

Field Guide to Visual and Ophthalmic Optics

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Errata to First Printing and Second Printings

page 11:

$$t(x, y) = e^{-\alpha[(x-x_o)^2 + (y-y_o)^2]} = 10^{-\alpha[(x-x_o)^2 + (y-y_o)^2] / \ln 10}$$

page 13:

$$\frac{AC}{A} = PD + d(\Delta_n - \Delta_d),$$

where PD is the **interpupillary distance** in cm, Δ_n is the prismatic deviation for a near object, Δ_d is the prismatic deviation of a distant object, and **d is the near object distance in meters.**

Example: Suppose the eyes are 6 cm apart ($PD=6$). If the visual axes are parallel for a distant object ($\Delta_d=0$ D) and converge to a point 1 m ($d=1$ **m**) from the eyes when accommodating 1 D, then $\Delta_n=3 \Delta$ and the $AC/A=3 \Delta / D$.

page 14:

Based on vergence, the **lens formula** is

page 31:

$$\theta_R = -\tan^{-1} \left(\frac{\frac{C_R}{2} + \sum J_0}{\sum J_{45}} \right) \quad \text{add } 180^\circ \text{ if } \theta_R \leq 0^\circ$$

First cell in the Table under **Sph** should read **2.75**.

page 54:

For $m < 0$,

$$Z_n^m(X, Y) = \sqrt{2(n+1)} \times \left[\sum_{s=0}^{\frac{n-|m|}{2}} \sum_{j=0}^{\frac{n-|m|}{2}-s} \sum_{k=0}^{\frac{|m|-1}{2}} \frac{(-1)^{(s+k)} (n-s)!}{s! \left(\frac{n+|m|}{2} - s \right)! \left(\frac{n-|m|}{2} - s \right)!} \binom{\frac{n-|m|}{2} - s}{j} \binom{|m|}{2k+1} \right] \times X^{n-2(s+j+k)-1} Y^{2(j+k)+1}$$

page 69 (see complete corrected page on the next page of this errata sheet):

page 72, last equation:

$$\begin{bmatrix} X_n \\ Y_n \\ Z_n \end{bmatrix} = [M]^{-1} \begin{bmatrix} l_{wn}/l_w & 0 & 0 \\ 0 & m_{wn}/m_w & 0 \\ 0 & 0 & s_{wn}/s_w \end{bmatrix} [M] \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}$$

page 88:

The $j = 25$ row should read:

$$\sqrt{14} (15X^6 + 15X^4Y^2 - 15X^2Y^4 - 15Y^6 - 20X^4 + 20Y^4 + 6X^2 - 6Y^2)$$

page 89:

Lens formula:

$$U + \Phi = V$$

$$\text{Magnification} = U / V.$$

page 91:

$$\theta_R = -\tan^{-1} \left(\frac{\frac{C_R}{2} + \sum J0}{\sum J45} \right) \quad \text{add } 180^\circ \text{ if } \theta_R \leq 0^\circ$$

page 95:

Conic surface:

$$z = \frac{r^2 / R}{1 + \sqrt{1 - (K + 1) \frac{r^2}{R^2}}}$$

$$z = \frac{1}{K + 1} \left[R - \sqrt{R^2 - (K + 1)r^2} \right] \quad (K \neq -1)$$

$$z = \frac{r^2}{2R} \quad (K = -1)$$

Colorimetry: Primaries and Gamut

The points R₇₀₉, G₇₀₉, B₇₀₉ and D65 are the standard red, green, blue primaries and white point for HDTV. The chromaticity coordinates for these values are

	Red	Green	Blue	White, D65
x	0.64	0.30	0.15	0.3127
y	0.33	0.60	0.06	0.3290

Primaries form a triangular region on the chromaticity diagram. The triangular region defines the **gamut** of the primaries, or in other words, colors within the region are obtained by the appropriate mixture of the three primaries. Colors outside of the gamut cannot be obtained.

Digital image formats such as BMP and JPEG typically conform to the sRGB format, with values ranging from 0 (unsaturated) to 255 (saturated) for 8-bit images. To convert from sRGB space to XYZ tristimulus values, each RGB value must first be normalized by 255, so that they range from 0 to 1. Next, the normalized RGB values must be converted to a linear RGB space denoted by the subscript L. The conversion is given by

$$C_L = \begin{cases} C/12.92 & \text{for } C \leq 0.04045 \\ \left(\frac{C+0.055}{1.055} \right)^{2.4} & \text{for } C > 0.04045 \end{cases} \approx C^{2.2},$$

where C corresponds to R, G, or B. Finally, the tristimulus values are obtained with the following matrix operation:

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} 0.412453 & 0.357580 & 0.180423 \\ 0.212671 & 0.715160 & 0.072169 \\ 0.019334 & 0.119193 & 0.950227 \end{bmatrix} \begin{bmatrix} R_L \\ G_L \\ B_L \end{bmatrix}.$$

The conversion can be reversed as well to calculate RGB values from tristimulus values. However, some XYZ coordinates lie outside of the gamut of the primaries. In this case, RGB values less than zero or greater than 255 represent colors outside of the gamut and cannot be properly displayed.