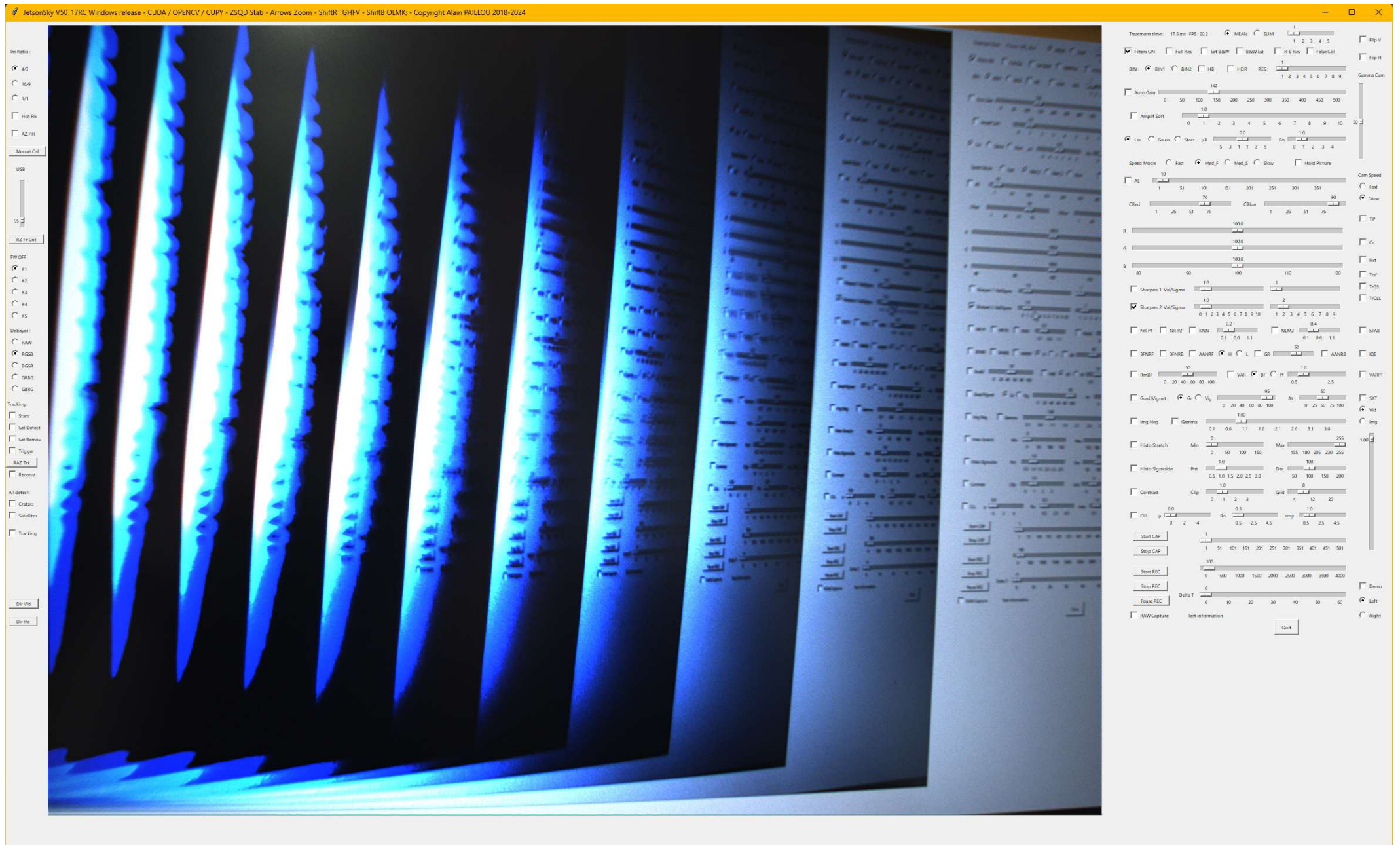


JETSONSKY V50_17RC – Brief information – Copyright Alain PAILLOU – October 2024



JetsonSky is a Python based program and needs a Nvidia GPU and some Python libraries to work properly.

JetsonSky is mainly dedicated to live videos treatments of the deep sky with small exposure time (smallest as possible) with very high camera gain.

JetsonSky is free of use for personal and non commercial use. This software and part of this software are not free of use for professional and or commercial use.

It can control a ZWO camera but it also works with videos and images (no camera required).

I recommend **Python 3.11** version

Nvidia CUDA SDK required

Libraries :

numpy

cupy

opencv (with or without CUDA)

pillow

psutil (optional)

pytorch (optional)

YOLOv8 (optional)

keyboard (Windows system)

pynput (Linux system)

zwoasi (if camera control needed, optional)

zwoefw (if filter wheel needed, optional)

synscan (only if you get a Skywatcher AZ-Gti mount, optional)

IMPORTANT NOTE :

Some functions can be used from keyboard and you will have to choose in the main program which kind of keyboard layout you have. 2 options :

- **AZERTY keyboard**
- **QWERTY keyboard**

Lines 52-23 in JetsonSky :

If you have an AZERTY keyboard, you must have :

```
keyboard_layout = "AZERTY"
```

```
#keyboard_layout = "QWERTY"
```

If you have a QWERTY keyboard, you must have :

```
#keyboard_layout = "AZERTY"
```

```
keyboard_layout = "QWERTY"
```

CAMERA CONTROL MODE

Supported ZWO cameras :

ASI120MC, ASI120MM

ASI178MC, ASI178MM, ASI178MM Pro

ASI224MC

ASI290MC, ASI290MM

ASI294MC, ASI294MM, ASI294MC Pro, ASI294MM Pro

ASI385MC

ASI462MC

ASI482MC

ASI485MC, ASI585MC

ASI533MC, ASI533MM, ASI533MC Pro, ASI533MM Pro

ASI662MC

ASI676MC

ASI678MC, ASI678MM

ASI1600MC, ASI1600MM

Supported motorized filter wheel :

ZWO mini filter wheel 5 positions

Supported motorized mount :

SkyWatcher AZ-Gti

Main Window LEFT SIDE controls (up to down) :

Sensor Ratio : select the camera sensor ratio Width / Height (3 possibles ratios : 4/3, 16/9, 1/1)

Hot pix checkbox : select to remove hot pixels

AZ/H checkbox : will display azimuthal coordinates of the center of the image (use only if you connected with an AZ-Gti with WIFI)

Mount Cal button : click on the button to calibrate the mount coordinate (use only if you connected with an AZ-Gti with WIFI). You must set the mount to center Polaris star. Then, click on the button to make coordinates calibration

USB slider (from 0 to 100%) : select the USB bandwidth for the USB camera connection. Default value is 95. Try other values to get highest frame rate.

Button **RZ Fr Cnt** : Reset the frame count in the Text In Picture information

FW selection boxes : only for ZWO mini filter wheel 5 positions control. Display **ON** if the filter wheel is detected. If not, display **OFF**

Select the filter wheel position you want (from 1 to 5).

Debayer : those selection boxes allow you to select the bayer matrix of your color sensor. 5 possibilities :

RAW (no debayer)

RGGB

BGGR

GRBG

GBRG

Tracking check boxes :

Stars : detect stars

Sat detect : detect satellites using OpenCV functions

Sat remove : remove the satellites from the video capture

Trigger : allow video capture only if satellites are detected

Reconst : Reconstruct image with theoretical stars and/or satellites (if you select stars and/or satellites detection)

AI detect (artificial intelligence) :

Craters : detect Moon craters (YOLOv8 model)

Satellites : detect satellites (YOLOv8 model)

Tracking : plot the detected objects trajectories

Button **Dir Vid** : open dialog box to select Videos directory (for video captures saving)

Button **Dir Pic** : open dialog box to select Pictures directory (for images captures saving)

Main Window RIGHT SIDE controls (up to down) :

Information about treatment time (filters) and FPS

MEAN, SUM and #FS slider : perform the mean (median) or the SUM of 2 to 5 images.

Filters ON : checked : the filters are active. Unchecked : no filtering (even debayering).

Full Res : display the center of the Full resolution image (depending of the resolution set). Useful for telescope fine tuning. You can navigate in the image using **arrows keys** to focus on a specific part of the video.

Set B&W : convert a color image into a monochrome image.

B&W Est : works only with color camera. Calculate the luminance you should have with a monochrome sensor. This allow you to get much more signal with a color sensor, without having too much noise. This is useful to get quite low exposure time.

R-B Rev : only for color sensor. Reverse red and blue channels.

False col : apply false colors to the video

Flip V : Flip the image vertically (Camera is performing the flip)

Flip H : Flip the image horizontally (Camera is performing the flip)

BIN1 : set the camera sensor in BIN1 mode

BIN2 : set the camera sensor in BIN2 mode

HB : hardware BIN (for supported cameras). Only works in BIN2 mode. Hardware BIN gives you the mean of the 4 neighbors pixels instead of the SUM (lower noise). Software BIN (default choice) performs the sum of the 4 neighbors pixels (higher noise but more signal).

HDR : HDR capture mode (multiple acquisitions with different exposure times) to improve video dynamic.

RES & slider : select the resolution of the camera within 9 defined resolutions (7 for BIN2 mode).

GAIN : set the camera sensor gain. The max gain depends of the camera characteristics.

Auto : the gain will be adjusted by the camera

Gamma Cam : set the gamma correction of the camera (from 0 to 100). The camera perform the gamma adjustment.

Ampli Soft : software amplification of each pixel with 3 modes

Lin : linear amplification for each pixel value (from 0 to 255)

Gauss : the amplification is set with a Gaussian function you can adjust with 2 parameters (μX and σ). This allow you to get selective amplification. Activate TrGS to see the Gaussian.

Stars : the same as Gauss but it will only amplify Stars.

Speed Mode : for selecting the exposure time

Fast : from 100 μ S to 10mS

MediumF : from 1 ms to 400ms

MediumS : from 1 ms to 1000ms

Slow : from 500ms to 20000ms (20s)

Hold picture: the video acquisition is stopped and you will work only on the last image acquisition.

Exposition & slider : select the exposure time with the slider

AE : Auto exposure. The exposure time will be adjusted by the camera

Cam speed selection boxes : select the camera acquisition mode (can improve the FPS)

Fast : fast acquisition mode

Slow : slow acquisition mode (default)

CRed & slider : select the camera response for Red channel (camera internal setting)

CBlue & slider : select the camera response for Blue channel (camera internal setting)

R, G, B & the 3 sliders : software adjustment and fine tuning for the three channels red green blue

TIP : Text In Picture – Add the date, time, the frame number and the FPS in the upper left corner of the image

Cr : Draw a cross in the center of the image

Hst : Draw the histogram of the image (RGB or Mono histogram)

Trsf : Draw the adjustments applied to the image (modifications applied to the pixels – RGB or Mono) – related to software gamma, histo stretch and histo sigmoïde)

TrGS : Show the amplification applied to each pixel – Related to Ampli Soft with 3 kinds of amplification : Linear, Gaussian and Stars – see on the RIGHT SIDE controls)

TrCLL : Show the transformation applied to each pixel using Contrast Low Light filter– Related to Ampli Soft with 3 kinds of amplification : Linear, Gaussian and Stars – see on the RIGHT SIDE controls)

Sharpen 1 & Val/Sigma sliders : will sharpen the image

Val : amount of sharpening

Sigma : level of sharpening detail (from fine to coarse)

Sharpen 2 & Val/Sigma sliders : the same as Sharpen 1. 2nd pass sharpening.

Note : *If Sharpen 1 & 2 are actives, we get the result of the 2 sharpen filters*

NR P1 : a personal noise removal filter (Paillou 1). Works on images and videos.

NR P2 : a personal noise removal filter (Paillou 2). Works on images and videos.

Dn KNN & slider : KNN noise removal filter. The slider allow to choose noise removal level. Works on images and videos.

Dn NLM2 & slider : Fast NLM2 noise removal filter. The slider allow to choose noise removal level. Works on images and videos.

STAB checkbox : Allow video stabilization. You can choose the stabilization zone using **ZSQD (azerty keyboard)** or **QSAD (QWERTY keyboard)** and move the zone. You can increase or decrease the size of the zone using + or – key.

3FNRF checkbox : 3 frames noise reduction filter applied to the RAW capture video (front applying). Personal filter. Only works with video.

3FNRB checkbox : 3 frames noise reduction filter applied to the treated capture video (back applying). Personal filter. Only works with video.

AANRF : Adaptive Absorption Noise Removal filter applied to the RAW capture video (front applying). Personal filter. Only works with video. You can choose **High dynamic** or **Low dynamic** option :

H : high dynamic

L : low dynamic with **GR** check box & **slider** : Ghost effect reducer – Can reduce the AADF ghost effect mainly for Low dynamic option.

AANRB : Adaptive Absorption Noise Removal filter applied to the treated capture video (back applying). Only high dynamic. Personal filter. Only works with video.

IQE checkbox : Image Quality Estimator. Useful to tune the image focus.

RmBF checkbox & slider : Remove Bad Frame. Can remove the blurry images. The slider allows to choose the quality threshold.

VAR checkbox : Allow to reduce variations between consecutive frames

2 selective boxes :

BF : Best frame; allow amount of variations considering the best frame of the video

PF : Previous frame : allow amount of variations considering the previous frame

The slider : allow a variation inside the % of variation between frame and reference frame (from 0,5 % to 3 %)

This filter is useful to manage atmospheric turbulence.

VARPT checkbox : same as VAR but this filter consider the post treatment image. VAR id Front treatment, VARPT is Back treatment.

Grad/Vignet : remove image gradient or image vignetting (**select in the checkbox the filter you want to apply**)

- **1st slider** : choose the threshold for the gradient/vignetting

- **2nd slider** : choose the attenuation of the gradient/vignetting correction

Img Neg check box : turns the image into a negative image

SAT checkbox : Image Color Saturation enhancement

Vid selectbox : better result with video

Img selectbox : better result with image

Slider from 0 to 40 :

0 : the video will be in gray levels

1 : no color modifications

above 1 : color saturation enhancement

Gamma & slider : modify the image gamma. Activate Trsf (LEFT CONTROL) to see how this filter works.

Histo Stretch & 2 sliders : modify the histogram. Activate Trsf (LEFT CONTROL) to see how this filter works.

Histo Sigmoide & 2 sliders : modify the histogram (sigmoide function). Activate Trsf (LEFT CONTROL) to see how this filter works.

Contrast CLAHE & slider : modify the contrast of the image

CLL : Contrast Low Light. Modify the contrast of the image mainly with low signal (no high signal amplification). 3 sliders μ , Ro and amp. Activate TrCLL checkbox to see how those parameters work.

Start CAP / Stop CAP buttons & slider :

Select the number of images you want to capture

Press Start CAP to start the images capture

Press Stop CAP to stop images capture

Note : don't forget to choose the capture quality you want by checking / unchecking HQ Capture

Start REC / Pause REC / Stop REC buttons & sliders :

Select the number of frames you want to capture with the **slider**.

If you select **0** with the slider, the number of frames will be set to **10000**.

Press Start REC to start the video capture

Press Stop REC to stop video capture

Press Pause REC to pause video capture

Delta T slider : set the number of seconds between 2 frames

HQ Capture : Select (or not) high quality for captures

High Quality : TIF for images and RAW videos

Low Quality : JPG for images and MPEG videos

Demo checkbox :

Left : the left side of the image is the RAW image – the right side of the image is the image with the treatments.

Right : the right side of the image is the RAW image – the left side of the image is the image with the treatments.

Quit button : exit the program

IMPORTANT : Some functions can be used directly from the keyboard

STAB : select the stabilization zone

with AZERTY keyboard :

up : z

down : s

left : q

right : d

increase zone surface : +

decrease zone surface : -

with QWERTY keyboard :

up : w

down : s

left : a

right : d

increase zone surface : +

decrease zone surface : -

Red channel alignment :

with AZERTY keyboard :

red up : t
red down : g
red left : h
red right : f
red reset : v

with QUERTY keyboard :

red up : t
red down : g
red left : h
red right : f
red reset : v

Blue channel alignment :

with AZERTY keyboard :

blue up : o
blue down : l
blue left : k
blue right : m
blue reset : ;

with QUERTY keyboard :

blue up : o
blue down : l
blue left : k
blue right : ;
blue reset : ,

Full res zoom – choose the part of the image :

Both AZERTY & QWERTY keyboards :

UP : up arrow
DOWN : down arrow
LEFT : left arrow
RIGHT : right arrow

VIDEO TREATMENT MODE (no camera control, no filter wheel and no mount control)

JetsonSky V50_17RC Windows release - CUDA / OPENCV / CUPY - ZSQD Stab - Arrows Zoom - ShiftR TGHFV - ShiftB OLMK - Copyright Alain PAILLOU 2018-2024

Hot Pix

USB

RZ Fr Cont

RW:

#1

#2

#3

#4

#5

Debayer:

RAW

RGGB

BGGG

GRGG

GBRG

Tracking:

Stars

Sat Detect

Sat Remov

Trigger

Reconst

A1 detect:

Craters

Satellites

Tracking

Load Vid

Load Pic

Dir Vid

Dir Pic

Treatment time: FPS: 21.2

MEAN

SUM

1

2

3

4

5

Filters ON

Full Res

Set B&W

B&W Ext

R-B Rev

False Col

Bin: BIN1

BIN2

HB

HDR

RES: 1

2

3

4

5

6

7

8

9

Auto Gain

0

50

100

150

200

250

300

350

400

450

500

550

600

Amplif Soft

0

1

2

3

4

5

6

7

8

9

10

Lin

Gamma

Stars

µX

0.0

1.0

5

3

1

1

3

5

0

1

2

3

4

Speed Mode

Fast

Med.F

Med.S

Slow

Hold Picture

AE

100

2100

4100

6100

8100

CRad

1

26

51

76

CBblue

1

26

51

76

R

100.0

G

100.0

B

100.0

Sharpen 1 Val/Sigma

0

1

2

3

4

5

6

7

8

9

10

Sharpen 2 Val/Sigma

0

1

2

3

4

5

6

7

8

9

10

NR P1

NR P2

KNN

0.1

0.6

1.1

NLM2

0.1

0.6

1.1

SPNRB

SPNRB

ANNRB

H

L

GR

50

ANNRB

ReNB

0

20

40

60

80

100

VAR

BF

PI

0.5

2.5

Grid/Vignet

Gr

Vig

95

Ar

50

Img Neg

Gamma

0.1

0.6

1.1

1.6

2.1

2.6

3.1

3.6

Histo Stretch

Min

0

50

100

150

Max

155

180

205

230

255

Histo Sigmoid

Phi

0.5

1.0

1.5

2.0

2.5

3.0

Dec

50

100

150

200

Contrast

Clip

0

1

2

3

Grid

4

12

20

CLL

µ

0.0

0.5

1.0

Ro

0.5

2.5

4.5

amp

0.5

2.5

4.5

Start CAP

1

51

101

151

201

251

301

351

401

451

501

Stop CAP

0

500

1000

1500

2000

2500

3000

3500

4000

Start REC

0

500

1000

1500

2000

2500

3000

3500

4000

Stop REC

0

500

1000

1500

2000

2500

3000

3500

4000

Pause REC

0

10

20

30

40

50

60

RAW Capture

Test information

Quit

Flip V

Flip H

Gamma Cam

Cam Speed

Fast

Slow

TP

Cr

Hat

Trif

TrGS

TrCLL

STAB

IQE

VAMP

SAT

Vid

Img

Demo

Left

Right

10/10

The camera control functions are not active.

Some small changes :

Debayer :

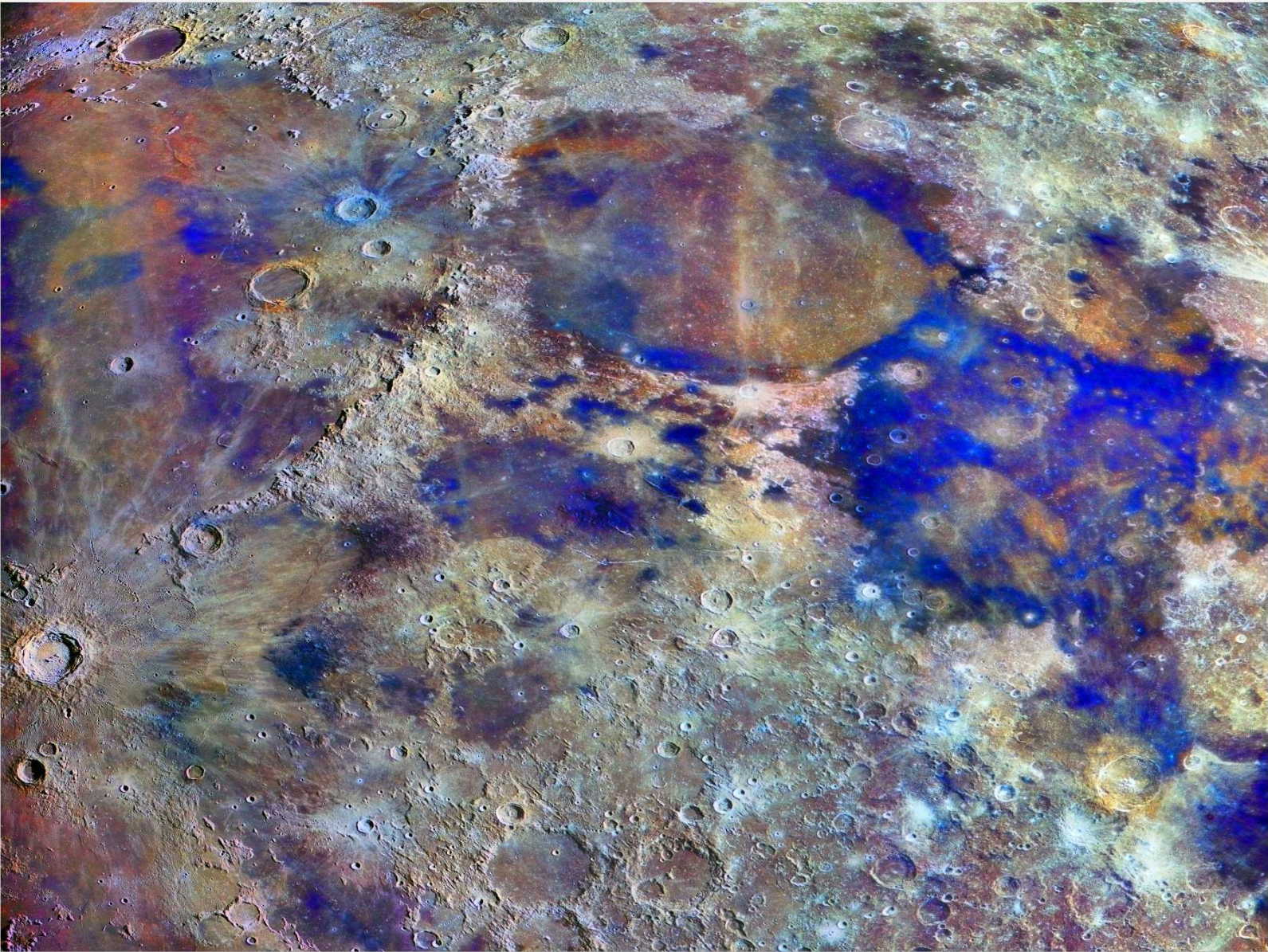
Select RAW if it is a RGB video

LOAD V/I button : open a dialog box to load the Video

RIGHT SIDE controls :

Information about FPS only.

IMAGE TREATMENT MODE (no camera control, no filter wheel and no mount control)



The same as Video mode except it is image treatment mode.

Debayer selection is not active. All images are considered as RGB images.

Some specific filters like 3FNR and AANR won't be actives.