# Monarch Pro – UNS310709
# Windows API Manual
# Python

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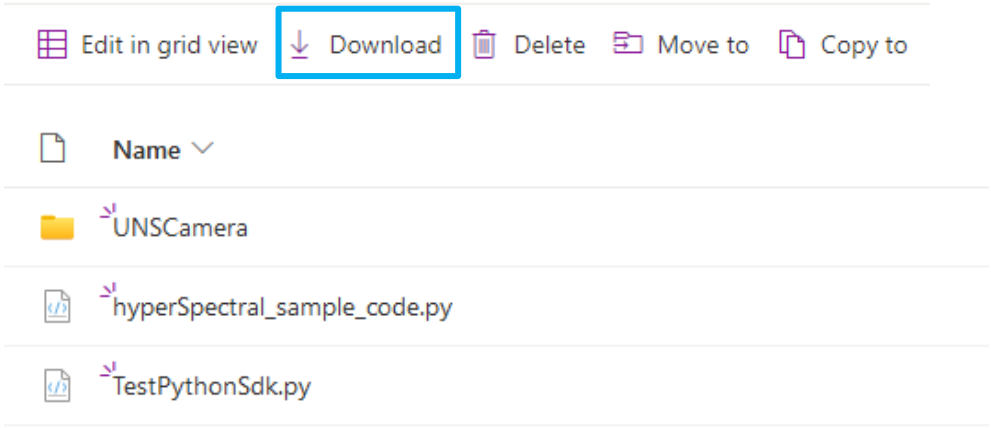
## 1). Prerequisites

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). Download the new API library files from >>>**here**<<<




1.3). Replace the previous version API files with new files just downloaded.

- Extract the zip file if needed.

## 2). Library Files content

2.1). UNSCamera folder

- 2.1.1). Dll files
- 2.1.2). camera_card_commands.py
- 2.1.3). cameracard_wrapper.py
- 2.1.4). camera_card_controller.pyd
- 2.1.5). envi.py
- 2.1.6). hyper_spectral.py

2.2). TestPythonSdk.py

2.3). hyperSpectral_sample_code.py

Note:
Folder hierarchy should stay as is.

## 3). Camera initialization

3.1). Import the CameraCardController library from the UNSCamera directory.

```
from UNSCamera.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/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: `exp_time = 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: `gain_value = 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: `data_cube = CaptureLUT()`

5.4). CaptureLUTCustom

Capture the spectral cube of custom bands.

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

Input: the list of wanted bands. The range should be 713~920.

- Output: flat array of 10-bit cube
- Example: `hs_cube= CaptureLUTCustom([713,720,800,920])`

5.5). RestoreLUT

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

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

## Advanced methods

5.6). EnableLowPower

Toggle video-stream in camera module.

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

5.7). GetLUTLine

Read the LUT line data (by given by index)

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

LUTLine fromat => ([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: `frame10 = 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: frame8 = `GetFrame8()`

### 6.4). GetPreview

Get a preview grayscale frame of 8-bit.

Usage: for display only.

- Input: ---
- Output: grayscale frame of 8-bit
- Example: `preview_frame = 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: `temp = GetTemperature()`

### 7.3). GetSerialNumber

Get the camera serial number from memory.

- Input: ---
- Output: serial number.
- Example: `SN = GetSerialNumber()`

### 7.4). GetFwVersion

Get the camera module FW version.

- Input: ---
- Output: FW version.
- Example: `fw_version = GetFwVersion()`

### 7.5). GetApiVersion

Get the camera module FW version.

- Input: ---
- Output: API version.
- Example: `api_version = GetApiVersion()`

### 7.6). Reset

Reset camera module controller.

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

## 8). Basic Code Workflow

Important note:

The API "UNSCamera" 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 UNSCamera.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 sample code of how to use SDK to take custom bands, please see the open code of hyperSpectral_sample_code.py

- Located in: SDK/hyperSpectral_sample_code.py

## Appendix A – Updated API Formatting

Please see below the API methods names update of the new version vs the previous version.

| Version 1.3.10 | Version 1.3.11 (New) |
|---|---|
| SetExposureFps | SetExposureFps |
| GetExposureTime | GetExposureTime |
| SetGain | SetGain |
| GetGain | GetGain |
| | |
| SetLineVoltages | SetLineVoltages |
| BuildCustomLUT | BuildCustomLUT |
| CaptureLUT | CaptureLUT |
| RestoreLUT | RestoreLUT |
| EnableLowPower | EnableLowPower |
| GetLUTLine | GetLUTLine |
| | |
| SkipFrames | SkipFrames |
| GetFrame10 | GetFrame10 |
| GetFrame8 | GetFrame8 |
| GetPreview | GetPreview |
| Release | Release |
| | |
| PowerLED | PowerLED |
| GetTemperature | GetTemperature |
| GetSerialNumber | GetSerialNumber |
| GetFwVersion | GetFwVersion |
| GetApiVersion | GetApiVersion |
| Reset | Reset |
| AutoExposure | AutoExposure |
| --- | CaptureLUTCustom |