User manual for ThermoViewer

by

TEX TECHNOLOGY

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Post Processing with ThermoViewer Software

ThermoViewer is the post-processing software provided by TeAx Technology to process RAW data captured with ThermalCapture devices. It allows users to quickly browse through recorded data and tune every single frame into the perfect result. For further usage of the data, they can be exported into images like JPG, TIFF and PNG, videos and CSV data. CSV and TIFF are especially useful, if further automatic data processing follows. There is also the option to export data into radiometric JPGs. Those files can be opened with powerful FLIR tools for deeper analysis, or automatic report generation.

1.1 Overview

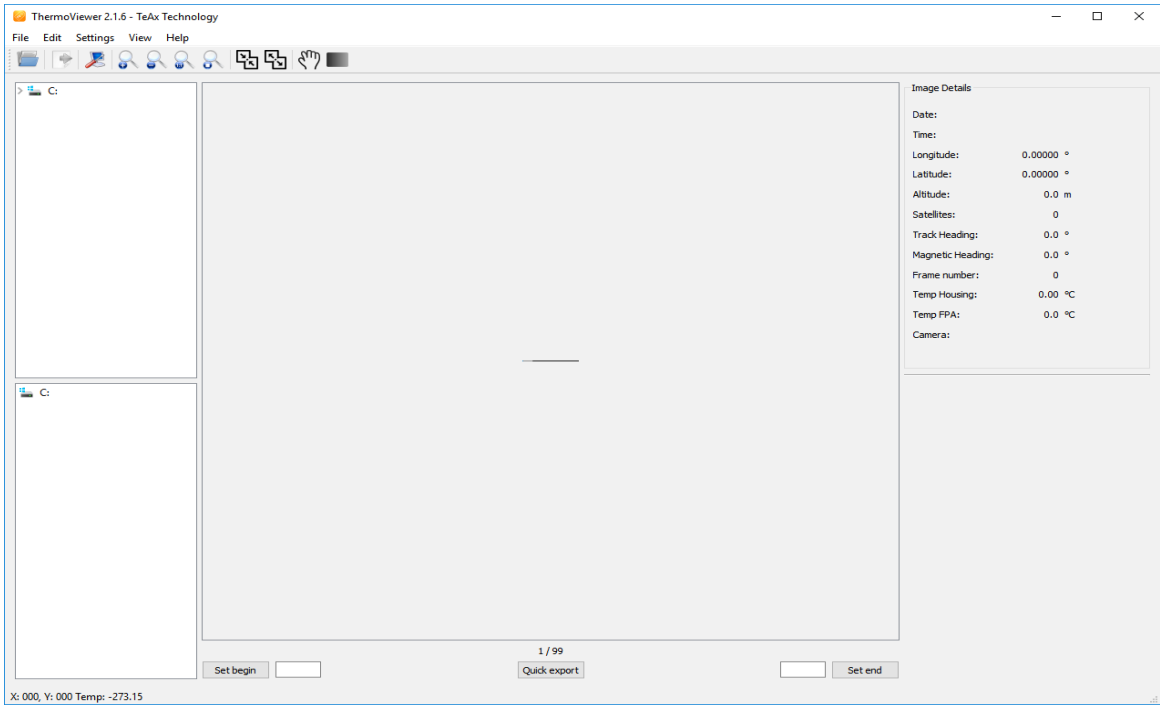


Figure 1: ThermoViewer after loading

Once you open up ThermoViewer you will see a window like shown above. On the top there are menu- and tool bar. The main window part below is split into three areas:

On the left side there are folder and file browsing areas (see 1.3). In the middle is the canvas for images. Underneath are the video control elements. On the right side additional image properties are displayed.

1.2 File handling

This section describes everything about opening and viewing of data, recorded with ThermalCapture products.

1.3 Open and browse files

Opening files can be done in three different ways:

1. Select the folder directly in the directory tree on the left side of the window. Once you select the desired directory, the file list underneath will show all compatible files within it.
2. Use the toolbar button: 
3. Use the corresponding menu item within the “File” menu.

Either way the first image is loaded and shown in the center area of ThermoViewer. All parameters needed for conversion from RAW into a user friendly representation are determined automatically, if this feature is not disabled by the user.

1.3.1 Playback

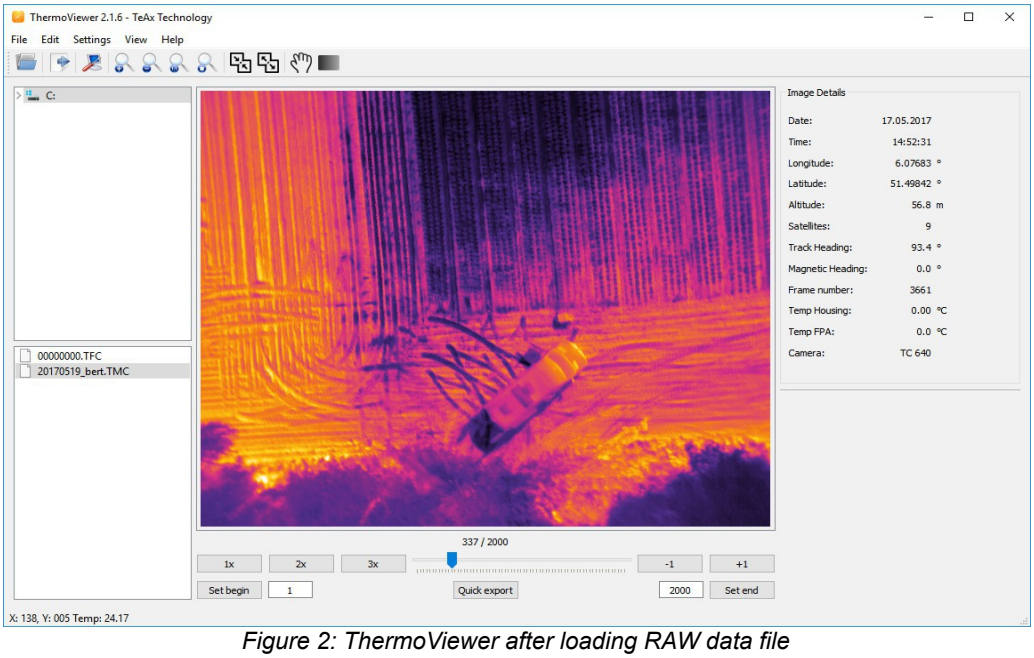


Figure 2: ThermoViewer after loading RAW data file

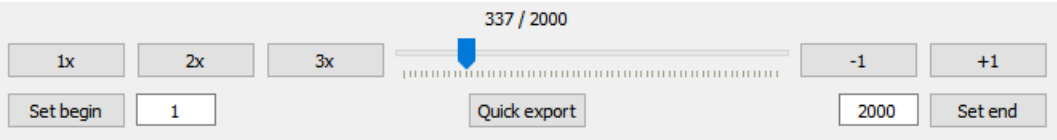


Figure 3: Video controls

A data set contains from 1 to 1000 frames, when recorded with ThermalCapture devices. To quickly browse through the frames, a simple slider drag, shown in Figure 3 is enough.

Left to the slider there are three playback buttons which start and stop an automatic replay with 1x, 2x or 3x of the recording speed. To the right of the slider there are two buttons which jump one frame back and forth from the current position.

Those functions also do have keyboard shortcuts. They are left- and right-arrow keys for navigating frame-by-frame and numbers 1 to 3 for playback.

Below those items are the elements related to frame export. “Set begin” and “Set end” buttons set those values to the currently visible frame. Those are then used in manual export (see 1.5).

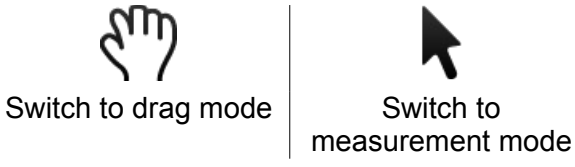
“Quick export” exports the currently visible frame without further need for user input.

1.3.2 Zooming and dragging

To zoom in and out simply place the mouse cursor over the image and turn the mouse wheel up, or down.

Alternatively three buttons from the toolbar can be used:

If the zoom level is high, the image may not fit into the canvas anymore. To move the currently visible part of the image, either the two scrollbars can be moved, or the mouse behavior can be changed.



When in drag mode the image can be dragged around by holding down the left mouse button and moving the mouse. This might be useful while navigating, if the current view is zoomed deeply into the dataset.

1.3.3 Split and merge

Sometimes it is useful to combine multiple recorded data files into one, or split a single file into smaller parts. There are two buttons within the toolbar for this tasks:

Merge

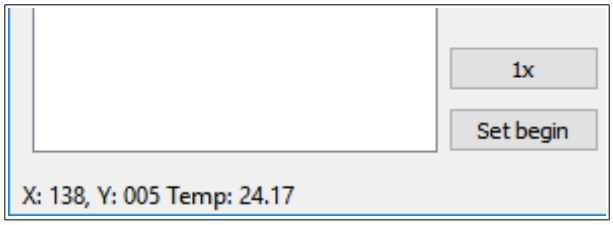
Split

Merge: Opens a dialog where multiple files can be chosen and merged into one single output file.

Split: Splits the currently loaded file starting with the frame defined using the “Set begin” button up to the one defined by “Set end”. After clicking, a file browse dialog appears, where location and name for the new file can be defined.

1.3.4 Temperature reading

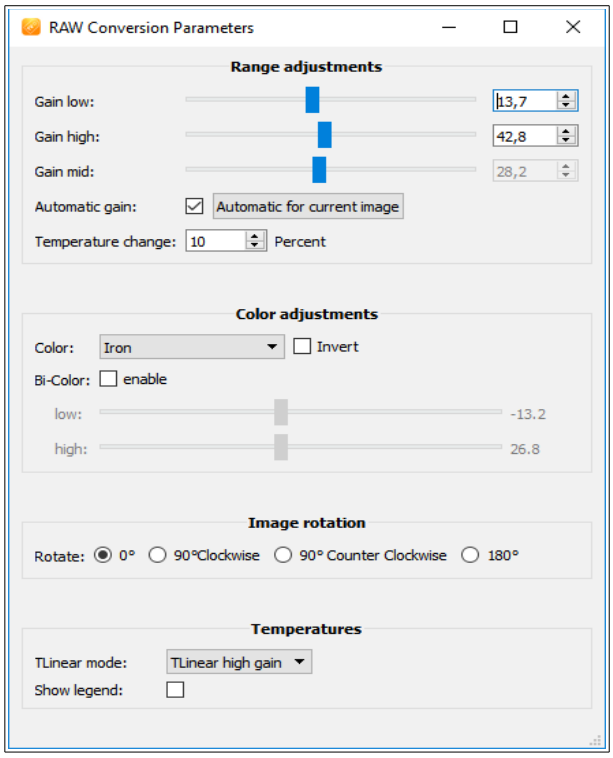
ThermalCapture devices store radiometric data. That means, that for every pixel in every frame, temperature information is available. To determine the temperature of a given pixel, simply move the mouse cursor over the pixel in question. It is recommended to switch the mouse mode to “measurement” to be able to select pixels more accurately. The temperature value is shown together with the pixel position in the lower left corner of the ThermoViewer window.



If instead of the temperature a RAW value is displayed you need to change the “Radiometry” setting. See 1.4.4 how to do this.

1.4 Adjust RAW conversion parameters

In general ThermoViewer uses a built-in algorithm to convert every recorded dataset into a good looking image. But in some cases the user wants to adjust parameters to specific needs in order to highlight details, or to fade out meaningless areas. This section describes the available tools to optimize the results.



1.4.1 Range adjustments

“Gain low” and “Gain high” represent the minimum and maximum temperatures, or RAW values, that are used to produce a false color representation of measured data. In standard settings this values are determined automatically for each frame. If this is not wanted, deselect the “Automatic gain” option. Then these values can be adjusted manually and stay the same for all frames displayed thereafter.

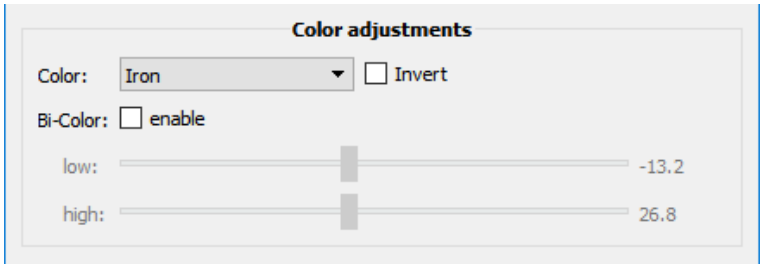
Manual settings are recommended, if recorded data contains a wide range of temperatures, but only a smaller range is of interest. By adjusting the boundaries, objects of interest can be segmented without the need for further post-processing. An example for this is given in Figure 6.

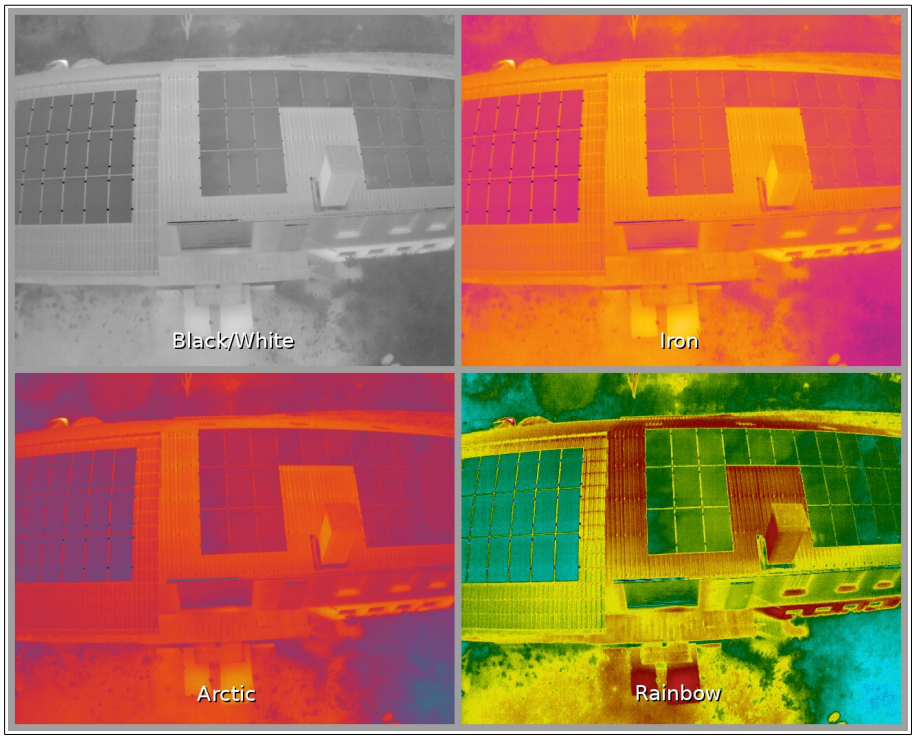
If the data results in flickering representation during automatic playback or after video export, the maximum changes for “Gain low” and “Gain high” from one frame to the next can be delimited. This acts like a low-pass filter for video and playback.

A third slider is “Gain mid”. This one can be used if the temperature span of interest is known, but the absolute temperature values are undefined. In this case the span can be set by “Gain low” and “Gain high” to an arbitrary range. The “Gain mid” slider will place itself automatically in the middle of those two values and changes on this slider, result in a shift of the “Gain low” as well as of the “Gain high” values.

1.4.2 Color adjustments

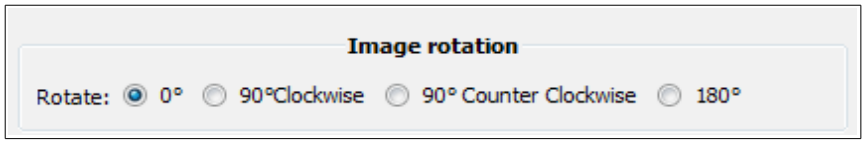
There are four different color palettes available, which all can be inverted for even better adoption to needed results. Figure 7 shows control elements for color adjustments. Figure 8 shows resulting false color images for the same dataset for each of the four color palettes.





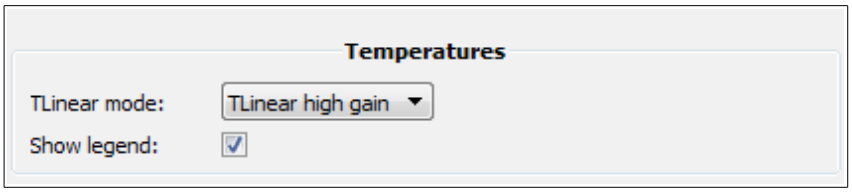
The “Bi-Color” feature allows users to have a subset of recorded data shown in false color representation and all other values outside of this range in grayscale. To make use of this feature the mode has to be enabled by checking the box and then the values of the “low” and “high” slider have to be set to the desired temperature values. Changes are instantaneously visible in the main window to comfortably find the desired result.

1.4.3 Image rotation



Depending on how ThermalCapture is mounted, it may be necessary to rotate recorded data. 90° steps are available.

1.4.4 Temperatures



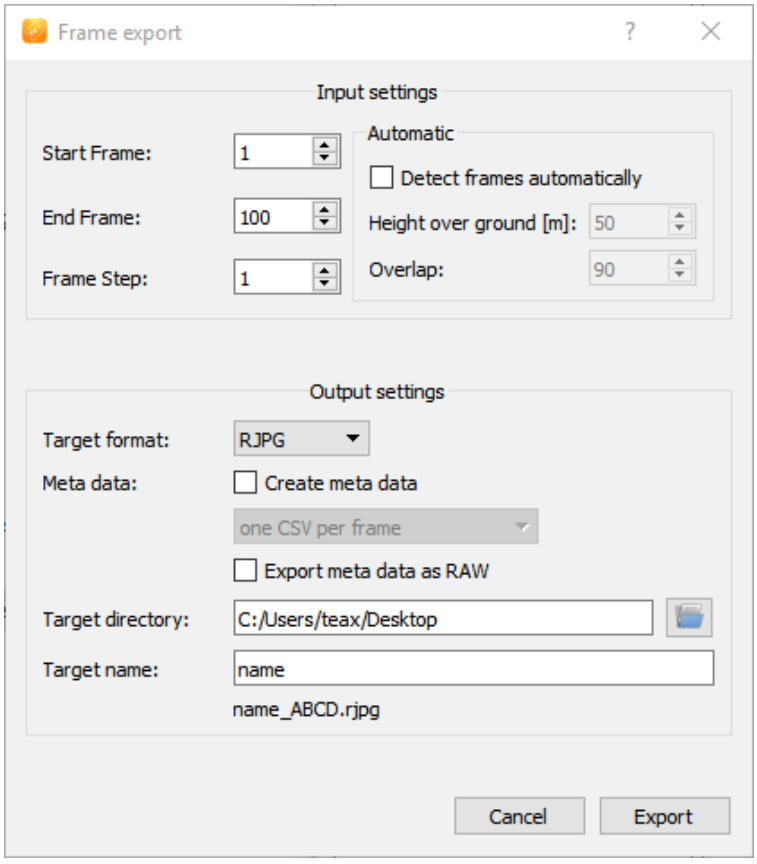
ThermalCapture, respectively the Tau Cores can operate in two different temperature ranges, which are called “High gain” and “Low gain”. In “High gain” mode temperatures between -25°C and +135°C can be measured. “Low gain” mode allows temperatures between -40°C and +550°C to be obtained, but with lower temperature resolution. Settings within ThermoViewer must match settings within the Tau Core to provide valid temperature output.

The “Show legend” checkbox determines, if a temperature scale together, with the minimum and maximum temperature of the scene is placed to the right side of an image, or not.

1.5 Export functions

Data can be exported into several output formats, in order to use them for reports or further post-processing with other software tools. Most requested feature is the compatibility to FLIR software packages like, FLIR Tools(+), or ResearchIR, Tools like Pix4D, Agisoft Photoscan and Icaros OneButton, as well as export into CSV (comma-separated-values) files.

To open the export dialog press the 2nd item from the left within the toolbar, or select the item “Export frames” from the file menu.



In the “Frame export” dialog the user can set all necessary options for the export of single or multiple frames.

1.5.1 Input Settings

The first step is to select frames, which should be exported. The values in the input fields are taken from the main window input fields, but can be adjusted here if needed. Also a “Frame Step” can be defined, which defines, if frames should be interleaved during export. A setting of “1” will execute all frames. A setting of “2” exports every second frame, and so on.

If recorded data is geo-referenced, ThermoViewer can determine needed frames automatically. In order to give appropriate results the “Height over ground” in meters and the wanted “Overlap” in percent have to be entered by the user. This is useful if during recording different flying speeds were used and a regular frame step leads to unwanted gaps in the exported data collection.

1.5.2 Target format

RJPG: 24-bit RGB image with compression; Includes complete radiometric information to be compatible with FLIR software.

PNG: 24-bit RGB image with lossless compression

JPG: 24-bit RGB image with compression

TIF: Single channel 16-bit image without compression. Contains the 14-bit data.

CSV: Comma-separated value file, which contains the RAW measurements, respectively the measured temperature per pixel. Output depends on the temperature settings (page 12) within the RAW conversion parameters dialog (page 9).

AVI: Video in motion JPG format. Settings from the RAW conversion parameters dialog (page 9) are applied.

SEQ: FLIR proprietary format for storing more than one frame in a single file.

Meta_only: Only generates meta data files, without exporting measurement data

1.5.3 Meta data

There is also the option to export meta information together with each frame to have position information. There are three target formats:

CSV: This selection creates either one file per frame, or one file for all frames containing rows for each frame in the following format:

Column	Content
1	Date: DD.MM.YYYY
2	Time: HH.MM.SS
3	Latitude: -180 to +180 decimal degrees
4	Longitude: -180 to +180 decimal degrees
5	Pitch: decimal degrees
6	Roll: decimal degrees
7	Yaw: decimal degrees
8	Altitude above N.N. in meters
9	Number of visible satellites

A third option for CSV is "*one CSV for all frames (Pix4D)*". This creates a file, which is readable by Pix4D in order to have exported data geo-referenced. This feature is rather deprecated, since RJPG and also TIFF files now contain geo-reference data in their EXIF information.

KML: This selection creates a Google Earth compatible output, which places a marker at each position, where a frame is recorded.

RAW: This exports the raw data recorded with each frame into a .DAT file, which can be parsed in post processing.

1.5.4 Filename

Target directory into which the output files will be written can be entered manually into the text field, or can comfortably be selected by opening a file browsing window using the button right besides the input field.

The target name consists of three parts. The first part can be entered by the user. ThermoViewer will automatically add a continuous number to this name and also the extension determined by the selected target format.

1.5.5 Quick export

Once the settings for export are made and further frames with the same settings shall be exported, the Quick export button below the image slider in the main window of ThermoViewer can be used. Every time the button is pressed, the currently visible frame is exported using the settings made before.

1.6 Meta Data Parser

1.6.1 NMEA parser

If a GPS receiver is connected to the serial interface of ThermalCapture Fusion and the device is set up to send NMEA data, then the “Parse NMEA Data” option in Settings menu can be activated. Extracted data from the GPRMC messages is then shown on the right side of ThermoViewer main window.

1.6.2 Mavlink parser

If a Pixhawk, or any other device outputting Mavlink messages, is connected and configured properly this option has to be selected in order to receive geo-referenced data.

Needed settings and messages can be found in our Knowledegebase:
http://thermalcapture.com/support/kb/faq.php?cid=2

1.6.3 microdrones downlink parser

When using a ThermalCapture product, together with a microdrones UAV, the digital downlink data can be stored and parsed in order to receive geo-referenced frames.

1.7 Data enhancement

ThermalCameras are rather prone to changing environmental conditions. In UAV applications, those can not totally be avoided at any time. Therefore ThermoViewer provides methods to minimize the effects using different methods.

1.7.1 Drift compensation

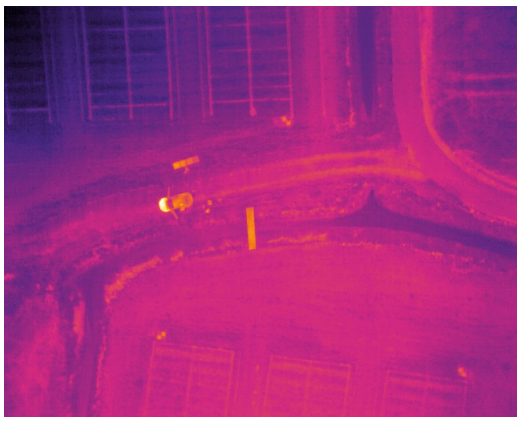
ThermalCapture products are based on FLIR Tau Cores. Those have a built-in shutter in order to calibrate themselves to changes of internal camera parts and of the sensor. This sometimes results in temperature jumps from before to after the so called FFC event (Flat Field Correction).

ThermalCapture detects those FFC events during data acquisition and marks them in recordings. This info can be used in post-processing to even out the effect, which is especially useful if data is further processed into ortho-mosaics.

Drift compensation can be enabled, or disabled within the “Settings” menu.

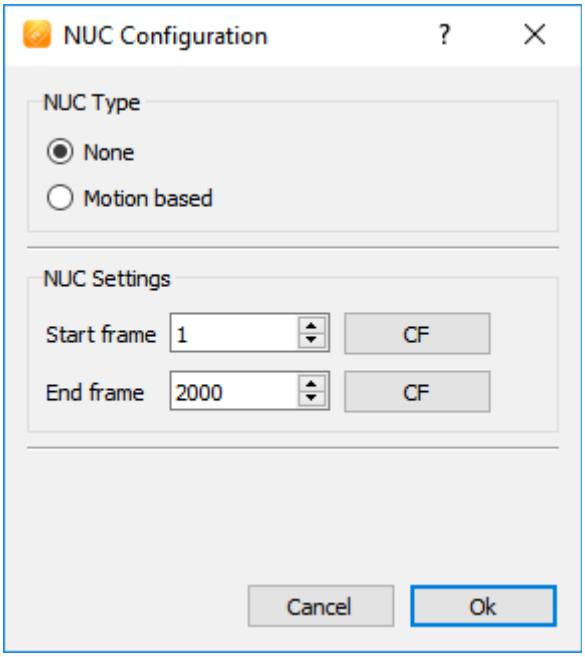
1.7.2 Non Uniformity Correction (NUC)

Every contactless thermal measurement device must be in a thermal equilibrium in order to provide usable data. Due to possibly changing external factors in UAV applications effects like “cold corners” may appear in recordings. An example is given in Figure 13.



Currently one NUC filter is implemented. It needs motion within the frames in order to distinguish constant error from measurement data. Also the temperature distribution should be rather even within the frames that are used for determining the correction mask.

Figure 14 shows the “NUC Configuration” dialog.



1.8 Command line arguments

In order to automate conversion from ThermalCapture data format into different output formats ThermoViewer can be started using command line arguments. All available parameters are listed in Appendix A.

Contact

TeAx Technology UG (haftungsbeschränkt) Hofstädtstr. 8 57234 Wilnsdorf Germany

Internet: http://www.thermal-capture.com/

E-mail: support@teax-tec.de

WEEE: DE47944405

Please provide the following information about the device when you make an inquiry:

• Name and manufacturer of your system

• Item and serial no. of the product

TeAx Technology

Appendix A

Man page of ThermoViewer command line arguments:

```
NAME
      ThermoViewer - Application to process ThermalCapture files

SYNOPSIS
      ThermoViewer [OPTIONS]

OPTIONS
      -c
          Automatically closes the application after processing all given tasks

      -cp palette
          Sets the color palette
          Available are: gray, iron, arctic, rainbow

      -folder path
          Processes all files in given path

      -help
          Displays this help screen

      -i file
          Loads the given file after opening the application

      -ic
          Enables color inversion

      -exef number
          Sets export ending frame to number

      -exfn name
          Sets the name prefix for exported files to name

      -exfo <format>
          Sets the export format
          Available are: png, jpg, tif, avi, csv, rjpg

      -expa path
          Sets the directory to which exports are written to path

      -exsf number
          Sets export starting frame to number

      -exmeta <type>
          Set the ouput format for meta data. If ommited, no meta data will be written
          Available options are:
              CSVpf - One CSV per frame
              CSVfa - One CSV for all frames
              Pix4D - One CSV for all frames, Pix4D compatible
              KML   - One .kml for all frames
              RAW   - Binary raw data
```

```
      -fs number
          Sets the frame step between two exported frames, standard is 1 (2 will
          result in every secondth frame exported)

      -merge <fileList>
          Merges all files from fileList into file specified by -exfn parameter
          IMPORTANT: -merge must be the last parameter follwed only by TMC filenames

      -pix4d
          Exports to TIF files and generates meta data file ready for Pix4D processing
          Overwrites -exfo and -exmeta settings

      -tl format
          T Linear settings
          Available are: none, high, low
              high = Tau core is in high gain mode
              low  = Tau core is in low gain mode

      -ltt temperature
          Sets lower temperature threshold for conversion

      -utt temperature
          Sets upper temperature threshold for conversion

      -l
          Adds a legend to the exported image

      -r degree
          Rotates the input frames. Supported degrees are 0, 90, 180, 270.

      -serial <type>
          Sets the type of serial data in order to do right parsing
          Available are: nmea, mavlink, md

      -driftcomp
          Activates drift compensation

      -nuc <startFrame> <endFrame>
          Activates non uniformity correction
          Frames between startFrame and endFrame are used to estimate correction mask

EXAMPLE #1
           ThermoViewer -i /home/thamke/Desktop/00000001.TMC -r 180 -l -cp iron -expa
/home/thamke/Desktop/ -exfn image -exfo jpg -exsf 42 -exef 42 -c
          * Opens the file '/home/thamke/Desktop/00000001.TMC'
          * Rotates the output by 180 degrees
          * Adds a legend to the image
          * Sets the color palette to iron
          * Set the export directory to '/home/thamke/Desktop/'
          * Sets the file prefix to 'image'
          * Sets the export format to 'jpg'
          * Sets the start frame to 42
          * Sets the end frame to 42
          * Closes the application after export

EXAMPLE #2
     ThermoViewer -exfn result.TMC -merge 1.TMC 2.TMC 3.TMC
```