



PLxCam Series



User guide

PLxCapture software © I-Nova

Version 2.1f

I-Nova

www.inova-ccd.com

33, rue des gros grès - 92700 Colombes – France - Tél. : +33-(0)1 47 84 70 27 – Fax : +33-(0)9 50 53 50 80

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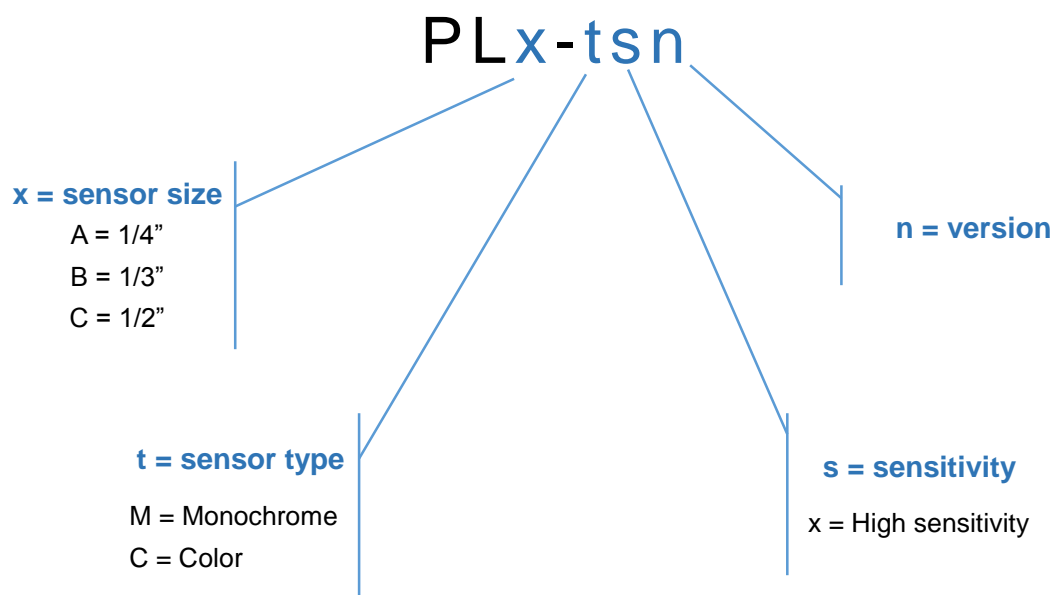
1 Introduction

i-Nova cameras – PLxCam Series are ideally designed for **specific usage in Astronomy**; optimization of the electronics makes them suitable for applications such as acquisition with **very low light**.

- The **PLxCapture software** was specially developed to fully exploit the potential of our cameras.
- An **integrated circuit including specific IC** (FPGA) allows significant reduction of electronic noise.
- **3 speeds of reading of the CCD / Cmos matrix:**
 - High speed for planetary/lunar/solar imaging (8 and 12bit);
 - Half maximum speed to reduce readout noise (12bit);
 - 1/4 maximum speed for deepsky imaging and enhanced visual mode (2bit) with a minimal readout noise.
- During a long exposure (deepsky or enhanced visual mode), the non-essential components will go into **energy-saving mode** which reduces the heating of these components and helps to reduce thermal noise as well.
- Cameras are equipped with a **TTL Serial communication port** which allows communication with other devices such as a GPS module or a cooling system kit for temperature regulation.
- The possibility to **connect several *i-Nova* cameras on the same PC** and to control every camera by one PLxCapture instance each and/or to add a PHDGuiding instance (autoguiding software) to the running system.
- The PLxCapture software works in **client-server mode**. Several configurations are possible:
 - PLxCapture in server mode and the Sequencer module in client mode,
 - Several *i-Nova* cameras connected on several PCs can be controlled by a third-party module (via an Internet browser for example).
- The **SDK is available** on request for programming (Microsoft C# or C++).

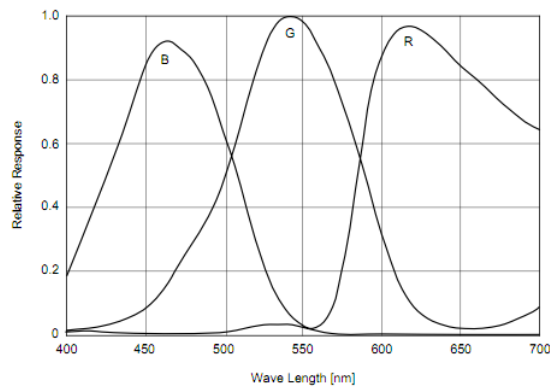
	PLA-C+	PLA-C2	PLB-C2	PLA-M	PLA-Mx	PLB-Mx	PLC-M	PLB-Cx	PLB-Mx2
CCD / CMOS sensor	Sony ICX098BQ	Sony ICX098BQ	Sony ICX204AK	Sony ICX098BL-E	Sony ICX618ALA	Sony ICX445ALA	Aptina MT9M001	Aptina MT9M034	Aptina MT9M034
Color/Monochrome CCD sensor	C	C	C	M	M	M	M	C	M
CCD / CMOS sensor size format	1/4"	1/4"	1/3"	1/4"	1/4"	1/3"	1/2"	1/3"	1/3"
Pixel dimension	5.6μ	5.6μ	4.65μ	5.6μ	5.6μ	3.75μ	5.2μ	3.75μ	3.75μ
CCD matrix (L*H)	640*480	640*480	1024*768	640*480	640*480	1296*966	1280*1024	1280*960	1280*960
A/D converter	12bit	12bit	12bit	12bit	12bit	12bit	10bit	12bit	12bit
FPS max (full resolution)	60 fps	60 fps	24 fps	60 fps	60 fps	23 fps	30 fps	30 fps	30 fps
PC interface	USB2.0	USB2.0	USB2.0	USB2.0	USB2.0	USB2.0	USB2.0	USB2.0	USB2.0
Hardware Binning 2*2	Y	Y	Y	Y	Y	Y	Y	Y	Y
Hardware ROI	Y	Y	Y	Y	Y	Y	Y	Y	Y
TTL serial com. port	N	Y	Y	Y	Y	Y	Y	Y	Y
Autoguiding port, ST4 style	N	Y	Y	Y	Y	Y	Y	Y	Y
Planetary imaging	***	***	***	****	*****	****	***	****	****
Lunar / Solar imaging	**	**	***	***	***	****	****	****	****
DeepSky imaging - Real time stacking	**	**	***	***	***	****	**	****	****
Autoguiding	*	**	***	***	****	****	****	***	****
Cooling system	N/Option	N/Option	N/Option	N/Option	N/Option	N/Option	N/Option	N/Option	N/Option
Software package (multilanguages)	Y	Y	Y	Y	Y	Y	Y	Y	Y
SDK (XP, Vista, Win 7,8 and 8.1 x86/x64)	Y	Y	Y	Y	Y	Y	Y	Y	Y
ASCOM V5.5, V6SP1, V6SP2 compliant	Y	Y	Y	Y	Y	Y	Y	Y	Y

How to read PLxCam Series nomenclature?



1.1 PLA-C2

- The PLA-C2 is not a webcam as it may look like. Of course, it is the same **color sensor ICX098** that many astrophotographers have already experienced. However, mentioning features such as: **12-bit binning and hardware ROI, USB2 interface**, is sufficient to clearly differentiate PLA-C2 from webcams.
- USB2 interface allows to get a rate of **60fps**, ten times higher than what is available in USB1.1!
- **Electronic noise is remarkably maintained low** on this sensor which allows long exposure times.



ICX098BQ Quantum Efficiency (QE = 0,45)

Source SONY

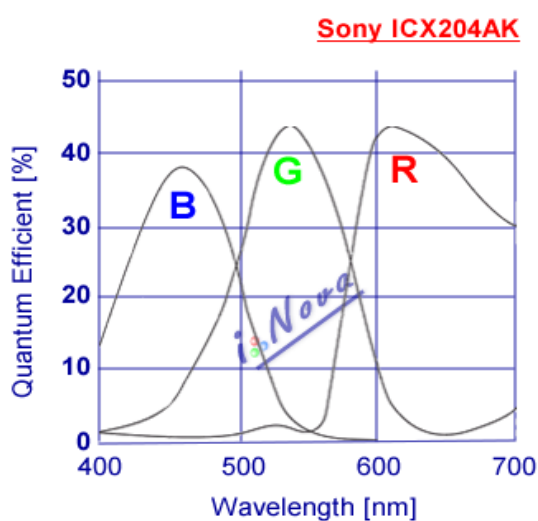
Communication ports:

- **ST4 interface** for autoguiding,
- **TTL serial**: for filter wheel control, focusing motors control, and telescope mount control (ASCOM V6).

1.2 PLB-C2

- **Sony Super HAD ICX204AK CCD sensor (1024 x 768 pixel array)** with a very high quantum efficiency in the whole visible spectrum.
- Ideally suited for **lunar/solar high resolution imaging, and deepsky imaging**, thanks to a very good sensitivity in the whole visible spectrum range, with a low electronic noise which allows long exposure times.
- Provides 2x2 hardware binning (512 x 384) to get a 9.3µm square pixel to be able to detect a faint star for autoguiding.
- **C-mount thread** (this standard allows users to take different kinds of adapters like 1.25" eyepiece holder, camera objective lens with step down ring, ...).

CMOS Sensor	Sony Super HAD ICX204AK 1/3"
CCD Matrix (L*H)	1024*768
Pixel size	4.65µm x 4.65µm
Hardware binning 2x2	Yes
Hardware ROI (region of interest)	Yes
A/D converter	10/12bit
Frame rate (8/12bit)	Up to 24 FPS at full resolution
Exposure time	From 0.1ms to infinity
Interface	USB2.0
Communication port	For filter wheel control, focusing motors control, and telescope mount control (ASCOS V6)



ICX204AK Quantum Efficiency

Source SONY

Performance

Frame rate (FPS) at full resolution:

Mode	Frame rate
8bit	<u>until 24 FPS</u>
12bit	<u>until 12 FPS</u>

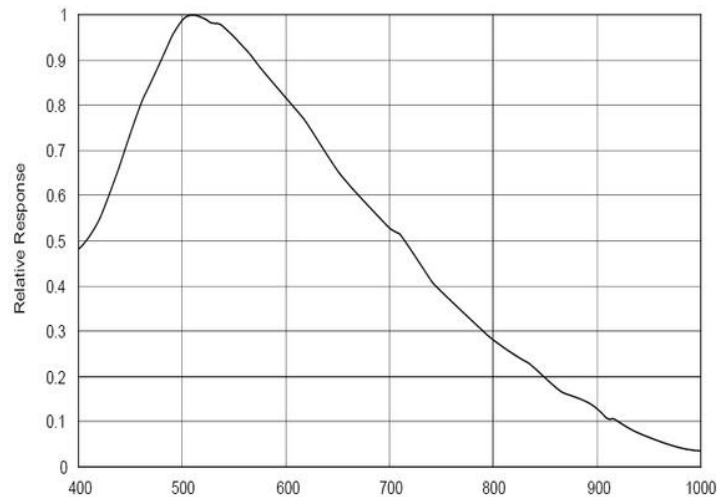
The surplus of pixels in the image we get is very useful to realize lunar or solar images at 24 fps.

Hardware ROI function provides maximum frame rate in planetary mode.

i-Nova

1.3 PLA-M

- **Monochrome sensor ICX098**
- **12-bit binning and hardware ROI**
- **USB2 interface** allows to get a rate of **60fps**, ten times higher than what is available in USB1.1!
- **Electronic noise is remarkably maintained low** on this sensor which allows long exposure times.



ICX 098BL Quantum Efficiency (QE = 0,45)

Source SONY

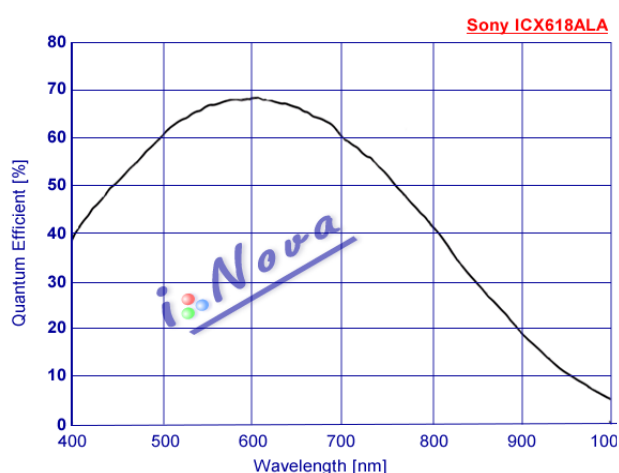
Communication ports:

- **ST4 interface** for autoguiding,
- **TTL serial**: for filter wheel control, focusing motors control, and telescope mount control (ASCOM V6).

1.4 PLA-Mx

- New **Sony Exview ICX618ALA CCD sensor (640 x 480 pixel array)** with a very high quantum efficiency from the visible spectrum to the near infrared (IR) region.
- Ideally suited for **planetary high resolution imaging**, thanks to an excellent sensitivity from the visible spectrum to the near infrared (IR) region.
- Provides 2x2 hardware binning (640 x 480) to get a 11.2µm square pixel to be able to detect a faint star for autoguiding.
- **C-mount thread** (this standard allows users to take different kinds of adapters like 1.25" eyepiece holder, camera objective lens with step down ring, ...).

CMOS Sensor	Sony Exview ICX618ALA 1/4"
CCD Matrix (L*H)	640*480
Pixel size	5.6µm x 5.6µm
Hardware binning 2x2	Yes
Hardware ROI (region of interest)	Yes
A/D converter	10/12bit
Frame rate (8/12bit)	Up to 63 FPS at full resolution
Exposure time	From 0.1ms to infinity
Interface	USB2.0
Communication port	For filter wheel control, focusing motors control, and telescope mount control (ASCOT V6)



ICX618ALA Quantum Efficiency (QE = 0,60)

Source SONY

Performance

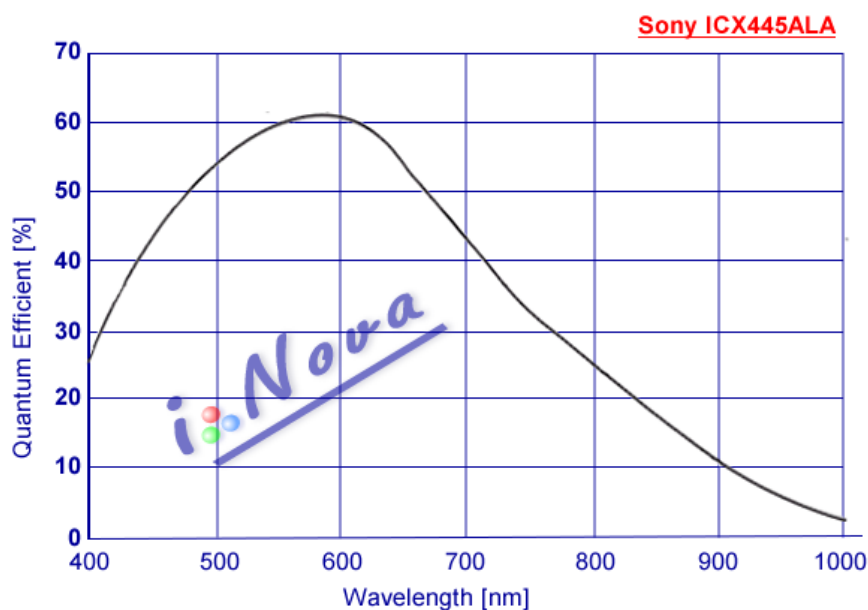
Method to reduce readout noise with lower frequency:

Mode	Usage	Frequency
<u>Fast mode</u>	<u>Planetary 8/12bit</u>	24Mhz
<u>Normal mode</u>	<u>Planetary 12bit</u>	12Mhz
<u>Low speed mode</u>	<u>Visual enhancement & Deepsky 12bit</u>	6Mhz

1.5 PLB-Mx

- **Sony Exview ICX445ALA CCD sensor (1280 x 960 pixel array)** with a very high quantum efficiency from the visible spectrum to the near infrared (IR) region.
- Ideally suited for **lunar/solar high resolution imaging**, thanks to an excellent sensitivity from the visible spectral range to the near infrared region, with a very low electronic noise which allows long exposure times.
- Provides 2x2 hardware binning (640 x 480) to get a 7.5µm square pixel to be able to detect a faint star for autoguiding.
- **C-mount thread** (this standard allows users to take different kinds of adapters like 1.25" eyepiece holder, camera objective lens with step down ring, ...).

CMOS Sensor	Sony Exview ICX445ALA 1/4"
CCD Matrix (L*H)	1280*960
Pixel size	3.75µm x 3.75µm
Hardware binning 2x2	Yes
Hardware ROI (region of interest)	Yes
A/D converter	10/12bit
Frame rate (8/12bit)	Up to 23 FPS at full resolution
Exposure time	from 0.1ms to infinity
Interface	USB2.0
Communication port	For filter wheel control, focusing motors control, and telescope mount control (ASCOT V6)



ICX445ALA Quantum Efficiency

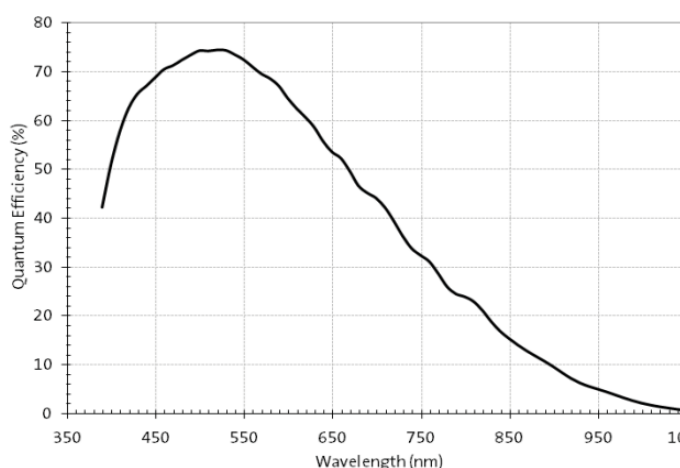
Source SONY

1.6 PLB-Mx2 / PLB-C2

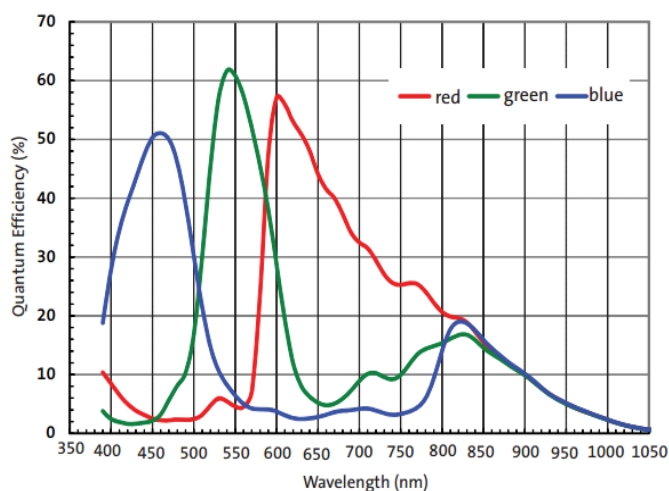
- New **Aptina MT9M034 Cmos sensor (1280 x 960 pixel array)** with a very high quantum efficiency from the visible spectrum to the near infrared (IR) region.
- Ideally suited for **lunar/solar high resolution imaging**, and deepsky imaging, thanks to an excellent sensitivity from the visible spectral range to the near infrared region, with a very low electronic noise which allows long exposure times.
- Provides 2x2 hardware binning (640 x 480) to get a 7.5µm square pixel to be able to detect a faint star for autoguiding.
- **C-mount thread** (this standard allows users to take different kinds of adapters like 1.25" eyepiece holder, camera objective lens with step down ring, ...).

CMOS Sensor	Aptina MT9M034 1/3"
CCD Matrix (L*H)	1280*960
Pixel size	3.75µm x 3.75µm
Hardware binning 2x2	Yes
Hardware ROI (region of interest)	Yes
A/D converter	10/12bit
Frame rate (8/12bit)	Up to 30 FPS at full resolution
Exposure time	from 0.1ms to infinity
Interface	USB2.0
Communication port	For filter wheel control, focusing motors control, and telescope mount control (ASCOT V6)

Monochrome sensor (PLB-Mx2)



Color sensor (PLB-Cx)



MT9M034 Quantum Efficiency

Source Aptina

Performance - Frame rate (FPS), 8bit mode:

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Resolution	Frame rate
1280*960	34 FPS
1280*480	68 FPS
1024*768	43 FPS
800*600	82 FPS
640*480	104 FPS
400*400	119 FPS
320*240	200 FPS

1.7 Getting started

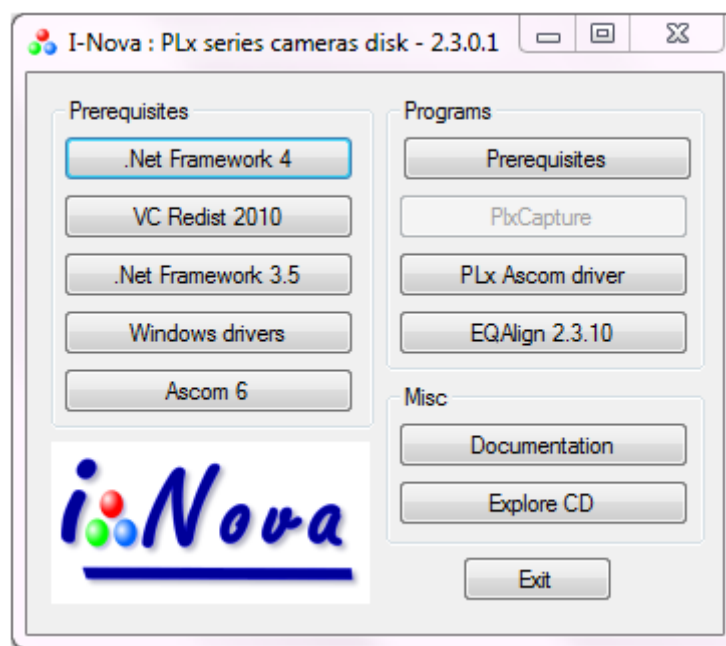
NOTICE: The PLx cameras are only compliant with PC running under one of the following operating systems: Windows XP SP3, Vista or Win 7 / 8 / 8.1 x86 / x64.

Insert the disk into a drive to start the installation program.

At this stage of the installation, **do not connect** the camera to the USB 2.0 port of your PC.

If you do not have an autorun feature or have it disabled, you may launch the installation program named **autorun.exe** (in the root of the CD-ROM).

The installation window below appears to select programs to install on the computer:



1. Third party components installation

Windows XP Vista:

PLxCapture software requires the installation of the following prerequisites: **.Net Framework 3.5**, **.Net Framework 4**, **Ascom V6** and **VC Redist 2010**.

Windows 7, 8 and 8.1 x64:

Only **Ascom V6** needs to be installed.

- For all applications, it is necessary to install software drivers: Click on "**Windows Drivers**" and select the **camera model** to be installed.
- For planetary imaging / long exposure and Visual enhancement, install **PLxCapture** application.

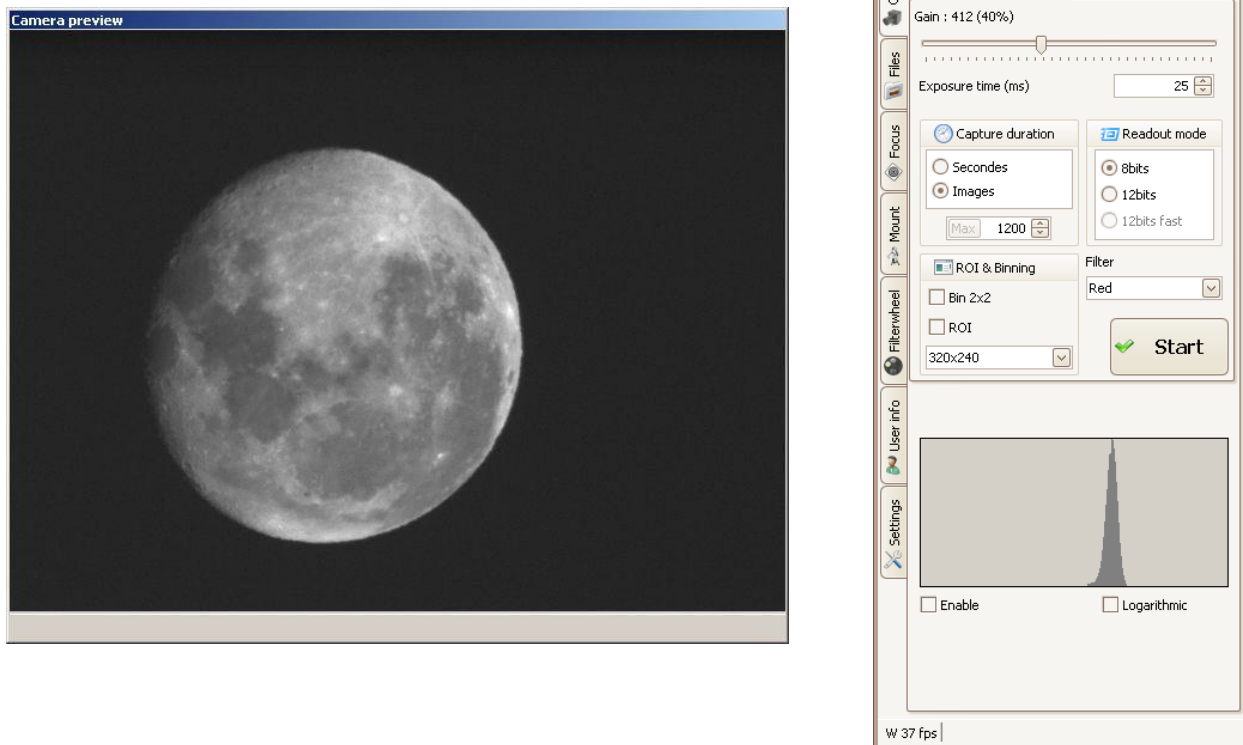
4. For Polar pointing, PE analysis and autoguiding, install **EQAlign** application.
5. To use the camera with other third party software, it is necessary to install **PLx ASCOM driver**.
6. **Connect the camera to the PC** and confirm the choice of Windows during the procedure "**Add peripheral Wizard**".
7. For a complete documentation of the software package, click on "**Documentation**".

We recommend to check frequently our FTP site and download the latest software package version from this link: [**http://www.inova-ccd.fr/download/**](http://www.inova-ccd.fr/download/)

2 PLxCapture presentation

Once the PLX capture software is installed, you can use your PLA-Mx camera to make your first capture.

The main window will look like the following image (without lens on the camera) ;



The window can be split in two parts:

- On the left: the preview window which displays the camera image;
- On the right: exposure, image control and major functions.

All these functions are presented in the following chapter 3.



Windows used in PLxCapture are sized to be compatible with “netbook platforms”.

3 PLxCapture commands

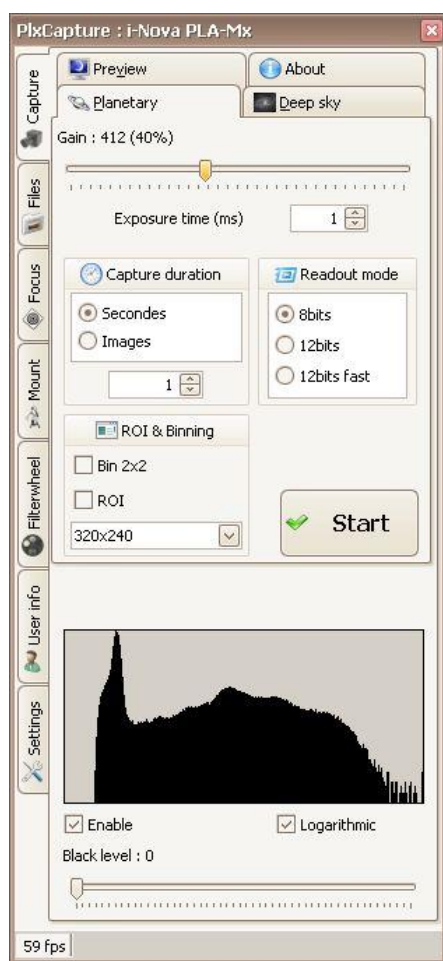
Current chapter will enumerate all available software functionalities. We select a functionality by clicking on the navigation tabs on the left side of the window. Upper tabs are generally considered as sub-functions.

3.1 Capture

In this window, 4 tabs are available to configure the camera in order to capture: “Planetary”, “Deepsky”, “Preview”, “About”. Color cameras use an additional tab to manage color balance.

3.1.1 Planetary

In planetary mode, it is possible to adjust exposure time from one up to 1000ms with one millisecond accuracy. The 1000ms is an arbitrary limit used to distinguish planetary and deepsky modes.



Gain is adjustable from 1 to 1023 (0% to 100%). The window preview reproduces changes immediately, even if the histogram is enabled.



Be careful higher gain values produces noise on images.

Capture can be made in 8bit or 12bit mode.



In 12bit mode, frame rate may be reduced by a factor of 2.

Then, the capture itself can be configured either in **frames** or in time in **seconds**.

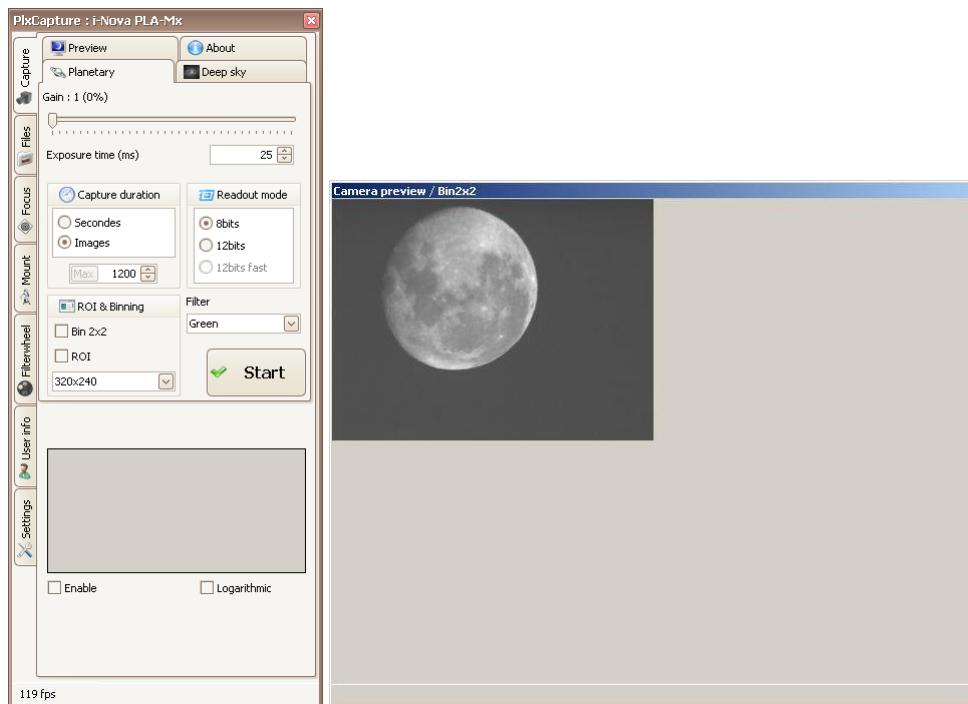
The **histogram** can be displayed in linear or logarithmic and shows the pixel saturation: if the curve reaches the right hand side of the windows, it means the image is “over-exposed”.

The camera can also operate in **2x2 binning mode**, and, in this mode, each block of 2x2 pixels is seen as a single pixel. The camera sensitivity is increased in a ratio of 4 but its resolution is reduced in the same ratio.

For example, 4 pixels of intensity 7, 8, 9 and 11, the resulting pixel will be seen as a single pixel with an intensity of 35:

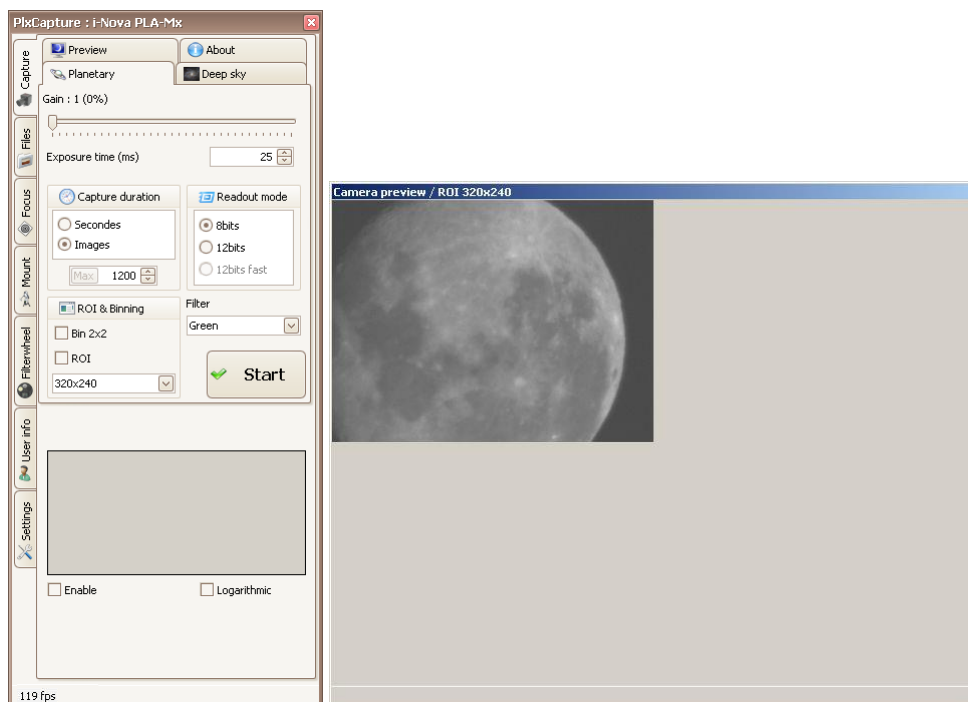
$$\begin{pmatrix} 8 & 7 \\ 9 & 11 \end{pmatrix} = 35$$

This greatly enhances sensor sensitivity by quadrupling the collecting area of a "pixel" and thus also quadrupling its "sensitivity" for a monochrome sensor (tripling for a color sensor). Its use is uncommon in planetary mode as it is usually more efficient to work with a focal length reduced by half when possible. But, for autoguiding, this is useful to catch faint stars.



ROI (Region of Interest) function allows to process a part of the total image again to optimize the bandwidth of the USB port. By default, several image sizes are predefined according to ROI. A "Custom" size can be defined manually (see ROI definition in Chapter 4.6).

Finally, the **Start** button starts capture process following configured settings. The button is deactivated when backup is impossible (e.g. if path does not exist).



3.1.2 Deepsky

In deepsky mode, maximum exposure of 1000ms is removed and there is virtually no limit for exposure time.

However, spending a few tens of seconds, an electronic noise will appear but this non-statistical noise which depends only on temperature and exposure can be manually removed by a dark frame, performed without flow (putting a cap on the objective lens of the camera) in the same temperature and gain exposure conditions.

We have then the possibility to capture Deep Sky Objects or planets in special conditions (e.g. Jupiter with a CH4 filter, or distant outer planets with at high F/D) when seeing condition is correct.

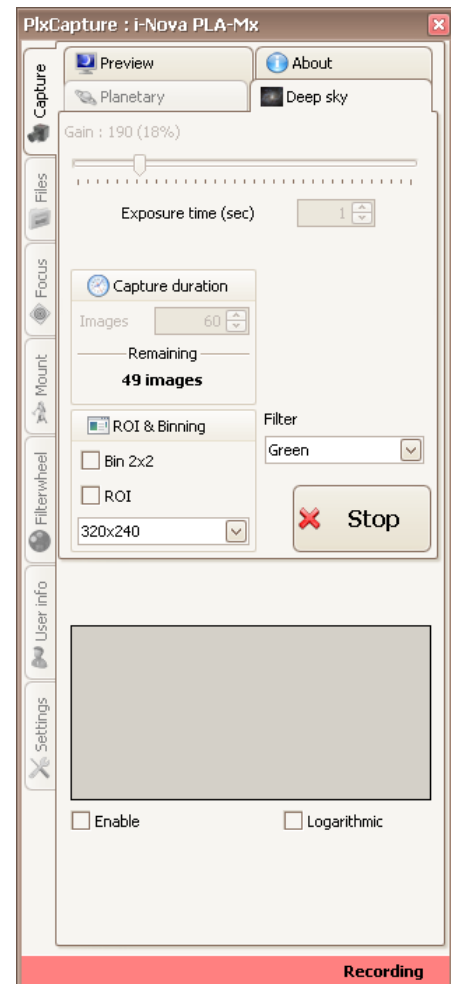
Again, **gain** value is adjustable from 1 to 1023.

Exposure time is now in second, and **capture duration** is given in frames.

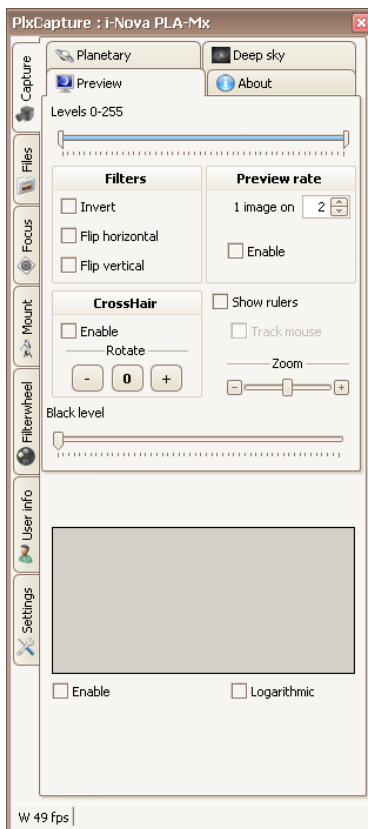
A progress bar informs you about the status of the current acquisition. Other commands (**ROI**, **binning**, **histogram**) are similar to those found in paragraph 3.1.1.

The **START** button shall activate the capture sequence and is deactivated when backup is impossible (e.g. if path does not exist). During capture, a countdown of images is displayed.

Nota: in deepsky mode, capture is automatically done in 12bit mode in a "slow readout" which improves the CCD readout noise.



3.1.3 Preview



This window contains options to configure image display. Configuration is ONLY for image display and does not affect the image recording.

- It is possible to reduce the dynamic image viewing by raising the **black level** (default zero) and reducing the white level (default 255).
- Commands allow images to **reverse horizontal and/or vertical axes**.
- For less powerful machines, it is possible to **display only one picture every N recorded**.
- For an accurate calibration, **dark level** can be adjusted manually.
- A **zoom function** allows to simplify focus operation by enlarging the image in a ratio of 2 to 4. It can also reduce the image size in a ratio of 1:2 to 1:4.
- A **crosshair** is available and can be rotated degree by degree. Of course, this crosshair is not registered with the stream from the camera.

3.1.4 About

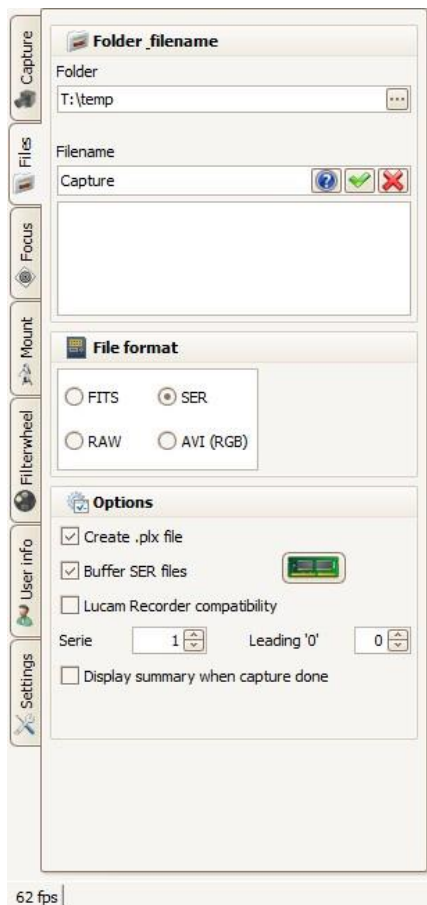
The tab “About” displays information: PLxCapture software version and information about the used camera.



3.2 Files

This command configures the **folder** for storing captured images (or videos).

The **file name** to be used in the series of files must be specified. In our example, the file will be named "Capture".



The selected file name can include operators preceded by the symbol "%" as follows:

%o: OBSERVER field. See Chapter 3.6: for definition.

%t: TELESCOPE field. See Chapter 3.6: for definition.

%s: current number of the sequence. This code will be replaced by an index (1st value defined) that is incremented with each capture.

%d: local date. Will be replaced by "YYYYMoDD_HHMiSS-mmm" with YYYY: year, Mo: month, DD: day, HH: hour, Mi: minute, SS: seconds and mmm: milliseconds.

%u: UTC date. Same format as %d but taking into account time zone and winter / summer time.

%f: filter number.

%n: filter name.

For example, to conform with the notation of planetary observations, one can use the notation **S%uTU_%o** for Saturn capture images.

The recording format can be set to one of the following:

Image format	8 bit	16 bit
FITS	✓	✓
Film format	8 bit	16 bit
AVI¹	✓	
SER²	✓	✓

¹ AVI format is stored in RGB (DIB format) and limited to 2Gb.

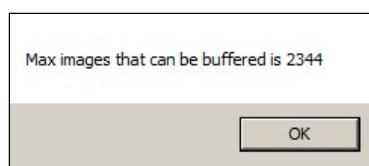
² SER format manages 8bit and 12/16bit images that are compatible with Registax 5/6, as well as Avistack 1.8 or 2.0 (all platforms).

It is possible to produce a "PLX" file associated to each capture. This file, in text format, contains a number of specific data related to the achieved capture³. An example for a SER file:

```
DateStart=2011-03-09T20:31:49.234
DateEnd=2011-03-09T21:12:02.531
ExposureDuration=30sec
Gain=104
Mode=16,Low
Images=80
FileFormat=SER
```

This acts as a notepad to record captures with all configured settings.

It is possible to use buffer RAM to increase acquisition speed – Number of acquisitions will depend on resolution (8/12bit):



It is also possible to produce compatible SER files with LUCAM Recorder. In mode "Compatible Lucam Recorder", header of the SER file contains "LUCAM RECORDER", in order to make the capture compatible with third-party programs that require such label.

Otherwise, the name "PlxCapture" is included in the header of the SER file.

See example below of an extract of a SER file:

- **Highlighted** fields are: acquisition software, the two configured user fields (user and device) – see Section 3.6,
- Field "i-Nova PLA-MX" indicates camera model.

"000000000	4C 55 43 41 4D 2D 52 45-43 4F 52 44 45 52 00 00		LUCAM-RECORDER		"
"000000010	00 00 00 00 00 00 01 00-00 00 80 02 00 00 E0 01			€ à	"
"000000020	00 00 10 00 00 00 65 00-00 00 4D 50 61 20 20 20		e	MPa	"
"000000030	20 20 20 20 20 20 20 20-20 20 20 20 20 20 20				"
"000000040	20 20 20 20 20 20 20 20-20 20 20 20 20 20 20				"
"000000050	20 20 69 2D 4E 6F 76 61-20 50 4C 41 2D 4D 78 20		i-Nova	PLA-Mx	"
"000000060	20 20 20 20 20 20 20 20-20 20 20 20 20 20 20				"
"000000070	20 20 20 20 20 20 20 20-20 20 43 31 31 20 20 20			C11	"
"000000080	74 20 20 20 20 20 20 20-20 20 20 20 20 20 20				"

A summary of the capture can be displayed in a window on demand. This avoids having to go and open the PLX file when it is created.

³ contents may change in future versions

3.3 Focus

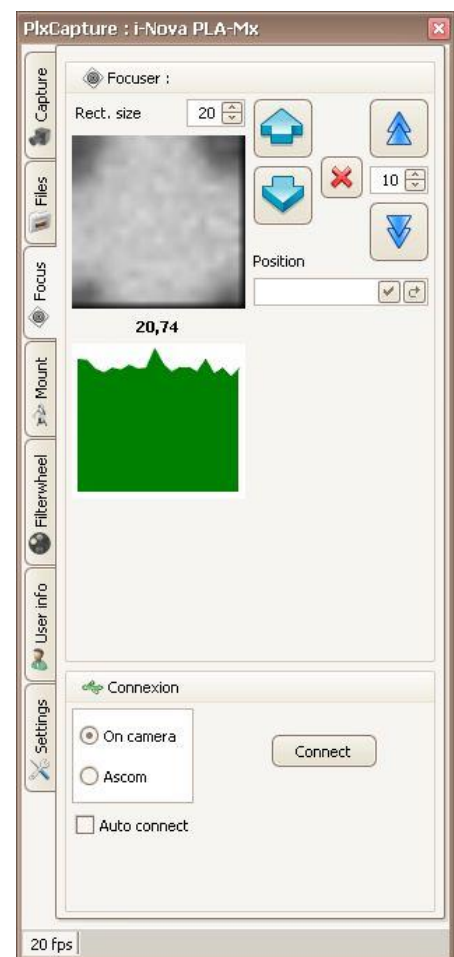
This command helps to focus from PLxCapture software and allows to control a focus motor working under ASCOM V6 protocol.

To do so:

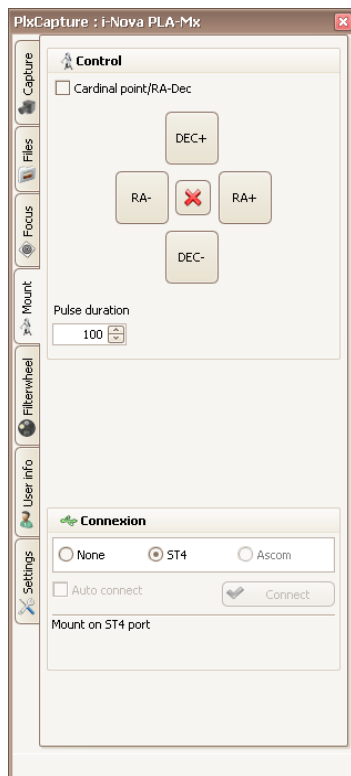
1. Select a star (a green box will appear around your target). The frame size can be modified (20 to 40 pixels) to best fit the targeted star:



2. A cross-section of the star is displayed with a FWHM computation in real time. Warning, this measure is given in pixels, not in arcseconds.
3. The navigation buttons can be used to control a motorized device via ASCOM protocol.



3.4 Mount



This command controls telescope's mount using ST4 interface (available on I Nova cameras) or using an ASCOM interface.

Pressing buttons generates pulses on the required axis. Pulse duration parameter can be adjusted (default value is 100ms).

3.5 Filterwheel

This command allows to specify the name of filters used.

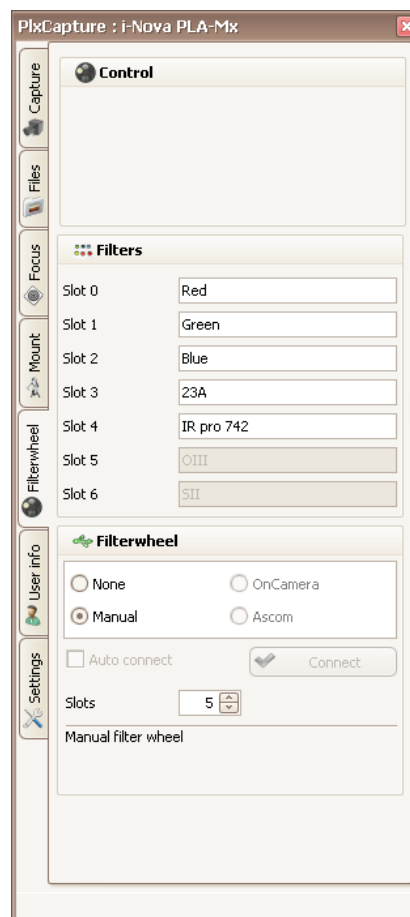
The user will fill in the name of each filter for each wheel position, and this information will be automatically available from communication with the filter wheel I-Nova.

This information is integrated into the FIT format, and in all cases in the PLX file backup settings (see chapter 3.2 - Files for more information).

If no filterwheel, filter selection is deactivated.

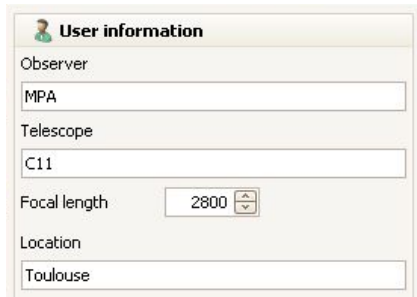
In manual mode, functionality is available.

"On Camera" modes and Ascom use respectively I-Nova and Ascom interfaces to select the automatized filterwheel.



3.6 User

Under this menu, the user will configure PLxCapture for his personal settings. It is possible to name files (see Chapter 3.2 : Files) or provide digital elements for PLxCapture computation.



User information

Observer
MPA

Telescope
C11

Focal length
2800

Location
Toulouse

- Observer and Telescope: this information will be used to populate the fields **OBSERVER** and **TELESCOP** in FIT files (fields **OBSERVER** and **TELESCOPE** in SER files).
- Field "**Focal Length**" will be used for some computations (see Chapter 4 - **PLxCapture** Mesures).
- Field "**location**": defined by default as \Mydocuments\Capture.

- Field **INSTRUMEN** (FIT file): contains the camera model.
- **PROGRAM** field is "I-Nova PlxCapture".

Here is a header FIT file with some parameters:

```

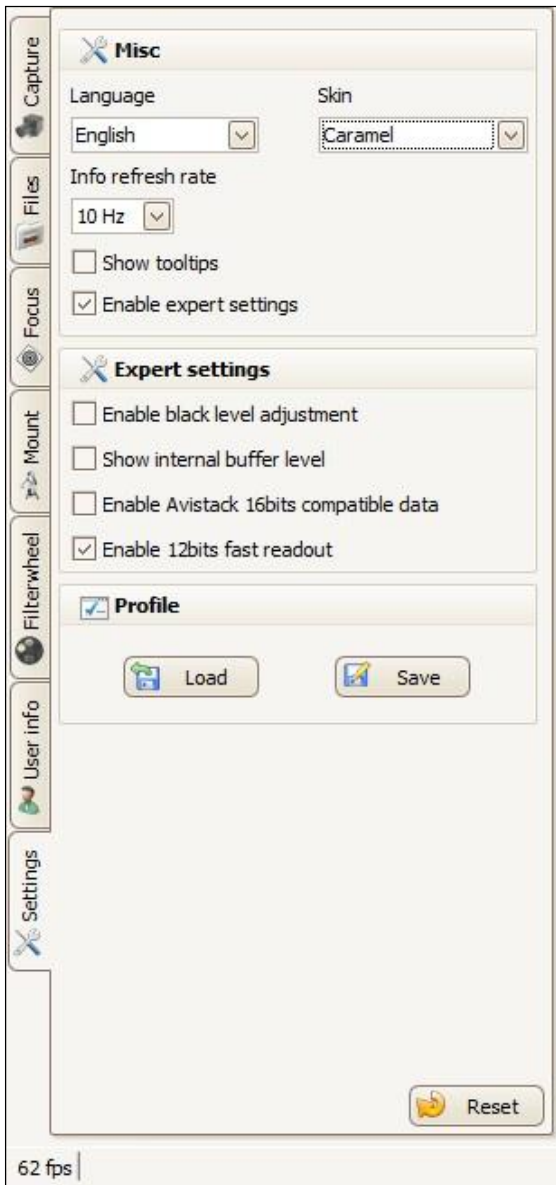
SIMPLE = T
BITPIX = 8
NAXIS = 2
NAXIS1 = 640
NAXIS2 = 480
OBSERVER= MPA
INSTRUME= i-Nova PLA-Mx
TELESCOP= C11
DATE-OBS= 2011-04-20T14:52:54.751
EXPTIME = 0.016
XBINNING= 1
YBINNING= 1
PROGRAM = I-Nova PlxCapture
END

```

3.7 Settings

In this window you can set:

- **Language** used for PLxCapture interface and a **color mode**: default is english. We can also activate **tooltips** (same language as interface).

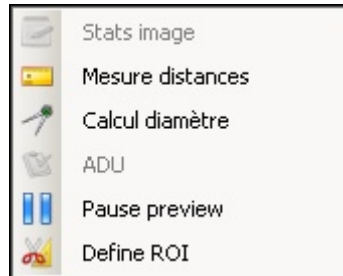


- **Refresh rate information** (histogram, FPS displays, internal buffer display and star refresh to focus) is adjustable to 1, 2, 5 (default) or 10Hz. This helps not to overburden CPU load for lowest configurations.
- **Expert setting**:
 - “**black level**” to precisely tune resulting gamma;
 - visualization of filling and emptying of PLxCapture **internal buffer**. This buffer shows the software's ability to maintain the best possible speed from the camera and to absorb a temporary disk latency. When buffer is full, PLxCapture has to wait until free space is available. If this occurs often, try to activate the buffering files SER (chapitre 3.2 : Files).

- PLxCapture generates 16bit files (or 2 bytes), but only 12 data bits are used. Generally, data is stored in the lower bits representing values from 0 to 4095. The higher bits (4096 to 65535) are forced to zero. AviStack software reads these data but only the higher byte for display; to make PLxCapture compliant with this mode, option “**Avistack compatible data**” has to be enabled.

4 PLxCapture Mesures

In this section, are described all operations that can be achieved on the preview window. Right clicking on the preview window, we get the following list:



4.1 Stats image

In dynamic mode, this functionality is deactivated. It allows to get statistics on the image. It provides minimum, maximum and average ADU and also standard deviation (σ).

4.2 Distance measurement

This operation involves linking two points on the window (eg. 2 stars) and, using focal value (see section 3.6), the result gives the distance between the 2 selected points in arcsecond. When focal length is not given, result is given in pixels.

4.3 Diameter

This operation involves selecting three points of the window (eg. 3 points over a moon crater) and, using focal value (see section 3.6), the result gives the object diameter in arcsecond. When focal is not given, result is given in pixels.

4.4 ADU

ADU stands for Analog/Digital Unit and gives the level of the selected pixel. Of course, preview needs to be in pause mode to get the result.

4.5 Pause preview/Start preview

This operation freezes or restart display as well as communications with the camera

4.6 ROI definition

This functionality defines a rectangular area that will be read from the sensor. This optimizes the USB bandwidth while reducing the size of the generated files. See Chapter 3.1.1: Planetary mode for more information on ROI.

To do so, start in a corner of the area to define and, while holding the left mouse button pressed, draw a rectangle to the opposite corner. ROI is the minimum size of 320x240 and its size must be a multiple of 8. PLxCapture will correct automatically invalid values.

5 Using PLxCapture

5.1 Planetary

The best way to use PLxCapture software to capture planets (or moon) is to run the planetary camera in 8bit or 12bit mode as appropriate. 12bit mode requires twice the bandwidth vs 8bit mode on the USB 2.0 link, thus, maximum frame rates decreases from about 55 fps in 8bit mode to around 25 fps in 12bit mode (12bit mode contains more information than 8bit mode).

In planetary mode, capture is realized with a global compromise between exposure time (often dependent on turbulence) and gain (brightness of the sky object).

With a monochrome camera, capture has to be performed several times to compose a color image: in this case, we talk about capturing RGB (Red, Green, Blue). To do so, the best way is to deal with a filtering device (it is strongly not recommended to disassemble the camera to change the color filter).

It is also possible to add an additional layer to RGB capture that contains all details:

- L-RGB with an additional filter L which lets the entire visible spectrum,
- or IR-RGB with a filter allowing only the infra-red.

Throughout this document, is used the generic term L-RGB but everything applies with IR-RGB in the same way.

1. Having captured 3 or 4 shots, processing has to be done on each one independently (considering that each one is a single black and white image). To do so, Registax v6.1, AviStack 2.0 or Autostakkert!2 are among the best tools currently available (included in PLxCapture CDROM). All of them are able to handle the flow of 8bit or 12bit images from the camera, in TIFF, FIT or SER format (see Section 3.2 for recording formats available). Unprocessed composite images (still in black and white at this stage) are usually backed up in FITS 16 or 32bit format.
2. To build a RGB (or L-RGB) image, all images have to have the same dimensions (for example 640x480 maximum size for PLA-Mx) as Registax v6.1 is not able to process images with various sizes.
Select 3 (or 4) FIT images and check RGB composite image (LRGB for 4 pictures).
3. Press R, G or B on each image of the "frame list" to indicate which image corresponds to which color (respectively Red, Green and Blue) plane (this step is not necessary if names of image files end with _R, _G _B (_L for the luminance) before the extension FIT).
4. Registration (picture alignment) will be done as usual. In case one image is deleted from the list, it is necessary to lower the quality threshold.
Compositing process provides a color picture directly.
5. At this stage, it is possible to refine plan alignment ("align RGB"), edit proportion of Red, Green and Blue in the image ("RGB scale"). In case of a RGB image, wavelet filtering is applied to all three planes simultaneously, or to an "internally" built image using the "Colour Mixing" functionality.:

This very important "Colour Mixing" button will allow you to play with coefficients α , β , γ of luminance following equation:

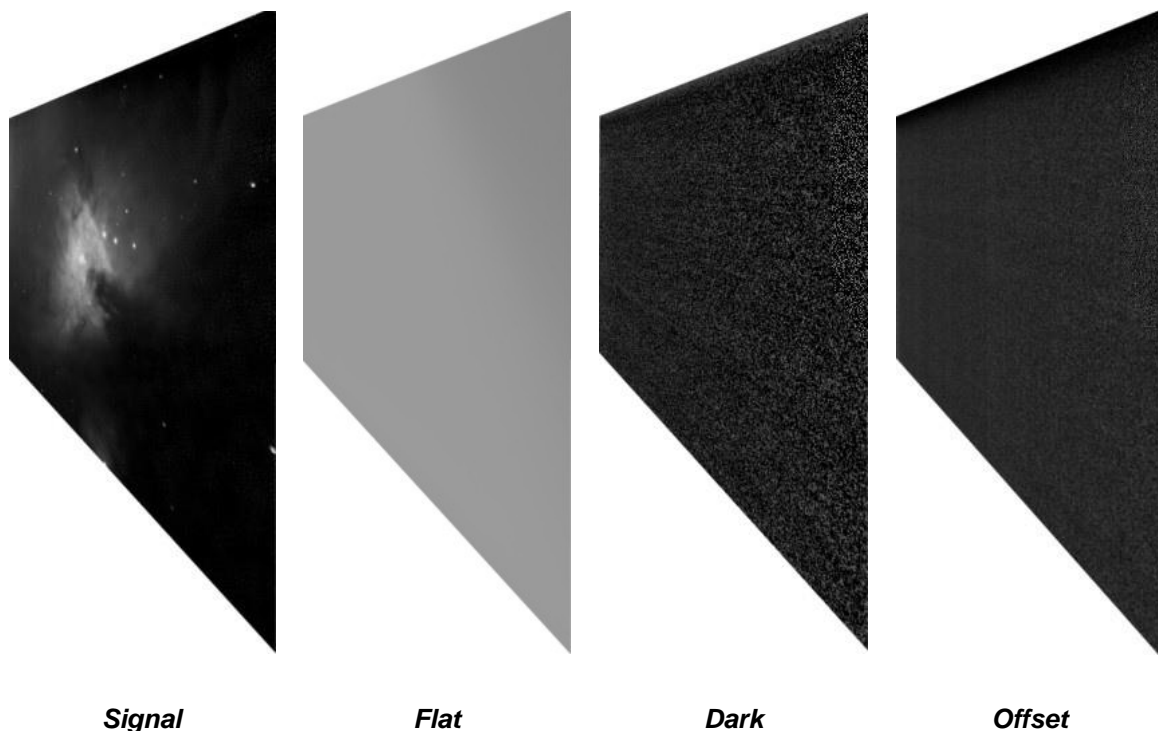
$$\text{Luminance} = \alpha * \text{Red} + \beta * \text{Green} + \gamma * \text{Blue}$$

Wavelet filtering applies on this Luminance plane - R, G and B planes only gives a color overlay.

You can also choose not to apply color (Create B/W image), or to use a real luminance image separately (Use Luminance (file)).

5.2 Deep sky

To use long time exposure, it is possible to use either PLxCapture or third-party software via the ASCOM plugin.



PLxCapture software can achieve pre-processing of images such as:

- OFFSET/BIAS images
This image type contains the readout noise of the camera.
- DARK images
Contain "hot pixels" of the CCD as well as the thermal noise for a given exposure time.
- FLAT Field images
This type of image allows to remove vignetting and dust on the sensor from deepsky images.

Images produced by PLxCapture can be processed by third-party softwares such as DeepSkyStacker (Freeware), IRIS (Freeware), Prism, AstroArt, MaximDL, Photoshop, ...

5.3 Autoguiding

ASCOM V6 and plugin **ASCOM I-Nova PLx camera** are required to use the camera for autoguiding.

Various softwares can be used:

- PHDGuiding (freeware),
- Prism,
- AstroArt,
- MaximDL, etc.

5.3.1 Example with PHDGuiding V1.12

1. Install pre-requisites as follows (included in the installation CDRom):

- .Net Framework 3.5**
- .Net Framework 4**
- Ascom V6**
- Redist 2010**
- Plugin Ascom PLxCam**

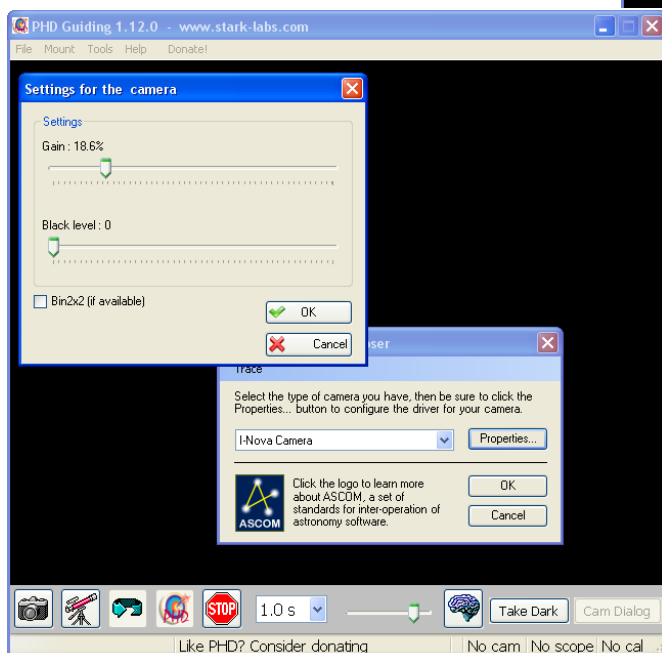
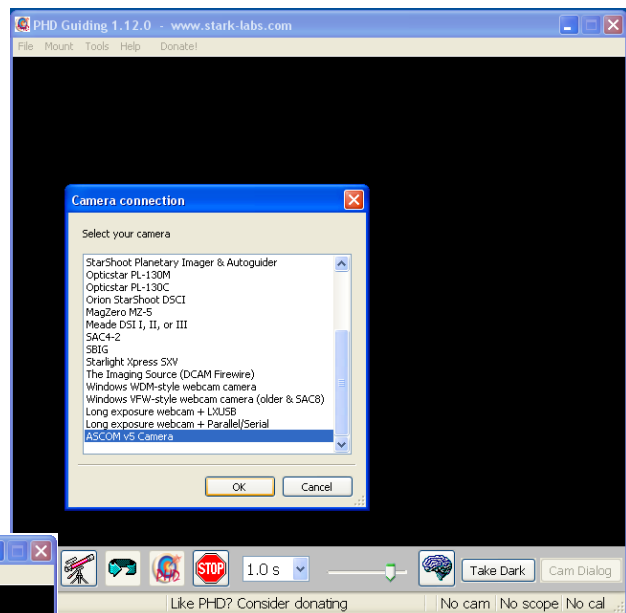
2. Launch PHDGuiding application, clicking



on the icon

3. Select "ASCOM V6 Camera", then "i-Nova camera" in the ASCOM window.

Select the binning 2*2 option to autoguide using a faint star.

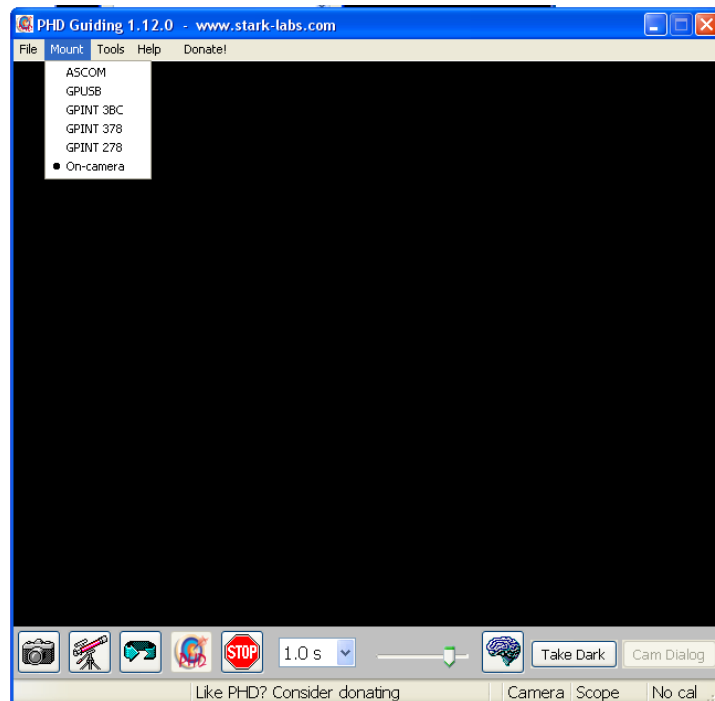



Notice :

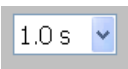



- For a color camera: in binning 2*2, sensitivity is twice or three times sensitivity at full resolution.
- For a monochrome camera, this ratio increases to four times.

4. Click on "Mount" and verify that interface "**On-camera**" is selected:



5. Click on the icon  to activate the ST4 interface.

6. Select the exposure time  (default value is 1 second).

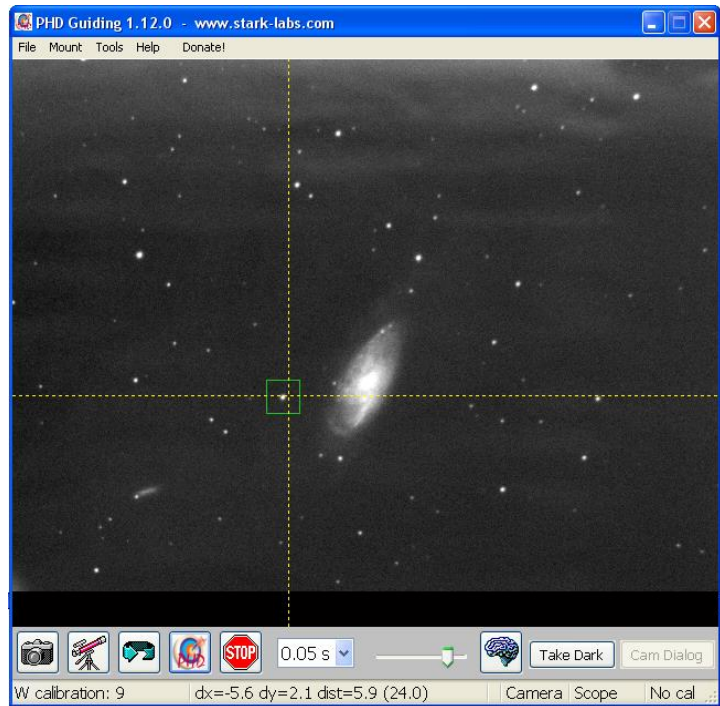
7. Click on the icon  to activate the camera display.



I-Nova

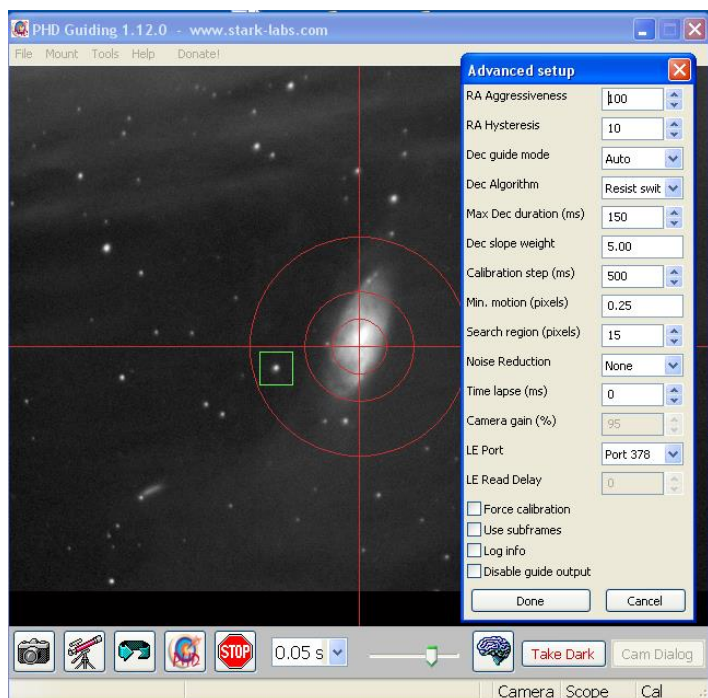


8. Click on the icon to start the calibration process (allows the software to measure and configure the correction pulses applied to the mount for a high quality autoguiding process).
9. When calibration is complete, the software starts to autoguide.



10. To change the autoguiding configuration of PHDGuiding, simply click on the icon

11. To stop autoguiding or exit the application, it is necessary to click on the **STOP** icon, before any other action.



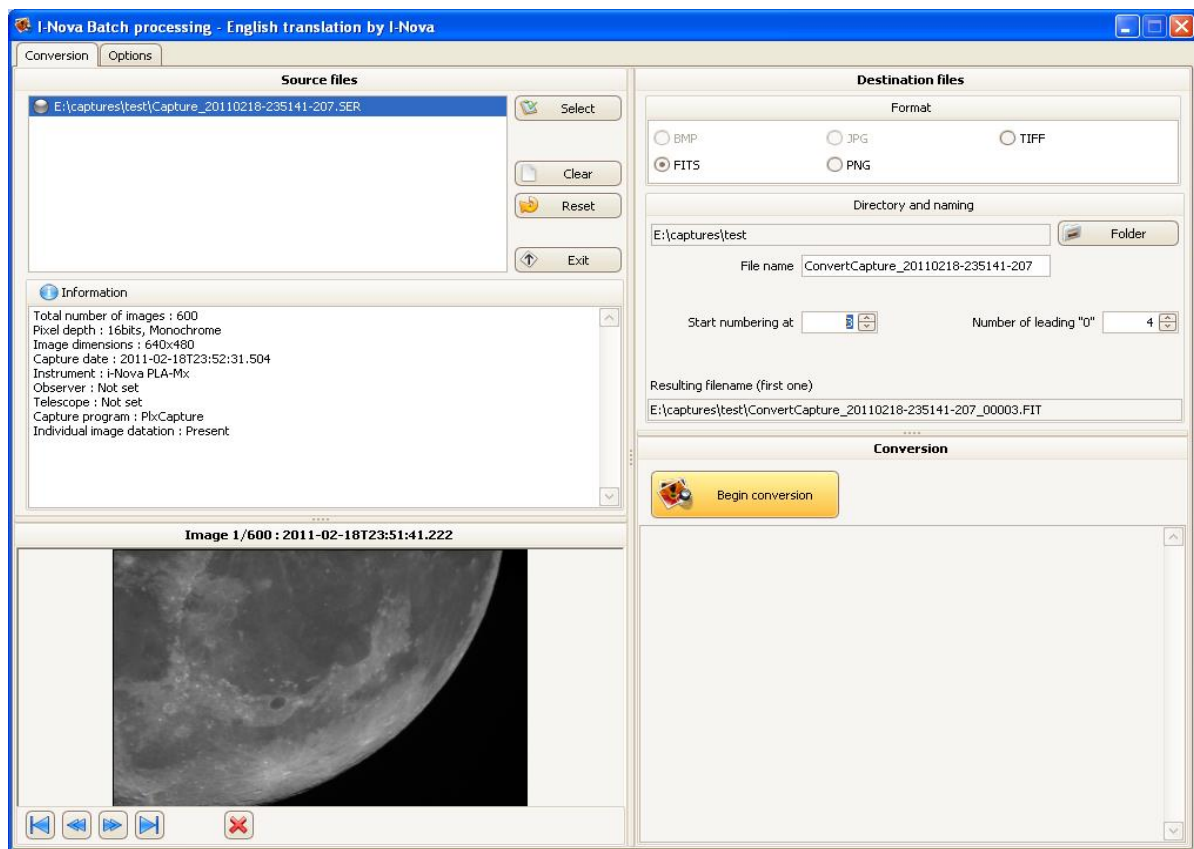
6 Batch processing

6.1 Generalities

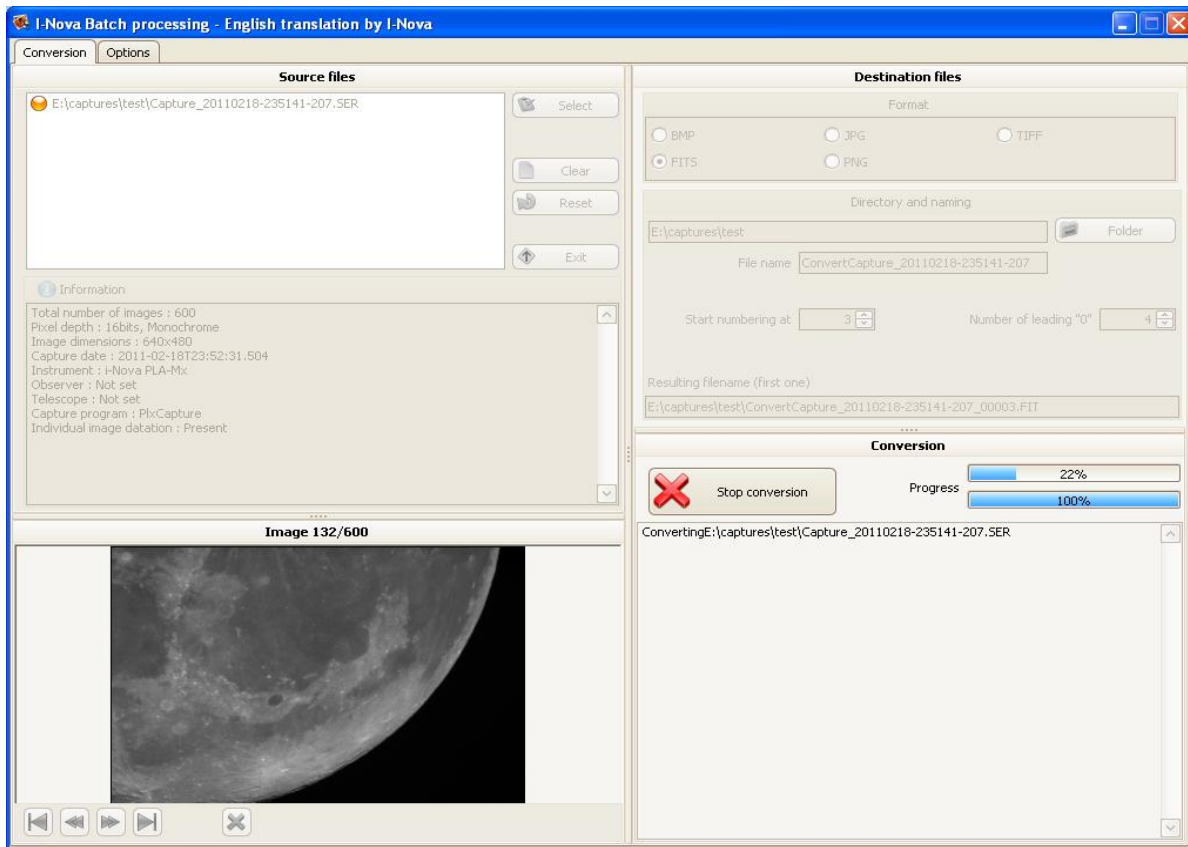
This command allows to convert files from one format to another one.

If an image processing software can not read the format of a captured video, the “batch processing” functionality can convert a video file into multiple single images.

1. The conversion begins with selection of the file to convert (AVI or SER). Then, a summary is provided and the first frame is displayed.
2. Top right, specify the output image format (FIT in the following example), and the output directory / output file name.



3. Output file index can be configured as needed.
4. Click on "Begin Conversion" to start conversion; a progress bar displays while the file is being converted.



6.2 Conversion SER to FIT (IRIS compatible numbering)

1. Select the file to convert.
2. Specify the output folder (generally the working directory of IRIS).
3. Fulfill a generic name (e.g. Sat for "Saturn")
4. Indicate "FIT" as output format and run "Begin Conversion".

As a result, files are created and can be directly used (including numbering) with the Iris software that allows to launch operations, Iris operating on sets (e.g. PREREGISTER, ADD_NORM ...).

7 Technical support

7.1 Support by phone and Email

I-Nova provides technical support and regular updates.

You can contact us by email to support@inova-ccd.com or by phone +33 (0)1 47 84 70 27.

For an effective technical support, tell us as much information as possible about your setup (type of instrument, frame, accessories, computer, operating system, etc..) and if possible a screen shot with the error message.

In case of major problem (software crash), PLxCapture will automatically create a data file and a screen shot to be sent to the support team. There is no personal information other than defining the working environment when the "bug" occurs.

Attached is a default file example.

8 Annex

8.1 Default file

Hereafter is a typical file sent to support team:

```
PlxCapture 2.0.0.43
Un élément avec la même clé a déjà été ajouté.
    à System.ThrowHelper.ThrowArgumentException(ExceptionResource resource)
    à System.Collections.Generic.Dictionary`2.Insert(TKey key, TValue value, Boolean add)
    à PlxCapture.Main.InitLangues()
    à PlxCapture.Main.Main_Load(Object sender, EventArgs e)
    à System.Windows.Forms.Form.OnLoad(EventArgs e)
    à DevExpress.XtraEditors.XtraForm.OnLoad(EventArgs e)
    à System.Windows.Forms.Form.OnCreateControl()
    à System.Windows.Forms.Control.CreateControl(Boolean fIgnoreVisible)
    à System.Windows.Forms.Control.CreateControl()
    à System.Windows.Forms.Control.WmShowWindow(Message& m)
    à System.Windows.Forms.Control.WndProc(Message& m)
    à System.Windows.Forms.ScrollableControl.WndProc(Message& m)
    à System.Windows.Forms.Form.WmShowWindow(Message& m)
    à System.Windows.Forms.Form.WndProc(Message& m)
    à DevExpress.XtraEditors.XtraForm.WndProc(Message& msg)
    à System.Windows.Forms.Control.ControlNativeWindow.OnMessage(Message& m)
    à System.Windows.Forms.Control.ControlNativeWindow.WndProc(Message& m)
    à System.Windows.Forms.NativeWindow.Callback(IntPtr hWnd, Int32 msg, IntPtr wparam,
        IntPtr lparam)
DataWidth : 64
Name : Intel(R) Core(TM) i7 CPU          920  @ 2.67GHz
Caption : Microsoft® Windows Vista™ Édition Familiale Premium
ServicePackMajorVersion : 2
TotalVisibleMemorySize : 6281392
CurrentBitsPerPixel : 32
CurrentHorizontalResolution : 1280
CurrentVerticalResolution : 1024
Description : ATI Radeon HD 4600 Series
```