ECVP Abstract: 2017
Subjects prefer to view a linear image when both image and display have the same dynamic range

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1 Teaser
The image-processing pipeline must be reevaluated for modern high dynamic range content and displays. We demonstrate that for natural images, the ratio of the dynamic range of the original scene and the displayed image is of critical importance to how an image is perceived.

46 words (max 50)

2 Main
Advances in technology are increasing the available dynamic range (DR) of modern capture and display devices. This is potentially problematic because the normalized median luminance of an image is inversely correlated with DR (Kane and Bertalmío, 2015) and the human visual system may be maladapted if the DR of the original scenes and the display are not matched. To investigate this issue, we present images on various sub-ranges of a professional HDR monitor (SIM2; DR > 10^6) by either fixing the mid-luminance level and varying the log DR (from 100% to 50% of the full display range) or fixing the DR (at 50%) and varying the mid-luminance level. Images were always viewed in a dark room. The image database used (Fairchild, 2007) contains scenes with a distribution of DRs spanning from 10^2 to 10^7. Subjects viewed each image under a variety of power-law transforms of value $\gamma$ and were asked to rate the overall image quality. We find that when the ratio of image dynamic range over monitor dynamic range is one, subjects prefer to view linear images ($\gamma = 1$). When the ratio is less than one, the image must be brightened ($\gamma < 1$) and when the ratio is greater than one, the image must be darkened ($\gamma > 1$). Increasing the mid-luminance level leads subjects to choose a higher system gamma, but this effect is, relatively-speaking, small. These findings indicate that the nonlinear processing of human vision is optimized to deal with the statistics of natural images, but only if the DR of the image is correctly displayed.

249 words (max 250)

3 The result
The abstract is based on the below figure. On the abscissa the figure plots the DR ratio of the original scene over the displayed image. The DR for the original scene was computed as the image max over the 0.001% lowest pixel value. The monitor DR was simply the max over the min of the display range used. On the left-hand side we plot the preferred system gamma against the DR ratio and on the right-hand side we plot the maximal image quality score against the DR ratio. That is, the image quality obtained with the optimal value of system gamma.
(1) Full  
(2) 75% centered  
(3) 50% centered  
(4) 50% lower  
(%) 50% upper