Deductive and inductive antagonistic TUB colorimetry to improve the CIE colorimetry for a wide range of luminance and chromatic adaptation *(abstract)*
For this paper, see http://color.li.tu-berlin.de/dfwg_23e.pdf in English or
http://color.li.tu-berlin.de/dfwg_23g.pdf in German.
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Introduction

The ISO /CIE colorimetry, for example of CIELAB, CIELUV, and CIEDE2000 according to ISO/CIE 11664-2, 5, and 4, is mainly used for surface colours with the tristimulus-value range Y_N=2,5 <= Y <=90=Y_W, see ISO/IEC 15775:2022. The ratio Y_W/Y_N=36 covers 1,5 log units. For the standard illumination 500 lux in offices this corresponds to the sample luminance range 4 cd/m^2 <= L <= 142 cd/m^2 with the grey surround luminance L_u=28 cd/m^2.

The following TUBLAB-colorimetry is intended for the surround luminance range 10 <= L_u <= 10000. The ratio of the surround luminance is 1000:1 and the sample luminance ratio is about a factor 36 larger. The TUB-colorimetry is based on both *physiological* and *psychophysical* experimental data on colour vision. For about five log units of the luminance adaptation the physiological data on visual responses and the psychophysical data on luminance thresholds have been analysed. The TUBLAB model for all achromatic and chromatic colours include the antagonistic properties of the complementary *Ostwald*-optimal colours of a *colour half* for all stages of chromatic adaptation.

Deductive and inductive TUB-colorimetry for a wide range of luminance adaptation

The *deductive* TUB-colorimetry starts with *physiological* data, for example of *Valeton and Van Norren (1973*), which are approximated here by the function tanh*(x) (tangens hyperbolicus),* see http://color.li.tu-berlin.de/eeg0/eeg00-5n.pdf. All respond functions are S-shaped and are similar. The derivation of one respond function is *Gaussian* shaped, see http://color.li.tu-berlin.de/eeg0/eeg00-3n.pdf.

The *inductive* TUB-colorimetry starts with *psychophysical* data, for example of *Lingelbach and Haberich (1977),* which are approximated by *Richter (1993)*, for example the luminance threshold dL as function of L and L_u, see http://color.li.tu-berlin.de/een4/een40-1a.pdf
The ratio L/dL is called the contrast, see http://color.li.tu-berlin.de/een4/een40-2a.pdf.
Therefore the *physiological and psychophysical contrast* functions agree to a high degree.

Physiological and psychophysical contrast calculation and interpretation

Only for high luminance levels the maximum contrast is at the luminance L_u of the surround. This is in agreement with the physiological (1993) data. The symmetry of the *physiological* contrast disappears in the *psychophysical* data. However, for very short viewing times (<0,1s) of the two adjacent stimuli the psychophysical contrast is symmetric. Therefore there is wide *agreement* between the *deductive* and *inductive* contrast as function of L and L_u

TUB-colorimetry for a wide range of chromatic adaptation

Richter (2020) has studied the colorimetric properties of the complementary *Ostwald*-optimal colours. For the tristimulus values, wavelength limits, chromaticities and chromatic values for the standard illuminant, D50 see http://color.li.tu-berlin.de/eeh3/eeh3.htm. All Ostwald colours (o) of a colour half have different tristimulus values Y_o, see http://color.li.tu-berlin.de/eeg8/eeg81-5n.pdf. However, the two chromatic values $C_{AB,2}$ and $C_{AB,3}$ produce approximately the same radial chromatic value for any hue and adaptation, see http://color.li.tu-berlin.de/eeg8/eeg81-7n.pdf for the adaptation to D50 as example.

TUBLAB-colorimetry for a wide range of luminance and chromatic adaptation

The antagonistic model TUBLAB for colour vision can therefore be applied for a wide range of luminance and chromatic adaptation, for example instead of CIECAM16.
A presentation based on this abstract is intended at the anual DfwG meeting in Potsdam 5/6. October 2023.