Transformation between the *Judd* tristimulus and opponent values

Data see *K. Richter*, PhD thesis, University of Basel (Switzerland), 1969, page 58.

elementary colour	dominant wavelength	*Judd* spectral tristimulus values $\bar{x}(\lambda)$	$\bar{y}(\lambda)$	$\bar{z}(\lambda)$	chromatic values *RG* $\bar{x}_2(\lambda)$	*YB* $\bar{x}_3(\lambda)$
blue	λ_B=475 nm	0,8267	0,9339	0,0017	0,0000	−
green	λ_G=502 nm	0,0107	0,0038	0,0005	−1,0000	0,0000
yellow	λ_Y=574 nm	0,1304	0,1124	0,9281	0,0000	1,0000
red	λ_R=494c,E nm	0,0028	0,3701	0,2238	−	0,0000

There are six equations to calculate the six constants: b_{21} to b_{33}

$\bar{x}_2(\lambda_B)=b_{21}\bar{x}(\lambda_B)+b_{22}\bar{y}(\lambda_B)+b_{23}\bar{z}(\lambda_B)=0$ $\quad\bar{x}_3(\lambda_G)=b_{31}\bar{x}(\lambda_G)+b_{32}\bar{y}(\lambda_G)+b_{33}\bar{z}(\lambda_G)=0$

$\bar{x}_2(\lambda_G)=b_{21}\bar{x}(\lambda_G)+b_{22}\bar{y}(\lambda_G)+b_{23}\bar{z}(\lambda_G)=-1$ $\quad\bar{x}_3(\lambda_Y)=b_{31}\bar{x}(\lambda_Y)+b_{32}\bar{y}(\lambda_Y)+b_{33}\bar{z}(\lambda_Y)=1$

$\bar{x}_2(\lambda_Y)=b_{21}\bar{x}(\lambda_Y)+b_{22}\bar{y}(\lambda_Y)+b_{23}\bar{z}(\lambda_Y)=0$ $\quad\bar{x}_3(\lambda_R)=b_{31}\bar{x}(\lambda_R)+b_{32}\bar{y}(\lambda_R)+b_{33}\bar{z}(\lambda_R)=0$

Together with the use of the standard equation: $\bar{x}_1(\lambda)=\bar{y}(\lambda)$ (1)

the equations between spectral opponent and tristimulus colour values are:

$$\begin{pmatrix}\bar{x}_1(\lambda)\\ \bar{x}_2(\lambda)\\ \bar{x}_3(\lambda)\end{pmatrix}=\begin{pmatrix}b_{11} & b_{12} & b_{13}\\ b_{21} & b_{22} & b_{23}\\ b_{31} & b_{32} & b_{33}\end{pmatrix}\cdot\begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix}=\begin{pmatrix}0,0000 & 1,0000 & 0,0000\\ 2,9797 & -2,6662 & -0,0960\\ -0,4139 & 1,4571 & -2,4046\end{pmatrix}\cdot\begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix} \quad (2)$$

Remark: The weighting ratio in the *RG* and *YB* direction is 2,8:1 or 1:0,3571.