INTERFERENCE FILTER TESTING
FOR
COLOR MEASUREMENT ACCURACY

Display Forum ‘97
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INTERFERENCE FILTERS CAN REVEAL INSTRUMENT PERFORMANCE

FLAT PANEL DISPLAY LABORATORY
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BANDWIDTH VARIATION

Spectrum locus

Error

Calculated (x,y)

Measured (x,y)

CIE 1931

BW=10 nm

BW=20 nm

x

y

0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8

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NIST
MISALIGNMENT

\[ \lambda_\theta = \lambda_0 \left[ 1 - \left(\frac{n_1}{n_2}\right)^2 \sin^2 \theta \right]^{1/2} \]

optical thickness = \( n_f \)
EFFECTS OF ALIGNMENT AND REFLECTION

- 550 nm filter
- predicted

angle of incidence (degrees)

change in transmission

0.00% 0.10% 0.20% 0.30% 0.40% 0.50% 0.60% 0.70% 0.80% 0.90% 1.00%

-20 -15 -10 -5 0 5 10 15 20

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DIVERGENT ILLUMINATION

\[ \frac{1}{f} = \frac{1}{s_o} + \frac{1}{s_i} \]

\[ \theta = \arctan\left[\frac{1}{s_i(h_i/2 + d/2)}\right] \]

\[ \lambda_0 = \lambda_0 \left[ 1 - \left(\frac{n_1}{n_2}\right)^2 \sin^2 \theta \right]^{1/2} \]
CHECKING LINEARITY

LMD

Iris A B

Lamp

Photodiode

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CHECKING LINEARITY

\[ x'_c = x_A + k(x_B - x_A) \]
\[ y'_c = y_A + k(y_B - y_A) \]
\[ k = \left[ 1 + \frac{y_B L_A}{y_A L_B} \right]^{-1} \]
UNEXPECTED BEHAVIOR

Chromaticity Measurements with Spectroradiometer B

Chromaticity Measurements with Colorimeter A

CIE 1931
- interference filters
- tungsten source
BACKGROUND NOISE AND SCATTERING

Raw Data of a Spectroradiometer Measuring a 700 nm Interference Filter

- light
- dark
- light-dark unclamped
- light-dark clamped

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INWARD CURVING AT THE EXTREME VALUES

Effect of Noise on Tristimulus Response Contribution

Normalized

wavelength

380 480 580 680 780

xbar
ybar
zbar
700 nm

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ERROR MODEL

Measured Data versus Model

- CIE 1931
- Model
- Interference filters
- Tungsten source

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SOURCES OF ERROR

Wavelength Shift, Temperature, and Drift

Bandwidth, Scattering

Background Subtraction (Noise)

Noise

Spectrum Locus

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