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TECHNICAL REPORT

Measurement methods – High dynamic range video

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MEASUREMENT METHODS – HIGH DYNAMIC RANGE VIDEO

FOREWORD

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IEC TR 62935, which is a technical report, has been prepared by IEC technical committee 100: Audio, video and multimedia systems and equipment.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
100/2642/DTR	100/2703/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

The market for the production and delivery of moving images has transitioned from film through analogue standard-definition video through digital HD video and now to 4K Ultra HD video. As the increase in resolution continues to 8K, the opportunity exists to increase the dynamic range of the video, including brighter peak luminance levels. This, in conjunction with wide colour gamut, increases the volume of possible levels and colours, resulting in more realistic and hyper-realistic presentations.

IEC TC 100 AGS SS9 (HDR) has identified a standardization opportunity related to measurement methods and test signals for HDR video. This Technical Report sets the groundwork for such an activity.

MEASUREMENT METHODS – HIGH DYNAMIC RANGE VIDEO

1 Scope

This document introduces the concept of High Dynamic Range (HDR) video, lists some of the related standards and activities, provides information about HDR in the marketplace, and proposes areas of HDR measurement that could be standardized.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
high dynamic range
HDR
span of image luminances that is larger than normally possible for standard, high definition, and ultra HD video

3.2
standard dynamic range
SDR
span of image luminances that is normally possible for standard and high definition video

Note 1 to entry: Standard definition, high definition, and ultra HD video systems are normally capable of producing luminances of 10 times that of an average mid-tone at the top (white) end of the range, and of 0,01 times that of an average mid-tone at the bottom (black) end of the range.

3.3
wide colour gamut
WCG
range of colours in a colour space that covers a large percentage of visible colours

EXAMPLE ITU-R BT.2020 [2][1] is considered to provide WCG while BT.709 [3] does not.

[1] Numbers in square brackets refer to the Bibliography.

4 Overview

4.1 Historical background

Still and moving pictures were initially captured and displayed with chemical processes, typically on film. The dynamic range varied by process and was limited by the maximum density achievable on the reproduction medium for representation of dark areas and by the minimum density achievable on the reproduction medium in representation of bright areas. Though there are hard limits with this technology, the processes involved resulted in the limits being approached gradually, with dynamic range expansion in the mid-tones, and dynamic range compression at the extremes.

Electronic images were initially captured and displayed using analogue means. Electronic noise limits the representation of dark areas and defined limits can clip the bright areas. Though a wire can carry much more than a 1 V signal (which represents 100 % white in some systems), various equipment in the processing chain might apply a hard clip. There is no natural compression as the signal approaches the white limit. Dynamic range compression is generally performed in the camera or in post-production with specialized equipment.

Today, most image capture, storage, and processing is based on digital technology. Dark details are limited by the noise and quantization error. White levels have a hard limit at the defined maximum white code value. Similar to analogue electronic techniques, dynamic range expansion in the mid-tones and compression at the extremes is performed by in-camera processing or in post-production.

Picture levels were standardized during the analogue time frame. Peak white for displays was defined as 48 cd/m^2 for the cinema and 100 cd/m^2 for video presentation in mastering suites under controlled, low-level lighting conditions. These standardized levels were retained during and after the transition from analogue to digital equipment and techniques.

NOTE Consumer televisions have higher peak luminance, typically around 350 cd/m^2, in order to allow for bright viewing conditions.

In order to optimize the use of signal levels, a gamma curve is applied between signal and display. This was done naturally by cathode ray tube displays and is done electronically in typical flat panel displays. The gamma equation is as follows:

$$V_{\text{out}} = AV_{\text{in}}^{\gamma}$$

ITU-R Recommendation BT.1886 [1][2]defines gamma (γ) as 2.4 and screen luminance for white as 100 cd/m^2 for standard dynamic range high definition video.

4.2 Scene versus display ranges

Images are captured in a variety of conditions – from the dark reaches of Pluto to the intense light levels of the sun. The captured ranges of these images are normalized by controlling exposure levels. The high dynamic range system covered by this document is not intended to capture Pluto and the Sun at a single exposure image; however, an HDR system allows the captured range of those two separate images to include deeper black levels above the noise level and brighter white levels without clipping. An HDR system preserves those larger ranges through display to the viewer. This requires higher bit-depths, displays capable of higher luminance peaks, and carefully designed transfer functions to optimize the relationship between signal and presentation.

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2 Numbers in square brackets refer to the Bibliography.