Line element of *Stiles* (1946) with „cone values" L, M, S separate colour response functions

$F(L) = i\ln(1+9L)$
$F(M) = j\ln(1+9M)$
$F(S) = k\ln(1+9S)$

Taylor-derivations:

$\Delta F(L,M,S) = \frac{dF}{dL}\Delta L + \frac{dF}{dM}\Delta M + \frac{dF}{dS}\Delta S$

$= \frac{9i}{1+9L}\Delta L + \frac{9j}{1+9M}\Delta M + \frac{9k}{1+9S}\Delta S$

iei20~1N

Line element of *Vos&Walraven* (1972) with „cone values" L, M, S separate colour response functions

$F(L) = -2i\sqrt{L}$
$F(M) = -2j\sqrt{M}$
$F(S) = -2k\sqrt{S}$

Taylor-derivations:

$\Delta F(L,M,S) = \frac{dF}{dL}\Delta L + \frac{dF}{dM}\Delta M + \frac{dF}{dS}\Delta S$

$\Delta F(L,M,S) = \frac{i}{\sqrt{L}}\Delta L + \frac{j}{\sqrt{M}}\Delta M + \frac{k}{\sqrt{S}}\Delta S$

iei20~2N

$F(x)$ „impulse rate = impulses / s"
threshold process W $-2\,Q\,[1,0(x-u)]$
threshold process N $1{,}00\,Q\,[1,4(x-u)]$
W
NW scaling
N
L_u $L_u = 100$ cd/m²
iei21~1N

$dF(x)/dx$ „impulse rate change"
white scaling W $d\,\{-2\,Q\,[1,0(x-u)]\}/dx$
sum for: scaling process
$d\,\{1{,}00\,Q\,[1,4(x-u)]\}/dx$ threshold process black N
L_u $L_u = 100$ cd/m²
iei21~1N

functions $q\,[k\,(x-u)]$ „achromatic signal"-description

with $x = \log L$ (L = luminance)
$u = \log L_u$ (L_u = surround luminan.)

$q\,[k\,(x-u)] = 1+1/[1+\sqrt{2}\,e^{k\,(x-u)}]$

function values:

$q\,[k\,(x-u)\ \to+\infty\,] = 1$
$q\,[k\,(x-u)\ =0\,] = \sqrt{2}$
$q\,[k\,(x-u)\ \to-\infty\,] = 2$

iei20~3N

$F(x)$ „colour response = impulses / s"
W-process: red R
cyan C
N-process: red r
cyan c
W-process: mean RC
N-process: mean rc
iei21~3N

colour response: amplitude modulation
W-process: U
N-process: u
W-process: $U + (R - C)$
$U - (R - C)$
N-process: $u + (r - c)$
$u - (r - c)$
iei21~4N

„achromatic signal"-description functions $Q_{1m}\,[k\,(x-u)]$

with $x = \log L$ (L = luminance)
$u = \log L_u$ (L_u = surround luminan.)

$Q_{1m}[k(x-u)] = \frac{1}{\ln\sqrt{2}} \ln q[k(x-u)] - m$

function values with $l = m = 1$:

$Q\,[k\,(x-u)\ \to+\infty\,] = 1$
$Q\,[k\,(x-u)\ =0\,] = 0$
$Q\,[k\,(x-u)\ \to-\infty\,] = -1$

iei20~4N

achromatic- and RC-opponent response
$-2\,Q\,[1,0(x-u+p)]$
$Q\,[1,4(x-u+p)]$
W
NW
pro-cess
N
$p = 1, 0, -1$
L_u $L_u = 100$ cd/m²
iei21~5N

chromatic response RC: light and dark
$-2\,Q\,[1,0(x-u+p)]$
$Q\,[1,4(x-u+p)]$
W
NW
pro-cess
N
$p = 1, 0, -1$
L_u $L_u = 100$ cd/m²
iei21~6N

„achromatic signal"discrimination as function of relative light density $h = \ln H = k\,(x-u)$ ln = natural log.

$Q' = \frac{d}{dH}[\ln\{1+1/(1+\sqrt{2}H)\}]/\ln\sqrt{2}$
$= -\sqrt{2}/[\ln\sqrt{2}(1+\sqrt{2}H)(2+\sqrt{2}H)]$

function values:

$Q'\,[k\,(x-u)\ \to+\infty\,] = 0$
$Q'\,[k\,(x-u)\ =0\,] = -0{,}5$
$Q'\,[k\,(x-u)\ \to-\infty\,] = 0$

iei20~5N

luminance discrimination possibility $L/\Delta L$ as function of H

with: $L = 10^x$ $H = e^h = 10^{\log e\ k\,(x-u)}$
$d\,L/dx = \ln 10\,L$ $dH/dx = k\,H$

it follows: $L/\Delta L = [k\,H/(d\,H\ln 10)]$
$\frac{L}{dL} = \text{const}\ H/[(1+\sqrt{2}H)(2+\sqrt{2}H)]$

$Q'\,[k\,(x-u)\ \to+\infty\,] = 0$
$Q'\,[k\,(x-u)\ =0\,] =$ maximum
$Q'\,[k\,(x-u)\ \to-\infty\,] = 0$

iei20~6N

achromatic ± RC-chromatic response
$-2\,Q\,[1,0(x-u+p)]$
$Q\,[1,4(x-u+p)]$
W
NW
pro-cess
N
$p = 1, 0, -1$
L_u $L_u = 100$ cd/m²
iei21~7N

achromatic- and RC-opponent response
$-2\,Q\,[1,0(x-u+p)]$
$Q\,[1,4(x-u+p)]$
W
NW
pro-cess
N
$p = 1, 0, -1$
L_u $L_u = 100$ cd/m²
iei21~8N

double line element of *Richter* (1987) for the lighting technic with luminance $L = F(L, M, S)$

luminance signal function $F(L)$

$F(L) = iQ(H) = \begin{cases} \bar{i}\,Q(\underline{H}) & (x<u) \\ \bar{i}\,Q(\bar{H}) & (x \geq u) \end{cases}$

with: $k = 1{,}4$ $\bar{k} = 1$ $\bar{i} = 1$ $\bar{i} = -2$
$x = \log L$ $u = \log L_u$
$\underline{H} = e^{k\,(x-u)}$, $H = e^{k\,(x-u)}$, $\bar{H} = e^{\bar{k}\,(x-u)}$

iei20~7N

double line element of *Richter* (1987) for the lighting technic with luminance $L = F(L, M, S)$

luminance signal function $F(L)$

$F(L) = iQ(H)$ $H = e^{k\,(x-u)}$
$Q[\ln\{1+1/(1+\sqrt{2}H)\}]/\ln\sqrt{2} - 1$

Taylor-derivations:

$\Delta F(L) = \frac{dF}{dL}\Delta L = i\,\frac{dQ}{dH}\Delta H$

$= -i\sqrt{2}\,\Delta H/[\ln\sqrt{2}(1+\sqrt{2}H)(2+\sqrt{2}H)]$

iei20~8N