Optimized Color LUT Transformations by means of Analysis of Image Memorable and Subject Important Colors

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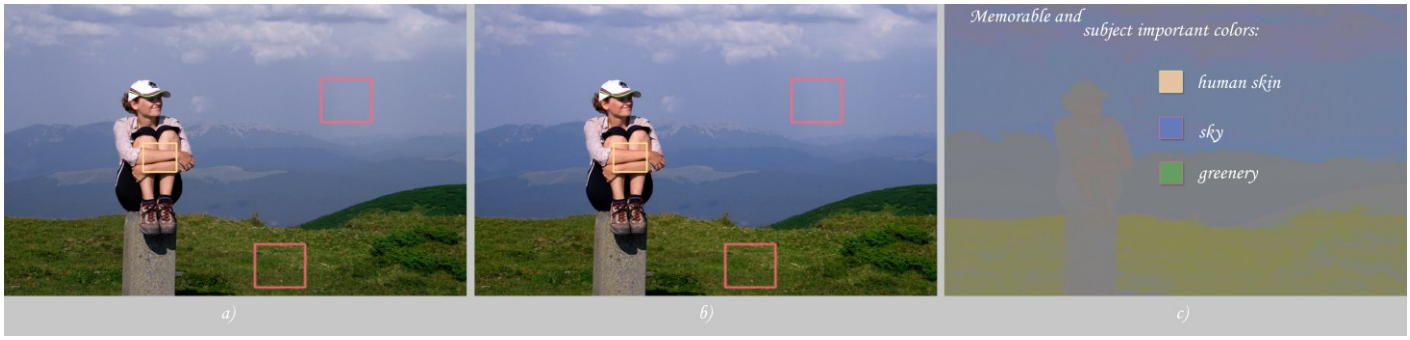

Figure 1: Result of transformations a) from workspace Adobe RGB → Lab → RGB-output profile Epson for printer Stylus Pro 4880, Premium Glossy Photo Paper; b) from workspace Adobe RGB → Lab → our RGB-output profile that takes into account memorable and subject important colors; c) color difference map

Abstract

In this work we are investigating ICC color management workflow in color imaging system and proposing improvement to standard ICC-based color management scheme. We are created optimal look-up tables of ICC profiles by using spline approximation and neural network for direct transformation RGB → Lab and regression models for inverse transformation Lab → RGB and integrated criterion (optimization criterion). Our algorithm implements corresponding color reproduction to accurately predict memorable and scene-important colors. Mean errors was reduced by 21% as compared to standard color profiles for particular output device and type of paper.

Keywords: LUT-tables, color image processing.

1 Introduction

Color management helps to achieve the same appearance on all of input, visualization and output devices. In color management systems there are a lot of transformations of digital workflow on the way from the input image to the output image. The basic way the ICC profiles are typically used to achieve color reproduction is by combining a source profile with a destination profile to enable input device data to be transformed to required one to give the required color at the output.

Insufficient knowledge in some questions of color management in computer systems is related to the complexity of the mathematical description of all the factors that affect the final perception of color information by human visual system. Therefore, the development of the algorithms of color transformations in the digital system is needed for accurate processing based upon image requirements.

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2 Our Approach

We propose improvements to standard ICC-based color management scheme by using spline approximation and neural network models (Generalized Regression Neural Network) to create look-up tables for direct transformation RGB → Lab and regression models for inverse transformation Lab → RGB of ICC profiles. The source data for comparative analysis of the methods for creating LUT-tables is the test chart which color coordinates has been established using spectrometric measurements.

For a process of creation color LUT it is developed integrated criterion (optimization criterion) which takes into account: average color difference ΔE between measured and calculated color coordinates in the device-independent color space Lab; the maximum color difference of all the colors of the sample E_{max}; color difference ΔEp in areas of a memorable colors (colors of human skin, greenery and colors of the sky); average color difference ΔEa of the achromatic colors because the human eye is most sensitive to color shifts in shades of gray; color difference ΔEo of sample of the colors on the gamut boundary. The sample consists of highly saturated colors that are often used to create a brand identity, as well as tints of blacks that are responsible for the details in the deep shadows. With this criterion we can estimate the accuracy of transformation by using various methods of approximation of the color data. The final value of the criterion calculated from the ratio value of each component.

Our algorithm realizes corresponding color reproduction to accurate predict memorable and scene-important colors of the images.

References

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