sensation scaling functions
lightness L^* and tristimulus value Y
adaptation on surround white W
$L^*_W = 100\ (\ Y\ /\ 100)^{1/2,0}$
adaptation on surround grey U
$L^*_{IECsRGB} = 100\ (\ Y\ /\ 100)^{1/2,4}$
description with CIELAB 1976
$L^*_{CIELAB} = 116\ (\ Y\ /\ 100)^{1/3,0} - 16$
adaptation on surround black N
$L^*_N = 100\ (\ Y\ /\ 100)^{1/3,0}$

Approximation of CIELAB lightness L^* as function of $\log Y$ coordinates L^* and $\log Y$ for 4 colours W ... N

Viewing situations of adjacent greys

Viewing situations of separated greys

CIELAB lightness L^* as function of CIE tristimulus value Y coordinates L^* and Y for achromatic colours

CIELAB lightness L^* as function of $\log Y$ coordinates L^* and $\log Y$ for achromatic colours

IECsRGB-triangle lightness T^* as function of $\log Y$ coordinates $\log T^*$ and $\log Y$ for 4 colours W ... N

IECsRGB-triangle lightness $\log T^*$ as function of $\log Y$ coordinates $\log T^*$ and $\log Y$ for 4 colours W ... N

$\log D_L = \log(\Delta Y\ /\ \Delta Y_W)$ relative IECsRGB-Y difference coordinates $\log D_L$ and $\log Y$ for 4 colours W ... N

$\log C_L = \log((Y\ /\ \Delta Y)/(Y_W/\Delta Y_W))$ relative CIE contrast coordinates $\log C_L$ and $\log Y$ for 4 colours W ... N

CIELAB lightness L^*, tristimulus value discrimination dY, contrast $(Y/\Delta Y)_L$ and sensitivity$(\Delta Y/Y)$

CIELAB lightness for all colours, L^*_n=50 for Y_n=18

$L^* = 66\ (Y/Y_n)^{1/3} - 16 \qquad (Y_n{=}18,\ Y > 1)$

For the grey discrimination we get:

$dL^*/dY = (66/Y_n)\ (1/3)\ (Y/Y_n)^{-2/3}$

and for dL^*=1 (about 3 thresholds) we can write:

$dY = 3\ (Y_n/66)\ (Y/Y_n)^{2/3}$

or $\log(dY) = \log(3\ (Y_n/66) + (2/3)\log(Y/Y_n)$

therefore in a log-log diagram the slope is (2/3).

for the CIE contrast sensitivity, and for dL^* = 1 it is valid:

$Y/dY = (1/3)\ (66/Y_n)\ (Y/Y_n)^{1/3}$

or $\log(Y/dY) = \log((1/3)\ (66/Y_n)) + (1/3)\log(Y/Y_n)$

CIELAB lightness L^*, CIE tristimulus value discrimination $dY$and CIE contrast sensitivity (Y/dY)

CIELAB lightness for all colours, L^*_n=100 for Y_n=100

$L^* = 116\ (Y/Y_n)^{1/3} - 16 \qquad (Y_n{=}100,\ Y > 1)$

For the grey discrimination we get:

$dL^*/dY = (116/Y_n)\ (1/3)\ (Y/Y_n)^{-2/3}$

and for dL^*=1 (about 3 thresholds) we can write:

$dY = (3/Y_n^{1/3}{\cdot}116)\ (Y)^{2/3}$

or $\log(dY) = \log(3Y_n^{1/3})/116) + (2/3)\log(Y)$

therefore in a log-log diagram the slope is (2/3).

for the CIE contrast sensitivity, and for dL^* = 1 it is valid:

$Y/dY = (1/3)\ (116/Y_n^{1/3})\ Y^{1/3}$

or $\log(Y/dY) = \log((1/3)\ (116/Y_n^{1/3})) + (1/3)\log(Y)$

IECsRGB-triangle lightness T^*, CIE tristimulus value discrimination dT and CIE contrast (Y/dY) sRGB: see IEC 61966-2-1

$T^*_{sRGB,100} = 100\ (Y/Y_n)^{1/2,4}$ is an approximation of L^*_{CIELAB} sRGB-triangle lightness for *achromatic* colours: W (Y_n=100)

For the grey discrimination we get:

$dT^*_{sRGB,100}/dY = (1/2,4)\ (Y/Y_n)^{1,4/2,4} = 0,42\ (Y/Y_n)^{-0,58}$

and for $dT^*_{sRGB,100}$=1 (about 3 thresholds) we can write:

$dY = 2,4\ (Y/Y_n)^{1,4/2,4}$

or $\log(dY) = \log(2,4) + (1,4/2,4)\log(Y/Y_n)$

therefore in a log-log diagram the slope is 1,4/2,4.

for the CIE contrast sensitivity, and for $dT^*_{sRGB,100}$=1:

$Y/dY = (Y_n{}^{1,4/2,4}/2,4)\ (Y/Y_n)^{1/2,4}$

or $\log(Y/dY) = \log(Y_n{}^{1,4/2,4}/2,4) + 1/2,4\log(Y/Y_n)$

IECsRGB-triangle lightness T^*, CIE tristimulus value discrimination dT and CIE contrast (Y/dY) sRGB: see IEC 61966-2-1

$T^*_{sRGB,100} = 100\ (Y/Y_n)^{1/2,4}$ is an approximation of L^*_{CIELAB} sRGB-triangle lightness for *chromatic* colours: RGB ($T^*_{sRGB,100} = 100\ (0,2126\,R + 0,7152\,G + 0,0722\,B)^{1/2,4}$, Y_n=22(R), =71(G), =07(B))

For the discrimination we get:

$dT^*_{sRGB,100}/dY = (1/2,4)\ (Y/Y_n)^{-1,4/2,4} = 0,42\ (Y/Y_n)^{-0,58}$

and for $dT^*_{sRGB,100}$=1 (about 3 thresholds) we can write:

$dY = 2,4\ (Y/Y_n)^{1,4/2,4}$

or $\log(dY) = \log(2,4) + (1,4/2,4)\log(Y/Y_n)$

therefore in a log-log diagram the slope is 1,4/2,4.

for the CIE contrast sensitivity, and for $dT^*_{sRGB,100}$=1:

$Y/dY = (Y_n{}^{1,4/2,4}/2,4)\ (Y/Y_n)^{1/2,4}$

or $\log(Y/dY) = \log(Y_n{}^{1,4/2,4}/2,4) + 1/2,4\log(Y/Y_n)$