HDR production pipeline for live TV broadcasting

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Keywords: HDR video, Live Broadcasting

Abstract

We present a real-time production pipeline for High Dynamic Range (HDR) video imaging covering all the steps required in a professional broadcasting environment. The proposed solution preserves all the luminance/chrominance information that the capturing hardware technology is able to acquire and presents it on a high performance HDR display.

1 Introduction

The digital transformation of the audio-visual content has enabled a rich set of possibilities in terms of video formats. High Definition is the main contribution of the Digital TV that has allowed the widespread of 720p and 1080i formats. Stereoscopic video was considered as the next step in the evolution of video formats. However, 3D did not get the required popularity in the mass market to be considered as the *de facto* format for the audio-visual industry. 4K is currently the main trend and TV manufacturers as well as camera developers have already a rich set of commercial products available. However, operators are not sure if the quality improvement introduced by 4K is enough to leverage the associated investments, both in the professional production side and by the consumer electronics market.

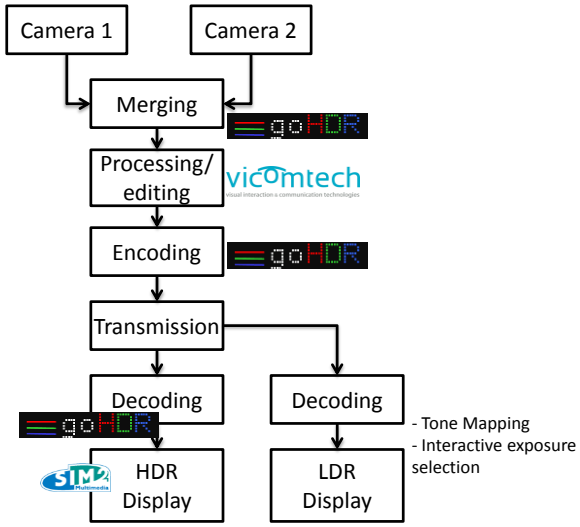
HDR imaging introduces a clear improvement in image quality by extending the lighting range (dynamic range) to the capabilities of the human visual system and thus exploiting one of the dimensions that did not evolve in digital video imaging as frame-rate and especially resolution aspects did [1]. However, the inclusion of a higher dynamic range introduces many technical and scientific challenges problems that have to be solved in order to endow regular video workflows with HDR properties.

2 Main S&T challenges

The main challenges related with the real-time HDR video broadcasts are **a) Capture**: Most solutions are based on taking different frames at different exposures. This fact might introduce some side effects such as blurring or parallax effects for multi-camera solutions, **b) Manipulation,** distribution, transmission. HDR requires at least 16 bits per channel that typically are extend to 32 (typical *float* data type). In HD format 720p it would imply 1.4Gb/s in raw. Moreover, standard codecs are not able to deal with this bit-depth and require new encoding techniques for efficient compressions purposes and **c) Display:** Current displays are below 500 cd/m^2 and operate at 8 bits per channel. There are few manufacturers that are developing new displays that go much further.

3 Proposed solution

Our proposed solution is shown in Figure 1.



The system is composed by a capturing system where the obtained frames are used to create the HDR image. The data flow can be edited in real time and all the operations are made on the original raw data flow. Then, the information is encoding following an encoding method that reduces the bandwidth by between 150-500: 1 depending on the content. The video information is send encapsulated in MPEG-4 H.264 in order to be compatible with existing infrastructures. Finally, the video flow is decoded and represented in a SIM2 display, capable of over 5.000 cd/m^2 and 16 bit per channel, were all the HDR features are preserved. For LDR displays either tone mapping techniques or interactive exposure selection options can be used.

4 Acknowledgements

This activity has been supported by the HDRi IC1005 COST Action (http://www.cost.eu/).

References

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