

Monarch Pro – UNS310709

Linux API Manual

Python

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1). Prerequisites

1.1). Make sure that the camera is upgraded with the latest FW version (v23)


- For upgrading the FW - refer to the [MONARCH PRO FW Upgrade Manual](#)


1.2). Supported OS platform


OS name	OS version	Kernel version	System
Raspberry Pi OS with desktop	Debian 11(bullseye)	5.15	32-bit
Raspberry Pi OS with desktop	Debian 11(bullseye)	5.15	64-bit
Ubuntu	20.04	5.13	64-bit

1.3). Download the new API library files from >>> [here](#)<<<

- Download the tar.gz file

 `linuxsdk-1.1.0_raspberrypi-32bit.tar.gz`

 `linuxsdk-1.1.0_raspberrypi-64bit.tar.gz`

 `linuxsdk-1.1.0_ubuntu20.04-64bit.tar.gz`

- Decompress the tar.gz file.

```
tar -zxvf linuxsdk-1.1.0-*.tar.gz
```

2). SDK Files content

- **lib folder** - libUCam.so and library files for Python API
- **TestPythonSdk.py** - Sample code
- **README.md** - guide of how to run the sample code

3). Camera initialization

3.1). Import the CameraCardController library from the lib directory.
`from lib.camera_card_controller import CameraCardController`

3.2). CameraCardController
Connects and initialize the camera module.

Note:

The initialization process time may take up to 15 seconds.

- Input: --
- Output: ---
- Example: `cam_controller = CameraCardController()`

4). Control methods

4.1). SetExposureFps
Sets the camera module exposure time in FPS units.

Note:

FPS (frames per seconds) = $1000/\text{exposure_time}$

- Input: fps (2-1000)
- Output: ---
- Example: `SetExposureFps(100)`

4.2). GetExposureTime
Gets the exposure time in milliseconds [ms].

- Input: ---
- Output: exposure time
- Example: `GetExposureTime()`

4.3). SetGain
Sets the gain value to the camera module [1-10].

- Input: gain value (1-10 float)
- Output: ---
- Example: `SetGain(2.6)`

4.4). GetGain
Gets the gain value.

- Input: ---
- Output: gain value
- Example: `GetGain()`

4.5). AutoExposure
Adjust the exposure time automatically.

- Input: ---
- Output: 1. exposure time 2.the index of brightest band
- Example: `AutoExposure()`

5). LUT methods

LUT - Look Up Table of voltages values per matching wavelength

- For each wavelength there are pre-defined voltages values stored in the camera module.

Basic methods

5.1). SetLineVoltages

Sets the filter voltages values for the desired wavelength.

Usually used for capturing a single band.

- Input: line index [0-9]
- Output: ---
- Example: **SetLineVoltages(4)**
(Sets the line voltages for 5th band)

5.2). BuildCustomLUT

Build a custom "playlist" with specified wavelength indexes

- Input: a list of relevant wavelength indexes
- Output: ---
- Example: **BuildCustomLUT([5,3,6,4,0])**

5.3). CaptureLUT

Capture spectral cube.

Performs camera module LUT and store all the frames in a dedicated array.

Note:

By default, this function sets to capture all 10 bands
(0-9 indexes).

For capturing less than 10 bands, use BuildCustomLUT to create a custom "playlist".

- Input: ---
- Output: flat array of 10-bit cube
- Example: **CaptureLUT()**

5.4). RestoreLUT

Restores the capturing custom "playlist" to 10 bands (default).

- Input: ---
- Output: ---
- Example: **RestoreLUT()**

Advanced methods

5.5). EnableLowPower

Toggle video-stream in camera module.

- Input: True/False
- Output: ---
- Example: **EnableLowPower(False)**

5.6). GetLUTLine

Read the LUT line data (by given by index)

- Input: line index
- Output: converted voltages vector (4), fps, gain, cwl.
- Example: **GetLUTLine(5)**

LUTLine format => ([v1, v2, v3, v4], data1, data2, band)

6). Camera methods

6.1). SkipFrames

Skip frames (x number_of_frames) from buffer to stabilize the filter position.

- Input: number of frames
- Output: ---
- Example: **SkipFrames(2)**

6.2). GetFrame10

Get grayscale frame image of 10-bit in 16-bit package.

usage: for raw and envi formats.

Note:

while in initialization process, an image frame won't be delivered, it will return the remaining time [sec] for completion.

- Input: ---
- Output: grayscale frame of 10-bit
- Example: **GetFrame10()**

6.3). GetFrame8

Get grayscale frame of 8-bit.

usage: for raw and envi formats.

Note:

while in initialization process, an image frame won't be delivered, it will return the remaining time [sec] for completion.

- Input: ---
- Output: grayscale frame of 8-bit
- Example: **GetFrame8()**

6.4). GetPreview

Get a preview grayscale frame of 8-bit.

Usage: for display only.

- Input: ---
- Output: grayscale frame of 8-bit
- Example: **GetPreview()**

6.5). Release

Release camera connection

- Input: ---
- Output: ---
- Example: **Release()**

7). Other methods

7.1). PowerLED

Toggle LED light on camera module.

- Input: True/False
- Output: ---
- Example: **PowerLED(True)**

7.2). GetTemperature

Get the camera temperature value in Celsius.

(The temperature sensor is located on the camera module PCB)

- Input: ---
- Output: temperature.
- Example: **GetTemperature()**

7.3). GetSerialNumber

Get the camera serial number from memory.

- Input: ---
- Output: serial number.
- Example: **GetSerialNumber()**

7.4). GetFwVersion

Get the camera module FW version.

- Input: ---
- Output: FW version.
- Example: **GetFwVersion()**

7.5). GetApiVersion

Get the camera module FW version.

- Input: ---
- Output: API version.
- Example: **GetApiVersion()**

7.6). Reset

Reset camera module controller.

- Input: ---
- Output: ---
- Example: **Reset()**

8). Basic Code Workflow

Important note:

The API "lib" folder should be located at the same path as your sample code file.
Or at any other location with specifying the direct path.

- 8.1). Import the required libraries and the camera_card_controller.pyd file

```
import cv2
import numpy as np
from lib.camera_card_controller import CameraCardController
```
- 8.2). Initialize camera connection

```
cam_controller = CameraCardController() # Init
print('camera has been successfully connected.')
```
- 8.3). Print Camera Information

```
print('temperature: ', cam_controller.GetTemperature())
print('serial number: ', cam_controller.GetSerialNumber())
print('FW version: ', cam_controller.GetFwVersion())
print('Api version: ', cam_controller.GetApiVersion())
```
- 8.4). Set default variables

```
# Exposure value in milliseconds [2-1000]
initial_exposure = 100
# Gain value [1-10]
initial_gain = 1
# Image resolution
FRAME_RES = [1024, 1280]
```
- 8.5). Set gain and exposure

```
cam_controller.SetExposureFps(initial_exposure)
cam_controller.SetGain(initial_gain)
```
- 8.6). Get spectral cube (captureLUT)

```
raw_cube = np.array(cam_controller.CaptureLUT())
```
- 8.7). Process cube
 - 8.7.1). Reshape cube to shape: (10, 1024, 1280)

```
raw_cube = raw_cube.reshape(-1, *FRAME_RES)
print("cube shape: ", raw_cube.shape)
```
 - 8.7.2). Convert cube type to uint8 (8 bit)

```
cube = (lut_raw_cube>>2).astype(np.uint8)
```
- 8.8). show image of specific wavelength

```
preview_band = 2
img = cube[preview_band]

cv2.imshow('Preview', img)
cv2.waitKey(0)
```
- 8.9). Release camera connection

```
cam_controller.Release()
```

9). **Sample Code**

For full sample code, please see the open code of `TestPythonSdk.py`

- Located in: SDK/TestPythonSdk.py

For running the sample code, please see the README.md

- Located in: SDK/README.md

10). **Appendix A – Comparison between Windows API and Linux API**

Please see below the API methods names comparison of the Windows version vs the Linux version.

Windows Version 1.39	Linux Version 1.0.0	Linux Version 1.1.0
SetExposureFps	SetExposureFps	SetExposureFps
GetExposureTime	GetExposureTime	GetExposureTime
SetGain	SetGain	SetGain
GetGain	GetGain	GetGain
SetLineVoltages	SetLineVoltages	SetLineVoltages
BuildCustomLUT	BuildCustomLUT	BuildCustomLUT
CaptureLUT	CaptureLUT	CaptureLUT
RestoreLUT	RestoreLUT	RestoreLUT
EnableLowPower	EnableLowPower	EnableLowPower
EnableVideoStream	EnableVideoStream	EnableVideoStream
GetLUTLine	GetLUTLine	GetLUTLine
InitCam	InitCam	InitCam
SkipFrames	SkipFrames	SkipFrames
GetFrame10	GetFrame10	GetFrame10
GetFrame8	GetFrame8	GetFrame8
GetPreview	GetPreview	GetPreview
Release	Release	Release
PowerLED	PowerLED	PowerLED
GetTemperature	GetTemperature	GetTemperature
GetSerialNumber	GetSerialNumber	GetSerialNumber
GetFwVersion	GetFwVersion	GetFwVersion
GetApiVersion	GetApiVersion	GetApiVersion
Reset	Reset	Reset
--	--	AutoExposure