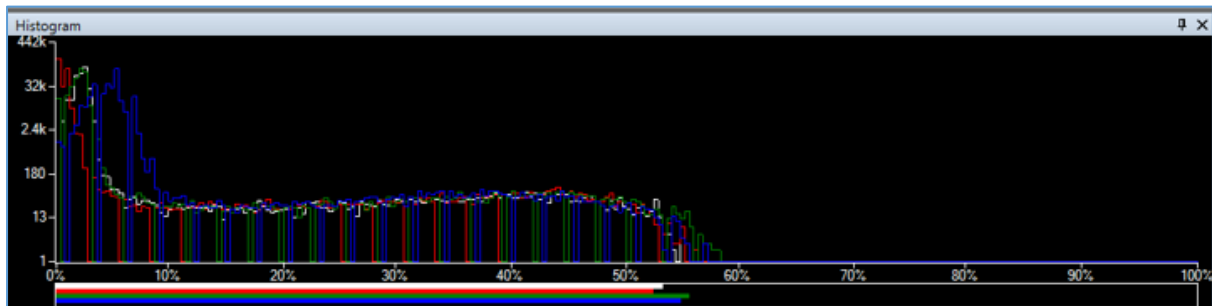
This image is of M92, the Owl Nebula, a faint planetary nebula in the constellation of Ursa Major. Lower the gain and use Live Stack to build a better image.

Histogram with Gaps

Below is an example of a histogram with gaps.

The problem – vertical bars and gaps appear in the histogram.

The solution – it is best to set the white balance back to default (remove the gaps in the histogram) and to correct the colour balance after stacking. This will avoid the data loss caused by applying digital white balance correction in SharpCap.



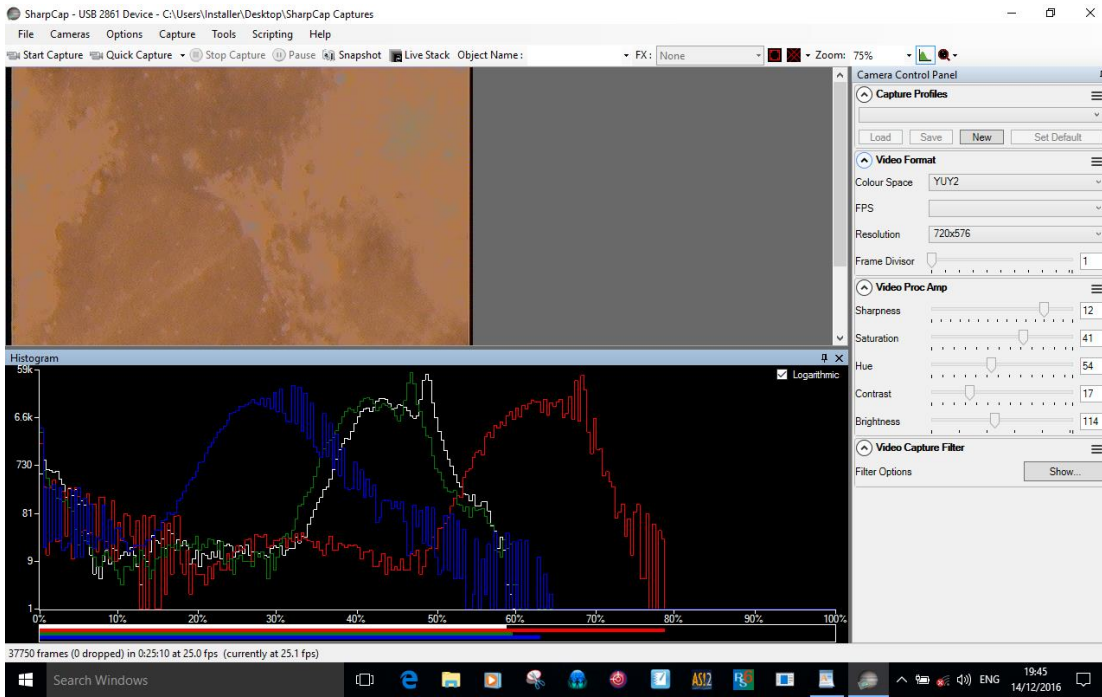
Colours are Wrong

Below is an example of a real world broken histogram and what needs to be done to improve it.

The problem – the colour looks wrong.

The solution – run up the *Image Histogram* from the *Tool Bar*. The LRGB histograms should be reasonably aligned but they are not. In the *Camera Control Panel* look for *White Balance* or *Colour Balance* and adjust as necessary until the four histograms are roughly aligned – achieved when the horizontal bars line up at each end.

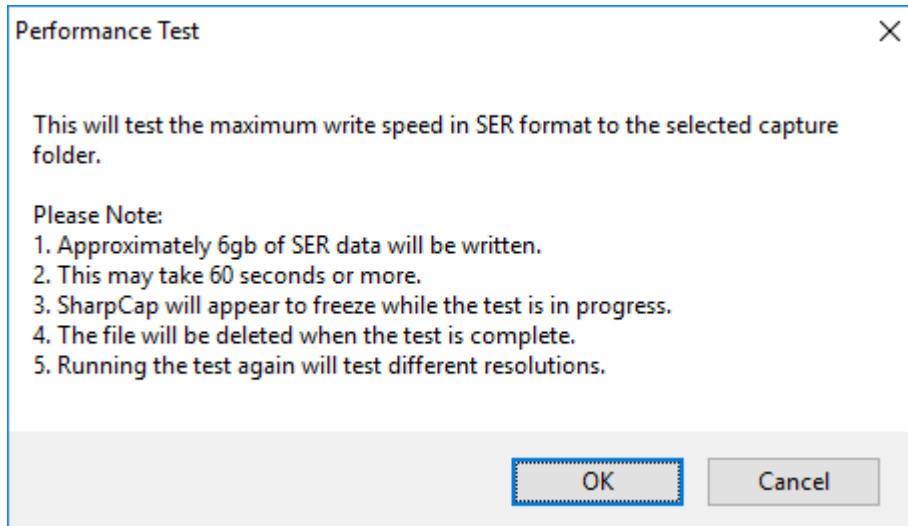
This capture was taken using an AVS DSO-1 analogue video camera with USB2 video capture device. The video grabber is classed as a DirectShow device – no camera controls are exposed in SharpCap – so adjustments are made using the camera's internal menu. In this type of camera, green would be adjusted by changing Red and Blue.



Appendix

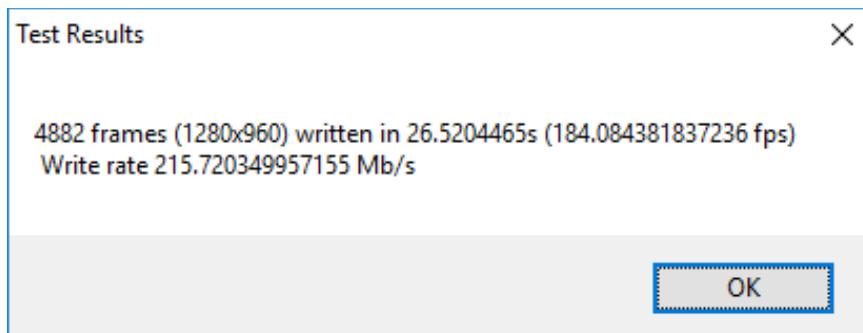
Test Write Speed

The following data is a summary of *Test Write Speed* carried out on various hardware configurations. The *Test Write Speed* button can be found via *File > SharpCap Settings > Filenames tab*. Notice the wide variance in Mb/s and frames per second with the various hardware.



Expect to see a spinning circle while the test is in progress (there is no visible feedback during the test). At the end of the test the results are displayed:

This test showed a write rate of 215Mb/s (on a 10,000rpm Western Digital Raptor drive running on a Quad Core Xeon processor motherboard with 16Gb of memory). The platform was Windows 10 Pro 64-bit. Results will vary here depending on hardware capability.



This table compares the performance of various hardware configurations. All tests wrote out 4,882 frames at 1280 x 960.

Hardware	Processor	Memory	Hard Drive	Operating System	Test Results	
					Mb/s	*fps
HP Z220 Workstation	Xeon Quad Core, 3.4GHz	16Gb	500GB SATA2, 10,000 rpm	Windows 10 Pro, 64-bit	215	184

ThinkPad W510 laptop	i7 Quad Core, 1.73GHz	16Gb	500Gb SATA2, 7,200rpm	Windows 10 Pro, 64-bit	240	205
ThinkPad T400 laptop	Core 2 Duo, 2.4GHz	8Gb	240Gb SATA2 SSD	Windows 10 Pro, 64-bit	191	163
ThinkPad X61 laptop	Core 2 Duo, 1.86GHz	4Gb (3Gb usable)	120Gb SATA2 SSD	Windows 10 Pro, 32-bit	97	83
Linx 10 Tablet	Atom Z3735F, 1.33GHz	2Gb	32GB eMMC	Windows 10 Home, 32-bit	44	38

Note: *fps = frames per second

Consider the hardware demands when purchasing high frame rate cameras.

SharpCap Uninstall Clean-up

After uninstalling SharpCap the following steps can, optionally, be carried out.

[Optional] Remove Profile data (if created) – profile data is stored in %APPDATA%\rwg\SharpCap\CaptureProfiles . Navigate to this folder from Search or Run and delete the contents of the *CaptureProfiles* folder.

The step below can be omitted but is included for completeness. **Always backup the registry before making changes to it.**

[Optional] Remove Registry Entry – run *Regedit*. **Export the registry as a precaution.** Navigate to HKEY_CURRENT_USER\SOFTWARE\RWG\SharpCap and delete the 2.9 key.

Maintenance of Capture Profiles

When a new capture profile, say *Jupiter RGB32*, is created, the following happens:

1. A text file called *Jupiter RGB32 (name of active camera>.ini)* will be saved in the folder %APPDATA%\rwg\SharpCap\CaptureProfiles.
2. The location of the stored profiles can be accessed by copying and pasting %APPDATA%\rwg\SharpCap\CaptureProfiles into the Windows search bar. This would be the way to delete unwanted capture profiles.

Useful Software

- [AutoStakkert!2](#), for alignment and stacking of image sequences.
- [DeepSkyStacker](#), pre-process deep sky pictures.
- [FITS Liberator](#), image processing for FITS files.
- [GIMP](#), image manipulation, 16/32-bit in v2.10 to be released 2017.
- [Image Composite Editor](#), Microsoft's image stitching software to create mosaics.
- [PIPP](#), pre-process planetary images (plus solar & lunar).
- [Registax](#), image stacking and wavelet filters.
- [SER Player](#), video player for SER files.
- [VirtualDub](#), split AVI video into individual frames (think ISS video here).

Glossary

ASCOM provides a standard interface to a range of astronomy equipment including mounts, focusers and imaging devices and runs on the Microsoft Windows platform. Further information can be found at the [ASCOM Standards](#) website.

FITS file format is an open standard adopted by the astronomical community for data storage. Detailed information can be found at https://fits.gsfc.nasa.gov/fits_documentation.html.

PLATE-SOLVING A software tool to calculate where in the sky an image is from the pattern of stars in the image. [All Sky Plate Solver](#) is an example of this type of software and can automatically detect the celestial coordinates of captured FITS and JPEG files.

UTC Universal Coordinated Time – the global standard for measuring time in a time-zone independent way. In practice UTC times are the same as GMT times. See https://en.wikipedia.org/wiki/List_of_UTC_time_offsets for a description of UTC Time Offsets.

WinJUPOS A software tool to help improve images of Jupiter and other planets by digitally correcting for the effects of planetary rotation. See <http://jupos.privat.t-online.de/index.htm> for information to assist with the processing of image captures of Jupiter.