



VIDEO PIPELINE & ADVANCED FEATURES
ON LEPTON USER APP

Advanced Lepton[®] Usage on Windows[®]

REV - 06/26/18



Presentation Outline

The purpose of this presentation is to demonstrate the following:

- Discover the Lepton User App advanced functionality
- Learn differences between Colorized & Raw images
- Introduce Automatic Gain Control (AGC)
- Demonstrate how to change palettes and when to use them
- Learn about TLinear and how to calculate pixel temperatures

Requirements

Everything covered in **PureThermal 2 & Basic Lepton Features** including:

- Lepton Camera
- Lepton User App
- Supported PureThermal board
 - *WARNING: Firmware v1.0.0 doesn't support the PureThermal 2 board*
<https://github.com/groupgets/purethermal1-firmware/releases/latest>
- Windows 10 PC running the Lepton User App
- Knowledge of the Lepton User App basic functionality

Colorized or Raw?

Colorized

- Lepton creates a pseudo-color image
- Coloring is based on the current palette
- FLIR default is Automatic Gain Control (AGC), applied in the Colorized mode (RGB 888)
- Lepton outputs images colorized RGB888
- PureThermal supports output of a variety of other color formats
- Lepton User App saves images as jpegs

Example colorized output



Raw

- Each pixel value is represented in grayscale by 16 bits
- Pixel value can cover all 14 bits of thermal information from the Lepton
- This information contains thermal data
- Normalization such as automatic gain control (AGC) should be applied to create a visible usage image. When in RAW video output mode, the user will need to apply their own AGC algorithm to obtain the best contrast of the scene
- The Lepton User App saves images as a tiff file

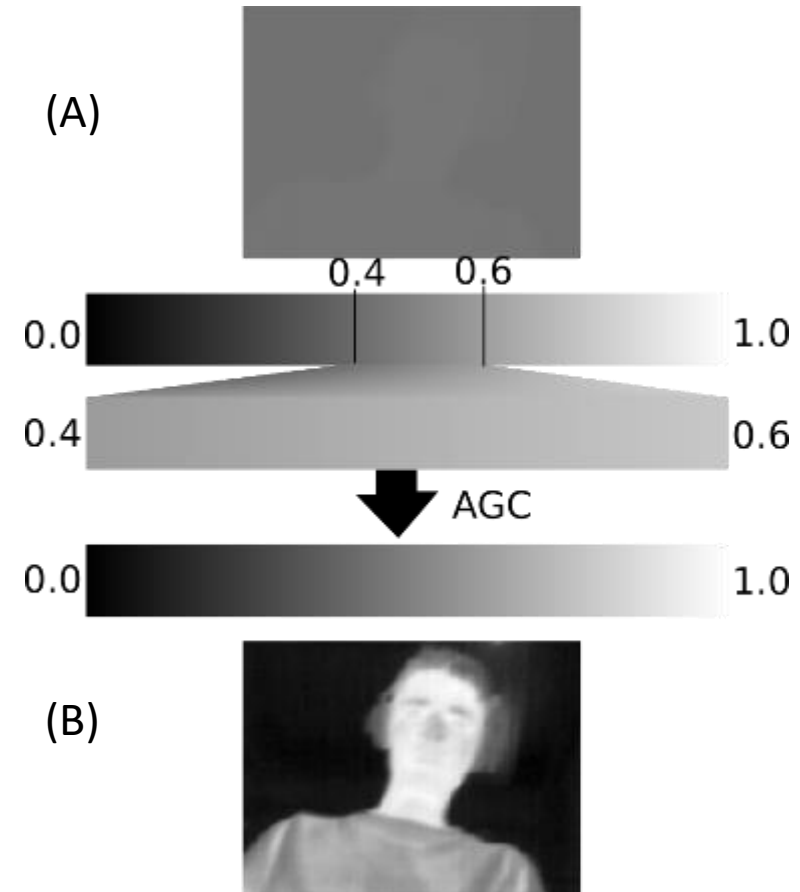
A non-normalized thermal image



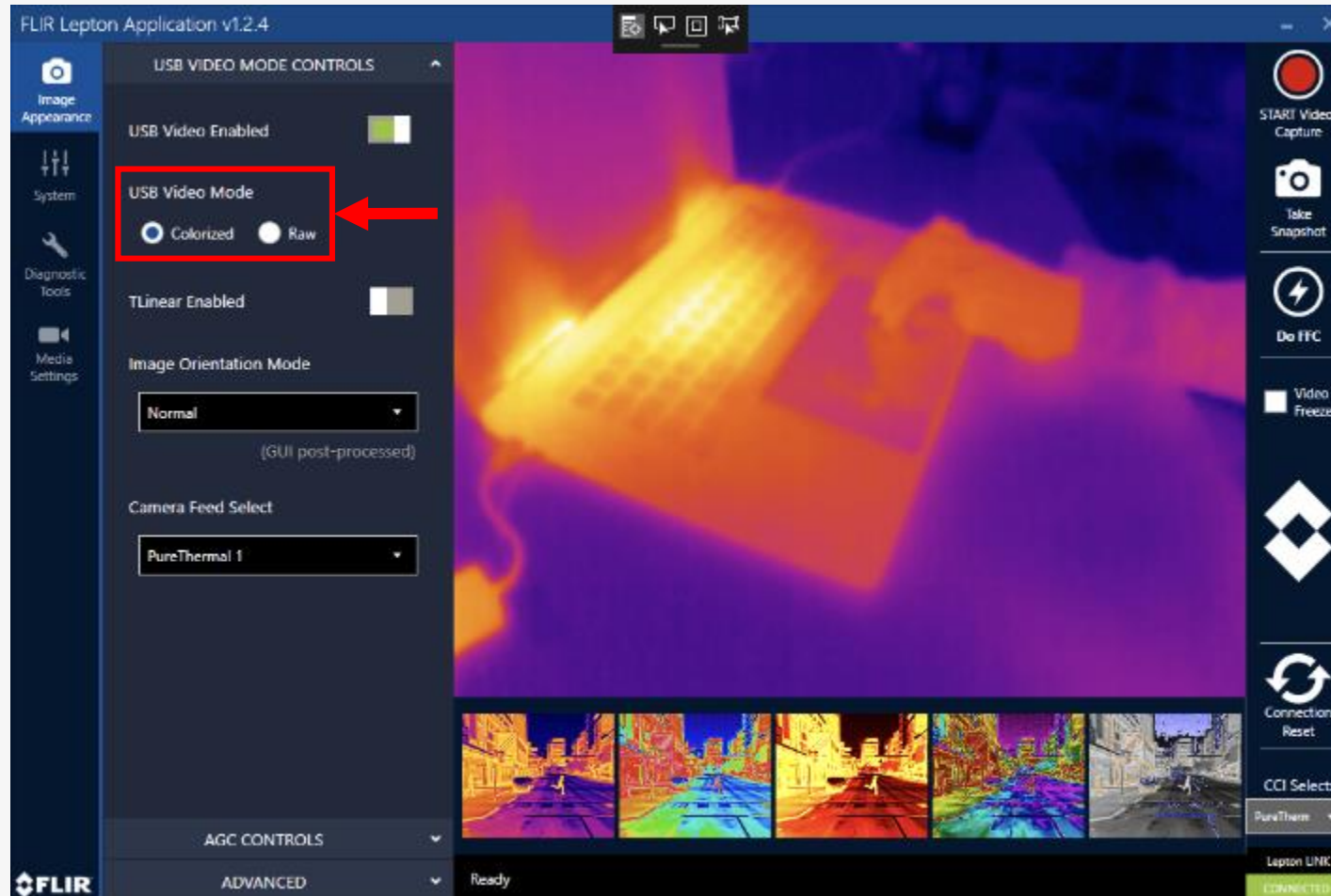
Normalization - Automatic Gain Control (AGC)

- A. Viewing raw thermal images can be challenging
- Unless there are huge temperature differences, the hottest and coldest pixels look the same
- B. Applying an AGC is used to set the coldest pixels to 0 and the hottest to 1
- The app performs this when displaying the RAW image

Normalization on a raw thermal image



Toggling in the App



Viewing the Images

- Saved colorized images can be viewed normally with most image viewers
 - Lacks ability to extract temperature data
- Raw images cannot be viewed like a regular image
 - Need to use a viewer such as ImageJ which applies normalization
 - Allows for the recovery of temperature data if captured with a calibrated camera

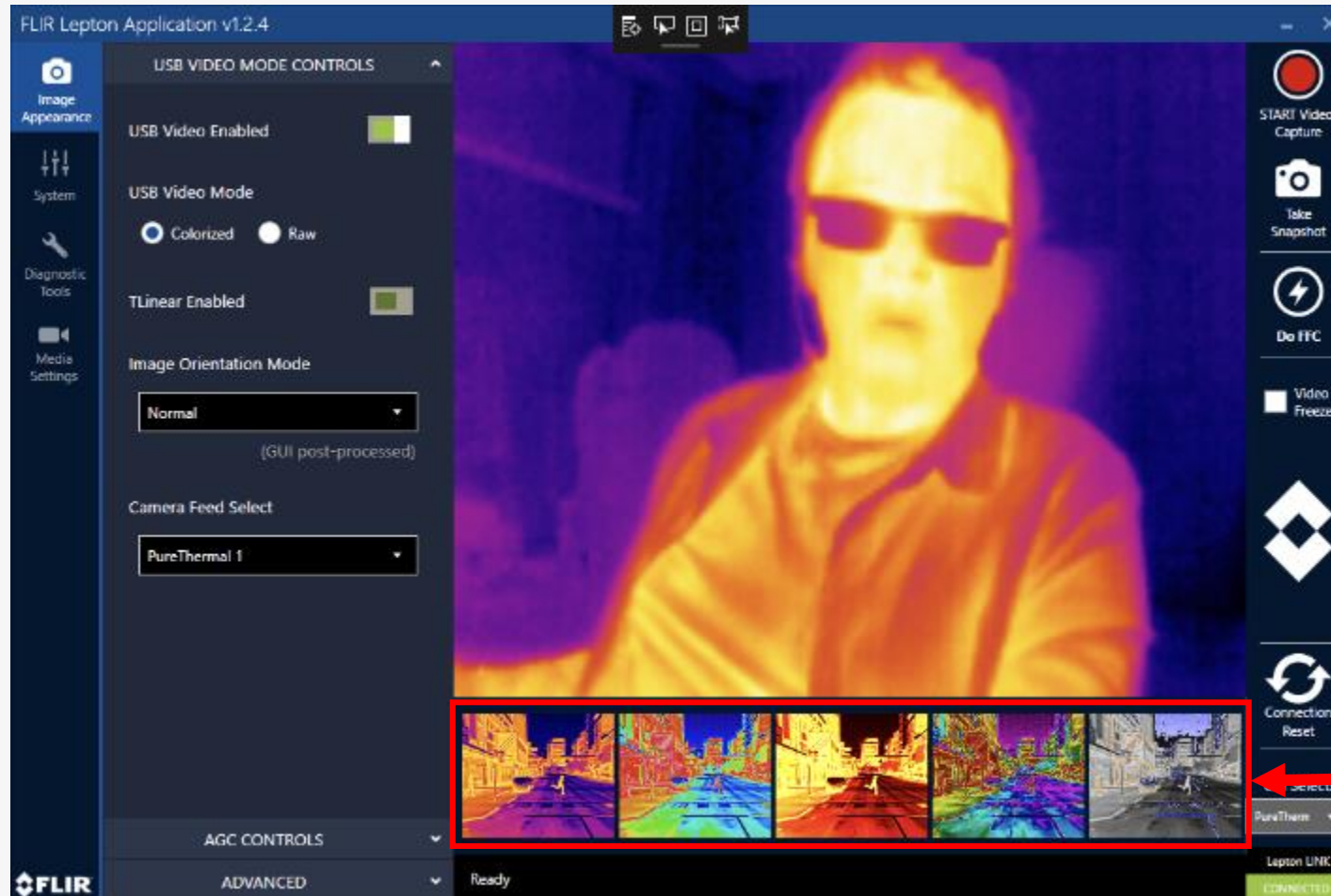
Raw images viewed by a normal image app



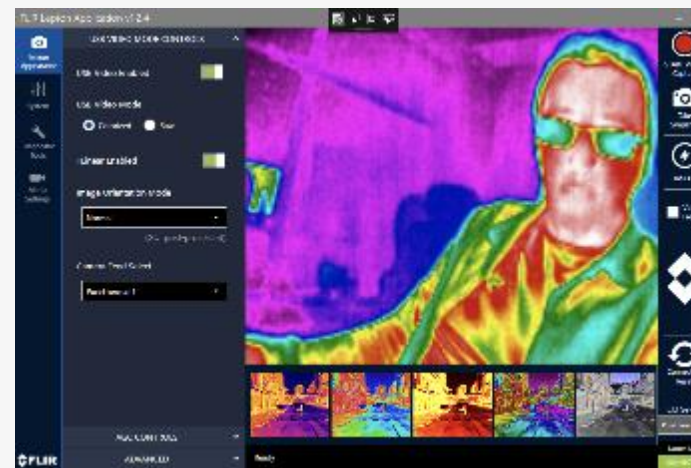
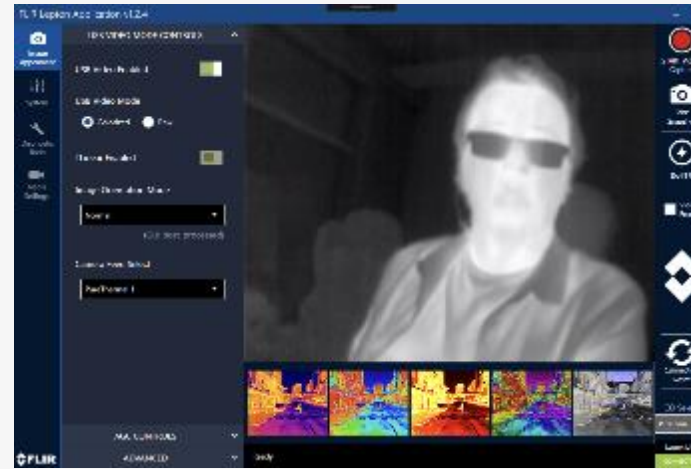
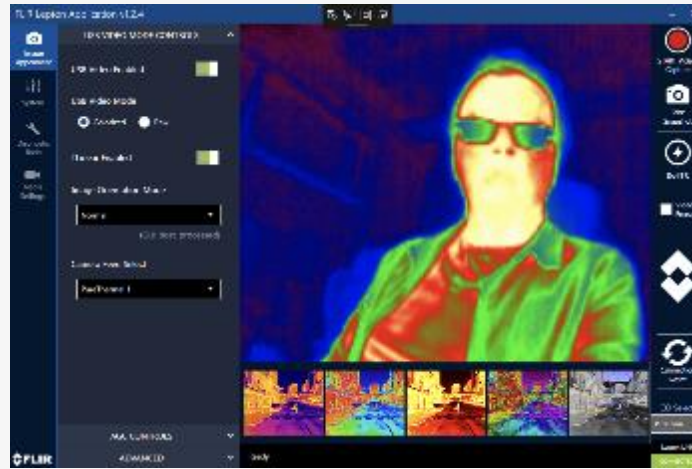
When and Where to Use Palettes

Changing Palettes in the App

- The Lepton will have a default palette at App launch
- Select the different buttons to change the Lepton's palette



Palettes Examples

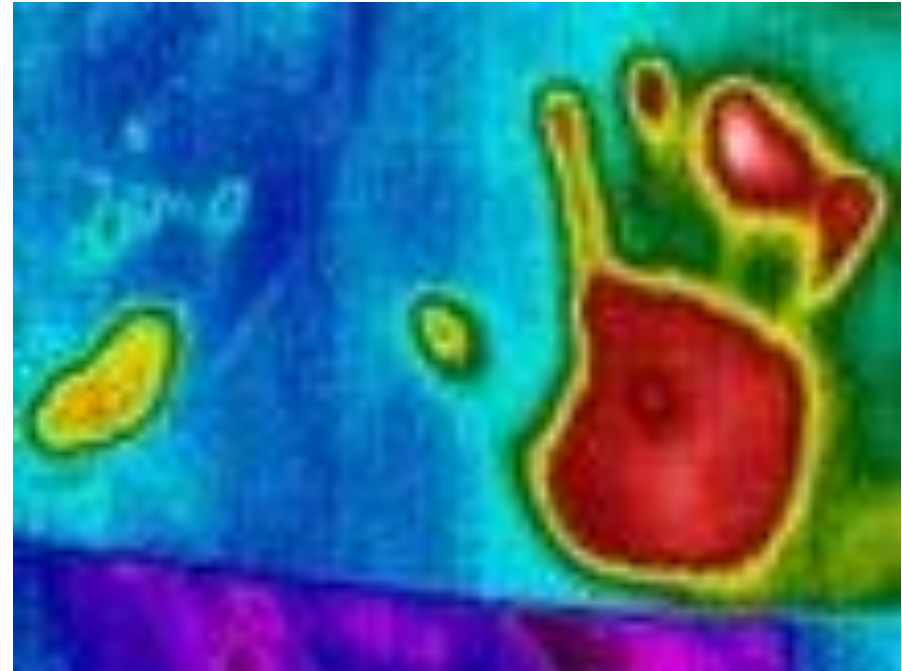
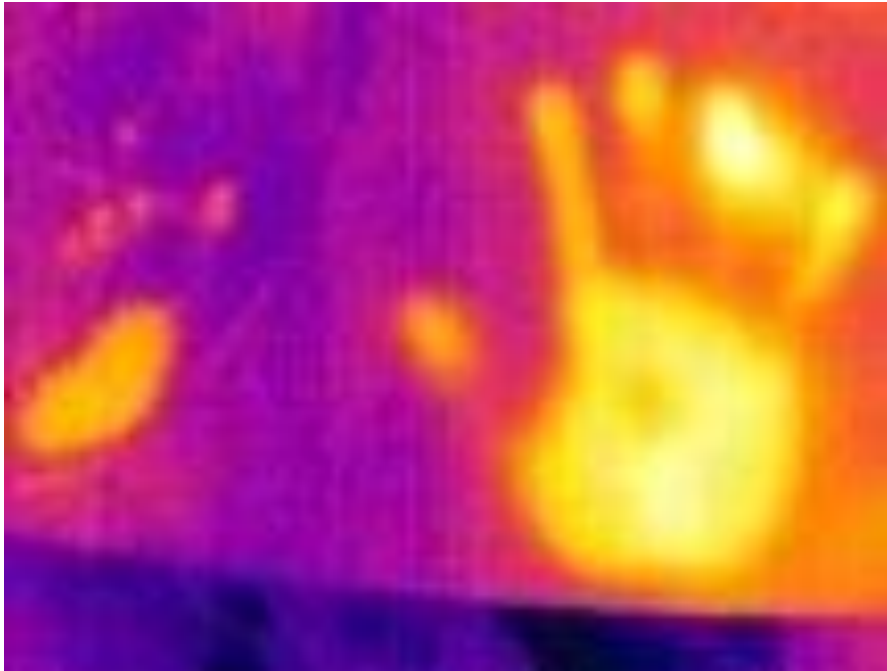


Why are different palettes needed?

- User preference
- The best palette to use varies by application
 - Range of temperature in scene
 - Temperature of target in scene
 - Objective of application
- Test multiple palettes to distinguish differences in temperature more clearly

Example Use Case

The image on the left is clearly a handprint, the one on the right is less clear



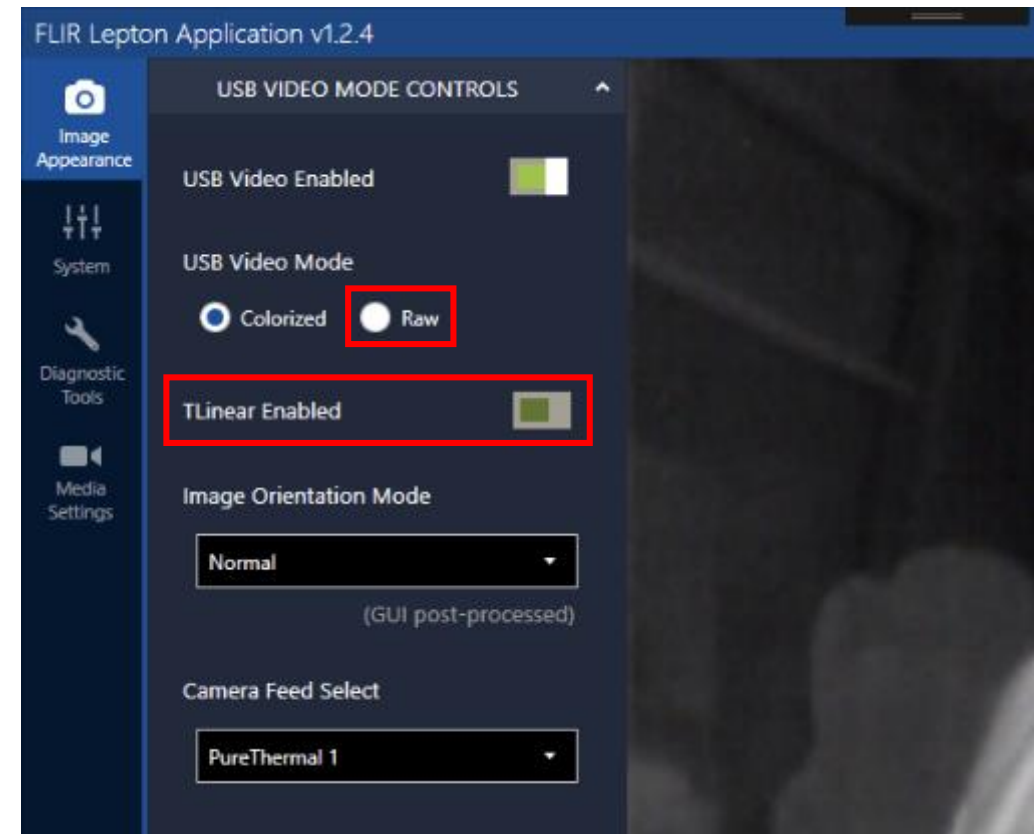
TLinear Mode to Get Temperature

TLinear

- Lepton 2.5 and 3.5 both support Temperature Linear (TLinear) mode
- Each pixel represents the temperature at that point in centikelvin (cK)
 - Convert centikelvin to Celsius with $TC = TcK / 100 - 273.15$
 - Where TC is the temperature in °C and TcK is the temperature in cK
 - Example: $29587/100 - 273.15 = 22.72^{\circ}\text{C}$

Saving images using TLinear

- Supported in Lepton 2.5 & Lepton 3.5
- Switch to Raw mode and enable TLinear
- TLinear is not available in Colorized USB Video Mode



More Information

- Learn more about Lepton and join the conversation on our developer forum at the [Lepton Developer Site](#)
- Firmware [download page](#)
- Click [here](#) to learn more about PureThermal 2



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