Simplified Calibration Methods for the Measuring of Lcd Monitor Charasteristics

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Abstract:

Nowadays the colour-correct visualizations of the LCD monitors become more and more important. Theirs disadvantages and features differs from the CRT monitors, for this reason the developed visual and instrumental calibration methods need new developments. As the first step to determine the characteristics, our main aim was to examine the different LCD panels spectral and gamma characteristics at different monitor manufacturers.

Keywords: *LCD, spectral characteristics, gamma, S-curve.*

1. Introduction

Nowadays thanks to the technical improvement, in more and more fields of research and workplaces are applied computerized displays in the areas of Computer Aided Design (CAD) and Desktop Publishing (DTP).

Special areas of application appeared outside classical areas, as medicine imagery image processing or, for example, examination of the vision. As the originality and the quality of reproduced colours in these areas are important, then it will be important to calibrate our displays properly. In the case of monitors the calibration means to have a hold on the parameters of photometry, radiometry and colorimetry. This may be carried out by configuring specific parameters or by the manipulations of the visualization. These latter calibration methods are concerned the topic of the "Colour Management".

2. Research of the colour vision

1.1. The correction of the colour-deficiency corrective lenses

The Faculty of Mechanical Engineering of the Department of Mechatronics, Optics and Engineering Informatics deals with the research of colour vision at the Budapest University of Technology and Economics (BUTE). Besides the study of the human colour-deficiency phenomenon, the correction of the colour-deficiency corrective lenses was developed which was patented as a Hungarian invention throughout the world [1].

Thanks to this, the colour-deficiency ability of the colour vision is processed, "The World has become more coloured with the glass!" - in accordance to their opinion. This is an important result because almost 10 percent of the male population possess some kind of coloured vision anomaly (dyschromatopsia).

We can distinguish more types of the dyschromatopsia. Accordingly we have got several correction-lenses too, the patients take after the correct diagnosis is set up.

1.2. To diagnose the colour-deficiency

As a first step, it is necessary to diagnose the fact and the stage of the colour-deficiency. Measurement of the dyschromatopsia is not a simple problem. Due to this fact nowadays several methods exist. The printed tests can diagnose only the existence of the colour-deficiency. The instrumental examinations operating on the optical concept give the most exact results. All instrumental and the printed tests can be obtained only at a very high price and it makes the spread of the lenses uneasy and the colour-deficiency diagnostics too.

To produce the above tests, our research team developed computer display tests. In case of this test thanks to the spread of the computerized systems, the diagnoses of the coloured vision can be done with less cost. Not incidentally, the computerized examination permits fast analysis and it can be personalized. The first tests developed by our research team were born optimalized on CRT displays [2, 3].

Since displays are used as measuring instruments in the course of the examination of the coloured vision, calibration of the monitors is indispensable. Unfortunately this is a disadvantage of coloured vision examinations software, however it has many benefits due to the fact that it is necessary to calibrate the monitor previously.

The calibration can be done instrumentally in the basic case. Spectrophotometers and convenient software are necessary for this. Such kind of instruments can be available in the commerce but the cost-efficiency of the examinations by the software is reduced to the large extent.

There is possible to use visual calibration with application of the subjective photometry beside the instrumental calibration, too. In this case the person operating the display measures different parameters of the monitors with the help of software by different tests figures.

In the case of CRT displays, the visualized calibration software developed in our research group was succeeded with very good results of the instrumental calibrations/ results of measurements. To a great extent of this reason the characteristics of spectral and gamma are formed by the side of stable parameters in case of different monitor manufacturers and types too. The stable spectral capacity distributions and the same gamma characteristics of the CRT monitors' allow calculating the monitors' specific parameters with iterative methods without the spectral measuring technique too [4].

3. The Liquid Cristal Displays

Unfortunately, this situation changed with the conquest of the LCD monitors (in the early 2000'). The visual calibration become impossible by the different RGB filters and the applied gamma correction, as well the variety of the background - lighting.

In the last few years the dumping of LCD monitors carried again changes. Many manufactures were closed, only some major panel factories remained. Except the simplification and optimalization of the displays manufacturing processed in the similar way in the parameters of the representing and manufacturing. This may influence advantageously repeated applicability of the visual calibration software. It is necessary to recognize again the LCD panels' actual production technology and characteristics and finally to evaluate and explain the data, too.

4. To measure different LCD's panels

The aim of our current research is to measure different manufactured LCD monitors as precisely as possible, so that we could recognize the LCD monitors' characteristics. During the course of our measurements, we examined 60 different types'- of monitors from 5 manufactures (LG, Apple, Fujitsu-Siemens, Samsung and NEC). These rival with the next panel types: TN + Film (Twisted Nematic), S-IPS (Super In Plane Switching) and PVA (Panel Vertical Alignment) [5]

The examined parameters were as follows: gamma characteristics, colour temperature, response time, contrast ration, and brightness.

The measurement was done with a spectrophotometer. In the first case we represented the measured values in a function of wavelength every red, green, blue and white (amount of the 3 colours) colour stimulus, there the monitor's contrast and brightness were 100 per cent.

We calibrated the instrument after the measurement of all of the parameters of each monitors (Fig. 1).

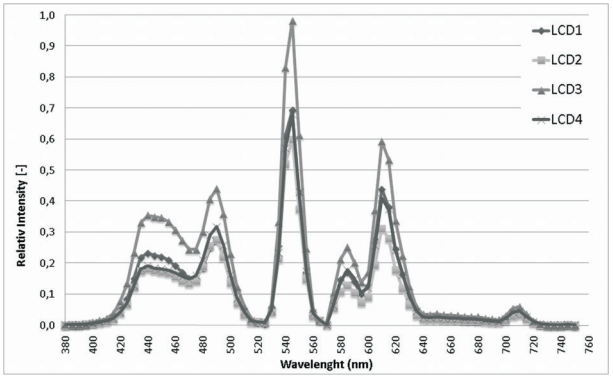

Fig. 1. LCD monitors' spectral output distributions in case of white colour stimulus.

After the analysis of the curves, we experienced spectral character similarity among the different panel types. The spectral distributions were deviated only in dimension of value from each other.

After representing the blue colour stimulus spectral characteristics it is possible to discover a so-called “anomaly” which is connected with the uptime or any other technical parameters (Fig. 2).

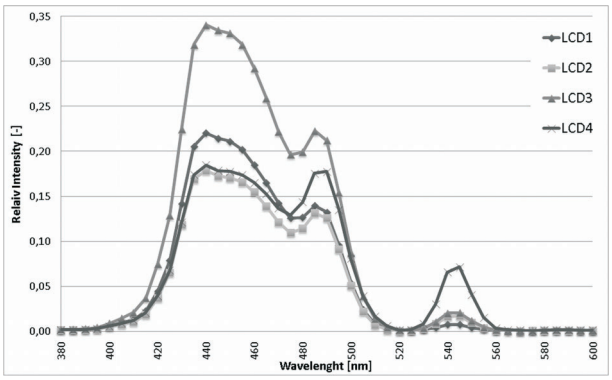

Fig. 2. LCD monitors' spectral output distributions in case of blue colour stimulus.

There will be possible to use these similarity qualities advantageously later in, of course, in planning the methods.

In the second case defining the channel characteristics we accomplished the measurement about the 3 main colours stimuli separated. Each measurement was performed 3 times and finally we received these averages. We took the specific diagram for the monitor when we represented the average light intensity as a function of the DAC (0-255) values.

After representing the diagrams in most cases it can be proved, that the curve does not look like the CRT gamma curve (Fig. 3 and Fig. 4). The gamma characteristic of the CRT monitor is really important because it reflects the human eyes in the best way.

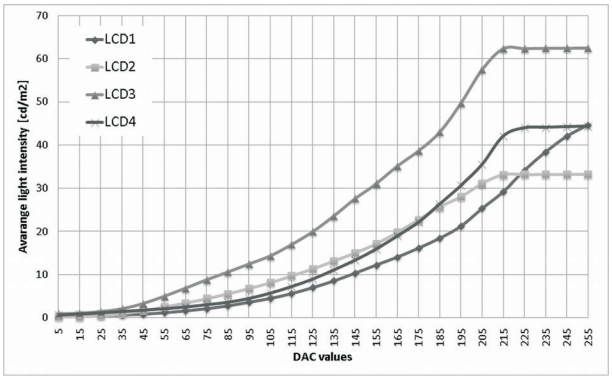

Fig. 3. LCD monitors' gamma characteristics in case of red colour stimulus.

The curves have got an S shape (called sigmoid) and the curves are straightened up above 200 DAC values (this phenomenon is called bending).

One of the reasons of the 'S-shaped' curve is the different panel type in different monitor types.

The other reason is while the CRT uses colour phosphors, LCD uses colour RGB filters to reproduce colours. Although highly pure RGB filters are used in professional LCD monitors, this different mechanism is an another reason why the colour of an LCD display does not perfectly match CRTs.

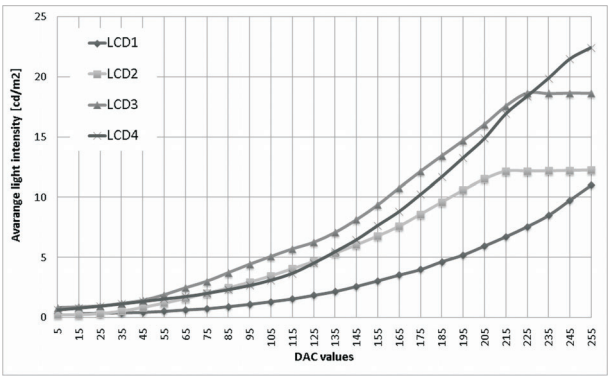

Fig. 4. LCD monitors' gamma characteristics in case of blue colour stimulus.

The scale of the "bending" is different and it would be rather true to type of the sigmoid characteristics. Then the projected picture's big palette values become saturation quickly and the projection's contrast-rates may be changed unfavourably. Moreover, the invertibility of the channel characteristics is dissolved and that is the essential condition of every calibration methods.

5. Conclusion

Thanks to the similar spectral characteristics of the new types LCD monitors the application of the visual calibration is enabled. Because of the similarity there is possible to produce the objective photometry onto an instrument which contains just one detector as well. This new measuring instrument may be more precise than other calibration instruments available on the market for a fraction of the price of others.

These methods and devices will help the colour vision diagnostics and other applications where the colour-correct visualization is important.

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