The Relationship between Blinking Rate and Response Time

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Abstract

In the present paper, we discuss the relationship between blinking rate and response time. When blinking rate increasing, the measurement of response time would be significant diversity. However, The blinking rate from 0.5 to 4 Hz, the values of response time were reasonable.

1. Introduction

Liquid crystal displays have been applied to many applications such as PC monitors, TVs, and projectors. When it comes to video applications, the response speed of a liquid crystal material becomes critical in order to reduce motion blur. Efforts towards fast liquid crystal devices include thin cell gap[1], overdrive operation scheme[2], optimization of liquid crystal materials[3] and switching modes[4].

Most panels specify response times of 45 to 25ms. Based on these numbers, these panels can only switch fast enough to create a 22 Hz to 40 Hz image. Standard NTSC video requires 30 Hz performance, and some progressive scan formats of HDTV require up to 60 Hz. So a panel with cell response times of 16.7 ms is needed in order to handle 60 Hz signals. Unfortunately, the picture for standard LCD panels is even more blurred than this. The response rate specifications are typically based on the average time to switch from full on to full off and back again. In practice, the response times required to switch from one gray scale level to another, ranging from 0 (black) to 255 (white) is much longer making this problem crucial for moving images as it is the case for TV applications.

Two problems affect the response time of LCDs. One is the nematic liquid crystal's slow response to an external field; the other is the driving method. Numerous efforts have been made recently to improve the time response performances of LCDs1-3. Nevertheless, the response time measurement itself is not straight forward especially when inter-gray levels with low differences are explored. [5~7].

In the present paper, we discuss the relationship between blinking rate and response time. As so far, no one confers the standard blinking rate for measuring response time. When blinking rate increasing, the measurement of response time would be significant diversity.

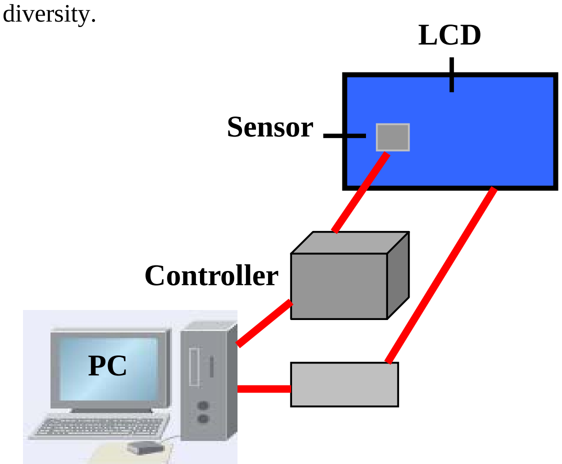

Figure 1. Schematic of the response time instrument.

2. Experimental procedure

A schematic diagram of the instrument is showed in Fig. 1. We give the different blinking rates to the LCD panel from the pattern generator. The range of blinking rate is from 0.5 to 16 Hz. In this experiment, we used the optiscope made by Eldim to measure the response time and waveforms. The measurements of response time were collecting immediately by the personal computer.

3. Result

3.1 The waveform of different blinking rate.

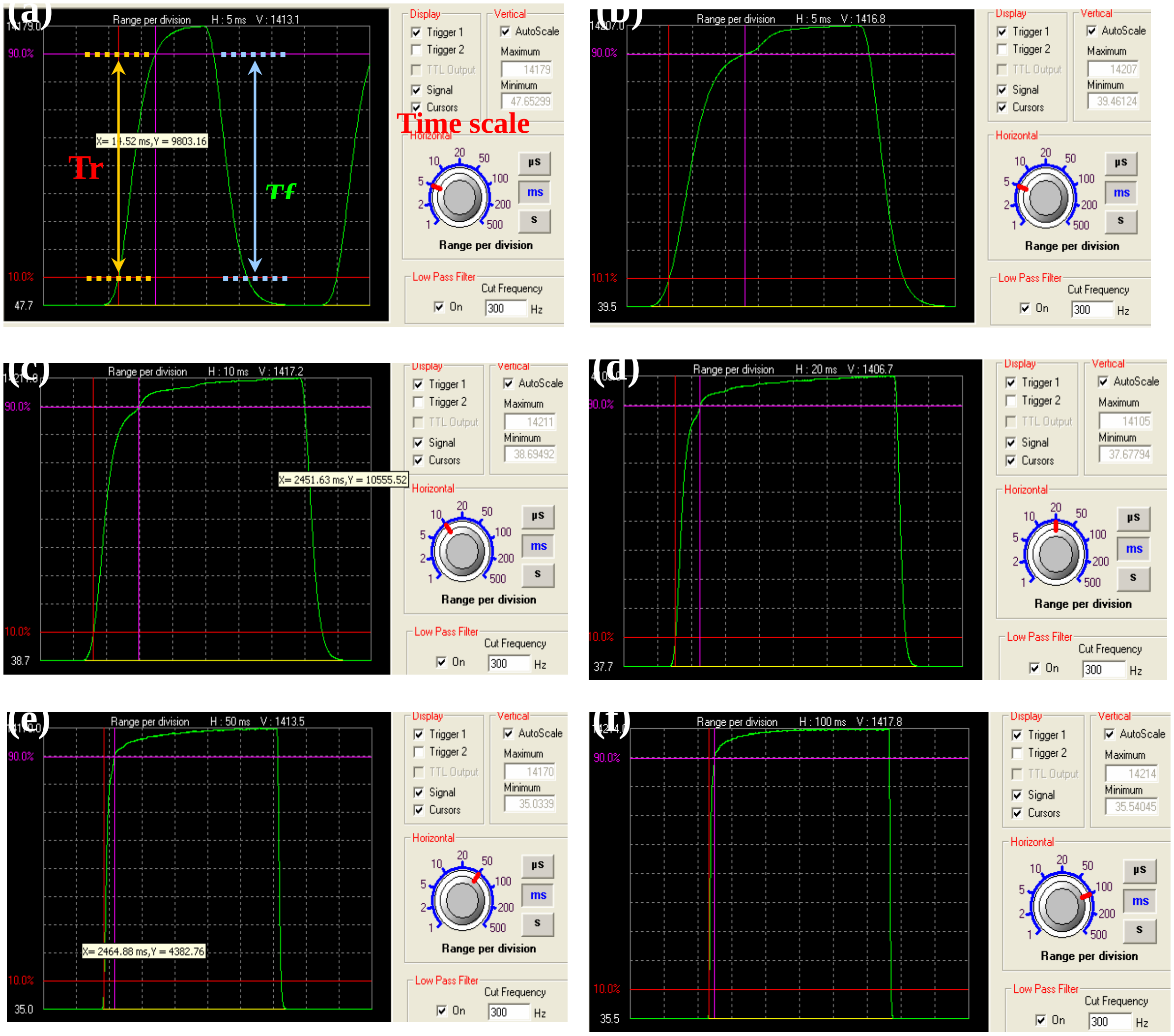

Figure 2. The waveforms of different blinking rate. Frequency: (a) 16, (b) 8, (c) 4, (c) 2, (d) 1, and (e) 0.5 Hz

The waveforms and response time of different blinking rate are showed in Fig. 2 and Table. 1 respectively. The Tr means the raising time (10 % - 90 % of the darkest to brightest.) and Tf means the falling time. As can be seen in Table 1, the Ttotal is 10.86 ms at blinking rate = 16 Hz. That is the lowest value of response time measurement at blinking rate from 0.5 to 16 Hz. As can be seen in Fig. 2a, the waveform of blinking rate is 16 Hz. The waveform was exhibited in sine form. At that blinking rate, the luminance of the LCD panel was not saturated. In other words, the liquid crystal was not completely falling down at this time period. Because of the response time is measured by photodiode used to detect the luminance of the LCD panel. So the response time value of 10 % to 90 % would be lower than standard measurement.

Table 1. The measurement of response time.

Blinking rate	Tr	Tf	Ttotal
16 Hz	5.68	5.18	10.86
8 Hz	5.96	5.24	11.20
4 Hz	8.45	5.66	14.11
2 Hz	8.52	5.63	14.15
1 Hz	8.75	5.32	14.07
0.5 Hz	8.86	5.41	14.27

When the blinking rate of the LCD panel was increased, the waveform was gradually changed form the sine to square waveform. Then, the values of rising time were little by little increased. But, the measurements of falling time were not changed with increasing blinking rate. So the values of Ttotal would be increased. However, when the blinking rate was achieved about 4 to 0.5 Hz, the values of Ttotal were near to the same. As can be seen Fig. 2f, the waveform of blinking rate = 0.5 Hz was close to square waveform. In other words, this measurement was the proper value of response time. This experiment proposed that blinking rate of response time measurement were 0.5 to 4 Hz. In this condition, the luminance of LCD panel reached saturation for measuring. And the values of response time were reasonable.

4. Conclusion

1. Ttotal = 10.86 ms is the lowest value at blinking rate 16 Hz. The waveform was exhibited in sine form. In other words, the liquid crystal was not completely falling down at this time period
2. When the blinking rate of the LCD panel was increased, the values of rising time were little by little increased. But, the measurements of falling time were not changed.
3. The values of response time were reasonable at the blinking rate from 0.5 to 4 Hz.

5. Acknowledgements

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6. References

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