The Examinations Of The LCD Monitor Parameters In Case Of The RGB Basic Colour-Stimuli

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Abstract

Nowadays thanks to the technical improvement, in more and more fields of research and workplaces are applied computers and at the areas of Computer – Aided Design (CAD) and Desktop Publishing (DTP) are indispensable the certification (calibration) of the monitors which are controlled by computer. My future aim will be to design a cheaper instrument which is simpler for his construction and usage. For this reason the available monitors on the markets have to get to know the monitors' construction have to be studied. The simplest way for it is to process the results of measuring the different monitors' parameters. For this reason at first I have to examination the most commonly applied panel types more fully; because the panels are the most important parts of the LCD monitors.

1. Introduction

Nowadays, the originality and the quality of reproduced colours are more important in more fields of research and workplaces. Therefore, the different devices of the colour-correct visualize are becoming more important, for this reason, it will be important to calibrate properly these displays, too.

In the case of monitors the calibration means to have a hold on the parameters of photometry, radiometry and colorimetry. Hereby, it will become possibility that the visualization occurs in accordance with the colour-correct expectation.

The calibration may be happened two different ways: one is the instrumental (to set a specific parameter) or another is the visual calibration (to manipulate the visualization). In case of the visual calibration, we calibrate the system with help of the ICC profile or the point of view on the given parameter. Meanwhile, to accomplish the instrumental calibration, more types with concept of operating spectroradiometers or detectors may be obtained in commerce.

We may execute the calibration of the monitors with the next influential parameters: contrast, brightness, gamma-curve and colour-temperature. However, the calibration requires the fast and precise measurement but to measure and analyze the different parameters are time-, cost- and calculation-consuming task. For example to measure the colour-temperature, you need spectroradiometer or measuring instrument, which all are complicated application and construction and very expensive.

For this reason, it would be more practical to create and design a new single construction and easy usable device. For this it is necessary to recognize monitors, to study the construction of the monitors as well as to recognize and examine the different parameters of the different types of the monitors which are on the markets.

2. LCD monitors

The development of the monitors has been based on three different concepts. The oldest monitor type is the CRT (Cathode Ray Tube) monitor. The next is the PDP (Plazma Display Panel) and nowadays the LCDs (Liquid Crystal Display) gain bigger ground.

The LCD display may be disassembled three main parts: onto the panel, the background lighting and the controller electronics (Fig.1.).

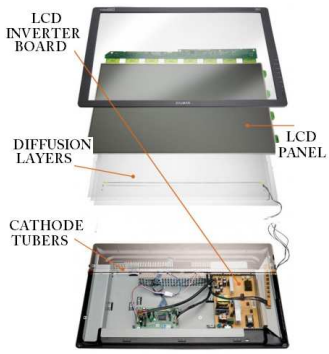

Fig.1. The LCD display

The given product's contrast, brightness, colour-reproduce and gamma-characteristics depend on these three components and on the consonance of the single parts. In general, the manufactures do not show the type of the panel but the quality of the monitor is basically determined by the panel types.

3. Measurement and Conditions

In the course of the measuring, the different types of LCD monitor spectral output distribution and the measuring of the gamma-characteristics had been done with the measuring of the three basic colour-stimuli (red, green, blue) in all cases. The measurement was carried out by SPECTROCAM spectrophotometer. During the measuring the monitor's contrast and brightness were 100 per cent and I calibrated the instrument after the measurement of all of the parameters of each monitors.

I was curious to two things. On the one hand, that the spectral output characteristics in case of the different colour-stimuli how they have a relation together (are they look like each other or deviate? and if the answer yes, the question is how much?, …), and on the other hand the question is the construction of the gamma-characteristics in the case of the different panel types monitors.

I measured nearly sixty different types and product monitors that were mostly LG, Samsung and Fujitsu-Siemens monitors.

4. The results of the measuring

4.1 The spectral output characteristics of the different LCD monitors

In the first case, my main task was to represent the spectral output characteristics in every red, green, blue and white (amount of the 3 colours) colour stimulus, too. In each case, I measured three times and finally I illustrated the average intensity as a function of the wavelength (I took up the values as 5 nanometers).

Some measured monitors characteristics visible in case of the white colour-stimuli (Fig.2.) and the green colour-stimuli (Fig.3.), too.

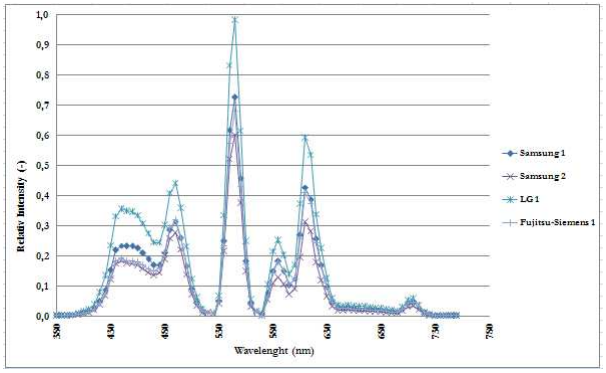

Fig.2. The LCD monitors spectral characteristics in case of the white colour-stimuli

After analysis of the curves, it is visible that the spectral characters are similar they are only deviated in dimension of value from each other in the different panel types. It will be possible to use these similarity qualities advantageously later in, of course, in planning the methods.

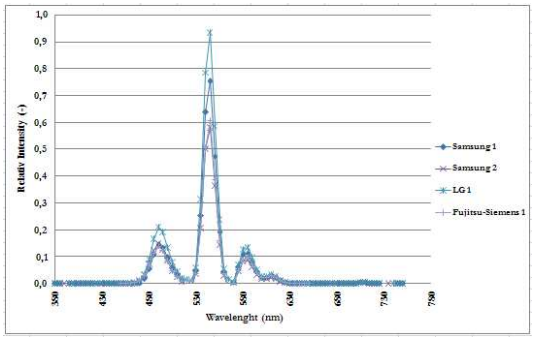

Fig.3. The LCD monitors spectral characteristics in case of the green colour-stimuli

After representing the blue colour stimulus spectral characteristics (Fig.4.), it is possible to discover a so-called "anomaly" which is connected with the uptime or any other technical parameters.

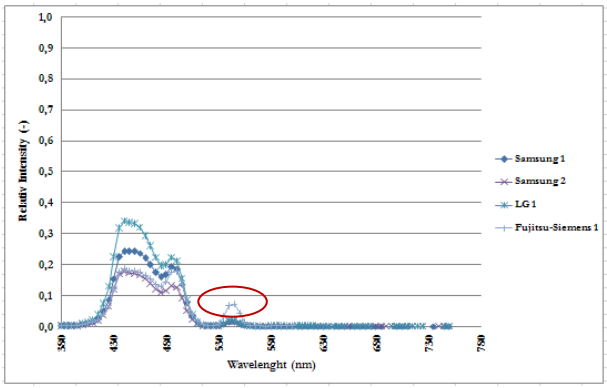

Fig.4. The LCD monitors spectral characteristics in case of the blue colour-stimuli

4.2 The gamma characteristics of the different LCD monitors

The gamma-characteristics are the most important among the measured parameters of the monitors, because it helps the other parameters besides the spectral characteristics to be calculated.

To the definition of the channel-characteristics, I measured the primary colour-stimuli 10-10 DAC values, completely until zero. I set the monitor's brightness and contrast to 100 per cent every time. In case of the monitors, where it was not possible to set the colour-temperature to 6500K, there I set the blue-green-red values to 50-50-50 per cent with help of the monitor's OSD menu, which it corresponds to the 6500K.

I accomplished the measurement about the 3 main colours stimuli separated, each measurement was performed 3 times and I took the specific diagram for the monitor and finally I represented the average light intensity as a function of the DAC (0-255) values.

Representing the different gamma-characteristics in case of green colour-stimuli (Fig.5.), you may observe two things. One thing is that there are curves like the CRT gamma-characteristics, another thing is that certain curves straighten when they achieve (i.e. brake down) certain DAC values.

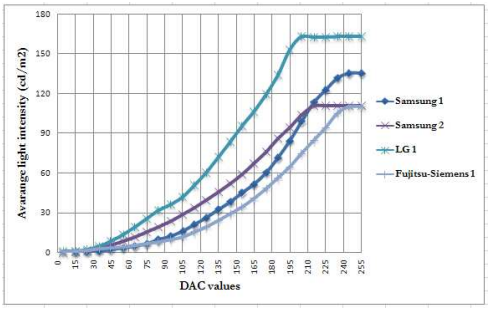

Fig.5. The LCD monitors gamma characteristics in case of the green colour-stimuli

There are such monitors which appear these two properties in the gamma-characteristics. That is to say, this straightening is realized at other and other values. This aspect of the gamma-characteristics is called "sigmoid" or "S-curve" characteristics.

The LCD monitor gamma-characteristics is similar to a CRT monitors, that is very important because the human eye's observation ratio of the light-intensity / luminousness is similar to the inverse of the CRT monitor's gamma-characteristics. The eye possesses an about 0,33 "integrated gamma value".

The shape of the S-curve is depends on that what kind of the LCD monitor's gamma-characteristics, so what sort of the panel and what kind of its dispose. This feature produces other and another S-shaped curves in case of all monitors. So the aim is the LCD monitor and the CRT monitor's gamma-curve (value between 1,8-2,2) should be more similar. Different chance and explanation exist about this.

At first this is possible with the so-called gamma-correction and the help of this, the brightness and the colour-sharpness of the monitors can be variable. The main point of this that the little or big intensity of the pixels is necessary to increase hardly but the mid-range intensity of the pixels is necessary to a large extent. Like this, the image's average brightness and contrast is rising. In case of the digital picture, this correction may be executed much more simply with help of the computer or manually. Until then, the electrical compensation of the monitor's gamma-curve is much more complicated because it must be accomplished between two non-linear curves.

At second, while the covered theatre-area indicates the types of the light-phosphor in the CRT monitors, till then in case of the LCD monitors this depends on the spectrum of the background. Because the background-module has an effect on the colour-saturation, the hue, the correct colour-temperature, so finally this affects that the appearing picture looks fine in true to nature colours in front of the User.

Third is the bending-phenomenon that the curve not takes up the normal-value for one on the value of 255DAC but a little earlier. The scale of the blending is different and rather it is typical for the sigmoid-characteristics. So the big DAC values for the specific average intensity-values of the visualized monitor-picture will be obtained to saturation quickly, and the contrast-ratio of the projected picture may be changed disadvantageously. Moreover, the invertation of the channel-characteristics stops, which is essential condition of the calibration process.

5. Conclusion

The calibration of the computerized displays is essential in the area of the computer-aided design, the desktop publishing or the visual eye-test. The calibration of the monitors may be executed by measuring the brightness, the gamma-curve and the colour-temperature.

I carried out measurements in the case of different LCD monitor types. In the case of the above listed parameters and I drew useful conclusions with the help of the different diagrams. Such an example that the similar spectral output-characteristics make it possible to apply the visual calibration and it will be possible to develop just like one detector measuring method, too.

I diagnosed that the most of the LCD monitors represent the blending- phenomenon in one of the basic colour-stimuli and the shape of the characteristics is S-shaped curve, which it results in terms of the calibration. For this reason later on, during the measuring the monitor's parameters will be examining between 0-200 DAC values. The development of the new measuring instrument will help the more precise colour-correct visualizatione.

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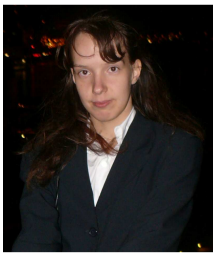

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