

Excellent Moving Picture Resolution of PDP, Proved by the New Measurement System Developed by the APDC

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Abstract

Excellent moving picture performance of plasma TV has been confirmed through the study and measurement using the method proposed by the APDC (Advanced PDP Development Center Corporation). Full-HD Plasma TVs with pixels of 1920 x 1080[1]-[2], showed more than 900 TV-lines of resolution out of maximum scale of 1080, while typical LCD of the same pixel count showed only 1/3 of the plasma's performance. Moreover, even the latest 120Hz models of 1920 x 1080 LCD do not much PDPs with pixels of 1024 x 768, or 1366 x 786 in moving picture resolution. The measurement system proposed by the APDC showed very good agreement with subjective tests.

Introduction

With the increasing penetration of digital still camera and PCs, consumers are getting much more interested in the resolution of their televisions. Until now, the resolution of flat-panel TV displays has been commonly expressed by the number of pixels on the display. There were no clear criteria to measure, or define the resolution of moving pictures of an HDTV. As a result, manufacturers use only the number of the pixels to define the resolution of a flat-panel display, although pixels are just to specify the still picture resolution, and it is often the case that some of the new display devices do not convey the high resolution in displaying moving picture.

The existing method called MPRT, is only the measurement of step response, meaning the measurement of response only in one level transition to another in gray-scale. Compared with this, details of the fabrics or textures in natural objects like surfaces of the fruits, are composed of frequent level transitions with different periods or frequency. Therefore, just measuring with step response does not guarantee the similar results in natural images.

Also from the viewpoint of basic signal processing, a step response of non-linear system does not tell the exact performance in frequency domain.

As a result, MPRT is just not good enough for a measuring standard for moving picture performance of any type of display.

Features of Newly Proposed Measurement for Moving Picture Resolution

The measurement proposed by the APDC has following five basic features[4].

- 1) Simple test, using newly developed test chart scrolling on display of any type
- 2) Using "TV- lines" as a unit
- 3) Typical speed of 6.5 ppf is set
- 4) Suitable for both subjective test and automated measurement
- 5) Drawing attentions from manufacturers and professionals

The test is carried out by scrolling a set of four-cycle sine burst with different levels and contrast. To simplify the evaluation procedures, the typical motion speed of the pattern is set as 6.5 ppf (pixel per field), corresponding to about five seconds per screen, or a representative motion velocity of the objects in various TV contents.

Fig. 1 is an example of test chart designed for subjective test by human observers. The chart has a different resolution patterns up to 1080 TV lines, with three different background colors, and each background has three different contrasts.

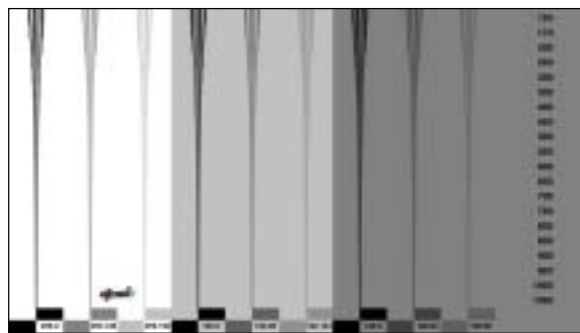


Fig.1 Example of APDC Test Chart for Subjective Test

The Importance of Typical Speed of 6.5 ppf

The motion speed of the test chart is set to 6.5 ppf:

- 1) To simplify the evaluation procedures by using single value
- 2) To represent various contents of TV programs.
- 3) To secure higher accuracy by so called *double-sampling effect* as shown in Fig. 3.

Fig.2 shows the typical scene description for various speed of contents, indicating that the speed of 6.5 ppf is a representative motion for the TV contents. It is also interesting that this 6.5 ppf is a typical maximum speed for human eye holding good motion response.

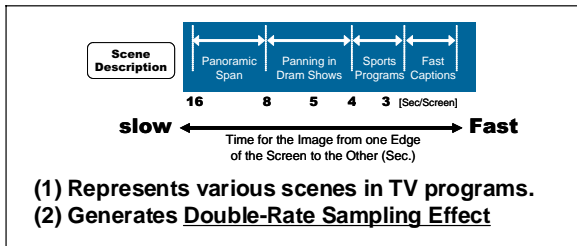


Fig. 2 Typical Scene Description for Various Speeds

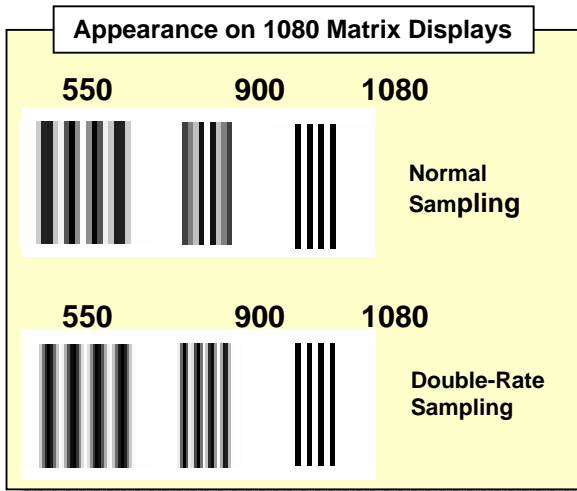


Fig. 3 Effect of Double-rate Sampling by 6.5 ppf

Fig. 3 shows the effect of *double-rate sampling*, generated by the specific motion speed of 6.5 ppf. As a matter of course, a matrix display having 1920 x 1080 pixels, can display clear image of "1080 TV-line resolution pattern" as in the upper part of Fig.3 at least in still picture. Also, 550 TV-line which is very close to 540 (= 1080/2), is displayed with proper response in the 1920 x 1080 panel. While a 900 TV-line pattern do not have exact frequency or pitch with the pixel pitch of a

display with 1920 x 1080 pixel count, and ends up displaying somewhat unclear image at round 900 TV-lines for example, as shown in the upper image in Fig. 3.

Motion speed of 6.5 ppf, a value having a letter "5" after the decimal point, is also designed therefore to create double-rate sampling effects, meaning 13 pixel points in two fields.

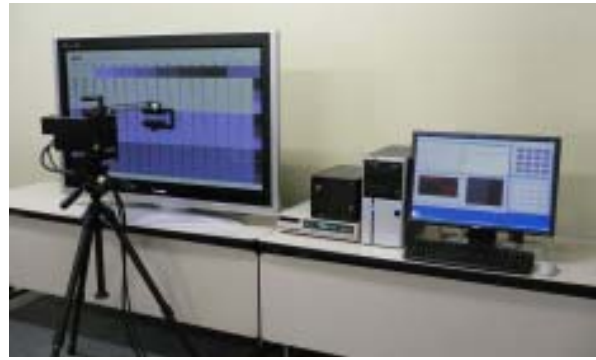


Fig. 4 Automated Measurement System Developed by the APDC

Automated Measurement System

Fig.4 is a photograph of the automated measurement system developed by the APDC. The system consists of a signal generator, a pursuit camera and a controller, PC system and a display. The pursuit camera has a movement inside so as to take a follow shot of test patterns displayed on the test sample display. The PC system is equipped with a numerical analyzing software which is also developed by the APDC.

The main task by the analyzing software is to check the waveform captured by the camera system whether each pattern has a enough response compared with the original sine burst in amplitude or in the waveform. The approach is mainly based on simple Fourier analysis.

Measured Examples

Fig.5 shows examples of the captured image using the automated system. From the image, human observers can easily recognize that the PDP maintains high resolution more than 900 TV-lines. On the contrary, 60Hz LCD has only 300 TV lines of resolution, although its pixel count is 1920x1080 (Full-HD). Other measured example are listed Fig 6, showing approximately 300 TV-lines of moving picture resolution for all 60Hz LCDs, and 600 TV-lines even for the latest model of 120Hz LCD. On the contrary, PDP of any pixel counts has better moving picture resolution than that the LCD with highest picture count of 1920 x 1080.

Fig. 7 is a snapshot from a screen of the automated measurement system.

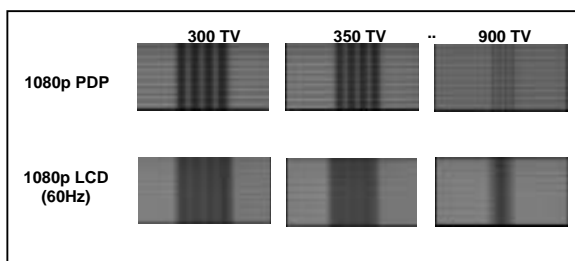


Fig. 5 Example of Captured images for PDP and LCD

	Pixel Counts	PDP	LCD (120Hz)	LCD (60Hz)
Full HD	1920x1080	> 900	< 600	~ 300
W-XGA	1366x768	> 720	< 600	~ 300
XGA	1024x768	> 720	< 600	~ 300

unit: TV-line

Fig. 6 Measured Example of Moving Picture Resolution for Display Types

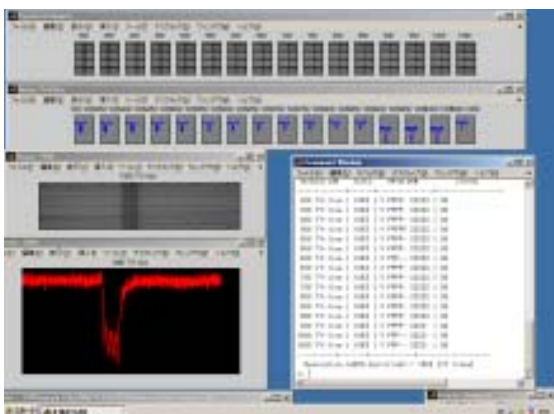


Fig. 7 Snapshot of Automated Measurement System

Discussion

(1) Correlation Between Subjective Test and Automated Measurement

Prior to the automated measurement, subjective tests have been carried out without telling the testers the type of displays or any expected values of the results. The measured result by the automated system as listed in Fig.6 showed very good agreement to the average of the results of subjective test, although result for subjective test varies from person to person, even from each trial to another for the same tester.

(2) MPRT Measurement for PDP and LCD

An MPRT measurement result for PDP and LCD

may sometimes show close values in response time in the unit of millisecond. However, most subjective tests say different results especially in evaluating natural scenes.

(3) Comparison of the Moving Picture Performance of PDP and LCD

From the test results, PDP generally shows very good reproducibility in details of the objects, because most of the important but subtle information is expressed in rather small level transition of the grayscale rather than a full scale level shifting. On the other hand, typical LCD shows almost constant response in various level transitions in the MPRT tests. This may look good characteristics at a first glance. However, this also implies mediocre response in almost every level transition like in a delicate surface of a fruit or a texture in a fabrics, requiring no small time even in very small level transition between the grayscale levels.

Conclusions

Through the measurement proposed by the APDC, excellent performance of plasma TV has been confirmed. A 1920x1080 PDP has more than 900 TV-lines of resolution for moving picture, and XGA or W-XGA PDP has more than 720 TV-lines. In contrast, 60Hz LCDs with 1920x1080 pixel count showed only 300 TV-lines of moving picture resolution,. Even the latest models of 120Hz LCD showed the resolution not better than 600 TV-lines on the average

The measurement system also proved that measuring just the response time is not good enough for moving picture performance of the display. Also, the method proposed by the APDC effectively differentiate the true performance in displaying moving pictures in TV contents.

References:

[1] I. Kawahara, S. Tsujihara, K. Otake: 2005 Digest of Technical Papers International Conference on Consumer Electronics. 363 (2005).

[2] I. Kawahara, S. Tsujihara, K. Otake, "Image Quality Technology for Digital High Definition Plasma TV", AMLCD-2005 Invited Paper.

[3] I. Kawahara, "New Findings on Display Performance in Large-Sized PDP", SID Symposium Digest of Technical Papers -- June 2006 -- Volume 37, Issue 1, pp. 151-154

[4] Internet Web links for the APDC:
<http://www.advanced-pdp.jp/english/index.html>
http://www.advanced-pdp.jp/news/e_01.html
<http://www.advanced-pdp.jp/fpd/english.html#4>