

Thermography plugin User Manual

Thermography Plugin User Manual_20230531



REVISION HISTORY

Issue	Date	Para	Details
1.0.0	31/05/2022	All	Initial release
2.0.0	31/05/2023	5	Update for drag & drop



TABLE

1.	INTE	RODUCTION	
2.	How	<i>ı</i> to use the plugin	
	2.1.	Installation	3
	2.2.	Getting started	
3.	The	rmography Wizard	
	3.1.	Emissivity map	
	3.2.	Reference temperature	5
	3.3.	Save the calibration file	
4.	Load	d calibration data	
5.	Disp	ılay	

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1. INTRODUCTION

First Light Vision offers a thermography plugin to enable a Planck-based thermal calibration of an imaging device based on one of First Light Imaging's camera.

An imaging device comprises a camera, an objective lens of fixed aperture and eventually spectral or optical density filters. The following cameras are supported: C-RED 3, C-RED 2 Lite, C-RED 2.

Note: No accuracy is guaranteed.

2. HOW TO USE THE PLUGIN

2.1. Installation

The thermography plugin must be used with First Light Vision 2.5.1 software. It allows to enable/disable the thermography mode of First Light Vision.

To install the thermography plugin, the "Plugin_thermography_x_x_x.zip" should be unzipped in the installation directory of First Light Vision.

Please refer to the First Light Vision documentation if it is your first use.

2.2. Getting started

Open First Light Vision and go in the "Plugins" tab. If the plugin has been unzipped in the correct location, you be able to display the menu:



Click on "Enable" to switch to the thermography display and "Kelvin" or "Celsius" to choose your unit. When thermography is enabled, all display and image statistics in First Light Vision will be in degree instead of ADU.

A thermal calibration must be done beforehand, either through the thermography wizard or by loading a calibration file.



3. THERMOGRAPHY WIZARD

A thermal calibration wizard is available with the plugin. To display it, click on "Thermography Wizard". This wizard will guide you through the calibration process.

1 Thermography	_		\times
Page 1			
Welcome to the thermography wizard			
This will guide you to calibrating your imaging system to perform thermography with y The method used is based on Planck's law, with knowledge of the spectral behavior the camera will convert ADUs to temperature values. The steps are the folk	your FLI camera of the system, owing :	.	
1/ Load or create calibration data 2/ Save and export calibration data 2/ Use Elivision for thermography			
No performance is guaranteed by First Light Imaging. Accurate measurements ca in a range of 300°C to 1600°C with a precise calibration.	an be made		
		N	lext
Fig. 2 : Wizard page 1			



3.1. Emissivity map

On page 3 of the wizard, the emissivity of the studied objects' surfaces can be defined.

Emissivity is a value between 0 and 1 that characterises the ability of a surface to emit heat radiation. It is defined as the ratio of the radiance of the studied surface to the radiance of an ideal black body. Hence, the surface of an ideal blackbody has an emissivity of 1. In the plugin, the dependence of emissivity on wavelength is assumed to be negligeable.

[iii [*] Thermography		_		×			
Page 3							
Emissivity map							
Here you can define a map of the emissivity values of the image. This will be accurate if objects are not moving in the field of view. Emissivity values are in a 0 to 1 range.							
Constant Emissivity							
1.00							
□ Spatially not constant							
Threshold: 1000 ADU 📩 Background emissivity: 1	.00 <u>÷</u> Snaj	pshot					
	Zone 0	1.00)			
Zone 0							
Previous							

Fig. 3 : Wizard page 3

The wizard offers two solutions:

- "Constant Emissivity": a constant emissivity is applied to all the image
- "Spatially not constant" allows to define a map of emissivity with several regions. The "snapshot" button allows to capture the image that will be used for defining the regions. By tuning the ADU threshold, the user can create a map of regions of interests, labelled "Zone 0", "Zone 1", etc.
 For each detected regions, an emissivity value can be set. The "background emissivity" is the value for the background region.
- 3.2. Reference temperature



On page 5, a region of interest is used to create a temperature reference.

The object used for this step should have known, stable and homogeneous temperature and emissivity. These values have to be provided to the wizard.

The wizard enables the user to set the threshold min and max values in order to accurately detect the reference zone.

FIRST LIGHT	f [†] Thermography	_		\times
	Page 5			
	Reference			
	Please place a calibration object in the field of view of the camera. Ideally this would be a blac within the measurement range. Alternatively, you can use a grey body of know	ck body at a te n emissivity.	mperat	ure
	Please select the region of interest where temperature is known, stable and ho For simplicity purposes, the emissivity is considered to be independant of the w	mogeneous. vavelength.		
	Body emissivity: 1.00 🚊 Body temperature: 1000 °C 主			
	Please choose a good range of threshold to detect the reference.			
	Threshold min: 1000 🛨 - Threshold max: 8000 🛨			
		Previo	us	lext

Fig. 4 : Wizard page 5



3.3. Save the calibration file

Once the user has gone through all the calibration steps, the wizard will enable saving the calibration data and turning on the thermography display.

pert ⁺ Theorem or group have					~			
inermography					^			
Page 6								
	Using FirstLightVision							
Now that you have created or	loaded the calibra	tion files, you can activate the thermograph	y mode in Firstl	LightVis	ion.			
A	I the measuremen The defai	ut display will be a color scale						
_		(C)						
Save	e calibration file	Leave wizard and enable thermography	ļ					
				Previ	ous			
		Fig. 5 : Wizard page 6						

4. LOAD CALIBRATION DATA



Once a calibration file has been created and saved using the wizard, it is possible to load it by clicking on "Load calibration data", then enabling the thermography mode.

The calibration file is a JavaScript Object Notation (JSON) format data, composed of all the data entered by user during the wizard:

- QeFile: corresponds to the quantum efficiency file used by the plugin (depending on the camera)
- ambiantTemp
- BodyEmissivity
- bodyTemperature
- isConstantEmissivity
- isKelvin
- refAduMean
- waveLengthMax
- waveLengthMin
- emissivity

All these values can be changed manually in the file by the user.



5. DISPLAY

When the thermography mode is enabled, the software will display the current image in a false color scale and in temperature units. All the usual features of First Light Vision will be available.



Fig. 6 : Display image with thermography mode enabled

The user can save the image stack in a custom ".thr.raw" format. In this format, the pixel values in degrees are multiplied by 10. This format can be opened by any software keeping in mind that the degree value is the pixel value divided by 10.



The ".thr.raw" format store the temperatures (x10) as double (64 bits) therefore to open such a file in a image software you will have to specify the image type such as 64-bit Real, the size of the image and check the number of images.

To open it inside Imagej for instance you will need to specify (for instance):

🛓 Import>Raw		×				
Image type:	64-bit Real	-				
Width:	640	pixels				
Height:	512	pixels				
Offset to first image:	0	bytes				
Number of images:	1000					
Gap between images:	0	bytes				
 ✓ White is zero ✓ Little-endian byte order ✓ Open all files in folder ✓ Use virtual stack 						
ОК	Cance	Help				

The import of a ".thr.raw" file inside First Light Vision is made possible by a simple drag & drop of the file in the Buffer area, the image type will be automatically detected as double. The dialog box will look like that (for instance):

📓 ⁺ Load RAW Buffer		?	×
Image type:	double	•	
Width:	640	÷	ixels
Height:	512	÷ P	ixels
Offset to first image:	0	÷ 6	ytes
Number of images:	100	€(Max
Ok	Cance	ł	

The thermography plugin is not needed to read these files since they already store some temperature values.