

TroublePix User's Guide

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About TroublePix

TroublePix is a professional software solution for using digital video to monitor and troubleshoot rapidly evolving processes. A typical application is to monitor production line jams in packaging operations. This requires live image display from a camera, continuous recording and simultaneous playback operations. TroublePix supports a wide variety of high-resolution and high-frame digital cameras.

TroublePix lets you continuously record digital video data to a computer memory or hard disk, so that when a problem occurs you can detect it, diagnose it and ultimately prevent it from happening in future. Simply point the camera to the area to troubleshoot, launch TroublePix, make whatever adjustments are needed and start recording. Images will be continuously stored, either to RAM or hard disk. When a trouble event occurs, review the captured images to identify the problem.

This makes it easy to document a trouble event, and a small AVI video file can be created and exported to share the discovery with co-workers.

TroublePix provides simultaneous triplex functionality:

- Live image display from the camera
- Real-time image recording
- Review and archival of captured images

Installing TroublePix

To install TroublePix, run **TroublePix-setup.exe** and follow the on-screen instructions. If an earlier version is present, there is no need to uninstall it first.

The installer will install all files required to run TroublePix. Depending on the camera or frame grabber you plan to use, it may be necessary to install a third-party device driver. Refer to your camera manual for further details. **Note:** it is strongly recommended to install your camera's applications and drivers *before* installing TroublePix.

Most settings for TroublePix are stored in a configuration file, **TroublePix.ini**.

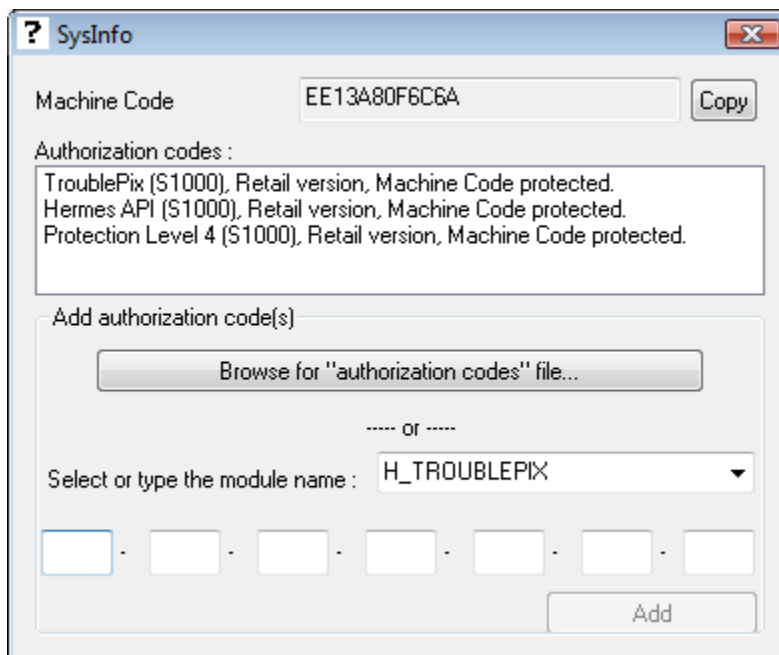
When you upgrade TroublePix from an older version, the configuration file is kept. There is no need to backup the INI file before running the update.

Licensing TroublePix

To run TroublePix, you must have a license. This can be requested by telephone at 514-846-0009, or by email at support@norpix.com. When doing so, it is important to mention the camera and/or frame grabber you plan to use. You will receive an email with a file attachment containing your TroublePix license. **Before continuing, please read the rest of this section completely.**

A TroublePix license must be associated with a physical device, be it one computer, using its unique **machine code**, or one **USB key**. In practical terms, a license based on a machine code is tied to the computer on which your copy of TroublePix is installed. A license based on a USB key can be moved from computer to computer along with that key, but in both cases you can use only one instance of TroublePix per license.

When you install TroublePix, a small utility called **SysInfo.exe** is included in the TroublePix folder. If you wish your license to be linked to your computer, run this utility *before* contacting Norpix to request a license. As shown below, **SysInfo.exe** will tell you the machine code required to activate your license.



Licensing with a Machine Code

Start by running the **SysInfo.exe** program located in the TroublePix folder, which will tell you your computer's unique **machine code**. Now contact TroublePix to request a license, either by telephone at 514-846-0009, or by email at support@norpix.com. We need to know your computer's machine code and the camera and/or frame grabber you plan to use.

TroublePix will send you an email with a file attachment containing your license. Save this file attachment to a temporary location, noting that its name ends in **.npx**. To activate your license, either open the **.npx** file yourself by double-clicking it in Explorer, or load it through **SysInfo.exe**.

Licensing with an External USB Key

A license based on a USB key allows you to run TroublePix on different computers. The USB Key must remain plugged into one of the computer's USB ports while TroublePix is running. To use this method, start by installing the **Sentinel Software driver**, which can be downloaded from Norpix or installed from the TroublePix CD. Now contact TroublePix to request a license, either by telephone at 514-846-0009, or by email at support@norpix.com. Remember to tell us the camera and/or frame grabber you plan to use.

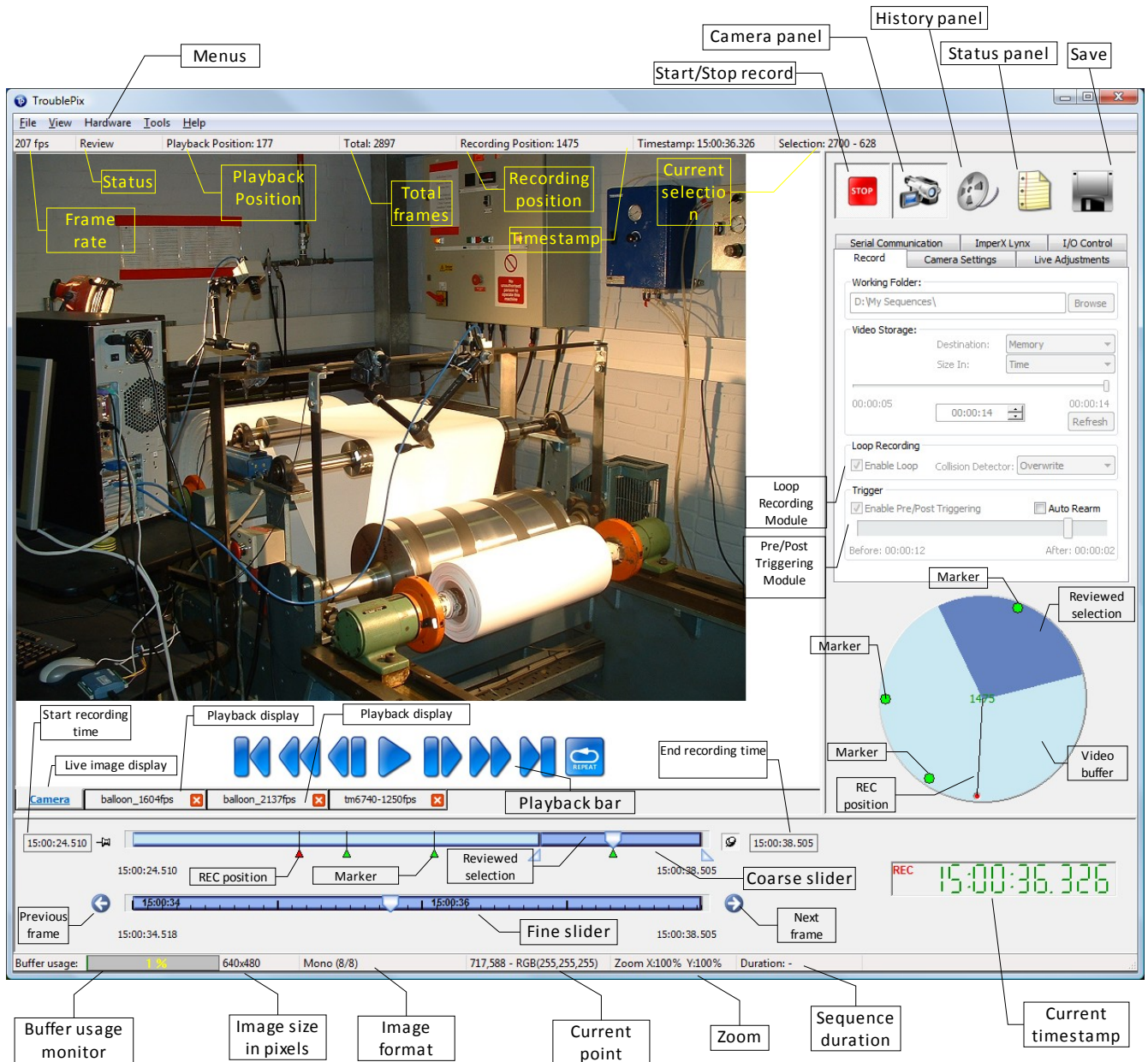
TroublePix will send you an email with a file attachment containing your license. Save this file attachment to a temporary location, noting that its name ends in **.npx**. To activate your license, either open the **.npx** file yourself by double-clicking it in Explorer, or load it through **SysInfo.exe**.

Remember that even if you use your USB-based license to run TroublePix on different computers, only one computer at a time can be running TroublePix for a given license.

Graphical User Interface

Overview

When you launch TroublePix, the user interface will look like the dialog below:



Here is a description of the various items in the user interface:

Image Display Area:

This area is used to display images either live from the camera or from previously recorded sequences. Up to 5 recorded sequences can be loaded simultaneously in separate windows, along with the camera window. Only one window can be viewed at a time, since it occupies the entire image display area. Windows are listed along the bottom of the image display area.

- **Camera Window:** Unless live capture is disabled, the camera window always displays incoming images from the camera, in real time, at up to 25 frames per second. (Even if the camera is capturing at a higher rate, like 200 frames per second, it would be pointless to display it live because the human eye, due to retina persistence, cannot perceive it.)
- **Window with a RAM Sequence:** This window contains a sequence that was just recorded to RAM: when recording stops a new window is created, containing that sequence. The window will be named RAM. When there are multiple RAM sequences they are sorted by age, the youngest being furthest from the camera window.
- **Window with a Saved Sequence:** This kind of window contains a sequence file that either was just recorded to disk or has been reloaded from disk for playback. The sequence window is named using the sequence file name, typically the timestamp for when recording started.

The image area can display images using various zoom factors. The default zoom factor is 100%: one screen pixel corresponds to one camera sensor pixel. Images can be zoomed in or out by pressing the **Plus** or **Minus** key on the numeric keypad. To reset zoom to 100%, press the * (multiply) key on the numeric keypad. When **View | Fit Image to Window** is selected, the image is stretched to use the entire display area. The current zoom factor is reported in the bottom status bar.

Menu Items:

Some menu items have keyboard shortcuts. If a keyboard shortcut doesn't respond, click the image display area to restore focus to TroublePix central.

Sequence Status Bar:

This status bar displays a variety of information about the current working sequence:

- Starting from the left, the **Frame Rate** field reports the number of images per second being received from the camera. Though the camera may be delivering images at a steady rate, the frame rate could fluctuate slightly.
- The **Status** field indicates the current working mode:
 - LIVE – TroublePix is receiving and displaying images from the camera
 - Review – While still recording, you are reviewing earlier parts of the sequence
 - Playback – You are playing back a recorded sequence
 - Standby – The camera is not delivering images
- **Playback Position** indicates the frame number of the current image in the current sequence.
- **Total** indicates the total number of frames stored in the current sequence.
- **Recording Position** indicates where the next frame will be stored in the sequence. In the case of continuous recording this is at the end of the file, but when loop recording is activated it will be at some location within the file.
- **Timestamp** displays the timestamp of the current frame, based on an absolute time reference.
- **Selection** reports the range of frames included in the current selection.

Right Panel: This area contains most of the controls for interacting with TroublePix:

- Click the **Record** button to start or stop the recording process.
- Click the **Camera** button to access the control panel, where you can configure TroublePix to work best with your video equipment.
- Click the **History** button to access previously recorded sequences.
- Click the **Status** button to display the application activity log and marker list.
- Click **Save** to save the current selection to a specific file on disk.

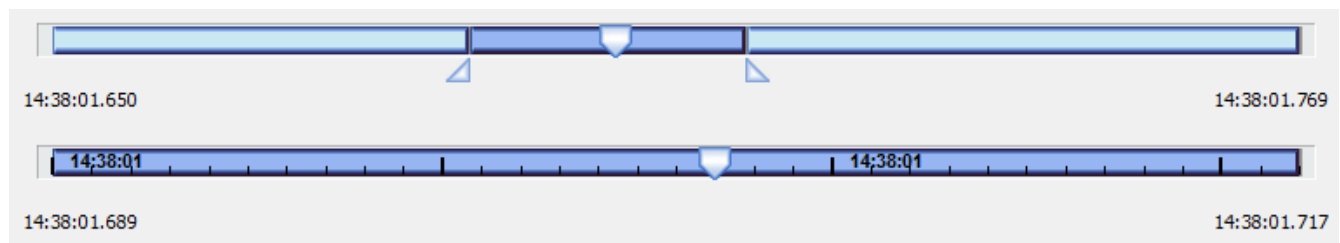
Bottom Panel:

Apart from the timer, this area is mostly used when reviewing a sequence in progress or playing back a recorded sequence. It includes tools to help you locate specific sections and frames.

- The **Timer** displays the timestamp of the current frame. The color depends on the current operating mode:
 - Blue – the camera is displaying live images, but you are not recording.
 - Green – you are playing back a previously recorded sequence, or reviewing part of a live recording (in which case REC is displayed in red).
 - Red – live images are being displayed and recorded (REC is displayed in red).
- The **Coarse Search Slider** lets you quickly isolate a specific section within a sequence. It can be used either while recording (to review an earlier portion) or during playback of a recorded sequence. The location of the “thumb” of the slider indicates your position within the sequence. Drag the thumb to move rapidly through the sequence. The pins on either side of the Coarse Slider are for use in reviewing, as explained in section **Reviewing and Playback**.
- The **Fine Search Slider** lets you find exactly the frame you want within the current selection range of the Coarse Slider, represented by the latter's blue section.

Defining a selection range

The **Selection Range** defines a portion of interest in the current sequence. It is represented by the blue section of the Coarse Slider and by the entire length of the Fine Slider. Defining a selection range is useful when just part of a sequence needs to be saved, or when searching for a specific frame in a particularly long sequence. The default selection range includes the whole sequence, so when you open a sequence, all frames are selected. To modify the selection range, drag the two small cursors located below the slider. A tooltip will indicate the duration of the selection as you drag.

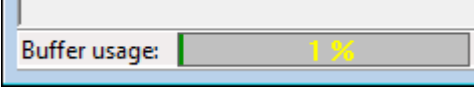


Each slider has two labels located at its extremities, giving the timestamps of the frames at these positions:

- **Start Recording Time** gives the timestamp of the first frame (the very first in the case of the Coarse Slider).
- **End Recording Time** gives the timestamp of the last frame (the very last in the case of the Coarse Slider).

Current Timestamp: displays the timestamp of the current image. In LIVE mode, it displays the current system time.

Bottom Status Bar: The bottom status bar displays status information such as:

- The **Buffer Usage** monitor indicates the percentage of temporary buffers holding images waiting to be processed. When recording is in progress, images received from the camera are stored in temporary memory buffers until they can be processed. If an image is received when no buffer space is available, that image is lost. Buffer usage is indicated both as a percentage and by a green bar that grows from the left of the indicator zone. At 100% full the bar turns red. On a well-configured system this should never occur. To validate your system, do a test recording and monitor the buffer usage. If the percentage reaches 50% or more, increase the number of buffers by 25% and repeat the test. Continue doing so until the indicator stabilizes and remains green. The number of buffers can be set by selecting **Edit Buffer Count** from the **Hardware** menu.
- 
- The screenshot shows a rectangular status bar with a light gray background. On the left side, the text "Buffer usage:" is displayed in a dark font. To the right of this text is a horizontal progress bar. The bar is mostly empty, with a small green segment on the far left. To the right of the green segment, the text "1 %" is displayed in a yellow font.
- **Image Size in pixels** indicates the width and height of the image being displayed, in pixels.
 - **Image Format** indicates the image format (mono, color, bayer) and the image bit depth shown as: "bit depth per channel / total bit depth".
 - **Current Point** indicates mouse coordinates relative to image and the pixel color under the mouse pointer.
 - **Zoom** indicates the current zoom ratio, X and Y being the horizontal and vertical zoom percentage respectively: 100% means one pixel of the screen corresponds to one pixel of the image, while 50% indicates that only 50% of the image pixels are displayed. Zoom can be adjusted through the View menu or by pressing the Plus and Minus keys on the numeric keypad.
 - **Sequence Duration** indicates the length of the sequence in time.

Displaying in Full Screen mode

In **Full Screen** display mode, all toolbars, status bars and window borders are hidden, letting the image or video take up the entire display. To ensure that you can still control the application and use its main features, a **Control Panel** is created at the top of the screen. The panel can be oriented either horizontally, which is by default, or vertically, so that it can be positioned on the left or right side of the screen. The orientation can be changed from the popup menu, displayed when you right-click on the Control Panel's title bar.



To enable **Full Screen** mode, either check **View | Toggle Full Screen** or use the **F12** keyboard shortcut. To return to regular mode, use the **F12** or **Esc** shortcuts or click the **Exit** button on the **Control Panel**.

Full Screen mode is fully compatible with a multi-display computer configuration.

Configuring TroublePix

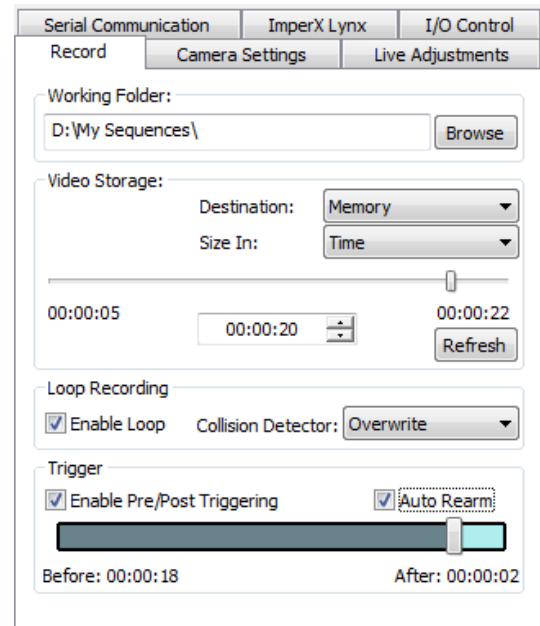
Depending on your recording needs, you may need to adjust a few settings to obtain the best results. Click the Camera button to access the control panel. All settings are provided through the tabs discussed below: Recording, Camera Settings and Live Adjustments. (Additional tabs will be provided for certain specific cameras, such as the ImperX Lynx, which is discussed in the **Using an ImperX Lynx Camera** section.)

Recording Tab – Adjust settings related to recording.

The **Working Folder** is where all new sequences will be located. By default, TroublePix creates a **My Sequences** folder in **My Documents** where files will be stored. Click the **Browse** button to change the name and location of this folder.

The **Video Storage** box lets you choose a number of parameters for video storage. These are: the **Destination** to which captured frames are stored, the **Size** category (time or number of frames) by which the length of a recording shall be measured, and the size of a recording relative to the space available.

Recorded frames can be stored either to the computer's **random access memory** (RAM) or to its **hard disk drive**. RAM is fast but typically limited in size, and of course not permanent. Therefore, select **Memory** only when the period to be captured is relatively short. For longer records, select **Hard Drive**. Since disk drives are slower than RAM, recording to the hard drive may not be able to keep up with the frame rate from the camera. Contact Norpix for further details and the computer specifications required to work best



with your camera.

Setting up for recording requires you to specify a *record length*. This length can be defined either as a length of **Time** or by the number of **Frames** to be captured. Adjust the length itself (whether as time or number of frames) by using the tools beneath the Destination and Type boxes. The position of the slider corresponds to the relation between the record length specified and the maximum length possible, which depends on the available storage space (in RAM or on the hard drive). Available RAM and disk space may both fluctuate considerably depending on computer activity. Click the **Refresh** button to reset the slider's indication of maximum possible recording length as determined by the space available at that moment.

The **Loop Recording** box lets you set parameters for working in **loop mode**. When **Enable Loop** is selected, TroublePix records in loop mode, meaning that when your predefined record length fills up, TroublePix continues recording, overwriting older frames from the beginning. For example, with a record length of 5 minutes, you get a sliding window of 5 minutes of captured history that continuously moves forward with the present. Loop recording can be run for hours without clogging computer resources, since only a limited number of frames are kept.

The two **Collision Detector** options, **Overwrite** and **Stop REC**, tell TroublePix what to do if you are reviewing in loop mode and the current recording position in the loop (ring buffer) collides with the frames you are currently reviewing. If **Overwrite** is selected, TroublePix will break out of review mode, returning to LIVE display as it overwrites what you were reviewing. If however **Stop REC** is selected, TroublePix stops recording before collision can occur. (Reviewing is discussed more thoroughly in the **Reviewing and Playback** section.)

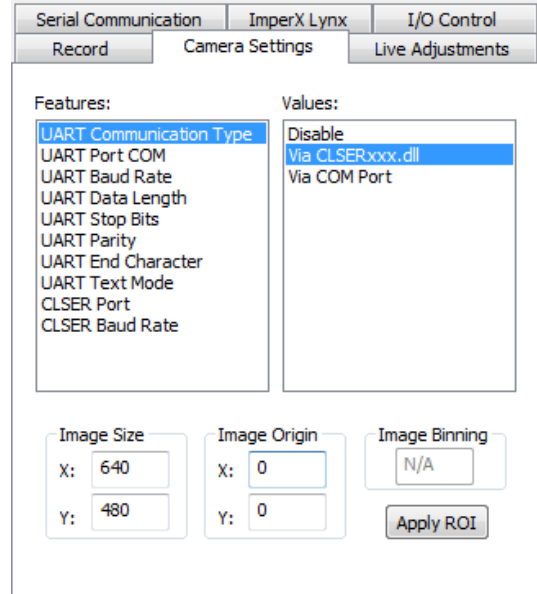
Pre/Post Triggering is a special recording mode.

Auto Rearm lets you continue recording even after Pre/Post Trigger mode recording stops. With this option selected, when triggered recording ends a new sequence file will be opened automatically and TroublePix will carry on recording, either until it runs out of space or you uncheck **Auto Rearm** or manually stop recording.

Camera Settings Tab – Here you can control the principal features of the camera and/or frame grabber you are using with TroublePix. Which features are presented will depend on your video equipment.

At the bottom of the tab, **ROI** stands for “Region Of Interest definition”. If your camera sensor supports this feature, you can define the region of interest here.

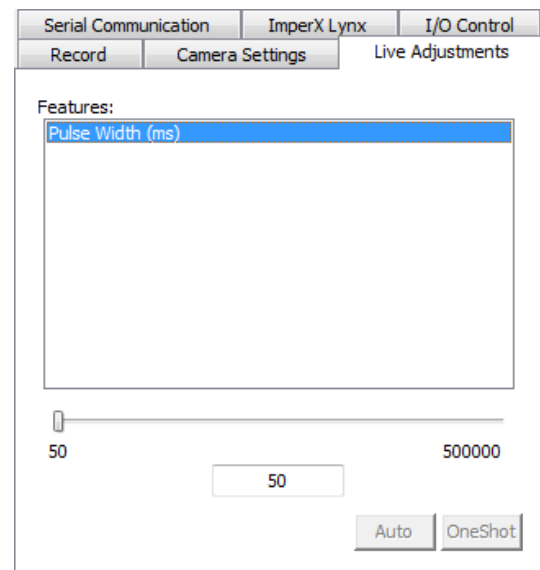
Note: during recording, the contents of this tab are read-only, since changing a value would break off the acquisition process.



Live Adjustments Tab – Adjust grabber settings that can be changed while the camera is streaming. Which settings are presented, if any, will depend on your video equipment. For example, on most cameras you can adjust the exposure, gain and brightness while recording LIVE.

Settings can be adjusted either by dragging the slider or by entering the desired value in the text box.

Some cameras offer **OneShot** mode, in which the camera attempts to find the best possible values for you. Some cameras offer **Automatic** mode, in which the camera will attempt to adjust itself automatically in response to changing conditions.



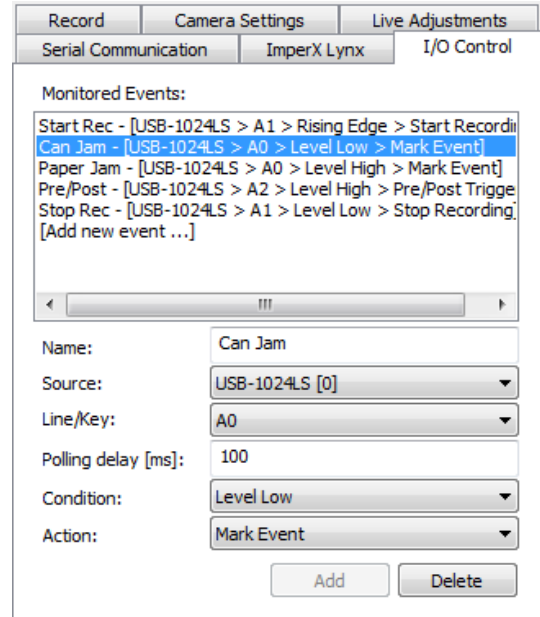
I/O Control Tab – Control TroublePix remotely, for example using output from a PLC device on a production floor.

I/O control is performed using a digital input device through which TroublePix will monitor input levels over an input line. A rising edge, falling edge, low level or high level would trigger TroublePix to perform the selected action.

Currently, the following predefined actions can be triggered:

- “*Start Recording*” to begin recording.
- “*Stop Recording*” to end recording.
- “*Toggle Recording*” to toggle recording.
- “*Pre/Post Event*” for use in Pre/Post Trigger mode, to trigger the ***Pre/Post Event***.
- “*Mark Event*” to mark a specific event and its corresponding frame, while recording.
- “*Line Testing*” to test the status of input lines during setup. Each time an event is detected, TroublePix displays information about it. To test a specific line, add an event on that line and send a pulse to trigger the event. Check the application activity log in the **Status Panel** to see if the event was detected correctly.

Note: More actions could be added in future at users' request.



The **I/O Control Tab** displays information related to remote inputs and actions to take. To create a new action, double-click on the **[Add new event...]** line or click on the **Add** button. To modify an existing action, click the line describing it and adjust its parameters. To delete an action click on the **Delete** button.

There are several parameters to set:

Name: This is a user friendly name of the monitored event.

Source: All I/O devices detected by TroublePix are listed. The source may be a grabber (frame grabber with input lines) or an external I/O device. For a list of all supported external I/O devices, please visit <http://www.norpix.com/applications/triggering/computertrigger.php>.

Line/Key: List all available input lines for the selected source. Select the input line to monitor.

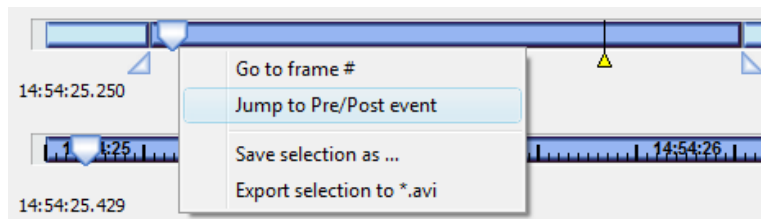
Polling delay: This is the interval at which the input line will be polled. If the value is too low, non-stop polling will occur, needlessly consuming system resources. However, a very high value might miss an event. For instance, if the input signal goes from low to high and back to low between two polling actions, TroublePix would not notice any change. If you are using a USB device the polling delay should not be under 10-15 ms, as the typical response time for such devices is around 10 ms.

Condition: This is the condition to monitor: a Low Level, High Level, Rising Edge or Falling Edge.

Action: This is the action to be taken when the *condition* is met. See above for possible actions.

Pre/Post Module

This module tells TroublePix to focus on recording images only around a specific trigger event. Adjust the slider to define how much time (or how many frames) should be kept *before* the trigger event (Pre-Trigger) and how much should be kept *after* it (Post-Trigger). Note that due to the nature of Pre/Post Trigger mode it can only be used when **loop recording** is enabled. When a Pre/Post event is triggered, either by an I/O action (see **I/O Control Tab**) or through the keyboard (space bar), TroublePix will continue recording for the “afterwards” (Post-Trigger) duration defined in the slider bar, then stop automatically. The resulting sequence will include what happened before and after the trigger event. The event will be indicated on the **Coarse Slider** as a yellow triangle. To go directly to this position, right-click in the **Coarse Slider** and select **Jump to Pre/Post Event**.



For more information about how to configure TroublePix to use this module, please refer to the **I/O Control Tab** section.

Multiple Event Markers

The primary function of TroublePix is to monitor evolving processes and help you troubleshoot them. A typical application would be to monitor a production line, linking images with external events that would be generated when failures occur.

TroublePix lets you record multiple events triggered from multiple sources. Each event captured is associated with the current image, based on the timestamp and frame index in the sequence file. All this information is represented on the graphical interface by a green symbol called a **marker**.

Marker List

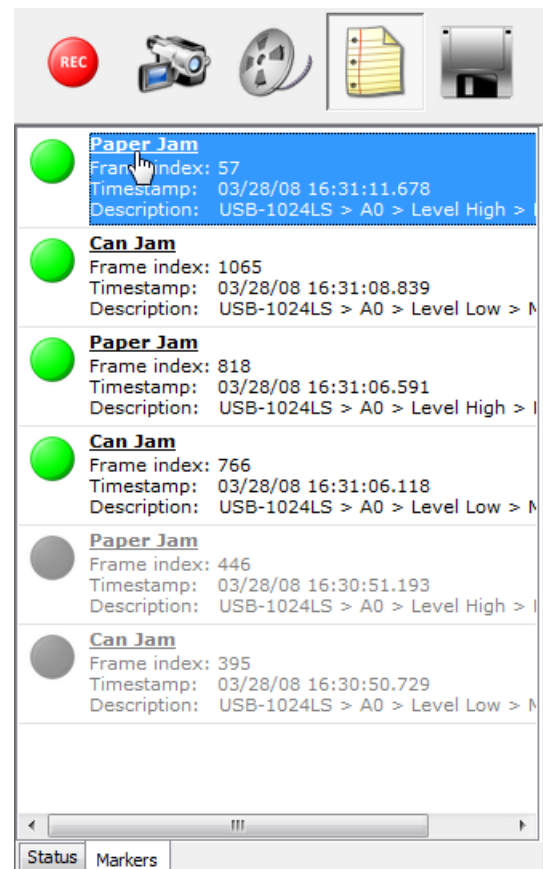
The event history is displayed in the **Marker List** on the **Status Panel**. Each marker is represented by a green or gray icon, the name, the timestamp and frame index from when the event was captured and a description of the corresponding event.

During recording the **Marker List** cannot be accessed, so all of the markers appear grayed. In **Review** mode the list becomes accessible again.

Markers are listed chronologically, with the most recently captured event always first on the list.

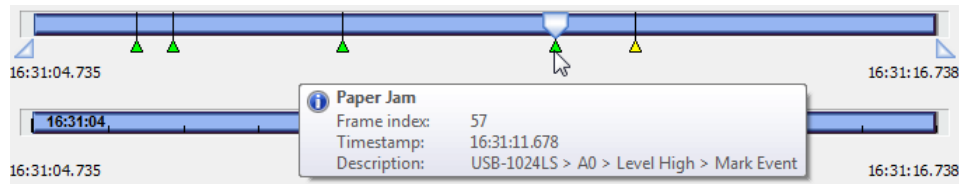
Valid vs. Invalid Markers

Normally, a valid marker is represented on the list by a green icon. However, during loop recording a marked frame may be overwritten, causing the associated marker to become invalid (since it no longer corresponds to an image). Invalid markers are represented by gray icons.



Event Markers on the Sequence Slider

On the **Sequence Slider**, event markers are represented by green triangles:



Moving the mouse pointer over a marker will display an info box describing the marker and the external event associated with it.

Browsing Event Markers

Event markers can be easily browsed. On the **Sequence Slider** or the **Marker List**, click on a marker icon to display its associated frame.

Saving Event History

Events are saved separately from sequences, in XML history files. The event history file for a given sequence will have the same filename as the sequence, with only the extension being different. Deleting such a file eliminates all information about events in the sequence.

During recording, the complete history of captured events is temporarily held in RAM. If recording to disk, when recording ends the event history is automatically saved to disk as an XML history file, using the naming convention explained above. If the sequence was recorded to RAM however, the event history is only saved to disk if the sequence itself is saved. Otherwise it is held in RAM until the sequence is closed.

When a recorded sequence is reloaded, its associated event history (if any) is also loaded and displayed automatically.

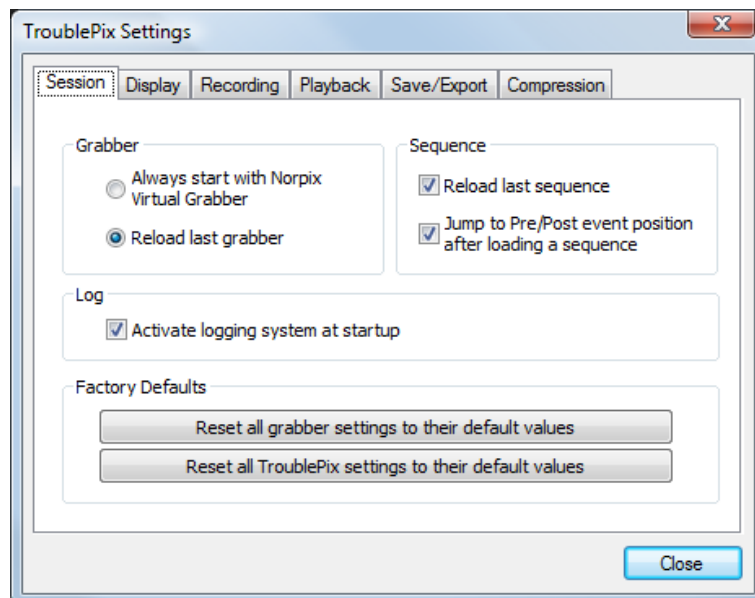
TroublePix Settings

Session Settings

This tab is used to adjust what TroublePix does at startup. You can reload the grabber or camera you used last, or start TroublePix using the Virtual Grabber. This setting is handy when you have problems loading a specific grabber. You can also define whether or not TroublePix should reload the most recently opened sequence. Check ***Jump to Pre/Post event position*** to go automatically to the Pre/Post event: when the sequence is loaded the corresponding frame will be shown. A yellow triangle represents the Pre/Post event on the sequence slider. For more information about Pre/Post events, please refer to the **Pre/Post Triggering** section.

If you wish to have a log of information about application activity, check ***Activate logging system at startup***. For more information about the logging system, please refer to the **Application Activity Log** section.

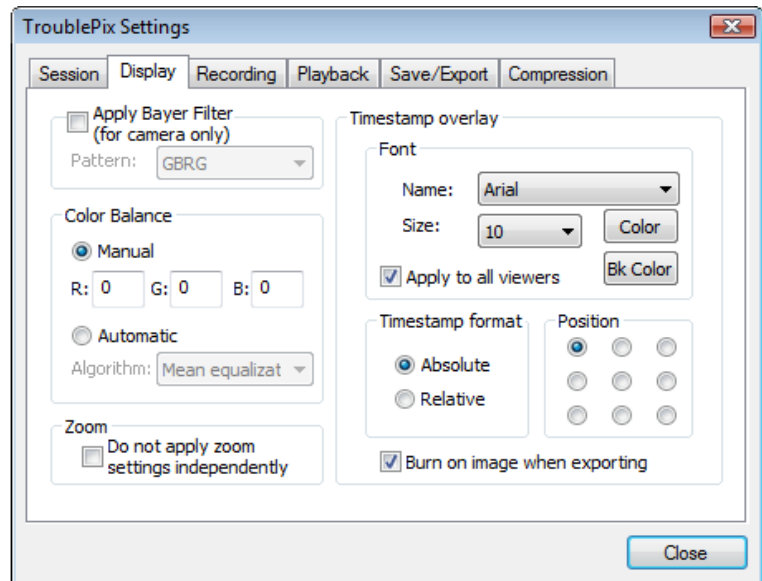
This tab also lets you reset certain settings to their default values. Resetting the grabber settings will flush all custom settings for all grabbers, i.e. everything you set through the **Hardware | Advanced Settings** and **Hardware | Live Adjustments** menus. Resetting TroublePix settings returns all application settings to their factory defaults.



Display Settings

This tab lets you customize your default settings for all displays. In particular, if your camera is of the Bayer type a filter can be applied to get a color image. Click the **Apply Bayer Filter** checkbox and select the appropriate pattern for your equipment. For more information about the Bayer filter, please refer to the **Bayer Conversion** section.

Color balance (sometimes referred to as white balance) refers to adjusting the relative amounts of red, green and blue to ensure that neutral colors are reproduced correctly. The color balance can be adjusted either manually, by setting custom values for each channel, or automatically, using an algorithm. The algorithm estimates the color balance of the first incoming image and applies it to all subsequent images. The choice of algorithms is explained below.



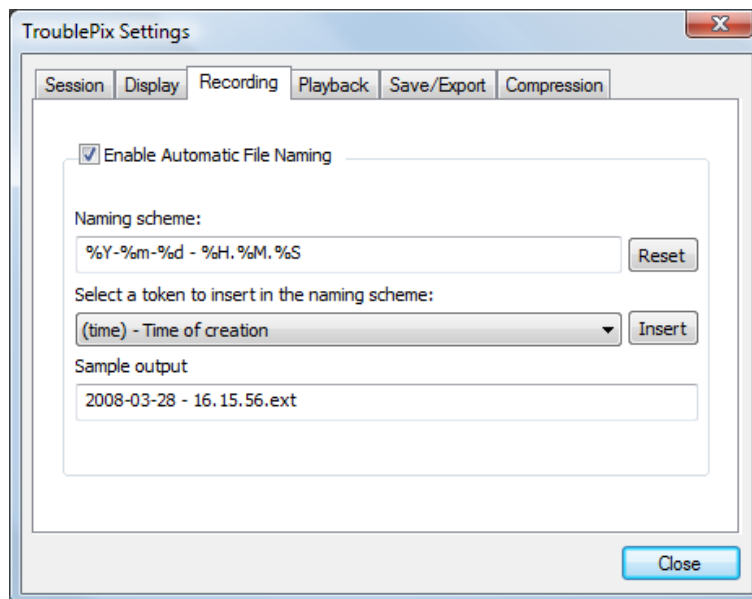
- **Mean equalization:** calculates the mean value of each channel, then adjusts each channel so that the mean values of the blue and red channels are equal to the green channel.
- **Gray world:** the sum of the red, green and blue channels is calculated, then adjusted so that the sum of the blue and red channels equals the green channel.
- **Standard deviation:** calculates the standard deviation of each color channel, then re-adjusts each to be 70 (on a scale of 1-256).
- **Mean and standard deviation (slowest):** adjusts the mean value of each channel to 128, and sets the standard deviation of each channel to roughly 70 (on a scale of 1-256).

Sometimes it is useful to know the exact time when an image was captured. To activate this feature, select **View | Show Timestamp Overlay** from the main menu. The time can be displayed as an absolute value or relative to a reference frame, usually the first one captured/recorded. You can also change the font name, font size, text color, background color/transparency or the position of the overlay. Font-related changes can be applied to all windows or to the current window only.

When saving or exporting a snippet, if **Burn on image** is selected TroublePix will permanently “burn” the timestamp onto every image in the snippet, using the same font and color settings as the overlay.

Recording Settings

Automatic File Naming is a new feature that tells TroublePix to generate filenames automatically without requiring user input each time you save or export a snippet.



By default, when TroublePix starts recording it uses a standard method to generate filenames. This can be customized according to your preferences. Type a naming scheme in the edit box, making sure that the resulting name will lead to a valid, unique filename. We recommend that you test the new scheme on a short recording before using it for a complete session. Once the naming scheme is in place, it is enabled by either creating new files through the **File | Save/Export ...** menu or by clicking the **Save** button located on the **Right Panel**.

Naming schemes are created using a list of predefined tokens. These tokens and their meanings are listed below:

%H.%M.%S	- Creation time;
%Y-%m-%d	- Creation date;
%a	- Abbreviated weekday name;
%A	- Full weekday name;
%b	- Abbreviated month name;
%B	- Full month name;
%c	- Date and time representation appropriate for locale;
%d	- Day of month as decimal number (01 – 31);
%H	- Hour in 24-hour format (00 – 23);
%I	- Hour in 12-hour format (01 – 12);
%j	- Day of year as decimal number (001 – 366);
%m	- Month as decimal number (01 – 12);
%M	- Minute as decimal number (00 – 59);
%p	- Current locale's A.M./P.M. indicator for 12-hour clock;
%S	- Second as decimal number (00 – 59);
%U	- Week of year as decimal number, with Sunday as first day of week (00 – 53);
%w	- Weekday as decimal number (0 – 6; Sunday is 0);
%W	- Week of year as decimal number, with Monday as first day of week (00 – 51);
%x	- Date representation for current locale;
%X	- Time representation for current locale;
%y	- Year without century, as decimal number (00 – 99);
%Y	- Year with century, as decimal number;
%u	- Milliseconds as decimal number (000 – 999);

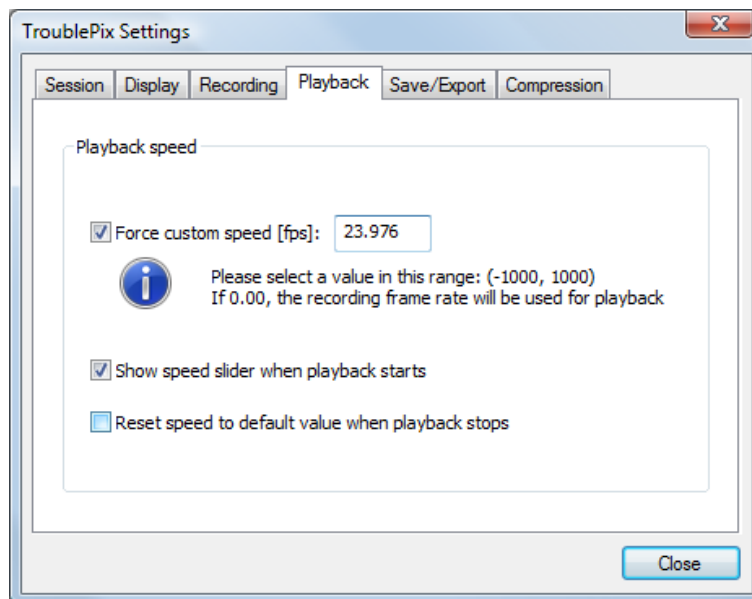
The **Sample output** box displays an example of how an automatically named file would be saved.

Remember, if you want TroublePix to generate filenames automatically using the naming scheme you have defined, you must enable this feature by checking **Enable Automatic File Naming**.

Playback Settings

When you play back a sequence, an important parameter is the playback speed. By default, when a sequence is played back TroublePix uses the same frame rate as the one used during recording. You can however force the default playback speed to a custom value. If zero, the recording frame rate is used.

During playback, you can modify the speed using the **Playback Speed Slider**, as described in the **Reviewing and Playback** section. To automatically see the Playback Speed Slider when starting playback, select **Show speed slider when playback starts**. The speed can be altered up to 400% in either direction (forward or backward). If you do not select **Reset speed to default value when playback stops** the altered speed will be used the next time playback starts.

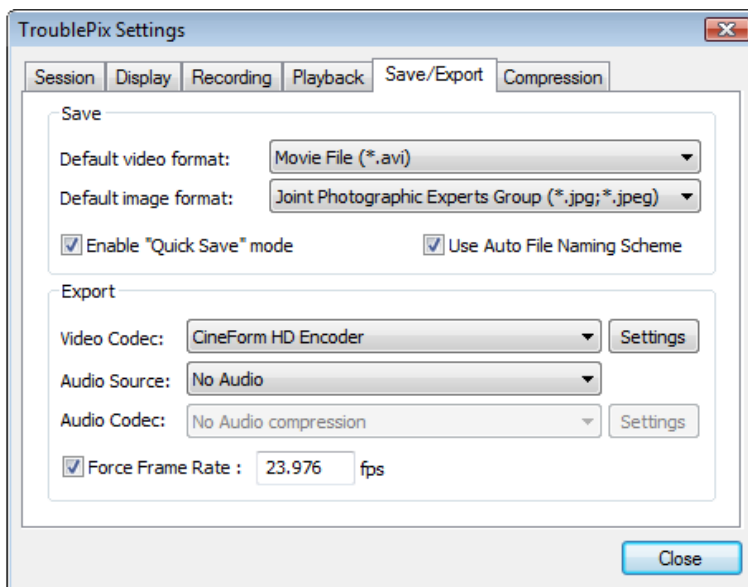


Save/Export Settings

This tab lets you set the default options for saving or exporting an image or snippet (see ***Saving or Exporting a Sequence*** for more details).

Saving or exporting a snippet is equivalent to saving the current selection as a new sequence or AVI file. This can work in conjunction with ***Quick Save*** mode. In ***Quick Save*** mode, TroublePix will generate a filename automatically and perform the save in the current working folder. To help you identify the snippet later, TroublePix takes the original filename and appends the selection range. If a file with that name exists already, an index is appended.

For example, if you choose AVI as the default sequence format, and enable ***Quick Save*** mode, TroublePix will quick save snippets as AVI files with automatically generated filenames. The snippets will be located in the current working folder.

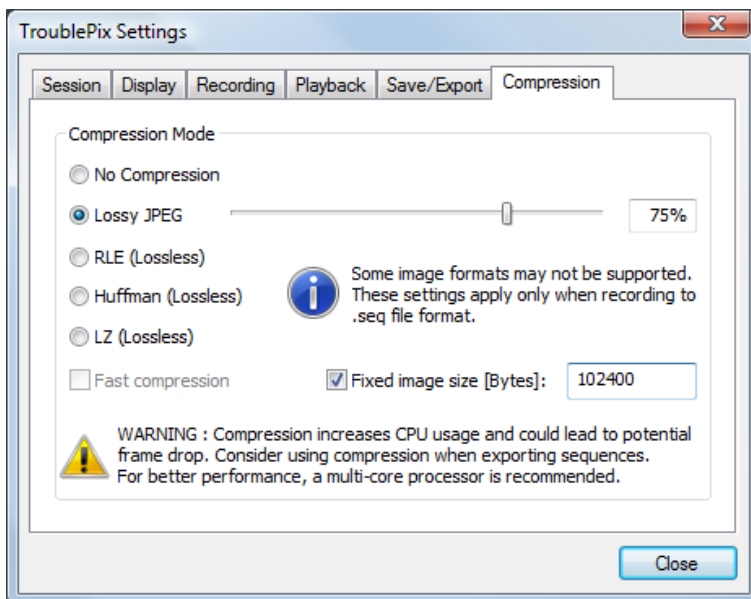


If ***Use Auto File Naming*** is enabled, the default naming scheme is used to automatically generate filenames when exporting video or image files. Exported files are saved by default in **Working Folder** using the format specified in ***Default video format*** and ***Default image format*** fields respectively.

The ***Export*** section lets you select an audio/video codec and customize its settings, select an audio source, or set a custom frame rate when exporting to AVI.

Compression Settings

This tab lets you enable or disable compression when recording in the sequence file format (.seq) or when saving a pre-recorded sequence.



Compression performance varies according to the following parameters:

- Image size and resolution (color, monochrome, 8 bit, 16 bit...);
- Image frame rate;
- Image texture and percentage of area unchanged;
- CPU speed;
- Compression algorithm.

The following table summarizes the kind of performance that can be achieved with an Intel P4 processor, clocked at 3.06 GHz, using monochrome or color RGB with 640x480 images:

Compression Type	Monochrome	Color
No Compression	120 fps	46 fps
JPEG	106 fps	62 fps
RLE	112 fps	37 fps
HUFFMAN	30 fps	8 fps
LZ	8 fps	1 fps

Lossy vs. Lossless Compression

In general, compression algorithms compress data (such as images) using one of two approaches: lossy or lossless. Lossy compression removes information that has little effect on overall quality, or that can be recovered by interpolation. This approach is generally used with sound and image formats. Lossless compression ensures that the original data can be fully reconstructed from the compressed version, with absolutely no loss of information. The lossless approach is used in situations where any loss of detail would be unacceptable. When using lossless compression it is strongly recommended that you select the **Fast compression** feature, which uses a multi-core optimized compression algorithm.

Real-time recording with compression is a very powerful feature in TroublePix. It is especially useful when you want to record for longer periods, using less memory or disk space, while maintaining practically the same level of quality as uncompressed data. However, compression demands more computational power than recording uncompressed data, and therefore requires a stronger PC configuration. Our recommendation for minimum system requirements would be an Intel® Core™2 Duo Processor with 2 GB of RAM, for recording 640x480 monochrome sequences at 30 fps.

Real-time compression can be performed with either continuous or loop recording and either to disk or to RAM. For loop recording, since compressed images vary in size you must set the **Fixed image size** parameter before starting to record. This value determines buffer size, and it must be large enough to hold any compressed image in the loop. If it is too small for a given image, compression will fail and the result will be a black image.

Compressing a pre-recorded sequence is similar to saving it. The only difference is that you have to enable compression and set the appropriate parameters. For more details, please refer to the section on **Saving or Exporting a Sequence**.

Recording

It's easy to start recording in TroublePix. At the minimum, just set a couple of parameters on the Recording tab (see the **Configuring TroublePix** section) and you're ready to go!

- Select whether you want video storage to be in RAM or on the hard drive
- Define a recording length (either by time or the number of frames)
- Click the Record button

TroublePix will immediately start recording all incoming images from the camera. Recording will continue until you click the **Record** button again, or (if you haven't selected loop mode) till the end of your predefined record length.

When recording to disk, frames are stored in a sequence file. This file is automatically named by TroublePix, using the timestamp from when recording began.

When recording to RAM, the sequence of frames is held in computer memory. RAM sequences are not named. Instead, when recording ends the sequence is represented by a **RAM sequence window**.

Reviewing and Playback

The words “Review” and “Playback” refer to two different things in TroublePix:

- **Review** refers to examining an earlier portion of what is currently being recorded.
- **Playback** refers to playing back a recorded sequence, after recording has stopped.

Playback can be done with any recorded sequence, whether it was recorded to RAM or to disk. Review can only be done with the sequence currently being recorded. Since you don't have to stop recording to examine previously captured frames, Review helps ensure that no potential event is missed while you analyze what has happened so far. Review displays frames using the **Camera window**, while Playback uses a dedicated window for each sequence (up to 5 can be loaded at a time). Sequence windows are listed along the bottom of the image display area.

There are two ways to switch to **Review** mode while recording:

- Drag the **Coarse Slider** to the left until you reach the area you wish to review.
- Click the **Lock/Unlock** pin to the right of the Coarse Slider, and use the **Fine Slider** to search for a specific frame to review. When the left pin is clicked, both the Coarse and the Fine Slider change to review mode.

Dragging the **Coarse Slider** lets you select a review segment anywhere in the recorded stream. Click the **Lock** pin to the right of the slider for immediate reviewing access to the frames that were just recorded.

To return at any time to LIVE mode, either:

- Right-click anywhere in a reviewed image and select **Back To Camera**; or
- Click the **Unlock** pin to the right of the **Coarse Slider**.

During both Review and Playback, there are four ways to navigate through a sequence:

- Drag the slider thumb to the desired location
- Proceed frame by frame by clicking the **Next** and **Previous** buttons at either end of the Fine Slider
- Hold down the SHIFT key and click the **Next** or **Previous** button to go to the next or previous *small tick* on the Fine Slider
- Hold down the CTRL key and click the **Next** or **Previous** button to go to the next or previous *big tick* on the Fine Slider

Note: Reviewing when you are recording in **loop mode** requires special consideration. In loop mode, once the record length has been filled the first time, each new frame is recorded by overwriting the oldest frame. This gives you a continuous sliding window that advances through time with the present. The right edge of the window is the present instant, while the left edge is at whatever distance in the past you set as your record length. This means that when reviewing a frame in loop mode, the left side of the window is steadily approaching your review position. What happens when it reaches you? That depends on which **Collision Detector** option you selected in the Recording tab of the Camera control panel (see the **Configuring TroublePix** section).

- **Overwrite** – if the recording position reaches the frame you are reviewing, TroublePix will break out of Review, returning to LIVE mode as it continues to overwrite the oldest frames in the sequence.
- **Stop REC** – if the recording position reaches the frame you are reviewing, TroublePix will stop recording. The current sequence now becomes a recorded sequence and is loaded to a new **RAM sequence window**, ready for playback.

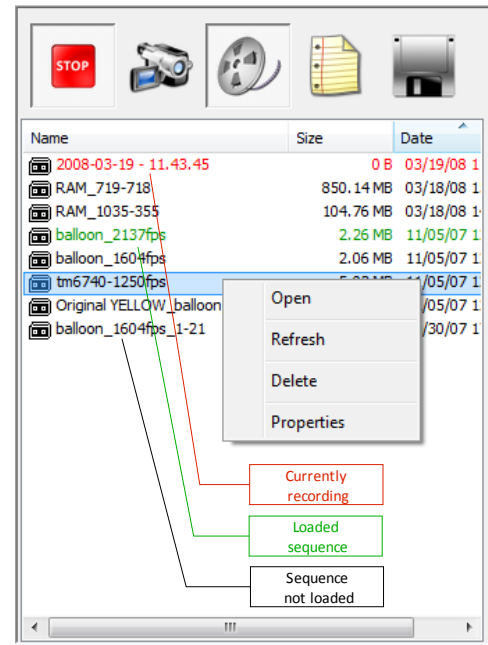
To help you with reviewing in loop mode, TroublePix indicates the **current recording position** using a small **red triangle** under the Coarse Slider. This represents the border between newer frames (to the left of the triangle) and older frames (to the right of the triangle).

Playback

Sequences recorded to disk are automatically named based on the date and timestamp of the beginning of the record, and saved in the current **Working Folder**. The **History** panel gives you access to these stored sequences. When you move the mouse pointer over a sequence file, useful information about the sequence is displayed in a pop-up, including a description if one has been entered.

Color coding indicates the status of each sequence:

- **Red** – this sequence file is currently in use for recording. There can be only one red sequence at a time.
- **Green** – these sequences are currently loaded in **sequence windows**, ready for playback (or being played back).
- **Black** – these are sequence files that are available for playback but not currently loaded. To load a file and begin playback, double-click on the filename, or right-click on it and select **Open**.













You can also use the drag and drop technique to open a file located in another folder, without changing the working folder. For example, open the file browser (Windows Explorer) and navigate to the folder where the file is located. Drag the file or files and drop in the display area.

The Playback Bar

The **Playback Bar** provides the customary commands for use in playing back recorded sequences.

To be more accessible, the playback controls are displayed as an image overlay.

-  - jump to the start of the playback range
-  - rewind
-  - step back
-  - begin playback
-  - stop playback
-  - step forward
-  - fast forward
-  - jump to the end of the playback range
-  - repeat playback in a loop
-  - stop playback automatically when it reaches the end.

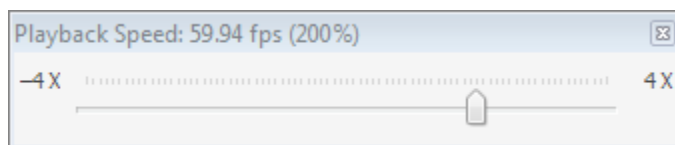
When playback begins, if your **Playback Settings** specify display of the speed slider a semitransparent window will pop up. This window lets you control playback speed, as explained in the section following.

Controlling Playback Speed

While playing a sequence you may wish to change the playback speed. This can be done using the **Playback Speed Slider**, which is displayed in a semitransparent window. If the window is not already visible, right-click in the image area to display it.

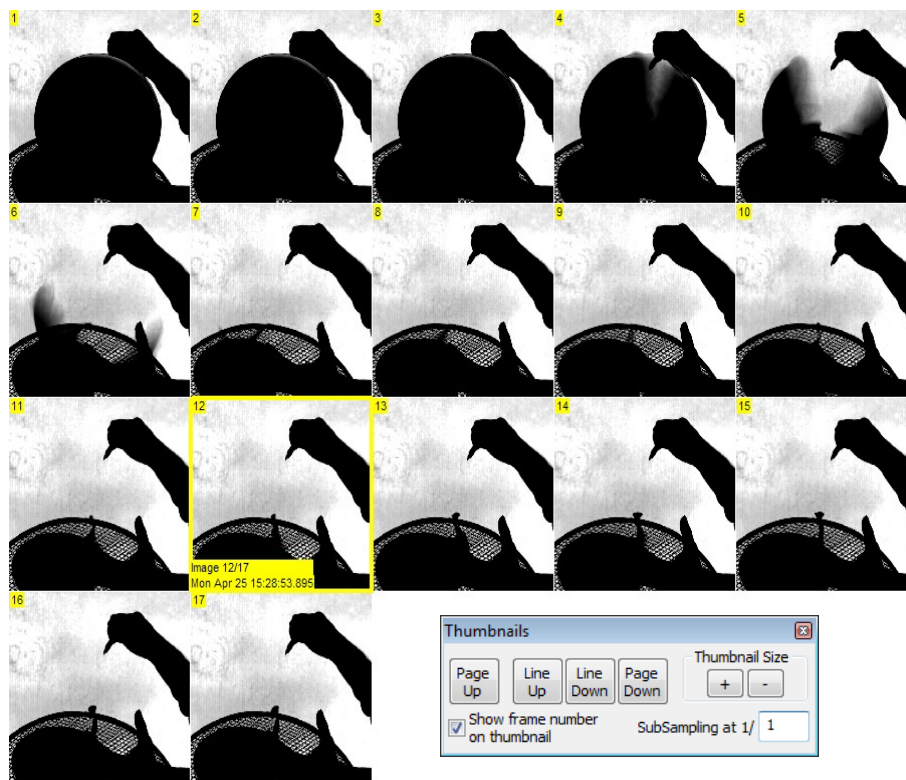
To increase *forward* playback speed (or slow down reverse playback) move the slider thumb to the right. To increase *reverse* playback speed (or slow down forward playback) move it to the left. To pause the sequence, leave it in the middle. The current speed is displayed as frames per second and as a percentage of normal speed. To return to normal speed, set the slider position at 100%.

For more information about playback settings and how to force playback at a custom speed value, please refer to the **Playback Settings** section.



Thumbnail View

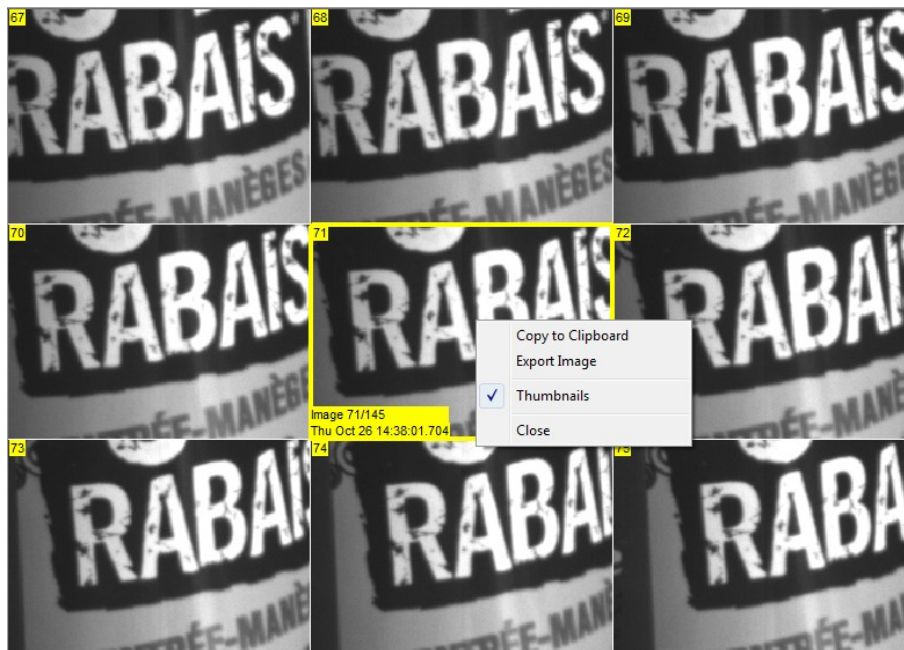
To view the contents of a sequence using thumbnail view, open the sequence and right-click on the display. A pop-up menu will appear. Select **Thumbnails** to switch to thumbnail view mode. The images in the sequence are displayed in miniature.



Select **Show frame number on thumbnail** to append a frame number to each thumbnail. Use the [+] and [-] keys to increase or decrease thumbnail size. Browse through the sequence using the **PageUp**, **LineUp**, **LineDown** and **PageDown** keys or by clicking in the display area and using the mouse wheel to scroll. Click on a thumbnail for information about it and to move the playback position to that image, or double-click to disable thumbnail view mode. You can also return to normal view by closing the Thumbnails dialog or by right-clicking in the display area and selecting **Thumbnails** again.

Exporting a frame from the current sequence

To export the current frame, use the **File | Export Image** menu entry or right-click on the image and select **Export Image**. This command lets you export the current frame as a **.bmp**, **.jpeg**, **.png** or **.tiff** file. If using **Thumbnail View** mode, right-click on the frame you wish to export and click **Export Image**. You can also copy the desired frame to the clipboard, for later use in any other application.



Saving or Exporting a Sequence

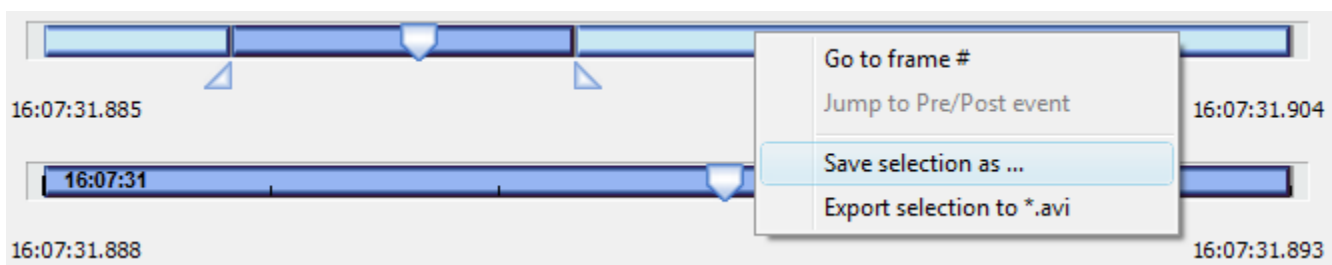
Saving a sequence

(*Caution:* Exercise care if you wish to save or export while TroublePix is recording fresh data to disk. Ensure that data transfer from the camera is well below your hard drive's maximum bandwidth, otherwise the recording process could be affected, resulting in lost frames.)

Sequences recorded to disk are already saved, but sequences recorded to RAM are not. If you have been recording to RAM and wish to save a sequence, click the **Save** button. Remember that to save the entire sequence instead of a selection from it, the whole sequence must be selected.

Typically, when using TroublePix to troubleshoot processes you will want to save a small section of a given sequence. That section, called a **snippet**, is where you have found the relevant information; the remainder can therefore be discarded. Saving a snippet makes it easier to document a phenomenon efficiently.

Saving can only be performed in Review or Playback mode, when the upper status bar displays the range of frames in the current **Selection**.

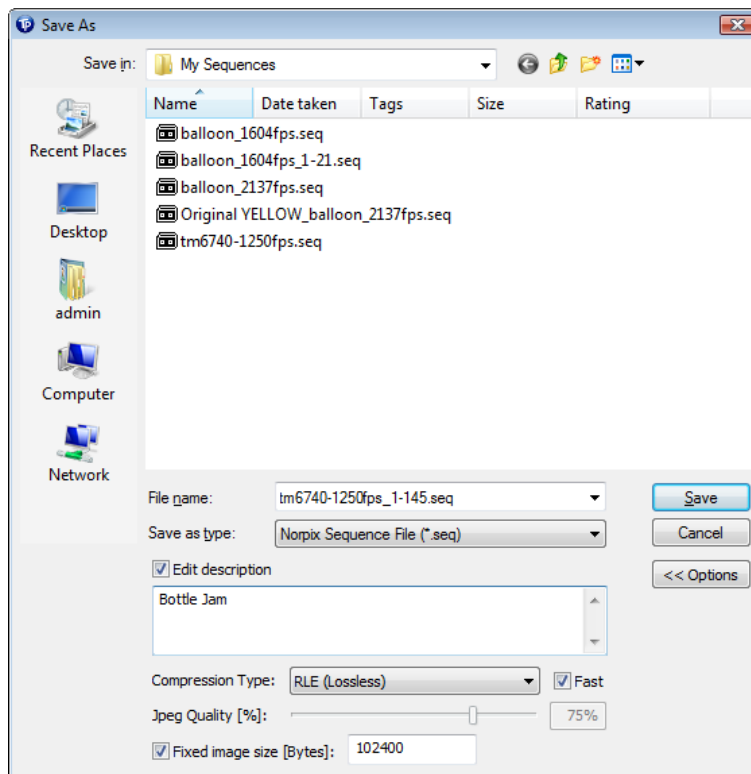


There are three ways to save a snippet:

- Click the **Save** button
- Select **File | Save Sequence As ...** from the menu
- Right-click on the **Coarse Slider** and select **Save Selection As...**

This opens the **Save As** dialog. When saving, you can add a **description** that will be stored in the header of the sequence file. This description will be displayed when the mouse pointer is over the file in the **History panel**.

If you intend to store the sequence for an extended period of time, it is recommended that you use compression to save disk space. This dialog lets you to enable/disable compression and change compression parameters as needed. Default compression parameters are set on the **Compression Settings** tab. For more details please refer to the **Compression Settings** section.



Saving a sequence or snippet creates a new sequence file with the **.seq** file extension.

Exporting a sequence to a Windows Movie File (AVI File)

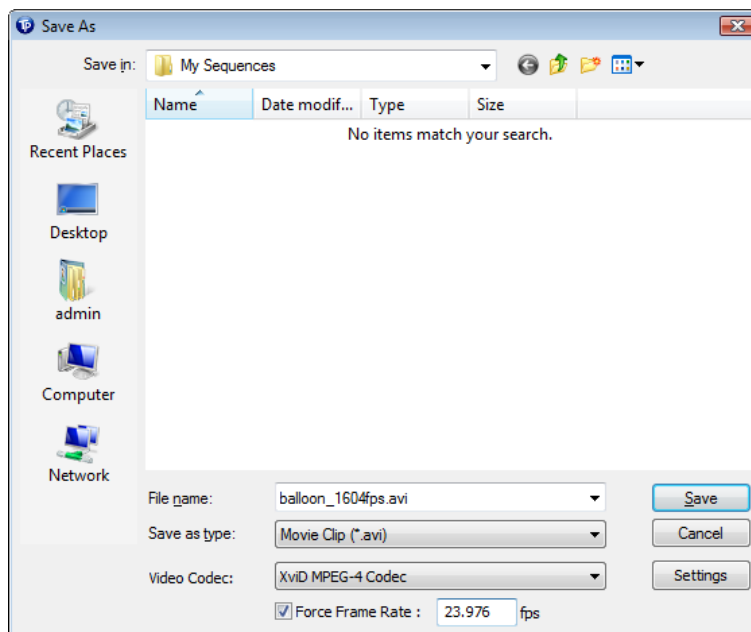
When you **Export** a sequence, it is converted and stored in a movie file with the **.avi** extension. AVI files can be displayed using a variety of media players and are easily shared. (TroublePix does not provide playback for AVI files.)

There are significant differences between SEQ files and AVI files. SEQ files contain the image data in raw format, along with a timestamp for each and every frame and additional information such as a description. AVI files also contain the image data, but typically in compressed form, for a savings in disk space that may be offset by reduced image quality depending on codec settings. AVI files do not include frame-specific timestamps, nor would they include your description.

Exporting a sequence to an AVI movie clip is similar to saving a sequence, with the difference that the Save As dialog lets you select and configure the video codec to perform compression and reduce file size.

There are two ways to export a snippet to AVI:

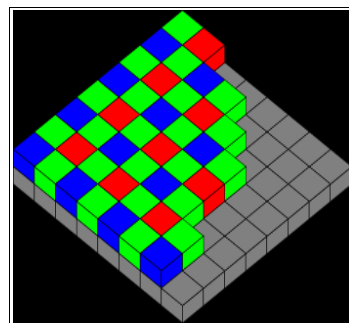
- Select **File | Export Sequence To AVI** from the menu
- Right-click on the **Coarse Slider** and select **Export Sequence To AVI**



Bayer Conversion

Bayer conversion is the process by which raw images from a Bayer camera are color-converted using a Bayer interpolation algorithm. Some cameras equipped with a Bayer filter will perform the color interpolation process before images are sent to output. However, most cameras do not do this, leaving interpolation to applications like TroublePix.

A **Bayer filter** mosaic is a color filter array for arranging RGB color filters on a square grid of photo sensors. The term derives from the name of its inventor, **Dr. Bryce E. Bayer** of Eastman Kodak, and refers to a particular arrangement of color filters used in most single-chip digital image sensors used in digital cameras, camcorders, and scanners to create a color image. The filter pattern is 50% green, 25% red and 25% blue, and hence is also called BGGR, GBRG, GRBG or RGGB depending on the color of the first pixel in a 2x2-pixel square.



Bryce Bayer's patent called the green photo sensors *luminance-sensitive elements* and the red and blue ones *chrominance-sensitive elements*. He used twice as many green elements as red or blue to mimic the human eye's greater resolving power with green light.

The raw output of Bayer-filter cameras is referred to as a *Bayer pattern* image. Since each pixel is filtered to record only one of three colors, two-thirds of the color data is missing from each. To obtain a full-color image, various demosaicing algorithms can be used to interpolate a set of complete red, green, and blue values for each pixel. Different algorithms requiring various amounts of computing power result in final images of varying quality.

TroublePix includes Bayer conversion functionality. Since a raw image contains all of the color information, TroublePix typically records images from such cameras as raw data. Bayer conversion is performed only when needed, namely when an image is being displayed, exported to an AVI movie or exported to an individual image file. This has two advantages: raw image size is 3 times smaller than

color images, and CPU resources are conserved (Bayer rendering is quite computation-intensive).

Bayer conversion can be enabled for each display window by selecting **View | Bayer Conversion | Apply Bayer Conversion** from the menu or by using the **Ctrl-B** keyboard shortcut.

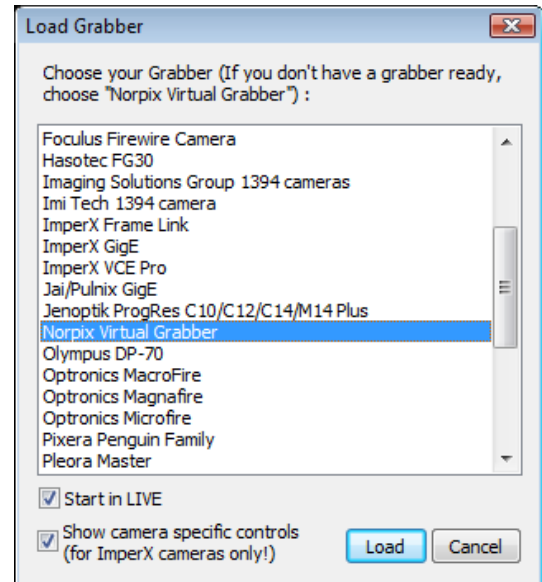
Since there are 4 possible Bayer patterns, and a Bayer filter can be any of the various pattern types, you must select the *Bayer Pattern* corresponding to the type of Bayer grid in the camera's sensor. This is the 4-pixel color pattern in the top left corner of the sensor. If this information is unavailable, experiment until you find the pattern that produces images with correct color rendering. The four possible patterns are GB-RG, GR-BG, BG-GR and RG-GB. The Bayer pattern can be changed by selecting **View | Bayer Conversion | Pattern** from the menu or by using the **Ctrl-P** keyboard shortcut.

Automatic color balance can be enabled/disabled by selecting **View | Bayer Conversion | Auto Color Balance** or by using the **Ctrl-C** keyboard shortcut. For more information about color balance please refer to the **Display Settings** section.

Configuring your Camera and/or Frame Grabber

In order for TroublePix to capture images, it must be connected to an **Image Capture Device**, namely a camera and/or a frame grabber. By default, the first time you start up TroublePix it will connect to the **Virtual Grabber**, a software component that simulates a camera, representing images with a set of bouncing rectangles.

To obtain a real image, TroublePix must be connected to a valid image capture device. Start by selecting **Hardware | Select Camera/Frame Grabber** from the menu. TroublePix will display the dialog shown to let you select the device corresponding to your equipment.



Select the camera or frame grabber you wish to connect to, then click **Load**. If no physical grabber or camera is currently installed, you can select the **Norpix Virtual Grabber**.

In the “Load Grabber” dialog box, uncheck the “Start in LIVE” check box if you don't wish the grabber to immediately start capturing images. This can be useful because frame grabbers often attempt to load a camera configuration file that may not yet be defined. Unchecking this option lets you first open the Hardware menu and select the appropriate configuration file before going LIVE.

If you are using an ImperX camera model, check “Show camera specific controls” to enable **ImperX Lynx** tab in control panel. For more details, please refer to the **Using ImperX Lynx Camera** section.

Once your image capture device is loaded, the **Camera window** in the **image display area** will display real-time LIVE feed from the camera. **Note:** loading an image capture device can fail if the grabber or camera is not connected or is currently being used with another application. Please refer to the **Grabber User's Guide** (a PDF document included and installed with TroublePix) for specific information about configuring and using your camera or frame grabber.

The image capture device automatically captures images unless the camera is set to ***trigger mode*** and no trigger pulse is running. To toggle the LIVE feed on or off, select **Hardware | LIVE** from the menu. Depending on the camera or grabber you are using, the image capture process may make greater or lesser demands on your computer's CPU. You may occasionally wish to suspend LIVE capture temporarily to free up CPU resources for other processing.

TroublePix is built to support a wide variety of image capture devices. Many grabbers have unique or non-universal properties and settings. To access all of the supported features of your device, select **Hardware | Advanced Settings** or **Hardware | Live Adjustments** from the menu.

Note: when you select **Hardware | Advanced Settings**, TroublePix has to stop reception of the stream of images. This is because a change to these settings can require profound software reconfiguration that cannot be achieved while capturing.

In contrast, ***Live Adjustments*** are grabber or camera settings that can be changed while the camera is streaming. Typically, exposure, gain and brightness are adjustable LIVE on most cameras. On most image capture devices, live adjustments are also available when the camera is not streaming.

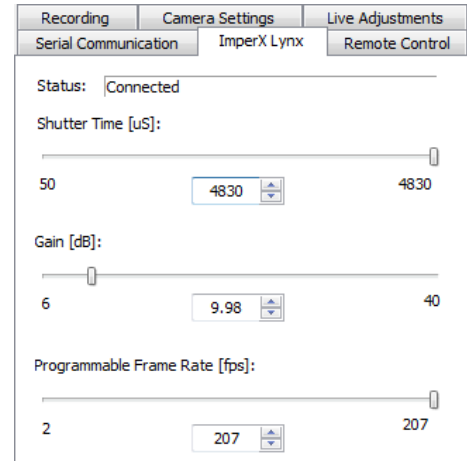
Note: in order to access the settings discussed above, the ***Camera window*** must be selected in the image display area.

Using an ImperX Lynx Camera

For a small number of special cameras, future versions of TroublePix will include dedicated tabs on the control panel for adjusting camera-specific settings.

The current version of TroublePix includes dedicated tabs for ImperX Lynx camera models. Please note that these tabs are not loaded by default. To enable them, select “Show camera specific controls” when loading the camera/grabber in the **Load Grabber** dialog, or else manually edit the *TroublePix.ini* file. You can open this file in a standard text editor (such as *Notepad.exe*) or by clicking **Start | Program Files | TroublePix | Configuration File**. Search for the **EnableImperXPage=0** line in the **[Devices]** section and change the value “0” to “1”. The next time you start TroublePix it will search for an ImperX camera, and if a serial connection can be established it will enable the camera-specific tabs.

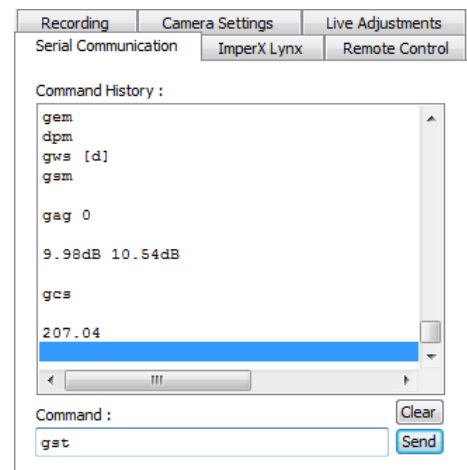
The ImperX tab shown here lets you quickly adjust 3 of the most important settings of the camera: **Shutter Time** (= exposure time), **Gain** and **Frame Rate**. Since the ImperX Lynx camera supports serial communication, there is also a **Serial Communication Tab** to enable advanced camera settings.



Serial Communication Tab (for advanced users only)

Some image capture devices support serial communication by emulating a serial COM port. This lets you type in and send direct commands to the camera.

To configure serial communication, refer to the **Grabber User's Guide** in the section related to the camera or frame grabber you are using. Refer also to your camera's user guide for information on how to format serial commands.



Application Activity Log

Logs are essential to understanding the activity of computer programs, particularly when problems occur.

In software engineering, a log serves to record information about a program's execution. This information is typically used by programmers for debugging. It can also let the user observe an application's internal status and better understand what's going on.

For example, suppose TroublePix is unable to load the grabber you wish to use. The log recorded as TroublePix attempts to perform this action could provide an indication as to the cause of the problem. The log should therefore be analyzed.

The **Save & Send** command lets you save the complete contents of the current log and send it by e-mail to our [Technical Support Department](#), all with a single click.

