

AISAKESTREL AIRBORNE OPERATIONS MANUAL V 1.1



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1 Introduction

AisaKESTREL is the first professional quality hyperspectral sensor family, intended for UAVs and other platforms of limited payload weight and size. Series include two imagers, AisaKESTREL 10 (400–1 000 nm) and AisaKESTREL 16 (600–1640 nm). They are pushbroom imagers with high light throughput and outstanding spatial resolution resulting in a complete UAV compatible system with various platforms capable of carrying 5 kg payload.

This document is an operational quick guide for using AisaKESTREL with LUMO software.

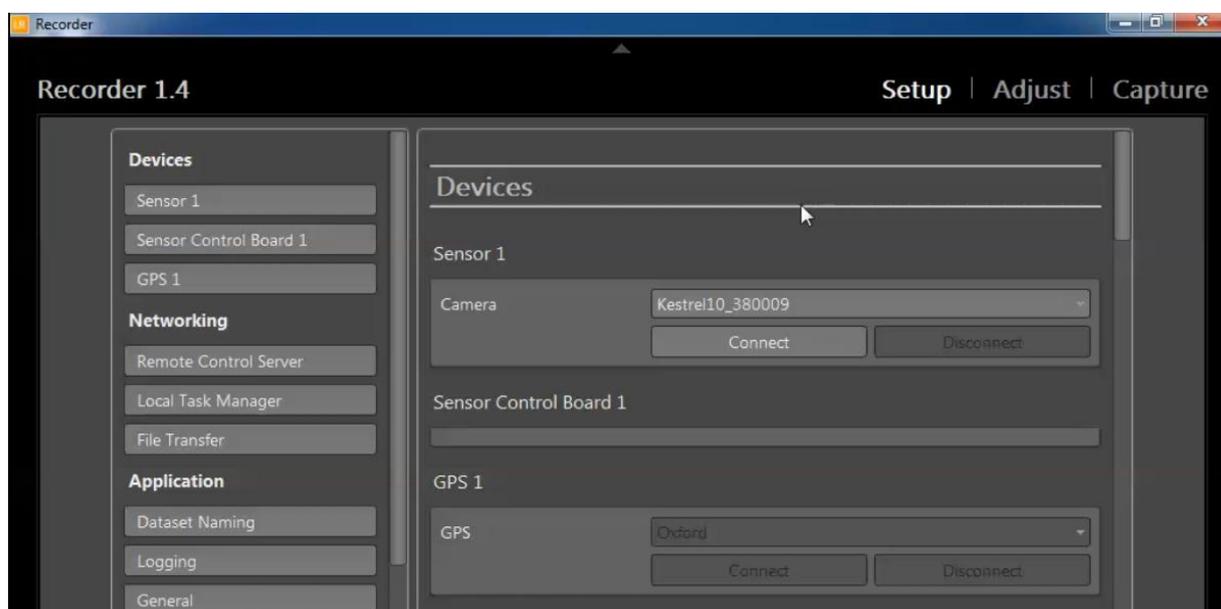
2 LUMO software

LUMO is a family of software products for hyperspectral sensor data acquisition. For airborne use we have LUMO Recorder and for ground use with scanner we have LUMO Scanner. Appropriate LUMO software is preinstalled on data acquisition computer delivered with the system.

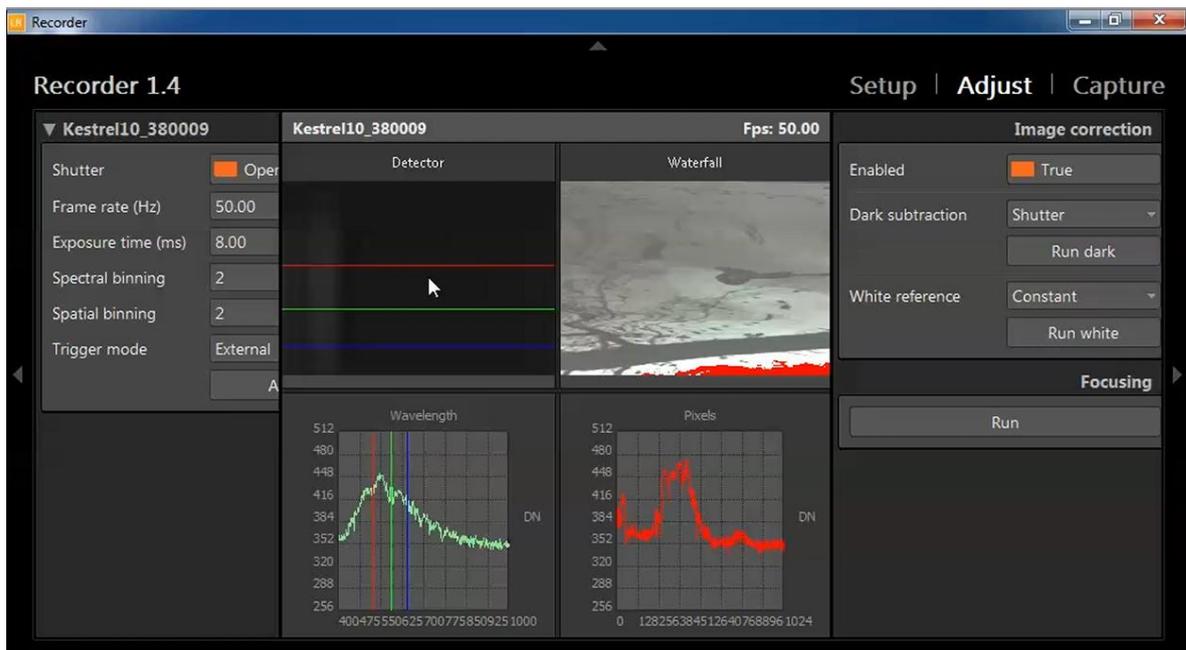
Detailed operating instructions for use of LUMO Recorder and LUMO Scanner can be found on their User Guides for each product, respectively. The following chapters contain a minimum set of operation steps to configure and operate AisaKESTREL sensor.

3 LUMO for Airborne use

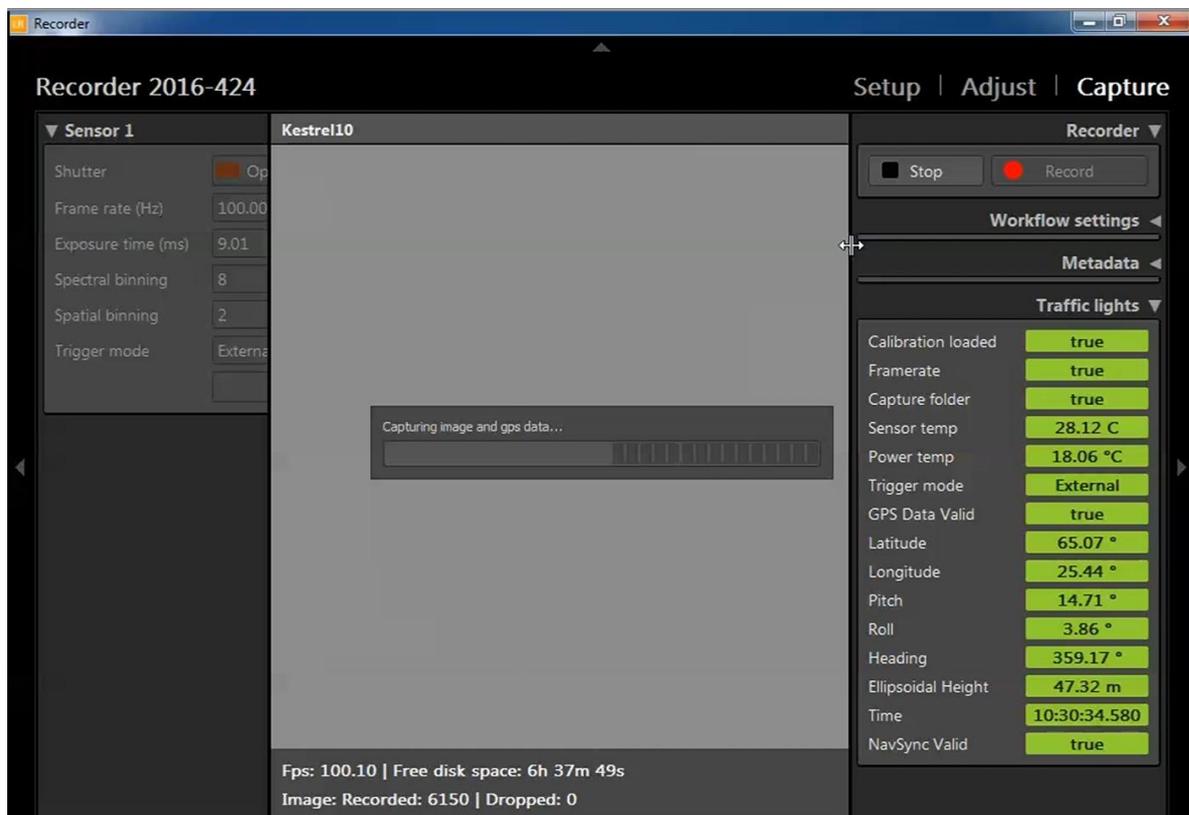
LUMO Recorder is used for airborne data acquisition of AISA sensors including AisaKESTREL. LUMO Recorder has three tabs. First of the tabs is “Setup”. Here you define initial settings for the system and make connection to sensor and auxiliary devices such as GPS/IMU or scanner.



Tab “Adjust” is intended for sensor parameter setting, system testing and operation prior to data recording. You can display full detector image, spectral and spatial profiles for chosen bands and waterfall image for up to 3 bands.



Tab “Capture” tab is for data recording and monitoring of system performance using sensor specific set of status information.

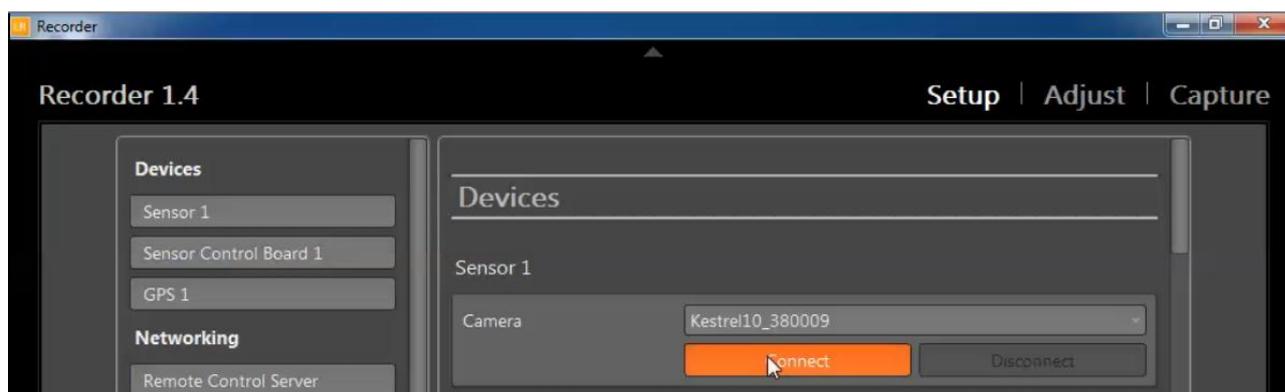


4 AisaKESTREL connections for airborne use

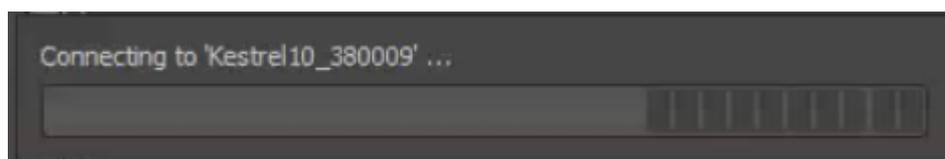
4.1 Sensor connection

At this point you should have all the cabling in place and system powered up. Start LUMO

Recorder (LR) software from  shortcut either on your desktop or taskbar. The software may open in a smaller window after the launch. Should this happen enlarge the view from top right corner of LR. Go to Setup tab. On section 'Devices -> Sensor1' make sure the Camera profile is set to AisaKESTREL and click <Connect> button.

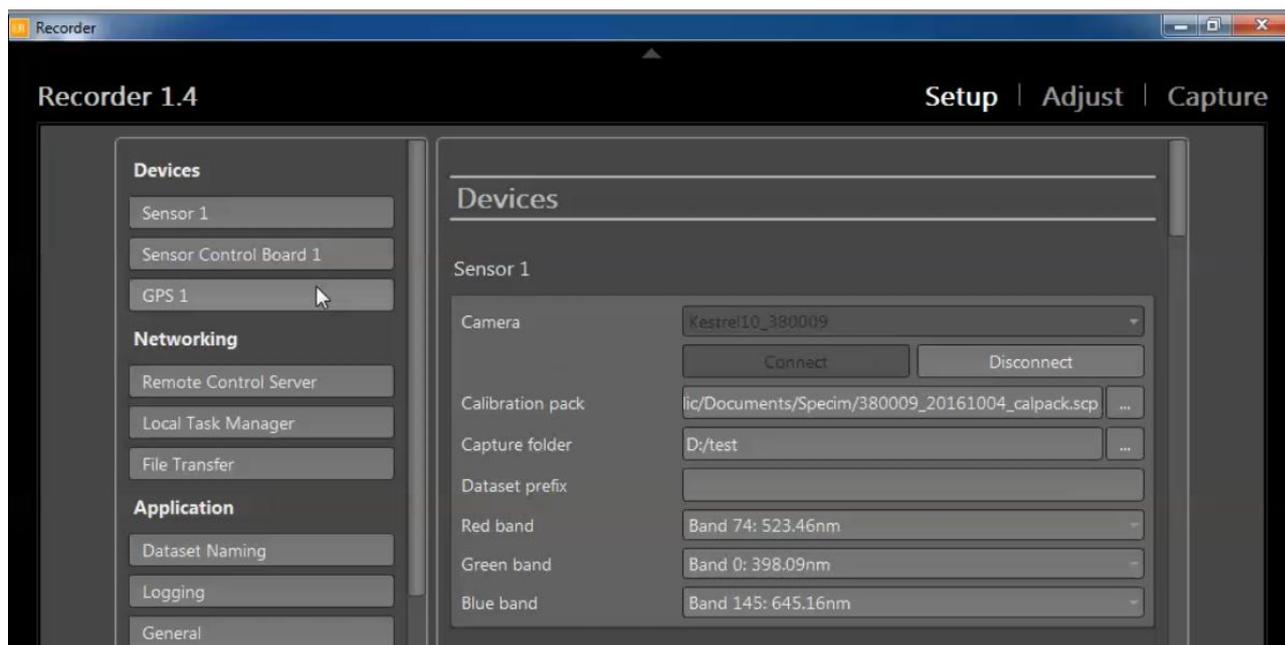


Wait for connection to the sensor. This may take several minutes. During the connection process you will see a progress bar on the screen (see figure below).



When the sensor is properly connected the <Connect> button is greyed out (inactive). If the <Connect> button remains still active the connection process was unsuccessful and you have to connect again. In case the connection is not successful after second try either check the cabling and power to the sensor.

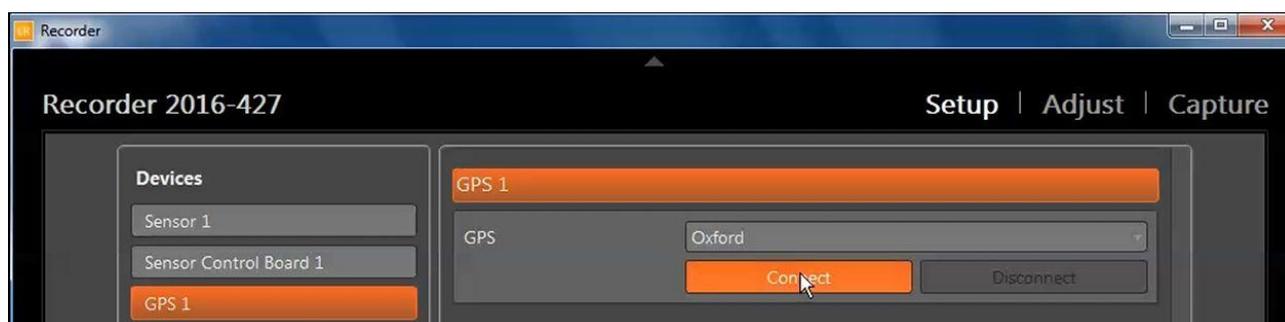
After a successful connection the screen looks like below. Make sure the "Calibration pack" field is populated. This indicates the calibration pack matching sensor type is found and properly loaded. Calibration pack includes information of sensor ROI (region of interest) settings, spectral calibration, bad pixel mapping (if required) and some additional auxiliary data. In case the calibration pack is not found navigate to location of your calibration pack. Default location for the file is in C:\Users\Public\Documents\Specim. In case the file does not load there is some mismatch in the file. Should this happen consult SPECIM for further information.



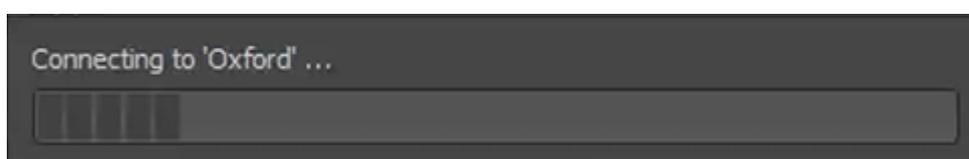
You can define the “Capture folder” and “Dataset prefix” here prior to moving to sensor parameter adjustment and capture. Default bands for the waterfall can be chosen here or later while setting up the views and profiles under “Adjust” tab.

4.2 GPS/IMU connection

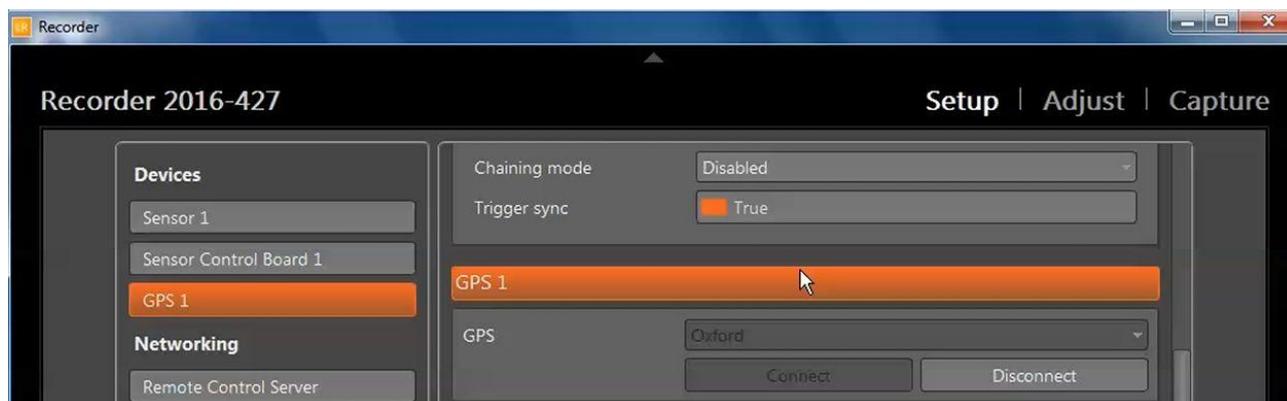
After connecting to sensor you can connect to GPS/IMU. While on “Setup” tab navigate to section ‘Devices -> GPS1’. Make sure the GPS profile matches to GPS/IMU sensor you are planning to use. For example profile “Oxford” is referring to Oxford Technical Solutions (OXTS) models from RT, Survey+ and xNAV families.



Wait for connection to the GPS/IMU. This may take a while. During the connection process you will see a progress bar on the screen (see figure below).



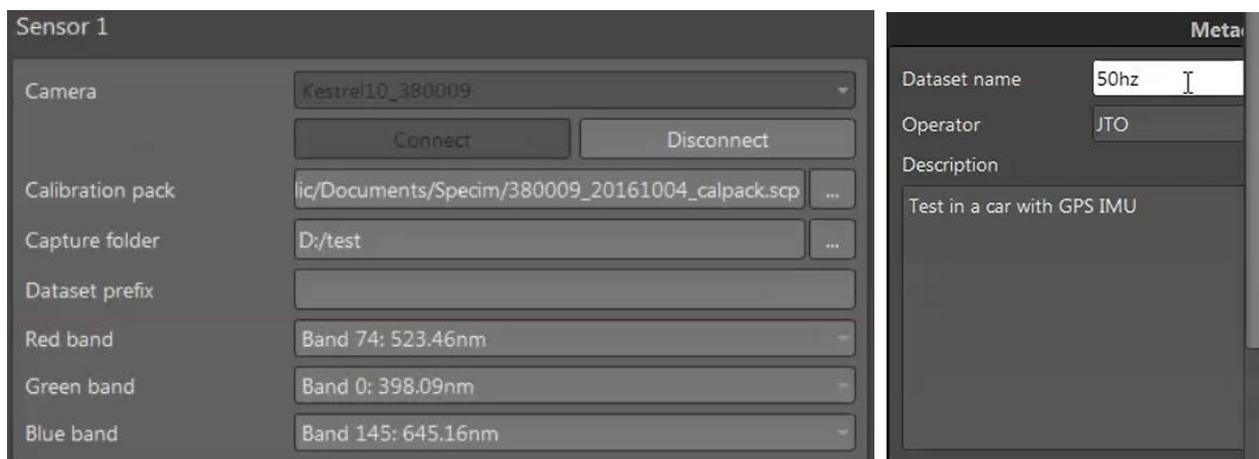
If the <Connect> button is still active the connection process was unsuccessful and you have to connect again. The reason for an unsuccessful connection may be due to use of incorrect profile, missing or incorrect COM port definition in the profile file, unsuccessful auto detection of COM port, unpowered GPS/IMU unit, or incorrect COM port detection on GPS/IMU unit. When the GPS/IMU is properly connected the <Connect> button is greyed out (inactive).



5 Operation

5.1 Dataset and capture folder settings

Capture folder and dataset prefix settings are defined on Setup tab (below, left) sensor connection buttons. Choose and optionally create and existing folder on button <...> next to “Capture folder”. File naming convention include various combination of timestamp options based on date and time, file name and additional prefix. You can define the prefix for your files on box “Dataset prefix”. Typically this prefix is used for defining your mission. Dataset name is defined under Capture tab (below, right). There you can define also some additional metadata for the dataset.

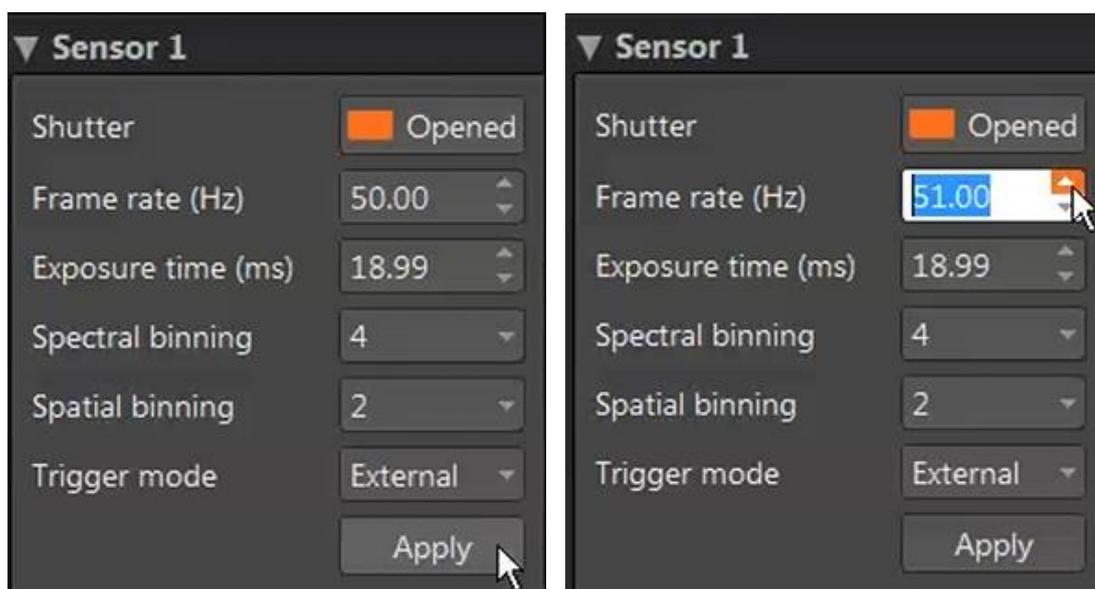


Details of Dataset naming convention are chosen on Setup tab under Application -> Dataset Naming.

5.2 Sensor settings

Sensor settings can be found on top-left corner of “Adjust” and “Capture” tabs. In case needed the shutter can be toggled manually from here. Data recording workflows control the shutter automatically making the need for manual shutter control a rare event.

On figures below you see the active settings on the left. You change the values by using up and down arrows or by typing directly into the activated edit box for Frame Rate and Exposure time and pull-down menus for binning and trigger mode.



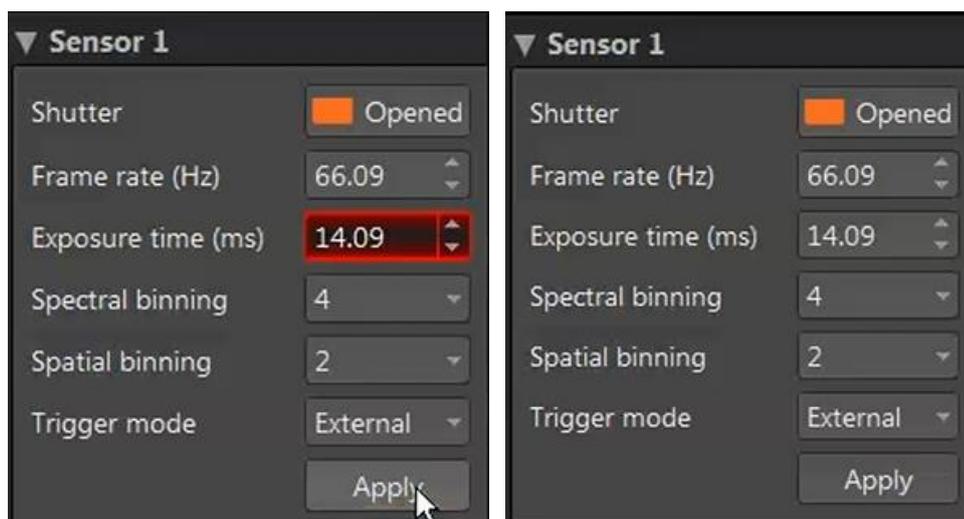
When setting the sensor parameters it is important to set them in specific order to make parameter limitation procedures to work properly. Do it in the following order

1. **Set Binning (Spectral and/or Spatial) -> Click <Apply>**
2. **Set Frame Rate -> Click <Apply>**
3. **Set Exposure time -> Click <Apply>**
4. **Set Trigger Mode -> Click <Apply>**

The above correct order is very important, because that causes entered parameters to be checked correctly against limits. In a figure below you can see an example when frame rate has been changed from 50 to 66.09 fps (maximum). The exposure time was earlier maximum value of 18.99 ms for 50 Hz, but is now limited to 14.09 ms that is highlighted with a red box. When you click <Apply> again the correctly limited value is send to camera and limitation box is removed. The formula for limitation is the following

$$\text{Maximum exposure time} = 1/\text{Frame rate} - \text{Frame Readout Time}$$

For AisaKESTREL the frame readout time is set to 1 ms. For example for 50 Hz frame rate the maximum exposure time is 18.99 ms.



External triggering mode should be used most of the time since that activates the SCB System Control Board to be used for camera triggering and time stamping of navigation data. This is important for accurate frame timing for example in airborne operation. Trigger status is displayed on diagnostics traffic lights. Make sure that is green External.



5.3 Settings diagnostics

On bottom right corner of Capture tab are settings diagnostics traffic lights. Green color indicates stable condition. Red indicates a value yet to stabilise or a temperature above the upper limit of desired range. Orange color is warning or temperature below lower limit of desired range.

Traffic lights ▼		Traffic lights ▼		Traffic lights ▼	
Calibration loaded	true	Calibration loaded	true	Calibration loaded	true
Sensor temp	-0.44 °C	Sensor temp	-0.44 °C	Sensor temp	-0.44 °C
Optics temp	26.01 °C	Optics temp	26.01 °C	Optics temp	25.99 °C
Camera ambient	27.76 °C	Camera ambient	27.88 °C	Camera ambient	27.88 °C
Power temp	21.85 °C	Power temp	21.98 °C	Power temp	21.98 °C
Framerate	true	Framerate	false	Framerate	true
Capture folder	true	Capture folder	true	Capture folder	true
Trigger mode	External	Trigger mode	External	Trigger mode	External
GPS Data Valid	true	GPS Data Valid	true	GPS Data Valid	true
Ground Speed	12.49 m/s	Ground Speed	10.89 m/s	Ground Speed	13.68 m/s
Pitch	1.70 °	Pitch	2.07 °	Pitch	1.87 °
Roll	-3.17 °	Roll	-2.56 °	Roll	-0.73 °
Heading	256.31 °	Heading	255.83 °	Heading	313.67 °
Altitude	13.32 m	Altitude	13.55 m	Altitude	13.29 m
Time	07:30:02.980	Time	07:30:04.840	Time	07:30:20.030
NavSync Valid	false				

A sample above (left) demonstrates a situation when recording has started, but a valid navigation time stamp is not yet detected. In the next figure (center) timestamp is valid and error condition is no longer present. However, frame rate measurement still indicates non-valid results for a moment until it stabilizes (right). This may happen momentarily in the beginning of data recording.

5.4 Data Recording

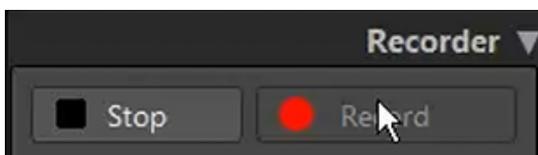
You control the data recording on Capture tab. Before starting the recording you need to set the Capture mode to “free” and select workflow “Image with GPS and embedded dark”. In this workflow you record dark data embedded to the end of image file when the recording is stopped. Navigation data is recorded into separate file. Recorded data folder for one flight lines looks like below (left). Data files are in capture folder (right).

Name	Date modified	Type
calibrations	2/7/2017 10:49 AM	File folder
capture	2/7/2017 10:49 AM	File folder
metadata	2/7/2017 10:49 AM	File folder
cartest_2017-02-06_10-41-16.png	2/6/2017 12:42 PM	IfanView PNG File
manifest.xml	2/6/2017 12:42 PM	XML File
properties.xml	2/6/2017 12:42 PM	XML File

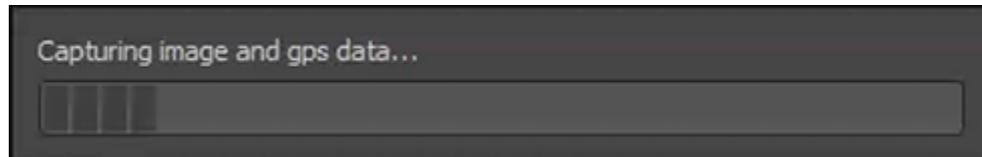
Name	Date modified	Type
cartest_2017-02-06_10-41-16.hdr	2/6/2017 12:42 PM	HDR File
cartest_2017-02-06_10-41-16.log	2/6/2017 12:42 PM	LOG File
cartest_2017-02-06_10-41-16.nav	2/6/2017 12:42 PM	NAV File
cartest_2017-02-06_10-41-16.raw	2/6/2017 12:42 PM	IfanView RAW File



You only need to choose the workflow and capture mode only once before the recording of the first file. After that you simply press button <Record> to start the recording and button <Stop> to stop image recording and start recording of embedded dark data for the amount of frame specified by “Dark frame count” above. Recorder of dark data stops automatically after the set number of frame is exhausted.



When the recording is started a progress bar is displayed on top of Capture tab waterfall display.



Below the waterfall you see current recording status. Check the measured frame rate is matching set frame rate. In this sample the frame rate was set to 50 Hz and measured value is 50.10 Hz. This means the system is operating with correct frame rate. Monitor also the number of dropped frames. A couple of dropped frames may occur when you start the recording or some dropped frames occasionally during the recording. But in case number of dropped frames increases during the recording you have most likely a performance issue with data disk used for recording or sensor settings.

```
Fps: 50.10 | Free disk space: 0h 23m 57s  
Image: Recorded: 4099 | Dropped: 0
```

When the recording of a flight line is finished without any problems the status information looks like below.

```
Fps: 50.05 | Free disk space: 0h 23m 53s  
Image: Recorded: 5746 | Dropped: 0  
Dark: Recorded: 100 | Dropped: 0
```

6 Contact us

Further information and technical support is available from SPECIM, Spectral Imaging Ltd. in Finland. (www.specim.fi, support email: support@specim.fi, tel. +358 (0)10 4244 400).

7 Appendix 1 - Troubleshooting

The following table includes most common issues and solutions for them

#	Issue	Solution
1	Sensor is not connecting	Check cabling and power. Make sure that sensor is connected to correct ports specified for the sensor you use
2	GPS/IMU is not connecting	Check GPS/IMU cabling and power. Make sure the connection COM port is valid.
3	Data is not recorded	Check data folder is valid and data disk is properly in place
4	Dropped frames in data	Make sure data disk is properly in place and formatted as NTFS basic disk. Set lower frame rate for the sensor.
5	Temperature measurement is shown red on traffic lights	Wait a moment to see if that vanished after a moment. If not, shutdown the system and wait for a moment before retry. If the problem persists write down the temperature readings and ambient operating conditions and contact Specim for further assistance.
6	“NavSync Valid” does not turn green	Make sure that GPS has valid solution with PPS pulse. Check cabling for PPS. Check that “External Triggering” is turned on.
7	Set frame rate does not match to measured frame rate	Frame rate may be too high or exposure time is too long. Set lower frame rate or shorter exposure time.