The SIM2 HDR PROJECTION AT ISE 2017

by Domenico Toffoli, R&D Director at SIM2

For SIM2, the human visual system is the reference for the reproduction of video images in general and in particular for the reproduction of images with the luminance of High Dynamic Range (HDR).

By convention, an HDR image must have a luminance dynamic equal to the one perceived by the human visual system without adaptation or approximation.

Tests conducted on large groups of people have identified this dynamic range as five orders of magnitude, or 16 f-stops.

To reproduce the conditions of visibility of the natural world, for which the human visual system has evolved over millions of years, we need a high maximum brightness, in the order of 10,000 cd / m2.

The **combination of these two factors, High Dynamic Range and Maximum Brightness, provide the actual dynamic that should be achievable from our HDR display.**

This approach had already been used by SIM2 in developing the Monitor HDR47ES6K, capable of a maximum brightness of 6000 cd / m2 and a dynamic range of more than 17 f stops.

By contrast, a projector equipped with HDMI 2.0a inputs, which is able to manage HDR static metadata, **does NOT mean** that it is able to reproduce HDR images in the correct way, if it doesn't present these characteristics in terms of light range projected on the screen.

SIM2 has sought a solution derived from serial double modulation, with 4 chips (including 1 chip to modulate the light from the UHP lamp and 3 chips for the modulation of RGB color information), but this solution is not efficient enough.

Instead, after several experiences in the laboratory, great results were achieved by stacking two projectors of the same platform (AR, the flagship) but differentiated from each other to 'share' the dynamic range.

In fact, the brightness produced by a single projector with single UHP lamp, albeit efficient as it can be from a 3 chip DLP projector, it is not enough to produce the required maximum brightness, so, it was decided that the superimposition of at least two 3-chip projectors, equipped with very efficient 0.95 " DMDs offered the best results.

Stacking two UHP lamp-equipped 5000 lm identical projectors, however, is not enough to guarantee a true HDR image, as this would simply duplicate both the bright maximum value and the value of stray, uncontrolled light, which affects the black level.

So, appropriate changes to the optics are needed on the projectors to limit its scattered light at low light levels, without damaging the full brightness too much.

Fortunately DLP technology is particularly suitable for this purpose thanks to its high contrast (Dark Chip 4) but still insufficient for a true projection HDR.

The differentiation was performed so that the contribution of the second was limited in the high lights compared to the first, but that would provide a negligible parasitic light, therefore able to ensure the correct reproduction of details at low and very low lights.

The wide range of brightness needs an internal modulation with a very high internal dynamics, to avoid banding phenomena.

Amongst other design features that we cannot disclose, we have utilized the full 14 gamma bits of the DLP chipsets and we carried out a very precise 2.4 gamma calibration of the projectors (cinema gamma).

However, the overlapping of the two projectors is not an easy task, as this has to be pixel perfect.

Therefore we developed a mechanical platform equipped with micrometric adjustments in all 6 axes, x, y, x, and pitch, yaw and roll. Special attention has been paid to the thermal stability of the system.

These two maneuvers have allowed to obtain the two projected images perfectly superimposed and stable in time and in temperature, along with a limited warm-up time.

The Dynamic improvement of the video images can be reached ALSO using old blue ray disk titles, FullHD, 24Hz, 8 bit per color, reproduced by consumer BRD players.

At CEDIA 2016 and ISE 2017, we showed the result of this R&D project: an 9000 Lm projection system displaying onto a 16:9 11' screen, gain one, that delivers 95 fL of maximum brightness and a dynamic range close to 15 f stops, very close to real HDR target (16 f stops).

A major breakthrough for this new technology.

Visually more satifying than additional spatial resolution, HDR is more pleasing to the eye as it matches more closely the dynamics of the real world.

This is the effect we wanted to create for the Sim2 demanding customers

We believe we did excatly that.