

Transformation between the *Judd* purity and chromaticity

Data see K. Richter, PhD thesis, University of Basel (Switzerland), 1969, page 83.

For the antagonistic spectral elementary colours

$\lambda_B = 475 \text{ nm}$, $\lambda_G = 502 \text{ nm}$, $\lambda_Y = 574 \text{ nm}$, $\lambda_R = 494 \text{ nm}$

modern coordinates $\bar{l}$, $\bar{a}$, $\bar{b}$ are used instead of $\bar{x}_i$ ($i=1$ to 3).

Relation between opponent and spectral colour values:

$$\begin{pmatrix} \bar{x}(\lambda) \\ \bar{y}(\lambda) \\ \bar{z}(\lambda) \end{pmatrix} = \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} \cdot \begin{pmatrix} \bar{l}(\lambda) \\ \bar{a}(\lambda) \\ \bar{b}(\lambda) \end{pmatrix} = \begin{pmatrix} 0,9093 & 0,3338 & -0,0133 \\ 1,0000 & 0,0000 & 0,0000 \\ 0,4494 & -0,0574 & -0,4136 \end{pmatrix} \cdot \begin{pmatrix} \bar{l}(\lambda) \\ \bar{a}(\lambda) \\ \bar{b}(\lambda) \end{pmatrix} \quad (2)$$

The tristimulus values L , A , B and X , Y , Z need the same transformations.

The unnormalized purity data a_u and b_u are defined in LabMUN 1969 as follows:

$$a_u = X/Y = x/z \quad (3) \quad b_u = -Z/Y = -z/y \quad (4) \quad z = 1 - x - y \quad (5)$$

Use of equations (2) to (5) leads to:

$$\begin{pmatrix} X \\ Y \\ Z \end{pmatrix} = \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} \cdot \begin{pmatrix} L \\ A \\ B \end{pmatrix} \quad (6) \quad \text{and with } x = X/(X+Y+Z) \text{ and } y = Y/(X+Y+Z) \quad (7)$$

$$x = [a_{11} + a_{12}a_u + a_{13}b_u] / [a_{11} + a_{21} + a_{31} + (a_{12} + a_{22} + a_{32})a_u + (a_{13} + a_{23} + a_{33})b_u] \quad (8)$$

$$y = [a_{21} + a_{22}a_u + a_{23}b_u] / [a_{11} + a_{21} + a_{31} + (a_{12} + a_{22} + a_{32})a_u + (a_{13} + a_{23} + a_{33})b_u]$$

$$x = (\alpha_{11} + \alpha_{12}a_u + \alpha_{13}b_u) / (\alpha_{31} + \alpha_{32}a_u + \alpha_{33}b_u) \\ = (0,9093 + 0,3338a_u - 0,0133b_u) / (2,3587 + 0,2764a_u - 0,4269b_u) \quad (9)$$

$$y = (\alpha_{21} + \alpha_{22}a_u + \alpha_{23}b_u) / (\alpha_{31} + \alpha_{32}a_u + \alpha_{33}b_u) \\ = (1,000 + 0,000a_u + 0,000b_u) / (2,3587 + 0,2764a_u - 0,4269b_u) \quad (10)$$