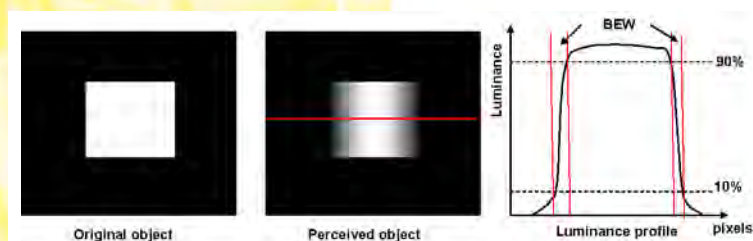


MPRT simulation of LCDs

Content

One of the main motion artifacts on flat panel displays is motion blur. The new VESA FPDM section addressing this problem introduces moving edge-blur that can be measured by various instruments like pursuit cameras. This evaluation is near the real conditions. It results in moving picture response time (MPRT) behaviors versus gray levels generally measured in very strict moving configurations.

However this solution is expensive and may be an overkill for some application needs. For certain application, simulation could be sufficient. Based on response time measurement, it will compute moving edge blur taking into account the driving properties of the display. ELDIM offers now a package including OPTIScope-SA sensor and a simulation module with the measurement and analysis DisplaySpec software that uses the standard grey to grey level response time measurements to simulate Moving Picture Response Time.



Definition of blurred edge width (BEW)

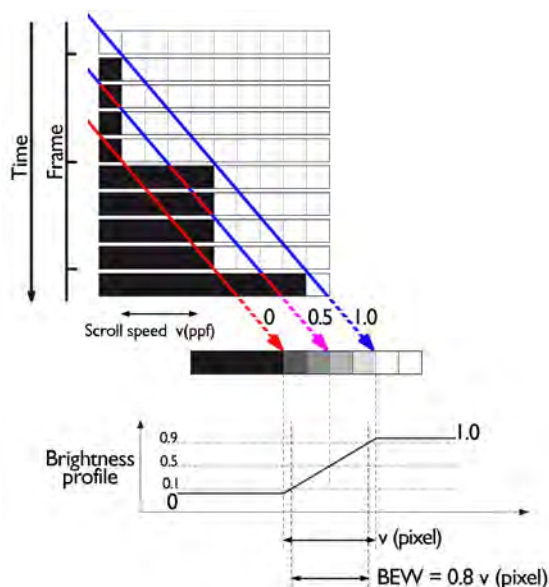
Simulation method

If $Y(x,t)$ is the luminance temporal dependence of pixel x from gray level 1 to gray level 2, and if we assume that the response time is lower than the time frame T_f , the light intensity profile $V(x)$ as perceived by the eyes of a block of pixels i pixels moving at a scroll velocity of v pixels/frame can be calculated by :

$$V_0(x) = \frac{1}{T_f} \sum_{x'=0}^{v-1} \int_{(x'-x)T_f/v}^{(x'-x+1)T_f/v} Y(x', t) dt$$

For an LCD with an ideal response time, the result is schematically represented in the figure. In general it is not the case and the Blurred edge width (BEW) is bigger than $0.8 i$. If the response time is higher than the time frame T_f , we apply the same formula for a number of frames comparable to the response time. No assumption is made on the luminance temporal dependence and we take directly the mean profile measured by OPTISCOPE SA.

Calculations are made automatically between each gray levels used during the measurement. The scroll velocity is a parameter. The time frame is supposed known. Blurred edge widths are then evaluated (generally between 10 and 90% of the luminance) both for rising and falling edges. Normalized blurred edge time (NBET=BEW/ i) can be also deduced which are quasi independent of the scrolling velocity.



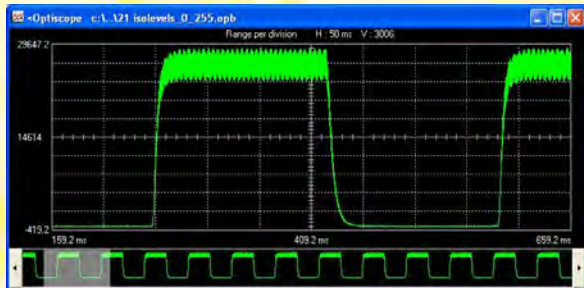
Schematic diagram of the MPRT simulation

APPLICATION NOTE

OPTIScope-SA

Software description & examples

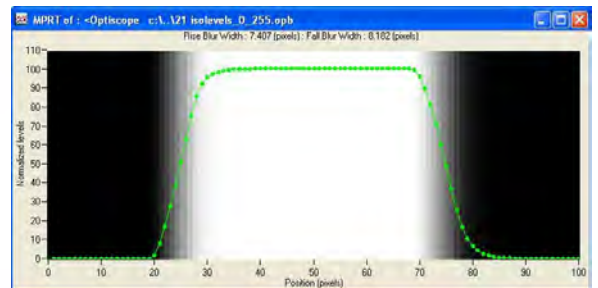
Each Response time measurement can be displayed and analyzed in details



Response time Measurements from each grey level to each grey level are recorded in a spreadsheet.

MPRT simulation is made for each response time measurement and results recorded in the same spreadsheet.

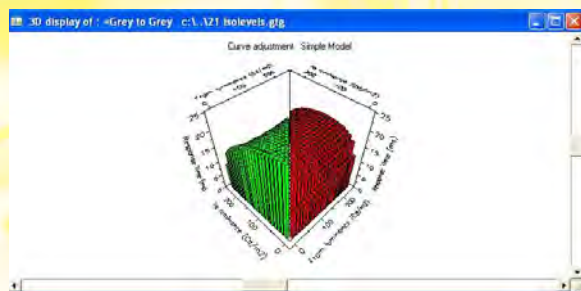
Corresponding MPRT simulation can be displayed in normalized, grey scale or luminance.



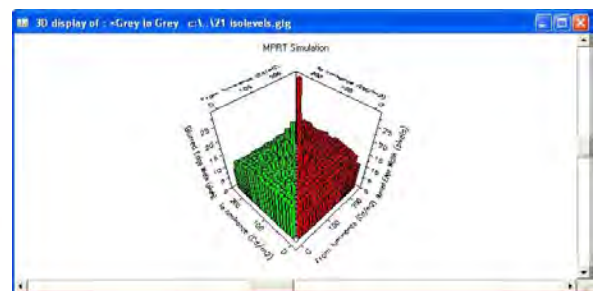
Measurement	FileName	Rising time (ms)	Tau rising (ms)	Rising St...	Rising Niter	Falling time (ms)	
Gamma Curve							
From Grey Level :0							
To Grey Level :45	21 isolevels_0_45	25.16 ± 442E-5	37.10 ± 652E-5	0.9741	8.000	10.46 ± 148E-7	1
To Grey Level :59	21 isolevels_0_59	25.27 ± 267E-4	37.26 ± 394E-4	0.6143	9.000	10.49 ± 109E-7	1
To Grey Level :69	21 isolevels_0_69	24.91 ± 234E-7	36.73 ± 344E-7	0.5172	9.000	10.54 ± 626E-4	1
To Grey Level :78	21 isolevels_0_78	24.44 ± 0.1336	36.04 ± 0.1970	0.4588	8.000	10.59 ± 576E-4	1
To Grey Level :87	21 isolevels_0_87	23.97 ± 0.1243	35.34 ± 0.1833	0.4469	8.000	10.65 ± 540E-4	1
Simulation							
From Grey Level :0							
To Grey Level :45	21 isolevels_0_45	14.91			10.25	18...	
To Grey Level :59	21 isolevels_0_59	15.44			10.35	19...	
To Grey Level :69	21 isolevels_0_69	15.11			10.35	18...	
To Grey Level :78	21 isolevels_0_78	15.51			10.33	19...	
To Grey Level :87	21 isolevels_0_87	16.13			10.39	20...	
To Grey Level :95	21 isolevels_0_95	15.88			10.11	19...	

Spreadsheet of one grey to grey measurement with simulation

3D display of response times and BEW and BET can be obtained

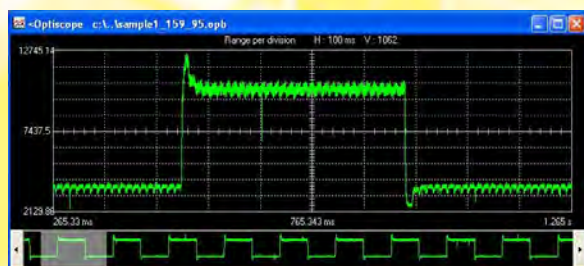


Response time from each grey level to each grey level

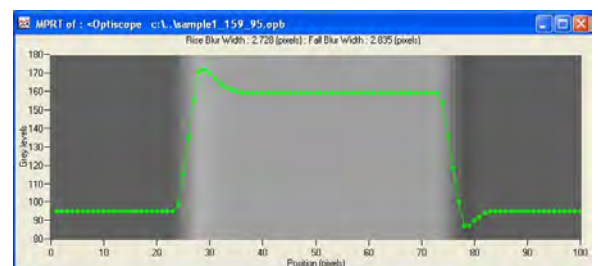


Blurred edge width from each grey level to each grey level

There is no assumption on the temporal dependence of the display. Experimental one is used directly. So, MPRT can be simulated with any temporal behavior.



Response time measurement with over and under drive



Corresponding MPRT with 4pixels/frame speed

Equipment required: OPTIScope-SA + MPRT Software option

ADVANCED COLORIMETRY by ELDIM

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