



Application Note #4

How to use : «Intensity range and visualization setting»

The application-note purpose is to guide the user in performing a correct intensity range setting and all the related adjustment operations of the image visualization.

Application Flowchart

Color Bar

- Color bar allows to modify the dynamic range.

Color Settings

- Color Settings allows to optimize the dynamic range.

Gamma Correction

- Color Settings allows to optimize the dynamic range

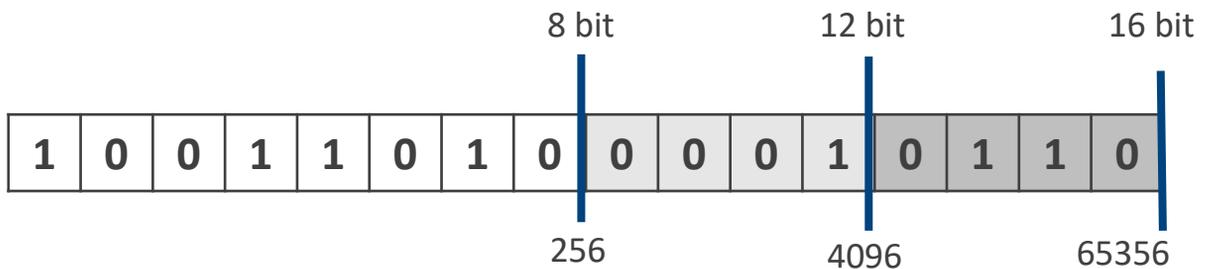
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1. Basic concepts
2. Color Bar
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4. Gamma Correction

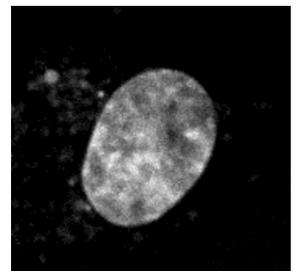
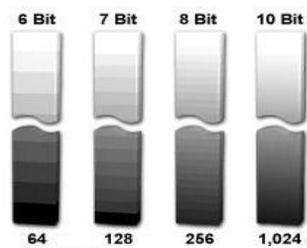
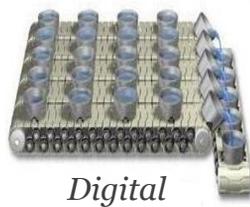
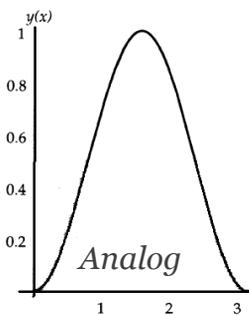


1. Basic concepts

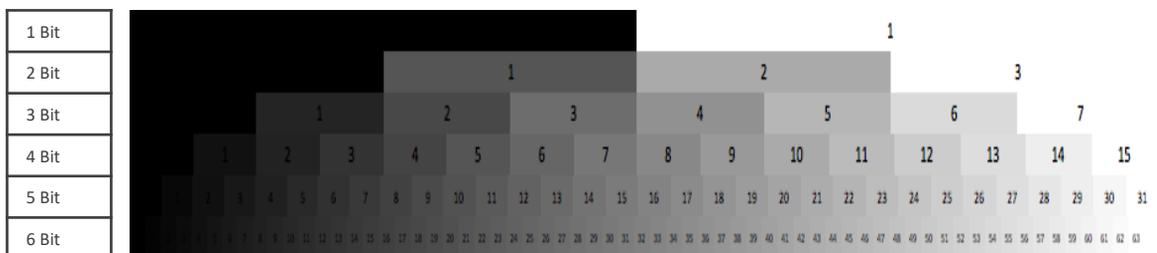
1.1 The **dynamic range** of the image represents the number of discrete values (Gray Levels) that make up the numerical scale used for the conversion of the analog signal into its digital form. The gray scale has a number of predefined ranges (8bit-256 GL, 12bit-4096 GL, 16bit-65356 GL), the range is also called Bit-depth



The **dynamic range** of the image is determined by the physical features of the acquisition device used.



1.2 Each numeric value (bin) on the gray scale represents an intensity level. The wider the numerical scale the smaller the level described by each bin.



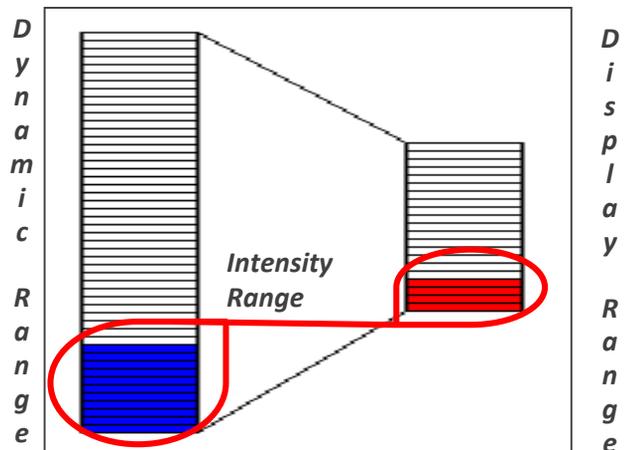
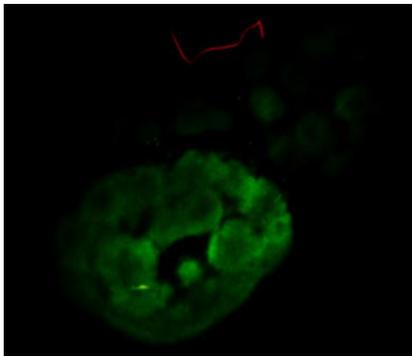
1. Basic concepts (continue)

1.3 The *Intensity range* of the image represents the real amount of Grey Levels describing the source signal intensity.

The *Intensity range* always fits with the *dynamic range*.

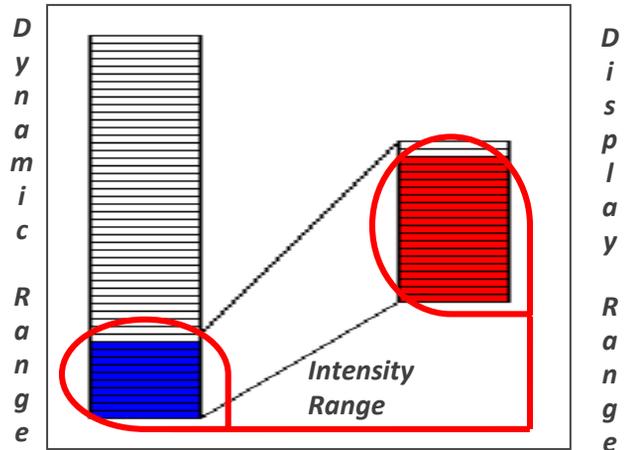
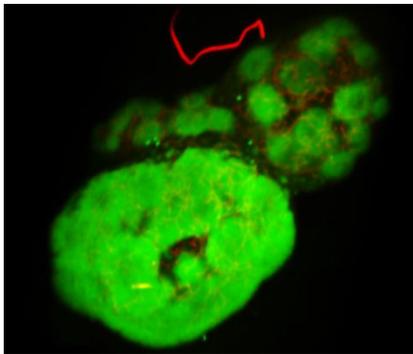
However, it could occupy only a small part of the whole *dynamic range*, typically the low part. This happens especially when the Bit Depth is bigger than 8 bit.

1.4 By default, the full *dynamic range* is mapped on the monitor screen for visualization purpose (*Display Range*). This means that, when the *Intensity range* is described by few Grey Levels, a dim or an almost black image is displayed. The intensity information are there but the observer cannot distinguish the image details.



1. Basic concepts (continue)

1.5 Using the dedicated controls, only part of the *dynamic range* can be mapped on the monitor screen (*Display Range*). This operation allows a better distribution of the real signal over the Display Range improving the details visualization.

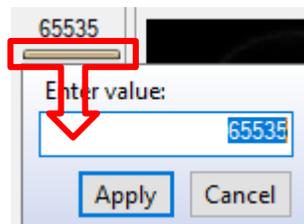


2. Color bar

2.1 Vision4D User Interface shows a *Color Bar* for each channel present in the dataset (The channel visibility must be set ON). The *Color Bar* usage has several purposes, one of them is the Dynamic Range optimal mapping respect to the Display Range .

2.2 Dragging the top and bottom slider along the Color Bar, the Dynamic Range can be freely set .

2.3 Right mouse click on the slider. The top or bottom range value can be digit manually



DETAILS:

The Dynamic range of each available channel can be adjusted independently.

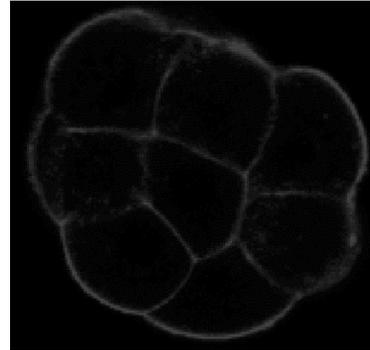
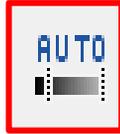


2. Color bar (continue)

NOTE:

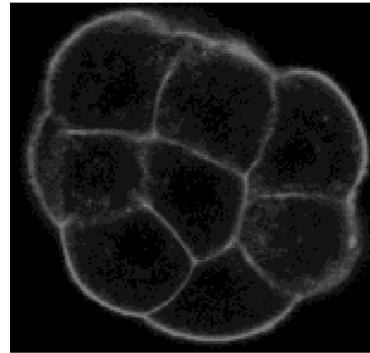
The Dynamic range changing does not influence the intensity measurements.

2.4 Pressing the *Auto* button, Vision4D computes the best Dynamic Range setting based on the active Z plane intensity distribution (Histogram).

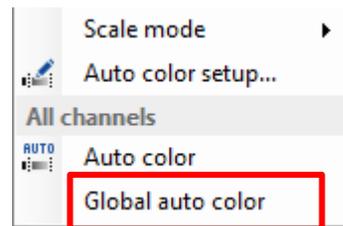


TIPS:

The active Z plane can be changed using the Navigator panel controls. Please refer to the (*arivis Vision4D Help*) for more details



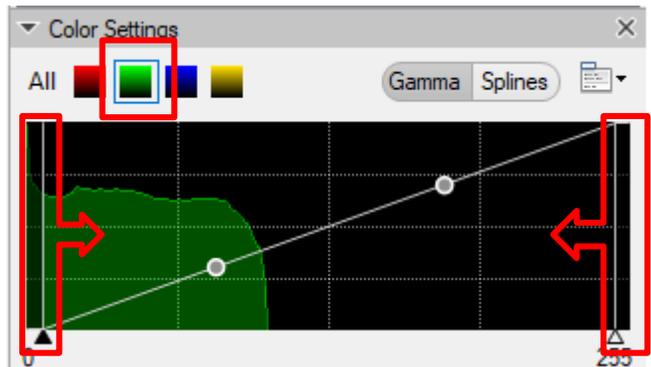
2.5 Right mouse click on the Auto button. A pop-up menu is displayed. Select the Global Auto color item to compute the best Dynamic Range setting based on all the Z planes Histograms.



3. Color settings

3.1 Basically, the **Color Settings** panel allows to modify the Dynamic Range mapping as already shown here above, but with a different approach. The range limits can be adjusted by dragging the end lines of the graph.

The target channel must be selected before moving the graph limits



4. Gamma Correction

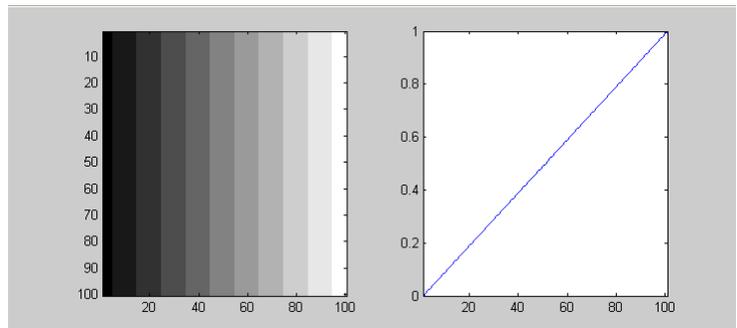
4.1 **Gamma** is an important but seldom understood characteristic of virtually all digital imaging systems. It defines the non-linear relationship between a pixel's numerical value and its actual luminance. Without gamma, shades captured by digital devices wouldn't appear as they did to our eyes (on a standard monitor). Understanding how **Gamma** works can improve the image visualization and the details visibility. Our eyes do not perceive light the way the acquisition devices do. With an acquisition device, when twice the number of photons hit the sensor, it receives twice the signal (a "linear" relationship). That's not how our eyes work. Instead, we perceive twice the light as being only a fraction brighter — and increasingly so for higher light intensities (a "nonlinear" relationship).

4. Gamma Correction (Continue)

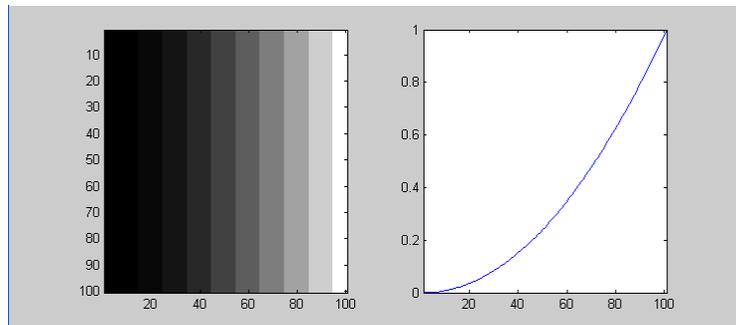
Compared to an acquisition device, we are much more sensitive to changes in dark tones than we are to similar changes in bright tones. There's a biological reason for this peculiarity: it enables our vision to operate over a broader range of luminance. Otherwise the typical range in brightness we encounter outdoors would be too overwhelming.

Here below some examples to clarify practically the **Gamma** concept.

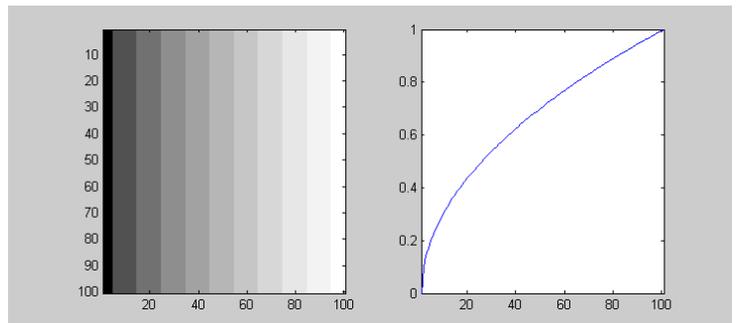
Gamma = 1.0
a "**linear**" transfer function.
This is the default value



Gamma = 2.0
a "**non-linear**" transfer function.
The dark part of the range is expanded



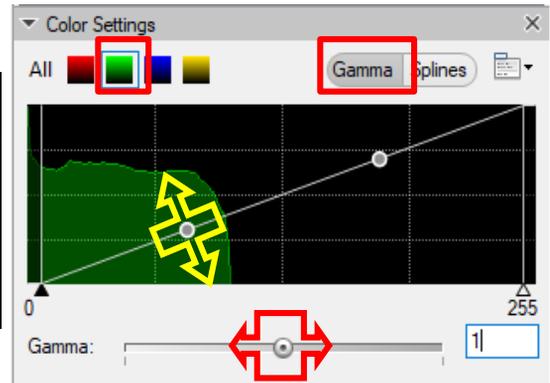
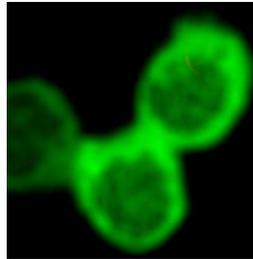
Gamma = 0,5
a "**non-linear**" transfer function.
The bright part of the range is expanded



4. Gamma Correction (Continue)

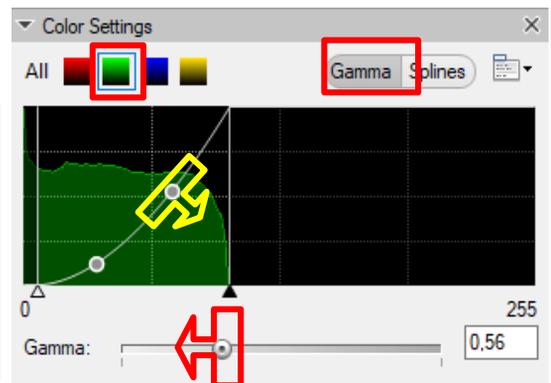
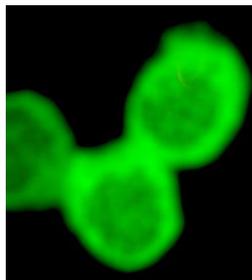
4.1 The **Gamma** value can be modified dragging left or right the gamma slider or directly inputting the value in the text box. The curve shape can be also modified.

Gamma = 1.0 - "linear".



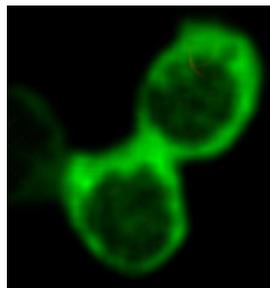
Gamma = 0,5 - "non-linear"

The bright part of the range is expanded



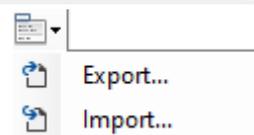
Gamma = 1,98 - "non-linear"

The dark part of the range is expanded



TIPS:

The Color Settings parameters can be exported / Imported as file.





Contact the arivis application support to receive additional technical details about the topic described in the application note, or how to adapt the application workflow to your requirements.

“The quantitative analysis of the images represents the art of transforming a visual sensation into its schematic and discrete form allowing its univocal description, classification and mathematical and logical interpretation of its spatial and temporal components”

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