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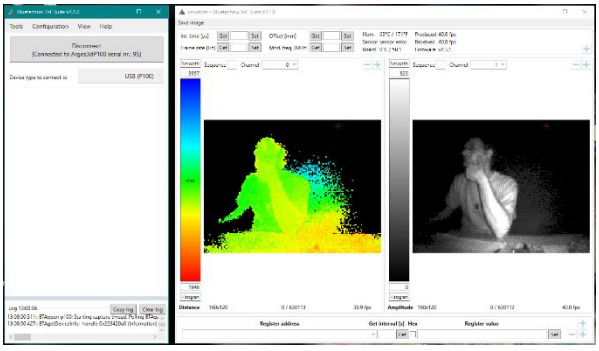
Bluetechnix ToF Suite v4.1



Software User Manual

Version 1

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Bluetechnix ToF Suite – Software User Manual

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Information

For further information on technology, delivery terms and conditions and prices please contact Bluetechnix (http://www.bluetechnix.com).

Warning

Due to technical requirements components may contain dangerous substances.

1 General Information

This guide applies to the USB and Ethernet based 3D camera products from Bluetechnix GmbH, referred to as ‘sensor’ throughout this document. Follow this guide chapter by chapter to set up, understand and use your product.

This document is focused on the Application BltTofSuite. Please refer to the corresponding manuals of your device before installing and powering any device.

2 Introduction

2.1 Dependencies

The Bluetechnix ToF Suite requires:

- .NET framework 4.6
- Visual C++ Redistributable for Visual Studio 2015

The software can be downloaded from the Microsoft homepage.

2.2 Setup for Ethernet devices

- On your Windows PC, change your network adapter settings:
  - IP address: 192.168.0.1
  - Subnet mask: 255.255.255.0
- Use the Ethernet cable to connect the sensor device with your PC
- Power the sensor device as described in the manual

2.3 Setup for USB modules

- Install the driver as described in the device's quick start guide
- Power the sensor device as described in the manual

3 Using the Software

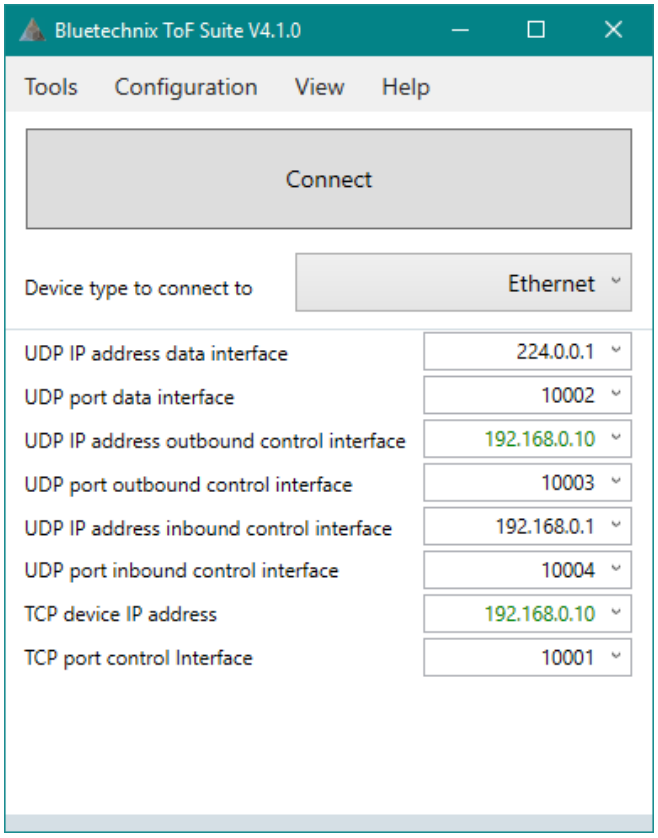
Start the application by executing the BltTofSuite.exe.

3.1 Connect to the sensor

This window connects to a sensor using the Bluetechnix ToF API (BltTofApi.dll). The connection is then shared with all other tools such as Visualizer, Model3d and Downloader.

If you want to use the expert mode and specify more connection parameters, please read the BltTofApi's user manual. There is a section explaining the elements of BTA_Config which are all represented in the main window in expert mode. Find the "BltTofApi v2.1 UM.pdf" here: https://support.bluetechnix.at/wiki/.

3.1.1 Ethernet connection

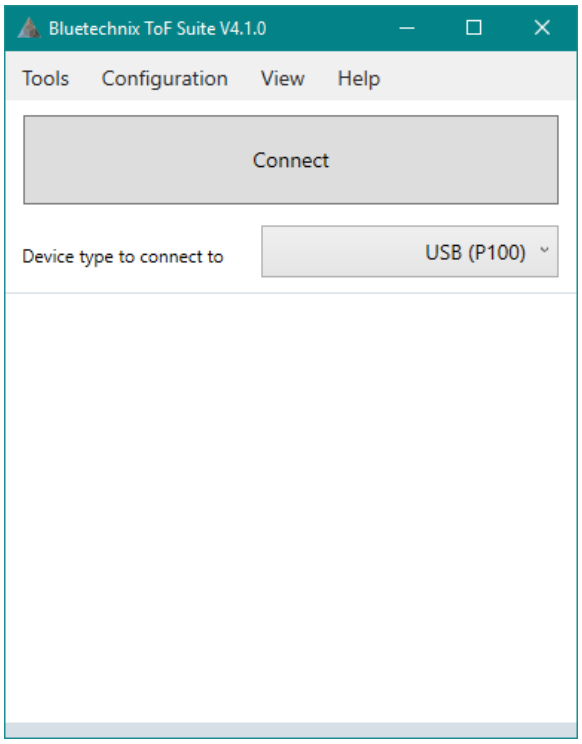


The data stream is read over UDP, the control interface is accessed over TCP or UDP

- Enter IP addresses and ports as configured on the sensor
- Press 'Connect'
- The 'Device IP address' is green if pingable and red if not
- When connecting to TCP control interface, the UDP control parameters can/should be left out and vice versa

- For more information on (expert) configuration parameters, please refer to the BltTofApi documentation on our support wiki

3.1.2 USB connection



- For more information on (expert) configuration parameters, please refer to the BltTofApi documentation on our support wiki

3.2 Overview

3.2.1 Coordinate system

The sensor data and visualization use the following coordinate system

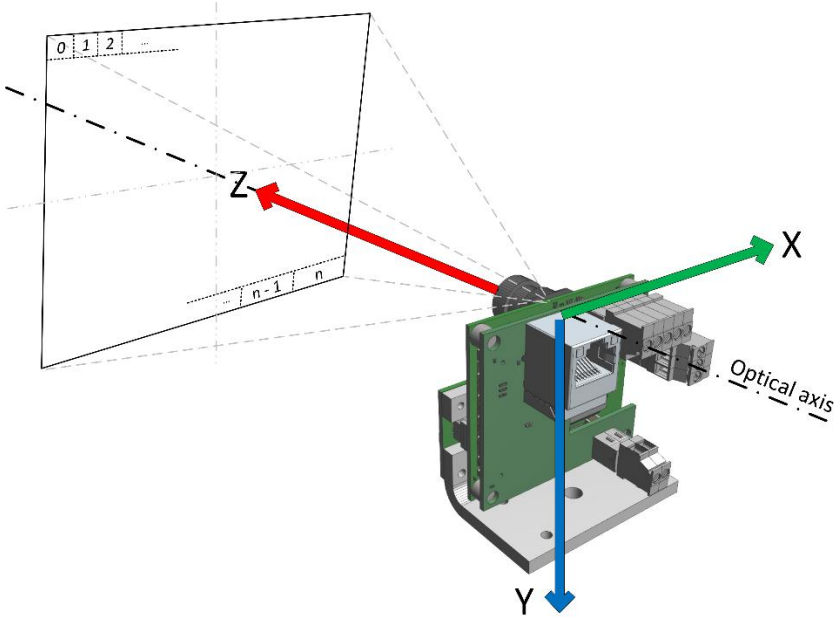


Figure 1: ToF coordinate system (here with a Sentins-ToF-M100)

The ToF device specific coordinate system orientation and origin can be found in its corresponding hardware user manual.

3.2.2 Menu

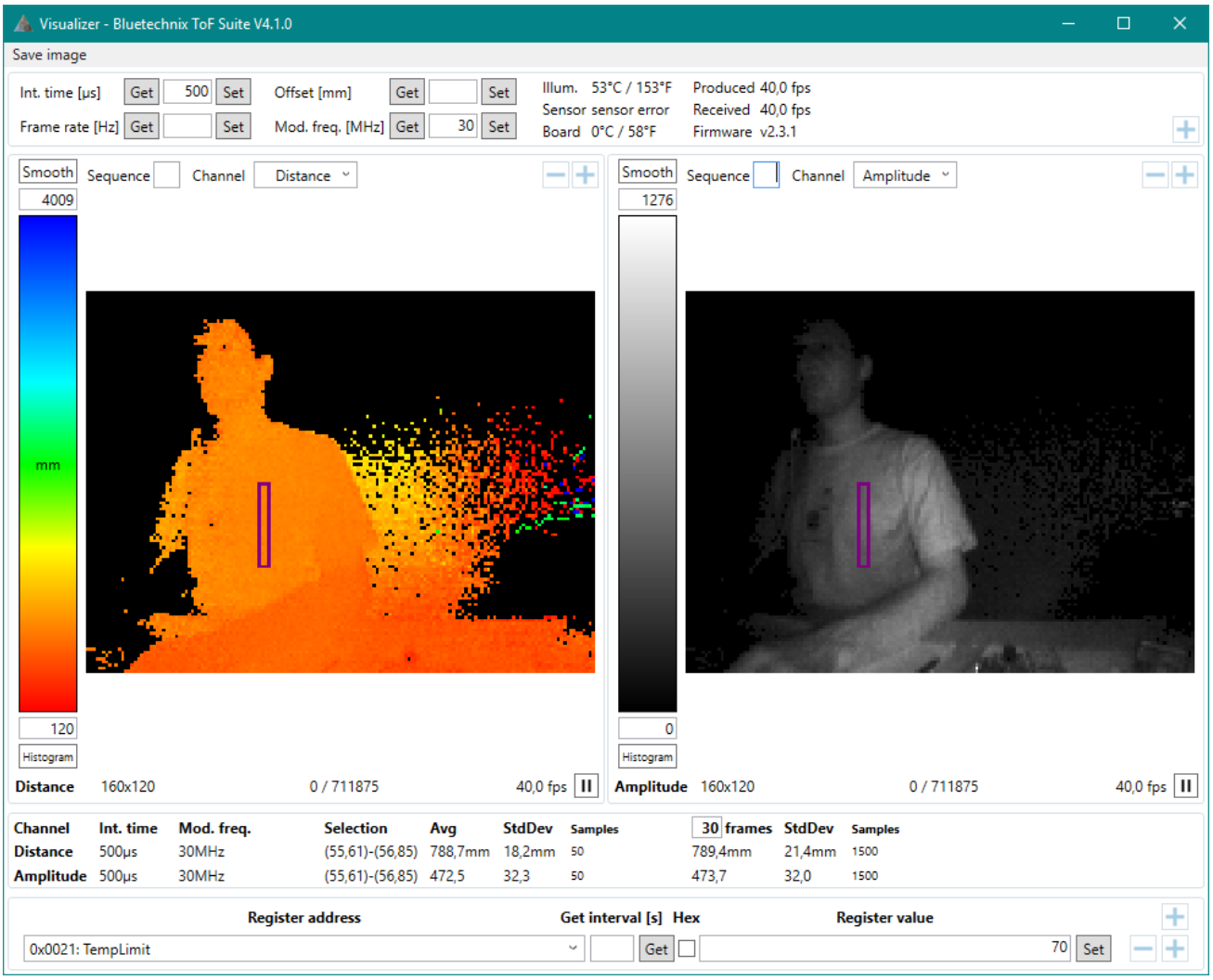
A list of the menu bar in the main window and their short description:

- Tools
  - Visualizer: It is opened automatically. In expert mode you can open more than one. Continue reading section 3.2.3.
  - Model3d: It shows the 3D point cloud and lets you visualize the model from any angle. Continue reading section 3.2.4.
  - Observer: A tool for observing register values. No documentation or support for this tool is provided at this time.
  - Downloader: It is used mainly for firmware updates. Continue reading section 3.2.5.
- Configuration
  - Frame mode: Please refer to section 3.4.
  - Save registers permanently: Please refer to section 3.7.
  - Restore default registers: Please refer to section 3.7
  - Reset device: Uses the API call BTAsendReset() in order to reset the device.
  - Mirror data at Y-Z plane: Please refer to section 3.5.
  - Rotate data 180° around Z-axis: Please refer to section 3.5.
  - Start device discovery: No documentation or support for this tool is provided at this time.
  - Stop device discovery: No documentation or support for this tool is provided at this time.

- Register values from device to file: Please refer to section 3.8.
- Register values from file to device: Please refer to section 3.8.
- Show camera information: Important information such as connection details and firmware version.

- View
  - Demo mode: Only basic visual elements are shown and the interactive elements are reduced to a minimum
  - Simple mode: Only basic functionality is exposed so the user can focus on the basic setup
  - Expert mode: Advances features and tools can only be used if switched to this view
    certain functionalities are only available in expert mode!
- Help
  - Help: Get some information about the different controls.
  - BltTofApi library version: Show the version information of the dynamically loaded BltTofApi.dll.
  - Online support: Opens the web page for support
  - Bluetechnix homepage: Opens the Bluetechnix main web page
  - About: About this version of BltTofSuite

3.2.3 Visualizer



The uppermost box (not visible in demo mode) lets you retrieve and change the main configuration parameters integration time, frame rate, offset and modulation frequency. Displayed on the right, you see the information received from the data interface (frame header).

The second box shows sensor data in 2D. You can change the sequence and the channel to be displayed. You can change the color scale by right clicking on it or directly modify the values above and below the scale. By clicking or dragging in the image you can select pixel(s) for analysis (right click for deselect).

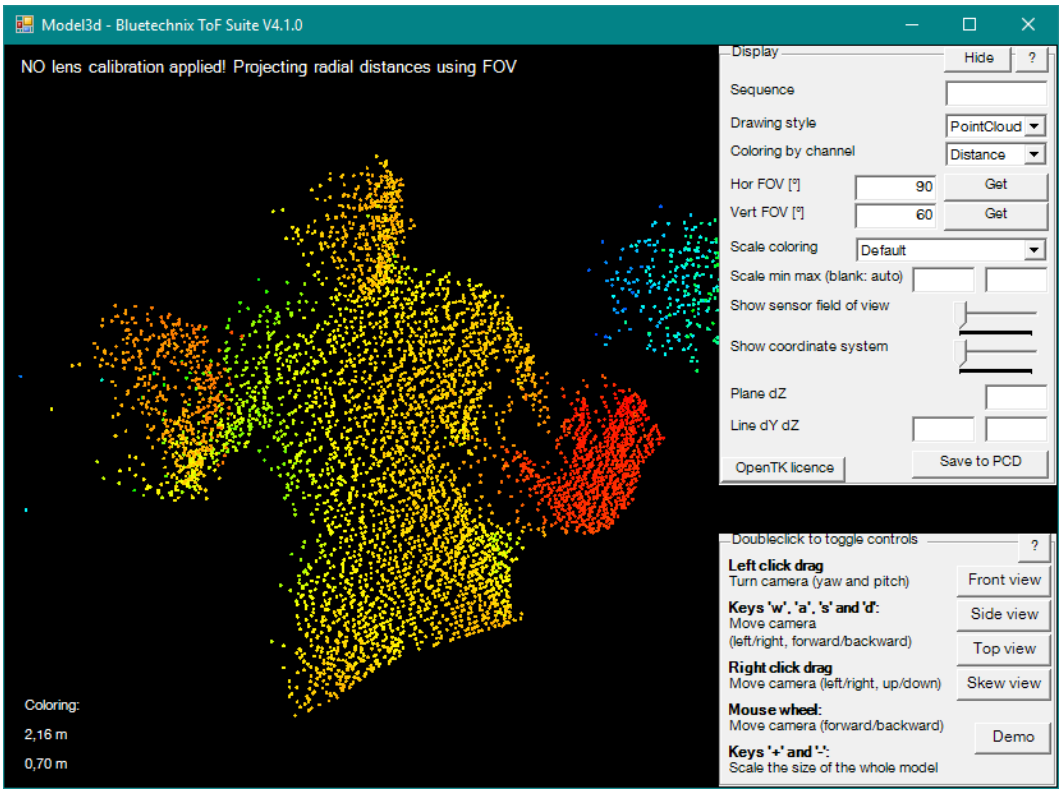
Clicking on  will open an additional image view which allows to analyse an additional sequence/channel.

Clicking on removes an image view.

The third box (not visible in simple or demo mode) lists values for each channel if pixels are selected as described above. The right columns also average over time (x frames as specified).

At the bottom there is a box (not visible in demo mode) for reading and writing registers. Please refer to section 3.3.

3.2.4 Model3d



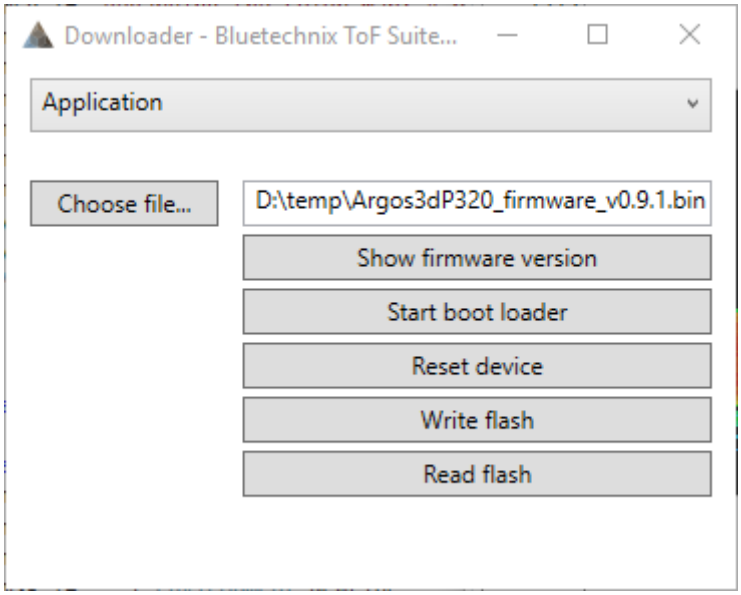
This tool can show the sensor data modelled in 3D. Modelling can be configured:

- The controls can be shown and hidden by double clicking on the image.
- Sequence: If you enter a number only the frames matching that sequence are displayed.
- Drawing style: Choose how each pixel is modelled and/or connected to the others.
- Coloring by channel: Let's you choose based on which channel the pixels are colored.
- Horizontal / vertical field of view: If there is no Cartesian pixel data applicable, these field of view values are used to project the radial distance data.
- Scale coloring: Choose a color palette for the color scale.
- You can adjust the color scale for the cloud's points. I.e. the min/max values based on which the color of a pixel is calculated
- Show sensor field of view: The sensor's field of view is indicated by a pyramid, showing the opening angles of the sensor. The opening angles are read from the sensor's corresponding registers.
- Show coordinate system: Activating this switch shows three white lines representing the coordinate system.

Navigation in the 3D virtual world is described in section 3.6.

For more detailed help, please click on one of the many question mark buttons or contact Bluetechnix support.

3.2.5 Downloader



This tool lets you access the flash memory of the sensor in various ways. Not all devices support all the options that are available.

- Drop down list: Choose the desired operation. Based on that selection you have to configure the flash write process.
- Show firmware version: Calls BTAgetdeviceInfo() of the Bluetechnix ToF API and shows some of that info.
- Start bootloader: Writes the register issuing some devices to reboot into bootloader mode.
- Reset device: Calls BTAsendReset() of the Bluetechnix ToF API issuing the sensor to reboot if it supports it.

Firmware update instructions are in section 3.10.

3.3 Reading and writing registers

The register fields in the Visualizer process register values and interpret them for the user. There are special cases to consider:

Multiple values: If a register contains more than one value, they are printed individually separated by spaces. For example:

0047	RgbLedColor	RGB565 color value of RGB LED Bit[0:4]… B Bit[5:10]… G Bit[11:15]… R

Scaling: If a register can't hold its value in SI units, it is scaled. For example:

0024	MaxLedTemp	Maximum tolerable LED-Board temperature 0,01[°C]

Read example 1:

- Select the RgbLedColor register via the drop down menu or enter "0x47", "71" or "RgbLedColor"
- Uncheck 'Hex' and click 'Get'. The output is something like "0 63 0" (interpreted values separated by spaces)
- Check 'Hex' and click 'Get'. The output is "0x7e0" (raw value)

Read example 2:

- Select the MaxLedTemp register via the drop down menu or enter "0x24", "36" or "MaxLedTemp"
- Uncheck 'Hex' and click 'Get'. The output is something like "90" (interpreted value in degree Celsius)
- Check 'Hex' and click 'Get'. The output is "0x2328" (raw value)

Write example 1:

- Select the RgbLedColor register via the drop down menu or enter "0x47", "71" or "RgbLedColor"
- Enter 'Register Value' "2 0 2" and click 'Set' or
- Enter 'Register value' "0x1002" and click 'Set' ('Hex' checkbox is irrelevant)

Write example 2:

- Select the MaxLedTemp register via the drop down menu or enter "0x24", "36" or "MaxLedTemp"
- Enter 'Register value' "80,5" and click 'Set' or
- Enter 'Register value' "0x1f72" and click 'Set' ('Hex' checkbox is irrelevant)

When hovering the mouse over 'Register value', a description of the register is shown.

Read repeatedly example:

- Select any register or register address (for example "MainBoardTemp")
- Enter 'Get interval [s]' "0,5" or "2" or any valid amount of seconds
- The read value is updated periodically

3.4 Changing the frame's format (frame mode)

The ToF cameras are able to deliver a variety of kinds of data. A frame contains one or more channels of data. The default setting is the frame mode DistAmp, meaning that a frame consists of two channels: radial distance data and amplitude data. From the main window under the menu item 'Configuration' → 'Frame mode' the user can choose from combinations of the following channels:

- Distance: Radial distance data
- Amplitude: Strength of signal
- X, Y, Z: Cartesian coordinates
- Flags: Additional information about the data
- Color: RGB data
- Intensities: Monochrome data
- Phase0, Phase90, Phase180, Phase270: Raw phase data
- Phase: Raw radial distance data

The frame mode CurrentConfig does not alter the camera configuration, and makes the SDK forward all channels. So, if you choose to make any related changes via register settings, use the frame mode CurrentConfig.

3.5 Mirror and flip sensor data

Please refer to the coordinate system in section 3.2.1.
Via the menu 'Configuration' the user can alter the camera data to best fit the camera installation. Like this the camera can be installed head-down for example.

3.6 Navigation in Model3d

Please note that all interactions manipulate your point of view (denoted by 'viewpoint') instead of turning or moving the point cloud. The fastest way to navigate is to hold down the left mouse button and use w, a, s and d on the keyboard. Like this the user can move in the scene like in a first person video game.

- When the graphics pane has focus the user can press:
  - W and S in order to move the viewpoint forwards and backwards.
  - A and D in order to move the viewpoint sideways (as in stepping left or right).
- Click somewhere (doesn't matter where) in the window, hold the mouse button and move the mouse:
  - Up and down in order to pitch the viewpoint (look up and down).
  - Left and right in order to yaw the viewpoint (look left and right).
- Right-click somewhere (doesn't matter where) in the window, hold the mouse button and move the mouse:
  - Up and down in order to elevate and lower the viewpoint (as in jumping and crouching).
  - Left and right in order to move the viewpoint sideways (as in stepping left or right).
- Scroll the mouse wheel in order to move the viewpoint forwards and backwards.
- Press + and – on the keyboard in order to scale the model. A big model can be scaled down in order to fit in the scene. A small model can be scaled up in order to better be able to examine details.

3.7 Saving / restoring default register map to / from device flash

Via 'Configuration' → 'Save registers permanently' the register configuration made by the user on writable registers is stored in the devices internal flash. On any subsequent reboot that configuration is loaded as initial state.

Via 'Configuration' → 'Restore default registers' the factory default settings are restored by erasing any previously saved register configuration. On any subsequent reboot that default configuration is loaded as initial state.

3.8 Saving / restoring register map to / from file

The complete register map can be saved to a file by clicking on 'Configuration' → 'Register values from device to file'. This is not a file intended to store a state that can be restored because it also writes read-only registers into the file. It provides very important information describing the device's state.

The feature 'Configuration' → 'Register values from file to device' can be used to easily write a set of registers. We strongly advice to only use this function if you know what you are doing or if Bluetechnix provides the file.

3.9 Capturing and playback of bltstream files

When in expert mode, there appears a Textbox and two buttons 'Browse' and 'Start grabbing frames'. Once you selected a file you can click on 'Start grabbing frames' in order to write all data received from the camera into that file. The UDP stream is grabbed as is including timing information.

Having the bltstream file allows you to replay the recorded scene exactly as it was recorded. Select 'Device type to connect to': 'Bltstream file'. Now you can insert or browse for the 'Bluetechnix stream filename'. A click on 'Connect' opens the file as it was a Bluetechnix camera and streaming from the file starts. Playback can be controlled with the buttons 'Play/Pause', 'Prev', 'Next', 'Replay', '<<' (slower playback) and '>>' (faster playback).
Depending on the bltstream file version the amount of available frames is known and the slider can be used to jump ahead in the stream.

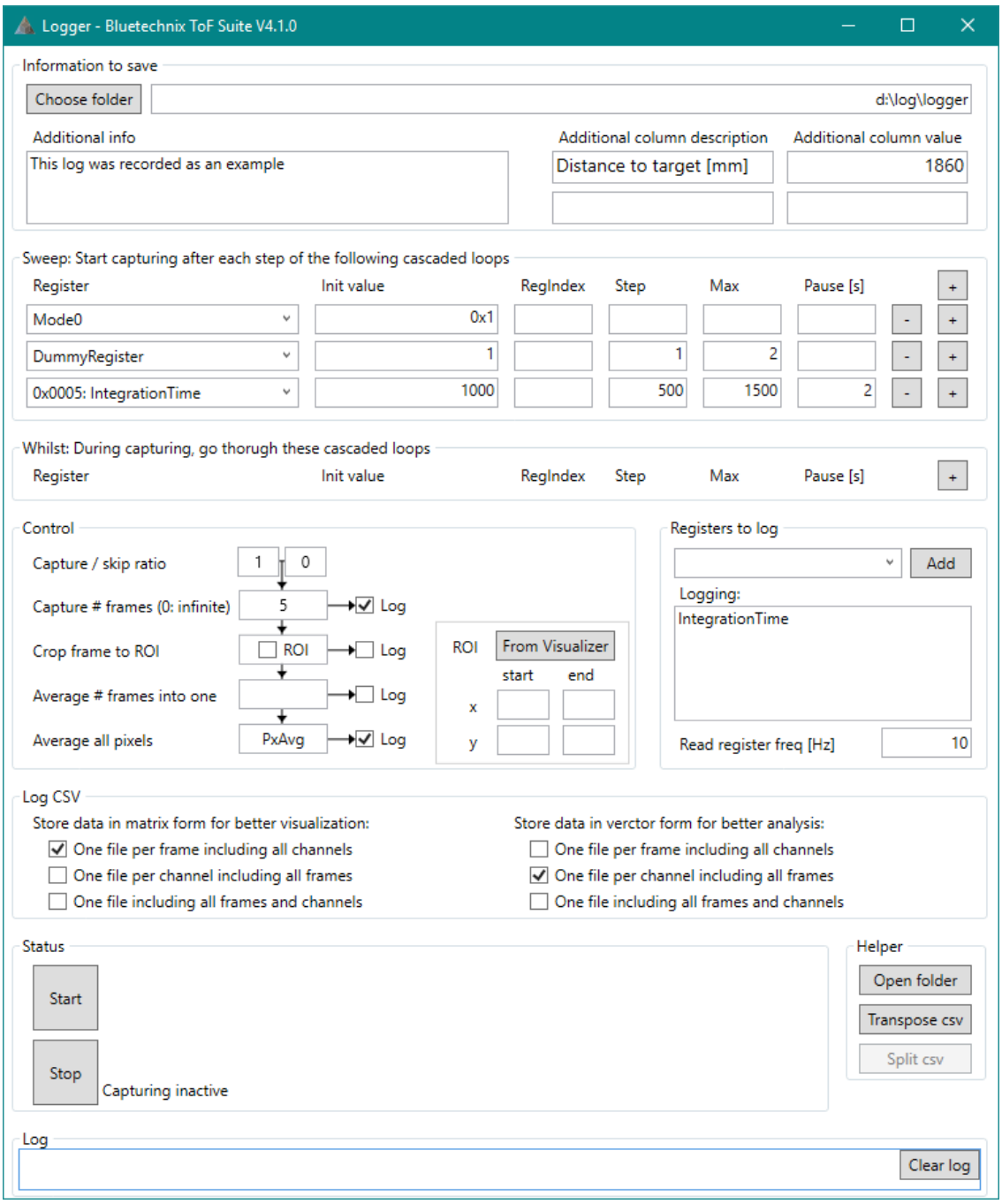
3.10 Firmware update

Whenever a firmware update for your camera is available you can use 'Tools' → 'Downloader' for updating:

- From the combo box choose 'Application'.
- Select the firmware file provided by Bluetechnix.
- If your device needs to be in bootloader mode for updating, click 'Start bootloader'. (If the device has different connection parameters in bootloader mode you need to reconnect to it with those parameters)
- Click 'Write flash'
- Click 'Reset device'

3.11 Using the Logger

The Logger is an advanced tool for deeper analysis of ToF data. It is found in the “Tools” menu if “BltTofDevelopment.dll” is included in the release.



Information to save

The user must select a folder where the log files can be saved. The section ‘Additional info’ is optional. The Text will be stored in the header section of each log file. The two ‘Additional column description’ and ‘value’ are also optional and they are logged just as ToF data or register values. In the example it is used to store the distance from camera to target, in order to be able to compare the value with measured values.

Sweep

This section is for automatically repeating a log with various register configurations.
Register: The register to be manipulated.

- **Init value**: This value is written as initialization. If the register consists of more than one value they must be provided separated by spaces. Alternatively the raw value in hex with prefix '0x' can be used.
- **RegIndex**: If the register consists of more than one value, the user can address a specific register value. If this is left empty and 'Step' and 'Max' are given in decimal values, then index 0 is used automatically. If this is left empty and 'Step' and 'Max' are given in raw values (prefix '0x'), then the register is always written with raw values. If an index is given, then the 'Step' and 'Max' must be in decimal value and only that part of the register is modified (including scaling as discussed in section 3.3).
- **Step**: This value is added to the initial value at every cycle.
- **Max**: The loop stops when this value is exceeded.
- **Pause**: After the register write operation a pause is taken (Or not if left empty).

When using decimal values for 'Step' and 'Max', bear in mind that every write operation is calculated by taking the 'Init value' and applying the 'Step' with the (default) 'RegIndex'.

The example in the image results in a sequence like described in below pseudo code:

```
Mode1 = 0x1
for (DummyRegister = 1; DummyRegister <= 2; DummyRegister += 1) {
    for (IntegrationTime = 1000; IntegrationTime <= 1500; IntegrationTime += 500) {
        Sleep 2.0 seconds
        Capturing and logging as defined in section 'Conrol'
    }
}
```

Whilst

This section is for manipulating registers while capturing frames is in progress. The input fields work the same way as in 'Sweep' above.
A typical use case is when operating the camera in manual trigger mode. The triggering of new frames via register is handled here, and the Logger captures the frame immediately.

Control

- **Capture / skip ratio**: In the left box enter the number of frames to capture after which the number of frames in the right box are skipped. "1 / 1" for example results in every second frame to be dropped and not taken into consideration for logging.
- **Capture # frames (0: infinite)**: The capturing process automatically stops after given number of frames. If necessary the next step of "Sweep" is begun. An ongoing "Whilst" operation is interrupted and aborted. When choosing infinite logging, it is not possible to do a "Sweep", obviously.

- **Crop frame to ROI**: In this step of the processing chain the frame can be cropped to a certain region of interest. The upper left and the lower right corner have to be set in the boxes framed right to the right.

  Average # frames into one: Several frames can be averaged. Like this the user can achieve averaging over time. Averaging several frames over a certain period of time is advisable when working with still targets. A moving target will produce motion artifacts. Leaving the box empty or entering “0” or “1” will disable averaging.
- **Average all pixels**: This step in the chain averages all pixels into one. It is useful when ROI is enabled for, say, the four centre pixels (as an example).

Registers to log

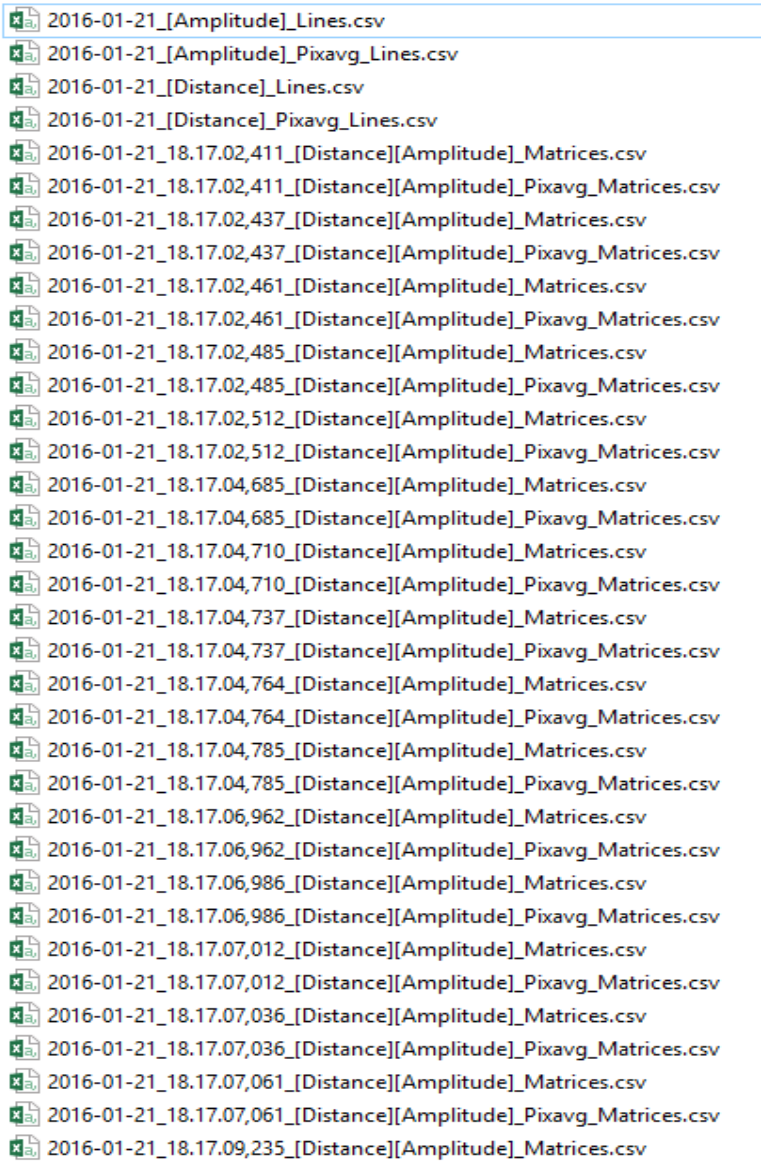
This section is for logging register values with the frames. The registers in the box below “Logging:” are read frequently with a rate given in “Read register freq [Hz]” and when a frame is logged, that lastly read value of the register(s) is logged with the frame.

Log CSV

Choose what files are written and how their content should be formed:

- **Store data in matrix form for better visualization**: This type of logging stores pixel data as is in a two dimensional array. By coloring the data it can be looked on like in the visualizer. Pixels can be located by column and row.
- **Store data in vector form for better analysis**: This type of logging stores all the pixels in one single line. As each line represents a complete set of data, it is easier to compare/separate samples among each other or to apply mathematic operations.
- **One file per frame including all channels**: If this option is enabled, each frame with all its channels is stored in its own file. There will be as many files as frames were captured.
- **One file per channel including all frames**: If this option is enabled, each channel is stored in its own file. In DistAmp frame mode for example there are two files. One for distances and one for amplitudes. Those files contain all the frames captured. There will be as many files as different channels.
- **One file including all frames and channels**: If this option is enabled, all the data is stored in a single file.

The example in the image creates the following CSV files:



The first four files are the result from “One file per channel including all frames”, where the files with “Pixavg” in them consist of one pixel only (average of all pixels). The standard deviation is stored as well.
The rest of the files were generated with “One file per frame including all channels”. The files with “Pixavg” in them contain an average distance value and an average amplitude value, each with standard deviation. The files without “Pixavg” in their name contain each one full DistAmp image.

Status

Start and stop (abort) the logging process. This area also informs about the current status of logging.

4 Recommended Documents

The “BltTofApi user manual” describes the underlying SDK used to access the device. It is the recommended reading for a better understanding of the Software and its usage:

https://support.bluetechnix.at/wiki/Bluetechnix_ToF_API_v2

5 Appendix

5.1 Support

5.1.1 General Support

General support for products can be found at Bluetechnix' support site

Support Link

https://support.bluetechnix.at/wiki

6 Document Revision History

Version	Date	Document Revision
1	2016 01 13	Document created

Table 6-1: Revision history