**General description of program requirements for capture of images using Artray camera**

Some camera details:

|  |  |
| --- | --- |
| Model | ArtCam-990SWIR-TEC |
| Hardware instruction manual | [INSTRUCTION\_ARTCAM-990SWIR-TEC\_V105\_20210909.pdf (artray.us)](http://www.artray.us/download/pmanual/INSTRUCTION_ARTCAM-990SWIR-TEC_V105_20210909.pdf) |
| Interface | USB3 only (\*\*don’t use USB2 port\*\*) |
| Pixel Array | 1280(H) x 1024(V) |
| Exposure time range (shutter speed) | 20.3μsec to 2sec. |
| Gain range | 0 to 42[dB] |
|  |  |

Available software files (all downloadable from <http://www.artray.us/download_pro.html>):

|  |  |
| --- | --- |
| Viewer software | <http://www.artray.us/download/measure/ART-MEASURE-TNIR_SWIR-CD-V1392-EN.zip> |
| Device driver | <http://www.artray.us/download/driver/other/USB3-T2_DRV_V3039.zip> |
| Camera SDK x64 | <http://www.artray.us/download/sdk/ArtCamSdk_990SWIR_TEC_x64_v1301.zip> |
| Header | <http://www.artray.us/download/sdk/ARTCCM-TNIR-lib_EN_ver.1.3.1.3b.zip> |
| Sample src (C#/VB/VC) | <http://www.artray.us/download/sdk/ARTCCM-TNIR-sample_EN_ver.1.3.1.3c.zip> |

Commands to be sent to the camera:

* Peltier temperature control – always set to ‘on’
* Analog gain – almost always set to zero, although some user adjustment may be useful.
* Image exposure time – set to some value between 20.3μsec to 2sec.
* Image format – always set to monochrome 12-bit and full resolution 1280 x 1024
* Trigger command – an external electronic trigger through the 6-pin connector to initiate image capture is not required. (However, for information, this facility may be needed at a later date.)

Information to be retrieved from the camera:

* The 1280 x 1024 greyscale image (12-bit)

Important: The pixel greyscale values of the acquired image should be raw. That is, there should be no *automatic* adjustment of gain or exposure time or white balance or brightness or contrast by the camera electronics. Gamma correction must always be set to 1.00 (i.e. the input-to-output relationship is always linear).

Software Task A (“Sensitivity Curve”) – Acquire sets of images at increasing exposure times

General description: The user inputs some initial set-up conditions (described below) and then starts the image acquisition. The code acquires a set of images and then automatically increments the exposure time before acquiring the next set of images. The exposure time is then increased again and a third set of images is acquired and so on. After about 60\* sets of images, the task terminates. (\*This number set by the user).

User-defined initial parameters:

* Filename of acquired image – the user inputs the root of the file name (e.g. Artcam\_myrun1\_ ) When the images are saved, the exposure time in microseconds (as a 7-digit field) and the image counter (3-digit field) are automatically appended to the root (e.g., the first image might be Artcam\_myrun1\_Exp0000050us\_001.tif).
* Number of images (**n**) acquired at each exposure time setting – Each occasion the exposure time is changed, the camera will acquire a set of n image files. Generally, n equals 1 or 2.
* The initial exposure time (**t**) in milliseconds – Minimum value is 0.021ms according to camera spec. It is unlikely that ‘t’ will ever be greater than 200ms.
* The increment in exposure time (**T)** between sets of images – For example, if ‘t’ is set to 1.000ms and ‘T’ is set to 0.500 ms, then sets of images will be acquired at 1.000ms, 1.500ms, 2.000ms, 2.500ms and so on.
* The number (**N**) of sets of images captured – this will generally be about 60 sets (i.e. N=60).

After the initial parameters are defined, the user presses “Capture” and the images are acquired automatically. Images should be saved in 16-bit TIF uncompressed format (the acquired image is 12-bit so the first four MSBs of each pixel value are added as zeros).

The following example will hopefully serve to clarify…

*Step 1.*

User enters the following variables (with user input example shown in brackets):

Base filename (= "Artcam\_990\_SWIR\_")

Number of images per set, n (=2)

Initial exposure time, t (= 0.050 ms)

Exposure interval, T (= 0.025 ms)

Number of sets, N (= 60)

*Step 2.*

User clicks on 'Capture' button

*Step 3.*

The software sets the exposure time to t.

The software captures a first image and then saves it as a uncompressed TIF file:  Artcam\_990\_SWIR\_Exp0000050us\_001.tif

The software captures a second image and then saves it as a uncompressed TIF file:  Artcam\_990\_SWIR\_Exp0000050us\_002.tif

*Step 4.*

The software sets the exposure time to t+T.

The software captures a first image and then saves it as a uncompressed TIF file:  Artcam\_990\_SWIR\_Exp0000075us\_003.tif

The software captures a second image and then saves it as a uncompressed TIF file:  Artcam\_990\_SWIR\_Exp0000075us\_004.tif

*Step 5.*

The software sets the exposure time to t+2T.

The software captures a first image and then saves it as a uncompressed TIF file:  Artcam\_990\_SWIR\_Exp0000100us\_005.tif

The software captures a second image and then saves it as a uncompressed TIF file:  Artcam\_990\_SWIR\_Exp0000100us\_006.tif

*Step 6.*

The software sets the exposure time to t+3T.

The software captures a first image and then saves it as a uncompressed TIF file:  Artcam\_990\_SWIR\_Exp0000125us\_007.tif

The software captures a second image and then saves it as a uncompressed TIF file:  Artcam\_990\_SWIR\_Exp0000125us\_008.tif

Then *Step 7, Step 8, Step 9*... and so on until

*Last Step.*

The software sets the exposure time to t+(N-1)T.

The software captures a first image and then saves it as a uncompressed TIF file:  Artcam\_990\_SWIR\_Exp0001500us\_119.tif

The software captures a second image and then saves it as a uncompressed TIF file:  Artcam\_990\_SWIR\_Exp0001500us\_120.tif

The task then stops automatically.

The user can then enter different parameters or re-run the task. The three digit counter at the end of the filename resets to \_001 on the next run.

Since the camera’s maximum exposure time is 2 seconds then t+(N-1)T =< 2000ms.

Software Task B (“Spatial Non-uniformity”) – Acquire one set of images at fixed exposure time

General description: The user inputs a base filename, the exposure time and the number of images required. The code acquires a set of sequential images, each with the same exposure time.

Note: This is actually equivalent to entering (for example) the following values in Software task A above

Base filename (= "Artcam\_sameRadiance\_")

Number of images per set, n (=200)

Initial exposure time, t (= 400.000 ms)

Exposure interval, T (= 0.000 ms)

Number of sets, N (= 200)

It will be clearer for the user to have Software tasks A and B as separate instructions.

Note to self: I ought to specify a destination folder for the acquired image files.