CelePixel SDK User Manual

CelePixel Technology Co. Ltd.

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1 CeleX Demo Kit Hardware

Please install the chipset in the following order:

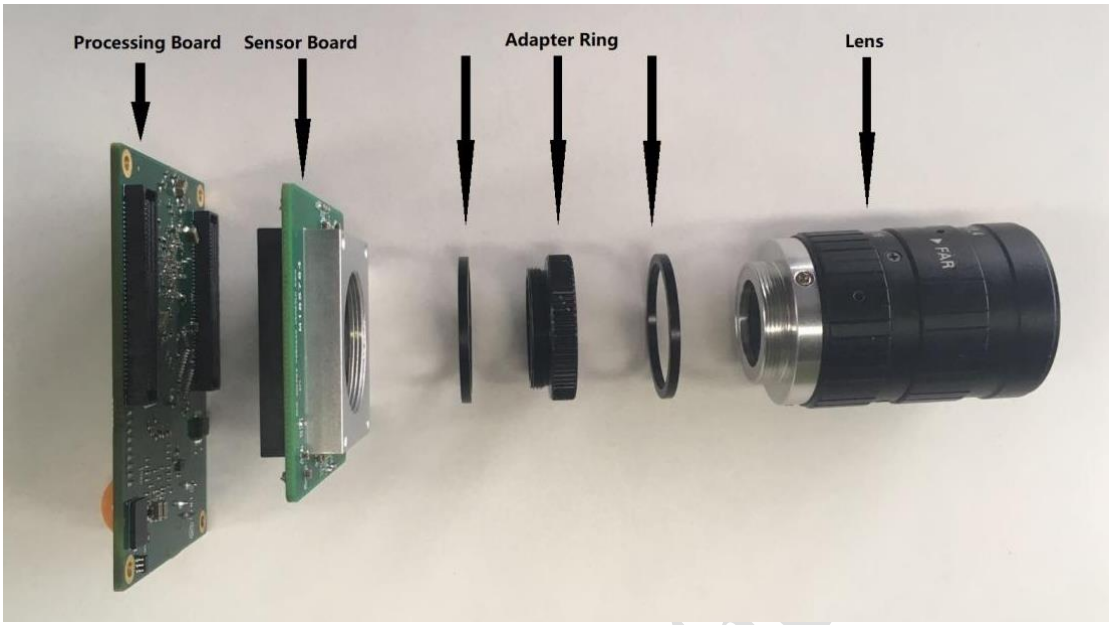


Fig. 1-1

Note: Do remember to put the adapter ring properly, for a good focus. (If NO adaptor ring, please ignore them during installation)

(1) Power Supply for OpalKelly XEM6310 processing board:

The XEM6310 requires that this supply be clean, filtered, and within the range of 4.5v to 5.5v. This supply must be delivered through the +VDC pins on the two device's two expansion connectors or the DC power connector. The DC power connector on the XEM6310 is part number PJ-102AH from CUI, Inc. It is a standard "canon-style" 2.1mm / 5.5mm jack. The outer ring is connected to DGND. The center pin is connected to +VDC.

It can also be USB3.0 port on the PC.

Note: Do NOT connect the processing board to any kind of power supply that produce output voltage above 5V, which will damage the board components presently.

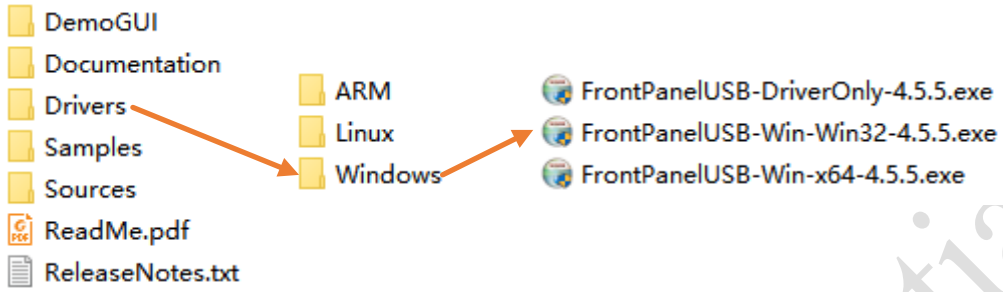
(2) Data line must connect with USB3.0 port on the PC, as USB2.0 would slow down the speed of transferring data.

2 User Steps of Demo Kit SDK

2.1 Install the Opal Kelly Driver

2.1.1 Windows

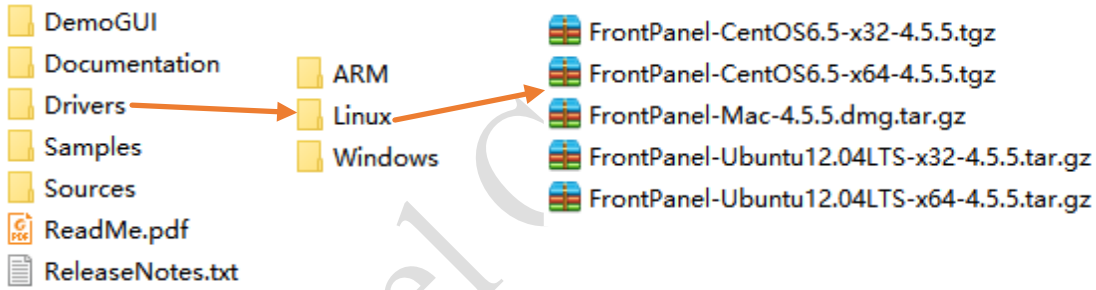
Please install the Opal Kelly driver from following folder:



You could choose one of these drivers to install according to the platform system.

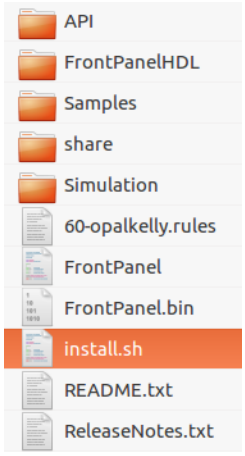
2.1.2 Linux

Please install the Opal Kelly driver from following folder:



You can choose one of these drivers to install according to the platform system.

For Ubuntu 16.04LTS-x64, choose *FrontPanel-Ubuntu12.04LTS-x64-4.5.5.tar.gz*, after extracting, users will see the following five files:



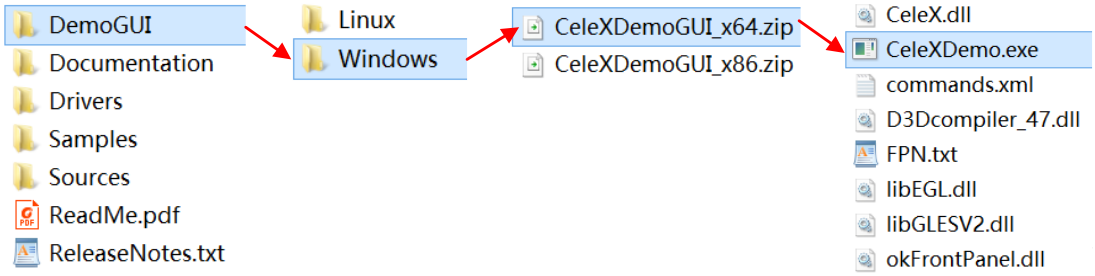
Open the terminal, enter the directory where install.sh is located, and input the following command to install the driver:

```
sudo sh ./install.sh
```

2.2 Run CeleX Demo GUI

2.2.1 Windows

After installing the Driver, user could open the Demo GUI from following folder:

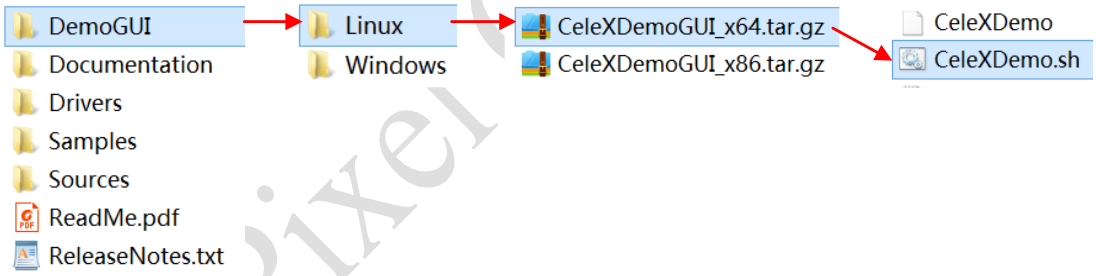


Double-click "CeleXDemo.exe" to open the CeleX Demo GUI, as shown in Figure 3-2 in Chapter 3.

Note: If the software cannot be opened and some windows message box popped out saying some dynamic library files was missing, which may be caused by lacking of Visual C++ supporting package. You can install the “vc_redist.x86.exe” under the folder *<Drives/Windows>* and try it again, the software should be working properly.

2.2.2 Linux

After installing the Driver, user could open the Demo GUI from following folder:



Open a terminal and enter the following command to open the Demo GUI，as shown in Figure 3-2 in Chapter 3.

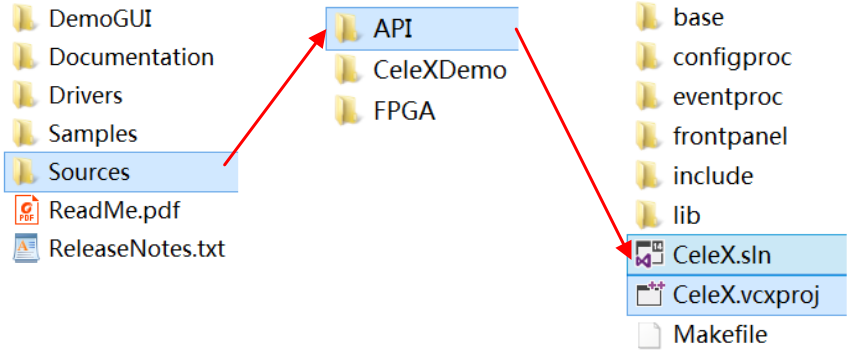
```
$ sh CeleXDemo.sh
```

2.3 Compile CeleX Library Source Code

The OpenCV library (Version 3.3.0) is involved in the CeleX API to develop some interfaces, so you need to install OpenCV and configure its development environment before compiling the source code of CeleX library.

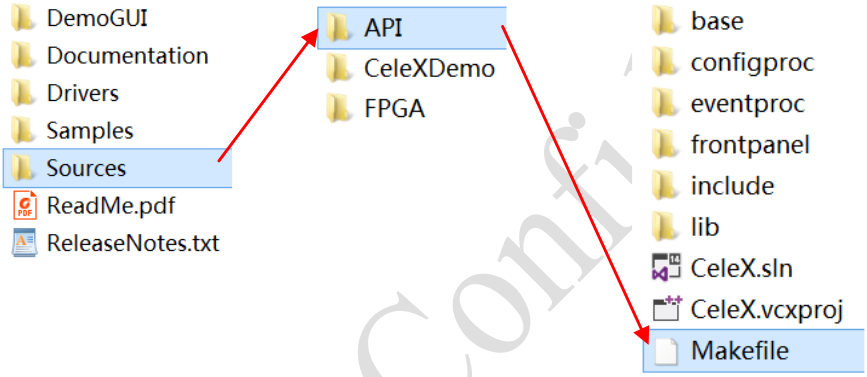
2.3.1 Windows

On the Windows platform, a VS2015 project file is provided to compile the source code, and the build library (CeleX.dll and CeleX.lib) will be imported into the directory *build/Windows*.



2.3.2 Linux

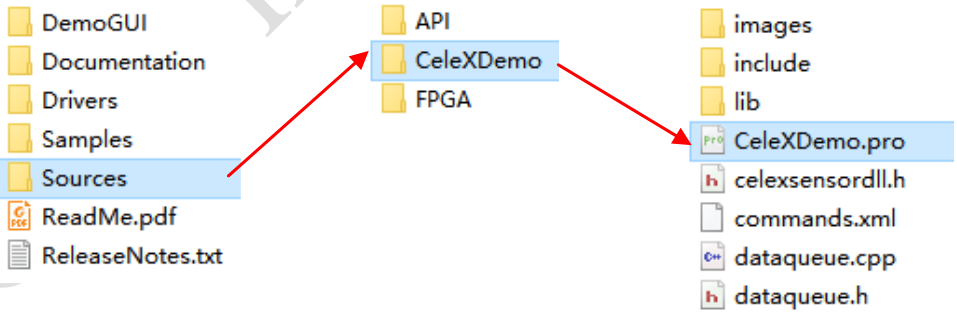
On the Linux platform, a Makefile is provided to compile the source code, and the shared library (libCeleX.so) will be generated in the current directory.



2.4 Compile Source Code of CeleX Demo GUI

Development Environment： Qt5.6.3 + OpenCV3.3.0

You could open the project in the following directory and compile it using Qt Creator easily.



Notes: It needs to modify the INCLUDEPATH and LIBS of OpenCV in the file *CeleXDemo.pro*.

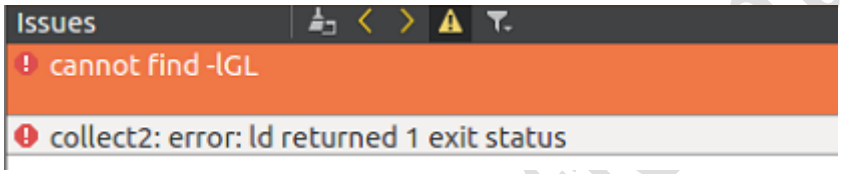
```
win32 {
    INCLUDEPATH += D:/opencv/build/include \
                   D:/Program Files/opencv/build/include/opencv \
                   D:/Program Files/opencv/build/include/opencv2
}
else {

    INCLUDEPATH += /usr/local/include \
                   /usr/local/include/opencv \
                   /usr/local/include/opencv2

    LIBS += /usr/local/lib/libopencv_highgui.so \
            /usr/local/lib/libopencv_core.so    \
            /usr/local/lib/libopencv_imgproc.so \
            /usr/local/lib/libopencv_videoio.so
}
```

Problems that may occur during compilation (Linux):

Cannot find -lGL

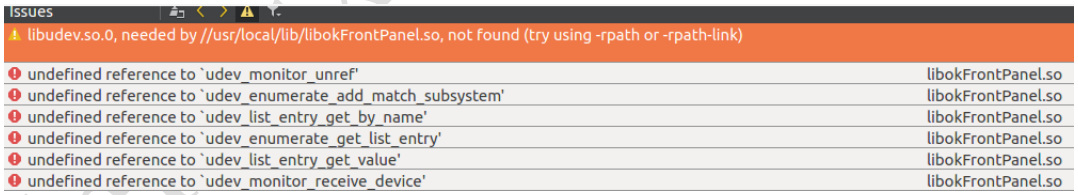


Solution:

sudo apt-get install libgl1-mesa-dev

Udev Errors

Since FrontPanel SDK-v4.5.5 only supports Ubuntu12.04LTS version, the **USB device might not be recognized** when connecting with our Sensor, if you are using higher Ubuntu version. It is caused by the incompatible between "libudev" version used for FontPanel SDK-4.5.5 and Ubuntu14.04 or Ubuntu16.0.



Solution:

To install the corresponding Ubuntu12.04 library for libudev used, you can either download it from the following address, or from our Release directory < *Drivers/Linux/libudev* >.

download link:

https://ubuntu.pkgs.org/12.04/ubuntu-main-i386/libudev0_175-0ubuntu9_i386.deb.html

Name of installation file:

libudev0_175-0ubuntu9_i386.deb or libudev0_175-0ubuntu9_amd64.deb

Installation command:

sudo dpkg -i libudev0_175-0ubuntu9_i386.deb

sudo dpkg -i libudev0_175-0ubuntu9_amd64.deb

2.5 Generate FPN file

FPN (Fixed Pattern Noise) is the term given to a particular noise pattern on digital imaging sensors often noticeable during longer exposure shots where particular pixels are susceptible to giving brighter intensities above the general background noise. To get rid of FPN, we need to create FPN files for CeleX™ Sensor. Each sensor requires its own FPN, and steps for generating FPN are illustrated in section 3.4.

3 The Functions of CeleX Demo Kit GUI

If there is no sensor device connected, the interface screen is shown as Fig.3-1, when there is a sensor device connected, the interface screen is shown as Fig.3-2.

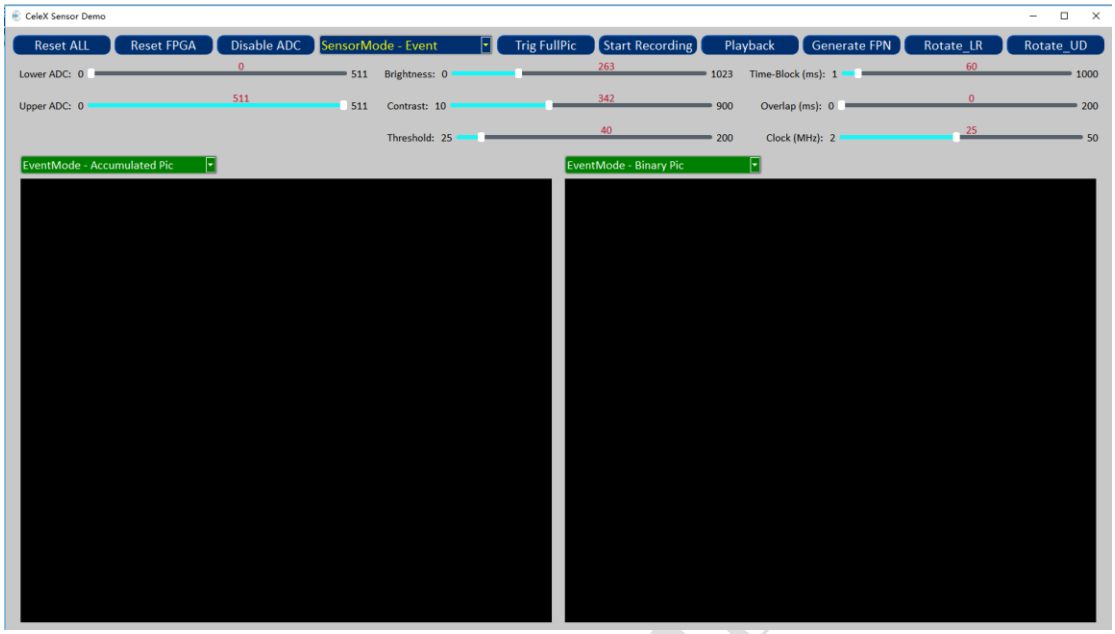


Fig. 3-1

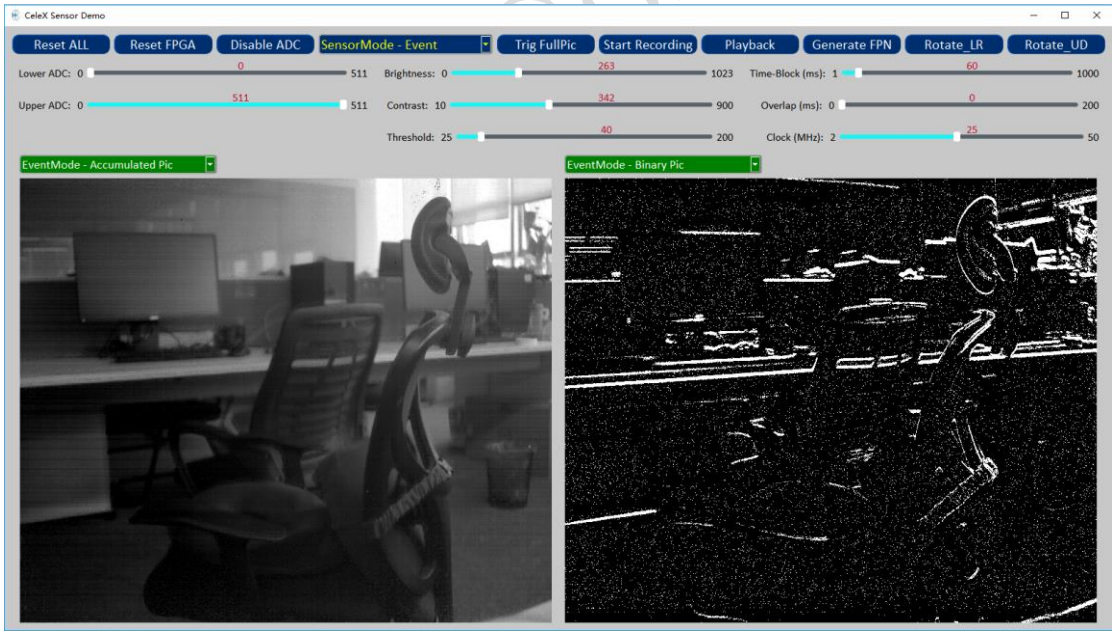


Fig. 3-2

3.1 Change Sensor Mode

Click the combo box button labeled by the red box to change the working mode of the Sensor. Fig. 3-3 shows the interface screen when the Sensor works in the Event mode. The left image shows the accumulated Full Picture and the right image show the motion event image.

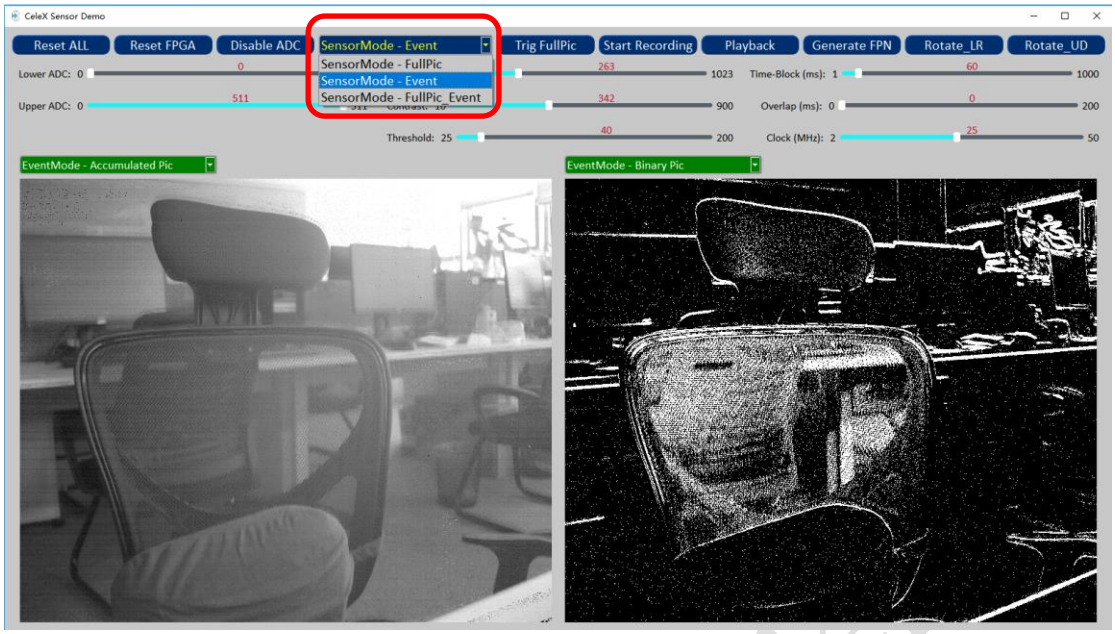


Fig. 3-3 Sensor works in Event mode

Fig. 3-4 shows the interface screen when the Sensor works in the Full-Picture mode. The image on the left is the Full Picture. Since the Sensor only output Full Picture in this mode, the image on the right is black, indicating there is no data output.

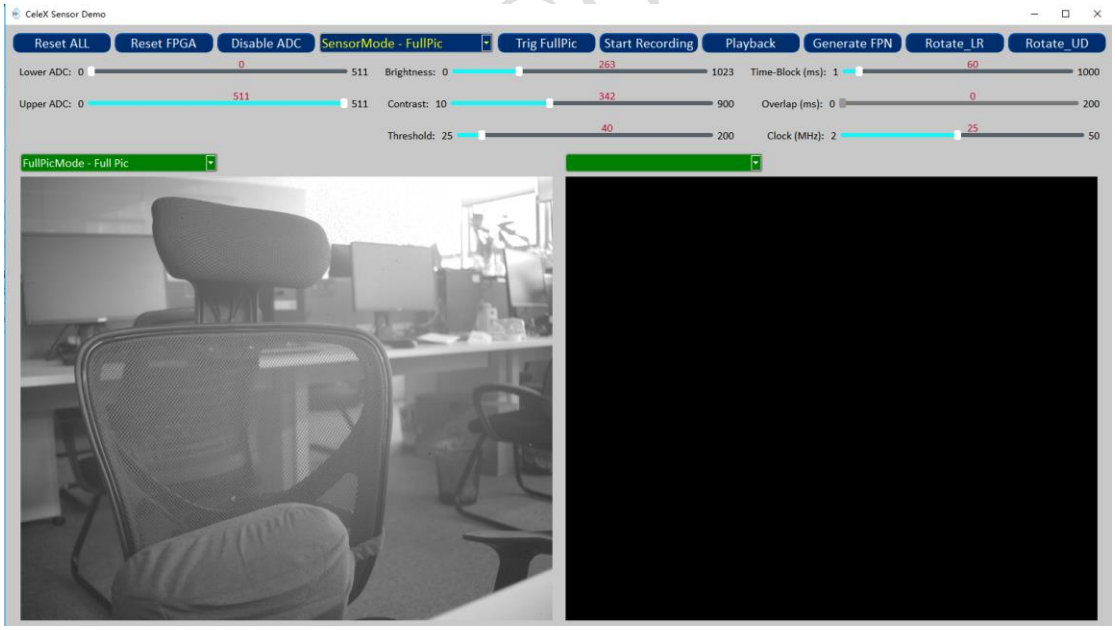


Fig. 3-4 Sensor works in Full-Picture mode

Fig. 3-5 shows the interface screen when the Sensor works in the FullPic_Event mode. The image on the left is the Full Picture and the image on the right is event picture.

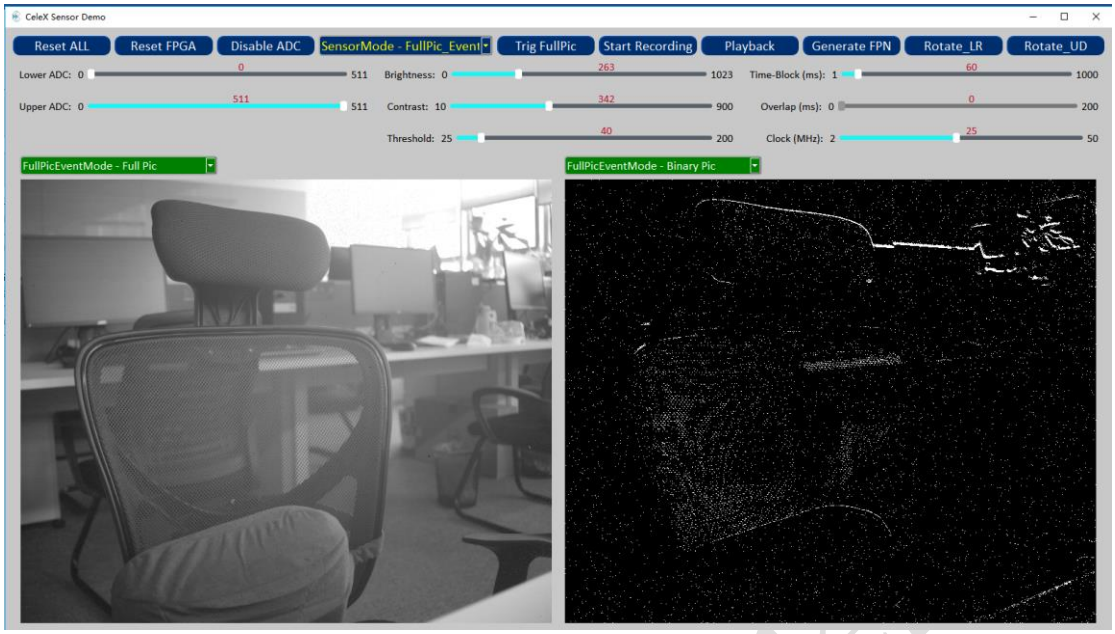
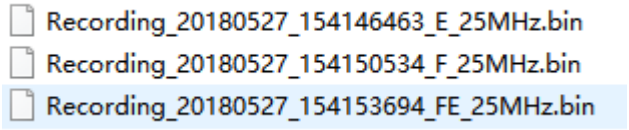


Fig. 3-5 Sensor works in FullPic_Event mode

3.2 Record Raw Data of Sensor (Bin Files)

Click the "***Start Recording***" button in Figure 3-6-1 to start recording bin data, then the text on the button will change to "***Stop Recording***" as shown in Figure 3-6-2. Click the "***Stop Recording*** " button to stop recording bin data. The recorded bin file will store in the same directory as CeleXDemo.exe and is named in the form of Recording_YYYYMMDD_HHMMSSSSS_SensorMode_ClockRate.bin, as follow:



E: Event mode, F: FullPic mode, FE: FullPic_Event mode

25MHz: The operating frequency of the Sensor is 25MHz

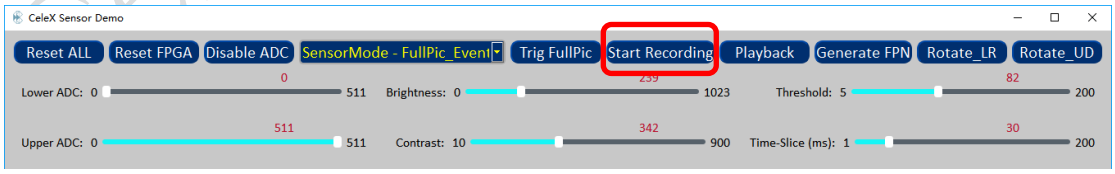


Fig. 3-6-1

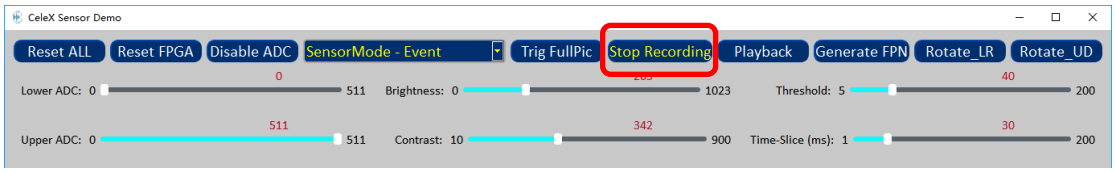


Fig. 3-6-2

3.3 Playback Recorded Raw Data of Sensor (Bin Files)

Click the "***Playback***" button to select a bin file to play, the interface is shown in Figure 3-7. What the left and right images show are related to the Sensor mode when you recorded the bin file. For what images could output in different modes, please refer to the description in section 3.1.

When playing the bin file, you can adjust the slider "***Time-Slice***" to change the time interval for creating each frame, you can also adjust the slider "***Display***" to change the time interval for playing each frame.

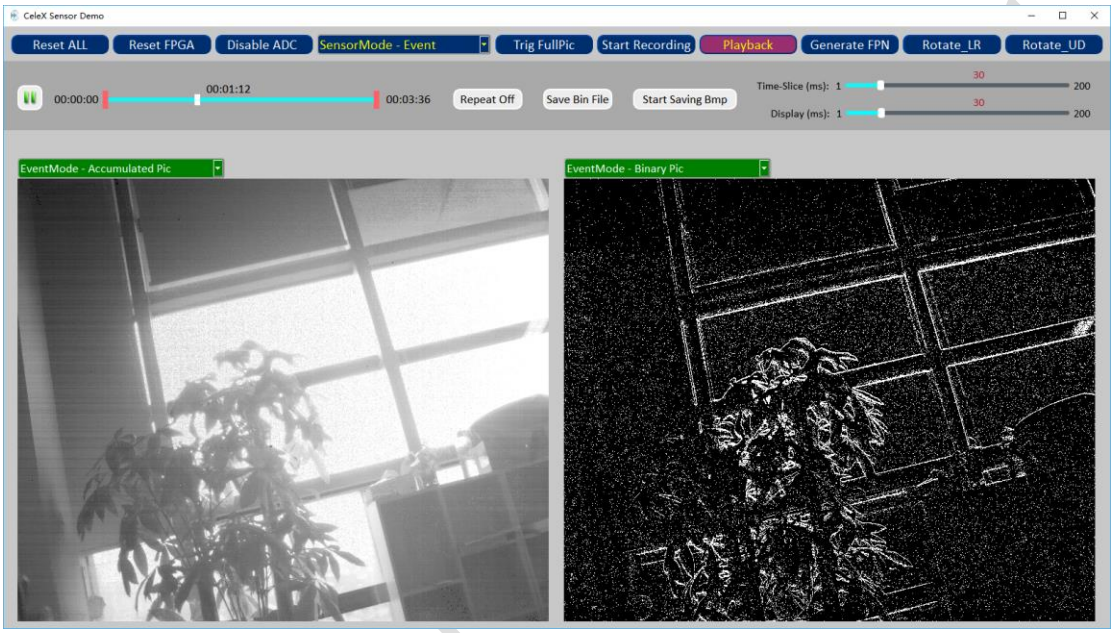
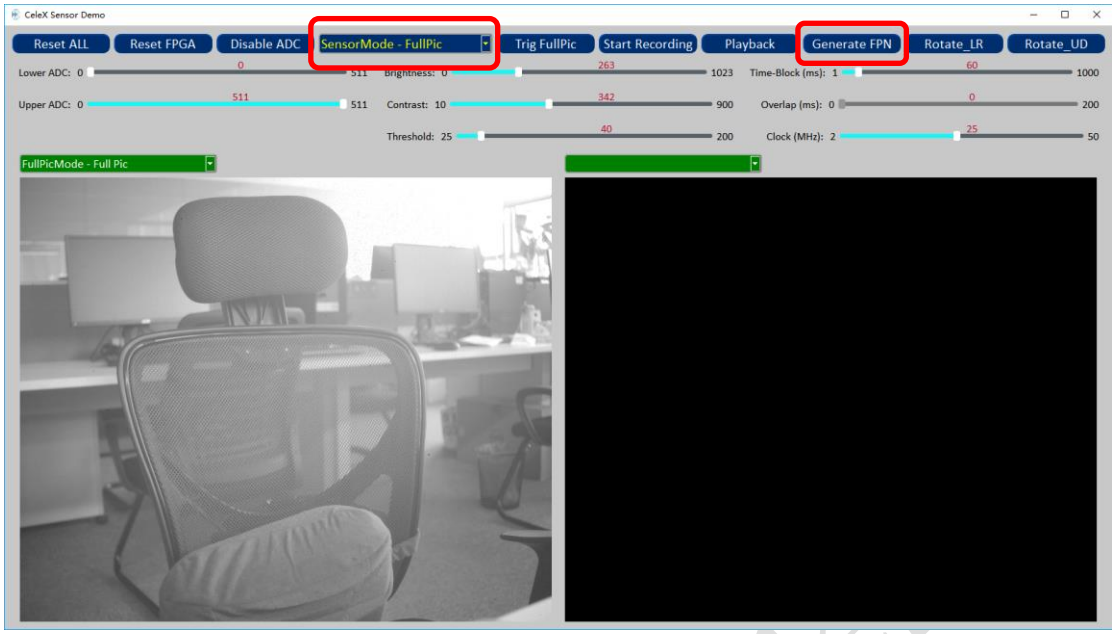


Fig. 3-7

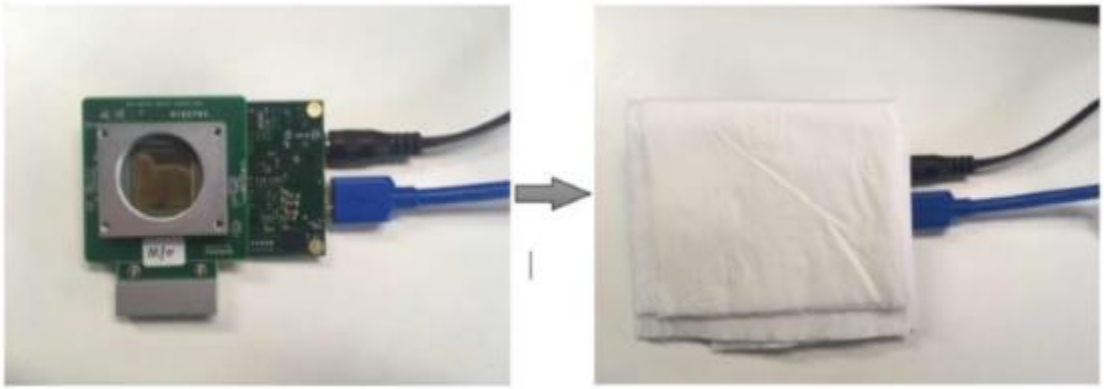
3.4 Generate FPN file

Each sensor requires its own FPN, and steps for generating FPN are illustrated as below:

1) Switch the Sensor operating mode into " Full Picture". Then, only the left side of screen will display images while the other side is closed.



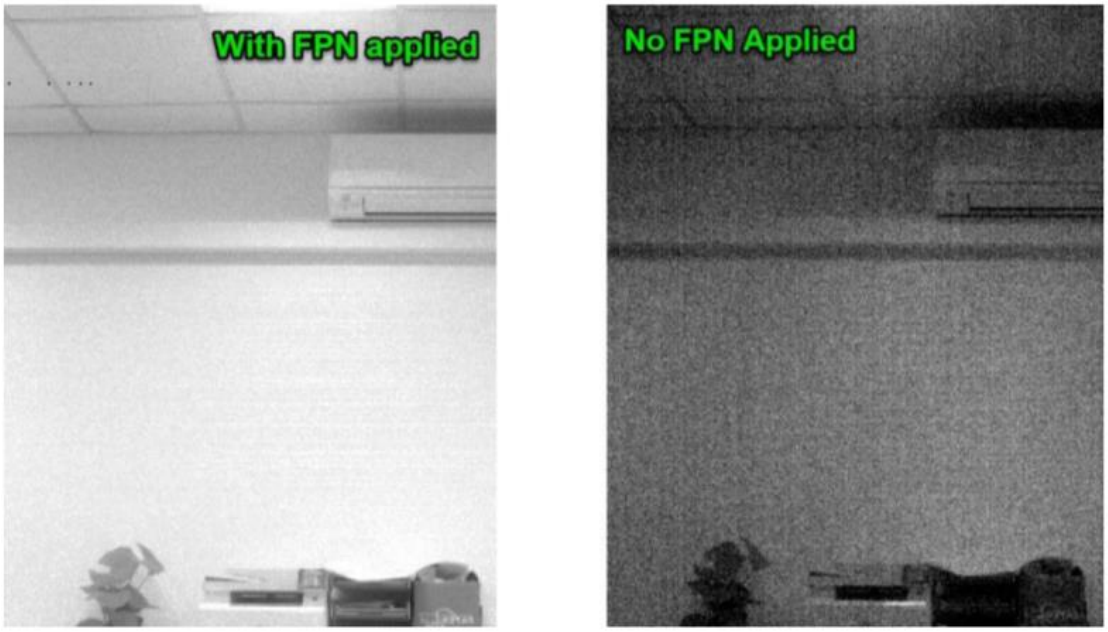
2) Since the FPN should be conducted under the condition of uniform illumination, we could use the way of removing optical lens and covering a piece of white paper (thin tissue or A4 paper) over the exposed Sensor. Make sure that paper completely covers the sensor and sheet is stationary. **NOTE: the effect will be better if you operate in natural light rather than the LED lamp.**



3) Before generating FPNs, please check the image screen and make sure it is normal, which is neither too dark nor too bright. Then, you could adjust the amount of paper over the Sensor or switch the " Brightness " slider in the GUI to change the luminance. **NOTE: the 3rd figure is the right luminance among the three figures below.**

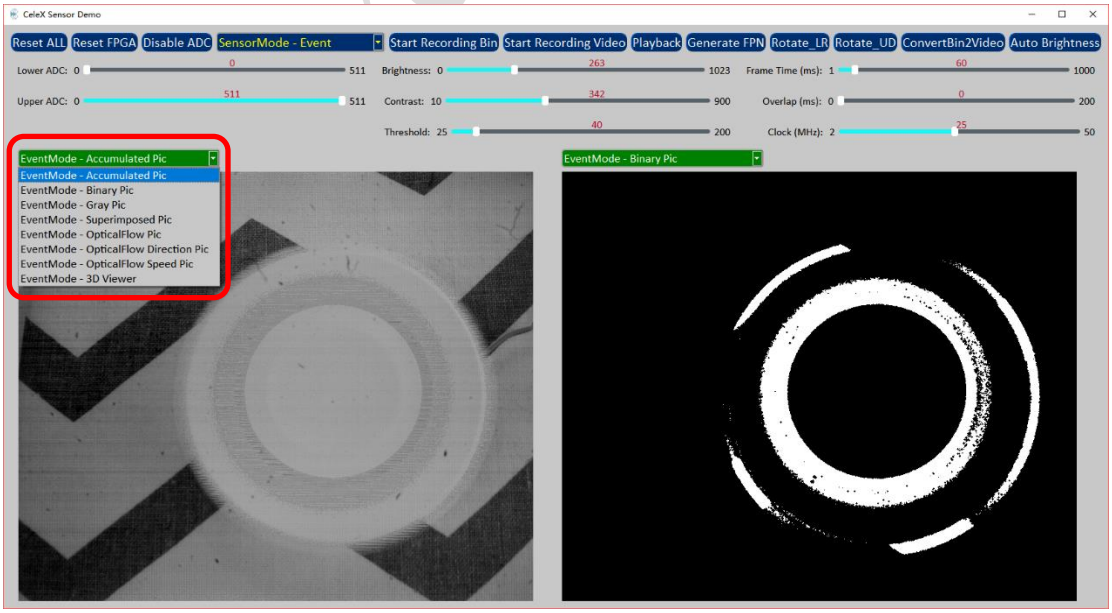
4) Click the “Generate FPN " button in GUI. Then, you could see the FPN.txt file in assigned direction after FPN file was successfully generated.

5) It will automatically use the new generated FPN file after restarting the GUI terminal. You should be able to see the differences of image quality then.



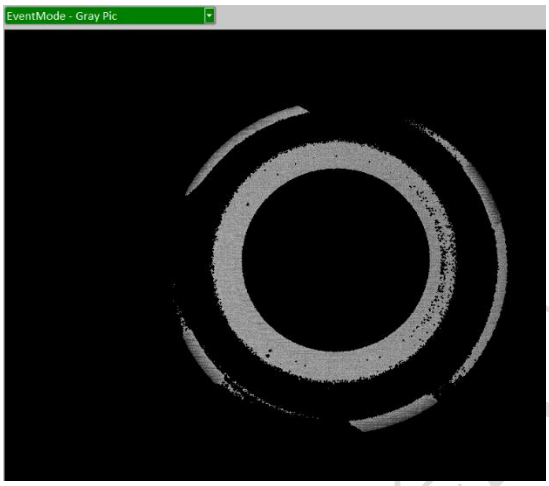
3.5 Display of Various Image Formats

We use the Event mode as an example to illustrate the display of various image formats. You can set the type of image to display by clicking on the combo box button in the figure below, as follows:



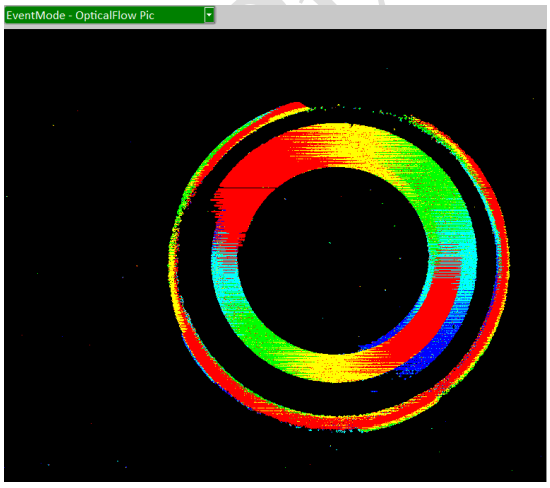
Accumulated Pic

Binary Pic

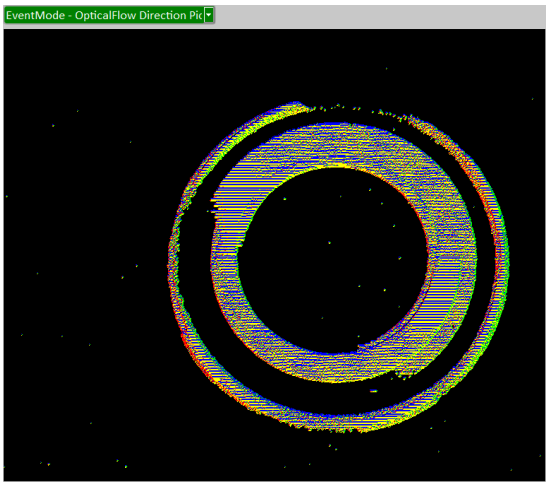


Gray Pic

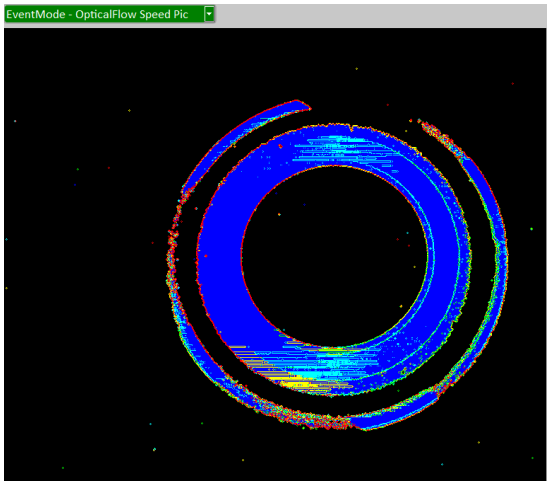
Superimposed Pic



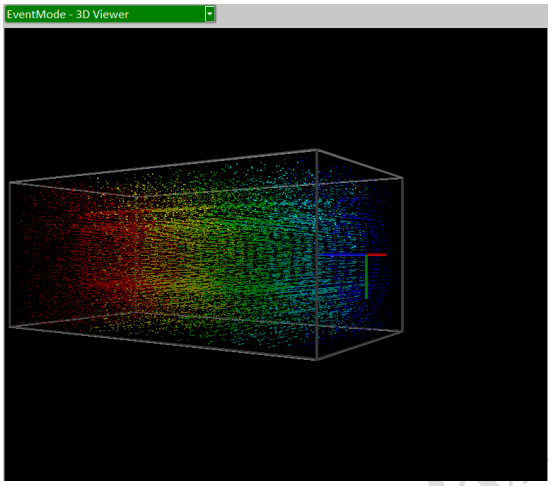
Optical-Flow Pic



Optical-Flow Direction Pic



Optical-Flow Speed Pic



3D Viewer

Note: Please refer to our API Manual for introduction of Optical-Flow.

3D Viewer：Click the left mouse button to rotate, the right mouse button to rescale, the middle mouse button to pan.

3.6 All Buttons' Function

(1) Button ***Reset ALL***: Reset both Sensor and FPGA

(2) Button ***Reset FPGA***: Reset FPGA

(3) Button ***Disable ADC***: Enable or Disable output of light intensity by a configurable parameter

(4) Combo Box ***SensorMode - Event***: Change Sensor mode

(5) Button ***Trig FullPic***: Force to generate a visual frame at Event mode

(6) Button ***Start Recording***: Record the raw data of Sensor

(7) Button ***Playback***: Play the raw data of Sensor

(8) Button ***Generate FPN***: Generate FPN file

(9) Button ***Rotate_LR***: Rotate the image left and right (Control the left and right images at the same time)

(10) Button ***Rotate_UP***: Rotate the image up and down（Control the left and right images at the same time）

3.7 All Sliders' Function

(1) Slider ***Lower ADC***: Adjust the lower limit of variable brightness range.

(2) Slider ***Upper ADC***: Adjust the higher limit of variable brightness range.

(3) Slider ***Brightness***: Adjust the brightness.

(4) Slider ***Contrast***: Adjust the contrast.

(5) Slider ***Threshold***: Adjust the threshold value where the event triggers (the change of light intensity happen to a pixel is greater than the threshold, the pixel can be marked as an event/active pixel).

(6) Slider ***Time-Block (Frame Time)***: Adjust the duration of creating a motion frame when Sensor works in Event mode (the larger the value, the longer the time; otherwise, the shorter the time); when Sensor works in FullPic_Event mode, adjust the output time of Motion Event in each time block.