EE 367 Project Proposal

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Motivation

Modern displays are used in different lighting conditions with the awareness of the ambient illumination levels, i.e., the displays automatically adjust the brightness levels depending on the ambient illumination. Such adjustment can reduce energy consumption and produce better visual experience for the users. However, there is a discrepancy that the display content is the same across the range of ambient illuminations, yet human visual systems do not retain a constant color and contrast perception. Therefore, the image quality and visual experience differ drastically when the same picture is shown at different situations. It is the goal of this project to take a closer look at different algorithms to adjust the image based on the ambient light situations and propose the best solution.

Related work

The CIE Technical Committee proposed a color appearance model CIECAM02 [1], based primarily on a set corresponding colors experiments and a collection of color appearance experiments. This model proposed a method to take into account the viewing condition to transform tristimulus values to or from perceptual attribute correlates. However, Wanat et al [2] argue that CIECAM02 model is almost entirely based on the cone-mediated vision, while a big portion of the color gamut in modern displays often lies in the luminance range below 3 cd/m^2, when visual signal is mainly influenced and perceived by the retinal rod cells. Thus, they propose a new appearance matching model and luminance retargeting method. This method relies on a model of color as well as human contrast sensitivity function [3]. The best compromise between retaining contrast and brightness is provided by optimizing the shape of a tone curve.

Project overview

Part one: We propose to first construct a scene using ISET, then implement and compare two different algorithms, namely, CIECAM2 and Wanat et al method, to massage the images under different viewing conditions.

Part two: Propose a new algorithm. Divide the image into a base layer and detail layer. Address each layer separately based on the contrast sensitivity function of human eyes. Compare the complexity/results of all three methods and propose an optimal solution.

Milestone, timeline & goal

~2/18: Literature study, construct scene in ISET

~3/4: Part one, refine new algorithm

~3/11: Part two

~3/13: Poster presentation

~3/16: Project due

Reference

[1] Moroney, Nathan et al. 2002. The CIECAM02 color appearance model. IS&T/SID Tenth Color Imaging Conference.

[2] Wanat and Mantiuk, Simulating and compensating changes in appearance between day and night vision, Proceedings of ACM SIGGRAPH 2014. ACM Trans. Graph. 33, 4 (July 2014).

[3]: BARTEN, P. G. J. 1999. Contrast sensitivity of the human eye and its effects on image quality. SPIE Press.