

1.4 The measurement of light — colourimetry

Photometry does not take into account the wavelength combination of the light. Thus it is possible for two surfaces to have the same luminance but the reflected light to be made up of totally different combinations of wavelengths. In this situation, and provided there is enough light for colour vision to operate, the two surfaces will look different in colour. The CIE colourimetry system provides a means to quantify colour.

1.4.1 The CIE chromaticity diagrams

The basis of the CIE colourimetry system is colour matching. The CIE Colour Matching Functions are the relative spectral sensitivity curves of the human observer with normal colour vision and can be considered as another form of standard observer. The CIE colour matching functions are mathematical constructs that reflect the relative spectral sensitivities required to ensure that all the wavelength combinations that are seen as the same colour have the same position in the CIE colourimetry system and that all wavelength combinations that are seen as different in colour occupy different positions. Figure 1.5 shows two sets of colour matching functions. The CIE 1931 Standard Observer is used for colours occupying visual fields up to 4° of angular subtense. The CIE 1964 Standard Observer is used for colours covering visual fields greater than 4° in angular subtense. The values of the colour matching functions at different wavelengths are known as the spectral tristimulus values.

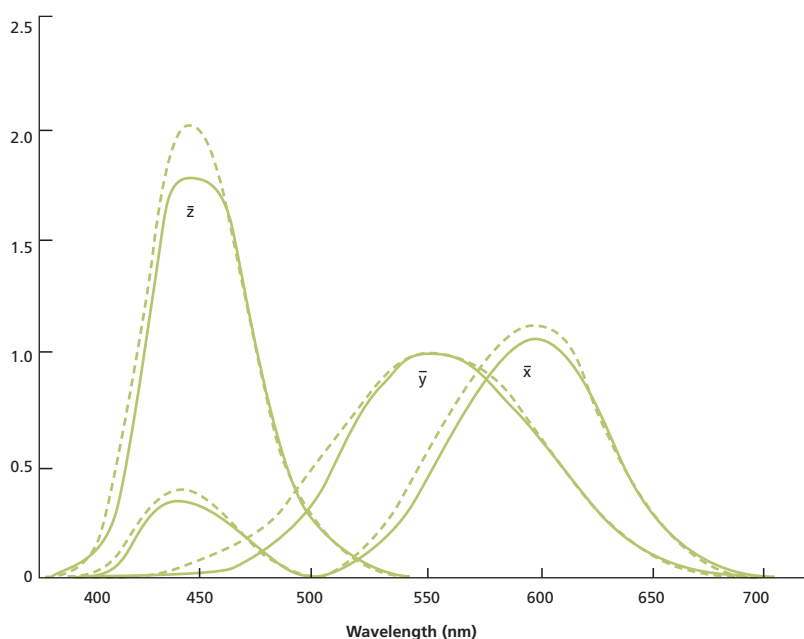


Figure 1.5 Two sets of colour matching functions: The CIE 1931 standard observer (2 degrees) (solid line) and the CIE 1964 standard observer (10 degrees) (dashed line).

The colour of a light source can be represented mathematically by multiplying the spectral power distribution of the light source, wavelength by wavelength, by each of the three colour matching functions $x(\lambda)$, $y(\lambda)$ and $z(\lambda)$, the outcome being the amounts of three imaginary primary colours X, Y, and Z required to match the light source colour. In the form of equations, X, Y and Z are given by: