AiryLab

Genika Astro

user manual

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Introduction

Genika is a video capture software suite for GigE, USB and IEEE1394 cameras.

The version you acquired targets planetary, lunar and solar imaging. For scientific applications you may use Genika Trigger available from [Airylab](#). The user interface has been designed to be as simple as possible for easy capture on the field.

This application is developed to deliver the best performances possible, including advanced software features such as heavy multithreading and DirectX to leverage multicore CPU and GPU. Nevertheless a good hardware is required to get all the performance your camera can deliver: Code 2 duo CPU, fast disk and GE interface are preferable.

Genika license is linked to your camera and you can install it on several PC as long as the license file is copied along the application.

Ephemeris data: Institut de Mécanique Céleste, 77, avenue Denfert Rochereau, 75014 PARIS, FRANCE

Genika uses TIFF TiffLib.net Copyright (c) 2008-2011, Bit Miracle, All rights reserved.

Genika uses SlimDX for DirectX rendering.

The SER toolbox uses Aforge for some color image debayering modes and FFT transform.

Hristo Pavlov's librairies are used for native ADV file format support.

Features

The current Genika release supports the following features:

- Can manage two different Basler cameras with two application instances
- Stream display with user selectable refresh delay and four zoom levels (free size in DirectX)
- Trigger mode
- Spectrum ramp, inverse and log palette display mode
- Programmable screen stretch
- H/V programmable levels display
- On the fly bayer conversion for display
- On the fly image averaging and dark/offset
- Exposure, auto exposure
- Gain (gain boost on IDS), sensor gain on IDS CMOSIS cameras
- Black level if available
- Gamma
- 8 bits, 11/12/14/16 bits mode
- Camera cooling and fan control (Andor and Raptor)
- Shutter mode selection (E2V sensors for IDS and Basler)
- Lin/log for IDS E2V camera
- Camera settings load/save, automatic camera setting saving at acquisition start
- Free AoI and AoI offsets selectable with the mouse directly on the image, calculation AoI mode
- Binning
- FPS and bandwidth display, FPS graph
- Low/High display thresholds in >8 bits monochrome modes
- Histogram with min, median, max and programmable refresh
- Real time image stabilization (8 bits and planets only)
- SER, AVI (8 bits only), TiFF, ADV and GNK file format
- Timestamping of the capture files and images in SER and GNK
- Text file including acquisition parameters and WInjupos date format
- User defined file prefix
- Selectable filter file suffix
- SER conversion toolbox to AVI, ADV, FITS and TIFF(single image, Cube FITS, multi image FITS) format
- SER file analysis tool, GNK converter
- Ephemerides with sampling analysis. Planet position in real time
- Optical alignment (collimation) assistant and PSF analysis
- Center of gravity or phase correlation autoguiding with pulsemode Ascom mount capable
- Mosaic helper on overlay
- Sampling calculation tool and auto F/D detection on planets
- 2D Focus assistant with micro-contrast display, noise distribution analysis with graph and data to disk
- Reticle with user selectable pixel/ArcSec ticks and circle
- Multiline sequencer with loop capability and automatic filter/focuser offset change
- Auto acquisition mode with a Solar Scintillation Monitor (SSM)

- ASCOM filter wheel and focuser control
- Focuser jog window
- GPS precision SER and GNK file resynchronization for occultation

Installation

You need the Microsoft the SDK from your camera supplier with .NET SDK option.

IDS uEye	uEye 4.21
Basler	Pylon 4.1
AVT/Prosilica	UNI 2.1
TIS/Celestron	IC Imaging control 3.3
Andor	SDK3
Raptor	EPIX drivers
Pointgrey	Flycap

You can then extract and launch the exe file to install Genika. Previous install should be removed prior new version installation. When installed the application further updates and done through the Internet from the update menu.

For ASCOM filter wheel and focuser control you need the ASCOM 6 platform.

You don't need to deactivate the idle C-States from the camera driver with IDS cameras, that is handle automatically by Genika.

Raptor Photonics requires a registry change for the 32 bits version to be used on 64 bits OS, please refer to the EPIX user manual or use the 64 bits version of Genika.

If you are using Flycap x86 on a x64 system, you have to use the x86 version of Genika Astro. The x64 version requires the x64 Flycap release.

TIS/Celestron requires the IC Imaging control SDK 3.3 with the following installation options:
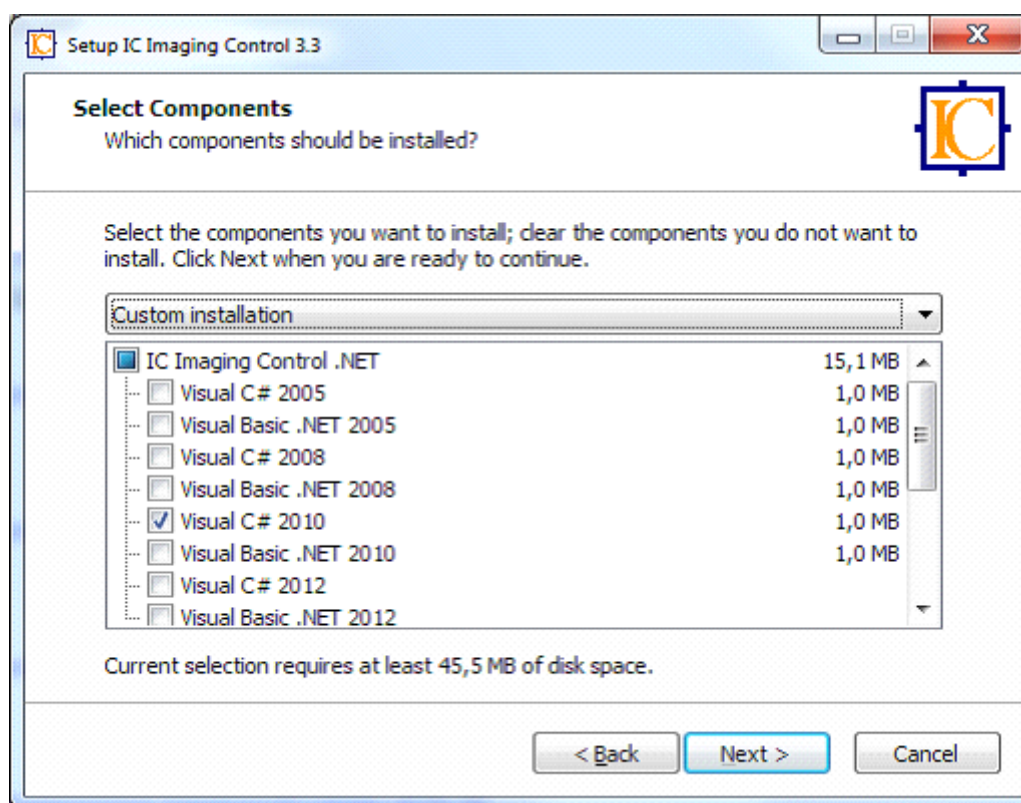
You can download the version required by Genika here : http://airylab.com/Drivers/ic3.3setup.exe

Supported cameras

Camera	Genika Astro	ASCOM driver
Andor Neo/Zyla	☑	☒
Basler IEEE1394	☑	☑
Basler GigEthernet	☑	☑
Basler USB3	☑	☑
IDS USB2 & USB3	☑	☑
IDS GigEthernet	☑	☑
AVT IEEE1394	☑	☑
AVT GigEthernet	☑	☑
Pointgrey USB2 & USB3	☑	☒
Raptor Photonics	☑	☒
The Imaging Source Celestron Skyris/DMK	☑	☒

Using the application

Launch and camera connection

Double click on the shortcut to launch the application. At the first launch you'll be asked for the camera brand you want to use. You can change this on the fly from the application afterward:
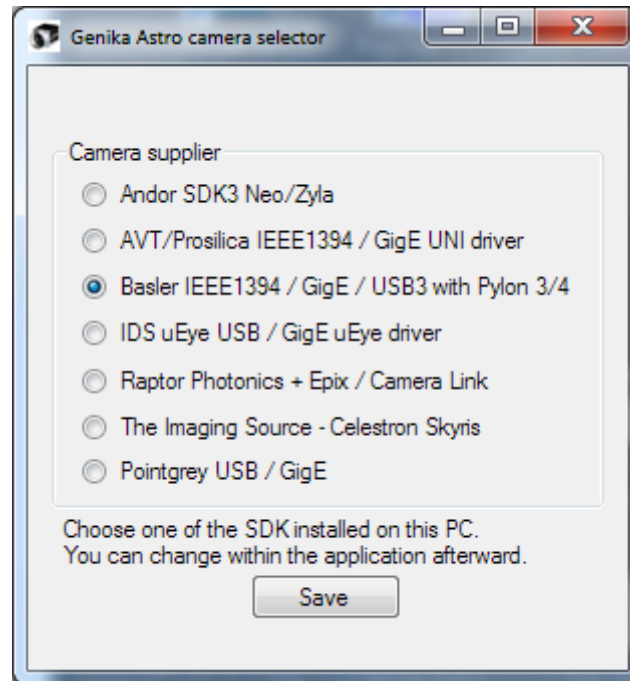
The main window will appear and the application will start looking for your camera automatically. Your camera can be connected before or after you launch Genika. When the camera is detected, the video stream will be displayed.
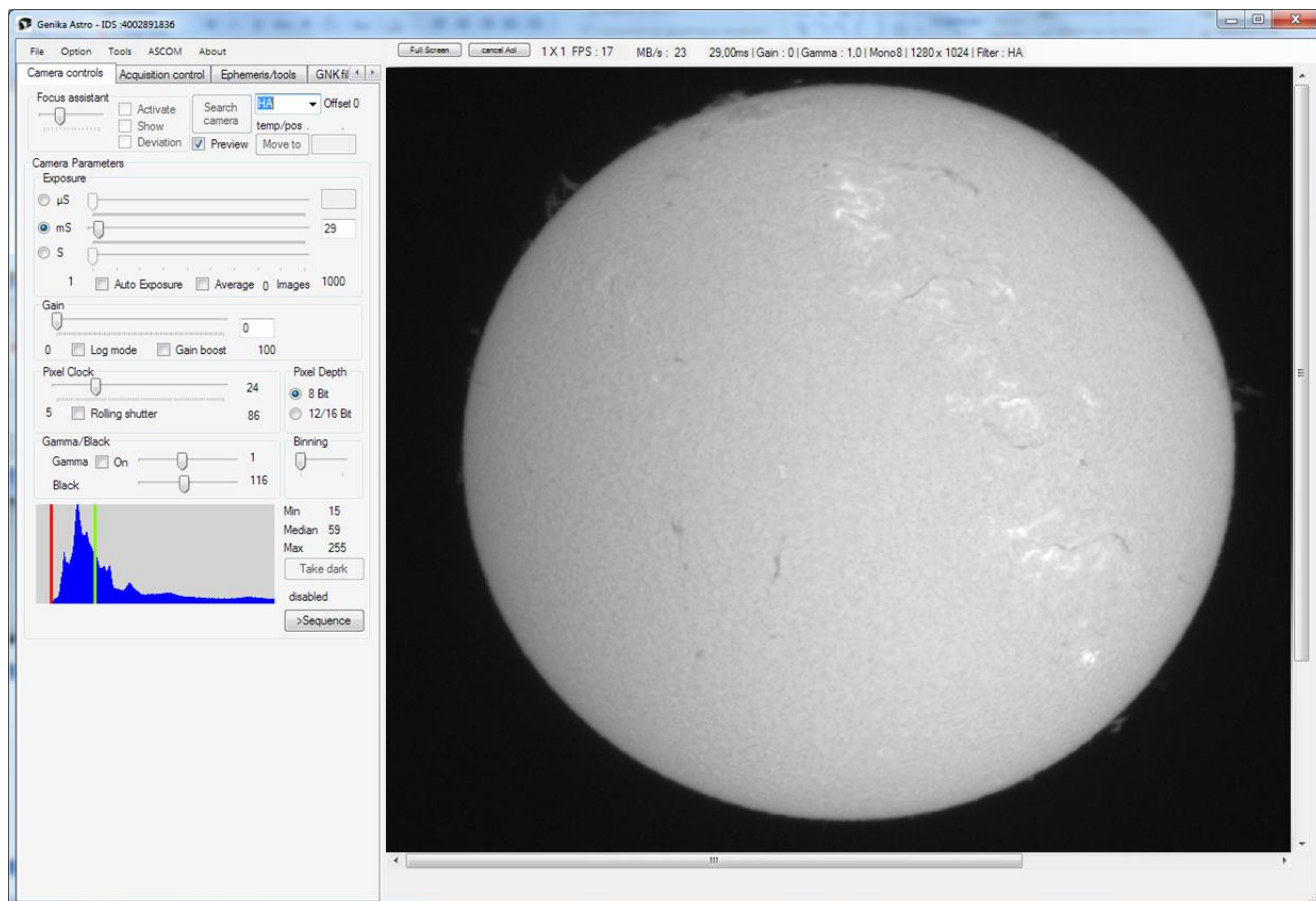
Note: if you disconnect the camera or switch of camera (same brand) Genika may recognize automatically the new camera depending on the camera supplier. You don't have to launch it again. If the camera isn't opened automatically you can retry with the *search camera* button.

Note: if two <u>**Basler cameras**</u> **are connected to the network, Genika tries to open the first one. If this one is busy, it will try to open the second one.** <u>**That allows to open two cameras with two instances of Genika Astro at the same time.**</u> **Nevertheless the configuration files are shared amongst the two instances. If you want different settings (directory, options…) it is recommended to install Genika twice in different directories.**

Note: If your camera is connected through a GE switch, the behavior is exactly the same as for a direct connection. Using your camera behind a router would severely impact the performances and is not advised.

If the picture is bigger than your actual screen, you can resize it through the zoom command in the *tools* menu or scroll the image around.

You can also reverse the image on X axis from the option window (Basler cameras).

Acquisition settings
The left tab gives access to the acquisition controls.
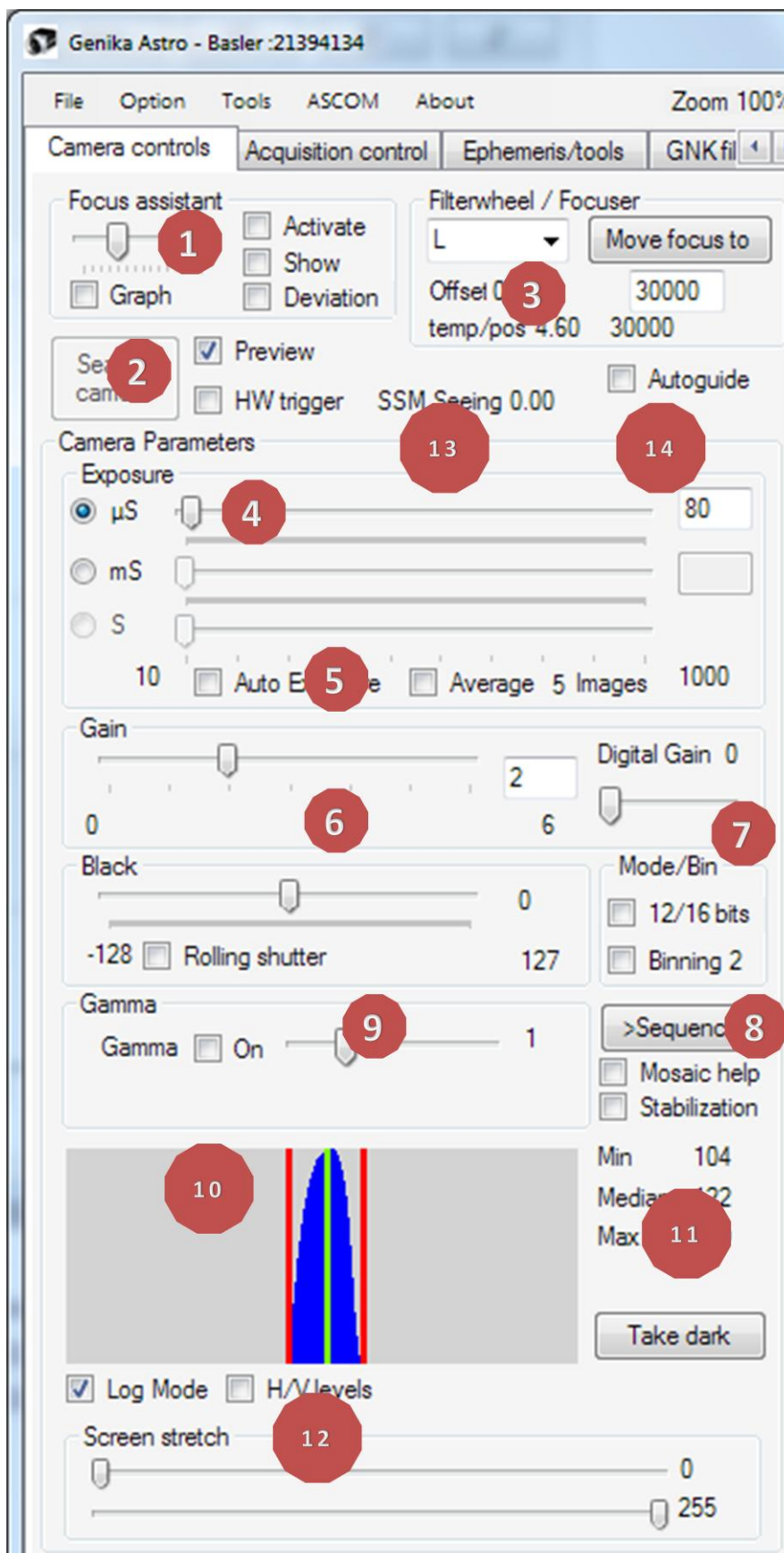
1. *Focalization assistant*: this feature provides you with a micro-contrast analysis tool that helps you for focusing your optical system. It is also possible to analyze the noise level of the image. This is explained in a dedicated chapter.

2. *Open camera, display and trigger mode*: if the camera hasn't been detected at launch of if you changed of camera or camera supplier you may start the camera detection using the *open camera* button. You may then launch image acquisition using the *preview* checkbox; and set up the hardware trigger mode.

3. *Filterwheel and focuser control* : you may choose the active filter from the list box. A default filter list is proposed. You can change the filter names editing the text file as described in a dedicated chapter. If you connect an Ascom filter wheel changing the filter name will move automatically the filter wheel and possibly focus position if an Ascom focuser is connected.

4. *Exposure* : Those controls allow to set the exposure time. Three sliders are available for microseconds, milliseconds and seconds. Note that all exposure time not available depending on your camera specifications. Sliders are linked to the input area. Sliders may also be moved using the arrow keys or your mouse wheel. Note that the exposure value will determine the final FPS, up to the maximum camera performance. The µS slider extends to 3000µS to solar imaging. Exposure range depends also on the pixel clock setting for IDS cameras.

5. *Gain* : The slider allows gain setting. Note that the min and max values can change depending on your camera model and other settings such as the pixel depth. The Lin/Log mode is available on some E2V IDS cameras. In that mode the gain determine the knee point between linear and log response. A secondary gain setting is available for some cameras.

6. *Black:* Use this slider to control the black level. Note some cameras don't support black level setting. TIS cameras don't support Black.

7. *Bit depth 8/12 Bits* : This setting specifies the pixel depth. It doesn't reduce the FPS, but increases the file size and the dynamic. 12 bits is a preferable choice if you can keep the gain low, such as for Lunar or Solar imaging. If the gain is too high, amplification will annihilate the additional dynamic of the 12 bits mode. Note that in 12 bits mode the maximum admissible gain is the maximum gain.

8. *Binning* : Binning is available from this control. Binning will increase the acquisition rate of your camera and decrease the resolution of a factor 4 for example for 2x2. Sensitivity will as well increase by a factor 4. TIS cameras don't support Binning.

9. *Gamma:* you may activate the Gamma and choose its value using the slider and the checkbox. TIS cameras don't support gamma.

10. *Histogram* : An histogram is available. You can select its refresh rate from *option* window. Histogram calculation is performed during acquisition as well. With very fast cameras you may want to decrease the refresh rate. Vertical bars show the Min, Max and Median values. If a subregion has been defined with the "focus" AoI it also applies to histogram calculation. By default the histogram response is a square(log) mode, you can have a linear response with the corresponding checkbox. If a mark has been placed on the image (right click), the value of the center pixel is displayed.

11. *To sequence, mosaic helper and dark frame*: the sequence button copies current setting to a sequencer line. It is possible to take a dark frame to correct hot pixels on the fly, the master dark is built with 10 frames averaged. The mosaic helper displays an overlay of the actual image with transparency to help with mosaic composition.

12. *Visualization threshold* : See description below.

13. *Seeing value* : When a SSM is connected, the seeing value in ArcSec is shown.

14. *Autoguiding engage* : When a mount supporting pulseguide is connected with ASCOM, this check box engage autoguiding.

Status and parameters status bar : It gives the real software acquisition speed and bandwidth throughput. If your hard drive isn't fast enough, with value will decrease after a while when the system cache is full. Acquisition parameters are also recapped in the status area, including the active filter.
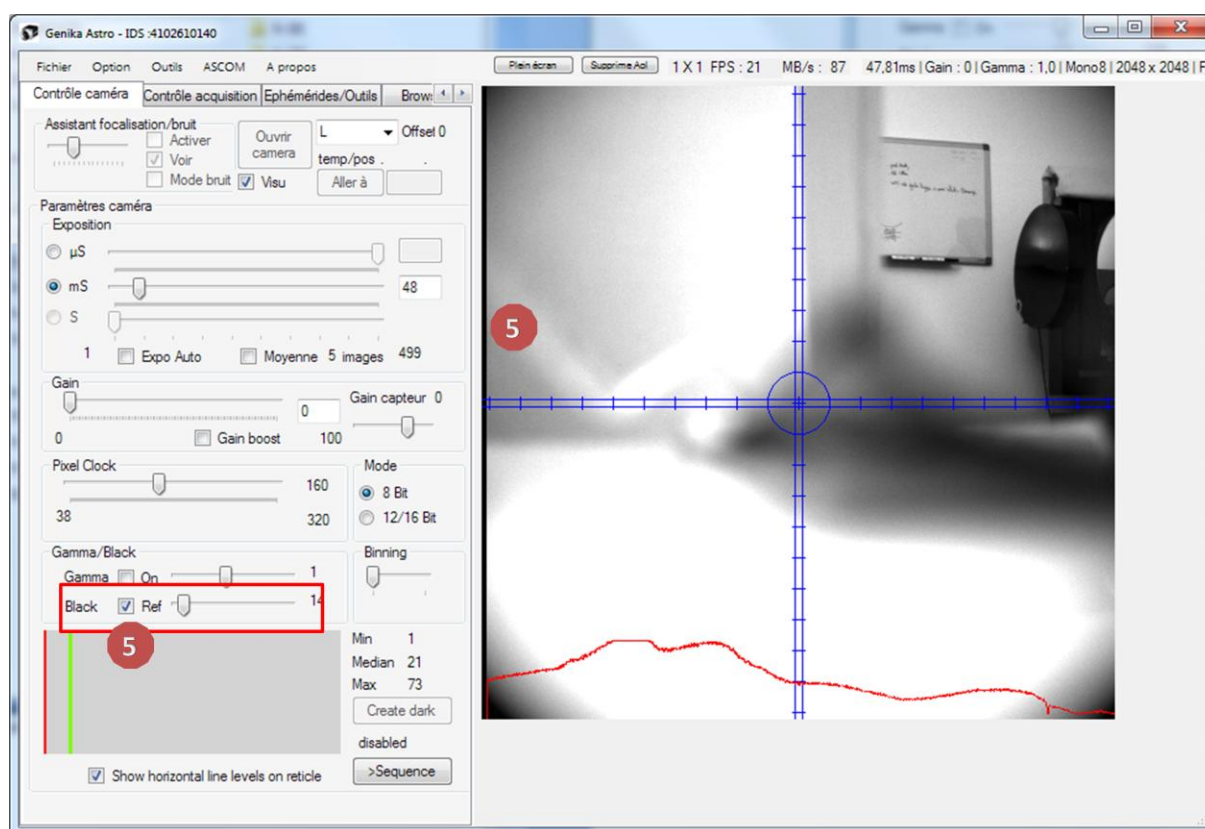
IDS camera specific settings

IDS cameras support specific features such as the speed used to read the sensor.
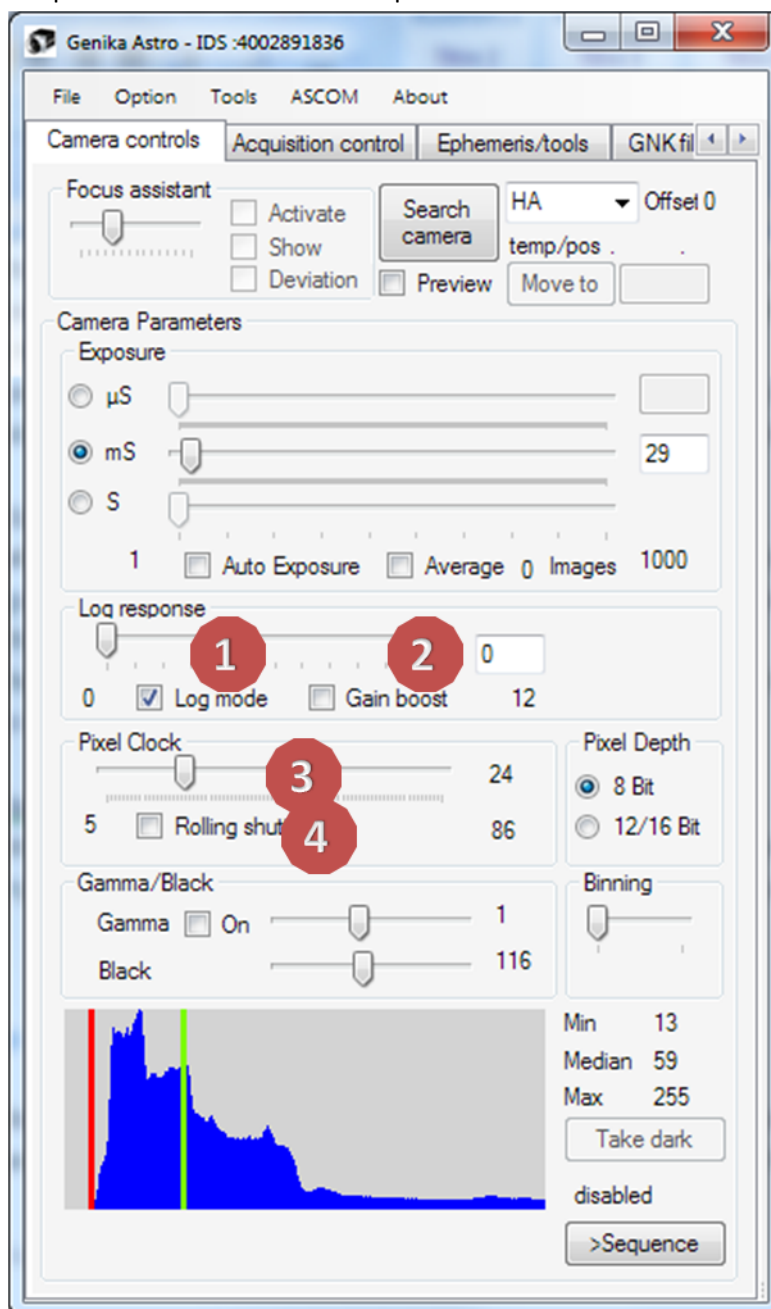
1 *Lin/Log Mode* : some sensors support specific ADU conversion known as linear/logarithmic. When the level reach the specific value the response mode switch from linear to logarithmic

to avoid saturation. You can activate this mode using the checkbox. The log response slider specifies the inflection point between the two response modes.

2 *Gain Boost* : this checkbox double or triple the gain value depending camera model.

3 *Pixel clock (IDS)* : IDS camera allows pixel read speed setting. This setting may change the exposure range and the throughput. When using a high pixel clock, frames may be lost because the interface isn't fast enough (USB3 camera on USB2 port for example). In that case reduce the speed until no frames are lost.

4 *Shutter mode* : Some camera supports both global and rolling shutter mode. The rolling shutter decrease the read out noise level, but introduce temporal discrepancies between pixels. It is recommended to keep the global shutter mode when exposure time is below 5ms.

5 *Black reference bar (CMOSIS sensors)* : you can display the black reference bar for the CMOSIS sensors with the *ref* checkbox near the bacl setting slider.
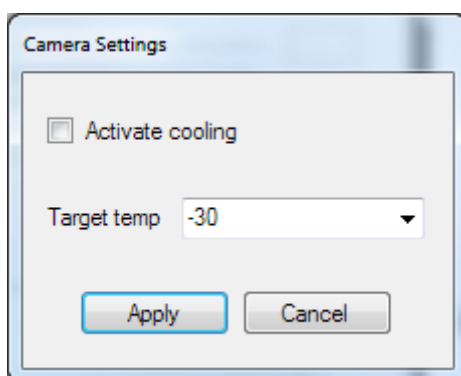
Andor Neo/Zyla specific settings

Andor cameras on Bitflow Camera Link frame have a specific gain/dynamic setting and can be cooled. Additionnal cooling/fan options are available through a dedicated menu *settings*
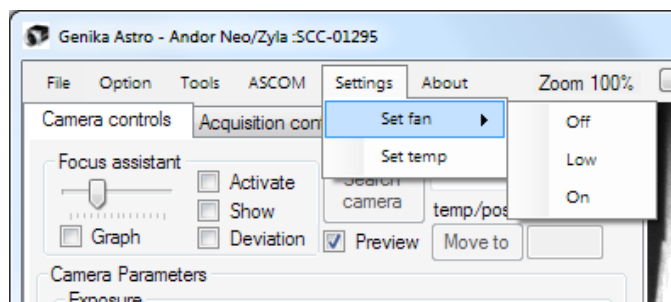
This menu allows you to choose the fan speed and the cooling temp and activity :

Actual Gain/well depth and dynamic are displayer in explicit text in the gain setting area :
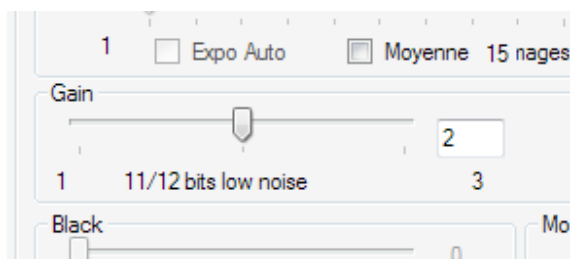
The dynamic setting depends only on the acquisition mode (11/12/16 bits). In 11 bits mode (Neo) the recording is performed on a 12 bits base, but the display is scaled from 11 bits. A saturated area will read a value of 2048/4096 in the file, but is displayed as white.

It is possible to change the overlapping setting in the option windows. With overlapping the camera throughput may exceed the camera link bandwidth and lead to latency above 30 fps.

Raptor photonics specific setting

As for Andor cameras, Raptors have a cooling management.
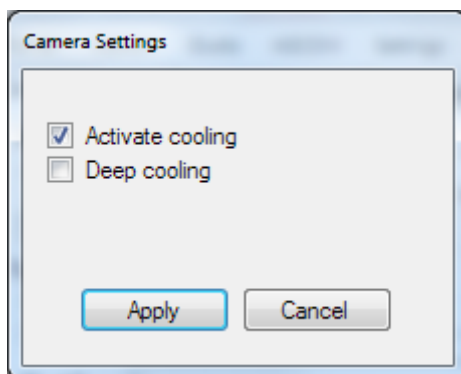
It is mandatory to select the camera model after choosing Raptor Photonics in the camera selector or the Option window. This is possible from the *setting/choose camera model menu :*
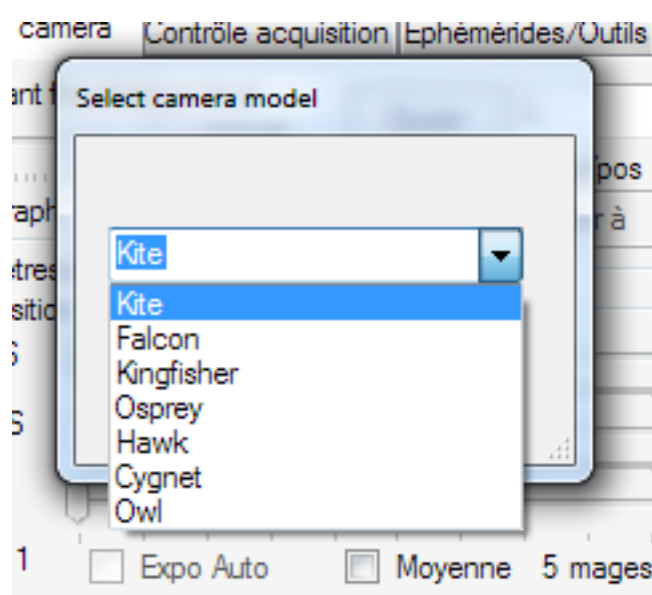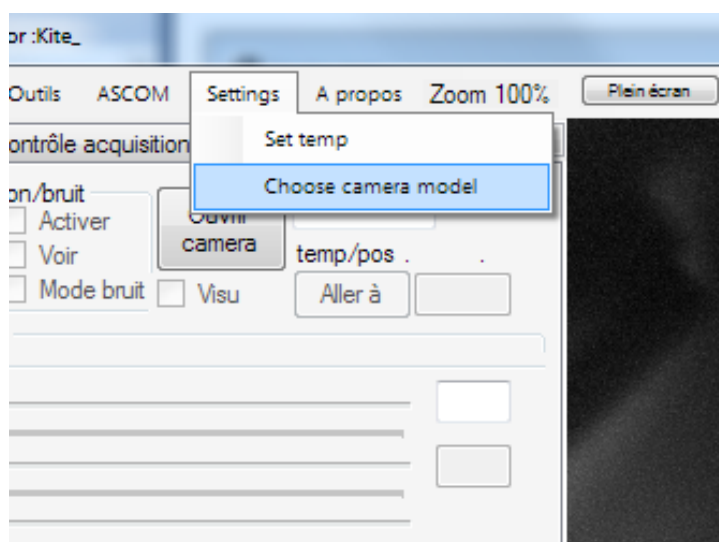


Then you must close and relaunch Genika Astro.

Color management

Genika acquires RAW images from color cameras without compression. Images are bayer processed for display and AVI only. Not that the RGB24 format for AVI uses three more time disk space than monochrome images.

| File format	Mode 8 bits	Mode 12/14/16 bits
SER	RAW	RAW
TiFF	RAW	RAW
GNK	Not supported	Not supported
AVI	RGB24	Not supported
ADV	Not supported	Not supported

Zoom

Zoom can be accessed through the view menu from 25 to 200%. It is possible to access directly to each zoom level with F1 to F4 keys.
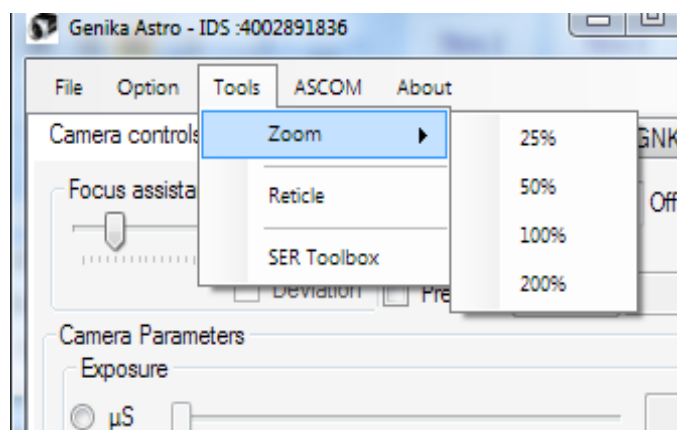

In DirectX mode, you can select more zoom levels by positioning the mouse over the image and using the mouse wheel or using page up/page down keys.

Current zoom level is indicated on the main window :
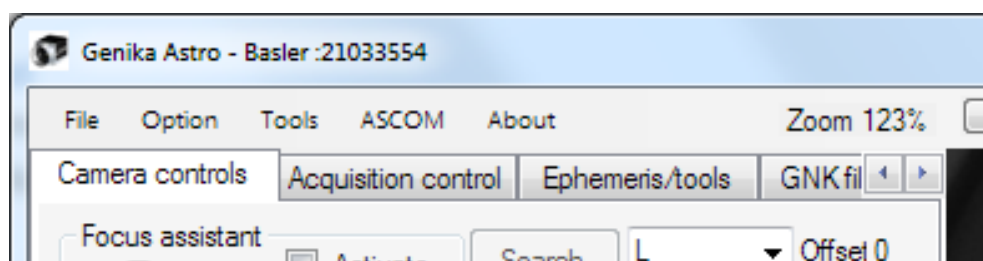
Reticle

A fully programmable reticle can be displayed on top of the image. The reticle shows a double cross cross with programmable ticks and programmable sized circle. Those two elements can be scaled in pixels or ArcSec if the ephemeris and telescope data has been set. You can access those elements from the options window.
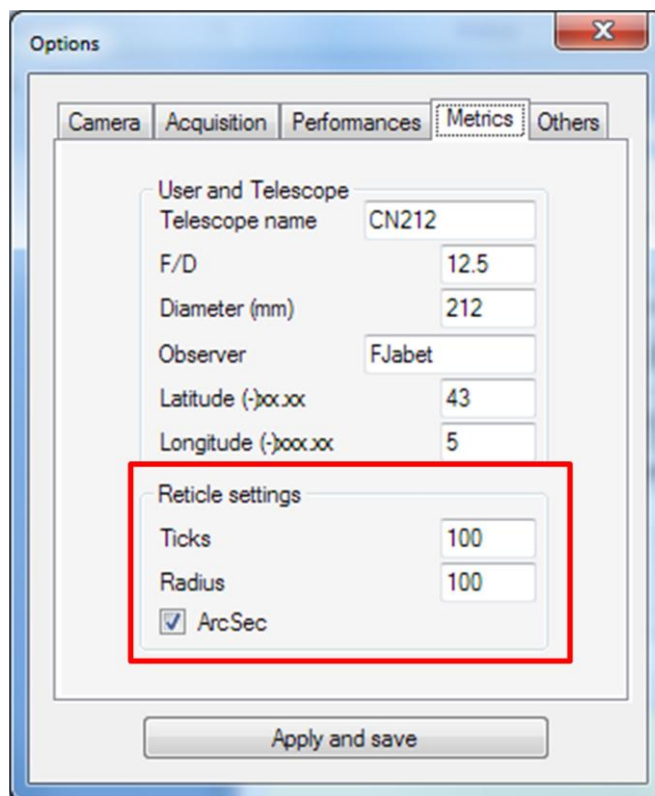
If an area of interest is being defined the sensor center is symbolized by a red circle.
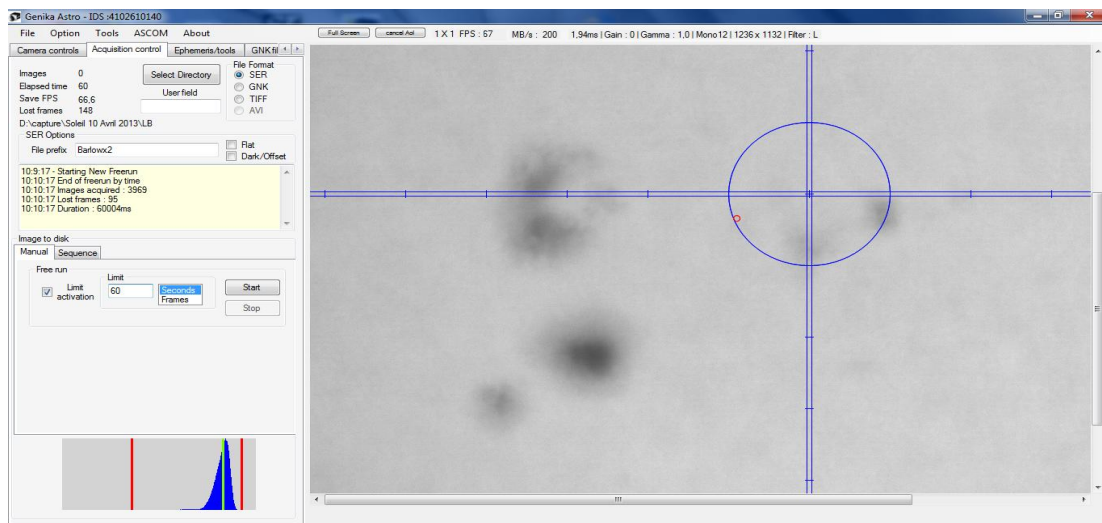

You may also define a mark on the image (green square) with a right click on the image. Click on the mark to remove it, or somewhere else to move it. The value of the pixel under the mark is then displayed near the histogram values:

Trigger Mode

A trigger mode is available for AVT, Basler, IDS and Raptor Photonics cameras. When this mode is activated, one frame is taken each time the edge rises on the first camera electrical input.
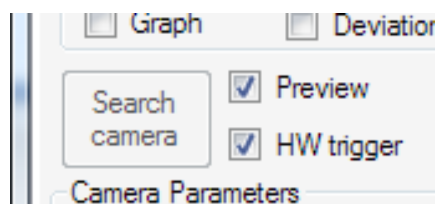
This feature has been implemented to slave the camera to a precise GPS clock. In that case, the precision is better than a few µseconds.

Note that if you need more advanced features such as burst mode, multi-camera synchronization, stereoscopy and more, you need to use Genika Trigger.

## Visualization thresholds and specific image rendering for monochrome cameras

Screen stretch

Genika displays the camera stream in 8 bits mode whatever the pixel depth is actually selected. This limit comes from Windows DirectX / GDI that doesn't handle more than 256 grey levels.

Genika has two user selectable sliders that select the low and high intensity limits for image display. It is possible to use a small ADU range to focus on the image real dynamic. For example in the case of a 16 bits image (Mono16) the image dynamic (0-65535) is compressed to 8 bits mode for display (0-255) with a linear response. The compression ratio is 256 (65536/256). If we set thresholds to 100-500, then those 400 ADU levels only are compressed to 256 levels, thus allowing seeing more dynamic although in a limited range. The ratio is then 400/256.

When activated, the threshold is also used for histogram calculation except for Basler cameras. If the low threshold value is above the high one, the image is inverted.
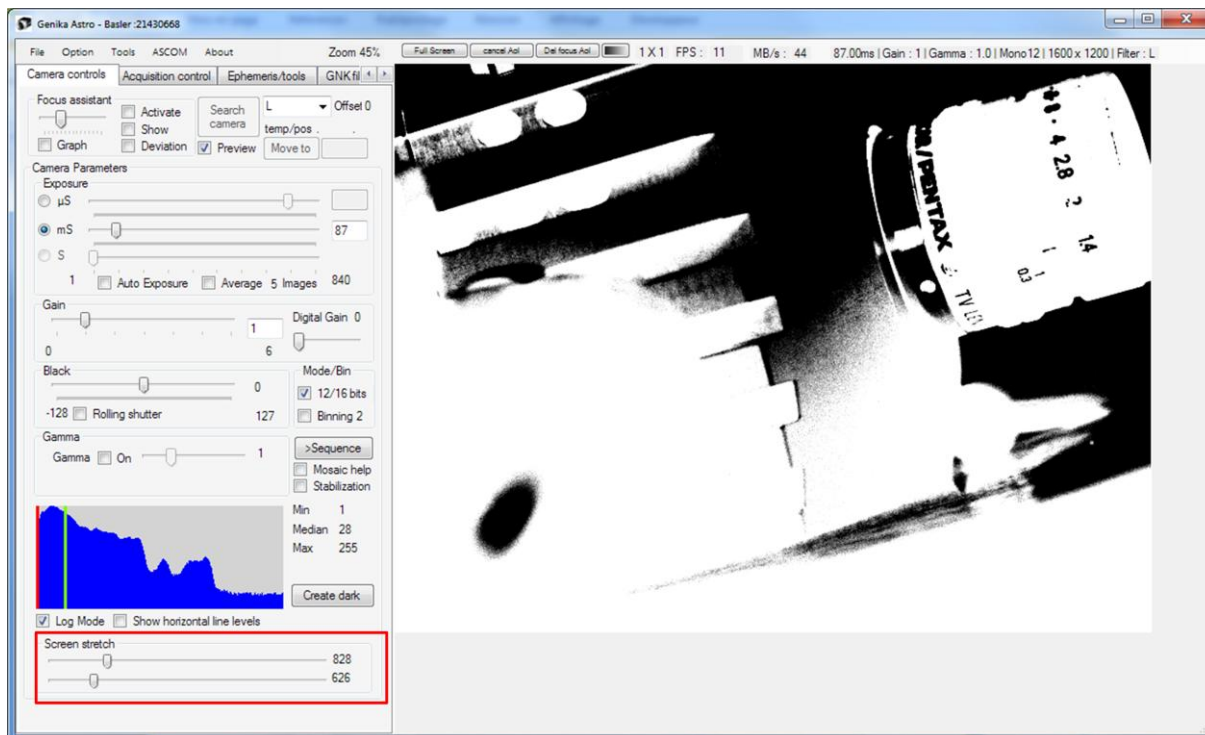
Here are some examples:
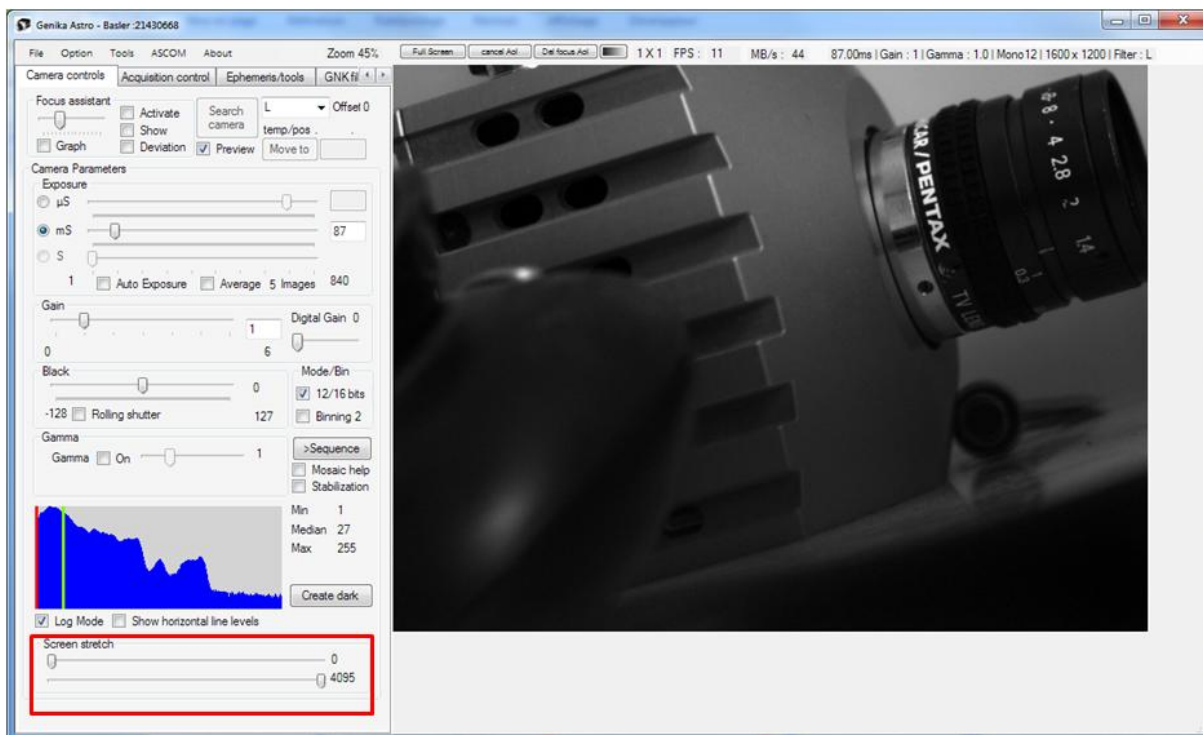
Full range display : no effect on image
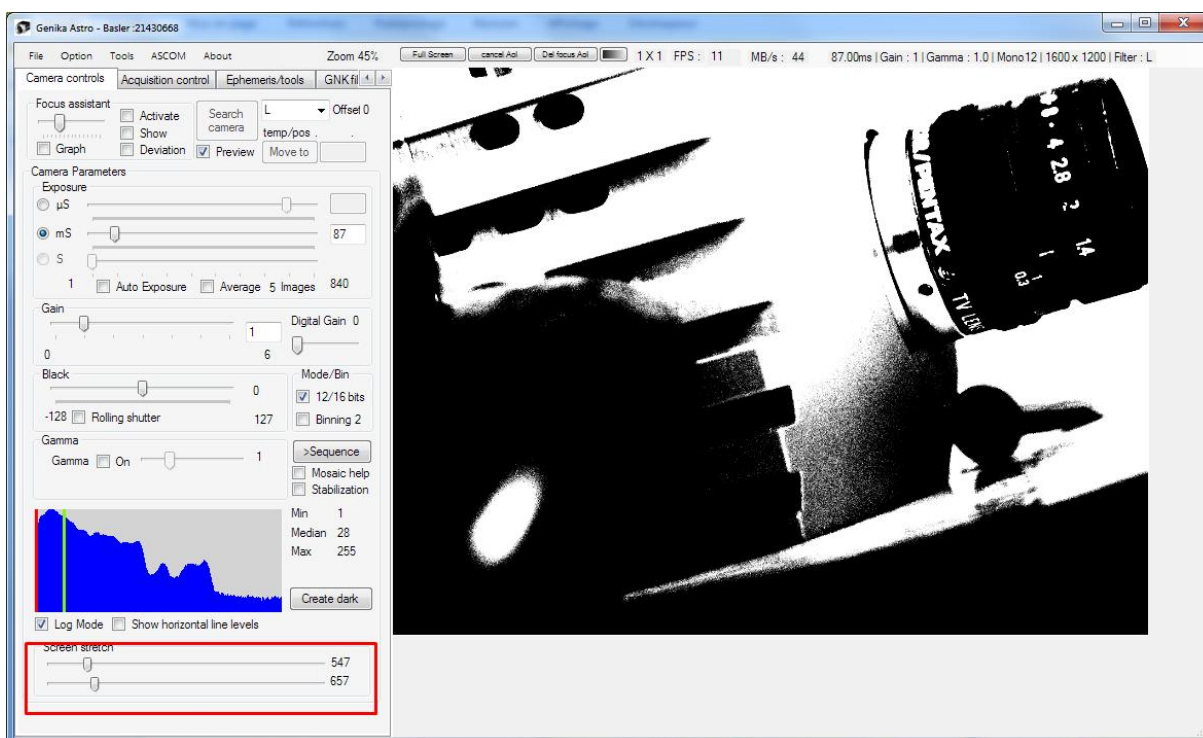
Highly stretched image: both thresholds are very close.

Inverted thresholds: the image is negative

False color image display mode

For all pixel depth it is possible to alter the 256 grey levels palette. Four modes are available:

Icon	Name	Rendering mode
	Standard mode	From black to white, linear response
	Spectrum ramp	Back is black, intermediate levels from blue to red, white (saturation) is white.
	Negative mode	From white to black, negative image. Linear response.
	Log	From black to white, log response to see low keys.

Note that the rendering mode cumulates with the screen stretch thresholds.
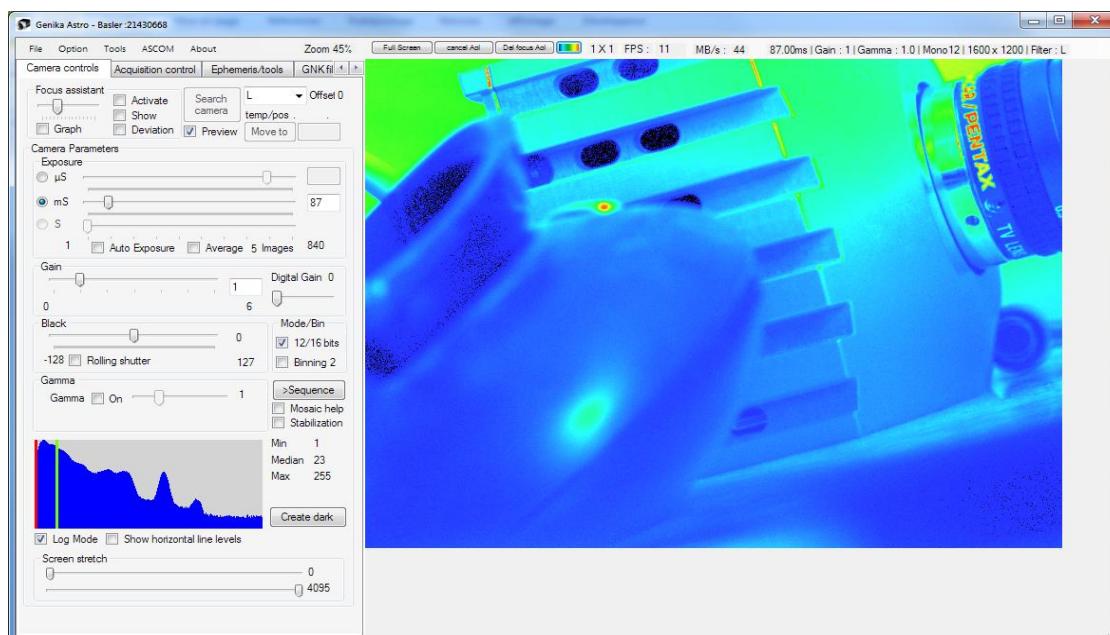
Spectrum ramp mode
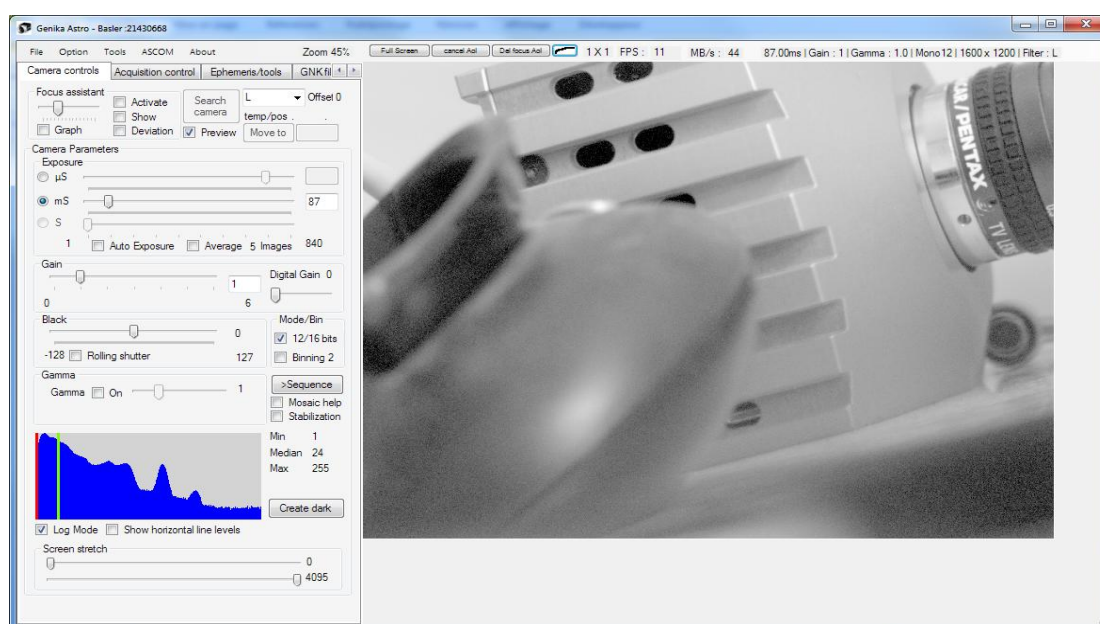
Log mode

Horizontal and vertical levels

Genika can show the signal level on a selectable line and column when the reticle is shown by using the checkbox under the histogram. Level display suspends histogram calculation and is refreshed at the same rate. It is possible to select the central position with a right click on the image.
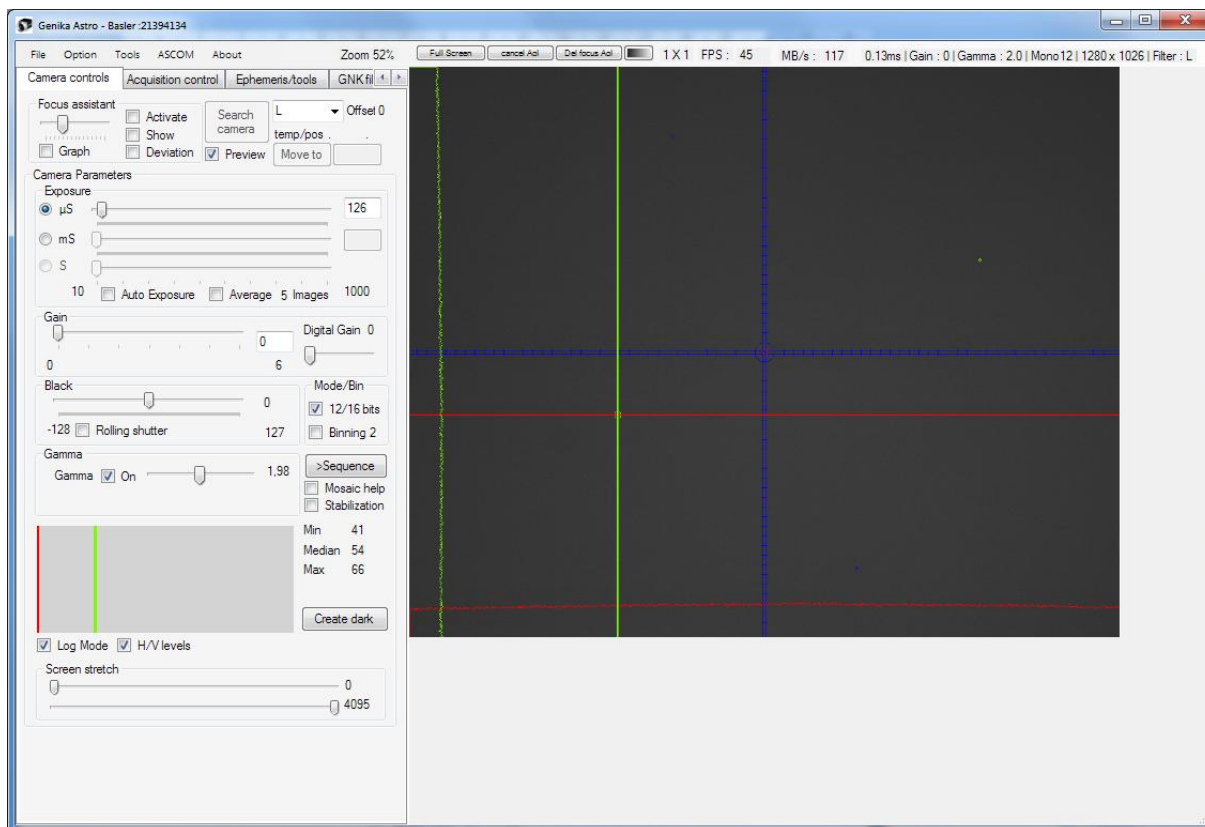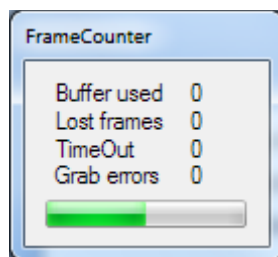

Grab statistics window

You may display statistics from the camera acquisition from the *options* window.

This window shows you the number of buffers actually used by the camera, the number of frames that have been lost, the number of time out and grab errors. A progress indicator shows the elapsed exposure time if exposure is above 990ms. In case of high CPU load the number of buffers being used will increase up to 24. Then the application starts to lose frames. If it loses more than 100 frames in a row the acquisition would stop and a window notifies you that load is too high.

You should then do whatever is necessary to reduce the CPU utilization such as choosing an another file format, reduce acquisition rate of check that your computer is not in energy saving mode.

If you lose frames with USB3 interface, please refer to the USB3 chapter in performance section.

Camera settings resiliency

Gigabit Ethernet camera setting are preserved even after power out. Genika automatically initializes with the current settings at connection.

Hot pixels and offset correction for CMOS IDS cameras

IDS cameras support sensor artifacts hardware correction. The settings are available from the option window. That includes hot pixels correction and fixed pattern correction depending on the camera model.
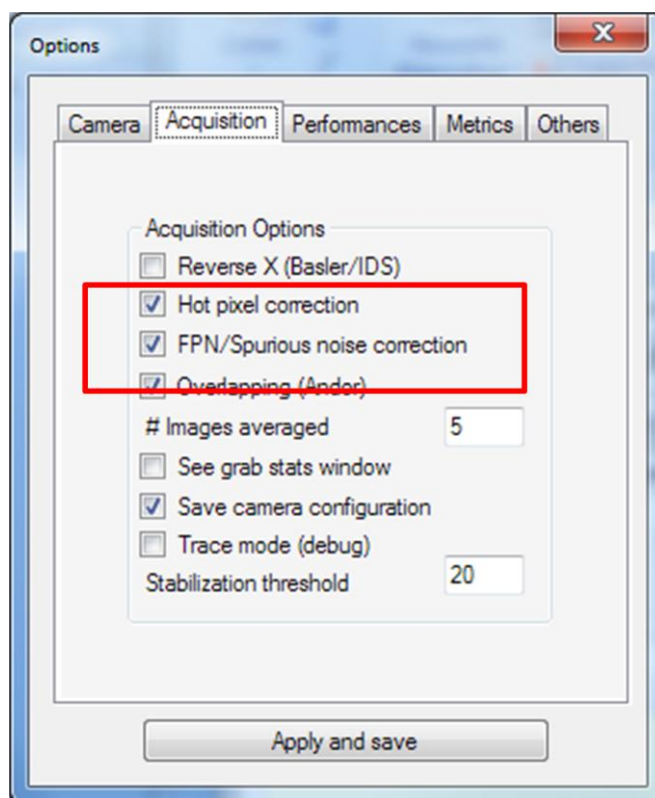
Software Hot Pixels correction

Basler cameras have no hardware pixel correction system. Genika Astro embeds software correction on the fly. You have to launch a hotpixel discovery from the menu tools, then cover your camera sensor. Genika acquires an image with 500ms exposure and ¾ gain and then reports the number and location of the hot pixels :
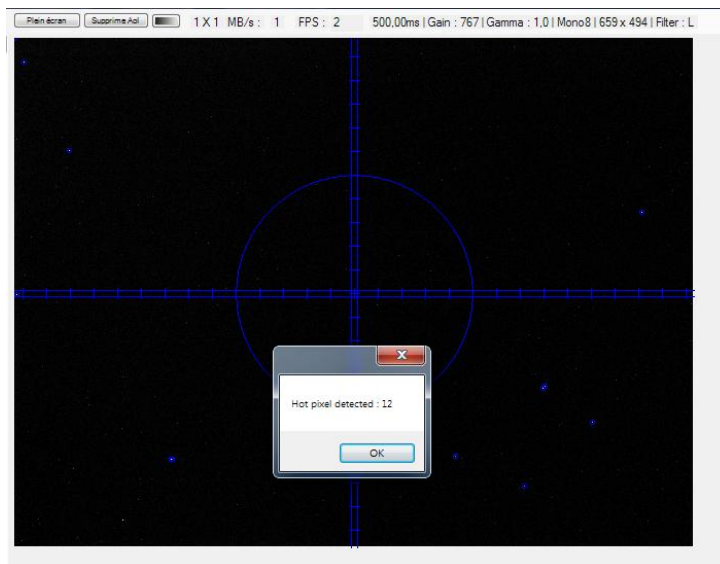
The map is stored in a txt file named after the camera serial number.

The correction is enforced when this file is present.

Image average

Genika can average images on-the-fly. The number of images to be averaged is specified from the option window. Note that this feature requires high CPU utilization and therefore should be avoided at high rates.
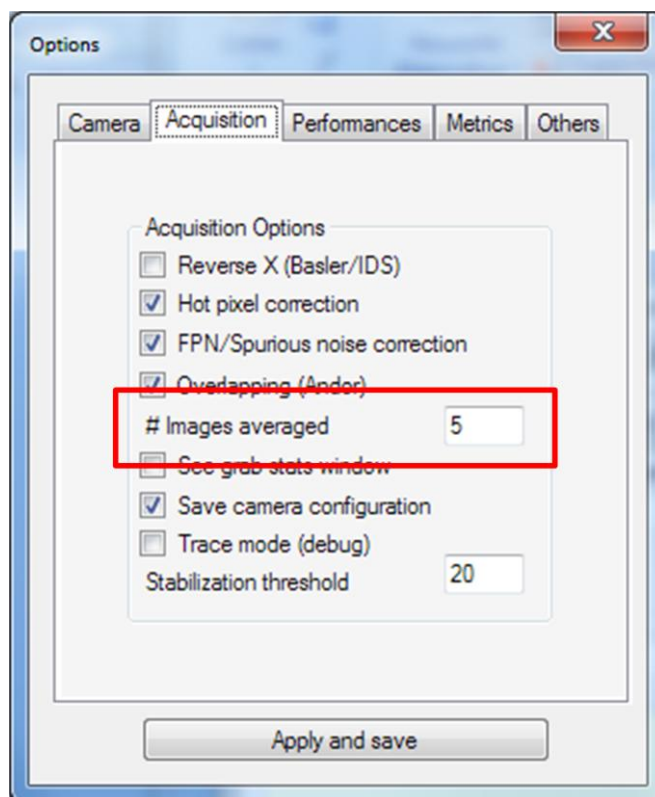
Saving and loading camera configuration

It is possible to load and save camera configuration (Basler, IDS, AVT). When doing this you retrieve the exact configuration including area of interest and binning. The configuration can be saved automatically at the start of an acquisition or sequence. This option can be set from the option window.

Not that in sequence mode only the first occurrence for each line is saved.
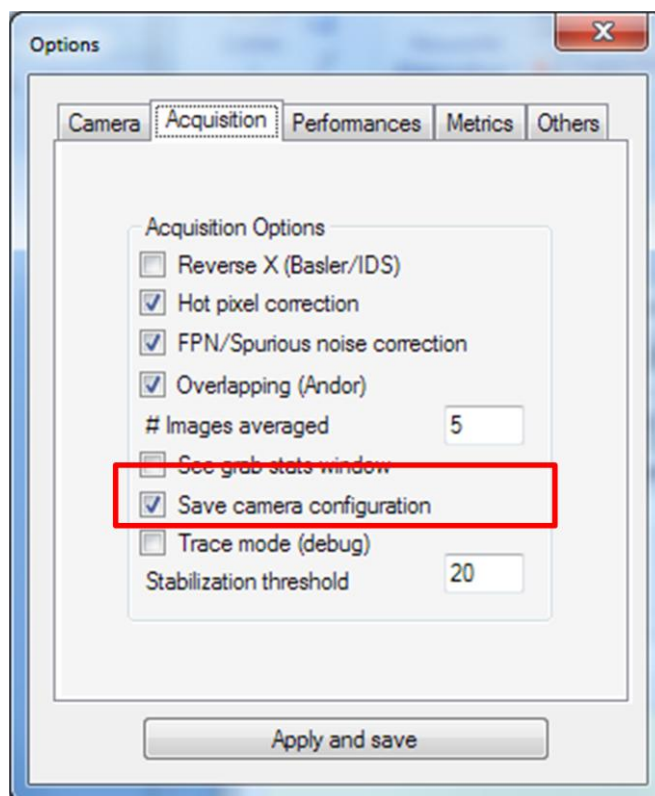
Area of interest

It is possible with most camera to reduce the area of the sensor that is acquired. These saves disk space and increase the achievable frame rate. Usually the frame rate depends on the number of lines within the acquisition area. Note that The Imaging Source/Celestron cameras don't support hardware AoI.

You can specify the area to be captured by clicking on the image and drawing a rectangle. A window then appears to resume the area of interest sitting and get confirmation. The Area of interest is then enforced.

It is not possible to define another area of interest while one is already active. You need to cancel the current sitting using the cancel AoI button.

Area of interest is difficult to produce using mouse selection. Also it is wise to save the camera configuration should you need the very same setting for example for flat or offset acquisition. That can be performed automatically from the option window.

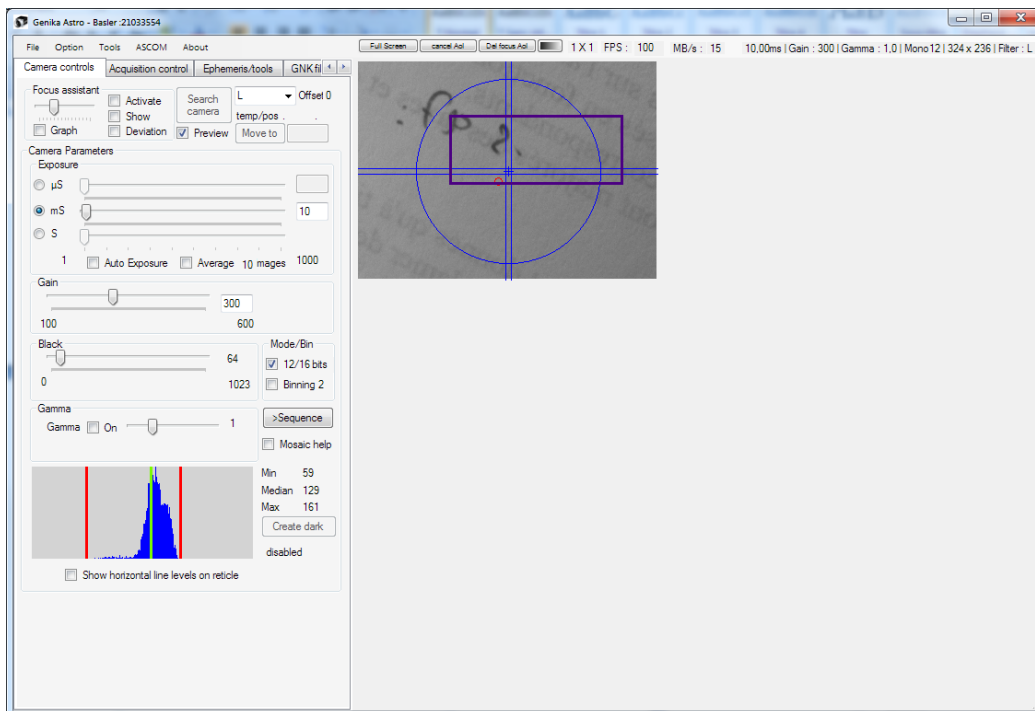It is also possible to enter manually the AoI setting from the AoI confirmation window.
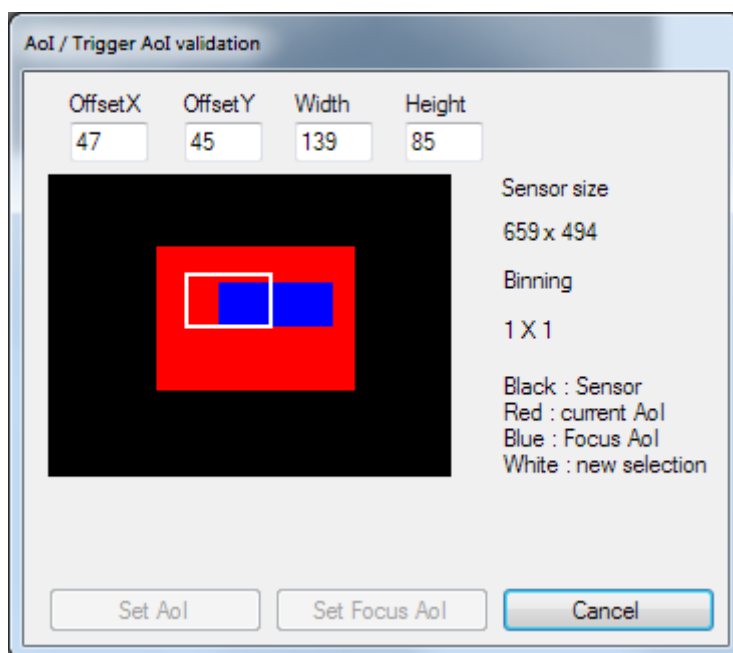
The focus AoI allows limiting the image area on which some calculations are performed, that includes:

- Focusing
- Noise analysis
- Histogram

When the reticle is shown (Ctrl + R), the calculation AoI is displayed as an indigo rectangle.

AoI and "focus" AoI can be cancelled from the button above the image area:
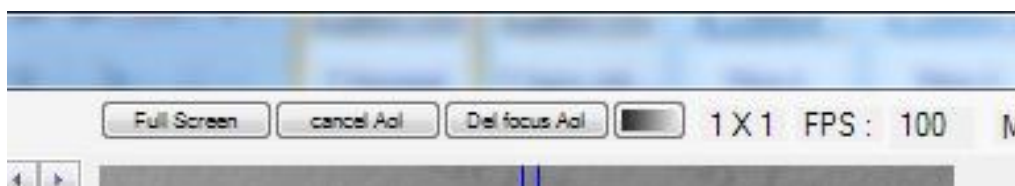
Focus assistant

Genika integrates an assistant to find the best focus by local contrast analysis. This algorithm is very efficient on large surfaces as the Moon or the Sun unlike the FWHM analysis that shows limited interest in planetary imaging. Assistance to the focalization is accessible from the camera control tab.

Note that the focus assistant and noise analysis canbe performed on a subregion of the image when activating the "focus" AoI. This if very useful if your hardware can not cope with a full image analysis.
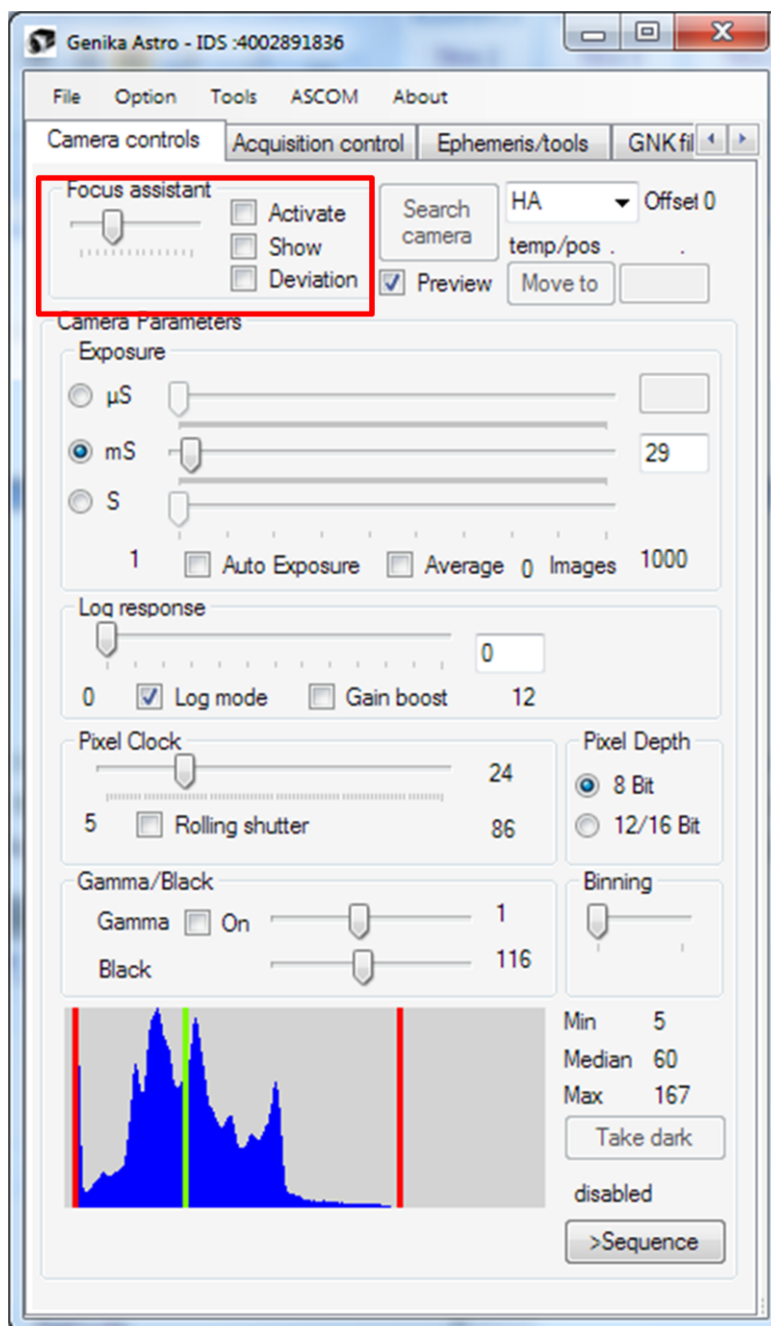
The trackbar defines the sensitivity of the analysis. A low value is suitable for clean and contrasted images, a higher value is recommended for high gain (noise). A bar appears on the left side of the image. The larger the bar is and the closer you are from the focus.

Focusing procedure :

The method used for analysis is relative and you need to browse the focus range to determine the best focus.

The first stage, after having opened the window, is to sweep the area your focuser. The bar keeps at the maximum up to the focus, and then decrease then when the point is exceeded:

level

Focalization
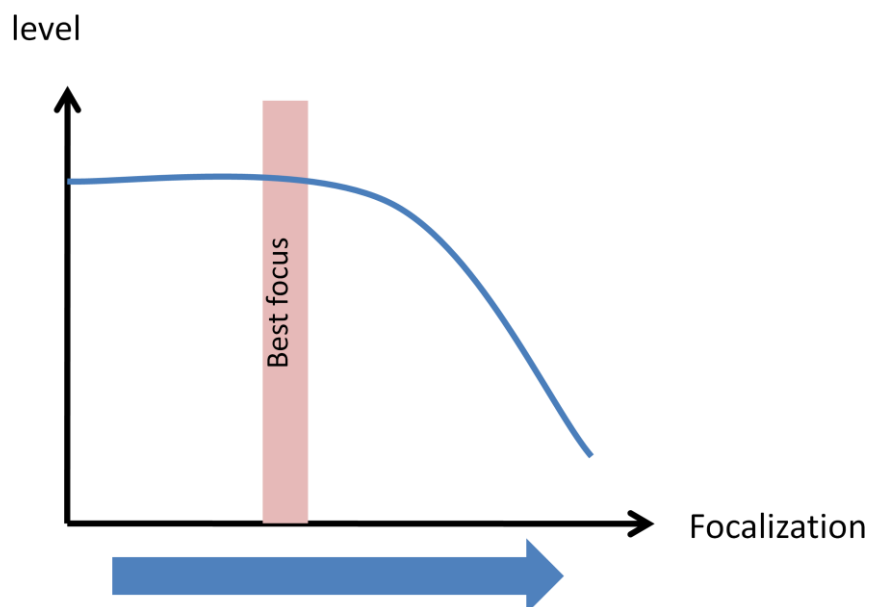
You can then go back until the bar returns to the maximum level: you're in this position at the best focus. You can refine this position by moving back and forth around this position.

level

Focalization
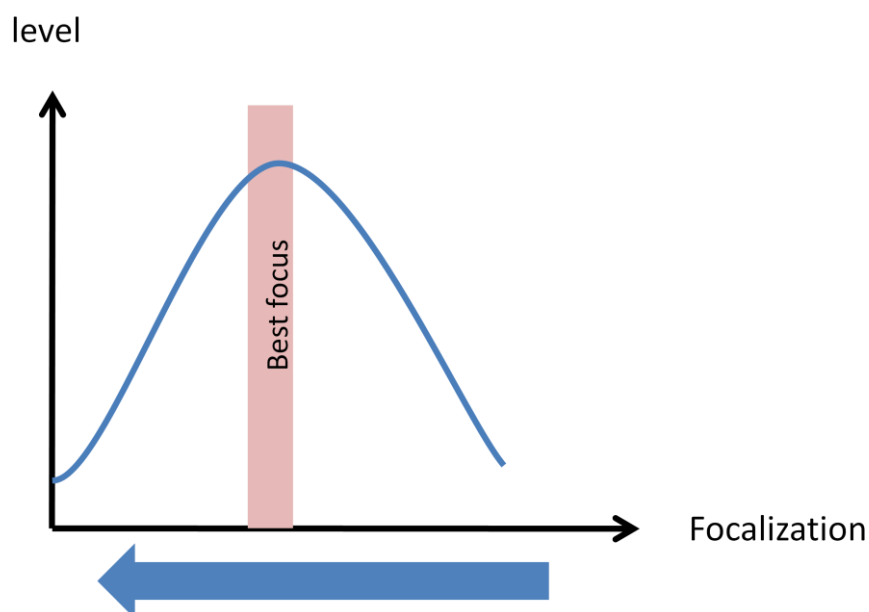
This method works in both directions (to extra intra focal or the reverse). If your exposure time is long, you must move slowly on the axis of focus: Genika averages 4 images to reduce erratic movements of the focusing bar.

To refine the measurement, you can chain several round trips. If you change of framing or if an object slides out of the scope of the camera, you must reset with the *Reset Focus* button. The procedure must then be repeated from the beginning.

Notes regarding the focus assistant

Planetary imaging (Saturn, Jupiter, Mars…)

Surface contrast is very low on those objects : focus must be calculated on the edge. Advised parameters are :

- Over expose the planet surface so that most of it is clipped
- Set sensitivity to 15

Lunar and solar imaging

In those cases the surface details are contrasted enough for Genika to use a correctly exposed image and the default sensitivity.

Using micro-contrasts visualization

The micro-contrast display mode allows to work visually only on the local contrast levels to converge intuitively the focus.

When this mode is activated, local contrasts are displayed as a green overlay on the image :
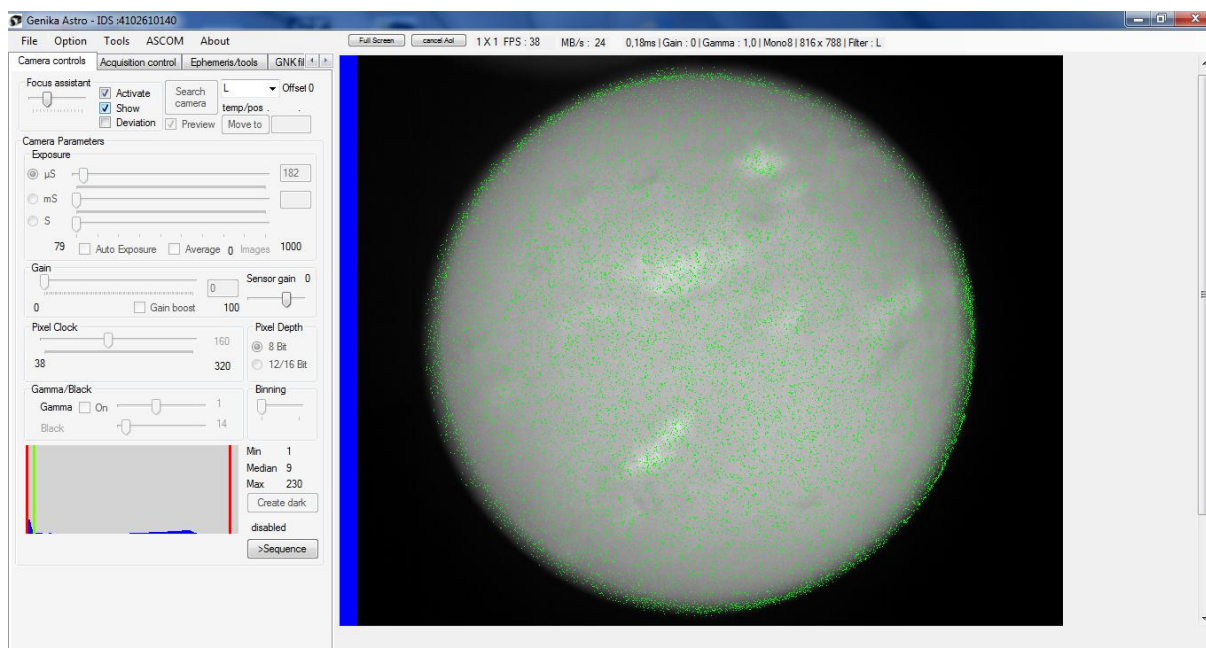
If the sensitivity is set too low the noise generated by the camera is taken into account. In that case set the gain to the minimal value that avoids this situation.

When closing on the correct focus the object edges appears :

The bar value decreases once the correct position is passed on.
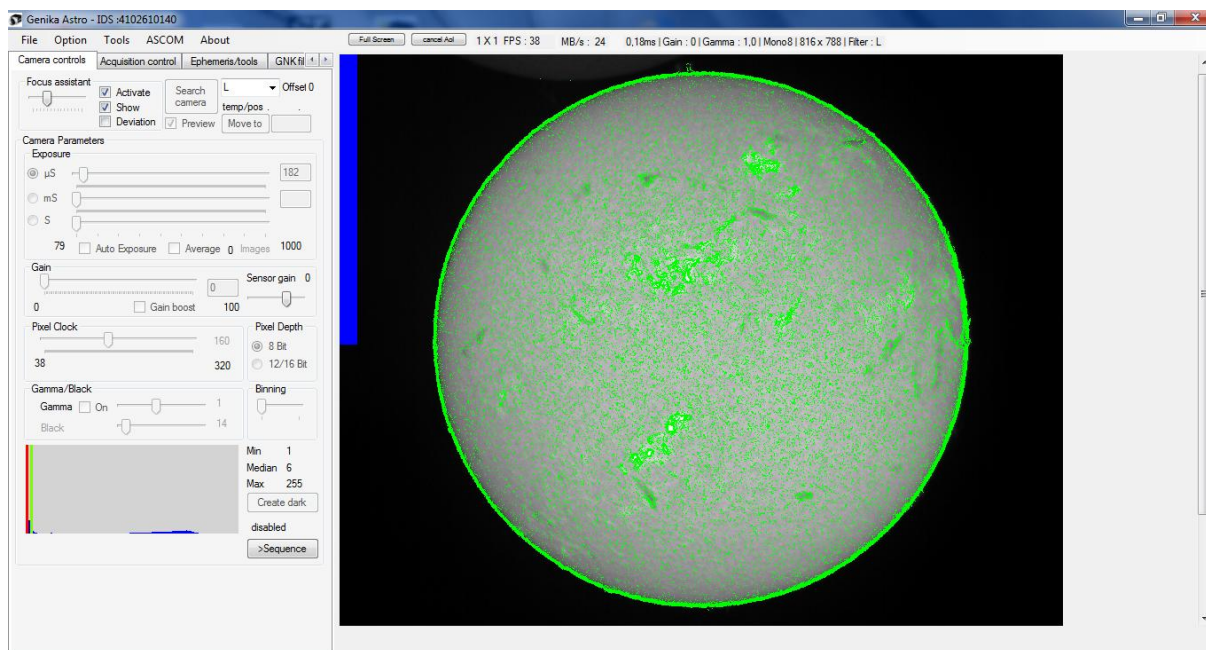
Until you reach focus and the bar is complete :
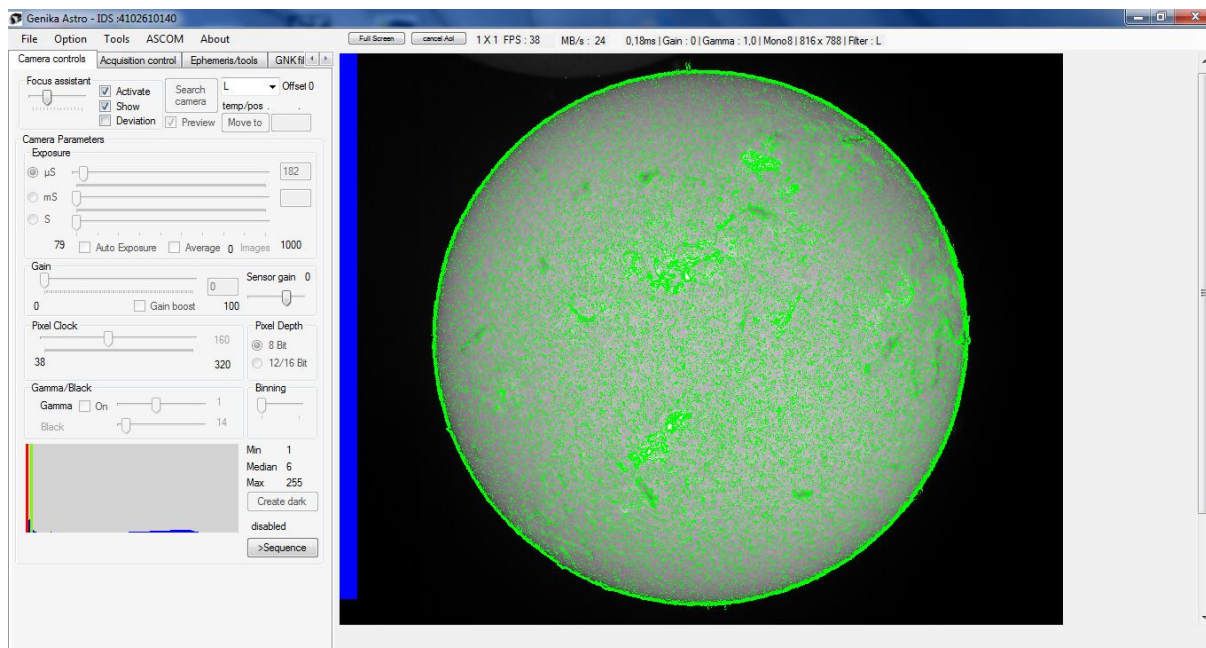
It is possible to increase the sensitivity to work only on the object boundaries:
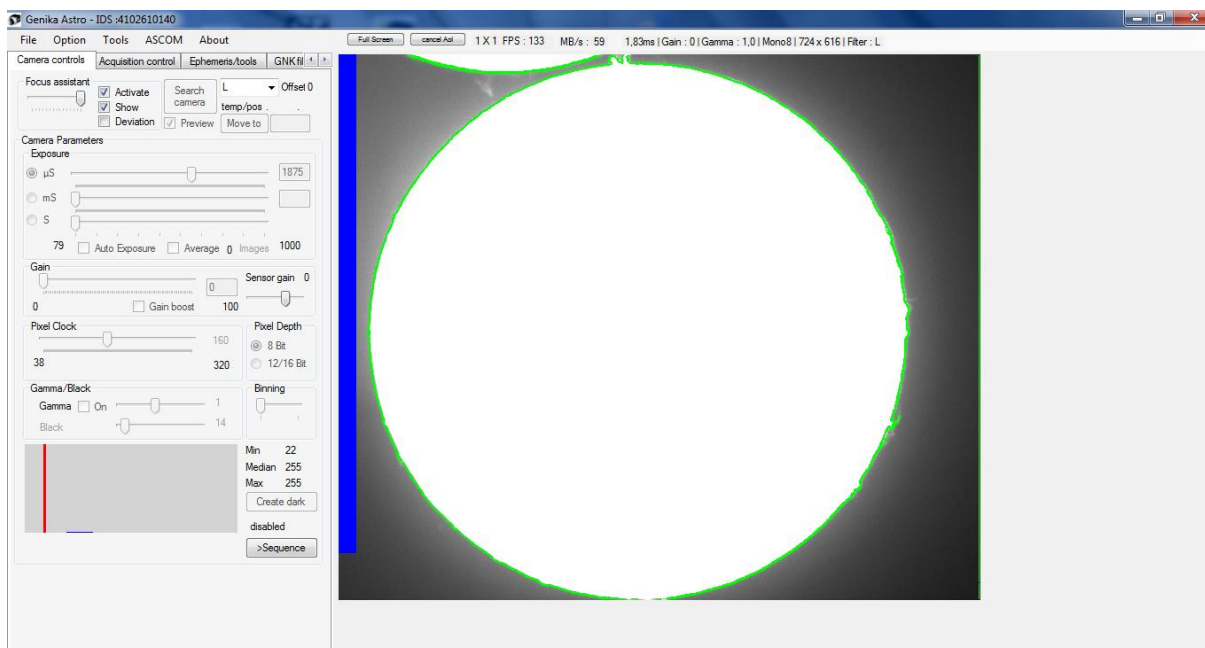
For low contrast objects or if the seeing is poor we advise to use the enlarged analysis mode. In the example (solar HA imaging) this mode makes possible to focus very precisely on the proms :
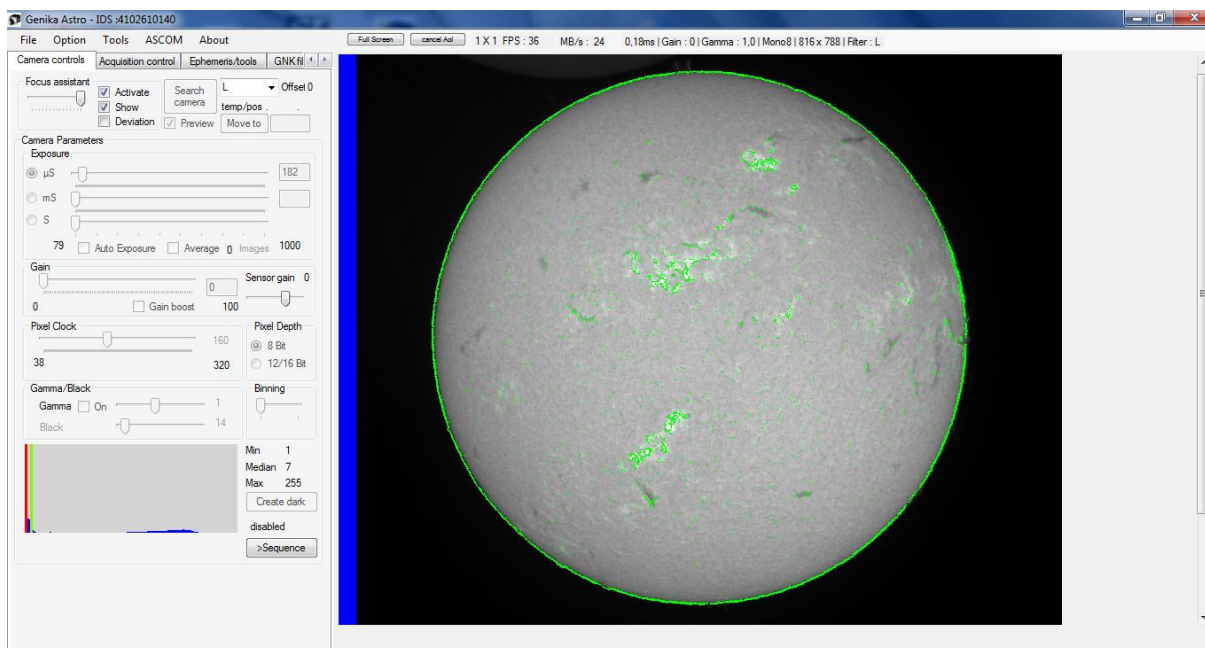
Noise analysis

When checking the deviation checkbox the focus assistant switch to noise analysis mode. In that mode the green spots show pixels that changed more than the track bar value in ADU since the last image. The number of pixels that changed is displayed on the upper left part of the image.
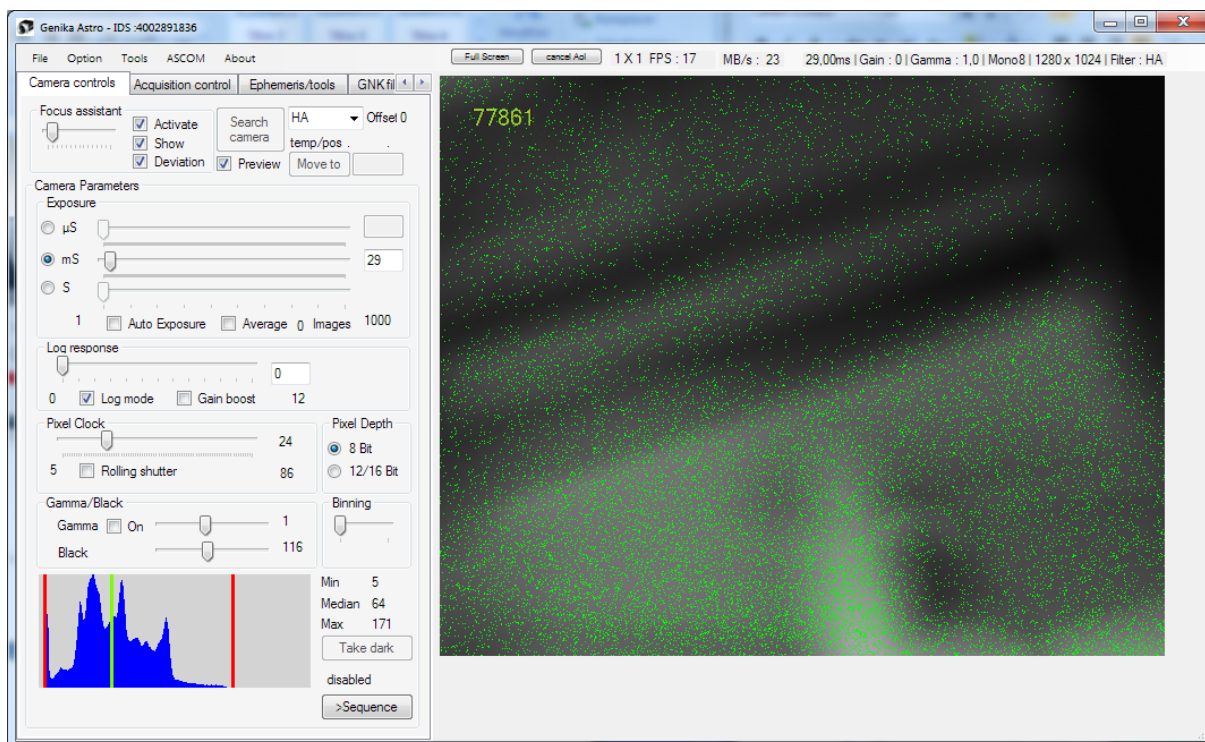
This mode is very useful to check acquisition parameters impact on the noise level : gain, shutter mode, black level…

Focus and noise chart window

It is possible to display a history chart for the focus and the noise analysis.

The graph activation button is in the focus assistant group.
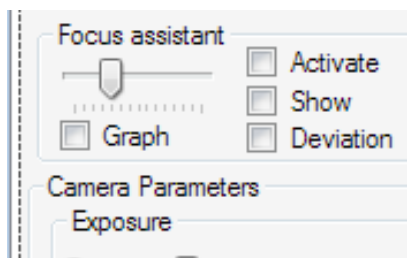
The graph shows the focus level (100 is maximum) or the noise total entropy with the blue line.

The red line is the moving average of the last 20 images. The reset button clear the graph.
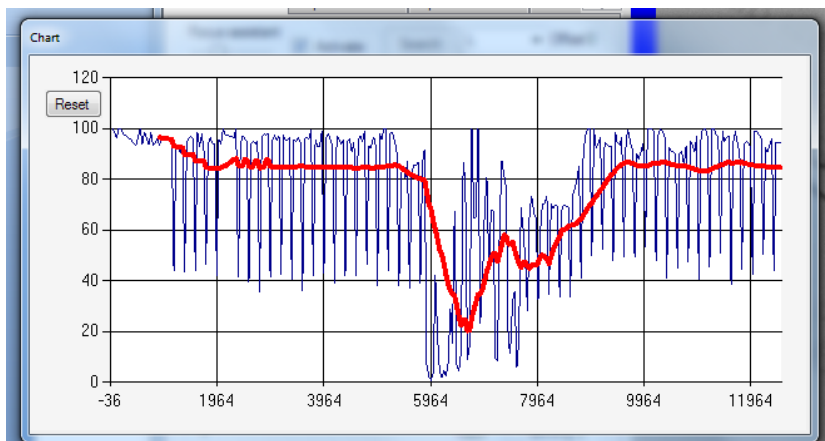
When selecting in the option window the *save chart data to file* option, a file with the entropy history over time is created for further analysis.
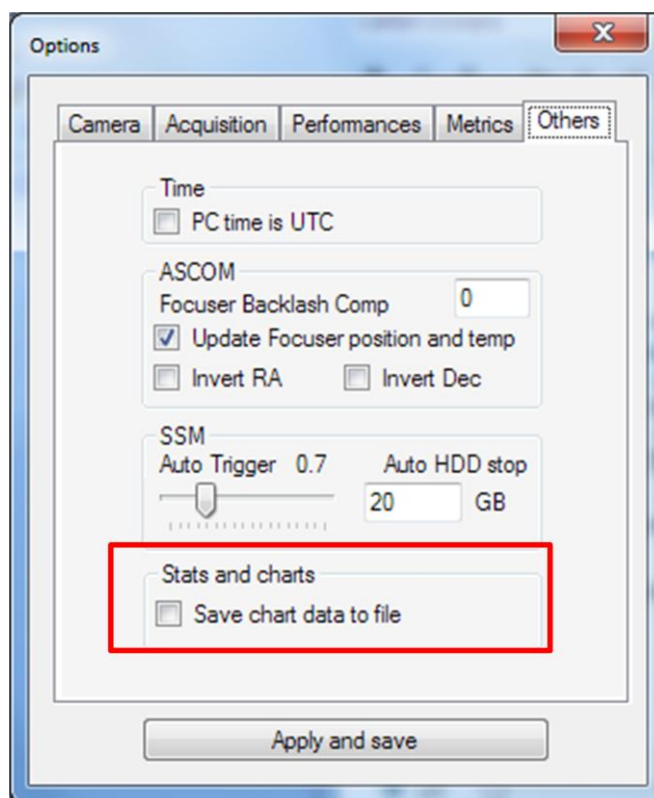
Autoguiding

Genika Astro can autoguide **by Center of Gravity** (CoG) **or phase correlation** when an ASCOM mount is connected. The mount must support the pulseguide orders, and the correction rate is set to x1 sideral speed. You may connect the mount through the ASCOM menu.

Note that the digital sampling must be accurate. Use the option window field to specify the actual diameter and the F/D. In case of doubt, you can use the auto F/D detection from the ephemeris tab and check the actual digital sampling value.

Genika doesn't provide any calibration tool, therefore the width of the camera must be the RA axis, and the height the Dec axis. Turn the camera accordingly to match this requirement.

You may reverse the axis direction and select the guiding mode from the option window:
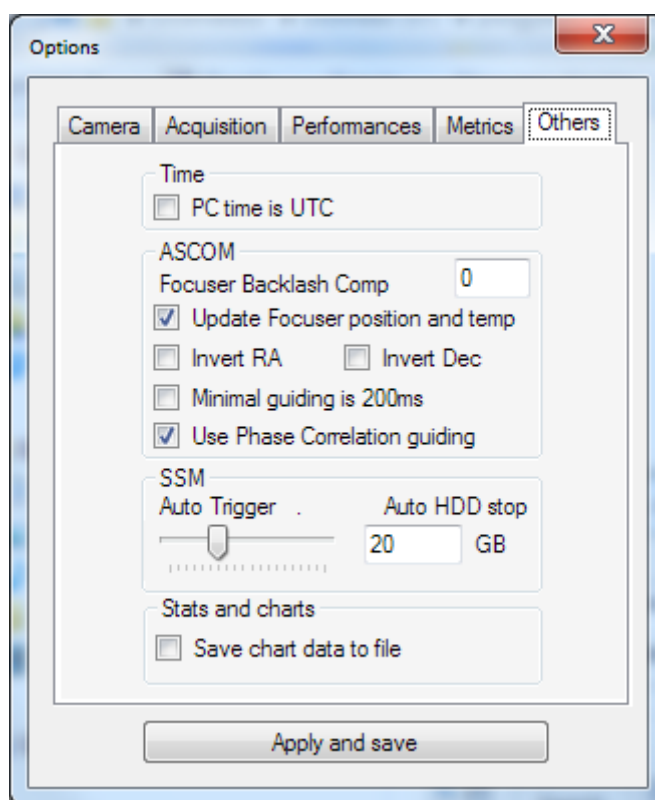
You may then engage autoguiding with the checkbox.

- Guiging is performed every 5 seconds
- Guiding correction are 1s max on each axis
- Guiding won't occur if the correction is less than 200ms at sidereal speed unless the check box is unckecked.
- Guiding order in RA and Dec are sent in sequence for mounts that do not support both axis correction
- Guiding speed is forced at x1 the sideral rate
- In x64 bits mode, use the POTH to manage 32 bits ASCOM drivers

Guiding with center of gravity

This mode is suitable to planets and objects that are completely inscribed in the camera FoV. The first CoG position is the reference position: guiding orders will try to move back the CoG to this position that is displayed as a small green circle on the reticle. The cyan circle shows the actual CoG.

Guiding with Phase Porrelation

This mode would correct slow drift over a long period of time for surface of the Sun and the Moon. A 512*512 pixels area with sufficient visible details (ex : solar spot or active zone, moon craters) is defined using the right click mark on the image. The mark should be at least 256 pixels away from the image boundaries. A reference image is taken and all subsequent images would be compared to this one to analyze the X/Y drift. A window appears to show the reference image and the actual.

Depending on the object selected the reference image may change or not:

- For any object BUT the sun, the reference image is taken at the beginning of guiding once for all.
- For the Sun, the reference image is updated every few minutes to adapt to the slow features modification of the photosphere and chromosphere.

If you choose a moving reference (ex: sun's prominence), the guiding would follow it.

Optical alignment assistant and PSF analysis

Genika Astro has an optical alignment ("collimation") tool to help you with the fine alignment of your telescope for high resolution imaging. It brings also PSF (airy disk) analysis and transformation tools.

Your telescope should always be aligned with a high magnification star image near the target you plan to image. A proper F/D ratio is between 20 and 40. Unfortunately seeing condition often prevents you to get a clear PSF (Airy disk) image. Genika assistant aligns and stacks on the fly star images to average the seeing and get a clear PSF image that will help you to get the best alignment based upon the first and second diffraction disk image.

Alignment procedure

Before starting you should have already made a gross alignment using the secondary mirror image with a defocus star image. Then you can focus and center the star on sensor and use a proper amplifier (Barlow) to reach a high F/D.

- **1 –** Center the **focused** star on the sensor. You can use this procedure with an AoI already defined. Nevertheless take care to have the CCD sensor center matching roughly with the AoI center. Genika indicates the CCD center with a small circle on the reticle display when an AoI is defined. With a monochrome camera we advice to use a red or NIR filter to limit seeing impact.
- **2 –** Activate the assistant from the menu *tools/optical alignment assistant :*
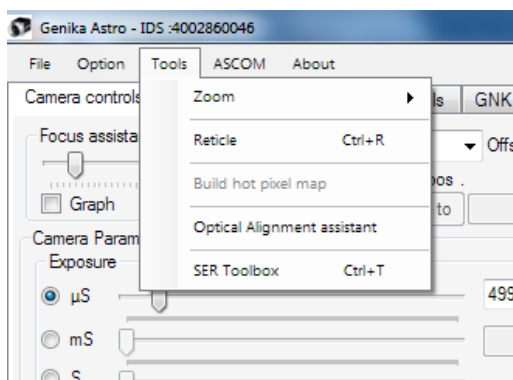
- The reticle is displayed with an additional green box in the center of the image. This 128*128 pixels zone is the area that will be stabilized (by center of gravity) and stacked for analysis. The analysis speed is the same as for the display. Acquisition speed isn't utterly important; the critical metrics are the time to get a convergence on the image and the exposure time. Don't hesitate to use high gain to limit the exposure time below a few milliseconds. Note that the star must be completed included in the green frame!
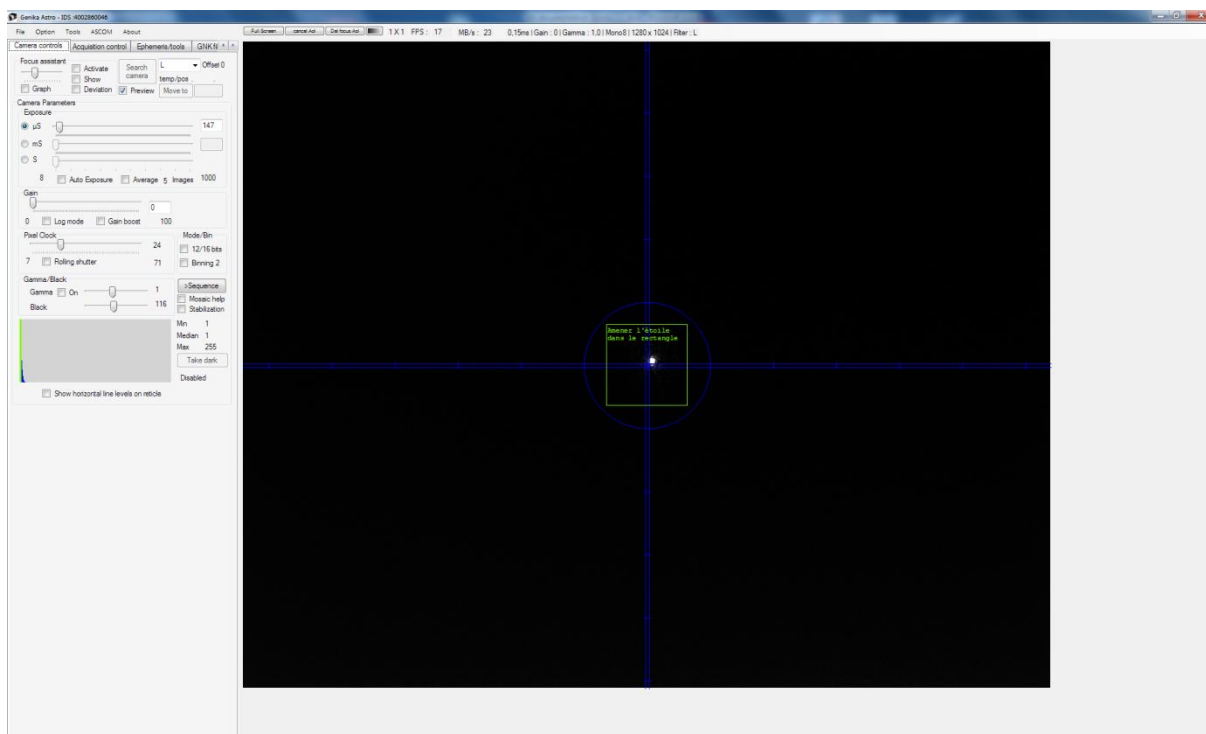
- The alignment window is displayed at the same time :
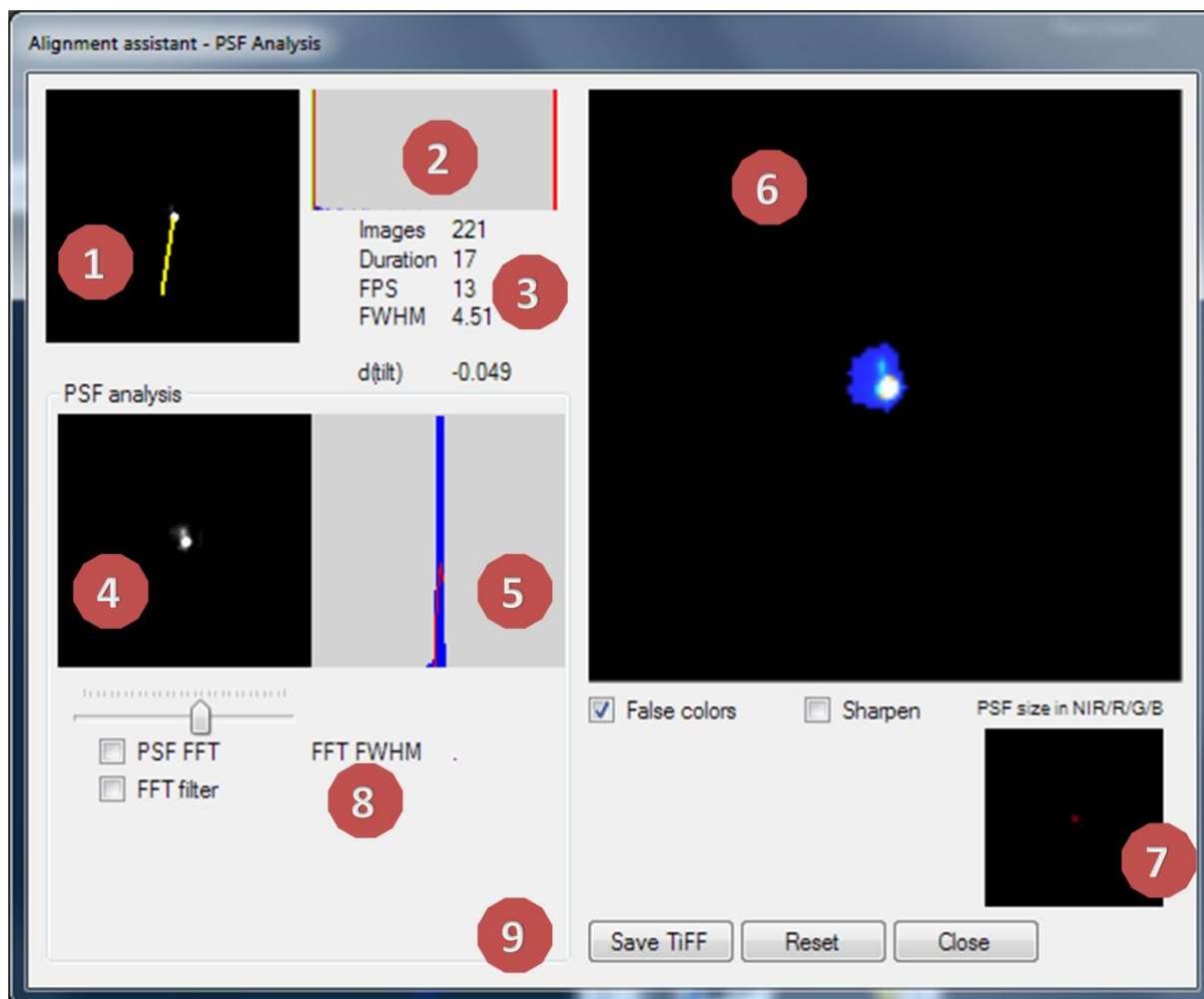
This window provides you with the following information:

1. Actual star aspect in the left area. The star is automatically centered. The red bar indicates you the actual correction made to center the star. Variations of the center position are due to both seeing tilt (40% of the atmospherical turbulence is tilt) and mount tracking errors.
2. PSF histogram. For better results try to not saturate the image.
3. Total stacked image number, throughput and duration. Usually the stacked image converges about 10s after the beginning. The throughtput of this window is the display refresh rate in the main option menu. The FWHM is calculated in ArcSec based upon ephemeris data (F/D and diameter) with a gaussian fit. The fit quality may be adjusted from the trackbar in area 8. Refine this value with the automatic F/D calculation if your are unsure of the actual FL of your configuration.
4. This image shows the PSF in log mode to check for low light diffraction patterns.
5. This area gives a longitudinal level of the PSF or the FFT. In PSF mode, the Gaussian FWHM fit is displayed in red.
6. The stacked image. This image is updated every 10 images stacked. You can display with the false color (spectrum ramp) to see easily the diffraction rings and apply a sharpen filter. The image is about three times larger than the real one.
7. A graphic gives you the real diffraction image size (center peak, right image scale) according to the data you entered in the option window about your instrument (F/D and aperture), the

amplifier selected in the ephemeris tab (barlow) and the sensor pixel size. The size is given for blue, green, red and NIR at 450, 550, 650 and 850nm.

8. The seeing index reflect the spread of the entropy analysis of the PSF. It represent both the seeing variation, and the focus quality. It can be used for fine focusing on a star.

9. You can save the stacked image as it is at the present time by hitting the save button. The format is 16 bits TiFF. The image is saved in the application current acquisition directory and it is time stamped. You can use this image for further accentuation using for example Registax wavelets as in this real example on Vega with a 212mm telescope at F/D 25.
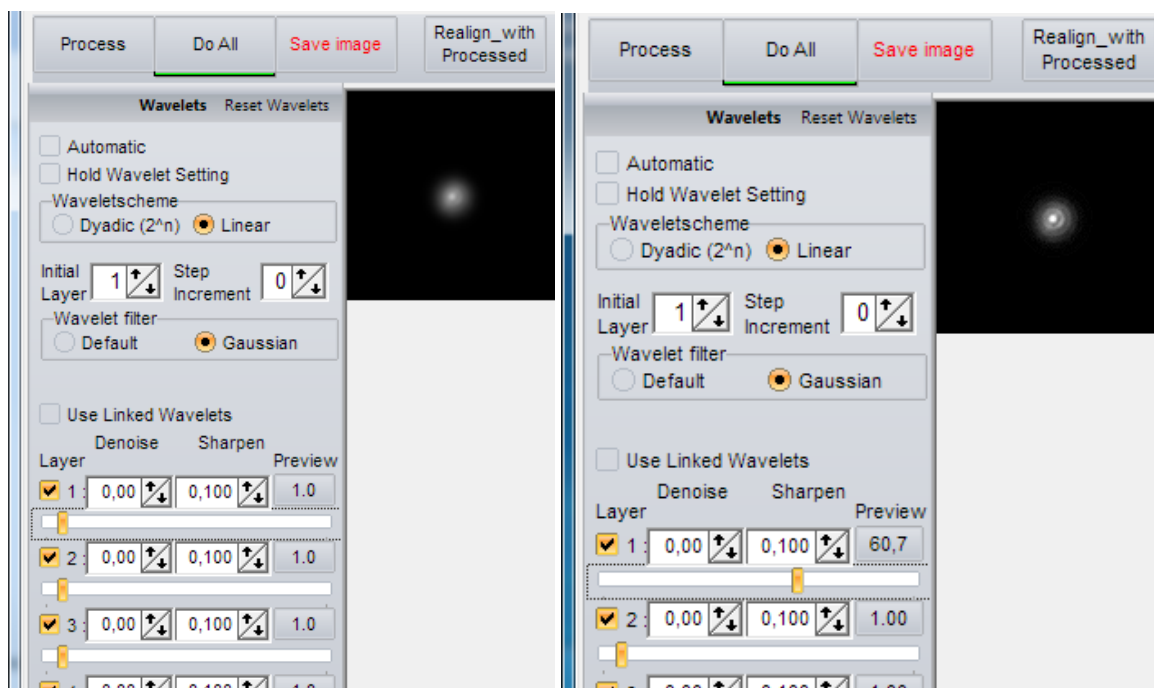
- **3 :** Move the star in the required correction direction using your mount handbox. Should it be the opposite direction you would see it pretty fast !
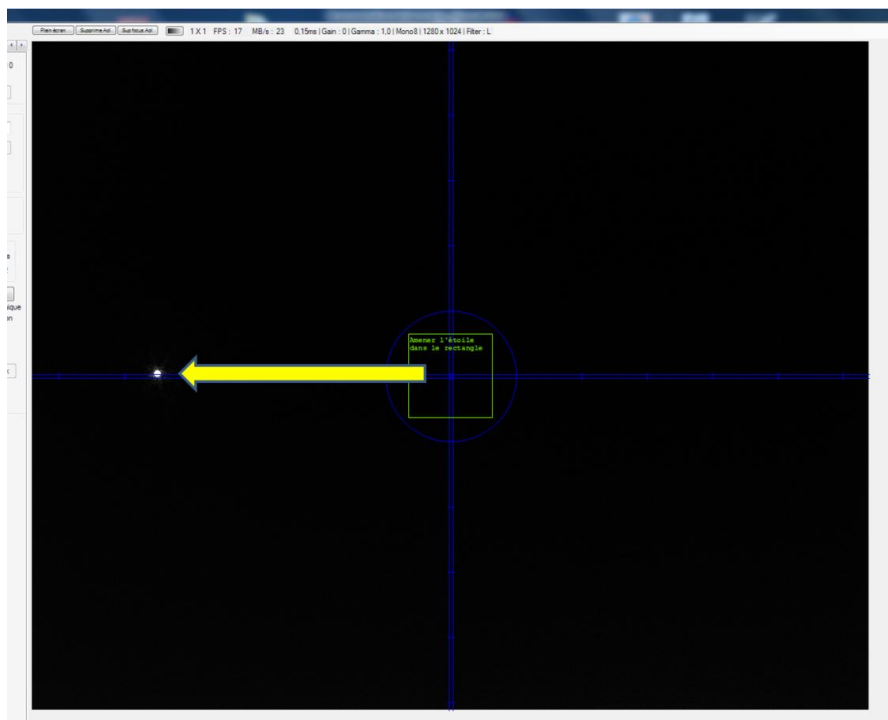
- **4 :** <u>Bring back the star in the green box using your telescope optical adjustment knobs.</u> Secondary mirror alignment in the case of a cassegrain, SCT or maksutov, primary for a newton telescope. If it's difficult to be precise enough you can finish using the handbox.
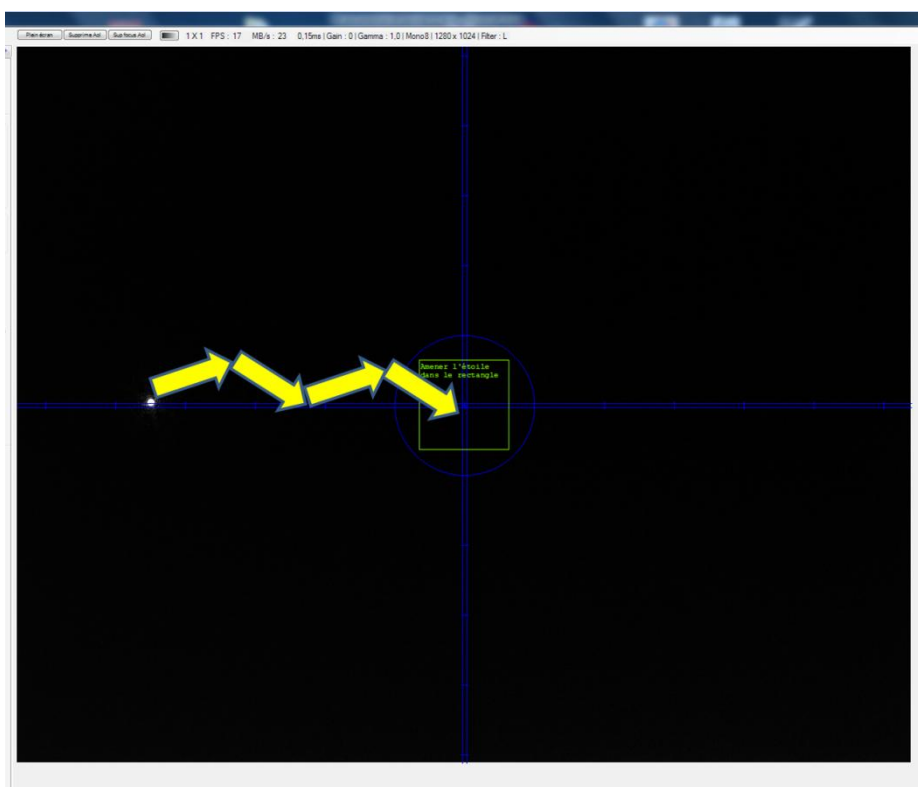
- **5 :** <u>Click reset on the alignment assistant.</u> After a few seconds you can see if the correction was in the right direction and enough. If not repeat the steps 3 to 5.

Note that the alignment assistant may also be use for double stars reduction.

PSF analysis tools

This window also provide several PSF analysis tools :

- A Gaussian fit of the PSF to calculate the FWHM. The trachbar adjust the fit that is displayed as a red curve over the PSF profile :
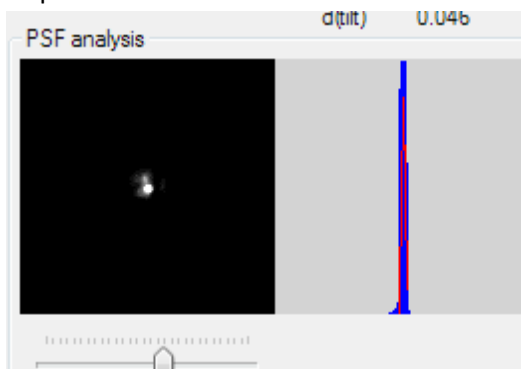
- You can have a Fourier frequency space image of the PSF. You can also filter high frequencies of this FFT with the trackbar and transform back in the intensity space. Filtering high frequencies remove image speckles due to the turbulence and allow finding back the PSF more easily. Take care that filtering too low frequencies removes also the PSF itself!
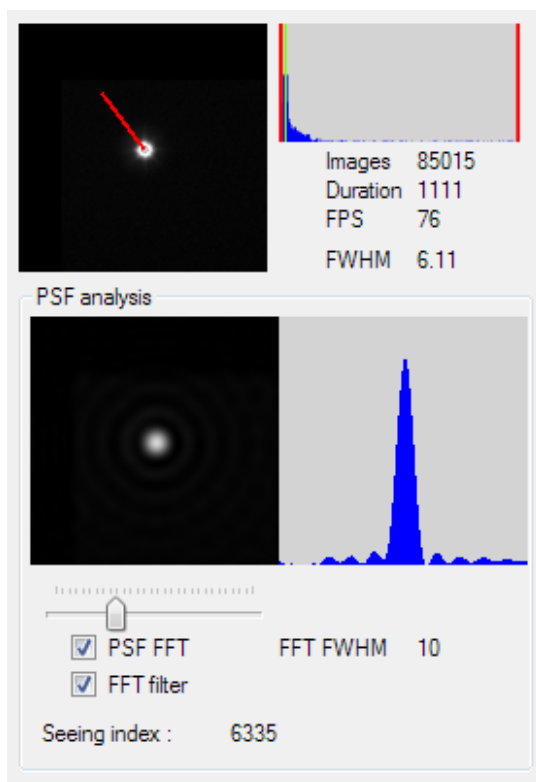
Ephemeris and sampling

Genika embeds a real time calculation of distance between the Earth and the different planets, the Moon or the Sun. By specifying the parameters of your setup, it can calculate for you the optical resolution, spatial sampling and other information to verify the relevance of your configuration for the object you want to image. Genika also gives you the actual elevation and azimuth of the selected object given that the latitude and longitude in the option window and system clock are correct. Those data are updated every 10 seconds.

The Ephemerides are accessible from the *ephemeris/tools* tab.
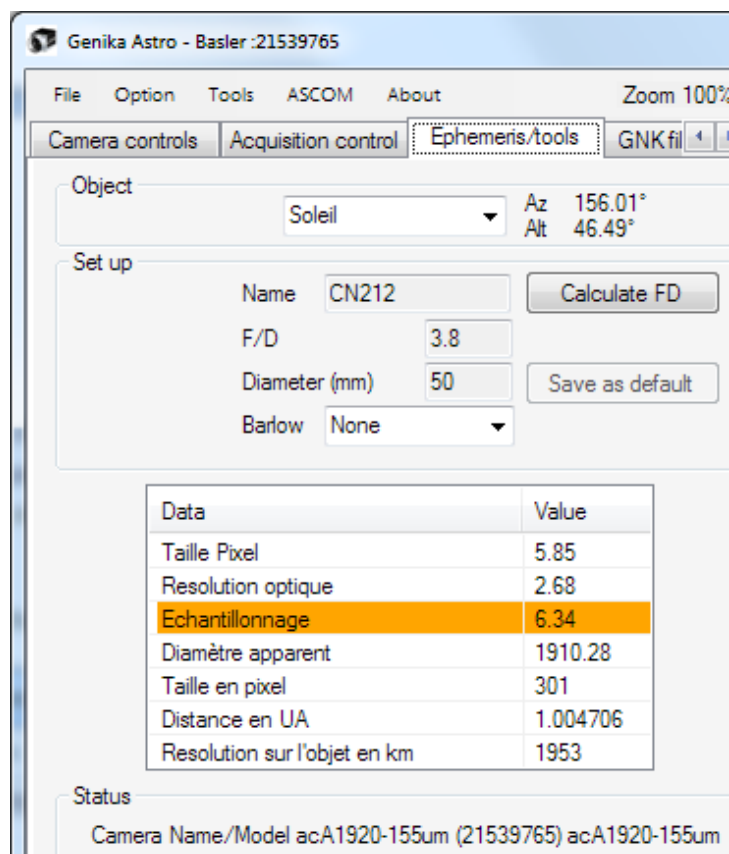
Configuration

To get accurate values for the digital sampling you need to give the application the characteristics of your setup from the options window :
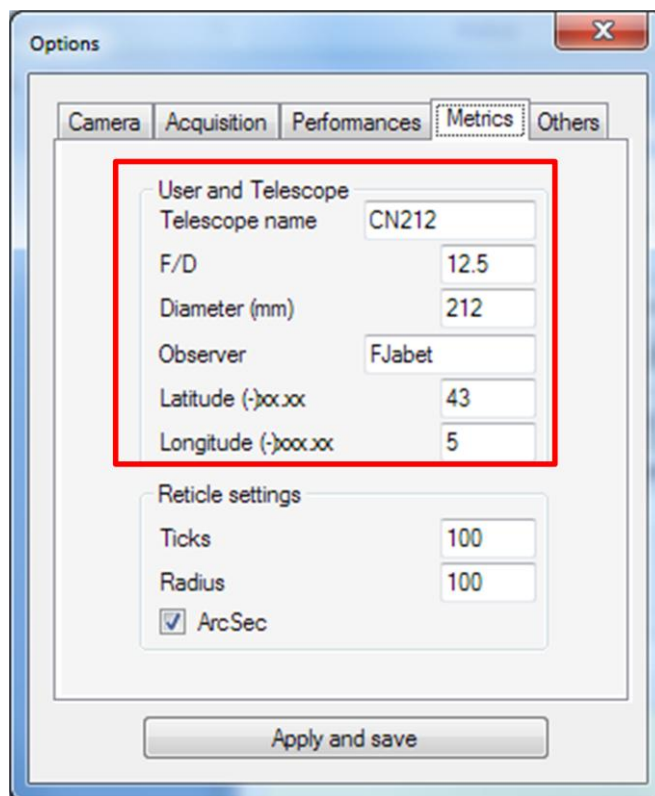
The telescope name and observer name are saved in the text log file as well as in the SER file header.

Note that digital sampling is required for autoguiding.

To get an accurate digital sampling you need also to specify if you use a barlow lens or a focal reducer. By default Genika provides a generic list of such equipment. You can modify this list to match your own equipment by editing the text file named barlow.txt in the application folder.

You should respect the format which is *Barlow Name ; amplification factor (digital separator : .)*.

The changes will apply at the next session. You can select up to 100 different equipments.

> *None;1*
>
> *Reducer 0 .63 ; 0.63*
>
> *Barlow x2; 2*
>
> *Barlow x2.5 ; 2.5*
>
> *Barlow x3 ; 3*
>
> *Barlow x5 ; 5*

Provided data

Genika ephemeris lists you the following data:

- Angular resolution : the optical resolution of your telescope : that is optical diffraction resolution without taking into account the optic's default nor the seeing
- Pixels size: Your camera's pixel size and Binning
- Sampling: it is the solid angle covered by each photosite camera
- Apparent diameter of the object: apparent size in arcsecond

- Diameter of the object in pixel: this value allows you to check if the object fits on your sensor, if it is preferable to use a Barlow or to make a mosaic.
- Distance: distance of the object in Earth radii or astronomical unit
- Distance resolution over target body: it is the projection of the optical resolution on the object.

Data are saved between two sessions and present in the log TXT file.

The color of the digital sampling gives you an indication :

- Orange is under sampling
- Green means that your digital resolution is between half and one third of the optical resolution
- Red means that your sampling is too high : you don't gain any resolution and you are losing light

Automatic F/D detection

When the object boundaries are partly or entirely visible inside the camera's field of view the application can instantly calculate the actual real focal ratio using the calculate F/D button. Genika only requires as input data the object you are actually imaging. Barlow and F/D ratio selected in the option window or in the ephemeris tab are not relevant for this calculation, but the diameter is. The object can be located almost anywhere on the field. The detection is done horizontally if the object is fully visible on the screen, and in both direction if only a part of the limb is visible. When imaging Saturn the rings should be placed vertically unless you want to take them into account.

When the calculation is done the circle appears around the planet. If the circle is too large try to reduce the acquisition time. If it is too small that means the image is too dim and you should increase the acquisition time. The F/D ratio is displayed at the top left.

Note that this value doesn't replace the settings specified in the option window but it allows to cross check them. It is up to you to change those settings or to update the barlow file to match the real F/D as it has been detected.

Those cases can be processed:
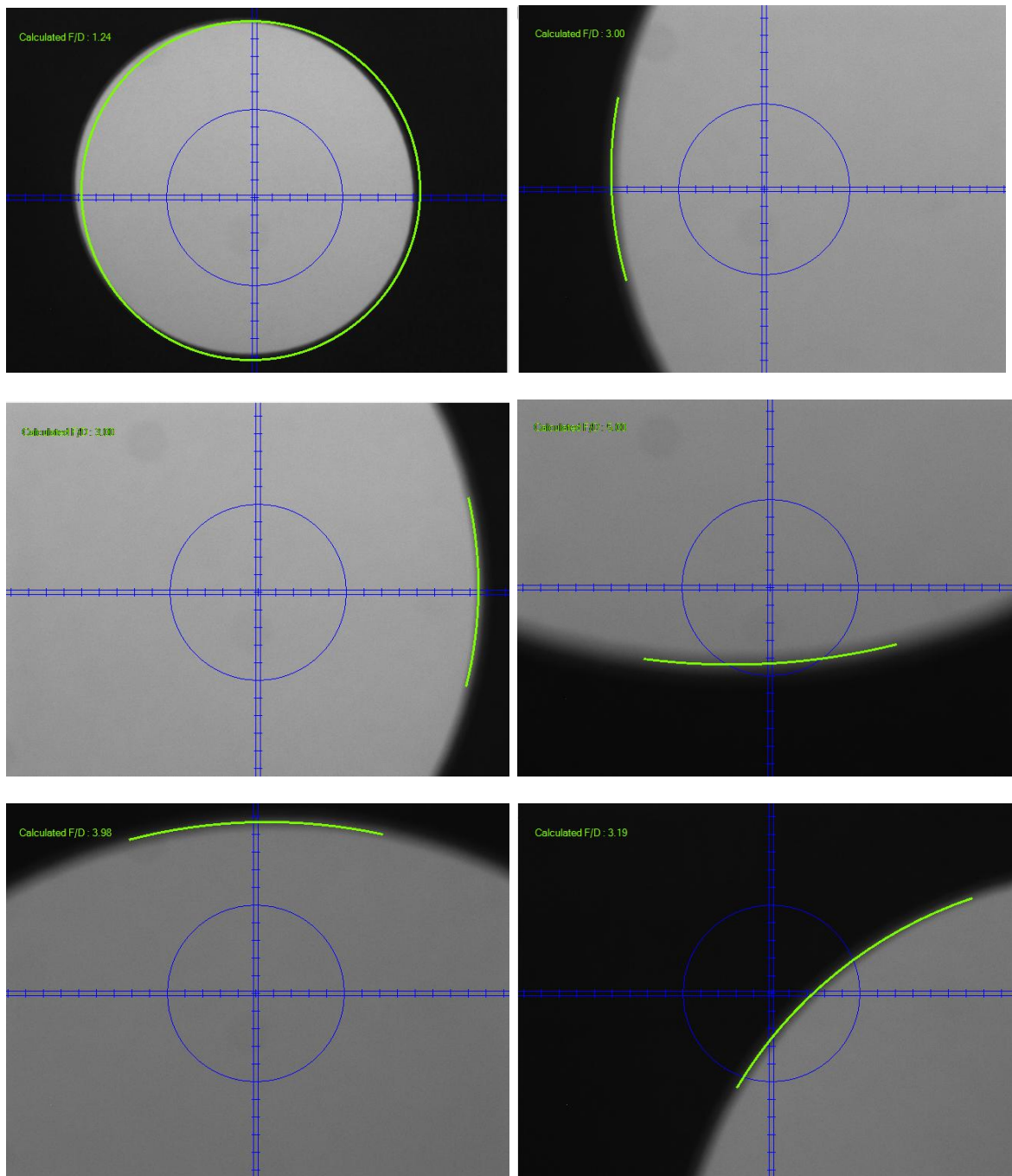
The next cases won't give a accurate result or any result at all:
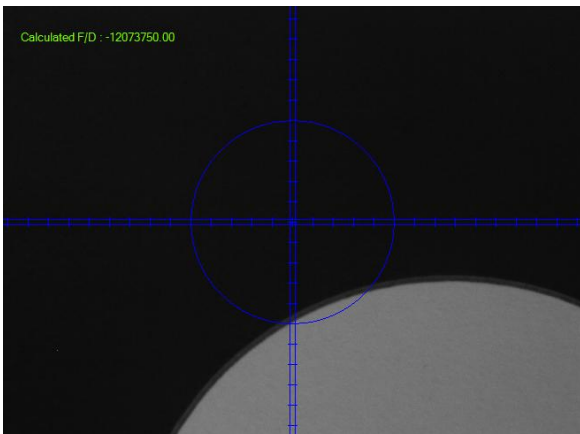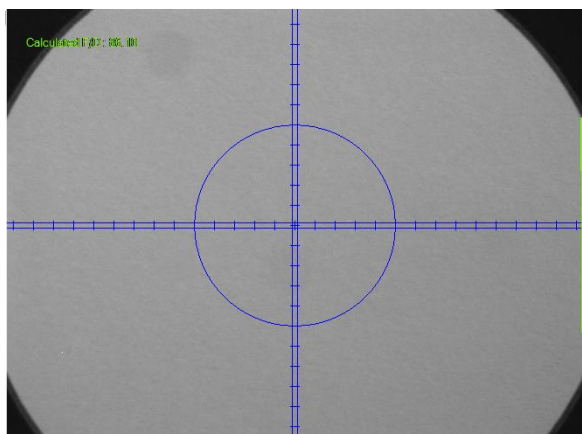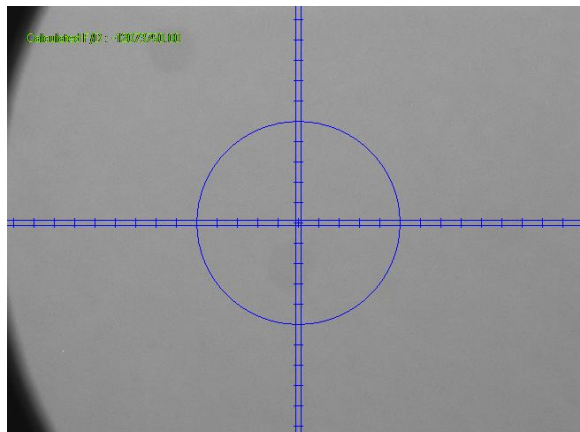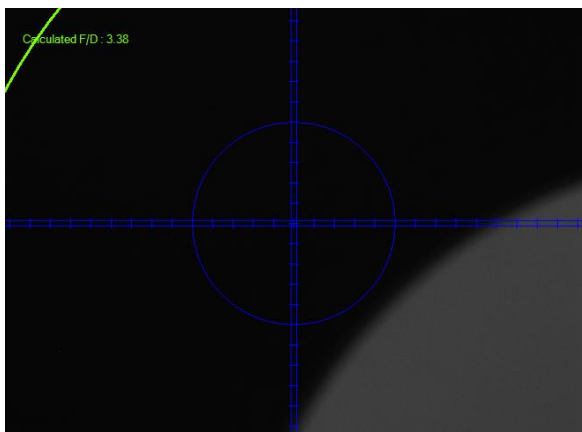
Acquisition

The current Genika version supports SER, AVI, TiFF and GNK file formats.

You have the possibility to convert GNK files to TiFF from the application, you may convert SER file from the SER toolbox from the tools menu.

Single acquisition tab

For single acquisition you can use the manual mode from the acquisition control menu.
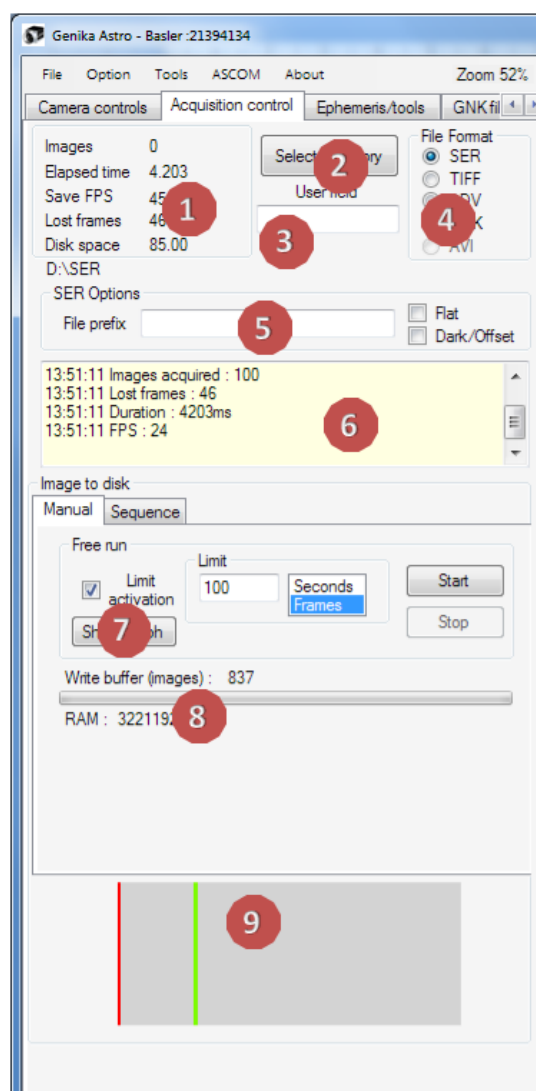
1. *Acquisition statistics and directory*: In this area are given main statistics of the acquisition. That includes : number of image saved, elapsed time since the beginning of the acquisition including the filter wheel and focuser movement, global acquisition throughput and the number of images that have been lost.
2. *Directory* : You can specify the active directory. By default c:\ or the last directory used.

3. _User field_ : in this field you can enter whatever you need. This field content would be saved in the text log file.

4. _File format:_ these radio buttons allow the selection the file format. Note that the AVI format is not available for 12 bits acquisition and GNK & ADV for color acquisition.

5. _Prefix and acquisition mode_: You can provide the file prefix in this input area. If you enter Jupiter the file name will look like this: Jupiter_date_T_hour_filter.SER. The automatic timestamping avoids files to be overwritten. If you check the flat or dark checkbox the file name is changed accordingly and the free run settings are changed as well. Those settings are automatically saved: you may have three different settings for dark, flat and light acquisitions.

6. _Log window_: this area recaps the different steps of the acquisition. It is re-initialized for each acquisition.

7. _Controls_: this area controls the acquisition. If you click on _start_, that's the free run mode. Capture will continue until you stop it or pause it. You can choose as well a number of images or a capture time.

8. _FIFO mode information:_ Genika has two acquisition mode. By default the image stream is stored in a dynamically sized acquisition FIFO buffer in RAM. If the disk isn't fast enough to handle the throughput, frame are temporary stored in this buffer. When the acquisition is over, the buffer is written down to the disk. This mode limits the risk to lose frames, but requires some time after the end of the acquisition to flush all data. When the FIFO is disable (from the option window), the images are send directly to the operating system. If the disk throughput isn't sufficient, frames are loss. Nevertheless this mode has no flushing and the acquisition can be launch again immediately. For data critical acquisition the FIFO mode is strongly preferable.

If the _save_ button is disable, that means your camera hasn't been unlocked. You need to ask again for the license file. It is possible that you or we made an error when proceeding the Mac address and serial number.

Note: Genika doesn't perform any treatment at the end of the capture only without the FIFO mode: you can launch another one right away if your disk system isn't struggling with the previous acquisition. For this reason the sequence mode never uses the FIFO buffer.

You can display the FPS variation over time after acquisition with the Show graph button.

It is possible to detach the acquisition tab with the small arrow button upper right. Press this button again to bring the tab back in place.
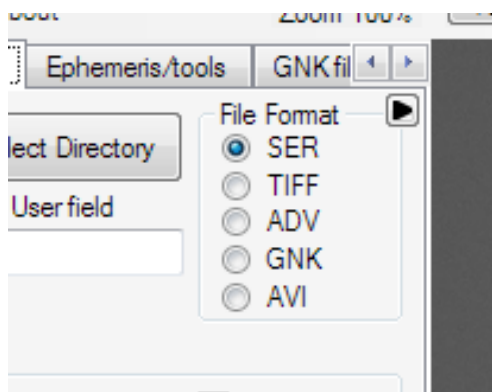
TXT acquisition log file

Each SER file has an associated TXT file with all acquisition parameters. This file has the same name as the SER file. It also contains the ephemerides data and the detailed time stamping if it has been selected. The time of mid acquisition is indicated in Winjupos format.

*********************** GENIKA ASTRO CAPTURE LOG FILE ***********************************

Observer : FJabet

D:\SER_L__2013-08-04_T_09-48-56-0652.txt

Camera manufacturer : Basler
Camera Model : acA640-100gm

Active filter : L

Number of images : 1229
Acquisition Length in mS: 10002
Mean FPS : 122,8754
Lost frames : 1
Mid acquisition time UTC (Winjupos hh:mm.mm) : 2013/04/08 7:49,02

User field : commentaire utilisateur

---------------------- Ephemeris data --
Axis : Geocenter, planetary theory : INPOP10, J2000 epoch
Crédit : Institut de Mécanique Céleste, 77, avenue Denfert Rochereau, 75014 PARIS, FRANCE

Object : Soleil
Distance (AU or terrestrial radii for Moon) : 1,001279
Telescope : CN212
Diameter : 212
Native F/D : 12,5
Amplifier : x1
Optical resolution : 0,566037735849057
Pixel size : 5,6
Digital sampling : 0,435320747303513
Resolution on object : 411,058778851639

---------------------- Camera parameters --

Exposure in µS : 8000
Auto-exposure : False
Gain : 300
Black (as read from camera) : 64
Gamma : 1
Gamma enabled : False
Pixel depth : Mono8
BinX : 1
BinY : 1
AoI X : 659
AoI Y : 494
AoI X Offset : 0
AoI Y Offset : 0
Forced FPS : False
Forced FPS Value : 9,9999999999999
resulting FPS : 122,850122850123

*********************** END OF FILE ***********************************

Sequencer
Introduction

Some objects require several acquisitions with different filters; it is the case to get color images using a B&W camera (LRGB, RRGB…). Some objects also provide a limited amount of time for the image acquisition because of their fast rotation (Jupiter, Saturn, Mars…) so color images have to be acquired in a limited amount of time. For the same fast rotating objects it is interesting to make acquisition at short intervals to build a rotation animation.

To make those tasks easier Genika Astro embeds a multiline sequencer on the third tab.
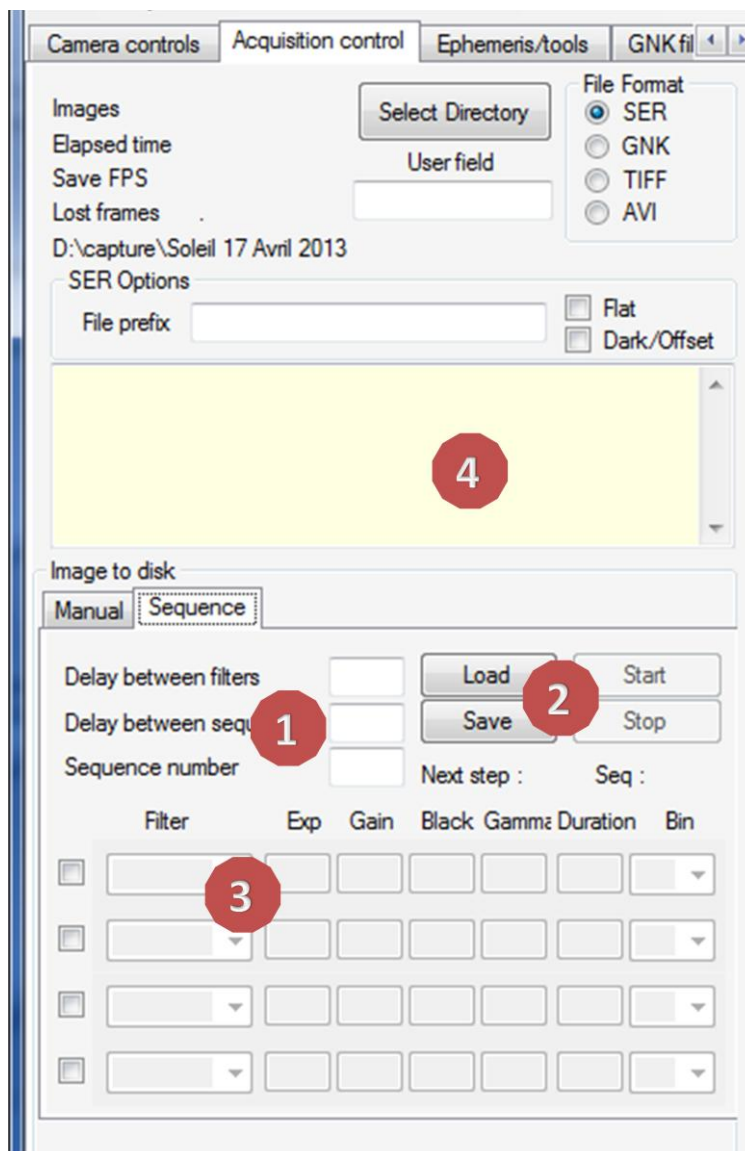
1. Pause between each sequence repetition (loop), pause between filters (if an ASCOM FW is connected, you may let that value void) and number of repetition of the full sequence.
2. Load/save sequence definition
3. Parameters for each sequence component :
   a. Filter name (ASCOM or generic filter list)
   b. Exposure in ms (decimal accepted for submillisecond exposure)

   c. Gain
   d. Black
   e. Gamma (decimal accepted)
   f. Duration in seconds
   g. Binning
4. Information control about the ongoing sequence

Sequence definition

There are three different ways to define the sequence details:

- Manually by typing the parameters for each line
- By loading an existing sequence built previously.
- You can transfer actual acquisition parameters from the first tab using the *to sequencer* button. Genika then asks for the filter, the line number and the duration :

Sequence behavior

A typical sequence rollout with 10 loops, 3s filter pause and 10mn pause between sequence would behave as below :
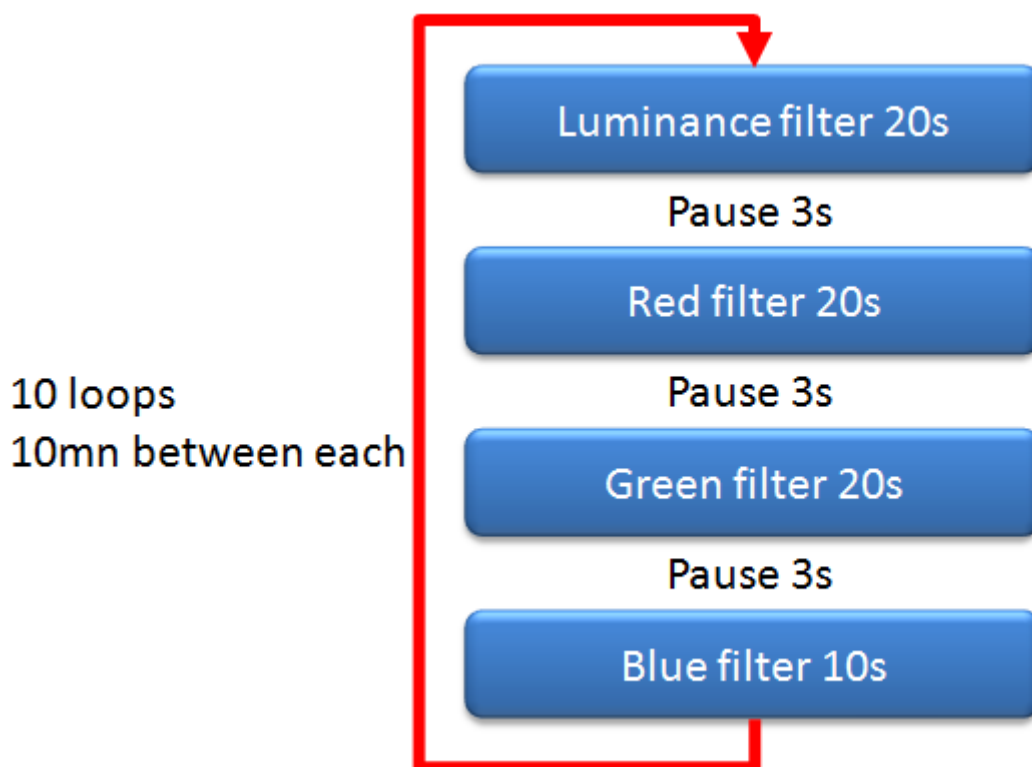
Note : If an ASCOM FW is connected with focus offset, the ASCOM focuser moves as required by offsets values. At the end of the sequence prior focuser position and filter are restored.

Note: Sequence never uses the FIFO buffer to respect the sequence timing.

Automatic camera parameters backup

The free AoI definition makes it difficult to reproduce it exactly when time's comes for dark/offset acquisition. You can ask Genika Astro to automatically save the camera setting for each acquisition, or the first ones in the case of a sequence.
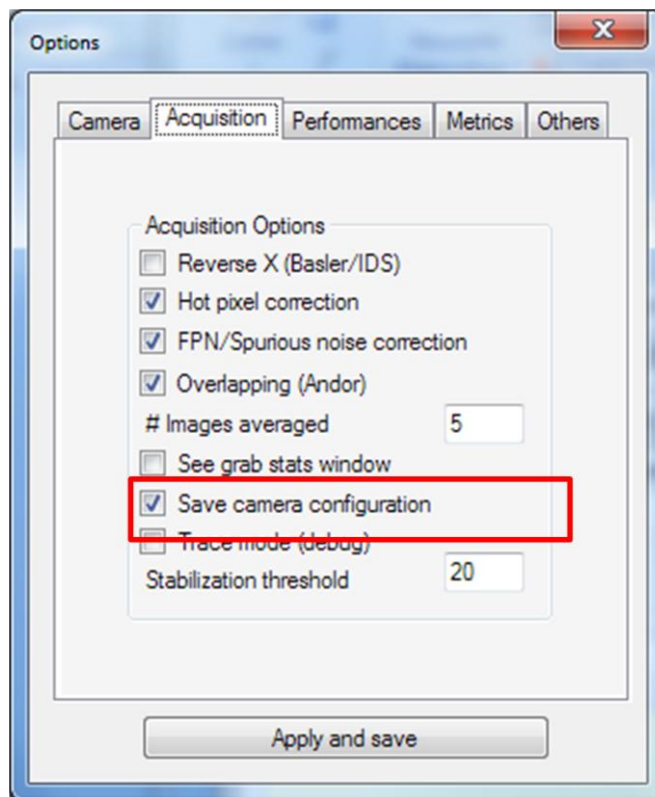
Auto acquisition mode

When connected to a Solar Scintillation Monitor, Genika can trigger acquisition based upon a seeing value threshold. The SSM must first be connected from the SSM menu :
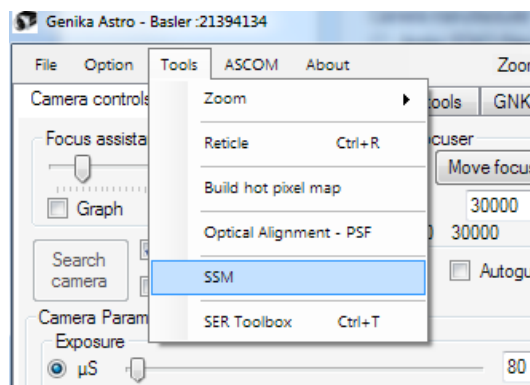
Then apply the SSM connection procedure as described in its user manual.
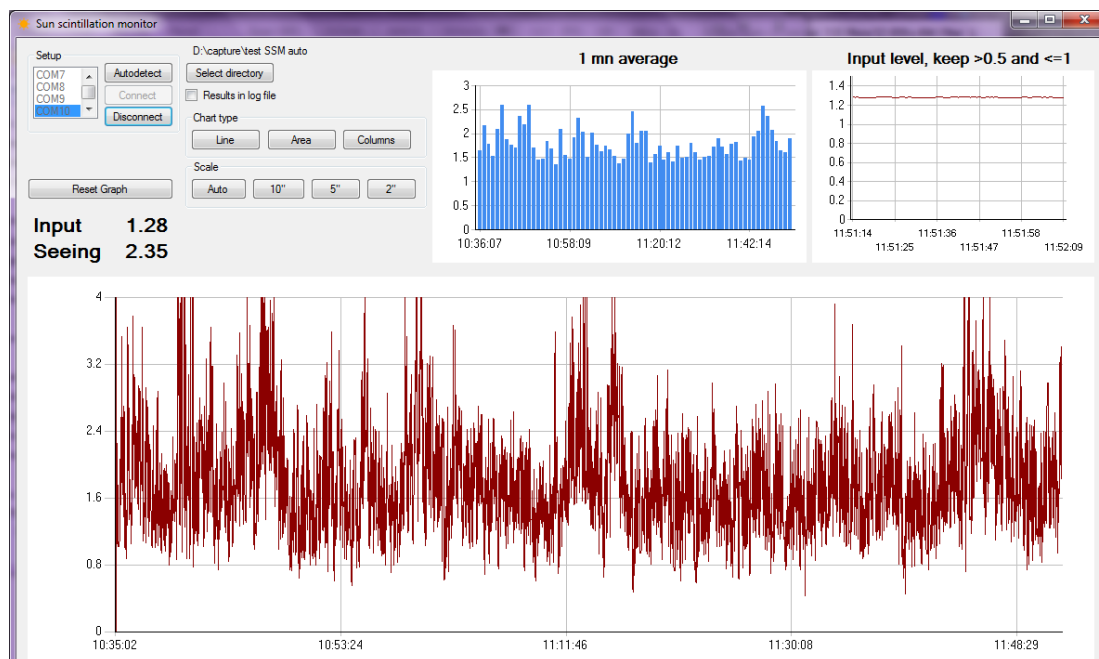
The threshold is selected from the option window. By default the value is 0.7". Another setting allows disengaging of the auto mode when free space on the target HDD goes below a limit in GB.
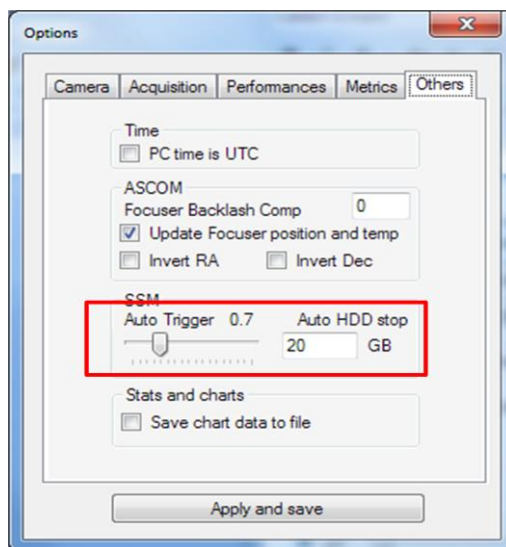
Then press the auto button to start acquisition, press again to stop. Limits are automatically activated in auto mode.

When operating in auto mode, the average value for each acquisition is mentioned in the text file.
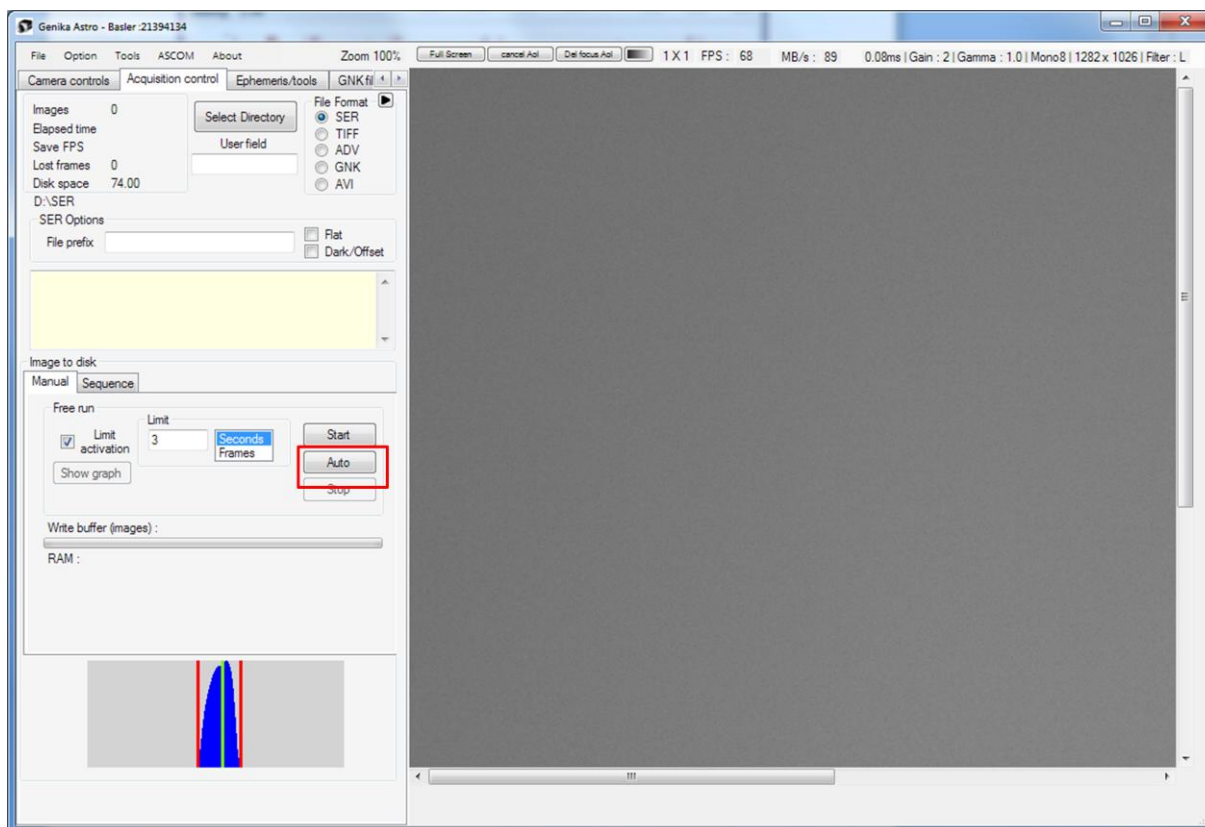
Please refer to the SSM user manual for more details about its operation.
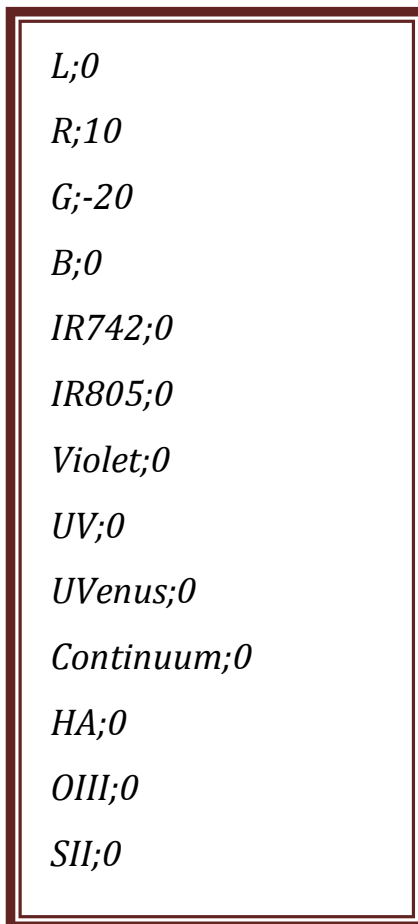
Image Timestamping

SER and GNK files contains time stamps for each frame. The timing is the frame reception by the application that matches closely the end of exposure.

The SER header contains both local time and UTC acquisition start time. If the option *PC time is UTC* has been checked in the option windows, then both field have the same date/time. The Sertoolbox checks this point and act accordingly when exporting SER to FITS format.

Filter list

The default filter list may be changed as for the barlow list. The file name is Filterlist.txt. The number after the semicolon gives the specific focusing offset for this filter. If an absolute focuser is connected its position is corrected automatically.

> *L;0*
>
> *R;10*
>
> *G;-20*
>
> *B;0*
>
> *IR742;0*
>
> *IR805;0*
>
> *Violet;0*
>
> *UV;0*
>
> *UVenus;0*
>
> *Continuum;0*
>
> *HA;0*
>
> *OIII;0*
>
> *SII;0*

When a filter wheel is connected its filter list replaces the default one. Focus offsets are also taken into account if available.

ASCOM features

ASCOM filter wheel control

Genika can operate automatically an ASCOM filter wheel using ASCOM 6 platform.

You may connect your filter wheel from the ASCOM menu.

If the ASCOM 6 platform is present, its filter wheel chooser pops up:
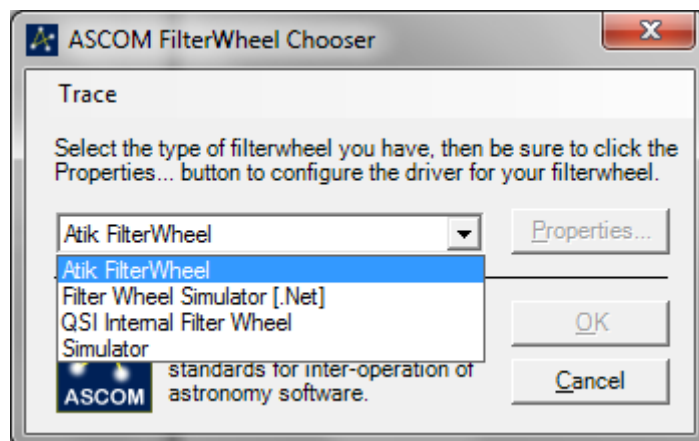
You can edit the filter name using the properties:
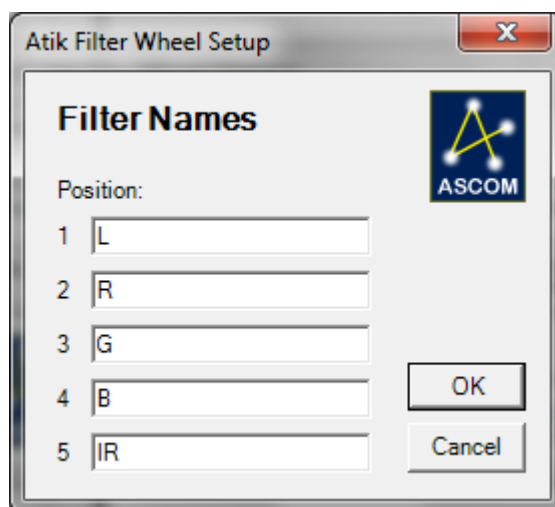
The generic filter list and offsets is then replaced by the filter wheel's at FW connection. Genika Astro remembers the filter wheel name for another session : you just need to connect then.

You can check the filter wheel connectivity and features from the ephemeris/tools tab.

To change the currently used filter, you can use the filter list on the camera settings tab.

Of course it is possible to use the filter wheel from the sequencer.

ASCOM focuser control

Genika Astro can also control an ASCOM absolute focuser. Connection is done the same way as for the filter list.

You can command the focuser from several location :

- From the first tab by typing the position you want to go to and then clocking on "move to",
- Focuser is controlled by the sequencer if filter offsets are presents,
- Focuser moves also when selecting another filter manually,
- You can access to the focuser jog.

The focuser jog presents several interesting features:
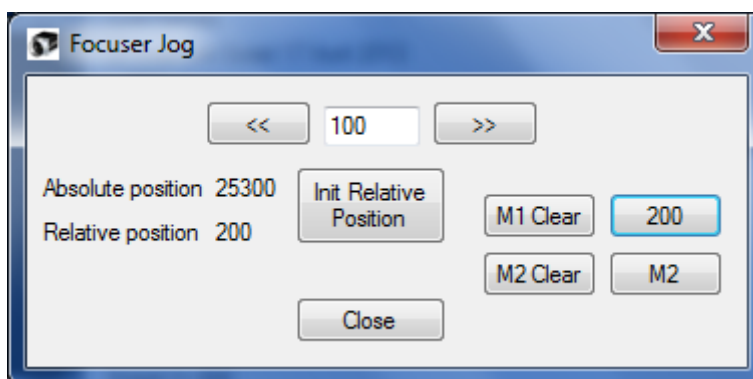
- Relative movements using the left/right buttons. The focuser moves of the value specified in the center field,
- Relative position index reset
- Absolute position
- Two memories that moves the focuser to the previously recorded position

Genika Astro also supports backlash compensation from the options window (out direction).

You can stop automatic position refresh (3s interval) when using very high FPS or if your focuser driver isn't multithreaded.
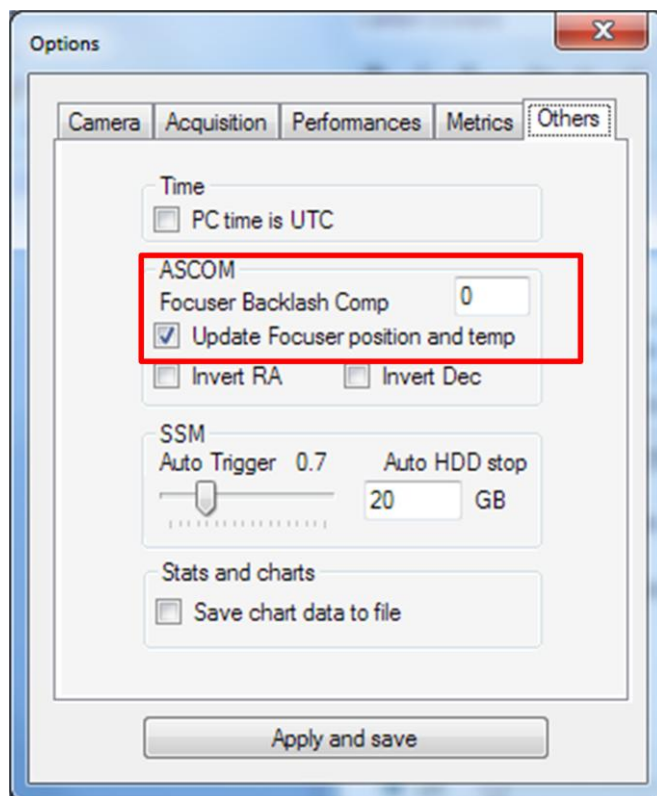
SER toolbox

A tool dedicated to the SER files management is available. You can launch it directly, its filename is *file_converter.exe* or you can get it from Genika's tool bar. Note that this module requires the .NET framework installed, release 4.

Color images are bayer processed for display only. TiFF and FITs conversions save RAW frames.
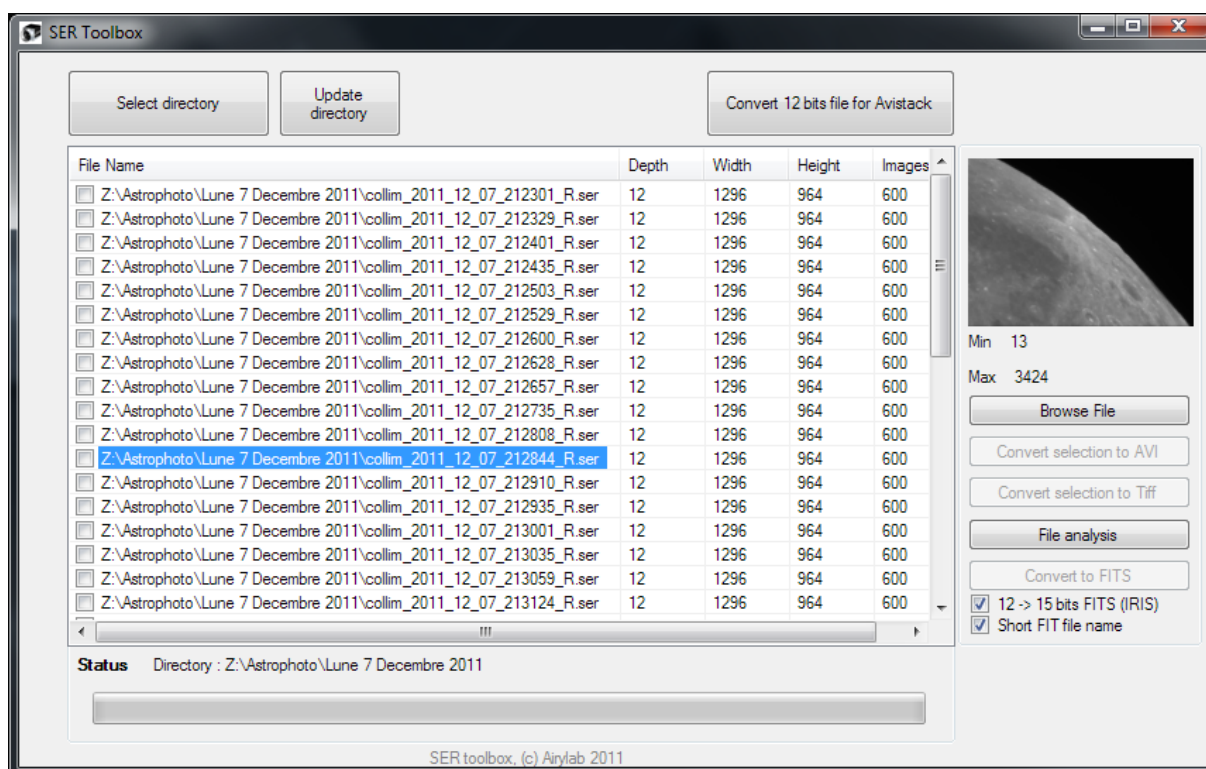
Using this module, you can :

- List all SER files in a directory. You'll see their dimensions, images count and pixel depth
- Get a preview of the first image with its minimum and maximum pixel value.
- Browse the file and save a individual Tiff image
- Convert all 12 bits file in the directory to 16 bits for Avistack processing. Original files are kept.
- Convert 8bits files to AVI format, and 8 bits or 16 bits files to individual TIFF or FITS images stored in an automatically created directory.
- Convert B/W SER files to ADV file format.
- Analyze a file: a text file with all images information will be created.
- Delete selected files (Be careful : files are definitely erased !)
- Three FITS format are available and are using the FITSIO.DLL : single FITS file per images, 3D cube FITS plus timestamp file, and multiFITS file.
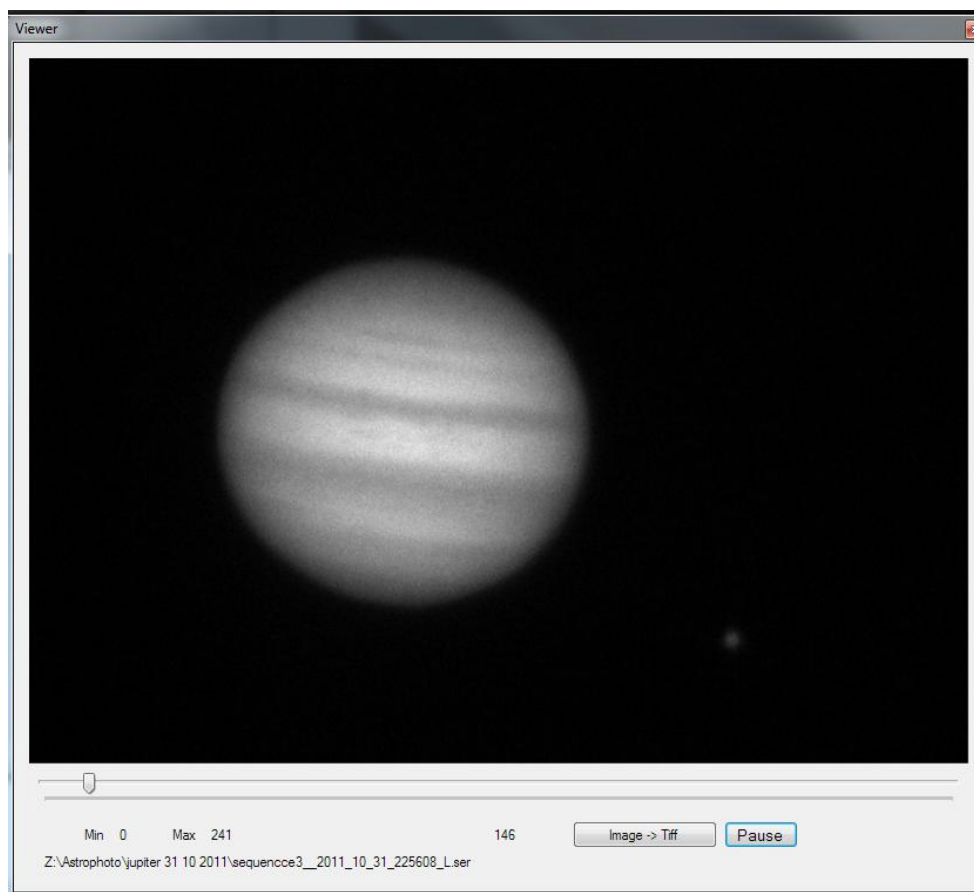
Note that the viewer resize the frame to a fixed file for display, it is not the acquisition size present on the disk.

You can play the current SER file at 10 fps.

Note for IRIS users : you can have a simple name convention for FIT files : "I"+image number. That makes command line in Iris easier.

SER and GNK timing synchronization through GPS reference

By default Genika Astro uses Windows internal clock to generate time stamp with 100ns granularity. Some applications may require a more stringent time stamping than Windows internal clock. Windows clock drifts unpredictably and may hinder time stamps pertinence over time. On another hand a stratum 1 clock (ANSI/T1.101-1987) is available with a low cost GPS receiver.

It's possible to use this kind of GPS clock to sync the PC and therefore Genika Astro time stamps as discussed in the *Time stamping strategies* application note. This requires a GPS card such as Meinberg products.

Another way is to use a GPS or IRIG appliance to get high precision time tamps.

Both solutions above provide a high precision synchronization at the µS scale.

Starting from release 2.7 Genika Astro provides an inexpensive way to synchronize GNK file with a GPS receiver within a few ms tolerance.

Acquiring a reliable GPS clock

The main communication protocol with GPS is NMEA. NMEA transmits once per second the complete GPS information including the UTC time. Nevertheless this protocol is very slow and it is not designed for high precision system synchronization on the GPS clock.

In addition some GPS receivers provide a high precision Pulse per Second line that can be used to mark the beginning on the actual second.

We use this PPS signal to generate a synchronization file between the Windows clock and the GPS Stratum 1 clock.

This signal shouldn't be acquired through a slow protocol stack such as the serial protocol. We use instead inputs that raise immediate events in Windows. One of them is the Data Carrier Detect on a serial input line.

Basically we re-route the PPS signal to the TTL DCD line of a serial port, this port can be native or goes through a serial to USB converter.

For this example we use a Sure Electronic GPS board:
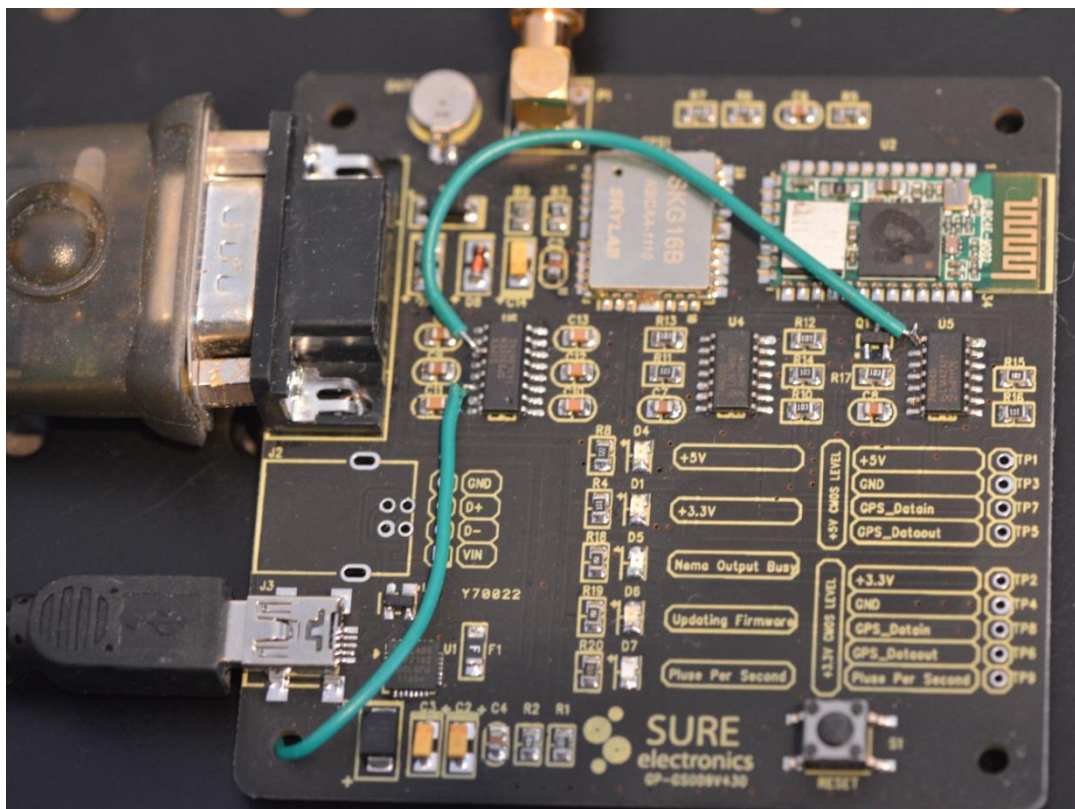
Some modifications are performed on the board in order to inject the 3.3V CMOS level PPS signal to the serial TTL DCD pin. The CMOS is converted to TTL using a free line on MAX232 board chip.

Reference timing acquisition

Genika Astro comes with a dedicated utility to capture this PPS signal and keep a trace in regard with the windows ticks : GPS DCD Tracker.
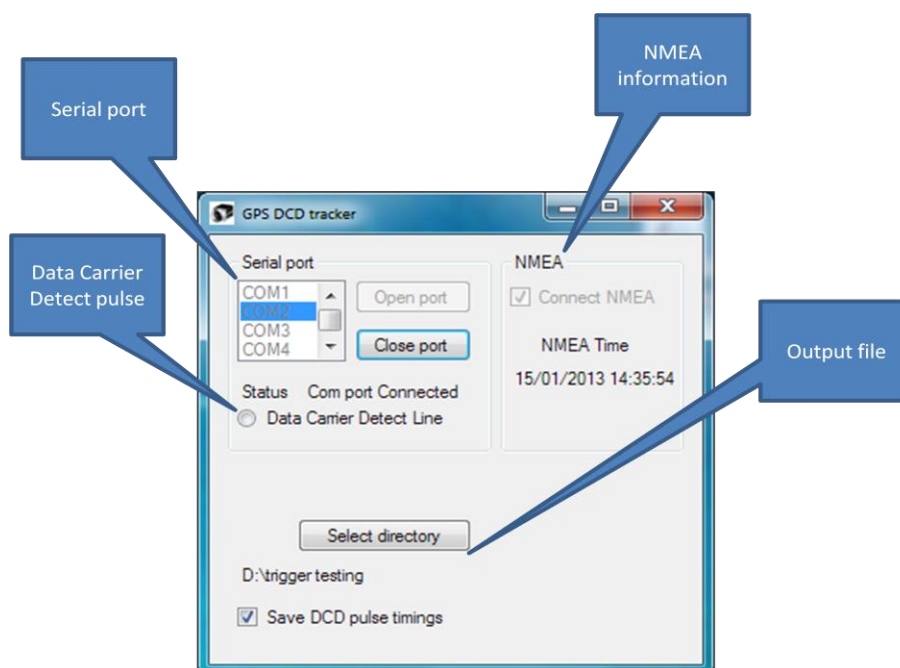
This application connects to the GPS :

- Using NMEA to get the UTC with one second precision
- Using the DCD line to intercept the GPS Pulse Per Second

When a PPS is detected the application saves the following information in a .stp file (text structure):

Genika Trigger PPS log file
****

Date, Time, Ticks, Offset to plain second in ms, jitter in 100ns, NMEA date/time
11-01-2013 , 10-47-39-0442 , 634934980594428071 , 442 , 6,34934980594428E+17 , 01/01/0001 00:00:00
11-01-2013 , 10-47-40-0440 , 634934980604408642 , 440 , 9980672 , 11/01/2013 09:47:38
11-01-2013 , 10-47-41-0440 , 634934980614409214 , 440 , 10000512 , 11/01/2013 09:47:39
11-01-2013 , 10-47-42-0440 , 634934980624409786 , 440 , 10000512 , 11/01/2013 09:47:40
11-01-2013 , 10-47-43-0441 , 634934980634410358 , 441 , 10000640 , 11/01/2013 09:47:41
11-01-2013 , 10-47-44-0441 , 634934980644410930 , 441 , 10000512 , 11/01/2013 09:47:42
11-01-2013 , 10-47-45-0441 , 634934980654411502 , 441 , 10000640 , 11/01/2013 09:47:43
11-01-2013 , 10-47-46-0441 , 634934980664412074 , 441 , 10000512 , 11/01/2013 09:47:44
11-01-2013 , 10-47-47-0441 , 634934980674412646 , 441 , 10000640 , 11/01/2013 09:47:45
11-01-2013 , 10-47-48-0441 , 634934980684413218 , 441 , 10000512 , 11/01/2013 09:47:46
11-01-2013 , 10-47-49-0441 , 634934980694413790 , 441 , 10000640 , 11/01/2013 09:47:47
11-01-2013 , 10-47-50-0441 , 634934980704414362 , 441 , 10000512 , 11/01/2013 09:47:48
11-01-2013 , 10-47-51-0441 , 634934980714414934 , 441 , 10000640 , 11/01/2013 09:47:49
11-01-2013 , 10-47-52-0441 , 634934980724415506 , 441 , 10000512 , 11/01/2013 09:47:50
11-01-2013 , 10-47-53-0441 , 634934980734416078 , 441 , 10000640 , 11/01/2013 09:47:51
11-01-2013 , 10-47-54-0440 , 634934980744406650 , 440 , 9990528 , 11/01/2013 09:47:52
11-01-2013 , 10-47-55-0440 , 634934980754407222 , 440 , 10000512 , 11/01/2013 09:47:53
11-01-2013 , 10-47-56-0440 , 634934980764407794 , 440 , 10000640 , 11/01/2013 09:47:54
11-01-2013 , 10-47-57-0440 , 634934980774408366 , 440 , 10000512 , 11/01/2013 09:47:55
11-01-2013 , 10-47-58-0440 , 634934980784408938 , 440 , 10000640 , 11/01/2013 09:47:56
11-01-2013 , 10-47-59-0440 , 634934980794409510 , 440 , 10000512 , 11/01/2013 09:47:57
11-01-2013 , 10-48-00-0441 , 634934980804410082 , 441 , 10000640 , 11/01/2013 09:47:58
11-01-2013 , 10-48-01-0441 , 634934980814410654 , 441 , 10000512 , 11/01/2013 09:47:59
11-01-2013 , 10-48-02-0441 , 634934980824411226 , 441 , 10000640 , * 11/01/2013 09:48:00
11-01-2013 , 10-48-03-0441 , 634934980834411798 , 441 , 10000512 , 11/01/2013 09:48:01
11-01-2013 , 10-48-04-0441 , 634934980844412370 , 441 , 10000640 , 11/01/2013 09:48:02

Windows clock at the reception of the PPS signal : Date, Time, Tick (100ns granularity) and offset to the next plain second,

Jitter of Windows clock in 100ns : that gives the window's clock drift,

GPS Date and time at the PPS : Milliseconds are not given as the information is saved at the PPS reception (i.e. plain second) and NMEA doesn't provide more precise information.

Important note about NMEA time : some GPS receivers may deliver NMEA information less often than once per second. The GPS DCD Tracker looks for NMEA updates twice per second. If the UTC time hasn't been updated between two PPS reception, the actual UTC time is interpolated by the application. Such occurrences are marked with a (*) in front of the GPS UTC NMEA time.

SER and GNK file re-synchronization
SER and GNK file resynchronization is automatically done by Genika Astro. To achieve this synchronization a stp GPS PPS timing file overlapping the GNK file duration is required.

Once the SER or the GNK file has been selected or opened in the SER toolbox or Genika Astro GNK browser respectively it is possible to select a stp file with the *GPS Resync* button.

The SER Toolbox can batch convert all selected files if they are included in the *stp* time reference.

The Toolbox (SER) or Genika Astro (GNK) checks if the file does overlap with the file and if the stp file contains incoherent timings. Genika Trigger duplicate the SER file and readjust timing according to the stp file. It is also possible to convert the resynchronized file to Tangra's ADV format.

Results

It is possible to achieve a precision better than 10ms with this method.

Keyboard shortcuts

F1	**Zoom 25%**
F2	Zoom 50%
F3	Native size
F4	Zoom 200%
Ctrl O	Option window
Ctrl R	Reticle toggle
Ctrl T	SER Toobox
Ctrl S	Start freerun
Ctrl D	Stop freerun

Notes about performances

CPU performances

CPU performances are not critical for Genika except at very high FPS or with the IDS 3370 camera.. You can gain reducing the live update or the histogram update. An automatic backoff threshold is used for CPU heavy processes such as histogram calculation or the focus assistant.

You may also activate jumbo frames for Basler GigE cameras : make sure your NIC driver has jumbo frames activated as well !
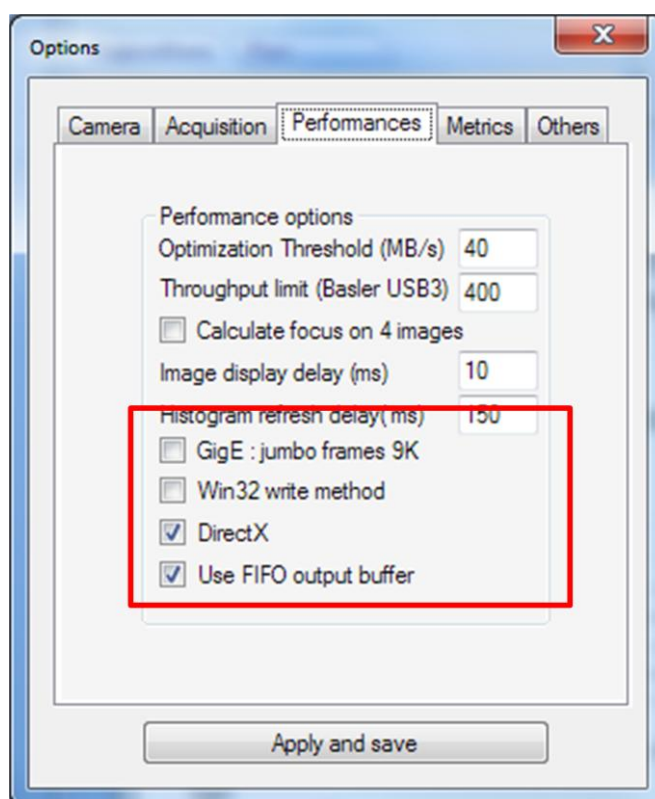
Genika uses multithreading with C2D and above.

Display performances

Genika display image with two modes : GDI+ and DirectX. The DirectX mode uses your GPU for hardware accelerated rendering and reduce the CPU load by 30 to 50%. This mode should be used whenever it is possible. However on some rare configurations the GDI+ is more performing better than DirectX.

Disk Performances

Your camera delivers high bandwidth that can overtake your hard drive. The Basler aca1300-30gm model delivers over 84 MB/s using 16 bits, it's usually more than a standard laptop hard drive can handle. Regarding HDD note that old models such as 10000rd/mn Raptor deliver a lower sequential throughput than the recent 5400 rd/mn HDD. The latest 5400 HDD can support 12 bits stream for

camera with throughput below 90MB/s. Some cameras require a last generation SSD to get the maximum throughput (IDS 3370 for example). That is the case of USB3 cameras or CMOSIS based cameras.

Genika has been optimized to deliver the best performances using specific parameters (Sequential writing, pre-allocation, multithreading). Nevertheless at some stage, when the system cache is full, it cannot go faster than your drive. Usually you will have no issue using 8 bits mode. Trouble comes with long 16 bits full speed acquisition. If you use your camera that way, you may have to use SSD, or Raid system to increase the disk performances.

Optimization tips are:

- Trim or defragment your SSD or HD before acquisition. File being very large (5GB for a 60s 16 bits capture with the Basler 1300-30gm model), the file system may waste some time searching for free clusters
- More RAM is better for it means more system cache. Note that CPU isn't critical, any C2D will be enough
- For very high performances, use a RAID system or a hardware desktop RAID
- Use 64 bits OS to address more than 3 GB of memory
- Use a last generation SSD that can handle all camera models such as the Samsung 840 Pro on SATA3 interface.

Two write modes are available:

- Managed mode filestream
- Unmanaged classical Win32 IO mode. This mode can be activated from the option window and maybe faster depending on the system.

Two write strategies are available :

- FIFO buffer mode : frames are stored in a dynamically allocated Firs In First Out buffer is the disk can't cope with the throughput. After the end of the free run, the buffer must be flushed to disk and it is not possible to launch another acquisition immediately.
- Direct to disk mode : in this mode, frames are directly sent to Windows. It is possible to relaunch an acquisition immediately but this mode is prone to frame loss.

GigE Performances

Sometimes the video stream will lose a frame due to a transmission error over the GE link. For most application it is not important and Genika has been written to handle those errors by ignoring them.

Nevertheless some applications cannot stand such errors. It is possible to optimize the transfer by network optimization as follow:

- If you have an Intel Pro1000 compatible NIC (Intel chipset for example), use the dedicated Basler performance driver. It can handle frame retransmission.
- Configure your NIC has follow :
  - Switch on *Jumbo Frames* with the maximal size, usually 9000 is fine,
  - Increase *transmission buffers* and *reception buffers* value,
- Increase the *interpacket delay* value on the camera side using the Pylon Viewer. You'll find an optimal value at some stage. Note that above this value, speed will decrease again.
- Use a Cat6 Ethernet cable,
- **Switch off power saving on the Ethernet port,**
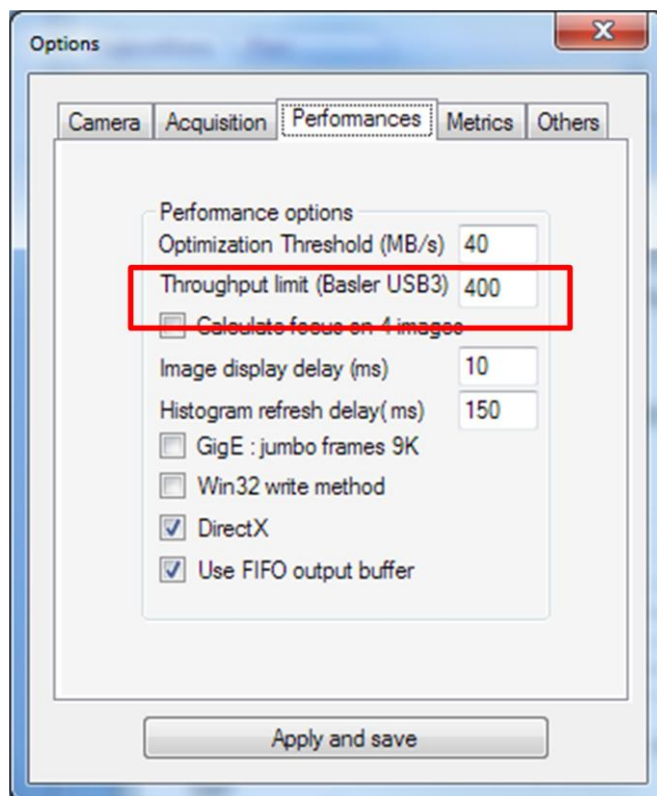- **Switch off antivirus for the disk and the Ethernet port.**

USB3

The effective throughput of USB3 interface spreads from 200MB/s up to 500MB/s. If the controller isn't fast enough, you will lose frames and that can be checked in the acquisition counter window:

```
FrameCounter

Buffer used    1
Lost frames    10
TimeOut        0
Grab errors    0
```

With IDS camera you should reduce the pixel clock setting.

With Basler camera, it is possible to limit the effective throughput of the camera from the option window. The unit is MB/s, effect is immediate:

End of this document