Siehe ähnliche Dateien der ganzen Serie: http://farbe.li.tu-berlin.de/igis.htm
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Mathematikgleichungen der Hyperbelfunktionen
Siehe: *Handbook of Mathematical functions, NBS, USA, Sec. 4.5*

$F_a(x_r) = a\frac{e^{x_r/a}}{e^{x_r/a}+e^{-x_r/a}} = a\frac{u(x_r,a)}{v(x_r,a)}$ [1]
$F'_a(x_r) = a\frac{u'(x_r,a)\,v(x_r,a) - v'(x_r,a)\,u(x_r,a)}{v^2(x_r,a)}$ [2]
$u'v = [(1/a)\,e^{x_r/a}]\,[e^{x_r/a} + e^{-x_r/a}]$ [3]
$v'u = [(1/a)\,e^{x_r/a} - (1/a)\,e^{-x_r/a}]\,[e^{x_r/a}]$ [4]
$u'v = [1/a]\,\{[e^{x_r/a}]^2 + 1\}$ [5]
$v'u = [1/a]\,\{[e^{x_r/a}]^2 - 1\}$ [6]
$u'(x_r,a)\,v(x_r,a) - v'(x_r,a)\,u(x_r,a) = 2/a$ [7]
igi50-1n

Mathematikgleichungen der Hyperbelfunktionen
Siehe: *Handbook of Mathematical functions, NBS, USA, Sec. 4.5*

$F_c(x_r) = c\frac{-e^{-x_r/c}}{e^{x_r/c}+e^{-x_r/c}} = c\frac{u(x_r,c)}{v(x_r,c)}$ [1]
$F'_c(x_r) = c\frac{u'(x_r,c)\,v(x_r,c) - v'(x_r,c)\,u(x_r,c)}{v^2(x_r,c)}$ [2]
$u'v = [(1/c)\,e^{-x_r/c}]\,[e^{x_r/c} + e^{-x_r/c}]$ [3]
$v'u = [(1/c)\,e^{x_r/c} - (1/c)\,e^{-x_r/c}]\,[-e^{-x_r/c}]$ [4]
$u'v = [1/c]\,\{[e^{-x_r/c}]^2 + 1\}$ [5]
$v'u = [1/c]\,\{[e^{-x_r/c}]^2 - 1\}$ [6]
$u'(x_r,c)\,v(x_r,c) - v'(x_r,c)\,u(x_r,c) = 2/c$ [7]
igi50-2n

Achromatisches Sehen mit relativer Leuchtdichte
Mathematische Hyperbel- und Potenzfunktionen

$F_{ab}(x_r,a) = b\tanh(x_r/a) = b\frac{e^{x_r/a}-e^{-x_r/a}}{e^{x_r/a}+e^{-x_r/a}}$ $x_r=\log(L_r)$, $L_r=L/L_u$, $x_r<=0$ [1]
$\frac{dF_{ab}(x_r,a)}{dx_r} = \frac{4b}{a[e^{x_r/a}+e^{-x_r/a}]^2}$ $x_r=\ln L_r/\ln(10)$, $dx_r/dL_r=1/(\ln(10)L_r)$, $m=1/(\ln(10)a)$ [5]
$\frac{L}{dL} = \frac{4bm}{[e^{x_r/a}+e^{-x_r/a}]^2}$ $dL = \frac{[e^{x_r/a}+e^{-x_r/a}]^2 L}{4bm}$ [7]
$\frac{L}{dL} = \frac{4bm}{[L_r^m+L_r^{-m}]^2}$ $dL = \frac{[L_r^m+L_r^{-m}]^2 L}{4bm}$ [8]
igi51-1n ieio1-1n

Achromatisches Sehen mit relativer Leuchtdichte
Mathematische Hyperbel- und Potenzfunktionen

$F_{cb}(x_r,c) = b\tanh(x_r/c) = b\frac{e^{x_r/c}-e^{-x_r/c}}{e^{x_r/c}+e^{-x_r/c}}$ $x_r=\log(L_r)$, $L_r=L/L_u$, $x_r>=0$ [1]
$\frac{dF_{cb}(x_r,c)}{dx_r} = \frac{4b}{c[e^{x_r/c}+e^{-x_r/c}]^2}$ $x_r=\ln L_r/\ln(10)$, $dx_r/dL_r=1/(\ln(10)L_r)$, $n=1/(\ln(10)c)$ [5]
$\frac{L}{dL} = \frac{4bn}{[e^{x_r/c}+e^{-x_r/c}]^2}$ $dL = \frac{[e^{x_r/c}+e^{-x_r/c}]^2 L}{4bn}$ [7]
$\frac{L}{dL} = \frac{4bn}{[L_r^n+L_r^{-n}]^2}$ $dL = \frac{[L_r^n+L_r^{-n}]^2 L}{4bn}$ [8]
igi51-2n ieio1-2n

Mathematikgleichungen der Hyperbelfunktionen
Siehe: *Handbook of Mathematical functions, NBS, USA, Sec. 4.5*

$F_a(x_r) = a\frac{e^{x_r/a}}{e^{x_r/a}+e^{-x_r/a}} = a\frac{u(x_r,a)}{v(x_r,a)}$ [1]
$F'_a(x_r) = a\frac{u'(x_r,a)\,v(x_r,a) - v'(x_r,a)\,u(x_r,a)}{v^2(x_r,a)}$ [2]
$u'v = [(1/a)\,e^{x_r/a}]\,[e^{x_r/a} + e^{-x_r/a}]$ [3]
$v'u = [(1/a)\,e^{x_r/a} - (1/a)\,e^{-x_r/a}]\,[e^{x_r/a}]$ [4]
$u'v = [1/a]\,\{[e^{x_r/a}]^2 + 1\}$ [5]
$v'u = [1/a]\,\{[e^{x_r/a}]^2 - 1\}$ [6]
$F'_a(x_r) = 2 / [e^{x_r/a}+e^{-x_r/a}]^2$ [7]
igi50-3n

Mathematikgleichungen der Hyperbelfunktionen
Siehe: *Handbook of Mathematical functions, NBS, USA, Sec. 4.5*

$F_c(x_r) = c\frac{-e^{-x_r/c}}{e^{x_r/c}+e^{-x_r/c}} = c\frac{u(x_r,c)}{v(x_r,c)}$ [1]
$F'_c(x_r) = c\frac{u'(x_r,c)\,v(x_r,c) - v'(x_r,c)\,u(x_r,c)}{v^2(x_r,c)}$ [2]
$u'v = [(1/c)\,e^{-x_r/c}]\,[e^{x_r/c} + e^{-x_r/c}]$ [3]
$v'u = [(1/c)\,e^{x_r/c} - (1/c)\,e^{-x_r/c}]\,[-e^{-x_r/c}]$ [4]
$u'v = [1/c]\,\{[e^{-x_r/c}]^2 + 1\}$ [5]
$v'u = [1/c]\,\{[e^{-x_r/c}]^2 - 1\}$ [6]
$F'_c(x_r) = 2 / [e^{x_r/c}+e^{-x_r/c}]^2$ [7]
igi50-4n

Achromatisches Sehen mit relativer Leuchtdichte
Mathematische Hyperbel- und Potenzfunktionen

$F_{ab}(x_r,a) = b\tanh(x_r/a) = b\frac{e^{x_r/a}-e^{-x_r/a}}{e^{x_r/a}+e^{-x_r/a}}$ $x_r=\log(L_r)$, $L_r=L/L_u$, $x_r<=0$ [1]
$\frac{dF_{ab}(x_r,a)}{dx_r} = \frac{4b}{a[e^{x_r/a}+e^{-x_r/a}]^2}$ $x_r=\ln L_r/\ln(10)$, $dx_r/dL_r=1/(\ln(10)L_r)$, $m=1/(\ln(10)a)$ [5]
$\frac{L}{dL} = \frac{4bm}{[e^{x_r/a}+e^{-x_r/a}]^2}$ $dL = \frac{[e^{x_r/a}+e^{-x_r/a}]^2 L}{4bm}$ [7]
$\frac{L}{dL} = \frac{4bm}{[L_r^{2m}+2+L_r^{-2m}]}$ $dL = \frac{[L_r^{2m}+2+L_r^{-2m}] L}{4bm}$ [8]
igi51-3n ieio1-3n

Achromatisches Sehen mit relativer Leuchtdichte
Mathematische Hyperbel- und Potenzfunktionen

$F_{cb}(x_r,c) = b\tanh(x_r/c) = b\frac{e^{x_r/c}-e^{-x_r/c}}{e^{x_r/c}+e^{-x_r/c}}$ $x_r=\log(L_r)$, $L_r=L/L_u$, $x_r>=0$ [1]
$\frac{dF_{cb}(x_r,c)}{dx_r} = \frac{4b}{c[e^{x_r/c}+e^{-x_r/c}]^2}$ $x_r=\ln L_r/\ln(10)$, $dx_r/dL_r=1/(\ln(10)L_r)$, $n=1/(\ln(10)c)$ [5]
$\frac{L}{dL} = \frac{4bn}{[e^{x_r/c}+e^{-x_r/c}]^2}$ $dL = \frac{[e^{x_r/c}+e^{-x_r/c}]^2 L}{4bn}$ [7]
$\frac{L}{dL} = \frac{4bn}{[L_r^{2n}+2+L_r^{-2n}]}$ $dL = \frac{[L_r^{2n}+2+L_r^{-2n}] L}{4bn}$ [8]
igi51-4n ieio1-4n

Mathematikgleichungen der Hyperbelfunktionen
Siehe: *Handbook of Mathematical functions, NBS, USA, Sec. 4.5*

$F_{ab}(x/a) = b\tanh(x/a) = b\frac{e^{x/a}-e^{-x/a}}{e^{x/a}+e^{-x/a}} = b\frac{u(x/a)}{v(x/a)}$ [1]
$F'_{ab}(x/a) = b\frac{u'(x/a)\,v(x/a) - u(x/a)\,v'(x/a)}{v^2(x/a)}$ [2]
$F'_{ab}(x/a) = b\frac{v^2(x/a) - u^2(x/a)}{a\,v^2(x/a)}$ [3]
$F'_{ab}(x/a) = \frac{4b}{a\,[e^{x/a}+e^{-x/a}]^2} = \frac{b}{a\cosh^2(x/a)}$ [4]
igi50-5n

Mathematikgleichungen der Hyperbelfunktionen
Siehe: *Handbook of Mathematical functions, NBS, USA, Sec. 4.5*

$F_{ab}(x_r/a) = b\frac{e^{x_r/a}-e^{-x_r/a}}{e^{x_r/a}+e^{-x_r/a}} = b\frac{u(x_r/a)}{v(x_r/a)}$ [1]
$F'_{ab}(x_r/a) = b\frac{v^2(x_r/a) - u^2(x_r/a)}{a\,v^2(x_r/a)}$ [2]
$F'_{ab}(x_r/a) = \frac{4b}{a\,[e^{x_r/a}+e^{-x_r/a}]^2}$ [3]
$x_r = \log(L/L_u) = \log(L_r)$ [4]
$e^{x_r/a} = 10^{x_r/a'} = L_r^{1/a'}$ [5] $a' = a\ln(10)$ [6]
igi50-6n

Achromatisches Sehen mit relativer Leuchtdichte
Mathematische Hyperbel- und Potenzfunktionen

$F_{ab}(x_r,a) = b\tanh(x_r/a) = b\frac{e^{x_r/a}-e^{-x_r/a}}{e^{x_r/a}+e^{-x_r/a}}$ $x_r=\log(L_r)$, $L_r=L/L_u$, $x_r<=0$ [1]
$\frac{dF_{ab}(x_r,a)}{dx_r} = \frac{4b}{a[e^{x_r/a}+e^{-x_r/a}]^2}$ $x_r=\ln L_r/\ln(10)$, $dx_r/dL_r=1/(\ln(10)L_r)$, $m=1/(\ln(10)a)$ [5]
$\frac{L/dL}{(L/dL)_u} = \frac{4}{[e^{x_r/a}+e^{-x_r/a}]^2}$; $\frac{dL}{dL_u} = \frac{[e^{x_r/a}+e^{-x_r/a}]^2 L}{4L_u}$ [8]
$\frac{L/dL}{(L/dL)_u} = \frac{4}{[L_r^m+L_r^{-m}]^2}$; $\frac{dL}{dL_u} = \frac{[L_r^m+L_r^{-m}]^2 L}{4L_u}$ [9]
igi51-5n ieio1-5n

Achromatisches Sehen mit relativer Leuchtdichte
Mathematische Hyperbel- und Potenzfunktionen

$F_{cb}(x_r,c) = b\tanh(x_r/c) = b\frac{e^{x_r/c}-e^{-x_r/c}}{e^{x_r/c}+e^{-x_r/c}}$ $x_r=\log(L_r)$, $L_r=L/L_u$, $x_r>=0$ [1]
$\frac{dF_{cb}(x_r,c)}{dx_r} = \frac{4b}{c[e^{x_r/c}+e^{-x_r/c}]^2}$ $x_r=\ln L_r/\ln(10)$, $dx_r/dL_r=1/(\ln(10)L_r)$, $n=1/(\ln(10)c)$ [5]
$\frac{L/dL}{(L/dL)_u} = \frac{4}{[e^{x_r/c}+e^{-x_r/c}]^2}$; $\frac{dL}{dL_u} = \frac{[e^{x_r/c}+e^{-x_r/c}]^2 L}{4L_u}$ [8]
$\frac{L/dL}{(L/dL)_u} = \frac{4}{[L_r^n+L_r^{-n}]^2}$; $\frac{dL}{dL_u} = \frac{[L_r^n+L_r^{-n}]^2 L}{4L_u}$ [9]
igi51-6n ieio1-6n

Mathematikgleichungen der Hyperbelfunktionen
Siehe: *Handbook of Mathematical functions, NBS, USA, Sec. 4.5*

$F_{abc}(x_r) = b\frac{e^{x_r/a}-e^{-x_r/c}}{e^{x_r/a}+e^{-x_r/c}} = b\frac{u(z,a,c)}{v(z,a,c)}$ $z=x_r$ [1]
$F'_{abc}(z) = b\frac{u'(z,a,c)\,v(z,a,c) - v'(z,a,c)\,u(z,a,c)}{v^2(z,a,c)}$ [2]
$u'v = [(1/a)\,e^{z/a} + (1/c)\,e^{-z/c}]\,[e^{z/a} + e^{-z/c}]$ [3]
$v'u = [(1/a)\,e^{z/a} - (1/c)\,e^{-z/c}]\,[e^{z/a} - e^{-z/c}]$ [4]
$u'(z,a,c)\,v(z,a,c) - v'(z,a,c)\,u(z,a,c) = 2\,[1/a + 1/c]\,[e^{x_r/a} \cdot e^{-x_r/c}]$ [5]
igi50-7n

Mathematikgleichungen der Hyperbelfunktionen
Siehe: *Handbook of Mathematical functions, NBS, USA, Sec. 4.5*

$F_{abc}(x_r) = b\frac{e^{x_r/a}-e^{-x_r/c}}{e^{x_r/a}+e^{-x_r/c}} = b\frac{u(z,a,c)}{v(z,a,c)}$ $z=x_r$ [1]
$F'_{abc}(z) = b\frac{u'(z,a,c)\,v(z,a,c) - u(z,a,c)\,v'(z,a,c)}{v^2(z,a,c)}$ [2]
$u'(z,a,c)\,v(z,a,c) - v'(z,a,c)\,u(z,a,c) = 2\,[1/a + 1/c]\,[e^{z/a} \cdot e^{-z/c}]$ [3]
$F'_{abc}(x_r) = 2\,b\,[1/a + 1/c]\,\frac{e^{x_r/a} \cdot e^{-x_r/c}}{[e^{x_r/a}+e^{-x_r/c}]^2}$ [4]
igi50-8n, iej30-8n mod

Achromatisches Sehen mit relativer Leuchtdichte
Mathematische Hyperbel- und Potenzfunktionen

$F_{ab}(x_r,a) = b\tanh(x_r/a) = b\frac{e^{x_r/a}-e^{-x_r/a}}{e^{x_r/a}+e^{-x_r/a}}$ $x_r=\log(L_r)$, $L_r=L/L_u$, $x_r<=0$ [1]
$\frac{dF_{ab}(x_r,a)}{dx_r} = \frac{4b}{a[e^{x_r/a}+e^{-x_r/a}]^2}$ $x_r=\ln L_r/\ln(10)$, $dx_r/dL_r=1/(\ln(10)L_r)$, $m=1/(\ln(10)a)$ [5]
$\frac{L/dL}{(L/dL)_u} = \frac{4}{[e^{x_r/a}+e^{-x_r/a}]^2}$; $\frac{dL}{dL_u} = \frac{[e^{x_r/a}+e^{-x_r/a}]^2 L}{4L_u}$ [8]
$\frac{L/dL}{(L/dL)_u} = \frac{4}{L_r^{2m}+2+L_r^{-2m}}$; $\frac{dL}{dL_u} = \frac{(L_r^{2m}+2+L_r^{-2m}) L}{4L_u}$ [9]
igi51-7n ieio1-7n

Achromatisches Sehen mit relativer Leuchtdichte
Mathematische Hyperbel- und Potenzfunktionen

$F_{cb}(x_r,c) = b\tanh(x_r/c) = b\frac{e^{x_r/c}-e^{-x_r/c}}{e^{x_r/c}+e^{-x_r/c}}$ $x_r=\log(L_r)$, $L_r=L/L_u$, $x_r>=0$ [1]
$\frac{dF_{cb}(x_r,c)}{dx_r} = \frac{4b}{c[e^{x_r/c}+e^{-x_r/c}]^2}$ $x_r=\ln L_r/\ln(10)$, $dx_r/dL_r=1/(\ln(10)L_r)$, $n=1/(\ln(10)c)$ [5]
$\frac{L/dL}{(L/dL)_u} = \frac{4}{[e^{x_r/c}+e^{-x_r/c}]^2}$; $\frac{dL}{dL_u} = \frac{[e^{x_r/c}+e^{-x_r/c}]^2 L}{4L_u}$ [8]
$\frac{L/dL}{(L/dL)_u} = \frac{4}{L_r^{2n}+2+L_r^{-2n}}$; $\frac{dL}{dL_u} = \frac{(L_r^{2n}+2+L_r^{-2n}) L}{4L_u}$ [9]
igi51-8n ieio1-8n

TUB-Prüfvorlage igi5; Farbsehodell für normierte Rezeptorerregung $F_{a/c/ab/cb}(x_r)$
Ableitungen $F'_{a/c/ab/cb}(x_r)$ mit Hyberbelfunktionen $e^{(x_r/a)}$ und $e^{(x_r/c)}$ für Kontrast $L/\Delta L$ und ΔL

TUB-Registrierung: 20250301-igi5/igi5l0np.pdf /.ps
Anwendung für Beurteilung und Messung von Display- oder Druck-Ausgabe
TUB-Material: Code=rha4ta