

### Equations: colorimetric data transfer from $rgb_d$ to $nce^*_d$ data and $LCH^*_d$ data

Given:  $rgb_d$  device colour data of any colour  $rgb_d = lab^*rgb_d$  and of 48 step colour circle  $j=0$  to 47

$rgb_{Md,j}$  and CIELAB data  $L^*_{Md,j}$ ,  $C^*_{ab,Md,j}$ ,  $h_{ab,Md,j} = LCH^*_{Md,j}$

Aim: calculate  $nce^*_d$  with  $(0 \leq n^*_d, c^*_d, e^*_d \leq 1)$  (similar to NCS data) and  $LCH^*_{a,d}$  data of the device colour  
Data of a given device (d) colour

$$\begin{aligned} \text{relative chroma of the device colour} & c^*_d = \max [ rgb_d ] - \min [ rgb_d ] & (1) \\ \text{relative blackness of the device colour} & n^*_d = 1 - \max [ rgb_d ] & (2) \\ \text{relative triangle lightness of the device colour} & t^*_d = 1 - n^*_d - 0,5 c^*_d & (3) \\ \text{relative red-green chroma in 6x60 degree system s} & a^*_{rs,d} = r_d \cos(30) + g_d \cos(150) & (4) \\ \text{relative yellow-blue chroma in 6x60 degree system s} & b^*_{rs,d} = r_d \sin(30) + g_d \sin(150) + b_d \sin(270) & (5) \\ \text{hue angle in 6x60 degree system s} & h_{ab,s,d} = \arctan[ b^*_{rs,d} / a^*_{rs,d} ] \quad (0 \leq h_{ab,s,d} \leq 360) & (6) \\ \text{hue number in 6x60 degree system s} & e^*_d = h_{ab,s,d} / 360 \quad (0 \leq e^*_d \leq 1) & (7) \\ \text{CIELAB hue angle in device system} & h_{ab,d} = \text{function} [ h_{ab,s,d} ] \quad (\text{with table/equations}) & (8) \\ \text{adapted CIELAB } LCH^*_d \text{ data of maximum colour } M_d & L^*_{Md} = \text{function} [ h_{ab,d} ] \quad (\text{with table/equations}) & (9) \\ & C^*_{ab,Md} = \text{function} [ h_{ab,d} ] \quad (\text{with table/equations}) & (10) \\ & h_{ab,Md} = h_{ab,d} & (11) \\ \text{relative lightness of maximum colour } M_d & l^*_{Md} = [ L^*_{Md} - L^*_{Nd} ] / [ L^*_{Wd} - L^*_{Nd} ] & (12) \\ \text{relative lightness of the device colour} & l^*_d = t^*_d + l^*_{Md} c^*_d + 0,5 c^*_d & (13) \\ \text{CIELAB } LCH^*_d \text{ data of the device colour} & L^*_d = l^*_d [ L^*_{Wd} - L^*_{Nd} ] + L^*_{Nd} & (14) \\ & C^*_{ab,d} = c^*_d C^*_{ab,Md} & (15) \end{aligned}$$

SE870-3N

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$rgb_{Md,j}$  and adapted CIELAB data  $L^*_{Md,j}$ ,  $C^*_{ab,a,Md,j}$ ,  $h_{ab,a,Md,j} = LCH^*_{a,Md,j}$

Aim: calculate  $nce^*_d$  with  $(0 \leq n^*_d, c^*_d, e^*_d \leq 1)$  (similar to NCS data) and  $LCH^*_{a,d}$  data of the device colour  
Data of a given device (d) colour

$$\begin{aligned} \text{relative chroma of the device colour} & c^*_d = \max [ rgb_d ] - \min [ rgb_d ] & (1) \\ \text{relative blackness of the device colour} & n^*_d = 1 - \max [ rgb_d ] & (2) \\ \text{relative triangle lightness of the device colour} & t^*_d = 1 - n^*_d - 0,5 c^*_d & (3) \\ \text{relative red-green chroma in 6x60 degree system s} & a^*_{rs,d} = r_d \cos(30) + g_d \cos(150) & (4) \\ \text{relative yellow-blue chroma in 6x60 degree system s} & b^*_{rs,d} = r_d \sin(30) + g_d \sin(150) + b_d \sin(270) & (5) \\ \text{hue angle in 6x60 degree system s} & h_{ab,s,d} = \arctan[ b^*_{rs,d} / a^*_{rs,d} ] \quad (0 \leq h_{ab,s,d} \leq 360) & (6) \\ \text{hue number in 6x60 degree system s} & e^*_d = h_{ab,s,d} / 360 \quad (0 \leq e^*_d \leq 1) & (7) \\ \text{CIELAB hue angle in device system} & h_{ab,a,d} = \text{function} [ h_{ab,s,d} ] \quad (\text{with table/equations}) & (8) \\ \text{adapted CIELAB } LCH^*_{a,d} \text{ data of maximum colour } M_d & L^*_{Md} = \text{function} [ h_{ab,a,d} ] \quad (\text{with table/equations}) & (9) \\ & C^*_{ab,a,Md} = \text{function} [ h_{ab,a,d} ] \quad (\text{with table/equations}) & (10) \\ & h_{ab,a,Md} = h_{ab,a,d} & (11) \\ \text{relative lightness of maximum colour } M_d & l^*_{Md} = [ L^*_{Md} - L^*_{Nd} ] / [ L^*_{Wd} - L^*_{Nd} ] & (12) \\ \text{relative lightness of the device colour} & l^*_d = t^*_d + l^*_{Md} c^*_d + 0,5 c^*_d & (13) \\ \text{adapted CIELAB } LCH^*_{a,d} \text{ data of the device colour} & L^*_d = l^*_d [ L^*_{Wd} - L^*_{Nd} ] + L^*_{Nd} & (14) \\ & C^*_{ab,a,d} = c^*_d C^*_{ab,a,Md} & (15) \end{aligned}$$

SE870-7N

### Equations: colorimetric data transfer from $rgb_e$ to $nce^*_e$ data and $LCH^*_e$ data

Given:  $rgb_e$  elementary colour data of any colour  $rgb_e = lab^*rgb_e$  and of 48 step colour circle  $j=0$  to 47

$rgb_{Me,j}$  and CIELAB data  $L^*_{Me,j}$ ,  $C^*_{ab,Me,j}$ ,  $h_{ab,Me,j} = LCH^*_{Me,j}$

Aim: calculate  $nce^*_e$  with  $(0 \leq n^*_e, c^*_e, e^*_e \leq 1)$  (similar to NCS data) and  $LCH^*_e$  data of elementary colour  
Data of a give elementary (e) colour

$$\begin{aligned} \text{relative chroma of the elementary colour} & c^*_e = \max [ rgb_e ] - \min [ rgb_e ] & (1) \\ \text{relative blackness of the elementary colour} & n^*_e = 1 - \max [ rgb_e ] & (2) \\ \text{relative triangle lightness of the elementary colour} & t^*_e = 1 - n^*_e - 0,5 c^*_e & (3) \\ \text{relative red-green chroma in 4x90 degree system s} & a^*_{rs,e} = r_e \cos(0) + g_e \cos(180) & (4) \\ \text{relative yellow-blue chroma in 4x90 degree system s} & b^*_{rs,e} = r_e \sin(0) + g_e \sin(180) + b_e \sin(270) & (5) \\ \text{hue angle in 4x90 degree system s} & h_{ab,s,e} = \arctan[ b^*_{rs,e} / a^*_{rs,e} ] \quad (0 \leq h_{ab,s,e} \leq 360) & (6) \\ \text{hue number in 4x90 degree system s} & e^*_e = h_{ab,s,d} / 360 \quad (0 \leq e^*_e \leq 1) & (7) \\ \text{CIELAB hue angle in elementary system} & h_{ab,a,e} = \text{function} [ h_{ab,s,e} ] \quad (\text{with table/equations}) & (8) \\ \text{CIELAB } LCH^*_e \text{ data of maximum colour } M_e & L^*_{Me} = \text{function} [ h_{ab,e} ] \quad (\text{with table/equations}) & (9) \\ & C^*_{ab,Me} = \text{function} [ h_{ab,e} ] \quad (\text{with table/equations}) & (10) \\ & h_{ab,Me} = h_{ab,e} & (11) \\ \text{relative lightness of maximum colour } M_e & l^*_{Me} = [ L^*_{Me} - L^*_{Ne} ] / [ L^*_{We} - L^*_{Ne} ] & (12) \\ \text{relative lightness of the elementary colour} & l^*_e = t^*_e + l^*_{Me} c^*_e + 0,5 c^*_e & (13) \\ \text{CIELAB } LCH^*_e \text{ data of the elementary colour} & L^*_e = l^*_e [ L^*_{We} - L^*_{Ne} ] + L^*_{Ne} & (14) \\ & C^*_{ab,e} = c^*_e C^*_{ab,Me} & (15) \end{aligned}$$

SE871-3N

### Equations: colorimetric data transfer from $rgb_e$ to $nce^*_e$ data and $LCH^*_{a,e}$ data

Given:  $rgb_e$  elementary colour data of any colour  $rgb_e = lab^*rgb_e$  and of 48 step colour circle  $j=0$  to 47

$rgb_{Me,j}$  and adapted CIELAB data  $L^*_{Me,j}$ ,  $C^*_{ab,a,Me,j}$ ,  $h_{ab,a,Me,j} = LCH^*_{a,Me,j}$

Aim: calculate  $nce^*_e$  with  $(0 \leq n^*_e, c^*_e, e^*_e \leq 1)$  (similar to NCS data) and  $LCH^*_{a,e}$  data of elementary colour  
Data of a given elementary (e) colour

$$\begin{aligned} \text{relative chroma of the elementary colour} & c^*_e = \max [ rgb_e ] - \min [ rgb_e ] & (1) \\ \text{relative blackness of the elementary colour} & n^*_e = 1 - \max [ rgb_e ] & (2) \\ \text{relative triangle lightness of the elementary colour} & t^*_e = 1 - n^*_e - 0,5 c^*_e & (3) \\ \text{relative red-green chroma in 4x90 degree system s} & a^*_{rs,e} = r_e \cos(0) + g_e \cos(180) & (4) \\ \text{relative yellow-blue chroma in 4x90 degree system s} & b^*_{rs,e} = r_e \sin(0) + g_e \sin(180) + b_e \sin(270) & (5) \\ \text{hue angle in 4x90 degree system s} & h_{ab,s,e} = \arctan[ b^*_{rs,e} / a^*_{rs,e} ] \quad (0 \leq h_{ab,s,e} \leq 360) & (6) \\ \text{hue number in 4x90 degree system s} & e^*_e = h_{ab,s,e} / 360 \quad (0 \leq e^*_e \leq 1) & (7) \\ \text{CIELAB hue angle in elementary system} & h_{ab,a,e} = \text{function} [ h_{ab,s,e} ] \quad (\text{with table/equations}) & (8) \\ \text{adapted CIELAB } LCH^*_{a,e} \text{ data of maximum colour } M_e & L^*_{Me} = \text{function} [ h_{ab,a,e} ] \quad (\text{with table/equations}) & (9) \\ & C^*_{ab,a,Me} = \text{function} [ h_{ab,a,e} ] \quad (\text{with table/equations}) & (10) \\ & h_{ab,a,Me} = h_{ab,a,e} & (11) \\ \text{relative lightness of maximum colour } M_e & l^*_{Me} = [ L^*_{Me} - L^*_{Ne} ] / [ L^*_{We} - L^*_{Ne} ] & (12) \\ \text{relative lightness of the elementary colour} & l^*_e = t^*_e + l^*_{Me} c^*_e + 0,5 c^*_e & (13) \\ \text{adapted CIELAB } LCH^*_{a,e} \text{ data of the elementary colour} & L^*_e = l^*_e [ L^*_{We} - L^*_{Ne} ] + L^*_{Ne} & (14) \\ & C^*_{ab,a,d} = c^*_e C^*_{ab,a,Me} & (15) \end{aligned}$$

SE871-7N

TUB-test chart SE87; Colorimetric coordinate transfer  
Equations for the transfer between  $rgb$ ,  $LCH^*$  and  $nce^*$

input:  $w/rgb/cmyk \rightarrow w/rgb/cmyk$   
output: no change