Line-element examples for grey samples (0,2≤x≤5)

F(x) is called the line-element function of ***f(x)***.
The following relations are valid for $x=Y/Y_u=Y/18$:

$$\frac{d[F(x)]}{dx} = f(x) \quad [1]$$

$$F(x) = \int \frac{f'(x)}{f(x)}\,dx \quad [2]$$

Example for the normalized tristimulus value $x=Y/Y_u$:

$$\frac{d[a\ln(1+bx)]}{dx} = \frac{ab}{1+bx} \quad [3]$$

$$a\ln(1+bx) = \int \frac{ab}{1+bx}\,dx \quad [4]$$

CEA00−1N

Line-element examples for grey samples (0,2≤x≤5)

$F_u(x)$ is called the line-element function of $f_u(x)$.
Both functions are normalized to the surround value:

$$\frac{d[F_u(x)]}{dx} = f_u(x) \quad [1]$$

$$F_u(x) = \int \frac{f'_u(x)}{f_u(x)}\,dx \quad [2]$$

Example for the normalized functions with $x_u=1$:

$$F_u(x) = \frac{F(x)}{F(x_u)} = \frac{\ln(1+bx)}{\ln(1+b)} \quad [3]$$

$$f_u(x) = \frac{f(x)}{f(x_u)} = \frac{1+bx}{1+b} \quad [4]$$

CEA00−2N

Line-element examples for grey samples (0,2≤x≤5)

$F_u(x)$ is called the line-element function of $f_u(x)$.
Both functions are normalized to the surround value:

$$\frac{d[F_u(x)]}{dx} = f_u(x) \quad [1]$$

$$F_u(x) = \int \frac{f'_u(x)}{f_u(x)}\,dx = \int \frac{b}{1+bx}\,dx \quad [2]$$

Example for $L^*(x)$ & ΔY with $x=Y/Y_u$, $x_u=1$, b=6,141:

$$L^*_u(x) = \frac{L^*(x)}{L^*(x_u)} = \frac{\ln(1+bx)}{\ln(1+b)} \quad [3]$$

$$f_u(x) = \frac{\Delta Y}{\Delta Y_u} = \frac{1+bx}{1+b} \quad [4]$$

CEA00−3N

Line-element equations according to CIE 230:2019

Colour-threshold (t) function $f_t(x) = \Delta Y_t = \Delta x\, Y_u$ [0]
$\Delta Y_t=(A_1+A_2Y)/A_0$ A_0=1,5, A_1=0,0170, A_2=0,0058

$$f_{tu}(x) = \frac{\Delta Y_t}{\Delta Y_{tu}} = \frac{1+bx}{1+b} \quad b=A_2Y_u/A_1 \quad x=Y/Y_u \quad [1]$$

$$F_{tu}(x) = \int \frac{f'_{tu}(x)}{f_{tu}(x)}\,dx = \int \frac{b}{1+bx}\,dx \quad [2]$$

Example for $L^*_{tu}(x)$, ΔY_t with $x=Y/Y_u$, $x_u=1$, b=6,141:

$$L^*_{tu}(x) = \frac{L^*_t(x)}{L^*_{tu}(x)} = \frac{\ln(1+bx)}{\ln(1+b)} \quad [3]$$

$$f_{tu}(x) = \frac{\Delta Y_t}{\Delta Y_{tu}} = \frac{1+bx}{1+b} \quad [4]$$

CEA00−4N

Line-element equations according to CIE 230:2019

Colour-discrimination function $f(x) = \Delta Y = \Delta x\, Y_u$ [0]
$\Delta Y=(A_1+A_2Y)/A_0$ A_0=1,5, A_1=0,0170, A_2=0,0058

$$f_u(x) = \frac{\Delta Y}{\Delta Y_u} = \frac{1+bx}{1+b} \quad b=A_2Y_u/A_1 \quad x=Y/Y_u \quad [1]$$

$$F_u(x) = \int \frac{f'_u(x)}{f_u(x)}\,dx = \int \frac{b}{1+bx}\,dx \quad [2]$$

Example for $L^*(x)$ & ΔY with $x=Y/Y_u$, $x_u=1$, b=6,141:

$$L^*_u(x) = \frac{L^*(x)}{L^*(x_u)} = \frac{\ln(1+bx)}{\ln(1+b)} \quad [3]$$

$$f_u(x) = \frac{\Delta Y}{\Delta Y_u} = \frac{1+bx}{1+b} \quad [4]$$

CEA00−5N

Line-element equations for thresholds and scaling

Colour-discrimination function $f(x) = \Delta Y = \Delta x\, Y_u$ [0]
$\Delta Y=1/[(1+x)(2+x)]=1/[1+x]-1/[2+x]$ $x=\sqrt{2}\,e^{k(u-u_0)}$

$$f_u(x) = \frac{\Delta Y}{\Delta Y_u} = \frac{1+bx}{1+b} - \frac{1+0{,}5bx}{1+0{,}5b} \quad b=1,\ x=Y/Y_u \quad [1]$$

$$F_u(x) = \int \frac{f'_u(x)}{f_u(x)}\,dx = \int \frac{b}{1+bx}\,dx - \int \frac{0{,}5b}{1+0{,}5bx}\,dx \quad [2]$$

Example for $L^*(x)$ & ΔY with $x=Y/Y_u$, $x_u=1$, b=1:

$$L^*_u(x) = \frac{L^*(x)}{L^*(x_u)} = \frac{\ln(1+bx)}{\ln(1+b)} - \frac{\ln(1+0{,}5bx)}{\ln(1+0{,}5b)} \quad [3]$$

$$f_u(x) = \frac{\Delta Y}{\Delta Y_u} = \frac{1+bx}{1+b} - \frac{1+0{,}5bx}{1+0{,}5b} \quad [4]$$

see K. Richter (1985), Computer Graphic and Colorimetry, p. 113−127
http://color.li.tu-berlin.de/BUA4BF.PDF

CEA00−6N

Line-element equations for thresholds and scaling

Colour-discrimination function $f(x) = \Delta Y = \Delta x\, Y_u$ [0]
$\Delta Y=1/[(1+x)(2+x)]=1/[1+x]-1/[2+x]$ $x=\sqrt{2}\,e^{k(u-u_0)}$

$$f_u(x) = \frac{\Delta Y}{\Delta Y_u} = \frac{1+x}{2} - \frac{2+x}{3} \quad x=Y/Y_u \quad [1]$$

$$F_u(x) = \int \frac{f'_u(x)}{f_u(x)}\,dx = \int \frac{1}{1+x}\,dx - \int \frac{1}{2+x}\,dx \quad [2]$$

Example for $L^*(x)$ & ΔY with $x=Y/Y_u$, $x_u=1$:

$$L^*_u(x) = \frac{L^*(x)}{L^*(x_u)} = \frac{\ln(1+x)}{\ln(2)} - \frac{\ln(1+0{,}5x)}{\ln(1{,}5)} \quad [3]$$

$$f_u(x) = \frac{\Delta Y}{\Delta Y_u} = \frac{1+x}{2} - \frac{1+0{,}5x}{1{,}5} \quad [4]$$

see K. Richter (1985), Computer Graphic and Colorimetry, p. 113−127
http://color.li.tu-berlin.de/BUA4BF.PDF

CEA00−7N

Line-element equations for thresholds and scaling

Colour-discrimination function $f(y) = \Delta Y = \Delta y\, Y_u$ [0]
$\Delta Y=1/[y(1+y)]=1/y-1/(1+y)$ $y=(1+\sqrt{2}\,e^{k(u-u_0)})$

$$f_u(y) = \frac{\Delta Y}{\Delta Y_u} = \frac{y}{2} - \frac{1+y}{3} \quad y=1+Y/Y_u,\ dy=dx \quad [1]$$

$$F_u(y) = \int \frac{f'_u(y)}{f_u(y)}\,dy = \int \frac{1}{y}\,dy - \int \frac{1}{1+y}\,dy \quad [2]$$

Example for $L^*(y)$ & ΔY with $y=1+Y/Y_u$, y_u=2:

$$L^*_u(y) = \frac{L^*(y)}{L^*(y_u)} = \frac{\ln(y)}{\ln(2)} - \frac{\ln(1+y)}{\ln(3)} \quad [3]$$

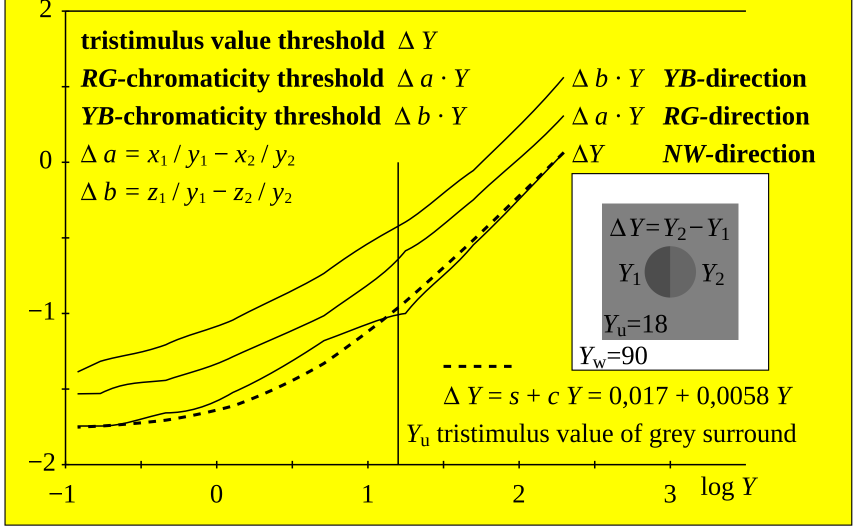
$$f_u(x) = \frac{\Delta Y}{\Delta Y_u} = \frac{1+x}{2} - \frac{1+0{,}5x}{1{,}5} \quad [4]$$

see K. Richter (1985), Computer Graphic and Colorimetry, p. 113−127
http://color.li.tu-berlin.de/BUA4BF.PDF

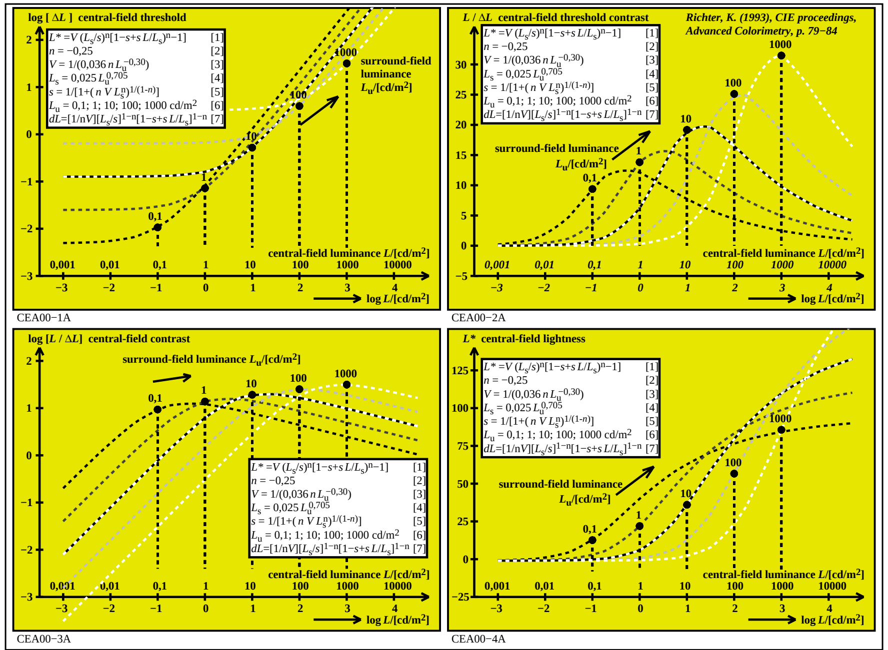
CEA00−8N

NW-achromatic, and *RG*- and *YB*-chromatic thresholds as function of *Y*

experiments and data: BAM-research report no. 115 (1985), page 72, see
https:/nbn-resolving.org/urn:nbn:de:kobv:b43-3350



CEA01−3N



CEA01−7N

see similar files: http://farbe.li.tu-berlin.de/CEA0/CEA0.HTM
technical information: http://farbe.li.tu-berlin.de or http://130.149.60.45/~farbmetrik
TUB registration: 20210701-CEA0/CEA0L0NP.PDF /.PS
application for evaluation and measurement of display or print output
TUB material: code=rha4ta