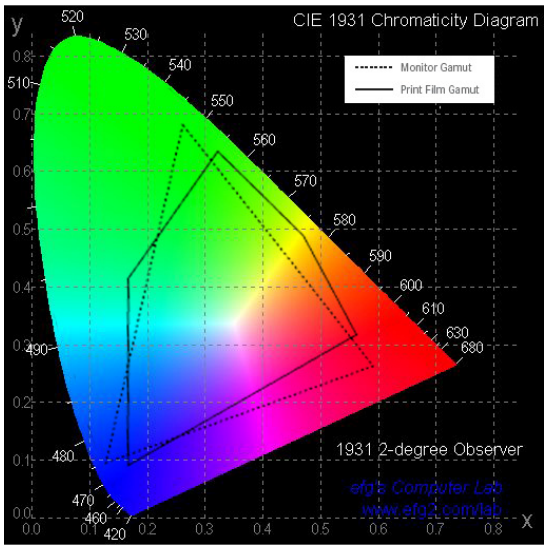
Lut (**L**ook **U**p **T**able), is a structure of data in a table form that relates values of entrance to others of exit. Luts allows to the file conversion of each pixel in a frame to another value. The LUTs are used to correct of gamma, conversions LOG- LIN and for colorimetries adjustments; normally to simulate other spaces of colour different from the original one, for example to see in a monitor the appearance of the image with certain photographic emulsion.



In the graph it is possible to be observed on the space of visible colour to human eye, the range of tones that can reproduce so much a monitor CRT as a film print. As you can see the emulsion catches Cyan/green colours that the monitor cannot or as this it uses red and magenta colours that the emulsion does not reproduce. Since these, there are other spaces of colour of representation like the CYMK, Lab, Luv, HLS, or versions different from the same space, for example RGB in digital projectors or monitors LCD, TFT, etc.

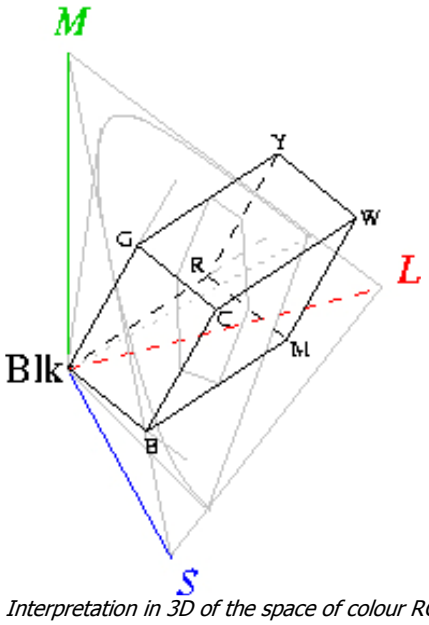
We can talk about different kinds of LUT according to its use: those that serve to calibrate and to simulate processes of other spaces of work and those that are used of creative form to have a certain appearance of the image. First they serve to assure that during the post production we see in the different processes from monitored the same result in relation to the final image, or this in 35mm, digital projection or TV. Thus the post production houses create their own LUTs for the adjustment between all the machines that take part in the process: monitors, software, scanners, film recorders, etc... The second type of LUTs serves to give to the image a certain appearance changing for example the colour balance, their saturation, contrast, as well as it fits in the shades and the high lights, etc.

A typical monitor CRT uses to generate the colour, Red, Green and blues phosphorus (RGB), so that the range of colours that can reproduce comes determined by the election of these phosphorus and thus each monitor has its specifications and there is no responds equal, although the values of colour RGB come determined by concrete standards (CIE). In a tube screen each primary colour is independent of the other two and the sum of the three primary to its maximum intensity produces the white target, so that the sum of the components in different values generates the different greys: x.R + x.G + x.B = x.White where x is greater or just as 0 and minor or just as 1. Being this thus, a value of entrance for a primary one creates a value of exit that just by primary one. And this is what we know like 1D Lut that works reasonably well in the surroundings of monitors CRT and LCD. Graphically:

3 1D LUTs

IN		OUT	
R	.5	R	.4
G	.3	G	.27
B	.2	B	.11

The digital projectors as well as the photographic emulsions behave of another way, for example first they add a new value of white that serves to increase the brightness and extend the primary ones to obtain a greater range of colour, so that the sum of R G and B does not give the white target like in the monitors; the photographic emulsion on the other hand, does not separate the red one, green and the blue one of independent form but that always are crossings of colour between the three layers that form the film, in addition that, film uses the subtracting system of colour instead of the additive of the monitors. In order to adapt better to these surroundings and to have a more precise transformation among them, one resorts which we know like 3D Luts which we can expose thus: [r 0 0] - [rR rG rB] so that for an entrance of value of a primary colour three values correspond, each one to a primary RGB, creating then a colour cube space.



Interpretation in 3D of the space of colour RGB on the colour cone defined by CIE with the dimension of brightness (http://en.wikipedia.org)

Graphically:

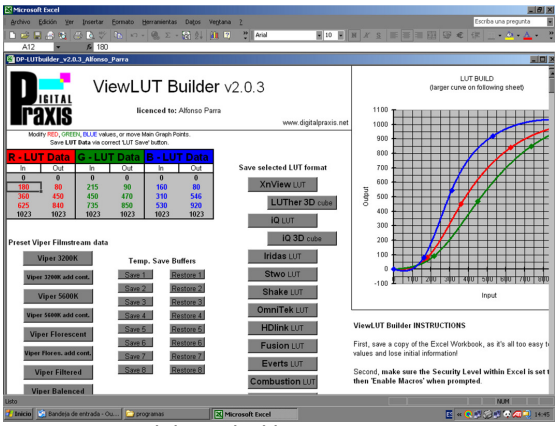
3D LUTs

IN		OUT		
		R	G	B
R	.5	.4	.01	.01
G	.3	.01	.27	.01
B	.2	.01	.02	.11

Serve this brief introduction to see now as the directors of Photography we can create our own LUT by means of specific programs, since at the present time we used the digital cameras with the greater possible dynamic range, modifying curves of gamma or linear or logarithmic, and needed to reconstruct for a correct image reproduction on monitor during the shoot, because these, so which is recorded, usually is very smooth, without contrast and with well-known deviations of colour.

For it, we are going to see the digital Praxis program LUTbuider by its simple handling. This program allows designing LUTs 2D and 3D as much for the curved correction of colour as well as of gamma to use with the cameras of Sony F900 and 950 by means of the CVPFile Editor.

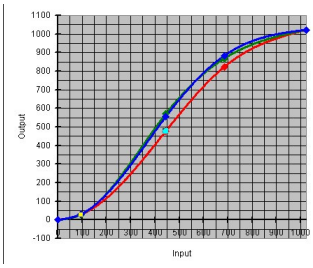
In the program the values of entrance and exit in RGB can be put seeing the modifications on the graphical curve and soon to keep it to load it in different software, therefore I could for example be kept for Combustion, Avid, Fusion, Xnview, IQ among others. Also preset values can be used, for example for the correction of the green tone of the Viper camera or to correctly visualize the images caught by the Sony cameras with curves DP also designed by Digital Praxis or those of the camera Genesis of Panavision. These LUTs we use it on shooting to visualize the images in the monitors of standard form considering that the recorded original image is not affected. Next to this first visual correction of the image we added another one more, than through different programs from correction of colour in the location, it allows us to get to have an image very near the final result in screen.



Aspecto general de LUTbuilder

Some examples:

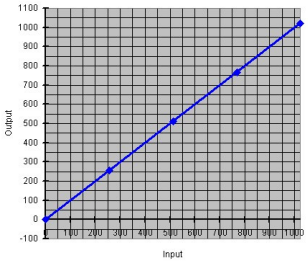
Original image of camera Sony F900/3 with the Digital Praxis curve Cin Log 709.



LUT applied to the image

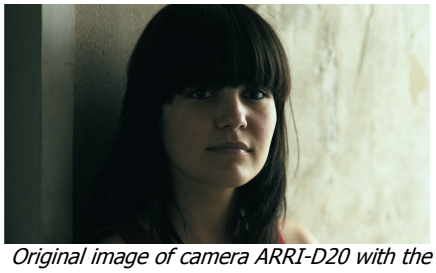
Final result in the monitor of set

Original image of camera Sony F900/3 with the Digital Praxis curve Cin Log 709.

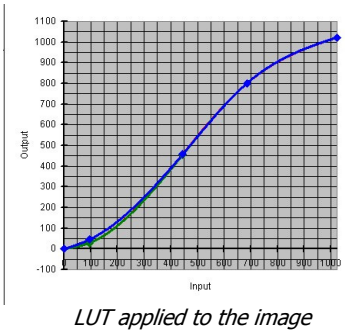


LUT applied to the image

Final result in the monitor of set

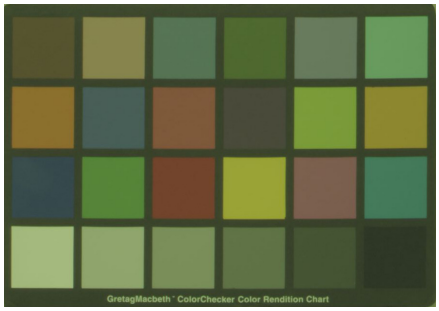


Original image of camera ARRI-D20 with the curve of Linear gamma ITU-R BT 709 EI 320

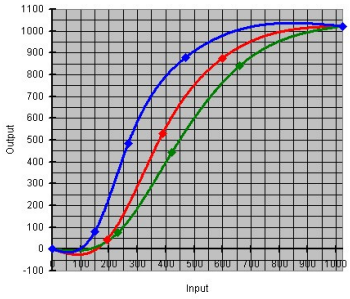


LUT applied to the image

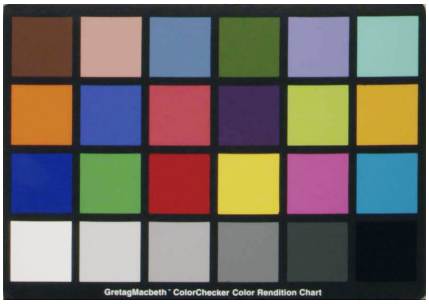
Final result in the monitor of set



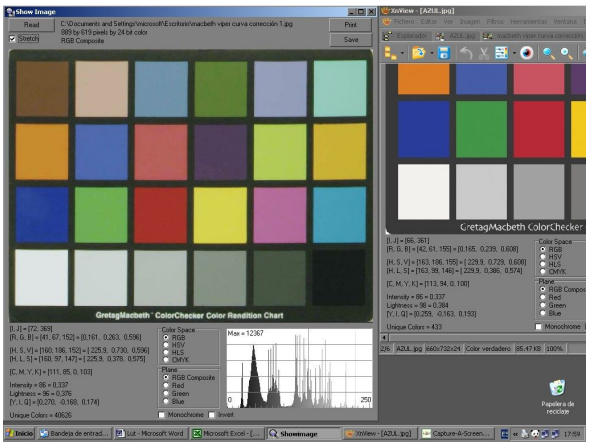
Original image of camera Viper. Filmstream



LUT applied to the image



Final result in the monitor of set



In order to balance Macbeth colour chart photographed by the Viper camera, we have gone fitting the values of the original image comparing them with a Macbeth reference chart in RGB. According to the measured values we have been modifying the curves until obtaining most suitable.

The process of work for the creation of LUTs would consist first of seeing that modifications we are going to make in the camera, well of gamma, colour, detail, etc. and once decided these to photograph a grey charts along with a colour chart and capturing created the different photogram to apply the LUTs to them with the LutBuilder until obtaining the wished result. The process can finish here if a specify grading is not desired to the image, but if it is not thus, the LUT can be loaded in programs of correction of colour in a laptop one and be made an approach of grading that serves as much as reference on set as in post production. The important thing in this second step is to have the guarantee to have a monitor properly calibrated and good surroundings adapted.

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