SID Bay Area Chapter Presentation

The ICDM International Display Measurement Standard - SID's First Standard

at National Semiconductor (Texas Instruments)

Santa Clara, November 9, 2011

Joe Miseli
Oracle
Abstract

The ICDM International Display Measurement Standard - SID's First Standard

This is the same metrology group who wrote the FPDM (Flat Panel Display Measurement standard) and derivatives in VESA. Now in SID, the ICDM is working to complete the most comprehensive display measurement standard yet produced, the IDMS (International Display Measurement Standard).

This standard is formidable in terms of content, comprehensiveness, and expertise. The principal editor was the chief display metrology scientist at NIST, and there are authored or co-authored contributions from approximately 50 of some of the best display-evaluation-related specialists in the field today.

The IDMS catalogs standardized methods to characterize displays of almost every type, with a range of measurements from somewhat basic parameters typically called out for marketing purposes of displays to very specialized and advanced methods which capture subtle operating characteristics that have never had standardized methods to quantify them.

This is the state-of-the-art standard for characterizing displays at all levels and will make a major contribution to the display industry for quantifying the performance of displays. We will give an overview of the standard and touch upon some of the specialized areas it contains.
The ICDM (International Committee for Display Metrology) became a part of SID in May of 2007. The ICDM will finalize its display measurement standard (DMS) in 2011-2012.

“ICDM: we set the standards for display metrology”

ICDM Committee
2008

http://www.icdm-sid.org
Introduction: About the ICDM
http://www.icdm-sid.org

International Committee for Display Metrology
A Committee within SID
❖ Part of the Definitions and Standards Committee
❖ First SID committee for standards
Over 200 participants from every major area of the Display Industry
❖ Many of the most prestigious display-related organizations in the world
  ‣ Including all major display manufacturers, many Universities, NIST, NASA, ITRI, KRISS, NPL, most test equipment manufacturers, etc.)
Participation by many major related display standards groups
What the ICDM is and what it will do for you

What is the ICDM?
❖ The standards committee within SID developing the ICDM display measurement standard.
   ‣ Originally the FPDM committee of VESA

Who is the ICDM?
❖ Over 200 people — evaluation professionals from throughout the display industry.

What will the ICDM do for you?
❖ Will help establish standardized methods for almost all types of display measurements and characterizing
   ‣ Will provide methods that help you to be sure that the measurements on your displays were done correctly.
   ‣ Will answer the questions about what the specifications really mean
   ‣ Will help reduce specsmanship

What the ICDM does for the industry?
❖ Provide a common language for those who measure displays to assure all are making the measurements in a consistent manner.
❖ Provide the tools to help all obtain and understand the true performance of displays
Organization and Structure

✦ Chairman - Joe Miseli, Oracle
✦ One Primary Editor - Ed Kelley, Keltek Research
  ➞ Several sub-editors
✦ 13 Subcommittees
  ➞ Various numbers of subcommittee participants
✦ Approximately 50 authors
✦ Approximately 120 reviewers
✦ Over 250 members
  ➞ Over 200 on the active members Email list
  ➞ Over 50 on the interest Email list
✦ Approximately 14 standards bodies participants
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<td>3. Setup of Display &amp; Apparatus</td>
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<td>13. Physical &amp; Mechanical Metrics</td>
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<td>16. Front-Projector-Screen Metrics</td>
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<td>18. Touch Screen and Surface Displays</td>
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<td>A. Metrology Considerations</td>
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<td>C. Variables &amp; Nomenclature</td>
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<td>G. Changes &amp; Correlations</td>
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<td>H. References</td>
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</table>
ICDM Subcommittees & Chairs

1. Gamma, Gray Scale: Don Gyou Lee
2. Viewing Angle: Thierry Leroux, Eldim
3. Uniformity: Ron Rykowski, Radiant Imaging
4. 3D-Stereo: Adi Abileah, Planar
5. Low Luminance: Jens Jorgen Jensen, Radiant ZEMAX
6. Motion Artifacts: Andrew Watson, NASA
7. Reflection, John Penczek, NIST
8. Touch Screens, Peggy Lopez, Orb Optronix
9. Front-projection Screens, Michael Rudd, Consultant
10. Validation and Verification, Max Lindfors, Nokia
11. Projection Displays, Michael Rudd, Proper Sound and Vision
12. Temporal, Mike Wilson, Westar
13. Ratification and Release, Tom Fiske, Qualcomm
First there was the FPDM2 (VESPA Flat Panel Display Metrology Standard)

- FPDM 2 was written in 2001 with an addendum in 2005

In 2007, the VESA FPDM group became the ICDM (International Committee for Display Metrology Standard)

- Now part of SID → And about to release the IDMS
Philosophy of the ICDM and its standard

✦ Simple English

✦ Consistent structure
  • Everything contained within a single book
  • Every section is written from a single template
    ➔ Section = 1 measurement
    ➔ Chapter = a group of measurements of a certain category

✦ Friendly style and manner
  • Full color
  • Contains cartoons, many references, tables, glossary, discussions
  • Extensive use of high-quality graphics
  • Icons to explain simple and repetitive setup functions

✦ On measurement per page whenever possible

✦ Aides to help in various manners
  ➔ Templates
  ➔ Test patterns
Examples of graphics of the ICDM

- ICDM - Clear and friendly style, abundant use of quality graphics to simplify and clarify
Examples of some test patterns of the ICDM

B. 32-level gray scale, color inversion target (see A112-4), and color bars.

C. Gray-scale ends and text samples.

D. Full-screen white, black, dark grays, and colors.
Setup information by means of icons

❖ Standard Conditions (Setup Icons of the ICDM)

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stable power required</td>
<td>Temperature, humidity, and air pressure in range</td>
</tr>
<tr>
<td>Warmup required, 20 minutes minimum</td>
<td>Don't change controls from initial setup</td>
</tr>
<tr>
<td>Measure in darkroom conditions $E \leq 1 \text{ lx}$</td>
<td>Measure normal to screen</td>
</tr>
<tr>
<td>Measure at least 500 pixels (circle of 26 pixel diameter)</td>
<td>Measurement field angle: 2° or less</td>
</tr>
<tr>
<td>Center-of-screen measurement</td>
<td>Adequate integration time to allow for screen refresh</td>
</tr>
<tr>
<td>Area array imagers: assured of no Moiré</td>
<td>Image resolution same as the display array</td>
</tr>
</tbody>
</table>
## Direct-View FPD Data Record — Suite of Basic Measurements

**Display Info:** Manufacturer: [Manufacturer], Model No: [Model], Serial No: [Serial], Rev. Level: [Revision].

**Description:** Diagonal Size: (hor) × (ver), Technology: [Technology].

**Pitch:** Horizontal: Pixel: [Pixel], Subpixel (Dot): [Dot], Other: [Other].

**Vertical:** Pixel: [Pixel], Subpixel (Dot): [Dot], Other: [Other].

**Colors:** Bits/color: [Bits], Color bias: [Color], Gray Levels: [Gray Levels], Total Colors: [Total Colors].

**Size:** Active Area: (hor) × (ver), LMD: [LMD], Make: [Make], Model: [Model], Serial No: [Serial], Distance: [Distance], AFOV: [AFOV].

**Overall Dimensions:** (hor) × (ver), Depth: [Depth], Mass (Weight): [Mass].

**Test Person:** [Person], Date: [Date], Warm-Up Time: [Time], min, Temperature: [Temp], °C Run: [Run], Page 1/2.

### Full-Screen Center (302-1-4)

<table>
<thead>
<tr>
<th>Full Screen Center (302-1-4)</th>
<th>Uniformity: Nonuniformity = 100% x [Min/Max] or ∆μ/ν’ (306-1, 2, 3, 6)</th>
<th>Power Consumption (401-1)</th>
<th>Frontal Lumin. Eff. (402-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L (cd/m²)</td>
<td>x</td>
<td>y</td>
<td>9 pt</td>
</tr>
<tr>
<td>White</td>
<td>1</td>
<td>1</td>
<td>High</td>
</tr>
<tr>
<td>Black</td>
<td>2</td>
<td>Low</td>
<td>Current</td>
</tr>
<tr>
<td>Dkrm. C</td>
<td>No Units for C</td>
<td>High</td>
<td>Power, P</td>
</tr>
<tr>
<td>Red</td>
<td>4</td>
<td>Inverter</td>
<td>Lc</td>
</tr>
<tr>
<td>Green</td>
<td>5</td>
<td>Low</td>
<td>Pattern × cm</td>
</tr>
<tr>
<td>Blue</td>
<td>6</td>
<td></td>
<td>Checkerboard Con. (304-9)</td>
</tr>
</tbody>
</table>

### Full-Screen Gray Scale (302-5)

<table>
<thead>
<tr>
<th>Full-Screen Gray Scale (302-5)</th>
<th>Level</th>
<th>L (cd/m²)</th>
<th>Opt-1</th>
<th>L (cd/m²)</th>
<th>8</th>
<th>White-7</th>
<th>White-15</th>
<th>9</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ave.</td>
<td>Max</td>
<td>14</td>
<td>6</td>
<td>11</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min.</td>
<td>Max</td>
<td>13</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonunif.</td>
<td>12</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>An. Low</td>
<td>10</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>An. High</td>
<td>9</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>An. Non.</td>
<td>8</td>
<td>Bkrm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Ambient Contrast (308-2)

<table>
<thead>
<tr>
<th>Ambient Contrast (308-2)</th>
<th>White L w</th>
<th>Black L b</th>
<th>L w</th>
<th>L b</th>
<th>L w</th>
<th>L b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cc</td>
<td>E</td>
<td>Cc</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Gamma

<table>
<thead>
<tr>
<th>Gamma</th>
<th>Viewing Angle (307-1 or 2)</th>
<th>White</th>
<th>Black</th>
<th>Red</th>
<th>Green</th>
<th>Blue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shad = 100%</td>
<td>Direct'n Angle</td>
<td>Lw</td>
<td>xw</td>
<td>yw</td>
<td>CCT(K)</td>
<td>Lb</td>
</tr>
<tr>
<td>Box at (A:E)</td>
<td>Lw</td>
<td>Up θa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Box (0-7)</td>
<td>Lw</td>
<td>Dwn θa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bkrm (0-7)</td>
<td>Left θb</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Comments:

\[ u' = 4x(3+12y-2x) \]
\[ ν' = 9y(3+12y-2x) \]
Reporting Forms/Records/Templates

✦ Considerations for various Tools to help organize and give references for what is to be measured.
  • Printed forms / Records
  • Smart forms
  • Templates
  • Smart Templates
  • Programs
  • Specialized Templates

✦ Will look to users of the ICDM document to make additional requests and we may develop more templates and post them the ICDM web site.
Sampling of measurements of the ICDM standard

✦ 3D - Stereo Displays
✦ Reflection
  • Ambient Contrast
✦ Low level contrast - Dynamic Contrast displays
  • Gamma for displays with global/local dimming (dynamic contrast)
  • Starfield contrast
✦ Color Characteristics — White point quality metric
  • CCT qualification based on $\Delta u'v'$
Sampling of measurements of the ICDM standard

- **3D - Stereo Displays**
- **Reflection**
  - Ambient Contrast
- **Low level contrast - Dynamic Contrast displays**
  - Gamma for displays with global/local dimming (dynamic contrast)
  - Starfield contrast
- **Color Characteristics — White point quality metric**
  - CCT qualification based on $\Delta u'v'$
3D Measurements of the ICDM

Items related to 3D displays defined for the ICDM DMS

- Eye-glasses Testing
- Stereo Extinction Ratio
- Design Eye Point (Sweet Spot)
- Optimum Viewing Distance and Range
- Viewing Freedom and Offset
- Two-View (one viewer at one location) vs. Multi-View
- Luminance Difference
- 3D Luminance
- 3D Crosstalk
- 3D Contrast Ratio
- 3D Chromaticity Coordinates
- 3D Uniformity
- Viewing Angle
- Stereoscopic Gamma
- And more…….
3D Displays

Stereoscopic Displays
- Spatially-aligned
- Spatial multiplexing
- Temporal multiplexing

Auto-stereoscopic displays (no glasses)
- Parallax barrier (rear or front)
- Lenticular lenses (optical separation)
- Auto-stereo (alternating backlight)

2-view-multi-view 2D/3D head tracking
- Polarization (linear, circular)
- Passive glasses
- Polarization (linear, circular)
- Spectral filters (narrow/broad-band)
- X-Pol (alternating retarders)

2D/3D head tracking
- Head-worn devices (HWD / HMD) (near the eye)
- Light field displays

Head-worn devices (HWD / HMD) (near the eye)
- Direct view (optical separation)

Volumetric 3D
- Moving (rotating) reflective surface
- Moving light points
- Layered display double, multi-layers
- Addressed media laser projection

Holographic

Family tree of 3D Display Technologies
Graphics showing 3D Autostereoscopic System Implementations

Figure 1: Parallax Barrier Autostereoscopic system (Top View). The parallax barriers are transparent and opaque strips to allow each eye to see different regions of the display behind the barrier.

Figure 2: Lenticular Lens Array Autostereoscopic system. The microlens system steers the light path to allow each eye to see different regions of the display behind the lenses.
Advanced Stereoscopic Topics

17.5 AUTOSTEREOSCOPIC LIGHT FIELD DISPLAYS

This chapter deals with stereoscopic displays in which the viewer is positioned in any location inside the viewing space and there is no need for eye glasses (autostereoscopic). These stereoscopic displays are called light-field displays or integral imaging (photography) displays, which reproduce light rays into real space. It is very difficult to distinguish light field displays and continuous multi-view displays. Some papers treat these issues in several aspects. [1, 2, 3]

Measurement methods that are listed below are not unique to light field displays and should be performed as other stereoscopic displays (see previous chapters).

1. Stereoscopic Contrast Ratio
2. Stereoscopic Luminance & Luminance Difference
3. Stereoscopic Colors & Color Difference
4. Stereoscopic Luminance Uniformity
5. Stereoscopic Color Uniformity
6. Stereoscopic Angular Behavior
7. Head Tilt

A variety of measurement methods are found in the previous chapters that are not unique to 3D and stereoscopic displays and can be performed as with 2D common displays.

Measurement methods include scanning in small angular increments to

BACKGROUND:

Light Fields provide a general representation of 3D information that considers a 3D scene to be the collection of light rays that are emitted or reflected from 3D scene points. The term Light Field, was first used by Levoy et al [4] to represent 3D information based on Michael Faraday's lecture on light flow in 1846, "Thoughts on Ray Vibrations," that light be interpreted as a ray or field, and formalized by Maxwell's equations in 1874. Levoy provided a survey of the theory and practice of light field imaging that included those historical references. [5]

A surface light field is a 4-dimensional function \( f(x, y, \theta, \phi) \) that completely defines the outgoing radiance of every point on the surface of an object in every viewing

Fig. 1. Comparison of multiview and light-field

Fig. 2. Light field
Sampling of measurements of the ICDM standard

- 3D - Stereo Displays
- Reflection
  - Ambient Contrast
- Low level contrast - Dynamic Contrast displays
  - Gamma for displays with global/local dimming (dynamic contrast)
  - Starfield contrast
- Color Characteristics — White point quality metric
  - CCT qualification based on $\Delta u'v'$
Ambient Contrast

- Ambient Contrast
  - Becoming popular
  - Very important
  - Confused by many in the industry
  - Highly requested from the ICDM

Reflection Components

Specular Component  Haze Component  Lambertion Component  Specular + Haze + Lambertion

Reflection measurement example

Ed Kelley
Determining Contrast Ratio

- Michelson Contrast Ratio used for motion contrast sensitivity & contrast degradation but not for full screen contrast
  - It is important to know the level at which perceptibility is not important
  - Michelson contrast constrains an infinite range of contrast to be from 0 to 1, so multiplying it by 100 gives percent of contrast.

\[
CR_M = 100 \left( \frac{L_{max} - L_{min}}{L_{max} + L_{min}} \right)
\]

**Michelson Contrast**

\[
CR = \frac{L_{max}}{L_{min}}
\]

**Basic Contrast**

Linear and infinite, just like luminance ∴ the right metric for contrast of a display
Ambient Contrast

$$C_A = \frac{\pi L_W + \rho_W E_{\text{hemi}} + \beta_{W\text{dir}} E_{\text{dir}} \cos \theta_s}{\pi L_K + \rho_K E_{\text{hemi}} + \beta_{K\text{dir}} E_{\text{dir}} \cos \theta_s}$$

Where

- $\pi$ is the divisor for the 2nd and 3rd terms
- $L_W$ is the measured white darkroom luminance
- $\rho_W$ is the hemispherical reflectance of a white screen
  - Reflectance, or flux out/flux in — from integrating or sampling sphere
- $E_{\text{hemi}}$ is diffuse illuminance (lux)
  - Uniform illumination falling on the display as from a integrating sphere
- $\beta_{W\text{dir}}$ is the luminance factor of direct illumination for white
  - Luminance of the material/luminance of a perfect reflecting diffuser — like a white puck
- $E_{\text{dir}}$ is the directional illuminance
  - Illuminance from the directed sources — the ambient light source
- $\theta_s$ is the incident angle of directional illumination from normal
- $L_K$ is the measured black darkroom luminance
- $\rho_K$ is the hemispherical reflectance of a black screen
- $\beta_{K\text{dir}}$ is the luminance factor of direct illumination for black
- $E_{\text{dir}}$ is the directional illuminance

This is well explained in the ICDM standard.
Sampling of measurements of the ICDM standard

- 3D - Stereo Displays
- Reflection
  - Ambient Contrast
- Low level contrast - Dynamic Contrast displays
  - Gamma for displays with global/local dimming (dynamic contrast)
  - Starfield contrast
- Color Characteristics — White point quality metric
  - CCT qualification based on $\Delta u'v'$
Dynamic Contrast

Dynamic Contrast (or global dimming, local dimming) turns off the backlight for displayed content with low luminance.
How do we measure this contrast?

The backlight turns off, so we have infinite contrast.

- **Dynamic Contrast & Adaptive or Global/Local Dimming & Boosting.**
  - Dynamic attenuation of the backlight to improve contrast, black-level, and power savings, and to give highlight luminance level boosts. Black luminance level decreased for black picture content.

- With LED backlights arrays, we have the capability to manipulate the backlight and spatial control of contrast.

- **Segmented Control**
  - **0D Design** – Dim entire backlight (Global Dimming)
    - Can be achievable with any dimmable backlight
  - **1D Design** – Scan 1D backlight tubes (Line Dimming)
  - **2D Design** – Modulate 2D LED array (Local Dimming)

- For measurements, we must assure a case where the backlight cannot be dynamically dimmed to 0, and thereby produce an artificial infinite contrast.

- The ICDM has solved this — Starfield Contrast
Dynamic Contrast

\[
\text{Input Signal} \rightarrow \text{Drive Level} \rightarrow \text{Output} \rightarrow \text{Luminance Level (cd/m}^2)\]

Gamma Curve with Dynamic Contrast
Gamma Curve with Dynamic CR disabled
ref gamma=2.2
Dynamic Contrast - Zoomed View

Output → Luminance Level (cd/m²)

Input Signal → Drive Level

Plotted gamma with global dimming

Normal gamma curve

\( \gamma = 2.2 \)
Starfield Contrast
Starfield Contrast

We use patterns with controlled content of white, then measure a black and white target in the center.

ICDM Starfield Contrast pattern example, shown for 30% white.

The ICDM pattern set ranges from 100% White To Black.
Starfield Contrast

Graphs showing Starfield White and Starfield Black contrast levels for varying Starfield patterns using Dynamic Contrast.
### Table 2. Analysis Example:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>$L_{W_{\text{max}}}$</td>
<td>255.6 cd/m²</td>
<td>3</td>
</tr>
<tr>
<td>$L_{W_{\text{min}}}$</td>
<td>51.68 cd/m²</td>
<td>21</td>
</tr>
<tr>
<td>$L_{K_{\text{max}}}$</td>
<td>0.252 cd/m²</td>
<td>1</td>
</tr>
<tr>
<td>$L_{K_{\text{min}}}$</td>
<td>0.0196 cd/m²</td>
<td>21</td>
</tr>
<tr>
<td>Full Dynamic Contrast Range ($C_{DC}$) or ($L_{W_{\text{max}}}/L_{K_{\text{min}}}$)</td>
<td>13,040</td>
<td>--</td>
</tr>
<tr>
<td>White Range Reduction Ratio ($L_{W_{\text{min}}}/L_{W_{\text{max}}}$)</td>
<td>0.2022</td>
<td>--</td>
</tr>
<tr>
<td>Black Range Reduction Ratio ($L_{K_{\text{min}}}/L_{K_{\text{max}}}$)</td>
<td>0.08</td>
<td>--</td>
</tr>
<tr>
<td>Starfield White ($L_{K_{sf}}$)</td>
<td>242.4 cd/m²</td>
<td>8</td>
</tr>
<tr>
<td>Starfield Black ($L_{K_{sf}}$)</td>
<td>0.163 cd/m²</td>
<td></td>
</tr>
<tr>
<td>Starfield Contrast Ratio ($C_{s}$) or ($L_{W_{sf}}/L_{K_{sf}}$)</td>
<td>1,478</td>
<td>--</td>
</tr>
<tr>
<td>Starfield Compression Ratio ($C_{DC}/C_{s}$)</td>
<td>8.823</td>
<td></td>
</tr>
<tr>
<td>ICDM Starlight pattern set number</td>
<td>1</td>
<td>--</td>
</tr>
</tbody>
</table>

Starfield Contrast Curve
Sampling of measurements of the ICDM standard

- 3D - Stereo Displays
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  - CCT qualification based on $\Delta u'v'$
CCT and Delta u'v' Combined Metric

Validity or figure of merit for a white point in u’v’ color space

We measure a white point (u’v’) and we want to know how good it is as an indicator of white.

We can calculate CCT for any u’v’ or xy value. CCT is meant to define a white point. Here is how we determine if it is a valid representative of a white point or not.
How to determine the validity of a white point in $u'v'$ color space

1. Measure $u'v'$ ($u'_w$ $u'_w$) for the white point of interest.

2. Calculate CCT from the measured $u'_w$ $u'_w$ points

$$T = \frac{(146413u'_w + 59240)v'_w^2 - 179737u'_w(u'_w + 0.01497)v'_w + 51870(u'_w - 0.18272)u'_w(u'_w + 0.5793) - 92673v'_w^3 - 21306v'_w + 3133.5}{(0.5574u'_w - 3.4864v'_w + 1.1148)^3}$$ (1)

3. From the CCT ($T$) find the $u'v'$ values for $T$ that lie on the Planckian Locus by the following equations.

$$u'_p = \frac{(128.641 \times 10^{-9})T^2 + (154.118 \times 10^{-6})T + 860.118 \times 10^{-3}}{(708.145 \times 10^{-3})T^2 + (842.42 \times 10^{-9})T + 1}$$

$$v'_p = \frac{(63.0723 \times 10^{-9})T^2 + (63.4209 \times 10^{-6})T + 476.098 \times 10^{-3}}{(161.456 \times 10^{-3})T^2 - (28.9742 \times 10^{-6})T + 1}$$

4. Calculate delta $u'v'$ to determine the distance of the measured $u'v'$ (or CCT) from the Planckian locus

$$\Delta u'v' = \sqrt{(u'_p - u'_w)^2 + (v'_p - v'_w)^2}$$
Summary

✧ The ICDM has written the most comprehensive Display Measurement Standard (DMS) ever produced in the display industry.
  • *It has more measurements and more categories of display measurements than any other display standard before it.*
✧ We look to make it usable and available to all.
✧ It will define the industry-leading language and methods for display measurements and metrology.
✧ It standardized many areas which have never had display metrology standards before.
✧ We welcome members who are interested in evaluation of displays.
✧ Today, we have shown a few examples of some of the metrology items we are addressing.
✧ Thank you for your attention.
SID Bay Area Chapter Presentation
The ICDM International Display Measurement Standard - SID's First Standard
at National Semiconductor
Santa Clara, November 9, 2011

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