Color matrices

For each color space is defined a 3×3 forward matrix MX_i for converting an RGB triplet to a CIE XYZ tristimulus value. This conversion takes the form $XYZ = MX_i \cdot RGB$. The forward matrices MX are calculated from the color primaries and white point using the equation:

$$MX_i = \left[\begin{Bmatrix} r_i \\ g_i \\ b_i \end{Bmatrix} \times \left(\frac{w_i}{w_i \cdot y} \cdot \begin{Bmatrix} r_i \\ g_i \\ b_i \end{Bmatrix}^{-1} \right) \right]^T$$

where

i is one of SD, HD and UHD (HDR uses same matrix as UHD),

r_i, g_i, b_i and w_i are the xyz triplets for the red, green, blue primaries and the white point of the color space i,

$w_i \cdot y$ is the y value of w_i, an xyz value being an xy chromaticity coordinate appended with $z = 1 - x - y$, and

$\cdot$ (dot) indicates the matrix product or inner product.

The resulting matrices are

$$MX_{HD} = \begin{Bmatrix} 0.412391 & 0.357584 & 0.180481 \\ 0.212639 & 0.715169 & 0.072192 \\ 0.019331 & 0.119195 & 0.950532 \end{Bmatrix}$$

$$MX_{SD} = \begin{Bmatrix} 0.430554 & 0.341550 & 0.178352 \\ 0.222004 & 0.706655 & 0.071341 \\ 0.020182 & 0.129553 & 0.939322 \end{Bmatrix}$$

$$MX_{UHD} = \begin{Bmatrix} 0.636958 & 0.144617 & 0.168881 \\ 0.2627 & 0.677998 & 0.059302 \\ 0 & 0.028073 & 1.060990 \end{Bmatrix}$$

The matrices for converting from linear RGB values in HD space to linear RGB values in the SD or UHD color space are obtained by combining forward and inverse matrices. The numerical values for the matrices are:

$$M_S = (MX_{SD})^{-1} \cdot MX_{HD} = \begin{Bmatrix} 0.957815 & 0.0421852 & 0 \\ 0 & 1. & 0 \\ 0 & -0.0119341 & 1.01193 \end{Bmatrix}$$

$$M_U = (MX_{UHD})^{-1} \cdot MX_{HD} = \begin{Bmatrix} 0.627404 & 0.329283 & 0.043313 \\ 0.069098 & 0.919540 & 0.011362 \\ 0.016391 & 0.088013 & 0.895595 \end{Bmatrix}$$

Transfer functions

The domain and range are $[0, 1]$ for all transfer functions used in this paper.