

Equations: colorimetric transfer from CIELAB hue angle h_{ab} to elementary hue number e^*

Given: CIELAB hue angle h_{ab} ($0 \leq h_{ab} \leq 360$)
CIELAB hue angles $h_{ab,eX}$ of four elementary colours $eX = RJGB$
Aim: Elementary hue number e^* of the given colour ($0 \leq e^* \leq 1$)
 Calculate elementary hue angle $h_{ab,e}$ in one of five possible cases for h_{ab} ($0 \leq h_{ab} \leq 360$):

If $0 \leq h_{ab} < h_{ab,eR}$ $h_{ab,e} = 270 + 90 [360 + h_{ab} - h_{ab,eB}] / [360 + h_{ab,eR} - h_{ab,eB}]$ (1)
 If $h_{ab,eR} \leq h_{ab} < h_{ab,eJ}$ $h_{ab,e} = 0 + 90 [h_{ab} - h_{ab,eR}] / [h_{ab,eJ} - h_{ab,eR}]$ (2)
 If $h_{ab,eJ} \leq h_{ab} < h_{ab,eG}$ $h_{ab,e} = 90 + 90 [h_{ab} - h_{ab,eJ}] / [h_{ab,eG} - h_{ab,eJ}]$ (3)
 If $h_{ab,eG} \leq h_{ab} < h_{ab,eB}$ $h_{ab,e} = 180 + 90 [h_{ab} - h_{ab,eG}] / [h_{ab,eB} - h_{ab,eG}]$ (4)
 If $h_{ab,eB} \leq h_{ab} < 360$ $h_{ab,e} = 270 + 90 [h_{ab} - h_{ab,eB}] / [360 + h_{ab,eR} - h_{ab,eB}]$ (5)
 Elementary hue number $e^* = h_{ab,e} / 360$ ($0 \leq e^* \leq 1$) (6)

Inverse equations: transfer from elementary hue number e^* to CIELAB hue angle h_{ab}

Given: elementary hue number e^* ($0 \leq e^* \leq 1$)
CIELAB hue angles $h_{ab,eX}$ of four elementary colours $eX = RJGB$
Aim: CIELAB hue angle h_{ab} of the given colour ($0 \leq h_{ab} \leq 360$)
 Elementary hue angle $h_{ab,e} = 360 e^*$ ($0 \leq e^* \leq 1$) (1i)
 Calculate CIELAB hue angle h_{ab} in one of four possible cases for e^* ($0 \leq e^* \leq 1$):

If $0,00 \leq e^* < 0,25$ $h_{ab} = h_{ab,eR} + [h_{ab,e} / 90] [h_{ab,eJ} - h_{ab,eR}]$ (2i)
 If $0,25 \leq e^* < 0,50$ $h_{ab} = h_{ab,eJ} + [h_{ab,e} / 90 - 1,00] [h_{ab,eG} - h_{ab,eJ}]$ (3i)
 If $0,50 \leq e^* < 0,75$ $h_{ab} = h_{ab,eJ} + [h_{ab,e} / 90 - 2,00] [h_{ab,eG} - h_{ab,eJ}]$ (4i)
 If $0,75 \leq e^* < 1,00$ $h_{ab} = h_{ab,eJ} + [h_{ab,e} / 90 - 3,00] [h_{ab,eG} - h_{ab,eJ}]$ (5i)
 only if $h_{ab} > 360$ then: $h_{ab} = h_{ab} - 360$ ($0 \leq h_{ab} \leq 360$) (6i)

ZE200-3

Equations: colorimetric data transfer from LCH^*_a (CIELAB) to nce^* and olv^*_3

Given: adapted CIELAB data of any colour L^* , $C^*_{ab,a}$, $h_{ab,a} = LCH^*_a = LAB^*LCH^*_a$
adapted CIELAB data L^* , $C^*_{ab,a}$, $h_{ab,a}$, a^*_a , b^*_a of eighth basic colours $X = OYLCVMNW$
Aim: nce^* and rgb device data olv^*_3 of the given colour

hue angle of the given colour and of M $h_{ab,a} = H^*_a$ (1)
 CIELAB $LCH^*_{a,M}$ data of maximum colour M $L^*_M = \text{function} [h_{ab,a}]$ (with table/equation) (2)
 $C^*_{ab,a,M} = \text{function} [h_{ab,a}]$ (with table/equation) (3)
 $h_{ab,a,M} = h_{ab,a}$ (4)
 relative lightness of the given colour $l^* = [L^* - L^*_N] / [L^*_W - L^*_N]$ (5)
 relative chroma of the given colour $c^* = C^*_{ab,a} / C^*_{ab,a,M}$ (6)
 relative triangle lightness of the given colour $t^* = l^* - [L^*_M - L^*_N] / [L^*_W - L^*_N] c^* + 0,5 c^*$ (7)
 relative blackness of the given colour $n^* = 1 - t^* - 0,5 c^*$ (8)
 relative whiteness of the given colour $w^* = 1 - n^* - c^*$ (9)
 elementary hue angle of the given colour $e^* = \text{function} [h_{ab,a}]$ (with table or equation) (10)
 relative olv^*_3 data of maximum colour M $o^*_{3,M} = \text{function} [h_{ab,a}]$ (with table/equation) (11)
 $l^*_{3,M} = \text{function} [h_{ab,a}]$ (with table/equation) (12)
 $v^*_{3,M} = \text{function} [h_{ab,a}]$ (with table/equation) (13)
 relative olv^*_3 data of the given colour $o^*_3 = w^* + c^* o^*_{3,M}$ (14)
 $l^*_3 = w^* + c^* l^*_{3,M}$ (15)
 $v^*_3 = w^* + c^* v^*_{3,M}$ (16)

ZE200-7

Inverse equations: transfer from standard hue angle $h_{ab,s}$ to CIELAB hue angle h_{ab}

Given: standard hue angle $h_{ab,s}$ ($0 \leq h_{ab,s} \leq 360$)
CIELAB hue angles $h_{ab,s,X}$ of six standard colours $sX = RJGC'BM'$
Aim: CIELAB hue angle h_{ab} of the given colour ($0 \leq h_{ab} \leq 360$)
 Remark:
 The standard hue angle $h_{ab,s}$ is usually calculated from the data rgb^*_3
 relative red-green chroma in system s $a^*_{rs} = r^*_3 \cos(30) + g^*_3 \cos(150)$
 relative yellow-blue chroma in system s $b^*_{rs} = r^*_3 \sin(30) + g^*_3 \sin(150) + b^*_3 \sin(270)$
 hue angle in standard system s $h_{ab,s} = \arctan [b^*_{rs} / a^*_{rs}]$
 Calculate CIELAB hue angle h_{ab} in one of seven possible cases for $h_{ab,s}$ ($0 \leq h_{ab,s} \leq 360$):

If $0 \leq h_{ab,s} < 30$ $h_{ab} = h_{ab,s,M'} + [h_{ab,s} + 360 - h_{ab,s,M'}] [h_{ab,s,R} + 360 - h_{ab,s,M'}] / 60$ (1i)
 If $30 \leq h_{ab,s} < 90$ $h_{ab} = h_{ab,s,R} + [h_{ab,s} - h_{ab,s,R}] [h_{ab,s,J} - h_{ab,s,R}] / 60$ (2i)
 If $90 \leq h_{ab,s} < 150$ $h_{ab} = h_{ab,s,J} + [h_{ab,s} - h_{ab,s,J}] [h_{ab,s,G} - h_{ab,s,J}] / 60$ (3i)
 If $150 \leq h_{ab,s} < 210$ $h_{ab} = h_{ab,s,G} + [h_{ab,s} - h_{ab,s,G}] [h_{ab,s,C'} - h_{ab,s,G}] / 60$ (4i)
 If $210 \leq h_{ab,s} < 270$ $h_{ab} = h_{ab,s,C'} + [h_{ab,s} - h_{ab,s,C'}] [h_{ab,s,B} - h_{ab,s,C'}] / 60$ (5i)
 If $270 \leq h_{ab,s} < 330$ $h_{ab} = h_{ab,s,B} + [h_{ab,s} - h_{ab,s,B}] [h_{ab,s,M'} - h_{ab,s,B}] / 60$ (6i)
 If $330 \leq h_{ab,s} < 360$ $h_{ab} = h_{ab,s,M'} + 360 + [h_{ab,s} - h_{ab,s,M'}] [h_{ab,s,R} + 360 - h_{ab,s,M'}] / 60$ (7i)
 only if $h_{ab} > 360$ then: $h_{ab} = h_{ab} - 360$ ($0 \leq h_{ab} \leq 360$) (8i)

ZE201-3

Equations: colorimetric data transfer from olv^*_3 to nce^* data and LCH^*_a data

Given: rgb device data of any colour $olv^*_3 = lab^*olv^*_3$
adapted CIELAB data L^* , $C^*_{ab,a}$, $h_{ab,a}$, a^*_a , b^*_a of eighth basic colours $X = OYLCVMNW$
Aim: nce^* and LCH^*_a data of the given colour ($0 \leq e^* \leq 1$)
 relative chroma of the given colour $c^* = \max [olv^*_3] - \min [olv^*_3]$ (1)
 relative blackness of the given colour $n^* = 1 - \max [olv^*_3]$ (2)
 relative triangle lightness of the given colour $t^* = 1 - n^* - 0,5 c^*$ (3)
 relative red-green chroma in 60 degree system s $a^*_{rs} = o^*_3 \cos(30) + l^*_3 \cos(150)$ (4)
 relative yellow-blue chroma in 60 degree system s $b^*_{rs} = o^*_3 \sin(30) + l^*_3 \sin(150) + v^*_3 \sin(270)$ (5)
 hue angle in 60 degree system s $h_{ab,s} = \arctan [b^*_{rs} / a^*_{rs}]$ ($0 \leq h_{ab,s} \leq 360$) (6)
 CIELAB hue angle in device system $h_{ab,a} = \text{function} [h_{ab,s}]$ (with table/equation) (7)
 elementary hue number of the given colour $e^* = \text{function} [h_{ab,a}]$ (with table/equation) (8)
 adapted CIELAB LCH^*_a data of maximum colour M $L^*_M = \text{function} [h_{ab,a}]$ (with table/equation) (9)
 $C^*_{ab,a,M} = \text{function} [h_{ab,a}]$ (with table/equation) (10)
 $h_{ab,a,M} = h_{ab,a}$ (11)
 relative lightness of maximum colour M $l^*_M = [L^*_M - L^*_N] / [L^*_W - L^*_N]$ (12)
 relative lightness of the given colour $l^* = t^* + l^*_M c^* + 0,5 c^*$ (13)
 adapted CIELAB LCH^*_a data of the given colour $L^* = l^* [L^*_W - L^*_N] + L^*_N$ (14)
 $C^*_{ab,a} = c^* C^*_{ab,a,M}$ (15)
 $h_{ab,a} = h_{ab,a,M}$ (16)

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 Technical information: <http://www.ps.bam.de>
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