Astrowl Box User Guide



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1 Introduction

The Astrowl box is an ultra-portable "all-in-one" system based on a sensitive sensor (depending on your box version, V1 and V1.1 : Sony IMX462, V2 : Sony IMX477, V3 : Sony IMX283, V4 : Sony IMX585) that will allow you to view objects in the night sky and capture details inaccessible to the naked eye, because they are too dim or blurred in turbulence.

It will therefore be possible for you with the Astrowl box, even in an urban area heavily polluted by light, to visualize the details of nebulae, galaxies, star clusters, to access colors otherwise inaccessible. The planets, the moon also reveal details that are difficult to perceive with turbulence. The satellites of some planets become visible when they are almost impossible to see, even with a large diameter telescope.

Astrowl has been designed to provide you with the main features of digital astronomy in an ultra-portable box. No need for a camera, a computer, cables, … all of this is already integrated into the box. The housing is equipped with a camera, known for its high sensitivity over a wide spectrum of light (even beyond human vision) and particularly well suited for use in astronomy.
The back of the case features a 4'' touch screen, offering a good compromise between reduced size and good image visibility.
Finally, the inside of the case incorporates a mini-computer: the Raspberry Pi (Pi4 or Pi5 for last version of Astrowl Box), particularly reliable and extremely widespread in the world, present in many products and projects.

The set is driven by proprietary software integrating the essential functionalities in digital astronomy, with several parameters at your fingertips if you wish to customize certain settings. This software is accessible from any device (smartphone, tablet, computer, … on IOS, Android, Windows, …) equipped with a web browser (Chrome, Edge, Firefox, Safari, …).
Adjustments and settings have been limited and designed to be quick and easy to access, so you can focus on your observing session and not have to read a tedious user manual and learn complex features, reserved for expert astrophotographers.
The box implements complex and real-time image processing, but you won't have to worry about the details of this processing. Some can be activated on your initiative, but they are limited and you will quickly learn their impact on the quality of the image, depending on the objects observed.

2 Description of the Astrowl box

The Astrowl box is equipped with:

- On its rear side, a 4'' touch screen, on which the images captured by the camera are displayed (it is also possible to display the images captured by the camera on the user interface - See features below).

- On its front side, the CMOS sensor, as well as a Canon EOS format adapter, on which it is possible to install a Canon EOS > T2 ring (see photo below. From the T2 format, you can install most astronomical extensions and accessories (31.75mm (1''25) or 51mm (2'') adapter, filter, projection for eyepieces, etc.).



- On the side of the case is the USB-C power socket. <u>The power supply must be 5 Volts / 5A</u> (or 3A for V1 of the box), available via a simple USB connection or an external battery. If your power supply is not powerful enough, the box will be unstable and may restart during a session, or even not start at all.



- The 'Lum' square opening allows you to adjust the brightness of the screen. By inserting a small rod (preferably non-metallic) and by successive presses, you can vary the intensity of the screen.

- A RJ12 socket for ST4 autoguiding, since Astrowl box V2

- A network socket (RJ45) is also accessible on the side of the case. This socket currently has no function.

- Two USB sockets to connect external camera for Plate Solving or any other futures functionalities.

3 How to install the box on your telescope

The box is installed in the focuser of your telescope or refractor, like an eyepiece. You will need to choose the right adapter depending on your use (T2 adapter > 31.75mm (1.25''), T2 > 51mm (2'') or other). If you are using a star diagonal with your eyepieces, insert it before putting on the Astrowl box. Remove any covers and protection from the front of the case to uncover the sensor. Careful, the sensor is not protected, it is preferable to avoid touching it. If dust appears during your observations, use a blower to gently remove it, but never rub the sensor directly.

I suggest you to buy an IR Cut filter to screw on the front of the camera (on the 31.75mm or 51mm output). This filter will protect the sensor and will allow shots with color balanced. The CMOS sensor is sensitive to infrared, if you make observations without such a filter, the color balance will be difficult to obtain. However, on certain objects such as nebulae, it may be interesting to shoot without the IR Cut filter.



4 Start the Astrowl box

Connect the box to a 5 Volt / 5A power supply in USB-C format. Once powered, the box will start by itself and display the Astrowl logo after approximately 1 minute.



Finally, the Astrowl logo will disappear and the image captured by the camera will be displayed over the entire surface of the screen with a predefined setting (by default *Starfield* mode). The camera is not equipped with a lens, you will not be able to focus. Your astronomical instrument (telescope or refractor) will serve as the lens and will focus the image.

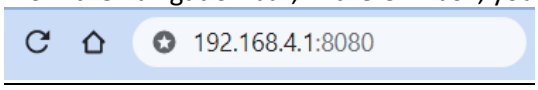
If your power supply is fixed relative to the movement of your mount, make sure that the power cable from the case is long enough. Otherwise you risk stretching the cable when moving the mount and tearing the Astrowl box from its support.

5 Open Astrowl Box user interface.

To interact with the Astrowl Box (modify parameters like gain, exposure, …, save snapshot ,…), you must open the user interface. There are two ways to display this interface, directly on the box screen or from a web browser. The two user interfaces offer nearly exactly the same options and parameters. Some options are not available from the user interface displayed on the box screen, simply because they have no utility and need an external device, like downloading image, updating internal software or display live image:

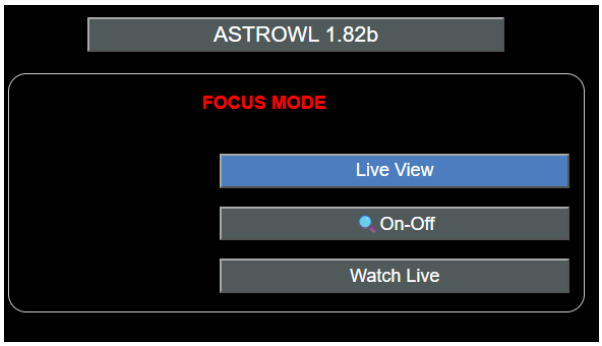
- To display the user interface on the box screen, use a stylus **with plastic point** (more precise than your fingers) on the Astrowl Box touch screen, you will open the user interface. By clicking another time, you will hide it.
- To display the user interface on a web browser from any device like smartphone, tablet, computer or whatever. To do so, you will have to connect to the Astrowl box using a wifi connection. Look in the list of wifi access points (from your smartphone, tablet, computer, etc.) for the network called *astrowlxx* (xx being numbers). Select this access point to connect to it. The password is the same as the network name, so *astrowlxx* . Your smartphone (or others) may possibly display a message telling you that this access point has no connection to the Internet and offers you to cancel the connection or to confirm it. You must confirm the connection and if possible validate this choice for future use.
  Once connected to the box, you must open a browser (Chrome, Edge or other) from the device you have connected to the Astrowl box.

  From the navigation bar, in the URL box, you must enter the following text:



Save it in your favorites, it will save you having to retype it each time. If the wifi connection has been correctly made and the Astrowl box works well, the browser displays the following page.

This is the *Focus* page which facilitates focusing by choosing a relatively fast image refresh rate and maximum gain.



6 Astrowl box control interface

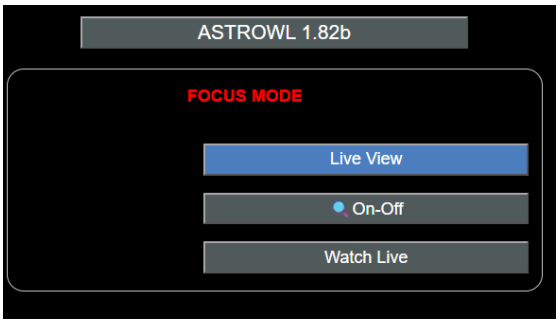
The interface will allow you to control the camera: adjust the shooting parameters (exposure and gain), switch from *Live view to Stack view, Timelapse view, Focus View or Plate Solving*, choose between several pre-configured modes (*Star Field, Nebulae, Galaxy, etc.*) or set yourself the parameters depending on the observed target, save an image, access the list of saved images and download them.

The interface is very simple and consists of only 8 screens: ***Live View, Stack View, Timelapse View, Focus View, Plate Solving, Download Snapshot, Watch Live*** and ***Astrowl software update*** screen

6.1 Focus screen

Focus View screen is the first screen displayed when you start the Astrowl Box. This mode sets the camera with a relatively fast refreshing rate and high gain to see stars and see quickly on the image the result of focusing modification you make on your scope focuser.

You should use this mode whenever you want to focus the image of the Astrowl Box.



By clicking the **Watch Live** button in a browser, you will display the same real-time feed that appears on the box itself, which may allow you to zoom in and fine-tune the focus.

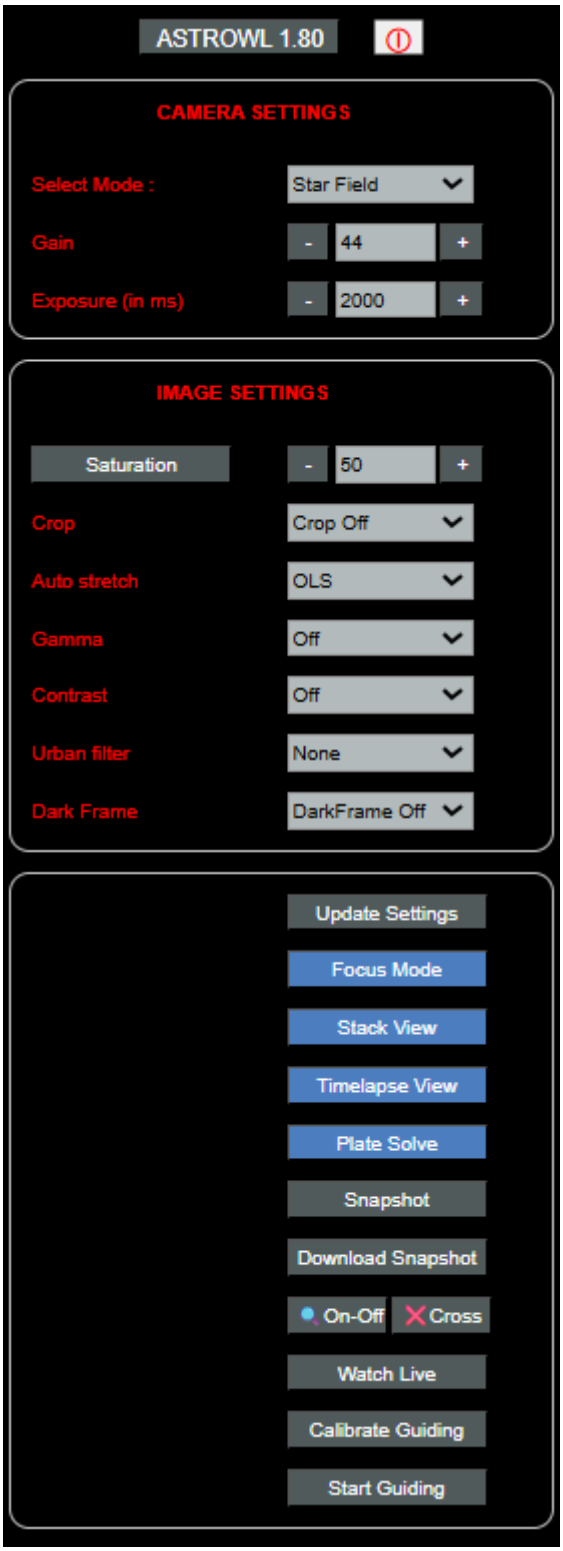
Press the **Live View** button once you have finished using Focus mode and wish to switch to Live View mode.

Focusing advices:
In most cases, the focusing between your eyepiece and the Astrowl Box is not the same, which explains why by putting the Astrowl Box in the eyepiece, you could not see anything appear on the screen of the box or at best blurred spots. It is therefore necessary to make the focus for the Astrowl Box. It is necessary to proceed by turning slowly and step by step the focus knob of your focuser, because the image on the screen of the box refresh around every ½ second and you could pass the focus point without realizing it.

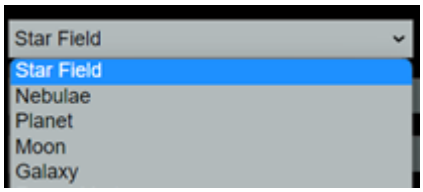
When you approach the focus, activate the magnifying glass (Magnify On Off button) and place it on the target or on a fairly bright star in the field. You can move the location of the magnifying glass by touching the Astrowl Box touch screen. Once the magnifying glass is positioned on the object, refine the focus. A good is to take note of the difference in focus between your eyepiece and the Astrowl box (graduation of the focuser or by counting the turns of the focus knob), which will allow you to switch from one to the other and find focus quickly.

6.2 Live View screen

Live View is the continuous viewing mode of the images captured by the sensor (much like a live video). This screen allows you to change the camera settings.

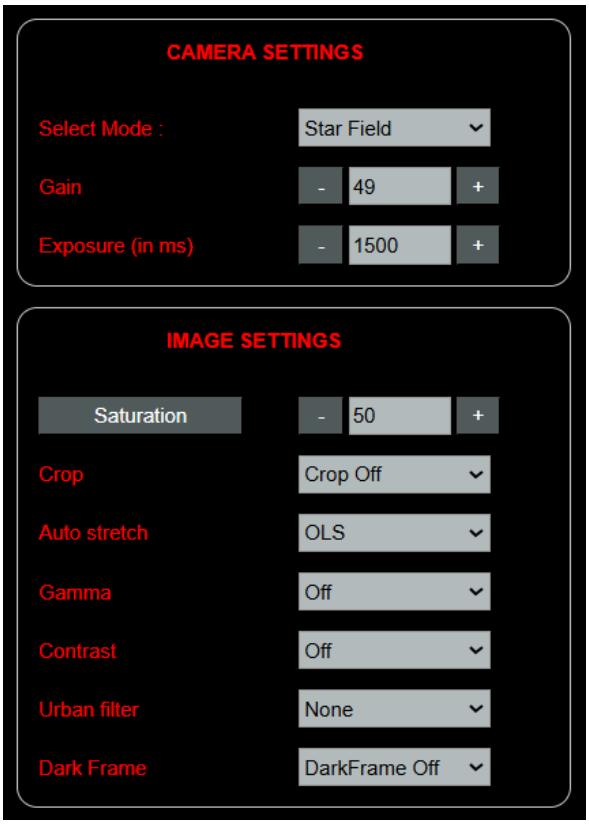


Under the top *Camera Settings frame is the* **Select Mode** drop-down list . Default is ***Star Field*** mode which is selected. Clicking on this list displays the different modes available: ***Star Field*** (for star fields), ***Nebulae*** , ***Planet*** , ***Moon*** , ***Galaxy*** . Depending on the target to view, choose the most suitable mode and click on the Update Settings button.



Depending on the telescope you use, these modes may be more or less suitable. For example, if you are using a telescope with a Focal/Diameter ratio of 10 or greater, ***Planet*** mode will probably be too dark. You will need to adjust exposure and gain manually**.**

Modes are just shortcuts for quickly adjusting ***Gain***, ***Exposure*** and ***Stretch*** settings. But you can also decide not to change the mode and modify the ***Gain and Exposure*** yourself manually according to the intended target.



Any modification must be validated by pressing the Update Settings **button to be taken into account by the Astrowl box. This will be the case from any screen of the user interface.**
There may be a delay in taking the new settings into account depending on the activity of the unit which may be busy with other processing.

The **Gain** parameter can take a value from 0 to 100. It is used to adjust the amplification of the signal captured by the camera. The higher it is, the more the sensor amplifies the captured photons and therefore is sensitive. The counterpart is that the noise also increases

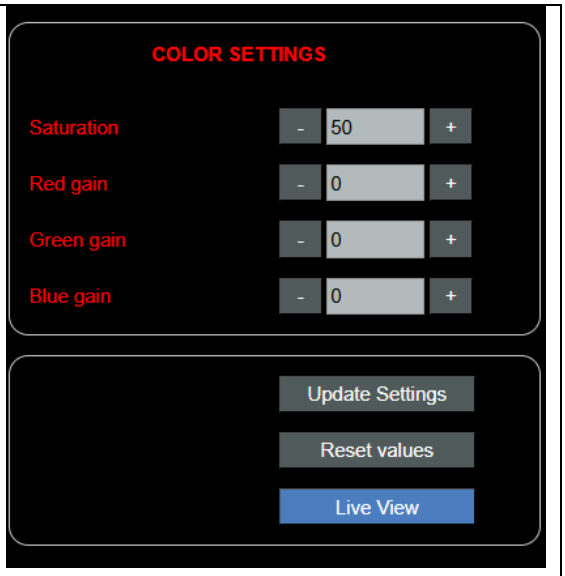
The **Exposure** parameter is expressed in milliseconds (for example 1000 ms is equivalent to 1 sec). Pressing the (+) or(–) buttons increases or decreases the value by 50 ms. It is also possible to enter a custom value directly in the text field. This parameter defines the exposure time per shot. The higher the time, the more photons will be accumulated per shot and therefore more low light detail. The counterpart is that the background of the sky also becomes more luminous and noisy.

The Saturation parameter, as its name suggests, allows you to adjust the saturation of colors and increase the coloring of the visualized targets (for example bringing out the famous red spot of Jupiter, accentuating the coloring of the nebulae, etc.). This setting should be used sparingly, as it can quickly distort the colors of the objects viewed.
By clicking on Saturation, you will enter the ***Color Settings*** screen, which gives you access to some advanced parameters (see below for explanations and details about this screen).

Color Settings

From this screen you can still change **Saturation**, but also :

- By modifying **Red gain**, **Green gain** and **Blue gain** parameters, you will deactivate the auto color balance and adjust yourself the wigth of each color in the image dispayed



Each time, you modify a value, you need to press Update Settings for the box to take it into account.

The Reset values set all paramerets (except saturation) to default values and can reactivate the automatic color balance. Don't forget to press Update Settings after reseting values.

By pressing Live View button you will switch back to *Live View* user interface.

The **Crop** parameter (available for IMX477, IMX283, IMX585), can be used to keep a portion of the sensor and display only this portion of the image on the screen. If you save the image after a crop this will also only save the portion of the image that is cropped. This functionality is useful if you want to display small targets to see details or planets that need fast processing (the smaller the image the faster the processing). This parameter has several values available through the drop-down menu which will crop more or less the image.

The **Auto stretch** parameter let you choose between several stretch methods or deactivate auto stretch. Stretch is automatically activated if exposure is above 300ms (except if you deactivate it). Stretch is a fundamental treatment in astronomy that will modify the image histogram (you can find lot of informations on the web regarding stretch in astronomy). The available methods are **OLS**, **MTF** and **GHS**. **OLS** is a homemade stretch and the default one, **MTF** refer to Midtone Transfer Function and **GHS** to Global Hyperbolic Stretch. Again you can find informations regarding this different stretch methods on Internet. Test this different methods to find the one that best suited for the displayed target.

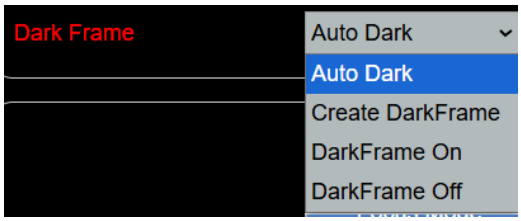
The **Gamma** parameter selectively enhances brightness by improving the visibility of celestial objects without increasing the overall brightness of the image, such as the sky background.

The **Contrast** parameter, as its name suggests, enhances image contrast.

The **Urban Filter** setting offers 4 intensity levels: *None, Low, Medium, High*. It helps reduce light pollution, which is very present in urban areas, by obscuring the sky and accentuating dimly lit details. It is especially useful for deep sky objects. The higher the value of the parameter, the more the sky will be darkened and the details accentuated. An intensity sets at *Low* level already have a significant impact. In certain situations if you push the intensity of the filter too high, the filter can significantly distort the colors of the image. You must therefore adjust it step by step to obtain the

best result. This filter can also be used under dark skies to reduce any diffuse light, such as the moon.

All sensors have defective pixels that create dots in the image. **Dark Frame** creates an image containing these defective pixels, which are then subtracted to the final image. The **Dark Frame** menu contains three options: **Create DarkFrame Off, DarkFrame On, DarkFrame Off**.



- **Auto Dark** is activated by default and will automatically cancel the hot and dead pixels.
- **Create DarkFrame**: Creates the image that will contain the defective pixels. Before launching this option, you must place a cover in front of the sensor and create total darkness. Once the process is complete, you will find a file named **darkframe.raw** in the images directory. This file contains the detected defective pixels. It can be deleted or recreated as desired.
- **DarkFrame On**: Enable the removal of defective pixels using the **darkframe.raw** file. This activation is enabled for both the *Live* mode and *Stack* mode images.
- **DarkFrame Off**: Disables the use of darkframe.raw.

The Update Settings button must be pressed systematically to take into account changes to the parameters entered above (*Mode, Gain, Exposure*).

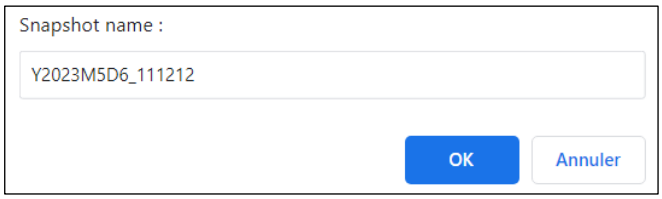
The Focus Mode button allow you to switch to the *Focus Mode screen* (help to focus image, see explanations on this screen above).

The Stack View button allows you to switch to the *Stack View screen* (image stacking, see explanations on this screen below).

The Timelapse View button allows you to switch to the *Timelapse View screen* (creation of videos from the assembly of several images)

The Plate Solve button allows you to switch to the *Plate Solve screen* (Plate solving anf Push to modes, see explanations on this scree below).

The Snapshot button is used to save the image displayed on the unit's screen in PNG format. A window will open asking you to rename the file before saving it. If you use an existing file name, the previous file will be overwritten.



The Download Snapshot button is used to access the list of images taken, to download them and to delete them (see section *Download Snapshot screen* below)

The On-Off button allows you to activate and deactivate a magnifying glass x3 on the screen of the Astrowl Box. By touching the screen you can move the magnifying glass to the desired area. Clicking the On-Off button again you turn off the magnification window.

The button Cross displays a red cross in the center of the image to facilitate object alignment and centering.

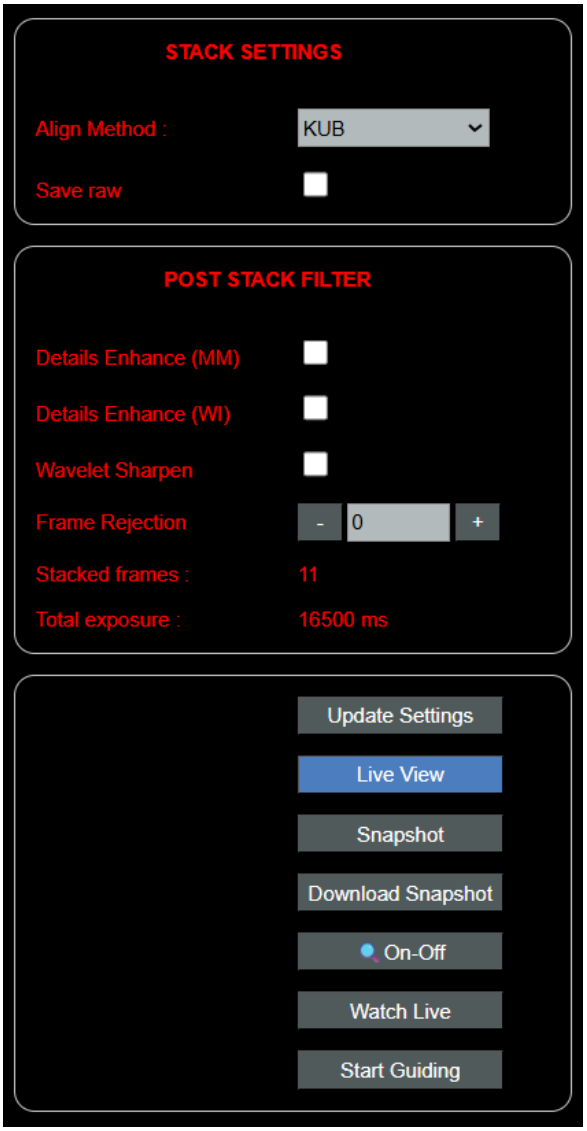
The Watch Live button allows you to view on your device connected to the Astrowl box, the image displayed on the built-in screen of the Astrowl Box. (see **Watch Live screen** below).

The Calibrate Guiding and Start Guiding buttons are used for calibration and activation of ST4 auto guiding (see the *Calibration and Activation of ST4 auto guiding* section)

6.3 Stack View Screen

The *Stack View screen* allows settings for shooting stacked images. Unlike *Live View,* which displays only one image at a time*, Stack View* mode will add several shots to bring out details and eliminate artifacts. In astrophotography it is considered that the addition, for example, of 5 shots of 1 second is equivalent to a single shot of 5 seconds.

By switching to the *Stack View* the stacking of images will start automatically with the settings (**Camera Settings)** defined from the *Live View* screen .



The settings specific to *Stack View* are located in the **Stack Settings** frame, they are kept each time you switch from *Live View* to *Stack View* .

Align Method field allows you to define the method used by the program to align the frames. The program automatically takes care of aligning the new frames with the previous ones before adding it to the final stacked image. This alignment is used to correct shifts between each shot, resulting from the imperfect tracking of your mount.

There are two alignment methods: **KUB** and **DSO .**

The **KUB** method performs best on planets, moon, and works quite well on deep sky objects. In most cases it should work fine.

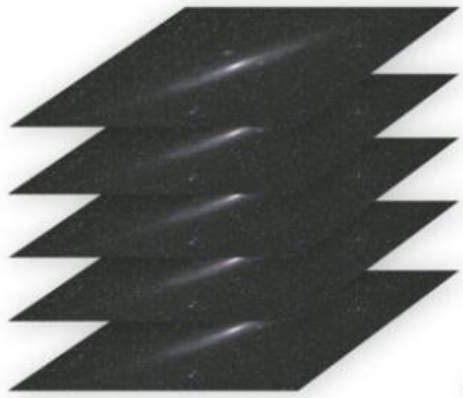
DSO method is rather dedicated to deep sky objects and is more accurate than the KUB method. For this method to be effective, several stars must be present in the field. Otherwise, the alignment will not work.

Field rotation is managed by this two methods.

If the shift between frames is very large, a black band may appear around the final stacked image. This band corresponds to the zone which existed on the initial frame, but which is no longer present on the new shifted frames.

How do stacking frames and creating the final image work?

The camera takes pictures (frame) continuously based on the settings you have defined. These images are then added and averaged to create a final image (stacked image displayed on the screen), which makes it possible to remove noise and random artefacts, bring out weakly luminous objects, improve details, ...



Frames added to the stack



Final image = addition of the frames from the stack

Available filters that can be applied to the final image

There are 3 filters that can be applied on the final stacked image. This means that it is not necessary to activate them throughout the processing, but rather after having already stacked several images. These filters consume computation time and it is therefore preferable not to leave them activated continuously. You can cumulate several filters to increase details and contrast, but keep in mind that each filter will add computing times.

Filter name	Functioning
Details Enhance (MM)	Applies an image restoration on the image with a virtual PSF
Details Enhance (WI)	Applies a Wiener Deconvolution to the final stacked image. This filter restores details that turbulence makes diffuse (particularly used in planetary images). There is plenty of documentation on the Internet about this filter.
Wavelet Sharpen	This filter will sharpen details.

Filters applicable on each frame before stacking on final image

The **Frame Rejection** filter allows you to reject parts of the image that deviate too much from a target value. It helps limit the impact of disturbances on the image, such as turbulence, cloud cover, vibrations, etc. If the exposure is below 300ms, the rejection method use the Lucky Imaging more dedicated to planetary observation. A level of 80 is well adaptated.

Above 300ms of exposure, another method is used to reject frame more adapted to deep sky. Normally, a value of 5 or 10 is already more than sufficient and very selective. You should only increase this value if the conditions are extremely unfavorable.

Under the filters you can track the number of stacked frames (**Total frames**) and the cumulative time (**Total exposure** , equal to the number of stacked frames X the exposure time of each frame). This data updates every time you reload the page or every 10 seconds.

Any modification of parameters, filters, etc. must be validated by pressing the Update Settings **button .**

The Live View button toggles to *Live View*. Again, the switch may take a few seconds while the frames being processed are popped.

The Snapshot button allows you to take a picture of the image displayed on the Astrowl box screen.

The Download Snapshot button is used to access the list of images taken, to download them and to delete them (see *Download Snapshot screen* below)

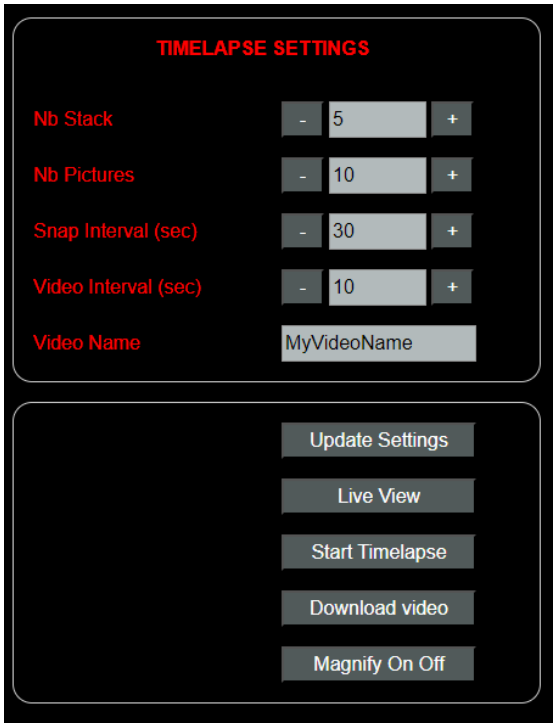
The Magnify On Off button enable and disable a x3 magnification window on the Astrowl Box screen. By touching the screen you can move the window to the area you want to zoom in on. Clicking the Magnify On Off button again turn off the magnification window.

Watch Live button allows you to display in your browser the image visible on the integrated screen of your Astrowl Box. (See *Watch Live* screen below)

6.4 Timelapse View screen

From this screen, you can create videos from a sequence of stacked images, also called Timelapse. This process is mainly used in solar imaging to create animations of solar flares, but you can also use it to create an animation of one of its satellites passing in front of Jupiter and the shadow moving on the Jovian surface or any astronomy scene having dynamics.

The principle is as follows: the video is a succession of static images which, when displayed one after the other, show the evolution of the scene. Each image is the result of several stacked images (like in Stack View mode). The images are taken at regular configurable intervals and then accumulated to create the video. The rate at which these images are displayed in the video is also configurable. For example, you can take images of the scene every 5 minutes and have it displayed in the video every 5 seconds. Which therefore displays the dynamics of the scene in accelerated speed.



The **Nb Stack** setting allows you to set the number of frames stacked to create each individual frame that will be displayed in the video. For more information on the principle of image stacking, read the Stack View section.

The **Nb Pictures** parameter allows you to define the number of individual images that you will take of the scene and which will then be displayed one after the other in the video.

The **Snap Interval (sec)** setting allows you to set the pause time between each new image taken. In summary, what happens to the object observed during this pause time will not be part of the video. You can set a fairly long pause time and take advantage of this pause time to refocus the image on the sensor. During the pause time, the image of the target continues to be displayed in real time on the screen, like Live View mode.

The **Video Interval (sec)** setting allows you to set how long each individual frame in the video is displayed. In summary, you could take shots of the scene every 15 minutes, but have them cycle through the video every 3 seconds. This will create a time-lapse video of the scene.

Finally, the **Video Name** parameter allows you to enter the name of the file in mp4 format which will be used to save the video on the Astrowlbox.

Finally the buttons are used respectively to:
- Update Settings take into account the change of parameters entered in the boxes above.
- Live View, return to the Live View screen
- Start Timelapse allows you to start the sequence of shots and construction of the video. If you want to stop the process before its end, click again on the button which will display Stop Timelapse. In this case, no video will be created.
- Download video allows you to download the videos you have created. You can also download them from the Download Snapshot screen of the Live View and Stack View screens, but the video files will be displayed with the image files.
- Magnify On Off allows you to activate the magnifying glass. It is not possible to activate or deactivate the magnifier when Timelapse is started

6.5 Plate Solving and Push To Screen

Some new and powerful features are introduced in release 1.80. They are **Plate Solving** and **Push to**.

With **Plate Solving** the Astrowl Box will display name and positions of objects (stars, nebulae, galaxies, clusters, …) that are in the field of view. It will help you to center faint objects and find them.

With **Push to** the Astrowl Box will help you to locate objects that are outside the field of view by giving you directions to push your telescope to and step by step center this objects.

IMPORTANT: PLATE SOLVING IS NOT POSSIBLE WITHOUT USING ONE OF THE TWO METHODS DESCRIBED BELOW. PLATE SOLVING WILL NOT WORK IF YOU LEAVE YOUR ASTROWL BOX IN THE EYEPIECE HOLDER OF YOUR TELESCOPE.

There are two ways to use the **Plate Solving** and **Push To** features :

- **First solution**, by plugging the USB camera that is available for sell on Astrowl Box website or by building it by yourself with the guide also available on the Astrowl Box website (it is possible that other USB cameras can also work, but without any warranty).
  This camera is equipped with a small 16mm lens, which delivers the perfect field of view for plate solving (smaller focal won't work and greater will give too large field of view to be precise).
- **Second solution**, by using the Astrowl Box and its sensor (no need to plug external camera) as a standalone plate solving tool. To do so, you will need to install a 16mm lens in the front of the Astrowl Box sensor. We recommend to buy EOS to C Mount adapter (something similar to picture below).
  However there is a drawback with this solution (compared to the first one), the Astrowl Box sensor will be used for Plate Solving and won't be available for EEA.

EOS to C Mount adapter



C Mount 16mm fixed focal lens

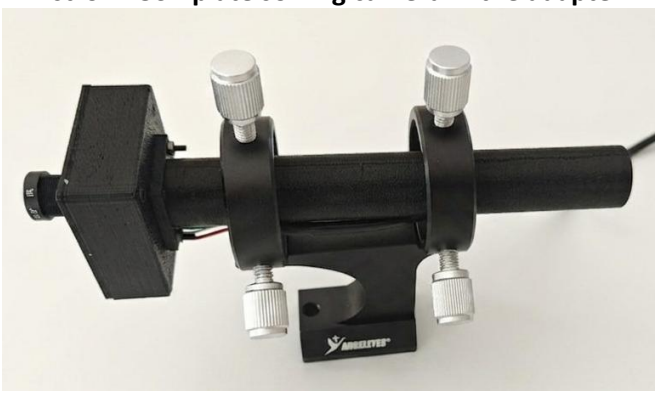


Regarding the setup with the **USB camera**, you will need a laser mount like the picture below and a saddle to install on your scope to set this laser support. Then place the **USB camera** and its housing in this mount and align it with your telescope, in the same way you would align a standard finder scope. If you want to build by yourself the Astrowl Plate Solving camera with its support, please read dedicated document from AstrowlBox website on the *Download* page.

Laser adapter for Telescope

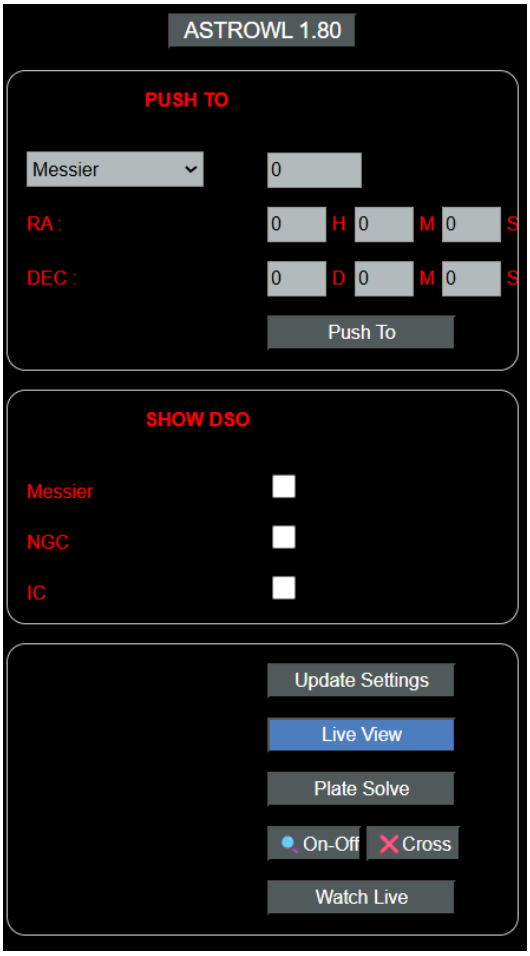


Astrowl USB plate solving camera in the adapter



6.5.1 Plate Solving settings screen

The **Plate Solving** mode screen looks like the one shown here.



To activate field recognition (plate solving), click the button Plate Solve, and to deactivate it, click the button again.
The Astrowl Box will attempt to identify the brightest stars in the field and display their names.
This identification should take less than 5 seconds. If it fails, the box will display an error message indicating that it has not identified the stars. In this case, check that you are using a 16mm focal length lens on the USB camera or in front of the box's sensor and try again in another area of the sky.

In the **PUSH TO** area, you can select an object you wish to search for.
You can either choose a pre-recorded object from the drop-down list containing the Messier, NGC, and IC catalogs or enter its number in the field to the right of the drop-down menu.
Or you can enter the coordinates of the object you are looking for. By default, if a number other than 0 is entered in the field to the right of the catalog dropdown menu, that object will be searched for, even if you have entered coordinates below it.
Once the object or coordinates has been entered, press the button Push To to activate the search and press it again to stop the search.

In the **SHOW DSO** area, you can select the Messier, NGC and IC catalog objects you want to appear on the device's screen during Plate Solving and available in the field of view. By default, only the brightest stars are identified.

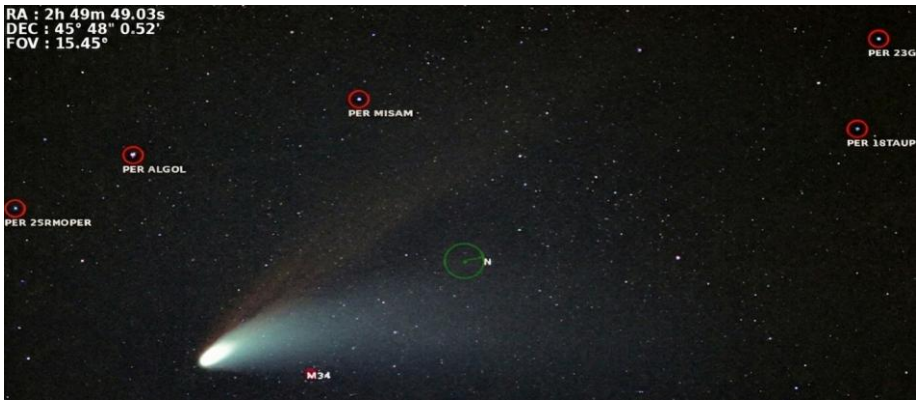
Press the button Update Settings to confirm these selections.

The buttons at the bottom of the screen are used to:

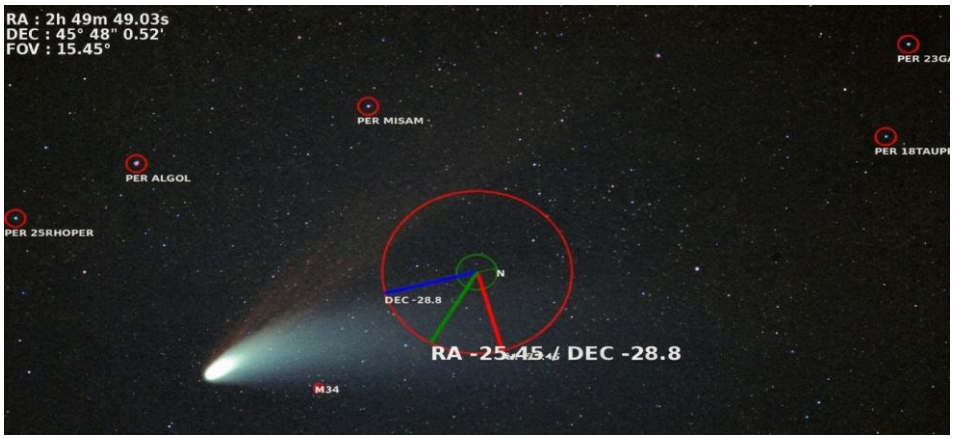
- Live View Switch back to *Live View* screen.
- Plate Solve Start Plate Solving,
- On-Off Display or hide the magnify,
- Cross Display red cross in the center of the box screen to help centering,
- Watch Live Mirror in your browser, image displayed on box screen

6.5.2 Informations displayed on Plate Solving screen

Once you have activated Plate Solving, the box will display a screen similar to the one below. In the upper left corner, the coordinates of the right ascension, declination, and the size of the field covered appear. In the image, the brightest identified stars are circled in red with their name (the first three letters of the constellation, followed by the star's name). If you have selected the display of Messier, IC, or NGC objects, they will also be circled in red with their name. Finally, in the center of the image, the green circle and line indicate the direction of the celestial north pole.



If you have enabled *Push To*, the image will appear as shown below. The large red circle in the center is composed of blue and red lines indicating the declination and right ascension directions of the object you are looking for. The white lines indicate the movement required in these directions to center the object (from the center of the red circle towards the perimeter). The green line indicates the mean direction of the object. You should move your mount in the indicated directions and observe the RA and DEC values approaching zero.



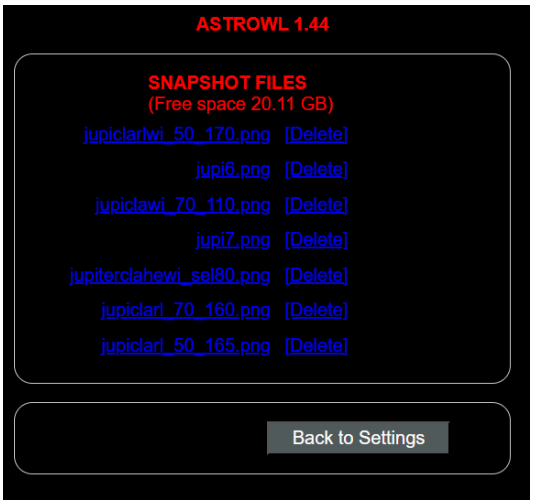
6.6 Download Snapshot Screen

From this screen you can download and delete the snapshots you have taken in Live View or Stack View modes or the video done in Timelapse View

The filenames of the shots and videos appear on the left. Just click on the name and the image or the video will be downloaded to your device.

To the right of the name of each file appears the [Delete] link. By clicking on this link you will permanently delete the file stored on the Astrowl Box (be careful, no confirmation window is displayed to validate the deletion).

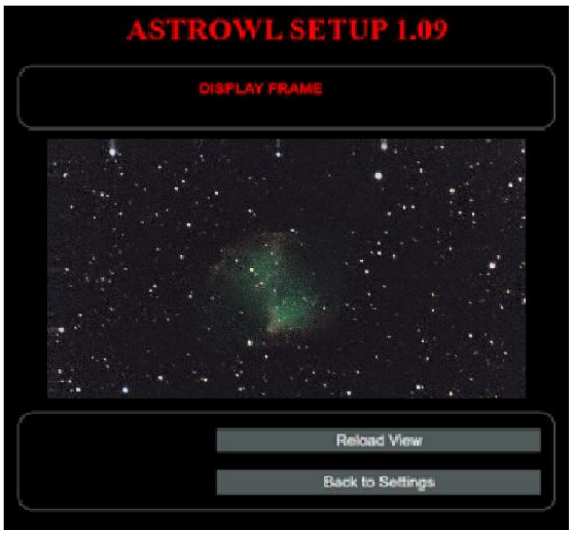
Free space disk is displayed above file names.



6.7 Watch Live screen

From this screen you can display in your browser (from a smartphone, tablet, computer, etc.) the image which is also displayed on the screen of the Astrowl box. The image size automatically adapts to the screen size of your device.

The **Back to Settings** button allows you to return to the box settings screen.



7 Informations displayed on Astrowl Box screen

The Astrowl Box screen, in addition to displaying the image of the object observed and visualizing the effects of the defined settings, provides you with some informations. This informations appear in red letters at the top left of the Astrowl Box screen.

You will be able to see if you are in Live or Stack mode, the preselected mode (starfield, nebulae, moon, etc.), which alignment method is used (KUB or DSO in Stack mode only), possible error messages.







8 Calibrate and Activate autoguiding ST4

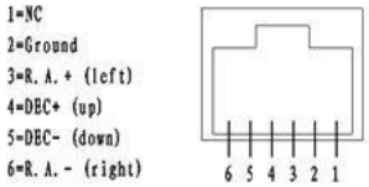
Tracking of motorized mounts, even with very good polar alignment, is always imperfect, which means that objects in the field of view drift little by little and can go out of the field of view. The ST4 protocol, which is present on most mounts, allows to compensate for this drift by sending correction pulses to the mount.

The Astrowl Box (from V2) is equipped with an ST4 port and can send corrections to your mount to keep the observed object in the field.



To enable ST4 guiding on the Astrowl Box, follow these steps:

- Connect the Astrowl Box to your mount, by plugging an ST4 cable (RJ11 with 6 connections) into the ST4 port of the box and the ST4 port of your mount. The ST4 port of the Astrowl Box has the following diagram, compatible with Orion, Celestron, IOptron, SkyWatcher, AstroPhysics, Losmandy, Vixen, ZWO.



- From the *Live View* screen, click the **Calibrate Guiding** button. The following message will appear on the Astrowl Box screen:



- Once the calibration is complete and if no error message has appeared, the calibration has been validated.
- You can then start and stop autoguiding by clicking the **Start Guiding** or **Stop Guiding** button, from the Live View or Stack View screen.

Please note the following points:

- Calibration must be redone each time you change targets or move the Astrowl Box,
- Autoguiding must be stopped before moving your mount, otherwise it will send inconsistent instructions to your mount,
- The Astrowl Box's ST4 autoguiding uses the same sensor as the one used to view images. For this reason, it is not as effective as ST4 guiding performed with an independent camera and telescope, while another camera is used to take images of the sky. For example, if you take an image with a 5-second exposure, the ST4 guiding will not be able to send a correction to the mount and will have to wait until the end of the shot.

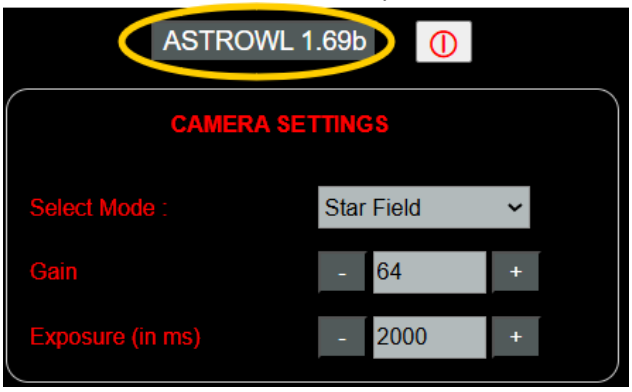
9 Astrowl software update

The Astrowl software running on the box is regularly updated to add features, correct bugs, etc. These updates will be available via the Astrowl site (under construction) or via a link sent by email.

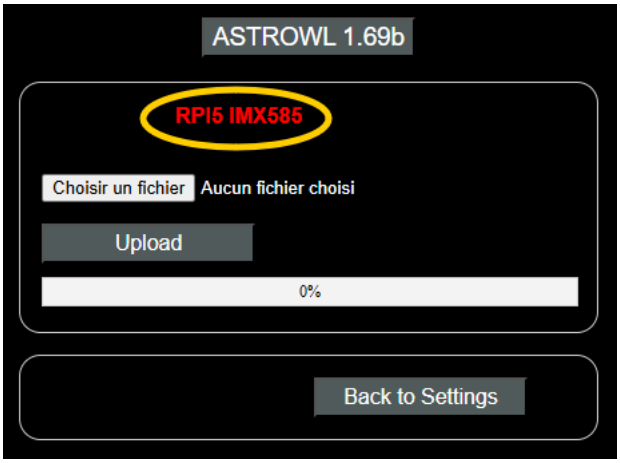
To update, follow the steps below (from version 1.13b):

- Download from a computer the new version of the Astrowl software and save it in a directory. It is best not to use a smartphone or tablet for this update.
- Start the Astrowl box,

- Connect via wifi to the Astrowl box from the computer on which you saved the new version of the software. Look for the wifi network starting with *astrowl* ,
- Open a browser (Chrome, Edge or other) from your computer and launch the Astrowl interface by typing in the address bar: http://192.168.4.1:8080
- *LiveView* interface should appear in your browser,
- Click the version name at the top of the screen:



- You arrive on the software update screen. In red, appears the version of your Astrowl Box (RPI type and sensor type), which will allow you to know which version of the program you need to download. Click Choose File: Click *Choose File* :

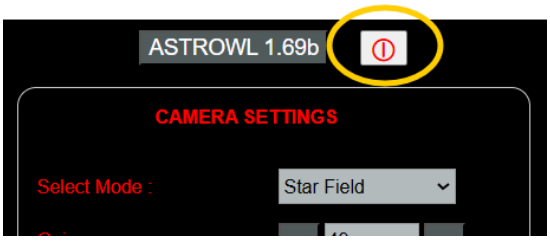


- An explorer screen is displayed to search the new version of the Astrowl software that you have previously saved on your computer. Go to the directory containing the Astrowl software and validate your selection.
- Click on the **Upload button**. The transfer of the new software to the box will start and the progress bar will display the download progression.
- This download may take several minutes, do not turn off the box and do not refresh the page on the browser until the operation is complete,
- When download reach 100%, the box will restart automatically. You will need to reconnect to the box, as wifi was interrupted during restart

IMPORTANT: Before moving your telescope to another target, it is important to switch to *Live View mode* , otherwise you will have completely inconsistent images, since the box will try to stack and align frames from different targets.

10 Shutdown Astrowl Box

To turn Astrowl Box off, you can simply unplug it or click the button in the top right corner from the Live screen.



11 Typical steps of on observation session with the Astrowl Box

1- Setting up your motorized mount

The first step before using the Astrowl Box is to set up your telescope and the motorized mount on which it is installed. There are a multitude of sites that clearly explain the steps to follow, which are also different depending on whether you are using an equatorial or azimuthal mount. But the idea is that your mount compensates the rotation of the earth as precisely as possible and keeps the objects observed in the field of your eyepiece or the Astrowl Box as long as possible. The more careful you have been with this station setting, the better your observing session will be.

2- Choose a target and center it in an eyepiece

Once your mount is stationed, you will choose the target you want to observe (during the first uses of the box and in order to familiarize yourself, I strongly advise you to choose a bright star as your target). Do not put the Astrowl Box in the focuser yet, but choose an eyepiece with a wide enough field of view. Accurately center the object in the eyepiece. You can now remove the eyepiece and replace it in with the Astrowl Box.

3- Focus the images displayed by the Astrowl Box

In most cases, the focusing between your eyepiece and the Astrowl Box is not the same, which explains why by putting the Astrowl Box in the eyepiece, you will not see anything appear on the screen of the box or at best blurred spots. It is therefore necessary to make the focus for the Astrowl Box. It is necessary to proceed by turning slowly and step by step the focus knob of your focuser, because the image on the screen of the box can be refreshed less than once per second and you could pass the focus point without realizing it. When you approach the focus, activate the magnifying glass (Magnify On Off button) and place it on the target or on a fairly bright star in the field. You can move the location of the magnifying glass by touching the Astrowl Box touch screen. Once the magnifying glass is positioned on the object, refine the focus. A word of advice, take note of the difference in focus between your eyepiece and the Astrowl box (graduation of the focuser or by counting the turns of the focus knob), which will allow you to switch from one to the other and find focus quickly.

4- Displayed objects are dim or difficult to see

Deep sky objects are faint and their brightness can vary greatly from one object to another. The Astrowl Box sensor is renowned for its high sensitivity, so if objects on the screen are dim, you need to adjust the gain or exposure. To do this, choose *Expert Mode* from the user interface and manually increase the *Gain* and *Exposure* (see detailed explanations above).

The *Starfield*, *Nebulae* preset modes are nothing more or less than *Gain* and *Exposure* presets. Depending on the Focal / Diameter ratio of your telescope, these presets may be a little too bright or too dark (they were chosen for an average F/D of around 6). In this case, you will have to change the *Gain* and *Exposure* yourself.