Hyperbolic response function of achromatic vision space T^*_{HYP3X}

nonlinear color terms	name and relationship with test field luminance L	*notes* equation type 1/(1+X)
threshold sum T^*_{HYP3X} T^*_{HYP3}	$T^*_{HYP3X} = A_1 / (1 + A_2 / L^t)$; $X=1/L^t=L^{-t}$ $= A_1 / (1 + A_2 \cdot X)$; $dX/dL=-t \cdot L^{-t-1}$ $= A_1 \cdot [1 + A_2 \cdot X)]^{-1}$	*T. Seim* 2014: exponent: t = 0,8 for presentation time: t_p = 0,1s of *Avramopoulos* experiments 1989
CIE luminance contrast sensitivity threshold L / dL	$dT^*_{HYP3X} /dX=-A_1 \cdot A_2 \cdot [1 + A_2 \cdot X)]^{-2}$ $dT^*_{HYP3X} /dL=dT^*_{HYP3X} /dX \cdot dX / dL$ $dT^*_{HYP3X} /dL=A_1 \cdot A_2[1+A_2 \cdot X)]^{-2} t \cdot L^{-t-1}$ *for* dT^*_{HYP3X}=1, and multiplication with L: $L / dL = A_1 \cdot A_2[1+A_2 \cdot X)]^{-2} t \cdot L^{-t}$ $= A_1 \cdot A_2 \cdot t \cdot / (L^t[1+A_2 / L^t)]^2)$	Hyperbolic function: $T^*_{max} = A_1$ $T^*_{average} = 0{,}5 \cdot A_1$ $A_{2x} = A_2^{1/t}$
CIE luminance difference threshold dL	$dL = L \cdot (L^t [1+A_2 / L^t)] / (A_1 \cdot A_2 \cdot t)$ $= (L^t + A_2)^2 / (A_1 \cdot A_2 \cdot t \cdot L^{t-1})$	

1−000030−L0 UE150−3N

Logarithmic response function of achromatic vision space T^*_{LOG3}

nonlinear color terms	name and relationship with test field luminance L	*notes*
threshold sum T^*_{LOG3}	$T^*_{LOG3} = A_1 \cdot \log (1 + A_3 \cdot L)^t$ $= A_1 \cdot t \cdot \log (X)$ $X = 1 + A_3 \cdot L$; $dX/dL = A_3$	exponent: $t = A_2$
CIE luminance contrast sensitivity threshold L / dL	$dT^*_{LOG3} / dX = A_1 \cdot t \cdot X^{-1}$ $dT^*_{LOG3} / dL = dT^*_{LOG3} / dX \cdot dX / dL$ $dT^*_{LOG3} / dL = A_1 \cdot A_3 \cdot t \cdot X^{-1}$ *for* dT^*_{LOG3}=1, and multiplication with L: $L / dL = L \cdot A_1 \cdot A_3 \cdot t \cdot X^{-1}$ $= L \cdot A_1 \cdot A_3 \cdot t \cdot (1 + A_3 \cdot L)^{-1}$	for large L: $T^*_{LOG3} = A_1 \cdot t \cdot \log(A_3 \cdot L)$ for least square fit: $dX/dA3 = 1$ $dX/dL = A_3$
CIE luminance difference threshold dL	$dL = X / [A_1 \cdot A_3 \cdot t]$ $= [1 + A_3 \cdot L] / [A_1 \cdot A_3 \cdot t]$	

1−000030−L0 UE151−3N

Exponential response function of achromatic vision space T^*_{EXP3X}

nonlinear color terms	name and relationship with test field luminance L	*notes*
threshold sum T^*_{EXP3X}	$T^*_{EXP3X}=A_1 \cdot \log (1+A_2 \cdot 10^{X-Xu})$; $X=\log L$ $=A_1 \cdot \log (1+A_2 \cdot 10^X/10^{Xu})$; $L=10^X$ $=A_1 \cdot \log (1+A_4 \cdot L)$; $dL/dX=\ln(10) \cdot 10^X$	L/dL $= A_1 \cdot A_4 \cdot L / (1+A_4 \cdot L)$ for large L it is valid: $1 << A_4 \cdot L$ therefore:
CIE luminance contrast sensitivity threshold L / dL	$dT^*_{EXP3X} /dL=A_1 \cdot A_4 / (1 + A_4 \cdot L)$ $=A_1 \cdot A_2 / [L_u \cdot (1+A_2 \cdot (L/L_u)]$ for dT^*_{EXP3X}=1, and multiplication with L: $L / dL = A_1 \cdot A_4 \cdot L / (1 + A_4 \cdot L)$ $= A_1 \cdot A_2 \cdot (L/L_u) \cdot [1 + A_2 \cdot (L/L_u)]$ The ratio L / dL is constant for large L	$L/dL=A_1$ = constant =*Weber−Fechner* law $A_4 = A_2 / L_u$
CIE luminance difference threshold dL	$dL = (1 + A_4 \cdot L) / (A_1 \cdot A_4)$ $= [1 + A_2 \cdot (L/L_u)] / (A_1 \cdot A_2/L_u)$	

1−000030−L0 UE150−7N

Logarithmic response function of achromatic vision space T^*_{LOG3}

nonlinear color terms	name and relationship with test field luminance L	*notes*
threshold sum T^*_{LOG3}	$T^*_{LOG3} = A_1 \cdot \log (1 + A_2 \cdot L + A_3 \cdot L^2)$ $= A_1 \log (X)$ $X = 1+A_2 \cdot L+A_3 \cdot L^2$; $dX/dL = A_2+A_3 \cdot L$	for large L: T^*_{LOG3} $= A_1 \cdot \log(A_3 \cdot L^2)$
CIE luminance contrast sensitivity threshold L / dL	$dT^*_{LOG3} / dX = A_1 \cdot X^{-1}$ $dT^*_{LOG3} / dL = dT^*_{LOG3} / dX \cdot dX / dL$ $dT^*_{LOG3} / dL = A_1 \cdot (A_2 + A_3 \cdot L) \cdot X^{-1}$ *for* dT^*_{LOG3}=1, and multiplication with L: $L / dL = L \cdot A_1 \cdot (A_2 + A_3 \cdot L) \cdot X^{-1}$ $= L \cdot A_1(A_2+A_3 \cdot L)/(1+A_2L+A_3 \cdot L^2)$	for least square fit: $dX/dA2 = L$ $dX/dA3 = L^2$ $dX/dL = A_2 + 2A_3 \cdot L$
CIE luminance difference threshold dL	$dL = X / [A_1 \cdot (A_2 + A_3 \cdot L)]$ $= (1+A_2 \cdot L+A_3 \cdot L^2) / [A_1(A_2+A_3 \cdot L)]$	

1−000030−L0 UE151−7N

see similar files: http://130.149.60.45/~farbmetrik/UE15/UE15.HTM
technical information: http://www.ps.bam.de or http://130.149.60.45/~farbmetrik

TUB registration: 20130201-UE15/UE15L0NA.TXT /.PS
application for measurement of display output

TUB material: code=rha4ta

TUB-test chart UE15; Colour thresholds spaces
Hyperbolic and logarithmic luminance sensitivity

input: *w/rgb/cmyk* −> *w/rgb/cmyk*_
output: no change