

A Quantitative Measurement and Evaluation Scheme for Image Sticking of Micro OLED

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ABSTRACT

A quantitative measurement and evaluation scheme for the image sticking of Micro OLED is proposed and verified. The coincidence degree between the result of this scheme and the judgment result of professionals' visual effect is 95%. The scheme's result trend is consistent with the judgment result trend of professionals' visual effect. The scheme can be used and assist in improving the product user experience.

1 Introduction

Micro OLED displays the same still picture for a long time, which will produce image sticking, which will seriously affect the product user experience. Therefore, it is particularly urgent to measure and evaluate the image sticking of Micro OLED and assist in improving the product user experience.

The existing Micro OLED image sticking measurement and evaluation methods usually rely on subjective judgment of human eyes. These methods rely on professional people and have a strong subjective consciousness. Some scholars have studied quantitative measurement and evaluation methods for image sticking of display screen [1, 2], but these methods are not applicable to Micro OLED. There are two reasons. On the one hand, the brightness of Micro OLED is very sensitive to the panel temperature, the impact of the panel temperature change on the image sticking measurement and evaluation results cannot be ruled out. On the other hand, the objective fact that the human eye contrast sensitivity function is not considered in the evaluation process.

In this work, a quantitative measurement and evaluation scheme for image sticking of Micro OLED is proposed and verified. The coincidence degree between the result of this scheme and the judgment result of visual effect of professionals is 95%. The corresponding result trend of the scheme is consistent with the judgment result trend of visual effect of professionals. The scheme can be used and assist in improving the product user experience.

2 Evaluation scheme

The Micro OLED displays the checkerboard picture (as shown in Fig. 1) for a long time. After switching to the pure

white picture, the image sticking, shown in Fig. 2, will be generated.

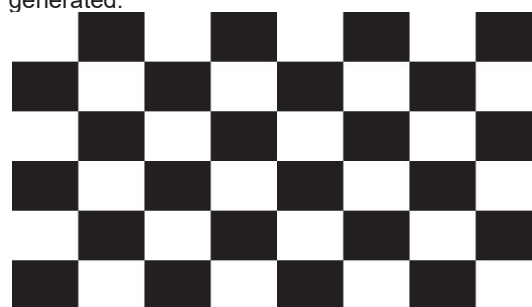


Fig. 1 Checkerboard picture



Fig. 2 Image sticking

In order to quantitatively measure the image sticking of Micro OLED, it is necessary to exclude the influence of panel temperature change on image sticking measurement and evaluation results, and consider the objective fact of human eye contrast sensitivity function.

The quantitative measurement and evaluation scheme proposed by this study is as follows:

(1) The Micro OLED that has generated image sticking is photographed by the full face imaging luminance meter [3]. The brightness values of all pixels on the Micro OLED are obtained through the measurement. In this way, the influence of the panel temperature change on measure results can be excluded.

(2) Taking the blocks in the $m \times n$ checkerboard as the unit, the pixel brightness values that do not meet the 3σ criterion [4] in each block region are removed in turn.

(3) Calculate the average value of pixel brightness in

each block region in turn. For example, the pixel level brightness mean value corresponding to block (i, j) is $L(i, j)$, as shown in Fig. 3.

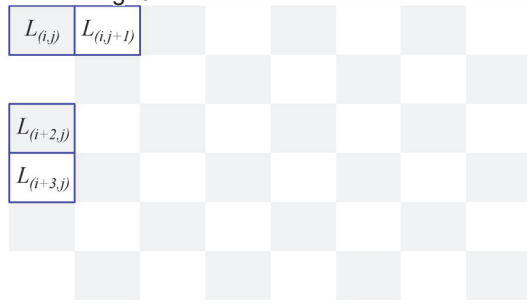


Fig. 3 Block distribution diagram

(4) The objective facts of the human eye contrast sensitivity function (as shown in Fig. 4 and Fig. 5) need to be taken into account. As shown in Fig. 4 and Fig. 5, the frequency corresponding to a specific Micro OLED product and $m \times n$ checkerboard is fixed. The contrast sensitivity needs to be calculated.

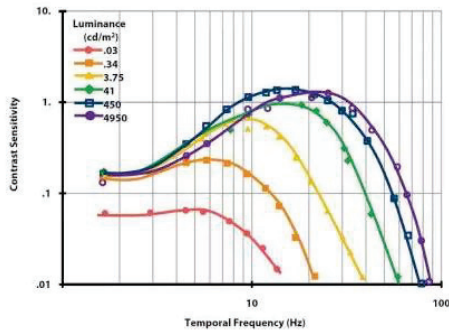


Fig. 4 Frequency contrast sensitivity function [5]

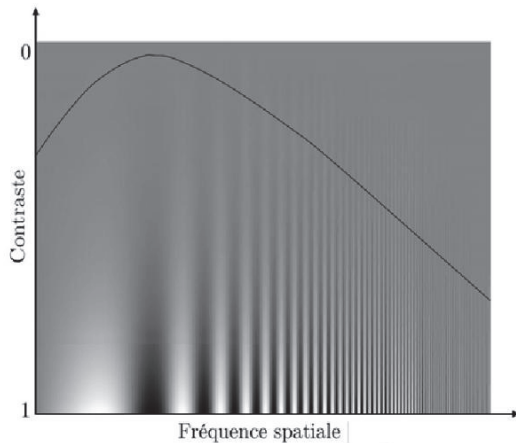


Fig. 5 Human eye contrast sensitivity function [6]

The horizontal contrast $CH(i, j)$ and vertical contrast $CV(i, j)$ of block(i, j) can be calculated by the following method.

① When i is odd and j is odd:

$$CH_{(i,j)} = \frac{(L_{(i,j+1)} - L_{(i,j)})}{L_{(i,j+1)}} \quad (1)$$

$$CV_{(i,j)} = \frac{(L_{(i+1,j)} - L_{(i,j)})}{L_{(i+1,j)}} \quad (2)$$

② When i is odd and j is even:

$$CH_{(i,j)} = \frac{(L_{(i,j)} - L_{(i,j+1)})}{L_{(i,j)}} \quad (3)$$

$$CV_{(i,j)} = \frac{(L_{(i,j)} - L_{(i+1,j)})}{L_{(i,j)}} \quad (4)$$

③ When i is even and j is odd:

$$CH_{(i,j)} = \frac{(L_{(i,j)} - L_{(i,j+1)})}{L_{(i,j)}} \quad (5)$$

$$CV_{(i,j)} = \frac{(L_{(i,j)} - L_{(i+1,j)})}{L_{(i,j)}} \quad (6)$$

④ When i is even and j is even:

$$CH_{(i,j)} = \frac{(L_{(i,j+1)} - L_{(i,j)})}{L_{(i,j+1)}} \quad (7)$$

$$CV_{(i,j)} = \frac{(L_{(i+1,j)} - L_{(i,j)})}{L_{(i+1,j)}} \quad (8)$$

(5) The ISP (short for the image sticking percentage) corresponding to a specific Micro OLED and $m \times n$ checkerboard can be calculated by equation (9). This value is the measurement and evaluation result of the image sticking of Micro OLED. The result not only excludes the influence of the panel temperature change, but also consider the objective fact of the human eye contrast sensitivity function.

$$ISP = \frac{\sum_{i=1}^m \sum_{j=1}^{n-1} CH_{(i,j)} + \sum_{i=1}^{m-1} \sum_{j=1}^n CV_{(i,j)}}{2mn - m - n} \quad (9)$$

3 Scheme verification

According to the grading rules shown in Table 1, the ISP is graded to obtain ISL (short for the image sticking level). This scheme is verified by comparing the ISL with the visual effect judgment results of professionals.

Table 1 ISL correspondence table

ISP interval	ISL
0~0.05	0
0.05~0.25	0.5
0.25~1	1
1~1.55	2
1.55~1.75	3
1.75 and above	4

Fig. 6 shows the verification results. It can be seen from the figure that the coincidence degree between the result of this scheme and the judgment result of visual effect of professionals is 95%. The corresponding result trend of the scheme is consistent with the judgment result trend of visual effect of professionals. The scheme can be used and assist in improving the product user experience.

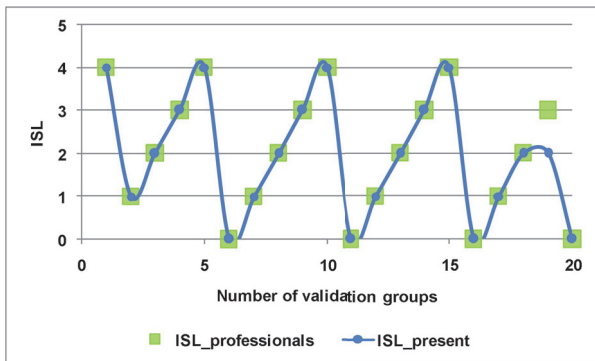


Fig. 6 Verification results

4 Conclusions

In summary, a quantitative measurement and evaluation scheme for image sticking of Micro OLED is proposed and verified. The coincidence degree between the result of this scheme and the judgment result of visual effect of professionals is 95%. The corresponding result trend of the scheme is consistent with the judgment result trend of visual effect of professionals. The scheme can be used and assist in improving the product user experience.

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