sRGB lin / log from X, Y, Z calculations

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Abstract

Simple set of equations to calculate sRGB, both linear and logarithmic, from X, Y, and Z values.

1 Spectral reflectance $\rho(\lambda) \rightarrow$ X, Y, Z

$$\phi(\lambda) = \int_{\lambda=380}^{780} S_{D65}(\lambda) \cdot \rho \, d\lambda \tag{1}$$

$$\tag{2}$$

$$k = \frac{100}{\int_{\lambda=380}^{780} S_{D65}(\lambda) \cdot \bar{y}(\lambda) \, d\lambda} \tag{3}$$

$$= 0.00946546296772023 \tag{4}$$

$$X = k \int_{\lambda=380}^{780} \phi(\lambda) \cdot \bar{x} \, d\lambda \tag{5}$$

$$Y = k \int_{\lambda=380}^{780} \phi(\lambda) \cdot \bar{y} \, d\lambda \tag{6}$$

$$Z = k \int_{\lambda=380}^{780} \phi(\lambda) \cdot \bar{z} \, d\lambda \tag{7}$$

2 X, Y, Z → sRGB, linear

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix}_{sRGB} = \begin{bmatrix} 3.2406 & -1.5372 & -0.4986 \\ -0.9689 & 1.8758 & 0.0415 \\ 0.0557 & -0.2040 & 1.0570 \end{bmatrix} \begin{bmatrix} \frac{X}{100} \\ \frac{Y}{100} \\ \frac{Z}{100} \end{bmatrix}^{*} \tag{8}$$

*) $\frac{\cdots}{100}$ is a typical weighting of the values when working with measured $\rho(\lambda)$-values as input.

3 sRGB, linear → sRGB, logarithmic

$$sRGB,\gamma = \begin{cases} 0 & \mid sRGB < 0 \\ sRGB \cdot 12.92 & \mid sRGB \leq 0.0031308 \\ 1.055\,^{\frac{1}{2.4}} - 0.055 & \mid sRGB > 0.0031308 \end{cases} \tag{9}$$

4 X, Y, Z → x, y

$$x = \frac{X}{X+Y+Z} \tag{10}$$

$$y = \frac{Y}{X+Y+Z} \tag{11}$$