Necessity of monitor quality control and total management with QA software

2020 Joint AAPM | COMP Virtual Meeting
Partners In Solutions program : Imaging and Diagnostic QA Software

Brian Cote
EIZO Inc.
July 14, 2020
Why is quality control needed for monitors?
Degradation of the monitor

✓ Structure of LCD monitor

White LED Backlight
Degradation of the monitor

✓ Degradation of backlight

✓ Factor (Heat and Light)
  ✓ Phosphor
  ✓ Resin to cover the elements
  ✓ Reflector

LED backlight = Long lifetime, but still degrade
Degradation of the monitor

✓ Other factors of imaging quality

✓ Color Temperature

✓ Color will change over time
✓ Native color temperature of LCD panel is NOT constant between individual units
✓ Color monitor can be calibrated with targeted color temperature
Dégradation de l’affichage

✓ Other factors of imaging quality

✓ Uniformity of Luminance and Color
  ✓ Native LCD panel has fluctuations in luminance and color
  ✓ EIZO even out fluctuations by Digital Uniformity Equalizer function

Adjustment luminance uniformity

Adjustment color uniformity
Example

After 6 months
- Usage Time: 4,000 h
- Luminance: 383 cd/m²
※Original: 400 cd/m²

After 5.5 years
- Usage Time: 55,000 h
- Luminance: 216 cd/m²
※Original: 400 cd/m²
Effect of monitor degradation

✓ Example: Variation within the same facility

Differences occur depending on location and use
Effect of monitor degradation

✓ Implications for reading

✓ Lack of necessary information
✓ Different views between different monitors
✓ Different views between different times
Calibration

✓ Elements of Calibration

✓ Luminance
✓ Gamma - Tone Curve
✓ Color Temperature (Color monitor only)
Monitor QC/QA Testing

✓ What is required?

✓ Acceptance Test / Consistency Test
  ✓ Pattern Check

✓ Measurement Check
  ✓ Luminance
  ✓ Grayscale
  ✓ Uniformity
Monitor QC/QA Standards

✓ Famous standards

✓ AAPM On-Line Report No.03 (TG18) : 2005
✓ NYC Quality Assurance Guidelines for Primary Diagnostic Monitors : 2015
✓ ACR–AAPM–SIIM Technical Standard for Electronic Practice of Medical Imaging : 2017
✓ Display Quality Assurance: Recommendations from AAPM TG270 : 2019
Monitor QC/QA Standards

✓ Examples of criteria : from NYC PDM guidelines

Acceptance Test
• A quantitative test to be completed at first install or when the environment changes. Also done yearly.

<table>
<thead>
<tr>
<th></th>
<th>NYC – Hospitals</th>
<th>NYC – Clinical Sites</th>
<th>NYC – Mammography</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luminance Check</td>
<td>L’max / L’mim &gt; 250</td>
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<tr>
<td></td>
<td>L’max &gt; 350 cd/m²</td>
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<tr>
<td></td>
<td>Lamb &lt; L’mim / 1.5</td>
<td>Lamb &lt; L’mim / 1.5</td>
<td>Lamb &lt; L’mim / 1.5</td>
</tr>
<tr>
<td>Grayscale Check</td>
<td>Target error rate &lt; 10% of GSDF</td>
<td>Target error rate &lt; 10% of GSDF</td>
<td>Target error rate &lt; 10% of GSDF</td>
</tr>
<tr>
<td>Uniformity Check</td>
<td>Gayscale: 204, 26 (Lmax-Lmim) / (Lmax+Lmim) x 200 &lt; 30%</td>
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Bi-weekly Test
• A subjective test completed every other week to ensure the image performance is maintained.

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<th>NYC – Mammography</th>
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<tr>
<td>Pattern Check (Used pattern)</td>
<td>Black SMPTE Shades of RGB White</td>
<td>Black SMPTE Shades of RGB White</td>
<td>Black SMPTE Shades of RGB White</td>
</tr>
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Consistency Test
• A quantitative test done quarterly to ensure the monitors are maintain luminance output and adherence to the DICOM GSFD gamma curve

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Monitor QC/QA Standards

✓ Comparison: TG18 / ACR-AAPM-SIIM 2017 / TG270

✓ Main Criteria: Luminance, Contrast, Luminance Response

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<tr>
<th></th>
<th>TG18</th>
<th>ACR-AAPM-SIIM 2017</th>
<th>TG270</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Primary</td>
<td>Secondary</td>
<td>Diagnostic for Mammogram</td>
</tr>
<tr>
<td>Minimum Luminance</td>
<td>-</td>
<td>-</td>
<td>L’ min ≥ 1.2cd/m²</td>
</tr>
<tr>
<td>Maximum Luminance</td>
<td>L’max ≥ 170cd/m²</td>
<td>L’max ≥ 100cd/m²</td>
<td>L’max ≥ 420cd/m²</td>
</tr>
<tr>
<td>Luminance Response</td>
<td>DICOM GSDF ≤ 10%</td>
<td>DICOM GSDF ≤ 20%</td>
<td>DICOM GSDF ≤ 10%</td>
</tr>
</tbody>
</table>

[Acceptable Ranges]
Monitor QC/QA Standards

✓ Recommended criteria (Excerpt.) : from TG270

✓ Luminance, Contrast, Luminance Response
  ✓ No significant difference from ACR-AAPM-SIIM 2017 / NYC PDM
    ✓ 350cd/m² for Diagnostic, GSDF error rate < 10% etc.

✓ Other elements
  ✓ Qualitative ambient luminance / illuminance
  ✓ Qualitative Uniformity
  ✓ Qualitative Spatial Resolution
  ✓ Color Assessment
  ✓ Etc.
EIZO monitor QC/QA solution
RadiCS
Monitor QC Software
RadiCS

✓ Standalone QC/QA

✓ All in One QC/CA software
  ✓ Calibration
  ✓ QC testing in easy steps

✓ Accelerate monitors value
  ✓ Improve workflow features
  ✓ Save monitor power and lifetime
RadiNET Pro Web Hosting
Network QC Management System
RadiNET Pro Web Hosting

✓ Overview

✓ Connect all monitors to our server for easy QA/QC management
✓ Remote QC testing / Calibration / Setting
✓ Show all monitor’s information
✓ Provide your settings by group policy function
RadiNET Pro Web Hosting

✓ Manage All Monitors from Server

✓ Execute QC test / calibration all at once
  ✓ Immediate execution / Scheduled Execution

✓ Record all results to Web Hosting Server
  ✓ Confirm all results on your desk
  ✓ Generate QC reports
RadiNET Pro Web Hosting

✓ Manage All Monitors from Server

✓ History List / QC Test Reports
✓ Record all action for each monitors
RadiNET Pro Web Hosting

✓ Easy Management for Your Monitor / WS

✓ Main Screen: Monitor and Computer list
  ✓ See a wealth information
  ✓ Conveniently switch the contents
    ✓ Easy-to-view location tree
    ✓ Customizable columns
    ✓ All columns has filter
RadiNET Pro Web Hosting

✓ Device List: All Device Information in Here

✓ Detailed monitor info.
✓ Usage Time
✓ Sensors setting
✓ Calibration target

✓ Workstation
✓ PC name / IP address

✓ Graphics Board
✓ Name / Driver Version

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asset Number</td>
<td>(undefined)</td>
</tr>
<tr>
<td>Usage Time (Daily Average)</td>
<td>-H (H)</td>
</tr>
<tr>
<td>Installed on</td>
<td>2019/11/22</td>
</tr>
<tr>
<td>Connection</td>
<td>USB (Connected)</td>
</tr>
<tr>
<td>Luminance Sensor</td>
<td>Integrated Front Sensor</td>
</tr>
<tr>
<td>Presence Sensor</td>
<td>Yes</td>
</tr>
<tr>
<td>Illuminance Sensor</td>
<td>Yes</td>
</tr>
<tr>
<td>See in inches</td>
<td>30</td>
</tr>
<tr>
<td>Resolution</td>
<td>3280x2048</td>
</tr>
<tr>
<td>Monitor Type</td>
<td>Color (Hardware Calibration)</td>
</tr>
<tr>
<td>UST</td>
<td>-</td>
</tr>
</tbody>
</table>

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<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAL Switch Mode</td>
<td>DICOM</td>
</tr>
<tr>
<td>Calibration Target</td>
<td>DICOM Part 14 GSDF [0.65cd/m²:2-400.00cd/m²:2] 7500K</td>
</tr>
<tr>
<td>Current Lamp</td>
<td>0.00cd/m²</td>
</tr>
<tr>
<td>Baseline Value</td>
<td>Lmax=400.00cd/m²:2, Lmin=0.00cd/m²:2, Lamb=0.00cd/m²:2</td>
</tr>
<tr>
<td>QC Guideline</td>
<td>Basic QC Primary</td>
</tr>
<tr>
<td>Multi-monitor</td>
<td>Enable</td>
</tr>
<tr>
<td>Use/Comment</td>
<td>(undefined)</td>
</tr>
<tr>
<td>Comment</td>
<td>(undefined)</td>
</tr>
<tr>
<td>Backlight Meter</td>
<td>Insufficient amount of data</td>
</tr>
<tr>
<td>Backlight Status</td>
<td>Unable to confirm backlight status</td>
</tr>
</tbody>
</table>
RadiNET Pro Web Hosting

✓ Smart Management with Group Policy Setting

✓ Provide various common settings to all monitors
  ✓ QC guideline
  ✓ Schedule
  ✓ Calibration setting
  ✓ Registration info.
  ✓ Enable functions
  ✓ Monitor setting
RadiNET Pro Web Hosting

✓ Smart Management with Group Policy Setting

✓ Flexible schedule setting for each task

✓ Daily
✓ Weekly
✓ Monthly
✓ Yearly
✓ Date and Time
RadiNET Pro Web Hosting

✓ Multi-site Management

✓ Support tele-radiography environment

Facility
- Top level (parent) organization such as entire Hospital group.

Gateway
- Child organization, grouped by a physical gateway computer

RadiCS computers
- Workstations where EIZO monitors connected, typically diagnostic workstations

Can set multiple local(Gateway level) administrators
Making Each Life Visual