TeraSense

Sub-THz imaging systems

Model TeraFAST-256

USER MANUAL

Revision 1.0

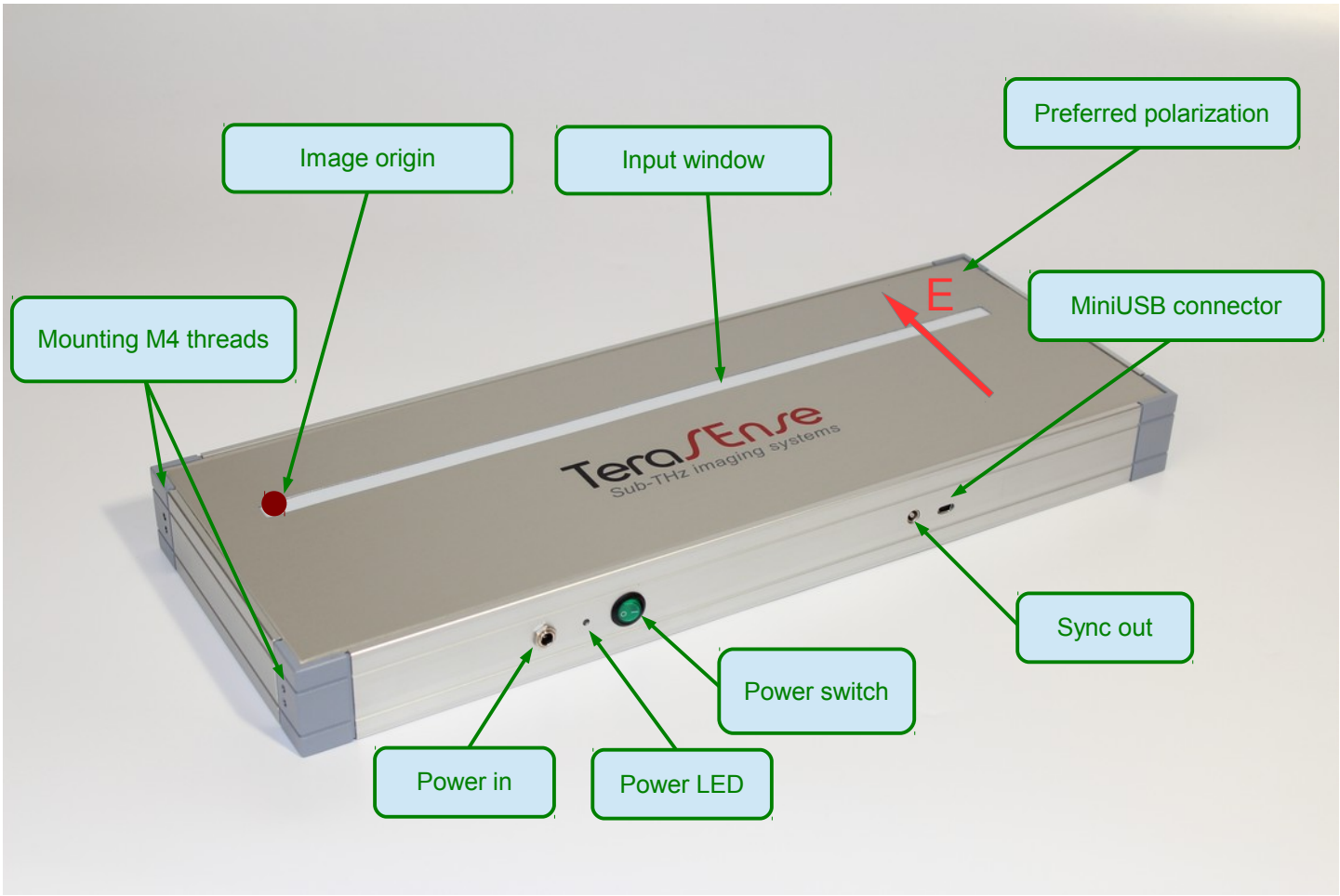
Contents

Notation

 left-click

 click-and-drag

 right-click



*** actual appearance may be different from the one shown

Overview

Terasense™ camera model teraFAST-256 is a compact linear sub-THz imaging sensor operating at room temperature intended for operation on conveyor belts or other scanning setups. Due to acquisition rate up to 5000 lines per second it can accommodate scan speed up to 15 m/s.

The sensor has single sensitivity band at 100±10GHz (or according to customer's specification). It is sensitive to polarization of incoming radiation. Preferred direction of electric field is indicated in the figure.

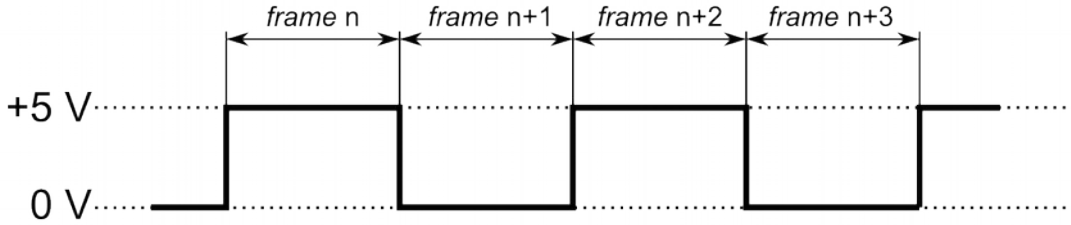
The devices use PC (connected via USB) for data acquisition and processing. Only Windows operating system is supported at the moment. Performance of the camera may be affected by performance of the PC, it is recommended to use PC with CPU score in Windows Experience Index of at least 5.

The cameras are powered by external DC adapter rated +24V, 2A.

Specifications

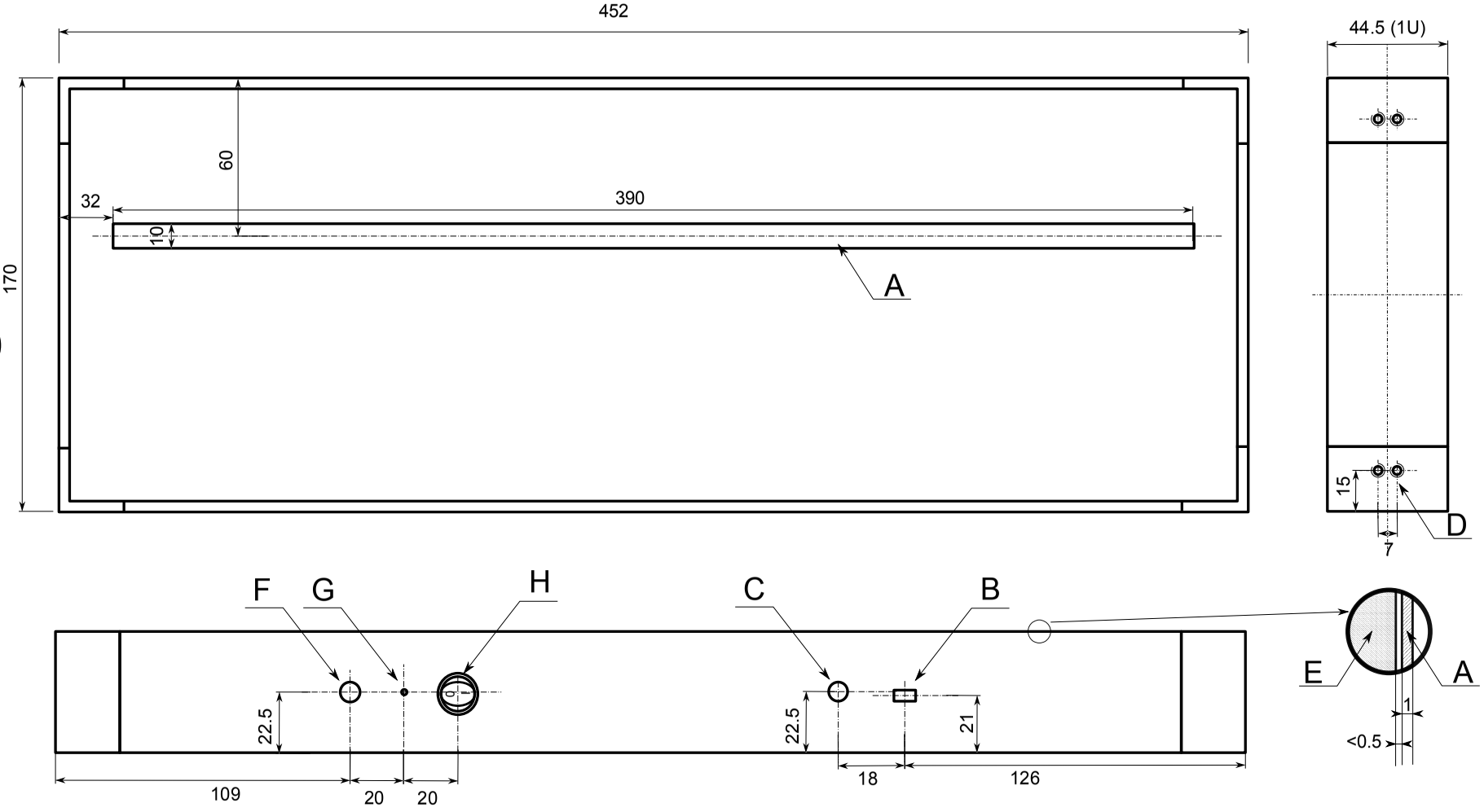
Dimensions:	452x175x44,5 mm
Sensor size:	384x3 mm, 256x1 pixels
Acquisition rate:	100 – 5000 lines/second
Connection:	miniUSB
Sync output	5V TTL (LEMO 00.250 series socket)
Power:	24V, 2A
Operating conditions:	15 to 30ºC, humidity < 80%
Storage conditions:	-30 to 45ºC, humidity < 90%

Sync out waveform



Drawings

TeraFAST-256



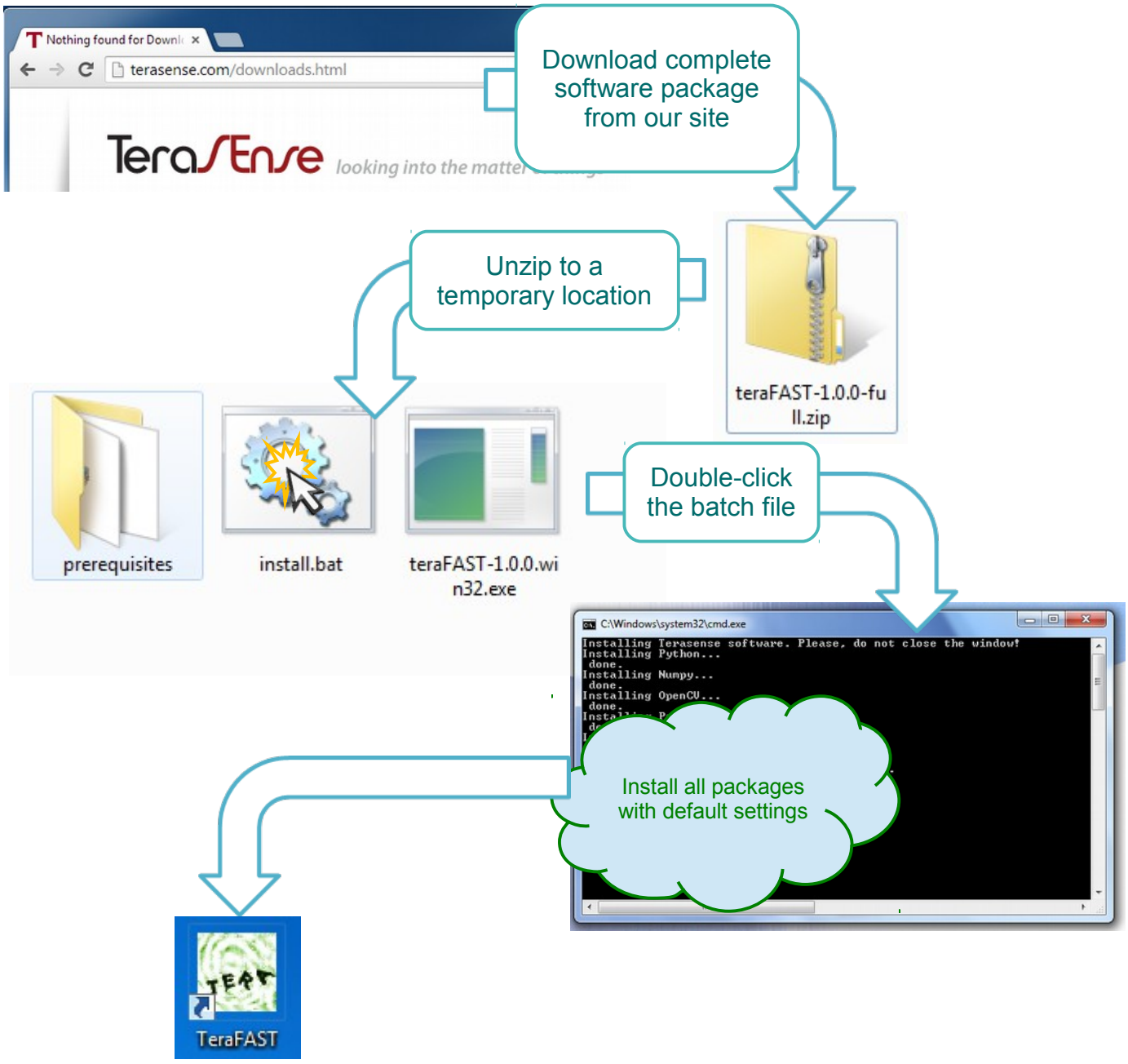
A - PTFE window
B - data connector (miniUSB socket)
C - sync out (LEMO 00 socket)
D - mounting holes (M4, 4 holes on both sides)
E - sensor's surface
F - power connector (5.5 OD/2.1 ID)
G - power LED
H - power switch

TeraSense 2015

Software Installation

Basic

If you are already using Python software, please, see next page



Congratulations, you are done!

TeraFAST (TeraSense Viewer) icon is created on your desktop and Terasense folder is created in your Start Menu.

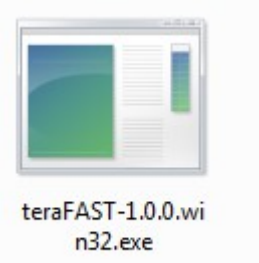
Software Installation
Advanced

TeraSense software depends on the following Python packages:

python 2.7 NumPy 1.7 OpenCV 2.4

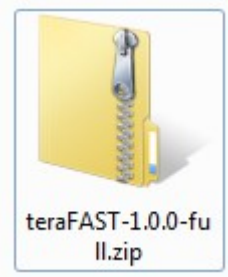
wxPython 2.9 PySerial 2.5

If you have all of them installed, you only need to download and install Terasense package proper:



When software installation finishes, connect your device to PC using USB-miniUSB cable, turn it on with the power switch and wait for Windows to install driver for the device controller (Opal Kelly XEM6001).

You can obtain missing packages from the respective repositories, or from complete software package on our website (in the “prerequisites” folder):



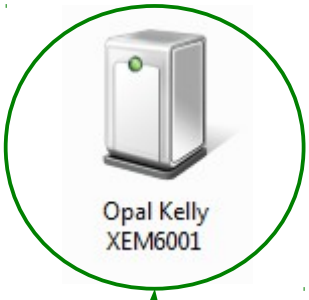
TeraSense software may or may not work with earlier versions of the prerequisite packages. Consult our support for more information.

TeraSense software won't work with Python 3.x ! It is not supported by some prerequisite packages, notably, Numpy. It is possible to install Python 2.7 and Python 3.x side by side, though.

Getting started

Plug-in DC power adapter, connect device to PC using USB cable, and turn it on using power switch.

Run TeraSEnse software



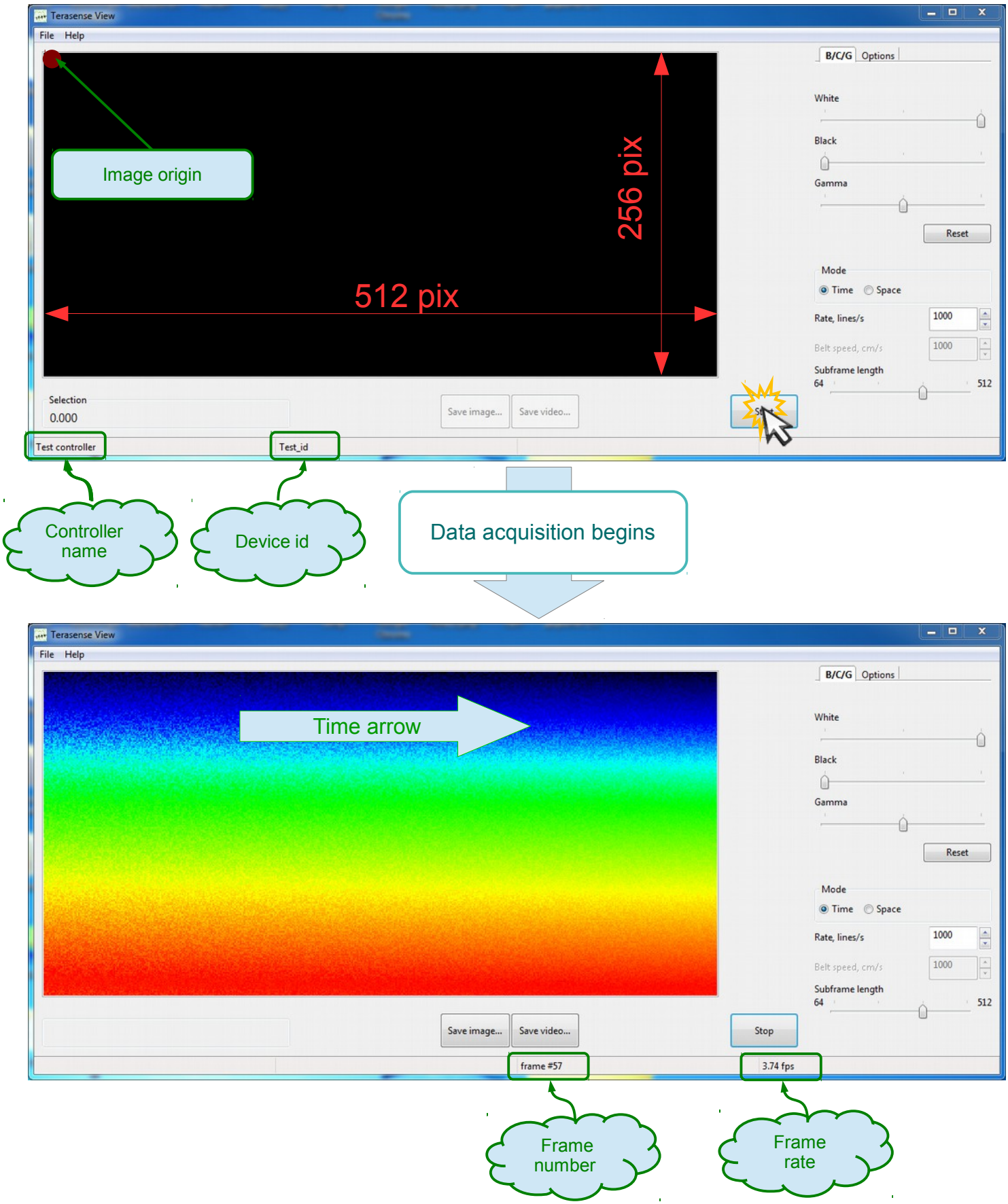
TeraSense device appears in the "Devices and Printers" window as "Opal Kelly XEM6001"

When connecting for the first time to a new PC you'll need to wait while Windows installing drivers for the device.

TeraSense camera is sensitive to changes in temperature. If you brought camera from a cold or hot place, please, wait until its temperature comes into balance and you'll likely need to take new recording of background data (see p.13).

Software operation

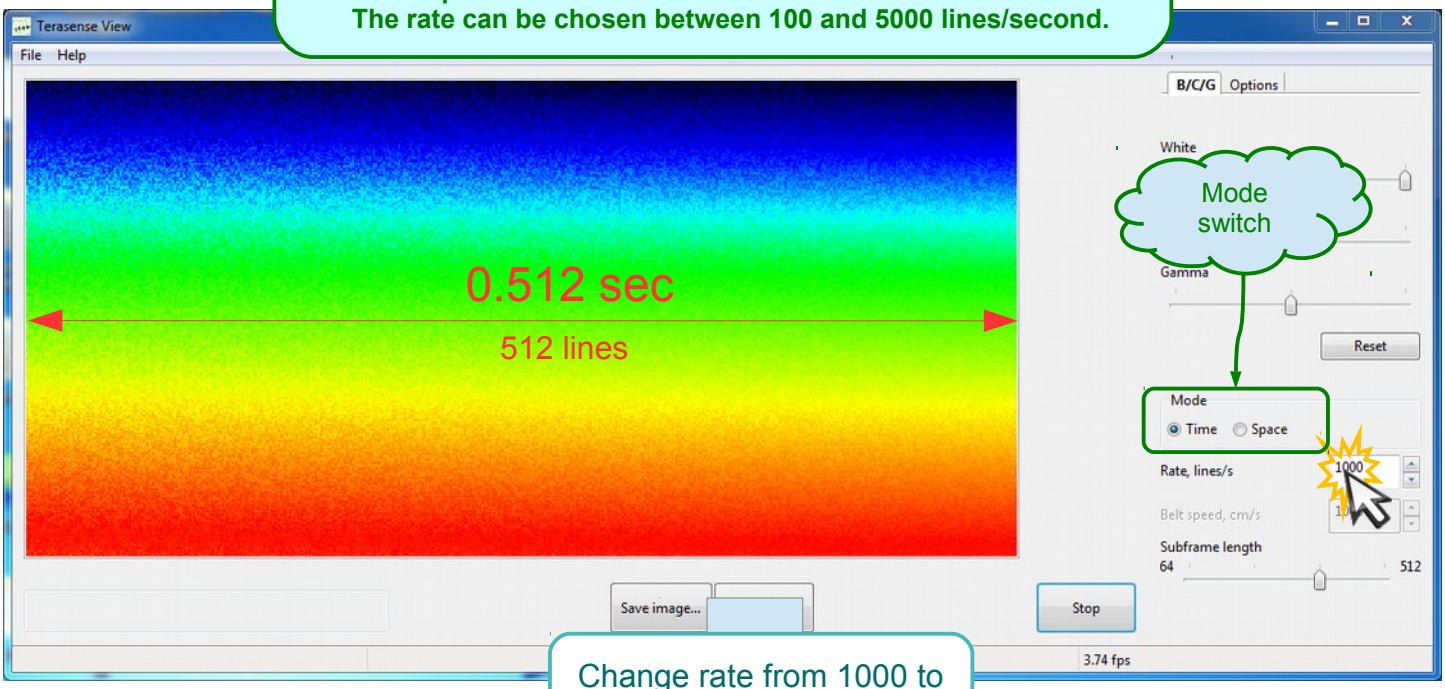
Basics



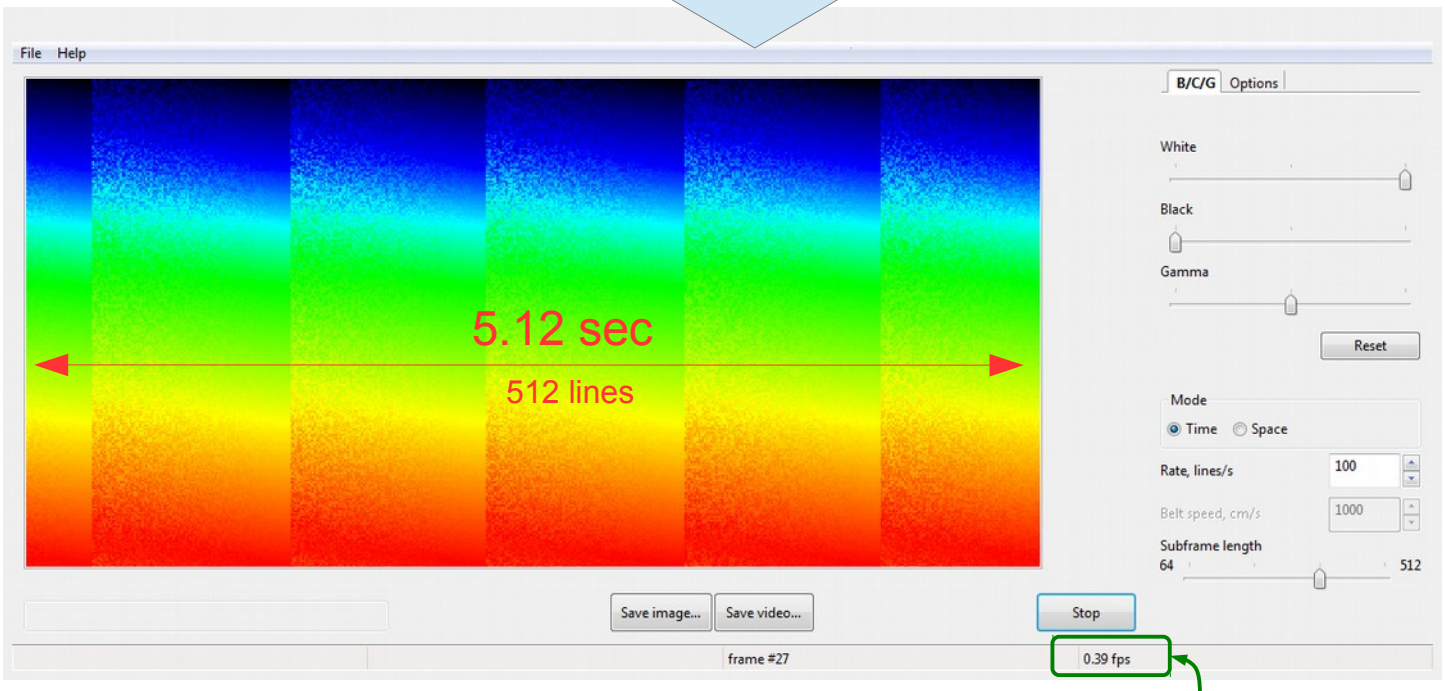
Software operation

Time Mode

When working in the time mode, the image is shown with time scan along the horizontal axis. The time resolution is inversely proportional to the selected acquisition rate, for example, for the rate of 1000 lines per second the resolution is 1ms/pixel.
The rate can be chosen between 100 and 5000 lines/second.



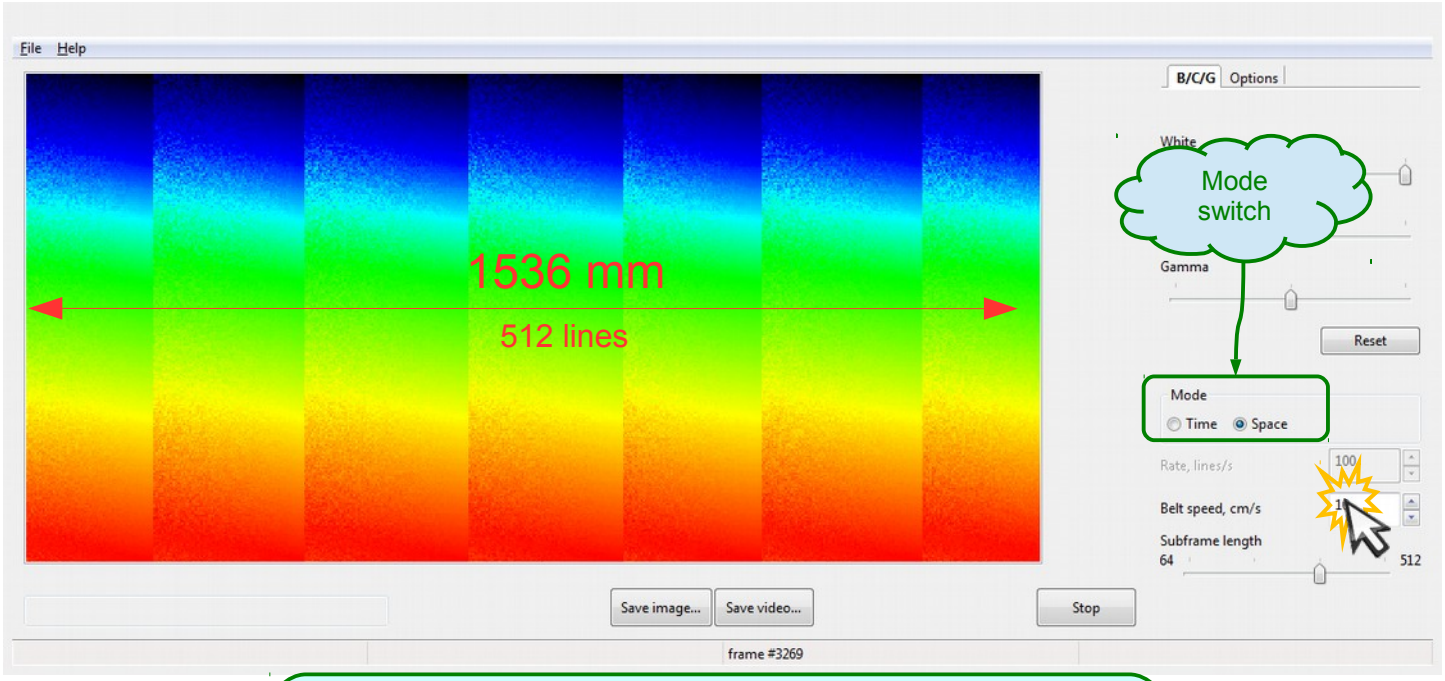
Change rate from 1000 to 100 lines per second



Frame rate drops proportionally

Software operation
Space Mode

When working in the space mode, the image is shown with space (length) scan along the horizontal axis. The distance is calculated using the belt speed parameter, resolution of the image in horizontal direction is always 3mm/pixel.
The speed can be changed between 10 and 1500 cm/s.

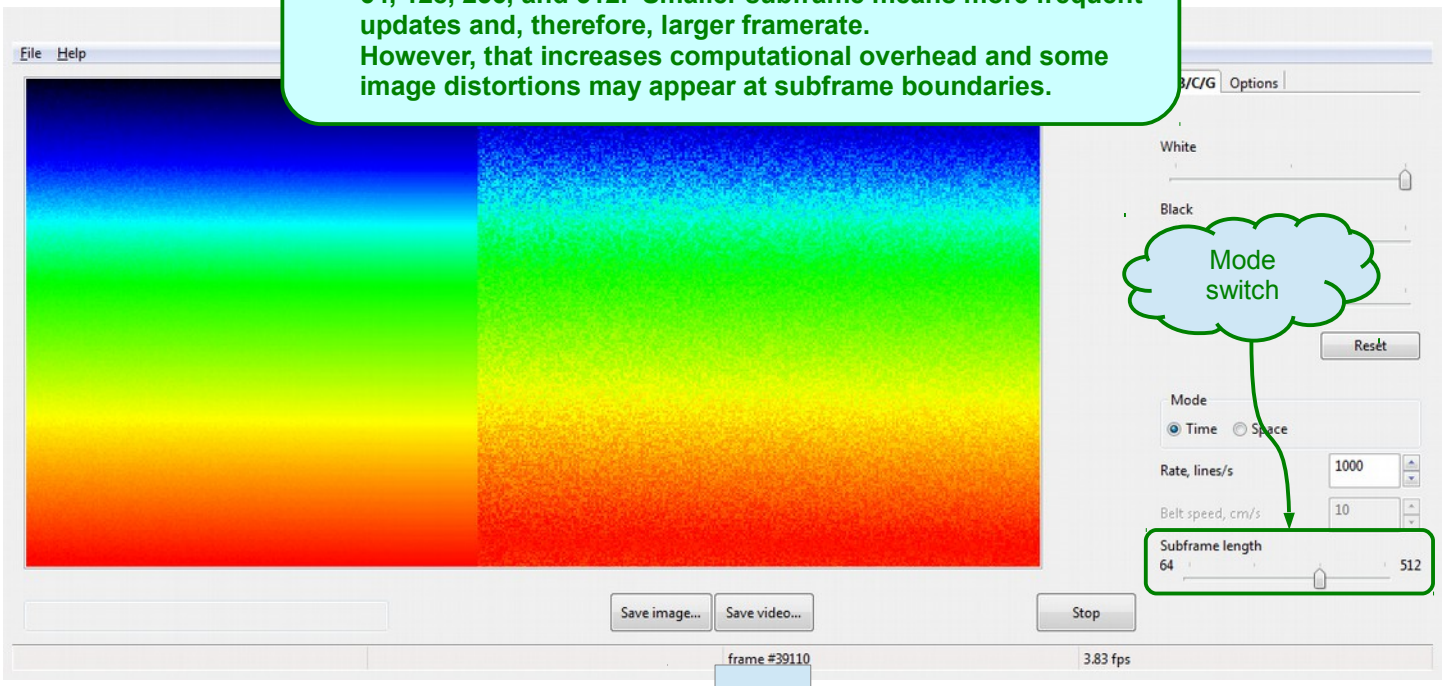


Actual acquisition rate in this mode is 3000 lines/s for speeds below 900 cm/s or 5000 lines/s for speeds between 900 and 1500 cm/s. The data then rescaled linearly to form the image.

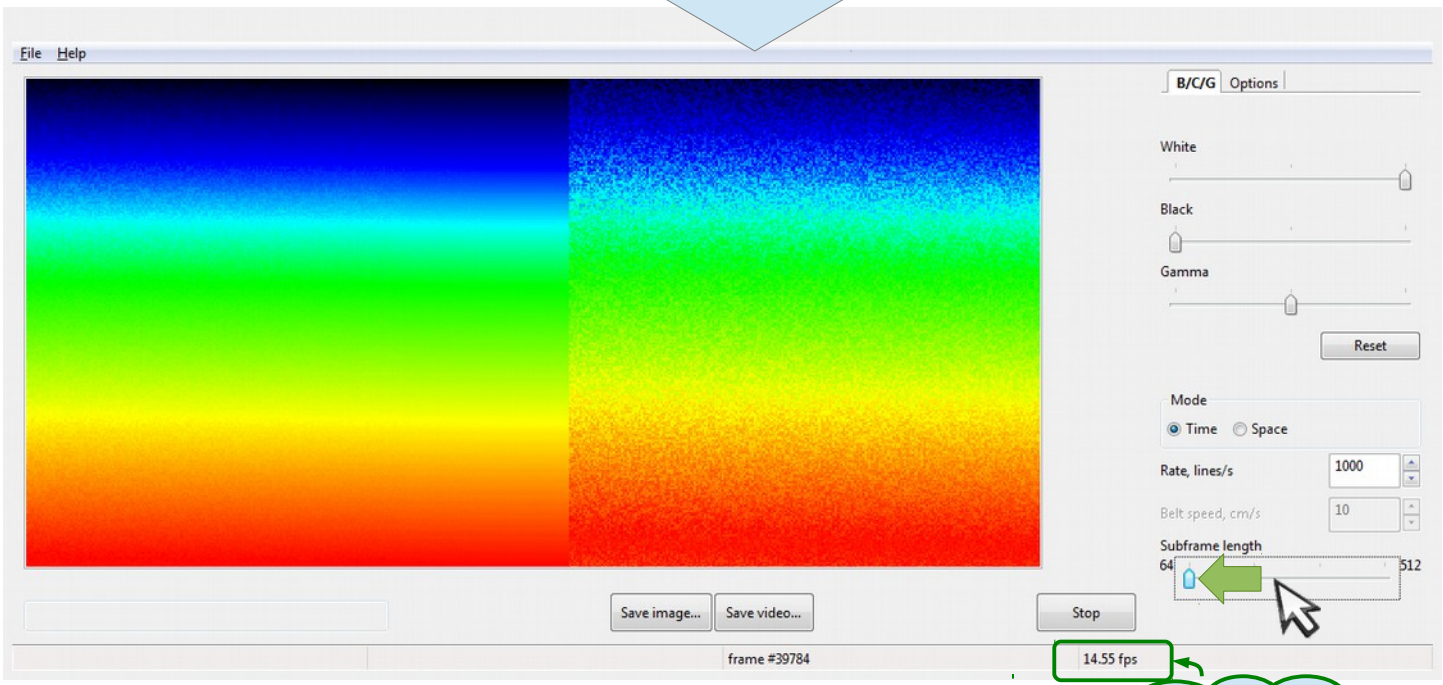
Software operation

Subframe length

The data are read from the camera in batches called subframes. You can choose the size of subframes between 64, 128, 256, and 512. Smaller subframe means more frequent updates and, therefore, larger framerate.
However, that increases computational overhead and some image distortions may appear at subframe boundaries.



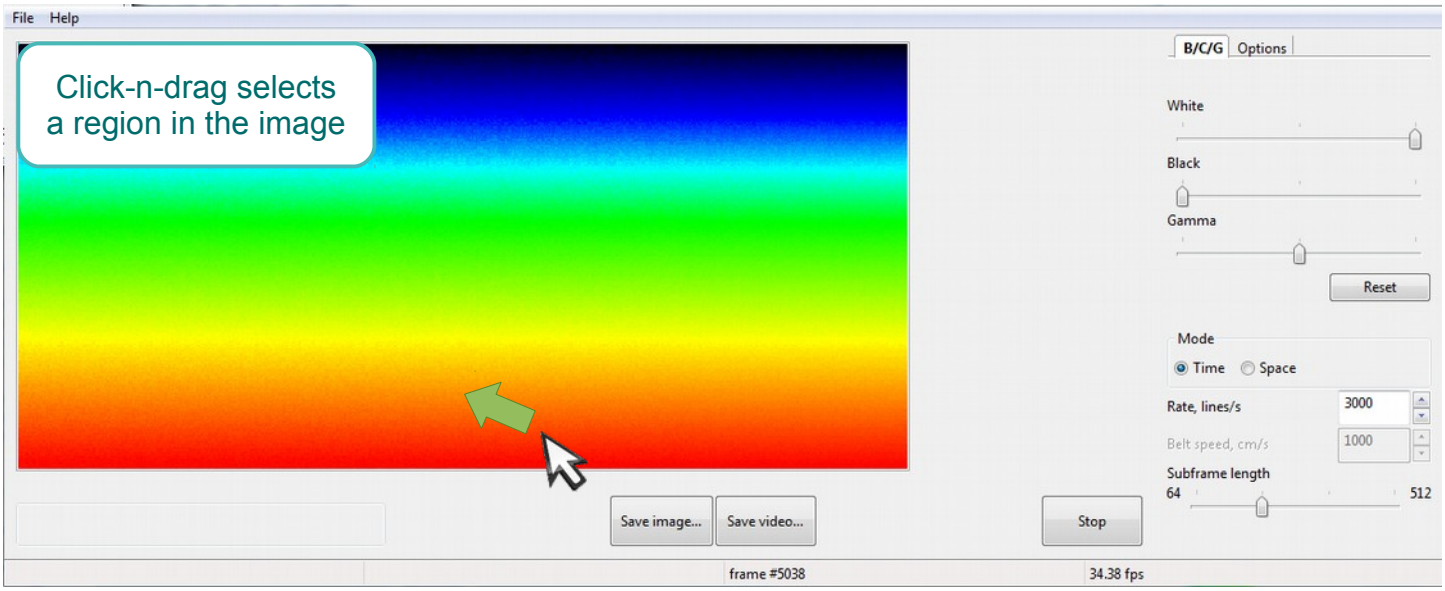
Switch subframe size from 256 line to 64

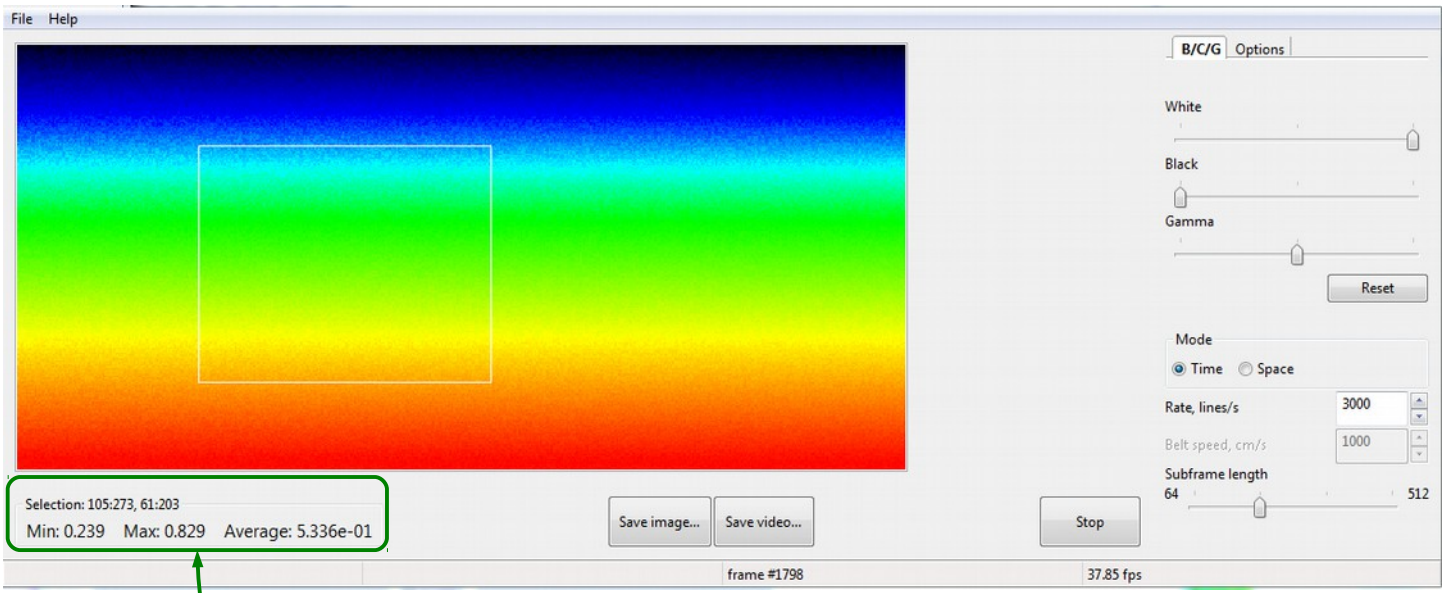


Frame rate increases proportionally

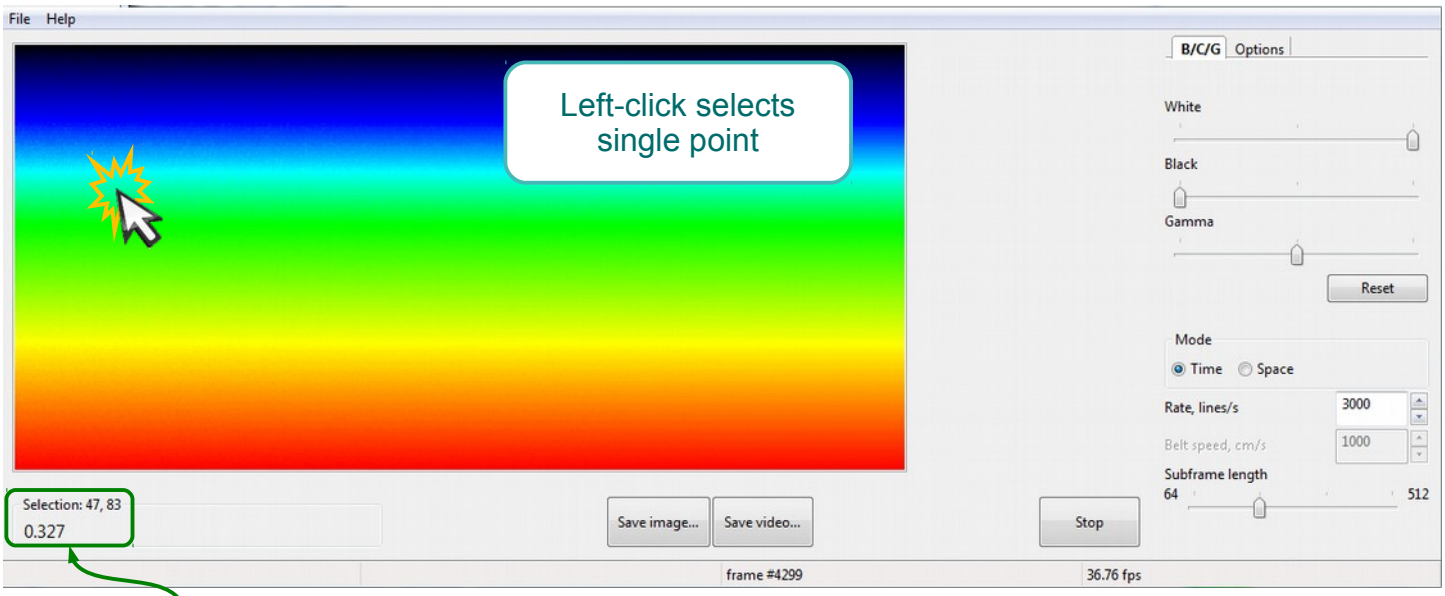
Software operation

Region of interest

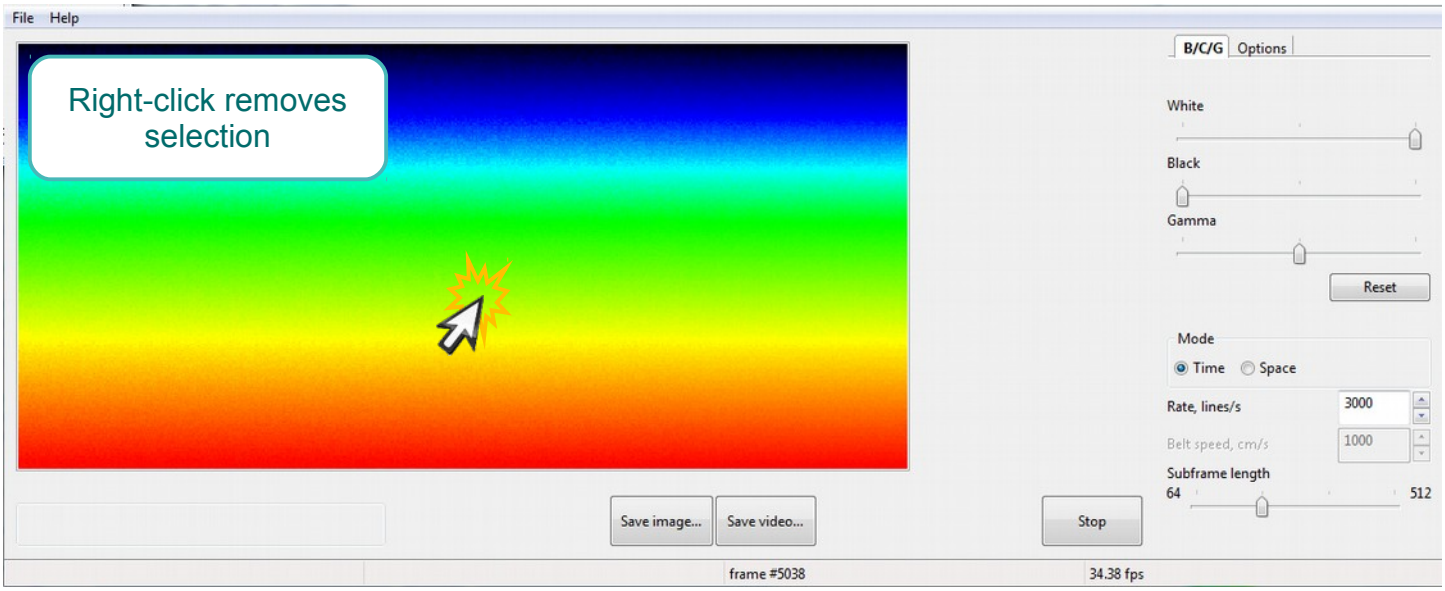




Statistics for the selected region



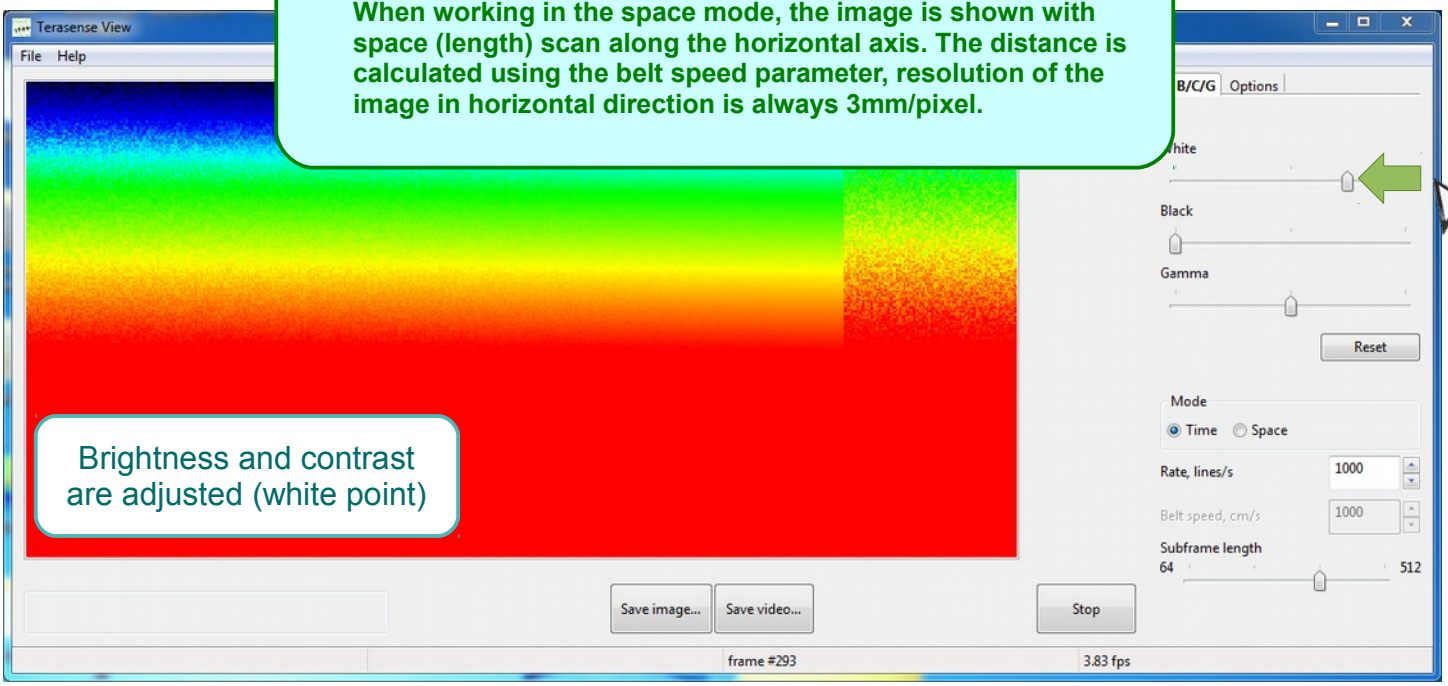
Coordinates and value at the point

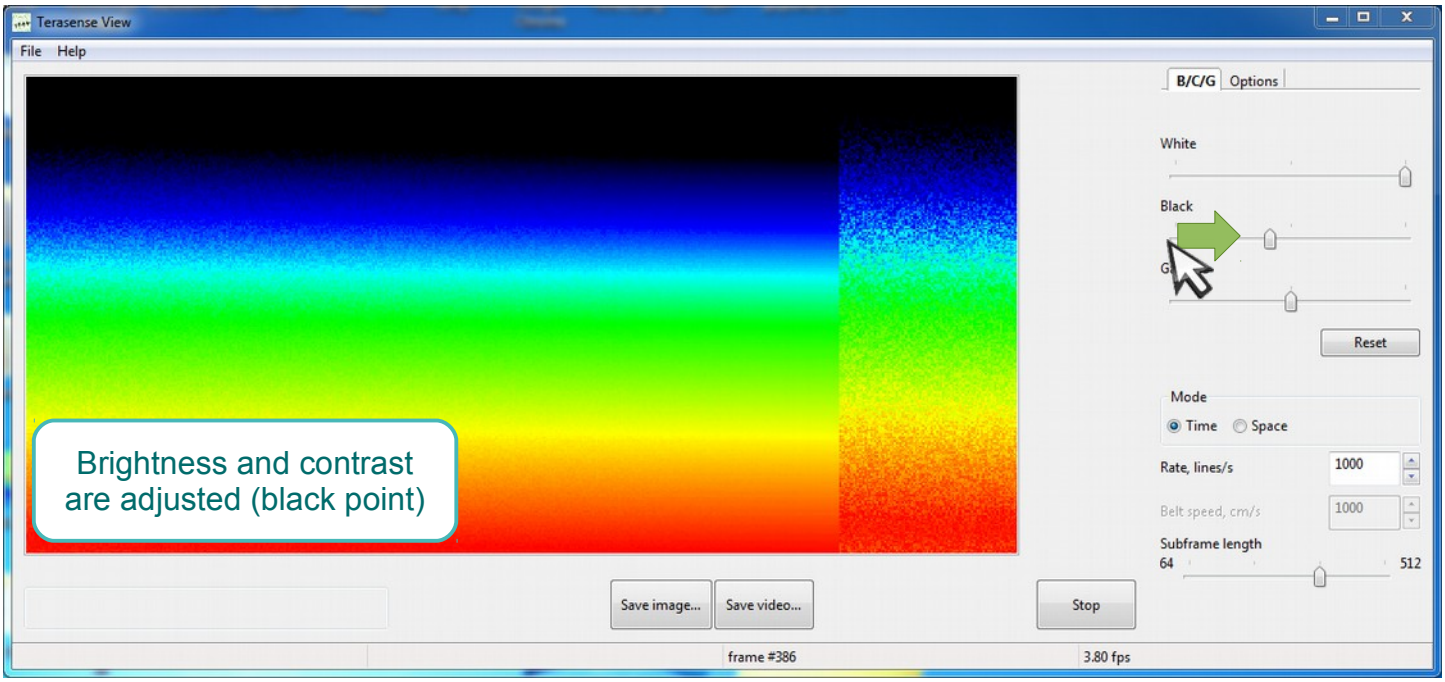


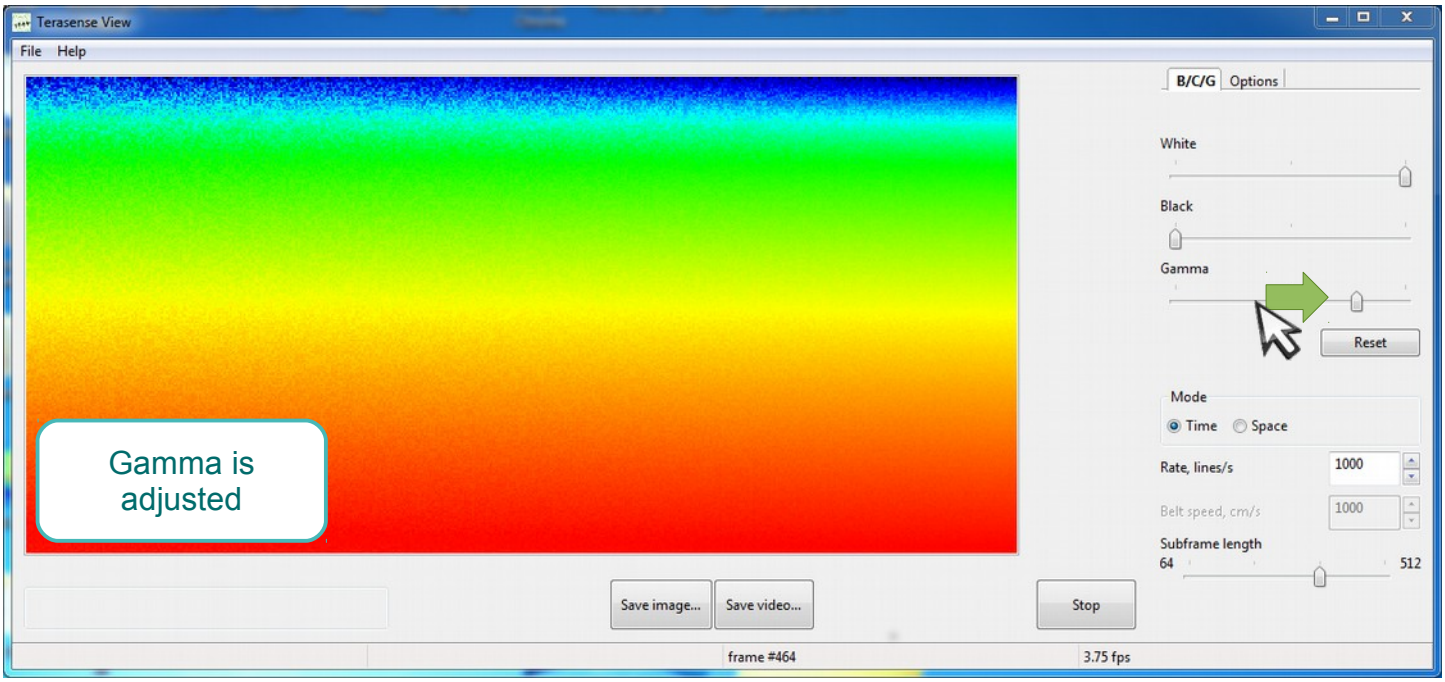
Software operation

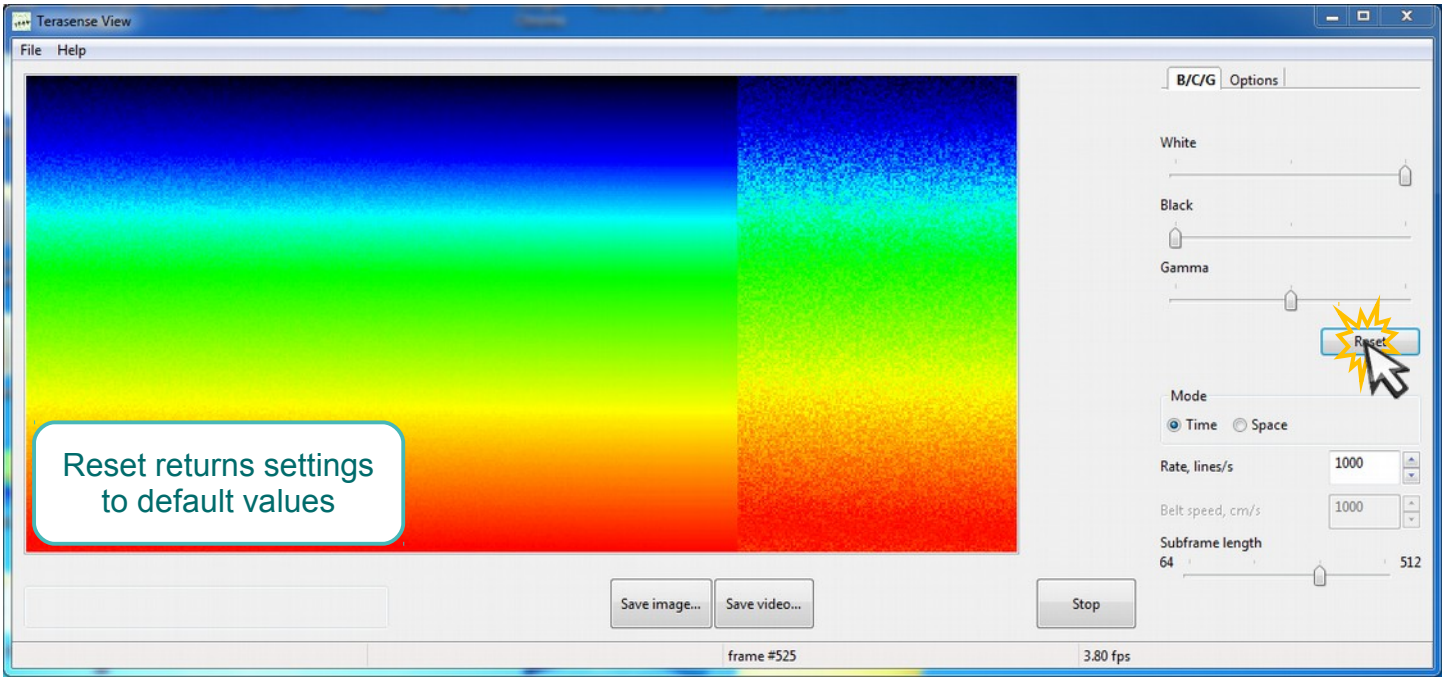
Brightnes/Contrast/Gamma

When working in the space mode, the image is shown with space (length) scan along the horizontal axis. The distance is calculated using the belt speed parameter, resolution of the image in horizontal direction is always 3mm/pixel.





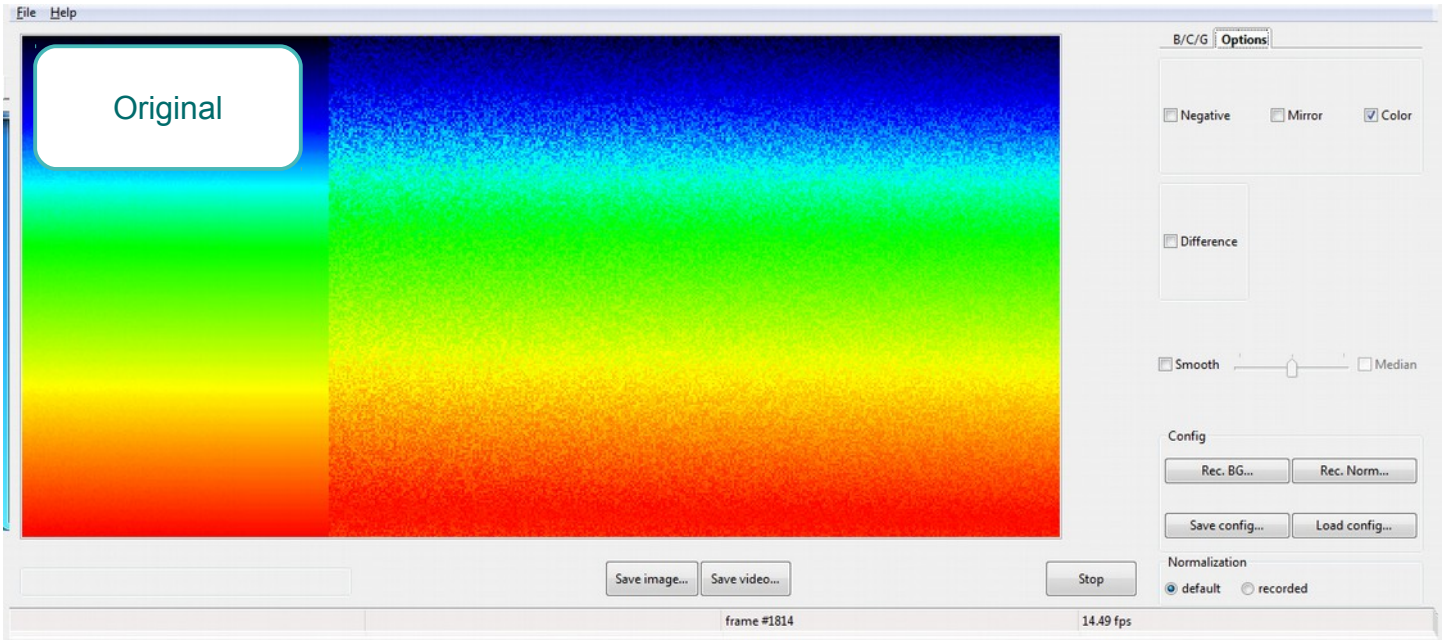


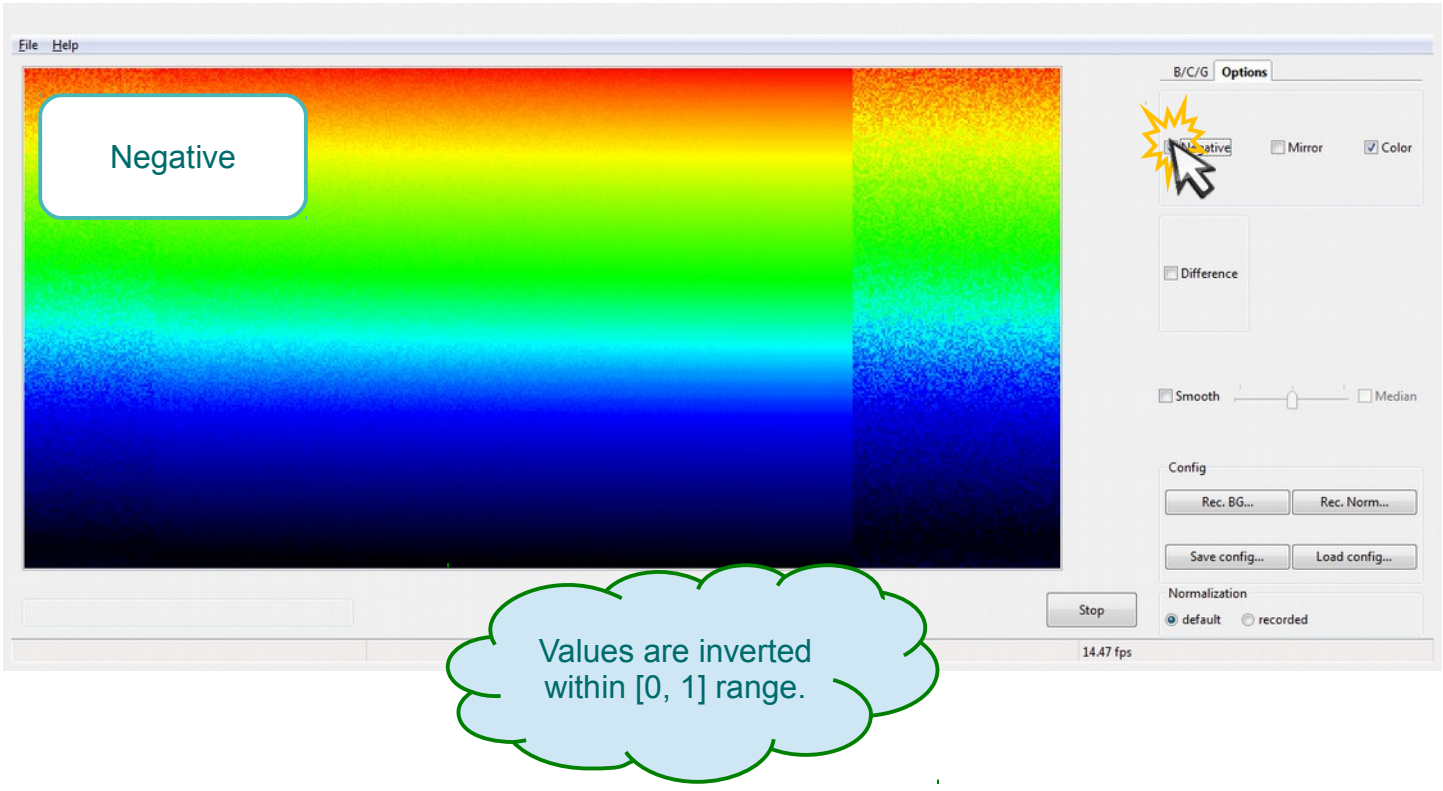


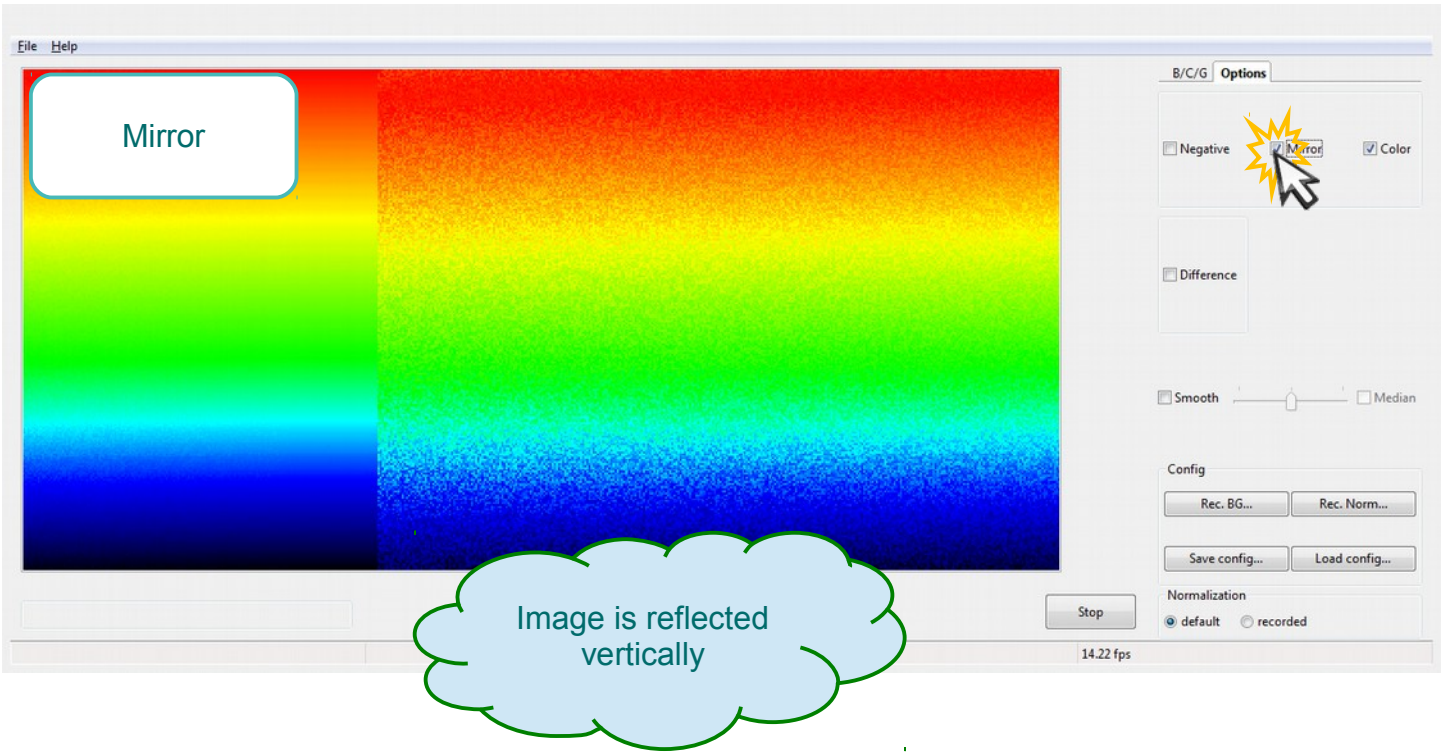
- **Adjustments in white point, black point and gamma affect only digital image postprocessing.**

Software operation

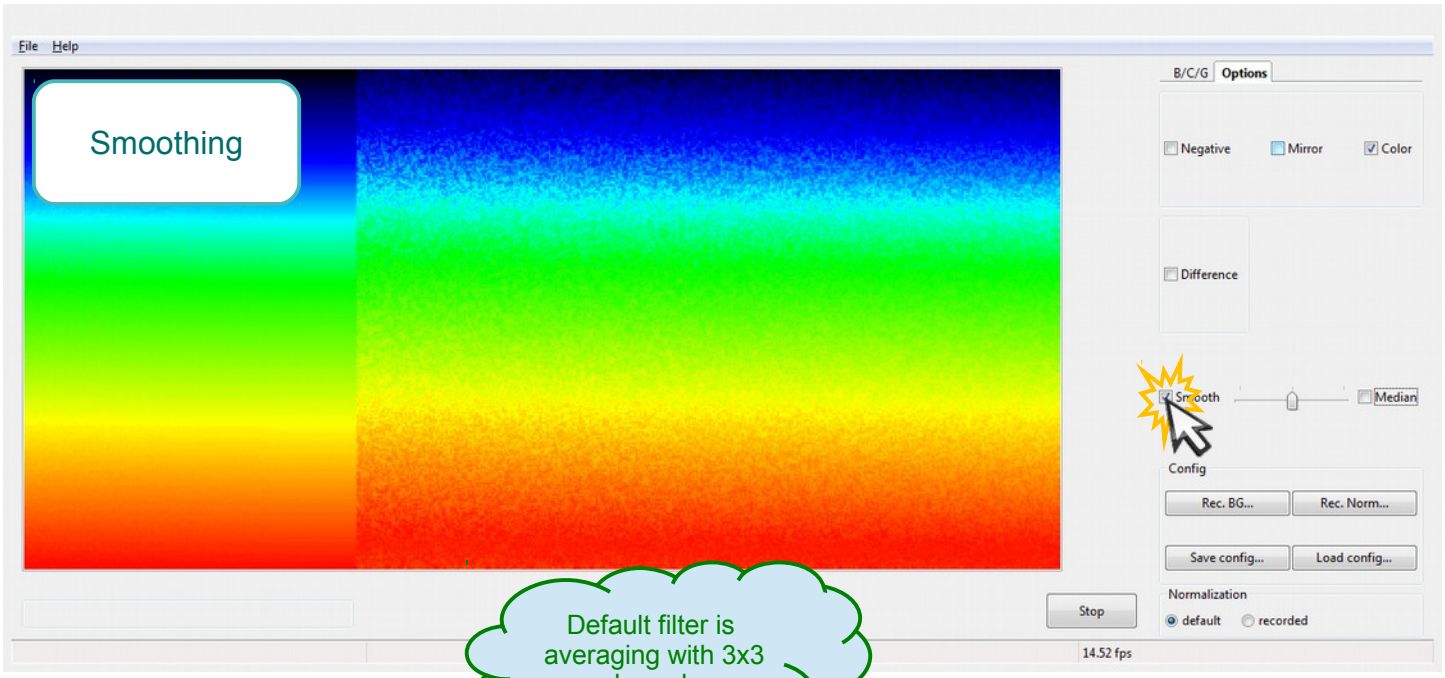
Options



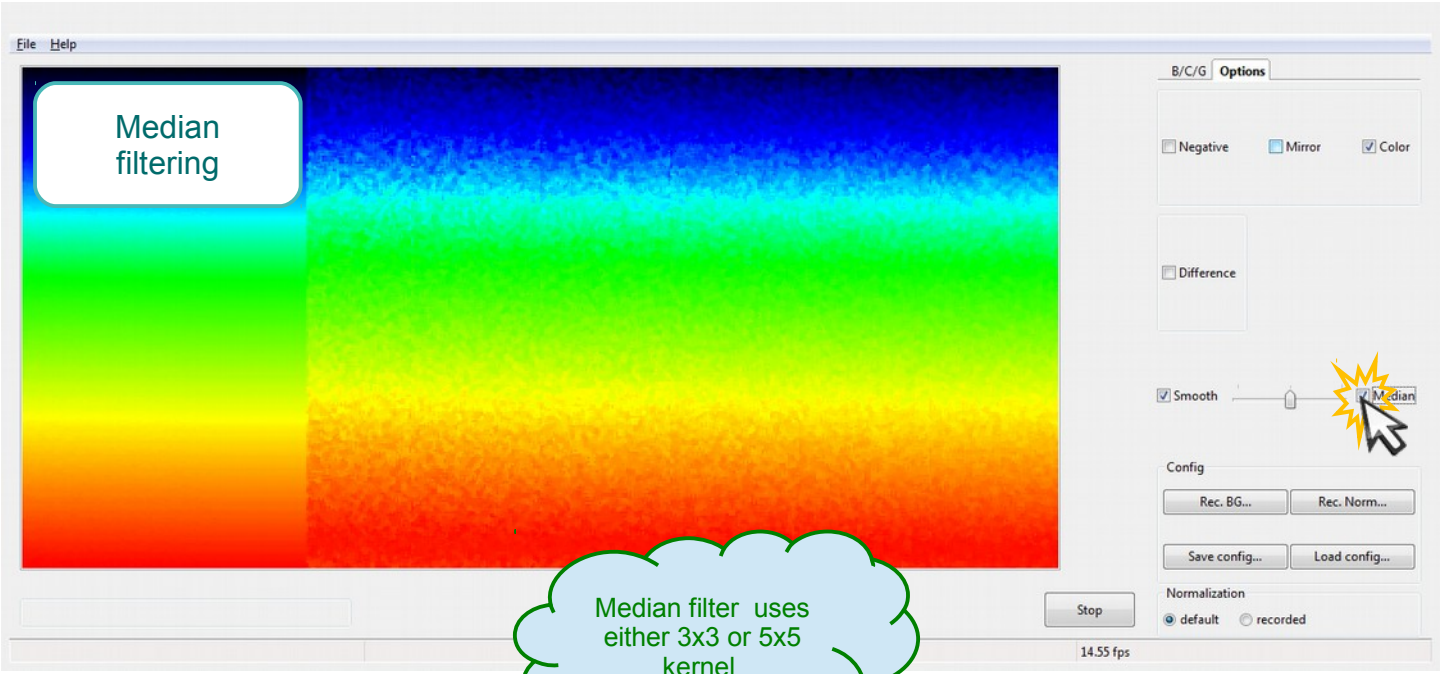



File Help
Mirror
B/C/G Options
Negative
Mirror
Color
Difference
Smooth
Median
Config
Rec. BG...
Rec. Norm...
Save config...
Load config...
Normalization
default
recorded
Stop
14.22 fps
Image is reflected vertically


File Help
Black-n-white
B/C/G Options
Negative
Mirror
Color
Difference
Smooth
Median
Config
Rec. BG...
Rec. Norm...
Save config...
Load config...
Normalization
default
recorded
Stop
14.54 fps
Palette is switched to monotone.

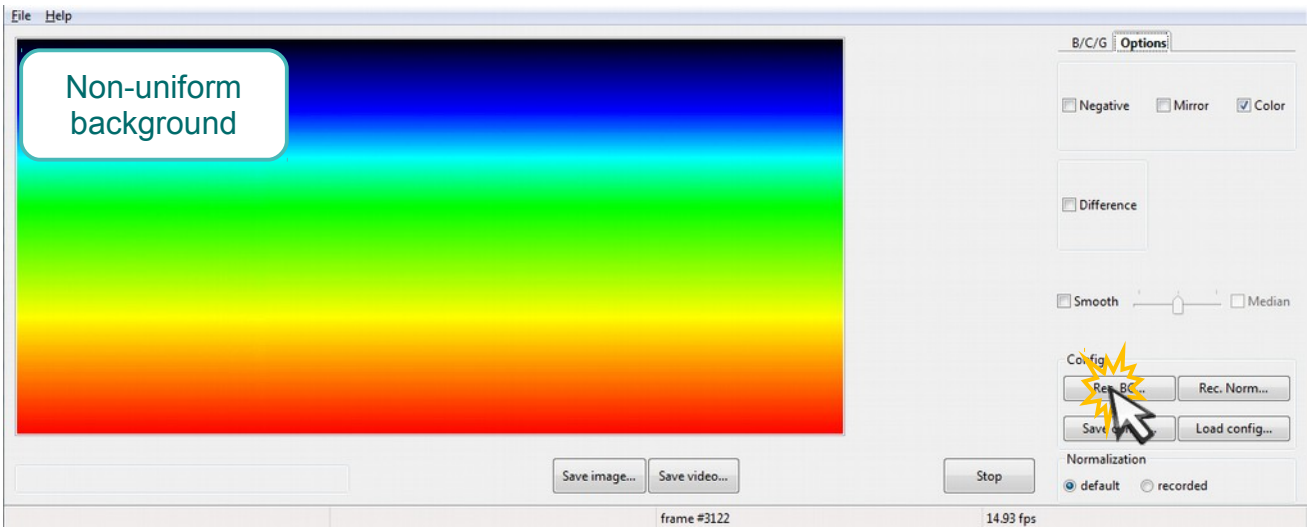


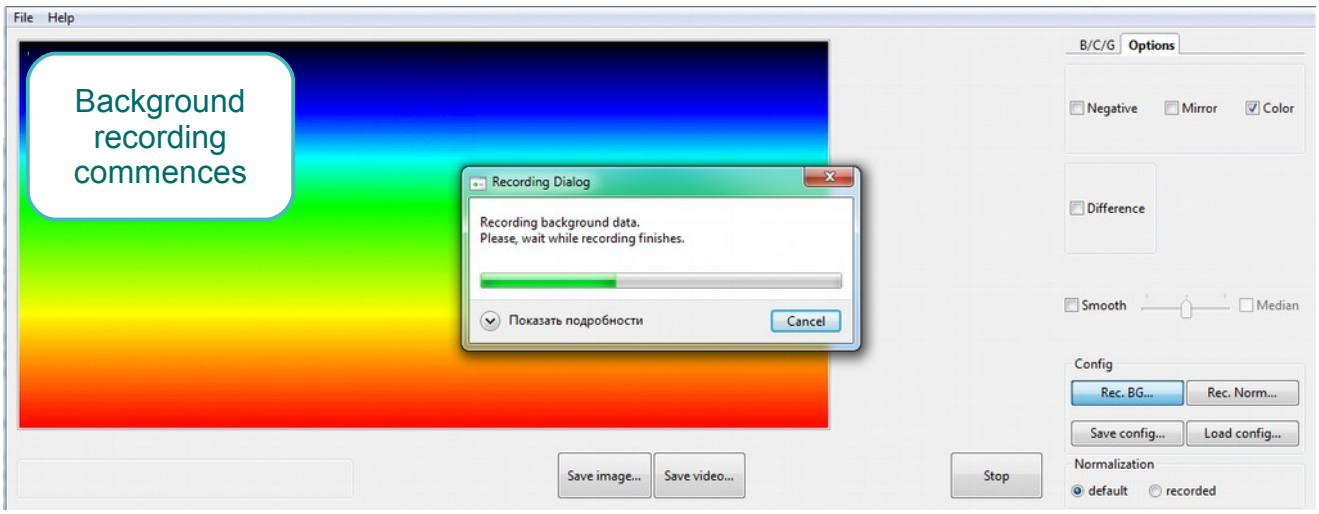
Default filter is averaging with 3x3 kernel

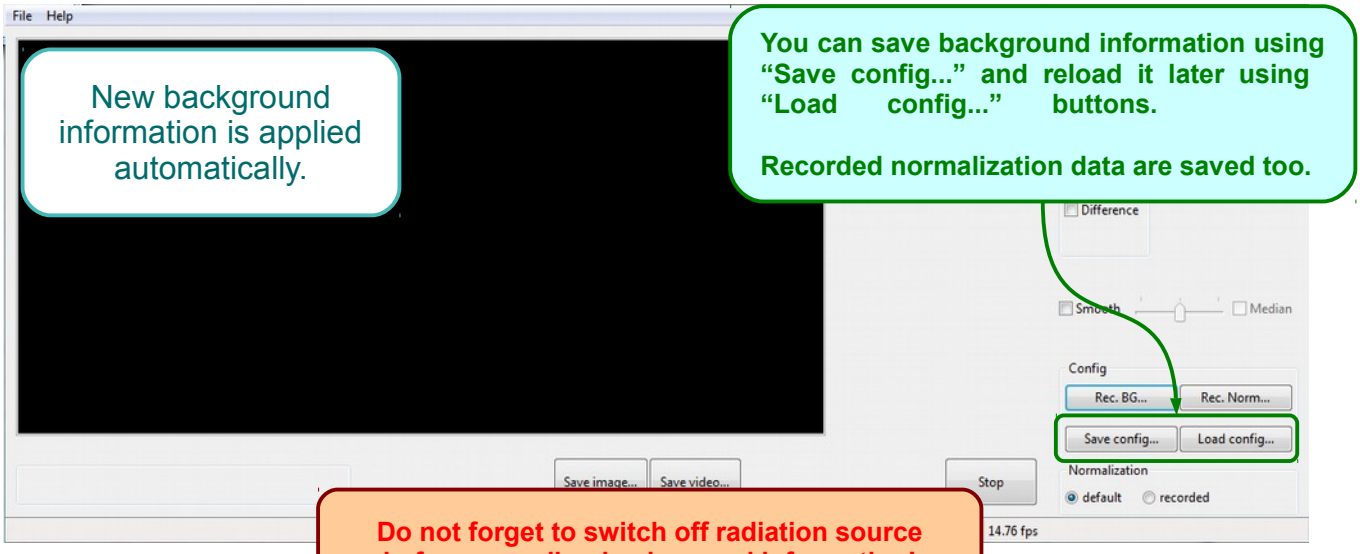


Median filter uses either 3x3 or 5x5 kernel

Software operation
Background compensation



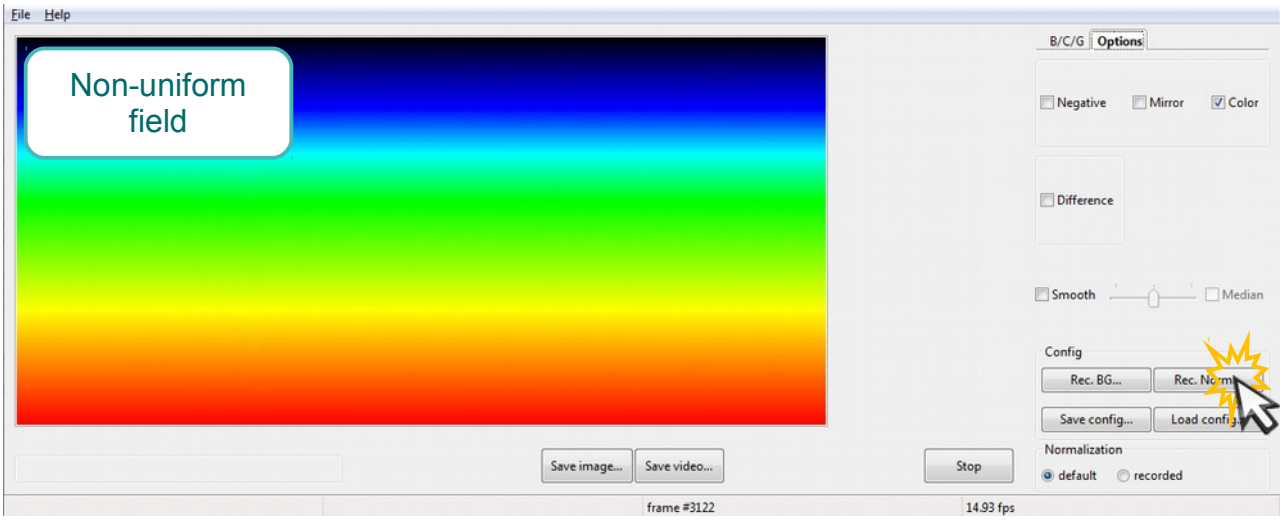


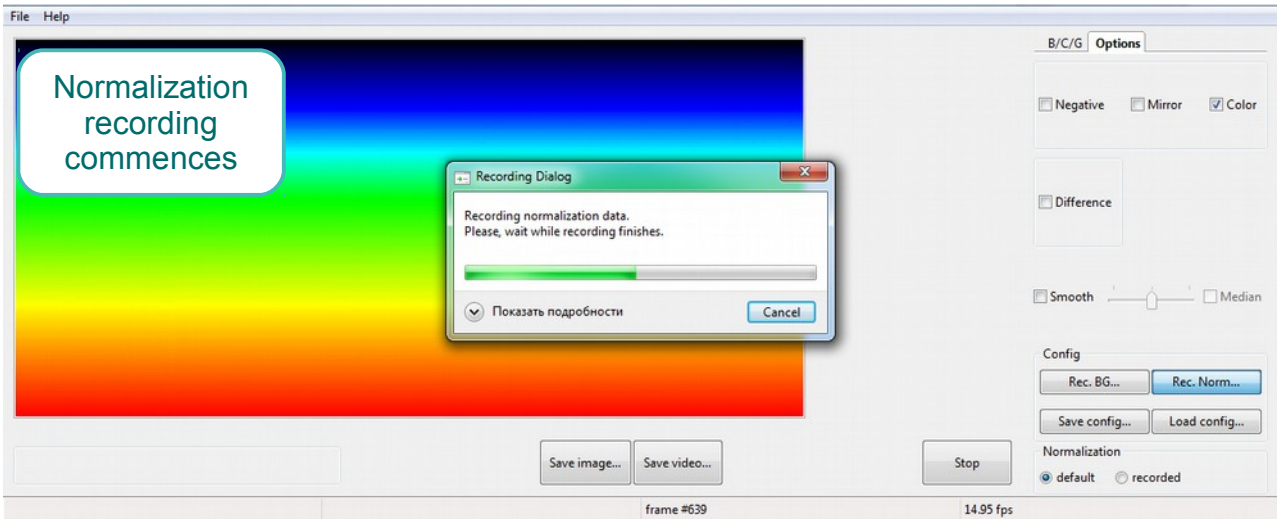


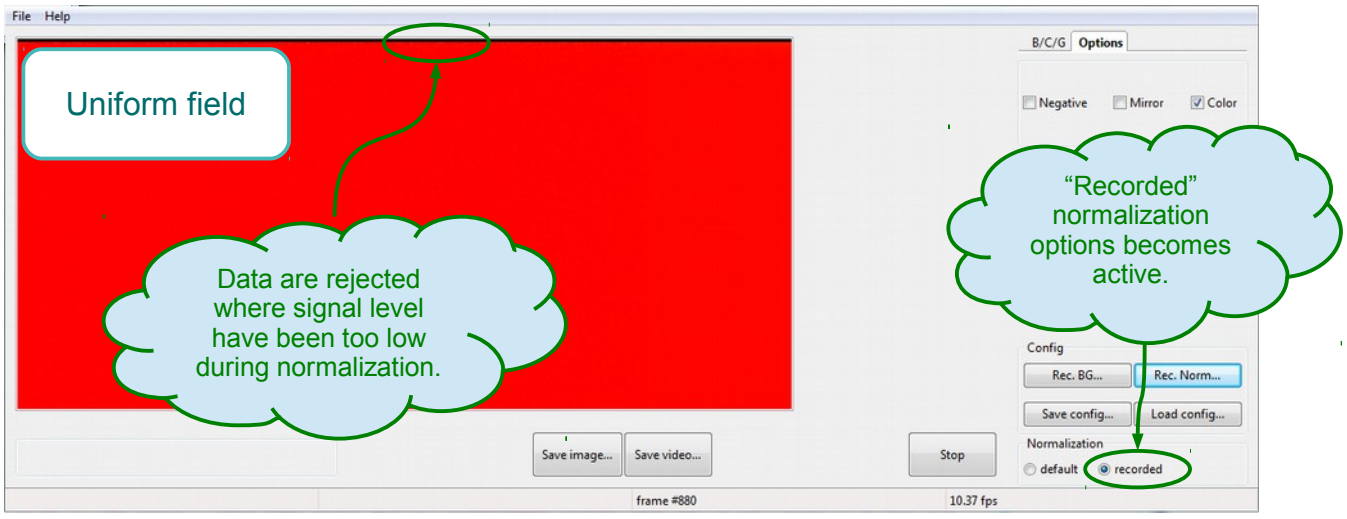
Software operation

Normalization

(compensation for beam profile)

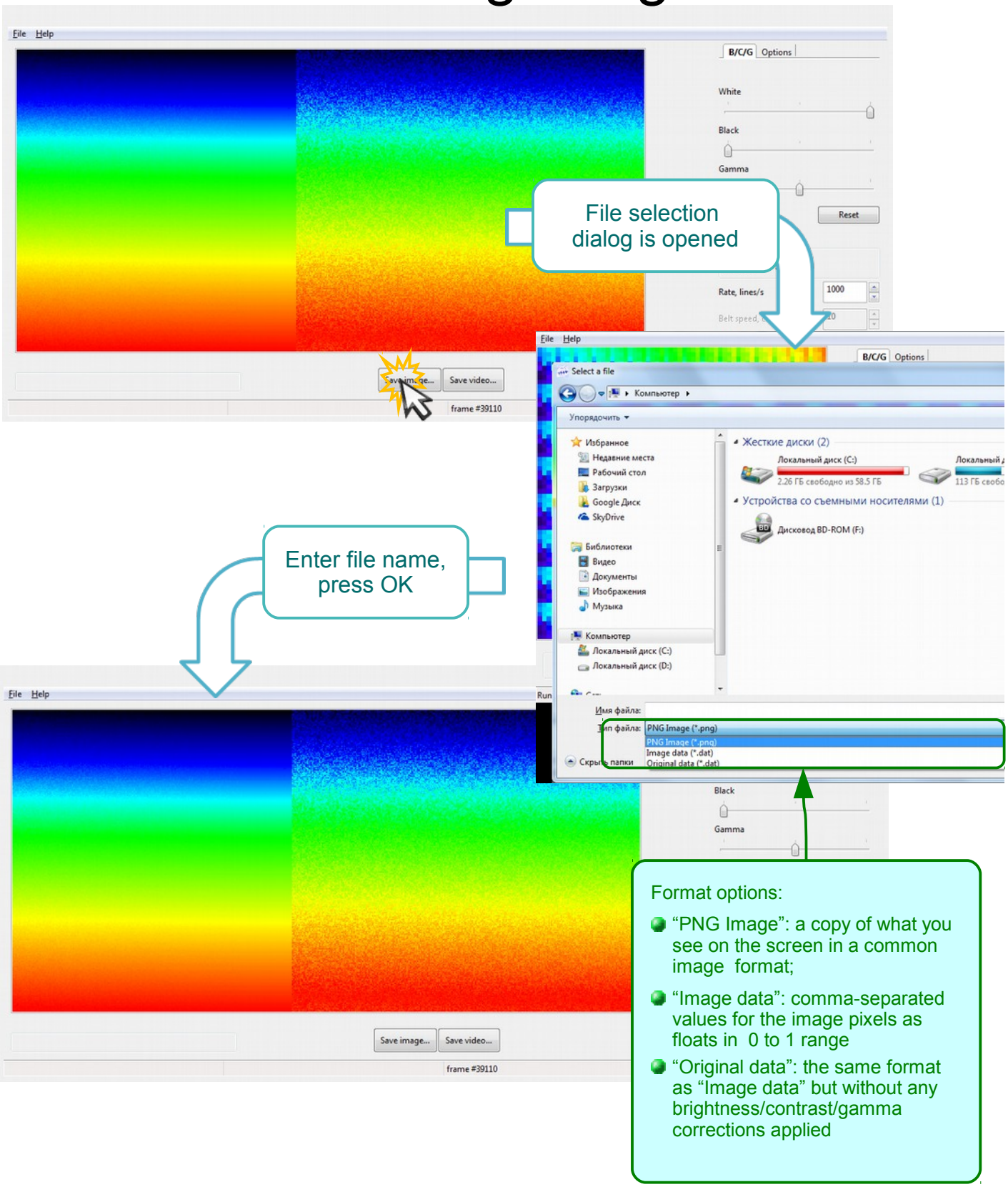






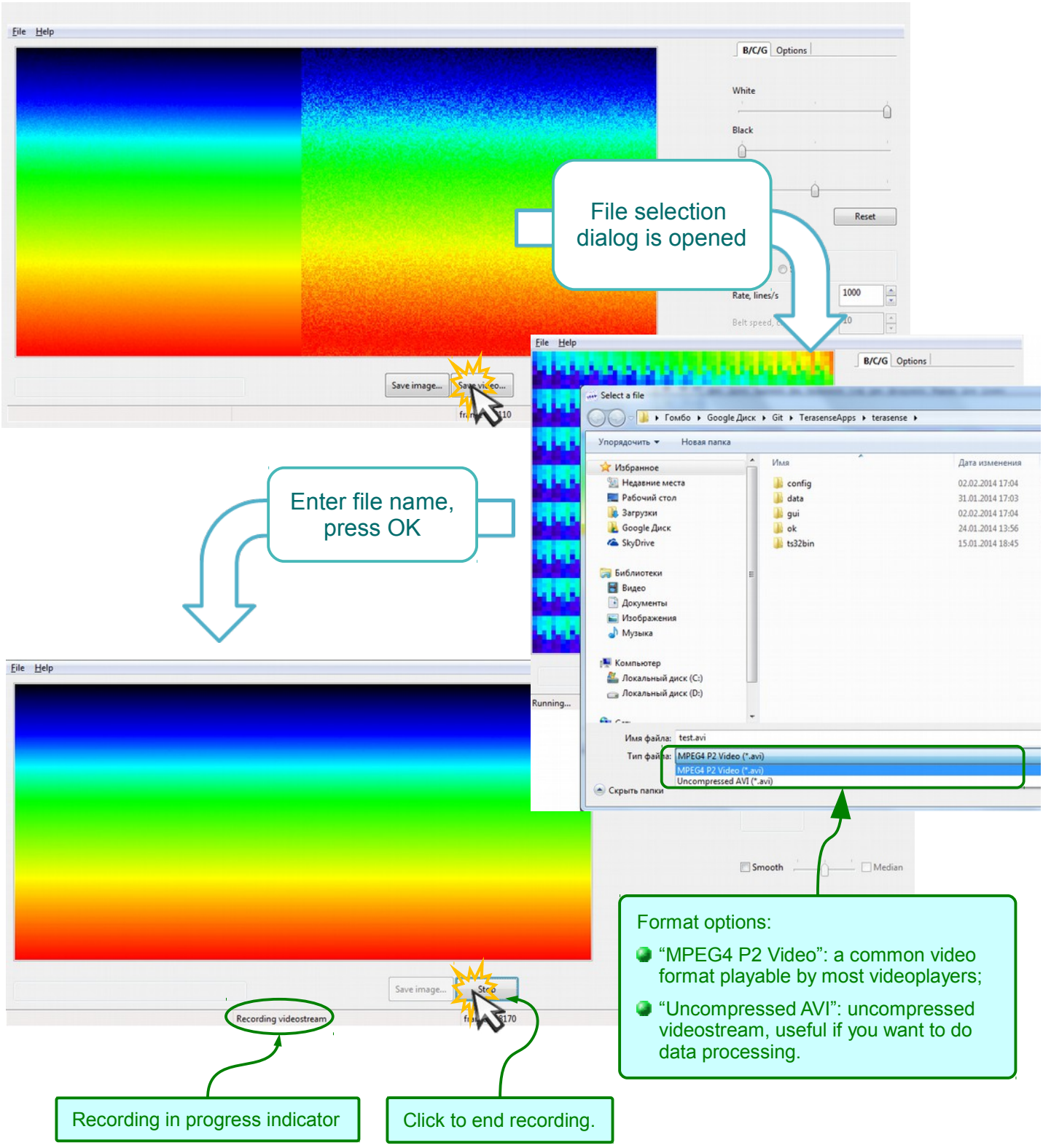
Software operation

Saving Image



Software operation

Recording video

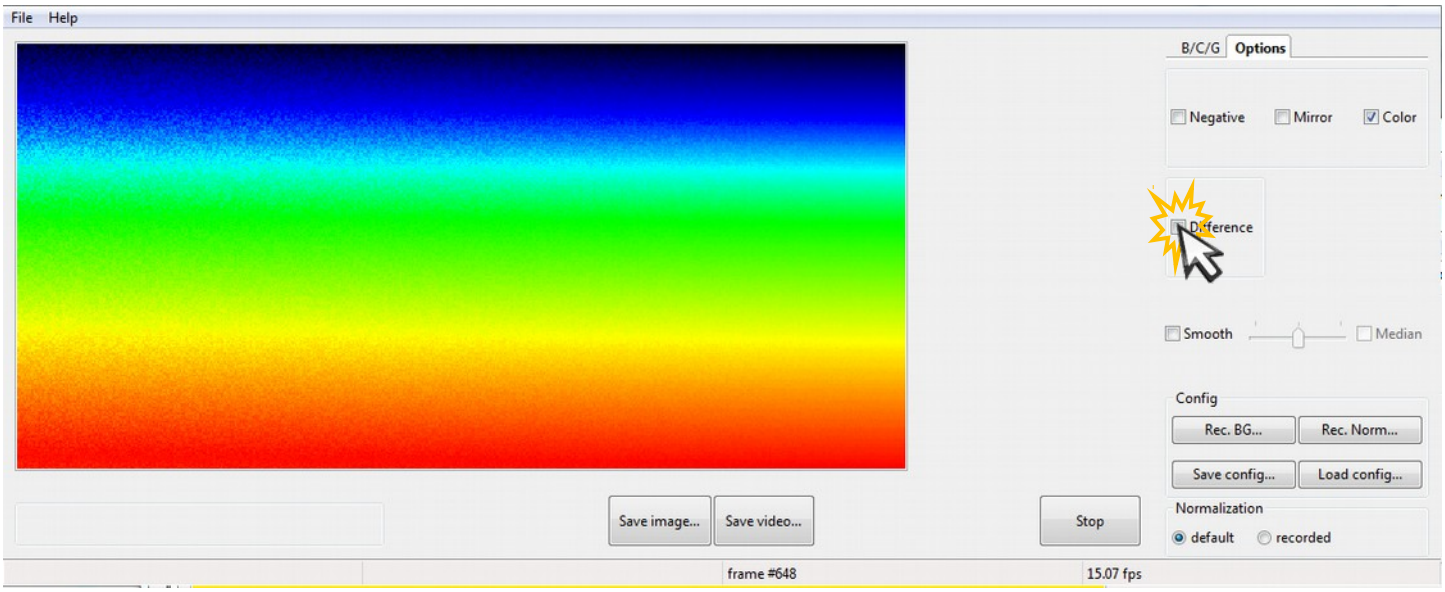


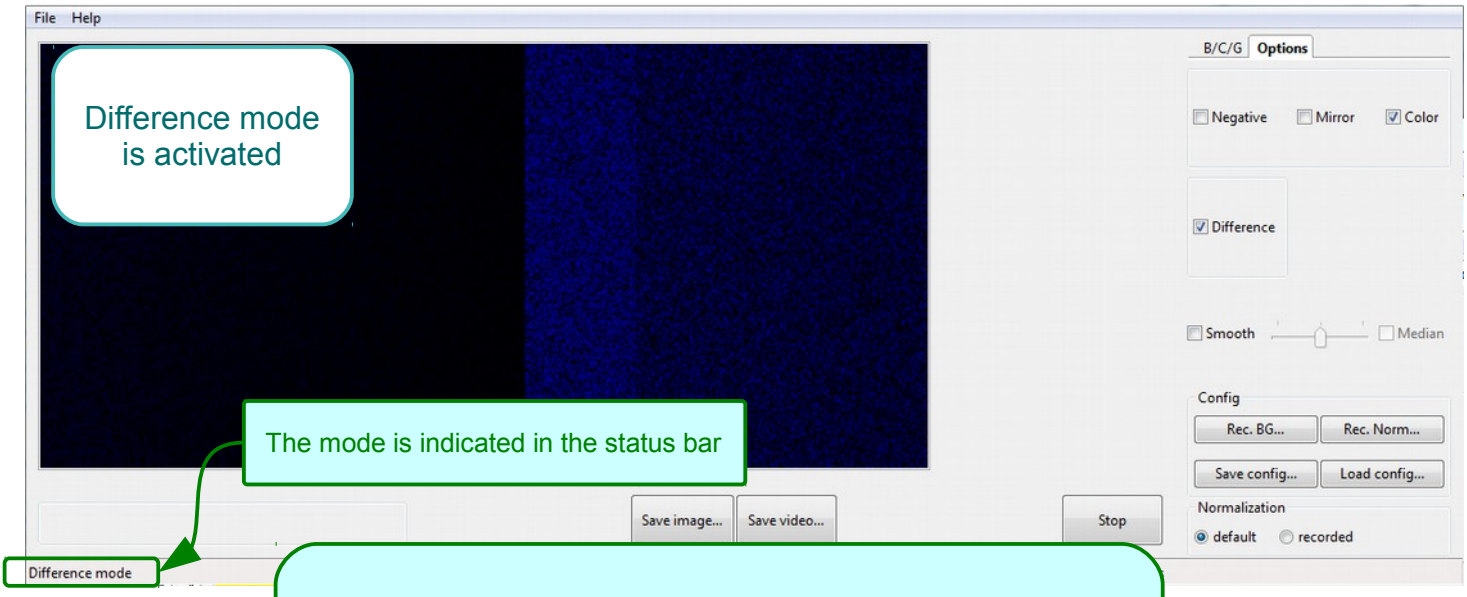
Generally, video is recorded at actual frame rate, but if it is less than 1 fps, frame rate of the video would be 1 fps.

Software operation
Difference mode

In this mode software displays absolute value of the difference between two consecutive frames. In order for the mode to be useful, you need to modulate radiation source by the sync out signal of the device. The sync signal is +5V TTL with level changes corresponding to frame boundaries (see p.5). You can equally well use high level as "radiation on" and low as "off" or vice versa.

In the difference mode background and all its slow variations are automatically canceled out.





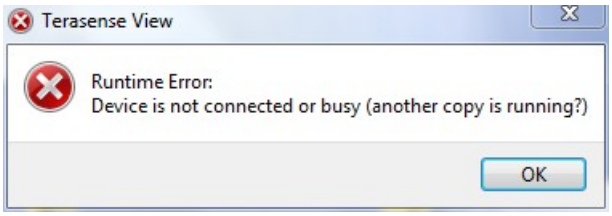
If you are using one of TeraSense (TM) IMPATT sub-THz generators, you should connect "sync out" output connector of the camera to "MOD IN" input connector of the generator.

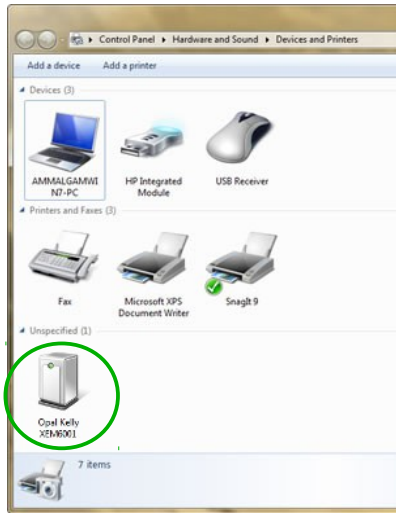
Maintenance

- Do not expose the device to excessive heat, do not leave it in direct sunlight for a long time.
- If ambient temperature changes, let the device to come in equilibrium before use.
- Device is not protected against environment. Do not use in very wet or very dusty surroundings.
- PTFE window is soft – be careful not to apply force to it.
- To clean the device use soft cloth. If necessary, moisten it slightly with mild detergent and then dry the device thoroughly. Never submerge it in water!

Troubleshooting

Problem:





Solution:

Is Opal Kelly XEM6001 present in "Devices and Printers" window?

Yes

Use "Alt-Tab" to look for another copy of the Terasense View software
(only one copy can be running at a time)

Use "Ctrl-Shift-Esc" to start Windows Task Manager and kill all pythonw.exe processes, then restart Terasense View software.

No

Check that the camera is connected and plugged in (Power LED should light).

If you are using USB hub (especially, unpowered USB hub), try to connect the camera directly to your PC.

Try to connect the camera to another USB port on your PC.

Disconnect any other USB devices and reconnect the camera.

If the software have crashed (for example, due to the device being disconnected during the run) it may have left a zombie process, which would prevent new copy from running .