Brightness compensated color vision tests on computer controlled CRT display

PhD work

Thesis

T1 Both the lin-log + MSE gamma calculation and the non-spectral CT method are applicable for the calibration of CRT displays used for color vision tests if there is prior information on the spectral distribution of the display’s phosphors.

T2 The equivalent luminance values in common CRT luminance ranges \((L_R=2\ldots40 \text{ cd/m}^2, L_B=1.5\ldots10 \text{ cd/m}^2)\) can be described with the following equations:
- \(L_G = a_{RG} + b_{RG} \cdot L_R\) (red-green) and
- \(L_G = a_{BG} + b_{BG} \cdot L_B\) (blue-green)

These equations represent equibrightness-perception lines.

T3 The Modified Minimal Apparent Motion (MMAM) brightness-perception matching method which is a further development of the Minimal Apparent Motion (MAM) has significantly better repeatability and smaller relative error than the following brightness-perception matching methods: Minimum Flicker (MF), Direct Matching (DM), Minimal Distinct Border (MDB), Minimal Apparent Motion (MAM).

T4 The following equations describe the luminances evoking equal brightness-perceptions at the Modified Direct Matching (MDM) method from the luminances created by the CRT primaries at the brightness-perception measurement of the Minimal Apparent Motion (MMAM) method:
- \(L_{R,DM} = -0.996 + 1.454 \cdot L_{R,MMAM} - 0.025 \cdot (L_{R,MMAM})^2\)
- \(L_{G,DM} = -0.620 + 1.431 \cdot L_{G,MMAM} - 0.010 \cdot (L_{G,MMAM})^2\)
- \(L_{B,DM} = -0.818 + 1.472 \cdot L_{B,MMAM} - 0.048 \cdot (L_{B,MMAM})^2\)

The equations can be applied at the following luminance ranges:
- \(L_{R,MMAM}=2\ldots15 \text{ cd/m}^2\), \(L_{G,MMAM}=2\ldots40 \text{ cd/m}^2\), \(L_{B,MMAM}=2\ldots10 \text{ cd/m}^2\).

T5 The equibrightness-perception lines measured with the red-green Modified Minimal Apparent Motion (MMAM) brightness-perception matching method can be applied for:
- a./ the determination of color deficiency,
b./ for the discrimination of protans and deutans where the gradient of the equibrightness-perception lines at protans is larger and at deutans is smaller than the gradient of the line at normal color vision.

Fig. T5.

T6 Modifying the color temperature of the adaptative field at the Modified Minimal Apparent Motion (MMAM) tests on CRT displays doesn’t have significant influence on the mean value of the parameters \((a_{RG}, b_{RG})\) in the red-green equibrightness-perception equation of normal color vision.

T7 The complex and P15 type pseudo-isochromatic tests:
   a./ require brightness-perception compensation
   b./ are capable to significantly discriminate protans and deutans after brightness-perception compensation.