Evaluation of Binary-Coded Light-Emission-Period Schemes for Improving the Moving Image Quality on PDP

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Abstract

While a moving image is displayed on AC-PDP, disturbances of gray scales and colors may be observed. Various methods to improve the image quality are quantitatively compared. Motion image disturbance on AC-PDP has been properly simulated on a computer by using a simple eye-tracking model to simplify the relation between the moving image on AC-PDP, light emission from the PDP, and the captured image with disturbance on retina. From the simulation results, we can easily choose an effective light emission scheme to improve the moving image quality on AC-PDP.

Introduction

Plasma display panels (PDP) are expected to be one of the next generation TV displays, offering the possibility of greater than 40 inches diagonal, flat screen and thin displays. HDTV display needs 8 bit, 256 gray levels. For color PDPs , gray scales are obtained by using pulse-number-modulation within-a-field technique as shown in Fig.1.

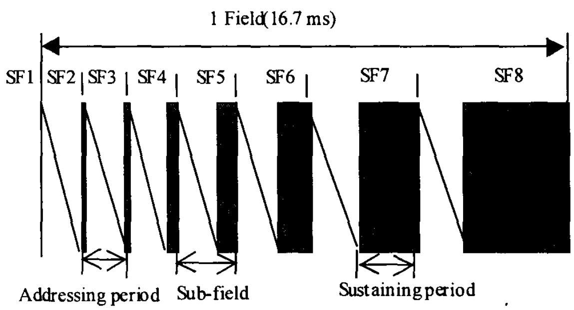


Fig.1 Pulse-number-modulation-within-a-field

This technique of gray scales expression divides each luminance field time into multiple independent sub-fields(SF) with various sustain period and expresses the specific gray level by combination of these SFs. Although this technique is quite sufficient to express still image, disturbances of gray levels and colors are often observed when displaying moving images. These are referred to as the dynamic false contours (DFCs).

As our eyeballs follow a change of the gray level from 128 to 127 of a pixel on AC-PDP, a peak error would arise on our retinas[1],and the one of the gray level from 127 to 128 would arise a peak error in the light-emission scheme. Some errors result in a brighter dot on retina and errors relatively result in a darker dot on retina.

Various methods of reducing the disturbance to increase the dynamic image quality and the comparison of them are listed in Table 1.

In large sized screens, scattering of disturbance [2], or error diffusion[3] may cause noise or checker-patterned side effects when motion is synchronized with the pattern. Multi-level sub-field(MLS)[4] makes the luminous be three forth of the traditional technique. Equalizing pulse[5] has little benefit with significant motion greater than 10 pixels per field, while techniques related to motion, and compression scheme[6] for AC-PDP seems to have to go the extra mile in practical application. Nowadays, to find the optimized SF order and weighting under a limited amount of SFs is more applicable to reduce false contour for us.

Some modified light-emission-schemes have been presented to effectively resolve the false contour. This paper presents the evaluation of those methods with the false contour map.

Table 1 Methods of reducing the dynamic false contour

	Luminous	Gray scales	Resolution	Circuit	Extra ROM
SFC/3D Scatter[2]	.	.	.	Complicated	Yes
Error Diffusion[3]	.	.	Bad	Complicated	Yes
MLS[4]	Bad	.	.	Complicated	No
Equalizing Pulse[5]	.	Bad	.	.	Yes
Compression[6]	Bad	.	.	.	No
Optimal Sub-fields[1]	.	.	.	.	No

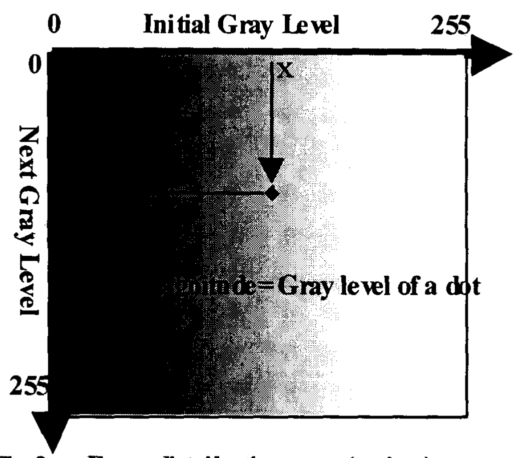


Fig.2 Error distribution map (x→ y)

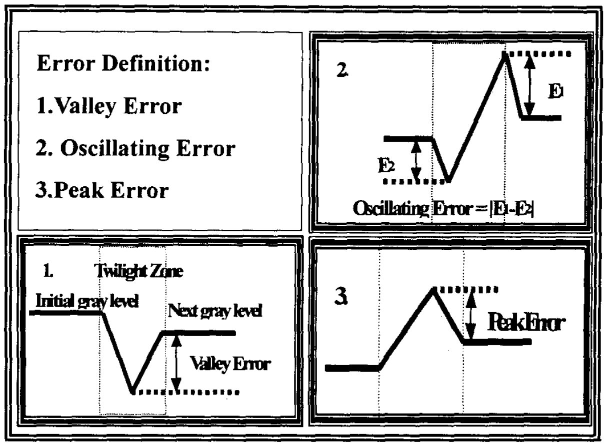


Fig.3 Error definition

Definition of the false peak/valley

Instead of the traditional signal to noise ratio (SNR)[7], we utilize an error distribution map as shown in Fig.2 and three error indices as shown in Fig.3 to evaluate those methods. As shown in Fig.2, the x-axis value represents the initial gray level of one pixel on AC-PDP and the y-axis value represents the next one. The gray level of dots in the error distribution map represents the magnitude of the error.

It is assumed that the false contour occurs in the transitive twilight zone between two different gray levels, as shown in Fig.3. Peak /valley error is respectively defined as the interval between the transitive maximum/minimum and the larger/smaller of the initial and final gray level. There are occasions that the peak and valley errors exist in the same twilight zone. The oscillating error is defined as the absolute difference of the peak and valley error because of compensation effects. The valley error will make human eyes sense a darker dot and the peak error will make human eyes sense a brighter dot. .

Next, we will use these error indexes to draw the error distribution map and calculate the total error.

Simulation of DFCs

To compare the presented light emission schemes for reducing the DFC, a simulation program is developed. Fig4 shows the flow chart of the simulation program. Simulation results are listed in Table2 and their error distribution maps are also shown in Fig. 5

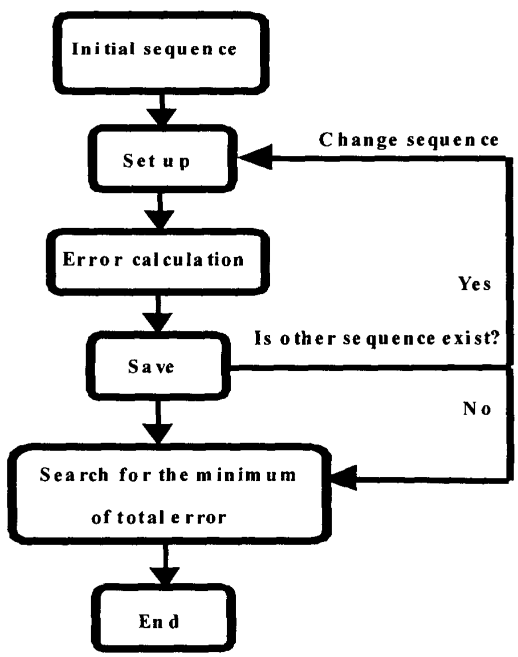


Fig.4 Flow-chart of the simulation program.

Table2 Simulating results of six different light-emission-schemes

Basic Sequence	1-2-4-8-16-32-64-128	1-2-4-8-16-32-48-48-48-48	1-2-4-8-16-32-32-32-32-32-32-32
Peak Error	557971	287473	190532
Valley Error	557971	287473	190532
Total Error	1115942	574946	381064
Good Coding	32-64-128-16-8-4-2-1	48-48-1-2-4-8-16-32-48-48	32-32-32-32-1-2-4-8-16-32-32-32
Peak Error	640864	130867	66937
Valley Error	640864	130867	66937
Total Error	950156	261734	133874

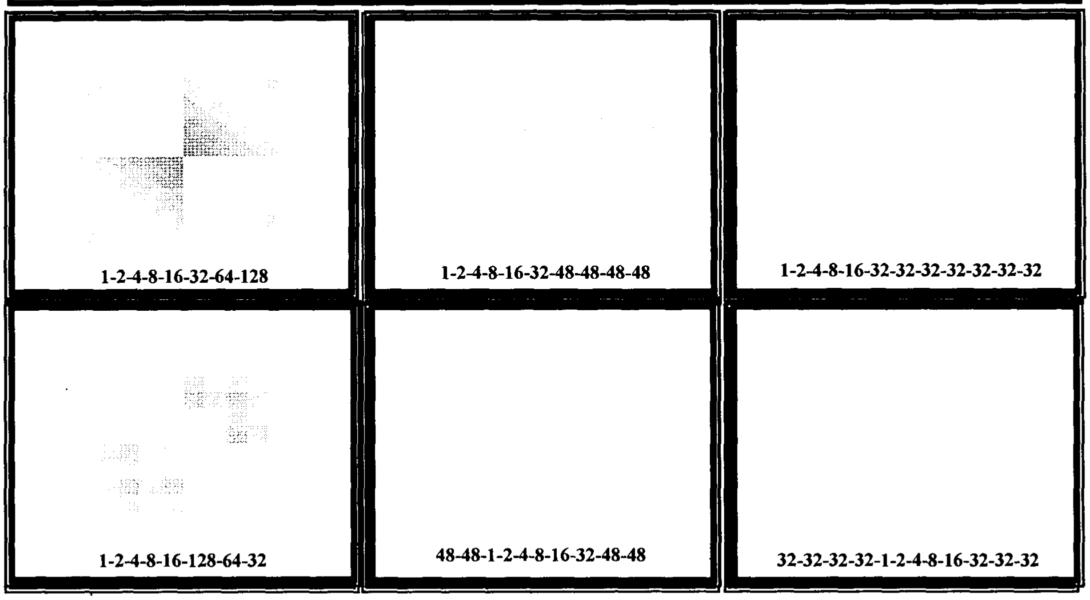


Fig5 Error distribution maps six kind of light-emission-schemes

Analysis of simulation results

From the simulation results, the following four points are observed.

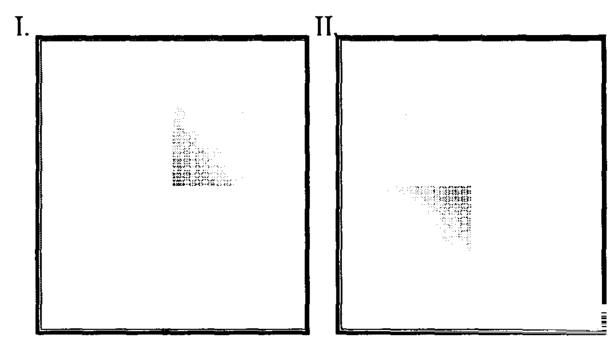
1.*Max error*:

The maximum of peak/valley is equal to the value of MSB minus one in any sequence. So a useful method to reduce the error is to split the MSB into some smaller ones.

2.*Reverse*:

The polarity of DFC reverses when the SF sequence is reversed as shown is Fig6. Different polarities will result in different visual sensitivity.

Human eyes are highly sensitive to error in darker images and less sensitive in lighter ones. The MLS technique employs this phenomenon to reduce false contour. If DFC appears between adjoining pixels, the reverse polarity effect will cause both pixels to compensate each other.



I. Peak error of sequence :1-2-4-8-16-32-64-128

II. Peak error of sequence :128-64-32-16-8-4-2-1

Fig.6 Reverse of the polarity

3.*Limitation of efficiency*:

More SFs seems to be more useful to reduce false contour. But in order to keep the luminosity, the number of SF is limited to a small number.

4.*Coding*:

Proper coding in 10 and 12 SFs will enhance the efficiency of improvement of false contour. Table 2 shows that a better coding results in smaller total error.

Conclusion

To improve the moving image quality on AC-PDP, simulation of DFC errors is developed and different presented schemes are quantitatively compared. According to the analysis results, guidelines for designing a better light-emission scheme to reduce the DFC are acquired..

References

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