Medical Imaging Working Group

Czech Academy of Sciences
Národní 3 117 20
Prague 1, Czech Republic
28 June 2017

Craig Revie, MIWG chair, opened the meeting at 10:45 and introduced the agenda as follows:

1. Introductions
2. Publication of Medical Photography guidelines
3. Electro-Optical Requirements for Medical Displays
4. Possible liaison with IEC 62B/MT51
   — Meeting 17-18 July to discuss possible liaison
5. Identification of possible future projects for MIWG
6. Action items review

1. Introductions

Mr Revie performed a sound check and participants introduced themselves. He encouraged members to participate in the colour naming experiment being run by Dimitris Milonas, which can be found at http://www.colornaming.net. Mr Revie also reminded the participants of the ICC MIWG web site, which contains pages for all the activity areas as well as minutes, presentations and recordings of the meetings.

2. Publication of Medical Photography guidelines

Phil Green reported that following the decision at the previous meeting to hold a two-week ICC technical review of the final document, there had been no further comments received and the document had passed the ballot with no negative votes. The document was now published on the ICC web site as ICC White Paper 46.

3. Electro-Optical Requirements for Medical Displays

Wonseon Song of LG presented a proposal to identify requirements for medical imaging displays [see attached], which followed on from her previous presentation on display technologies used in medical imaging at the April 2017 meeting in Tokyo. The goal was that all users should be able to see the same image, and the key properties were contrast, gray scale characteristics, viewing angle, luminance maintenance and temporal aspects (such as flicker). The presentation focused on the properties to measure, and it was important to have consistency between reported measurements. One possibility would be to have a registry of test images to be used for measurement and reporting.

Contrast was defined as the peak white to black luminance ratio. The gray scale was to be defined by measuring a ramp of R=G=B. Viewing angle dependence was determined by measuring a patch at different locations on the screen, and reporting the change in EOTF with angle.

The meeting noted that the ICDM defines measurement methods for displays, and a new revision with greater coverage of modern display technologies such as OLED was due shortly. OLEDs are expected to become dominant in the future, and are very different from LCD and LED displays with very wide field emission. One aspect that would be useful to specify was the luminance level at different angles.

It was agreed that two things could be done: one was to define the measurement methods to be used, and the other was to define requirements of displays used by medical practitioners.

4. Possible liaison with IEC 62B/MT51

Mr. Revie proposed a liaison of ICC MIWG with IEC 62B/MT51 in updating a standard on medical displays [see attached]. This IEC committee liaises with AAPM TG 196 on medical displays. The AAPM recommendations are widely used in the medical field and are based on setting up displays for GSDF, but are based largely on older display technologies. There is a New Work Item in AAPM TG 196 to extend the standard to colour displays.

It was noted that ICC White Paper 44 on 'Visualization of medical content on color display systems' relates both to this project and the proposal by Song.

It was agreed that any ICC contribution to this work should focus on colour aspects. A liaison would be desirable so that ICC MIWG could provide input on colour, possibly including new metrics, following discussion in MIWG.

It was agreed that Mr. Revie should meet with Dr Aldo Badano, who chairs the AAPM TG, to discuss an MIWG liaison. He also undertook to request input from Ms Song, determine any liaison requirements from IEC, and invite Dr Badano to participate at the next ICC meeting in Toronto where the ICC role can be discussed and clarified.

5. Identification of possible future projects for MIWG

Mr Revie presented a list of possible future projects for MIWG [see attached].

5.1 Guidelines for digital pathology viewing environment.

The need to check telemedicine guidelines was noted.

5.2 Recommendation for colour vision testing and development of tools to aid practitioners with colour deficiency

It was suggested that one concrete application was Daltonisation to improve diagnostic ability when viewing colour images, and some work on doing this with ICC profiles had been reported at previous meetings.

5.3 Algorithms for analysis of medical images

This is primarily an image processing task using spatial features, and we need to determine what the ICC could do to help with this.

5.4 LG medical display/application assessment

Ms Song confirmed that she was interested in continuing this work.

It was suggested that those willing to lead on any of the above could draft a proposed scope and aims. Craig Revie also undertook to invite those |MIWG and ICC Honorary members not present to contribute.

6. Action item review

The meeting discussed open action items as follows:

MIWG-16-01: Left open. It was noted that Dr Pescatore has moved to a different division within Biomerieux.
MIWG-15-30: Left open.
MIWG-16-12: Dr Green undertook to progress this by drafting an ICS based on the existing GSDF profiles.
MIWG-16-20: Left open.
MIWG-17-03: Left open.

There being no other business, the meeting closed at 12:45.

Action items

The following action item was agreed at the meeting:

MIWG 2017-04 Meet with Aldo Badano to discuss ICC participation in AAPM activity, obtain input from Song by email, determine liaison requirements from IEC, invite Badano to participate in ICC meeting in Toronto (Revie)

MIWG 2017-05 Develop ICS for GSDF, using iccMAX profiles as a basis (Green)

MIWG 2017-06 Contact university MIWG members to invite input on future MIWG activities (Revie)

ICC Medical Imaging Working Group

Prague

28 June 2017

Colour Naming Experiment

colornaming.net

Colour Naming Experiment

Colour Naming Experiment | Colournamer | Terms and Cor

Select the language in which you would like to name colours

English
Ελληνικά
Español
Deutsch
Català
Italiano
中文(簡體)
中文(繁體)
Français
한국어
Dansk
Lietuvių
ภาษาไทย
Português
Svenska
Русский язык
日本語
Türkçe
Tiếng Việt
Nederlands
Norsk
Polski

more will be added
If your language is not listed yet, please send me a request.

Welcome

This is a multi-lingual colour naming experiment. It is part of research on co
categorisation within different cultures, and aims to improve the inter-cultur
part you are helping us to develop an online colour naming model which wil
language provided from your responses.

As part of this simple experiment you will be asked to name a series of colour samples. It should not take longer than 10 minutes, but if you would like to quit you are free to withdraw at any time.

The experiment requires the latest Flash player and Java Script enabled. By clicking the Start button you agree to take part in this study.

Start

Contact us or join us on facebook.

Colournamer

colornaming.net/research/

Colournamer (name a colour, any colour)

English | beige | Enter a colour name | Go

RGB: 255 | 0 | 0

HTML: #ff0000

orange

red

salmon

Dimitris Mylonas

University College London, Computer Science, Graduate Student | Colour Vision +25

Dimitris obtained MSc in Digital Colour Imaging from the University of the Arts London for his work on colour naming in different cultures. After holding a research post in applied colour science at the School of Psychology, University of Liverpool, he worked in the Wellcome Laboratory of Neurobiology, University College London. He continued his research in Media and Arts Technology at the School of Electronic Engineering and Computer Science, Queen Mary University of London and he is currently a PhD student at the Computer Science, University College London.
He is Chairman of the Study Group 'Language of Colour' of the International Colour Association (AIC).

Colour Naming Experiment

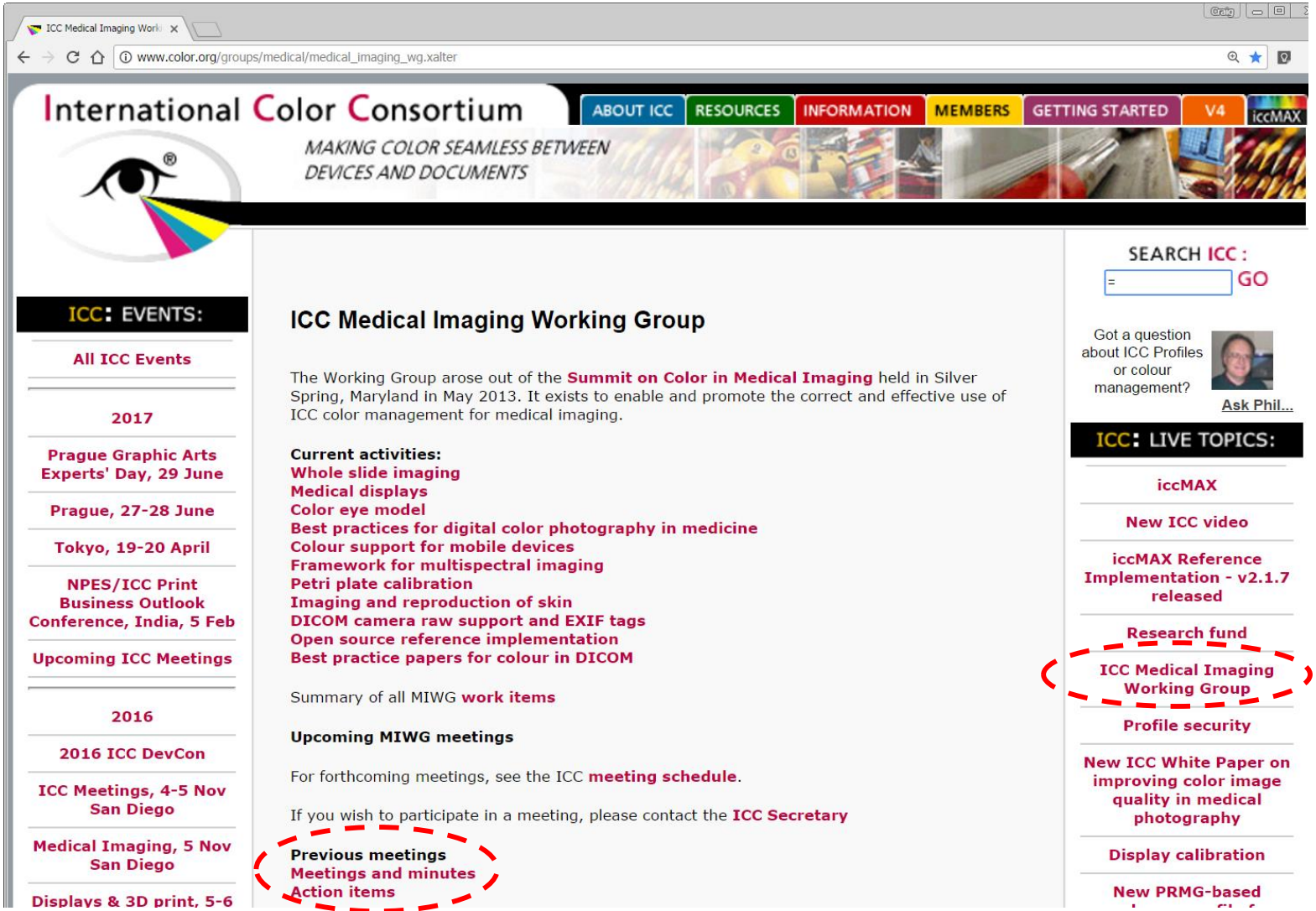
Terms and Conditions

Research:

This research aims to develop an online colour naming model to facilitate colour communication within & between cultures.

- Title: Colournamer - An Online Colour Naming Model
- Researcher: Dimitris Mylonas
- Current Host Academic Institution: Department of Computer Science, University College London (UCL)
- 1st Supervisor: Dr Lewis Griffin
- 2nd Supervisor: Prof Andrew Stockman
- 3rd Supervisor: Dr Lindsay MacDonald
- Host Academic Institution 2013-2014: Media & Arts Technology, School of Electronic Engineering and Computer Science, Queen Mary University of London (QMUL)
- Host Academic Institution 2011-2013: Wellcome Laboratory of Neurobiology, Institute of Neuroesthetics, University College London (UCL)
- PI: Professor Semir Zeki
- Host Academic Institution 2010-2011: School of Psychology, Laboratory of Visual Perseption, University of Liverpool
- PI: Professor Sophie Wuerger
- This project was initiated as part of: MSc Digital Colour Imaging
- Supervisor: Professor Lindsay MacDonald
- Course Director: Dr Phil Green
- Host Academic Institution (2007-2009): London College of Communication, University of Arts
- Munsell REnotation Data: Rochester Institute of Technology The Munsell Color Science

ICC MIWG web page at www.color.org



ICC MIWG Working group meeting

Thursday 28th June 2017, 10:45 - 12:45

- Introductions
- Publication of Medical Photography guidelines — Phil Green
- Electro-Optical Requirements for Medical Display — Wonseon Song, LG
- Possible liaison with IEC 62B/MT51 — Craig Revie
  - Meeting 17-18 July to discuss possible liaison
- Identification of possible future projects for MIWG — Craig Revie
- Action items review — Craig Revie

Proposal to Identify Requirements for Medical Display

Wonseon, Song

June. 28. 2017

Contents

LG Display

1. Previous & Current

- MIWG Presentation

1) Electro-Optical Requirements for Medical Display (20 April 2017, Tokyo)

- Introduced the Application of OLED in Medical Display

- General Physical Characteristics of Medical Display

2) Proposal to identify requirements for Medical Display (28 June 2017, Prague)

- Measurement Performance for Medical Display

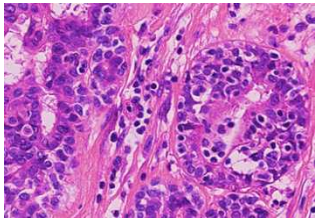
- To discuss why an integrated evaluation is required for medical display.

2. Structure of the Suggested Standard for Medical Display

1. Purpose & Scope
   - The Integrated evaluation for medical display helps users make better judgment and guide them to medical standards.
   - The scope of this proposal is to cover measurement methods, conditions, and metrics for medical display in terms of electro-optical performance.
2. Measurement Methods

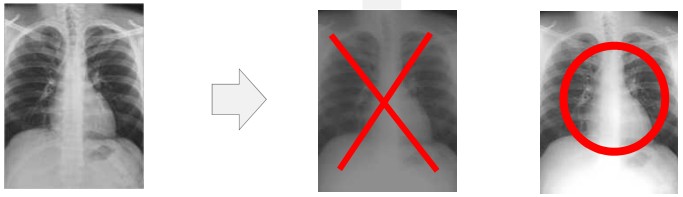
Contrast/Luminance

✓ Luminance Contrast Ratio



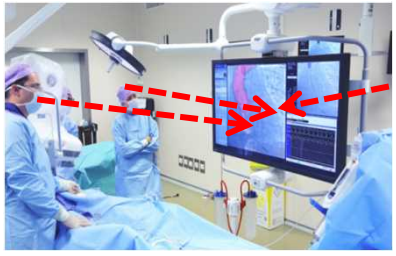
✓ Color Contrast Ratio

Gray Scale Characteristics



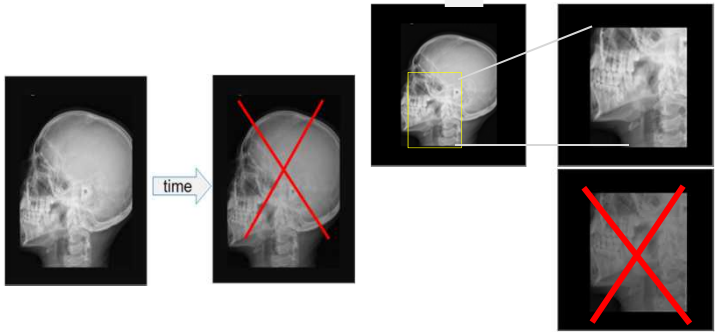
✓ Tone characteristics

Viewing Angles



✓ Directional Luminance Contrast Ratio
✓ Directional Color Contrast Ratio
✓ Directional Gamma Distortion Ratio

Luminance Maintenance



✓ Time
✓ APL (Average Pixel Lum)

Temporal Properties

✓ Response Time
✓ Flicker

3. Summary

- We introduced the electro-optical requirements for medical display last meeting.

- To measure the performance of medical display,
  1) Contrast : Luminance and Color Contrast
  2) Viewing Angles
     - Directional Luminance Contrast
     - Directional Color Contrast
     - Directional Gamma
  3) Gray Scale Characteristics
  4) Luminance Maintenance
  5) Temporal Properties : Response Time, Flicker

- The Integrated Measurement Method for medical display is needed because it can guide more accurate judgment and standards.

Appendix. Contrast

- **In Medical Display, Contrast is an important measurement factor since lesion observation should be easy**
- **Measure the center luminance and optionally the chromaticity coordinates and CCT of full-screen white.**

Display A

Display B

Fig. 1. Example for Luminance CR

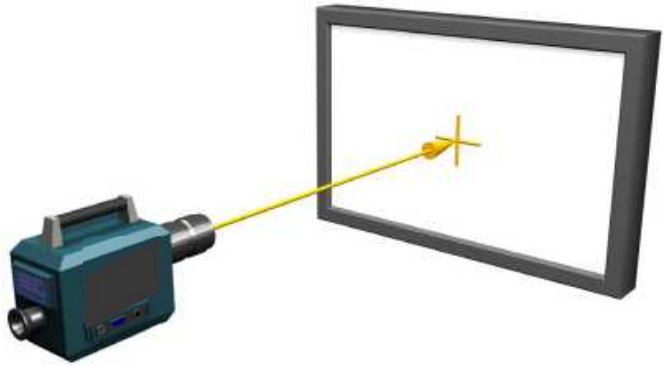


Fig. 2. Measurement Method (ref. IDMS 1.03b)

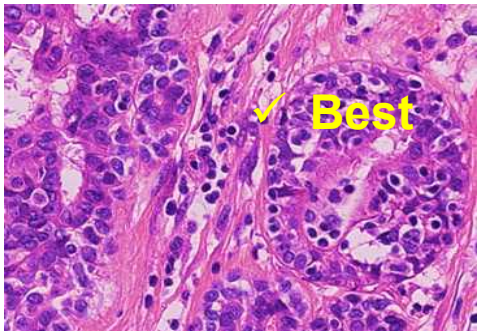
CR=Lw/Lk (for example)

Fig. 3. Test Pattern

*Ref. image : http://cancer.snuh.org/2011www/cdoctor/center/CIC/sub05/sub05/index.jsp?cat_id=CAT_20110610161196

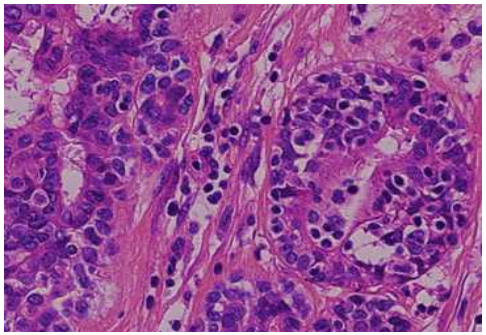
Appendix. Contrast

- **In Medical Display, Color Contrast is an important measurement factor since lesion observation should be easy**
- **Many color coordinates definitions have been standardized and can be used to define the color variation with respect to the measurement direction.**

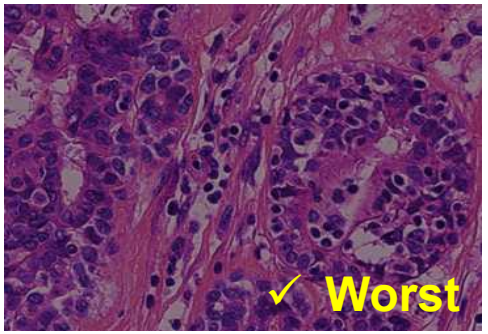


Display A

→ Easy to find objects



Display B



Display C

Fig. 1. Comparison of Color Contrast

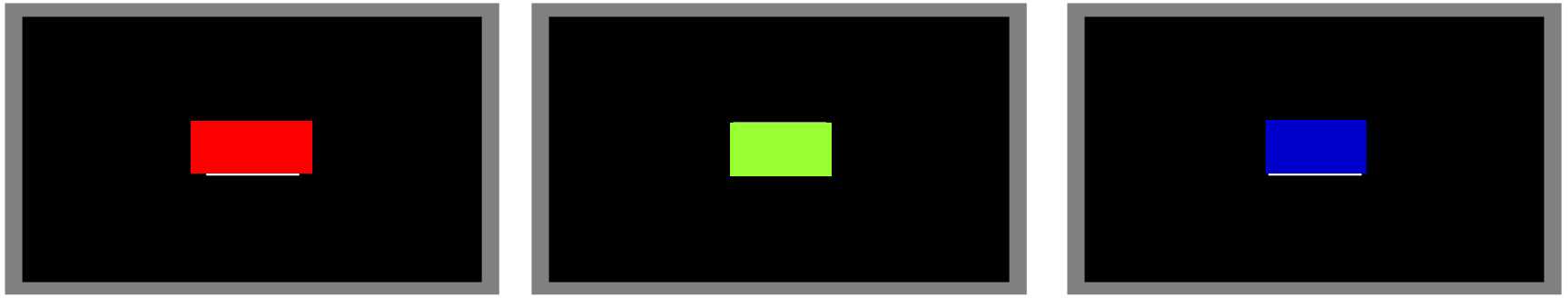
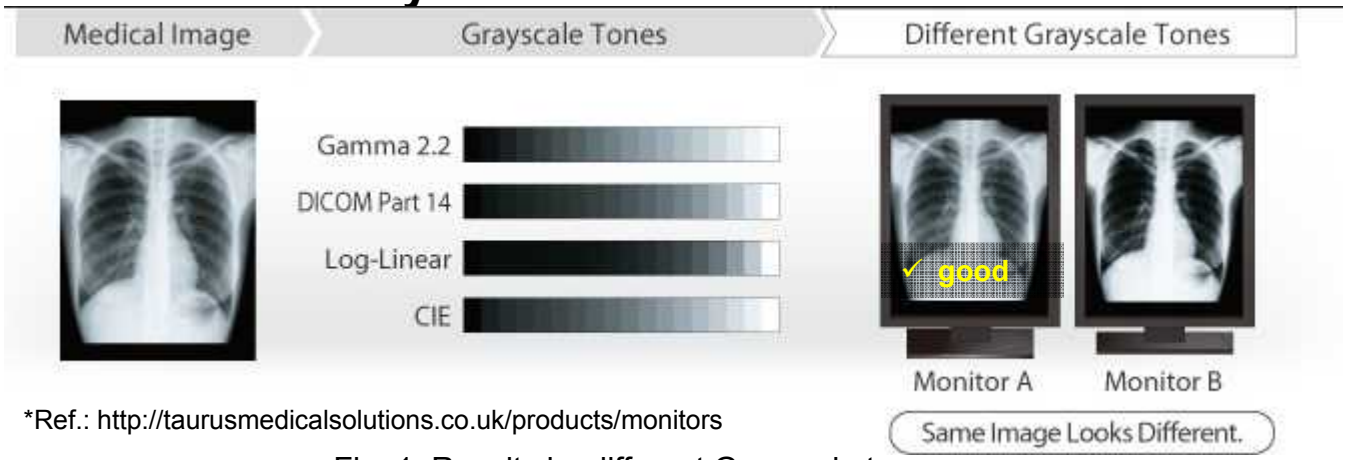


Fig. 2. Center measurement is made on 20% linear box (ref. IDMS 1.03b)

Appendix. Gray Scale Characteristics

- **Gray scale characteristics are important for original image reproduction in medical display.**
- **Evaluation method can be used to measure the target, which can be a medical standard, DICOM Part 14 Gray Scale.**



*Ref.: http://taurusmedicalsolutions.co.uk/products/monitors

Fig. 1. Results by different Grayscale tones

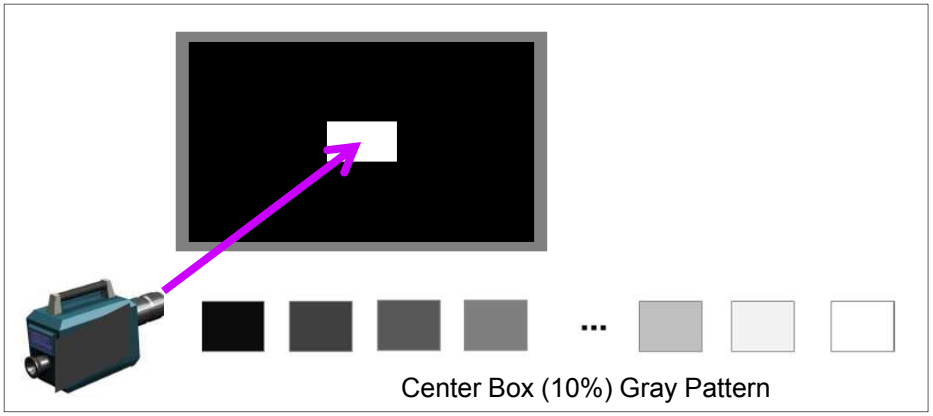


Fig. 2. Measurement Method

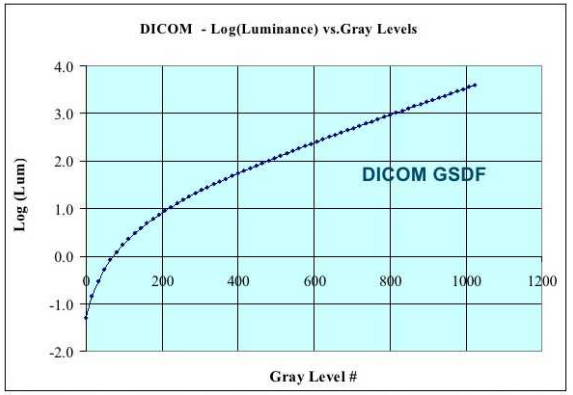
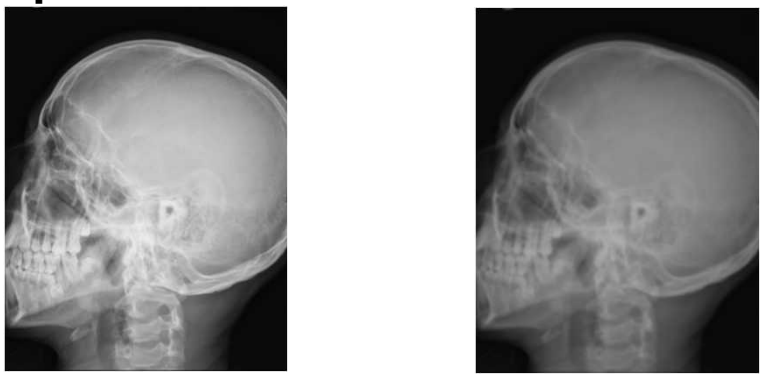


Fig. 3. DICOM function (Reference gamma)

Appendix. Viewing Angles

- **All users should be able to observe the same medical image regardless of their position.**
- **Measure the directional contrast of 1/5 size white box compared to four 1/10 size boxes placed in each corner.**



Display A　　Display B

Fig. 1. Example Image for Luminance CR

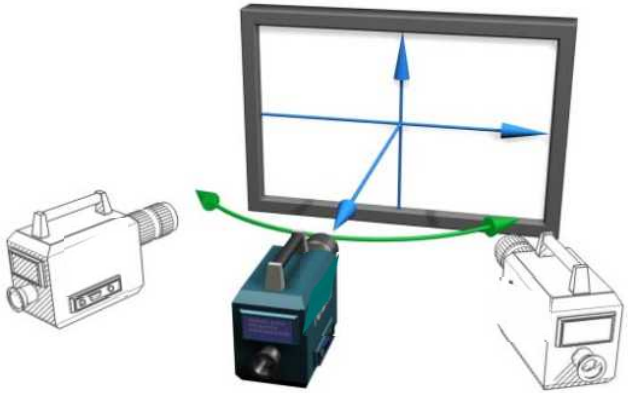
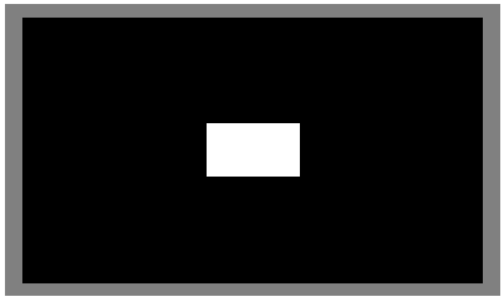


Fig. 2. Measurement Method



(a) White center measurement is made on 20% linear box

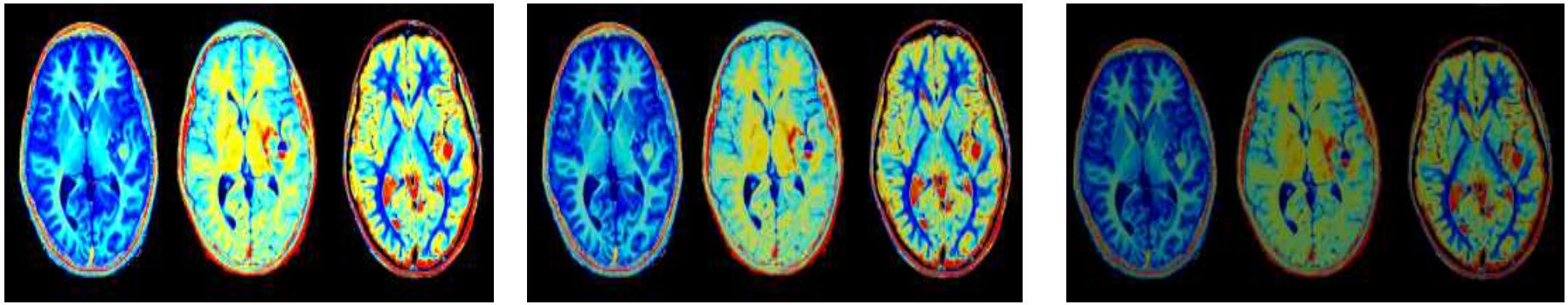
(b) Black center measurement is made with 10% linear boxes in corners

Fig. 3. Test Pattern

*Ref. image : http://cancer.snuh.org/2011www/cdoctor/center/CIC/sub05/sub05/index.j?cat_id=CAT_20110610161196

Appendix. Viewing Angles

- **Many color coordinates definitions have been standardized and can be used to define the color variation with respect to the measurement direction.**
- **All users should be able to observe the same medical image regardless of their position.**



Display A　　Display B　　Display C

Fig. 1. Comparison of Color Contrast

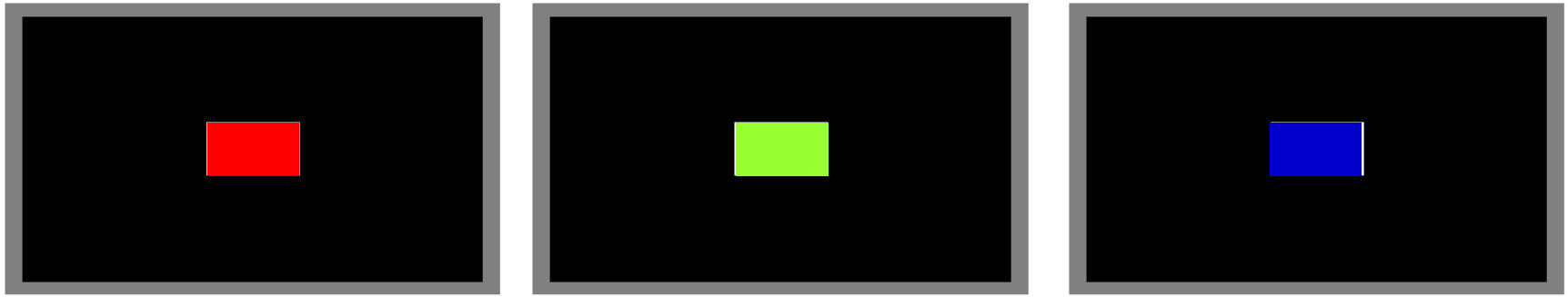


Fig. 2. Center measurement is made on 20% linear box

*Ref. image : jkna.org/journal/view.php?number=6235

Appendix. Viewing Angles

- **Measure the gray scale at center screen and at four angles about the screen normal- up, down, left, right- as need.**
- **The ideal display device has a characteristic that the gamma values are constant in any viewing directions.**
- **This method measures how the gamma values change from the usually viewing direction.**

Fig. 1. Example of DICOM Images

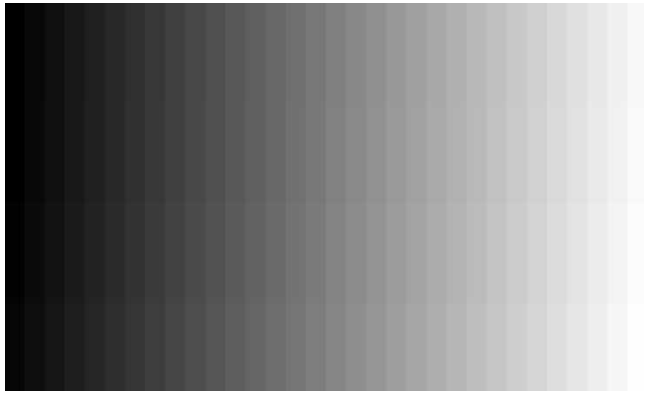


Fig. 2. Gray-Scale Gamma

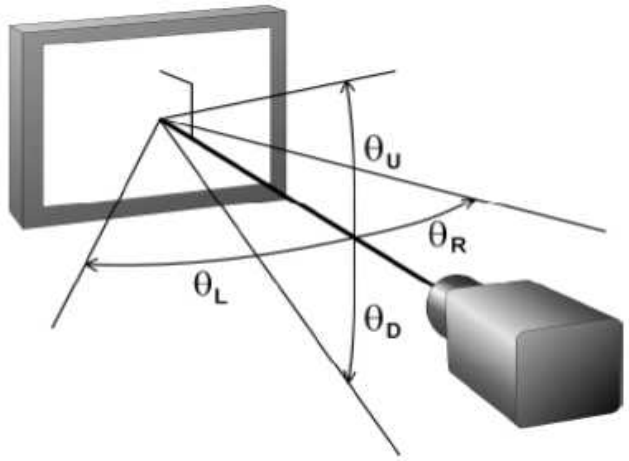


Fig. 3. Measurement Method

*Ref. image : http://weresite1.weebly.com/skeletal-diagrams.html

Appendix. Viewing Angles

- **Luminance color scales of the primary colors are measured at 9, 17, or more color levels for each primary color.**

Fig. 1. Example Image for Color-scale Gamma

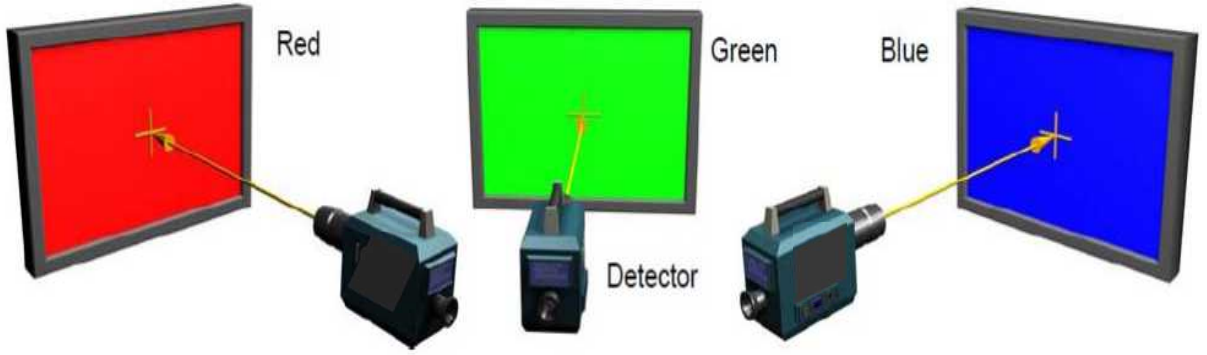


Fig. 2. Full screen patterns of primary colors are shown here, but other patterns may be more suitable depending upon the display technology.

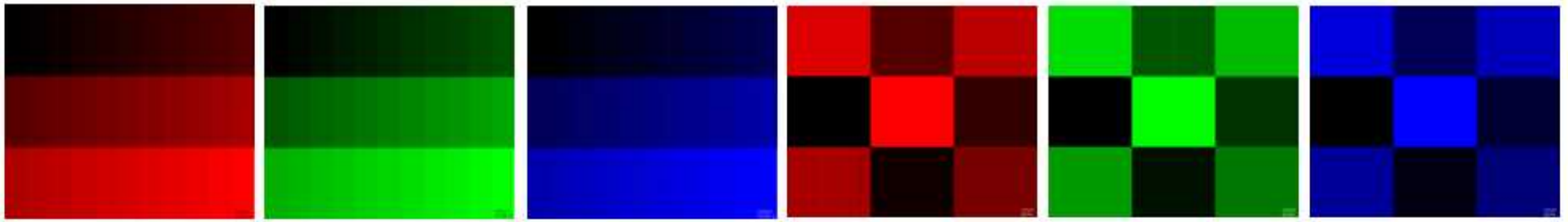


Fig. 3. Constant-picture-level patterns that cycle the various color levels at the center

Appendix. Luminance Maintenance

- **Measured that the luminance is maintained even when the APL (Average Pixel Luminance) is changed.**
- **By maintaining the luminance, we can identify the correct medical image.**

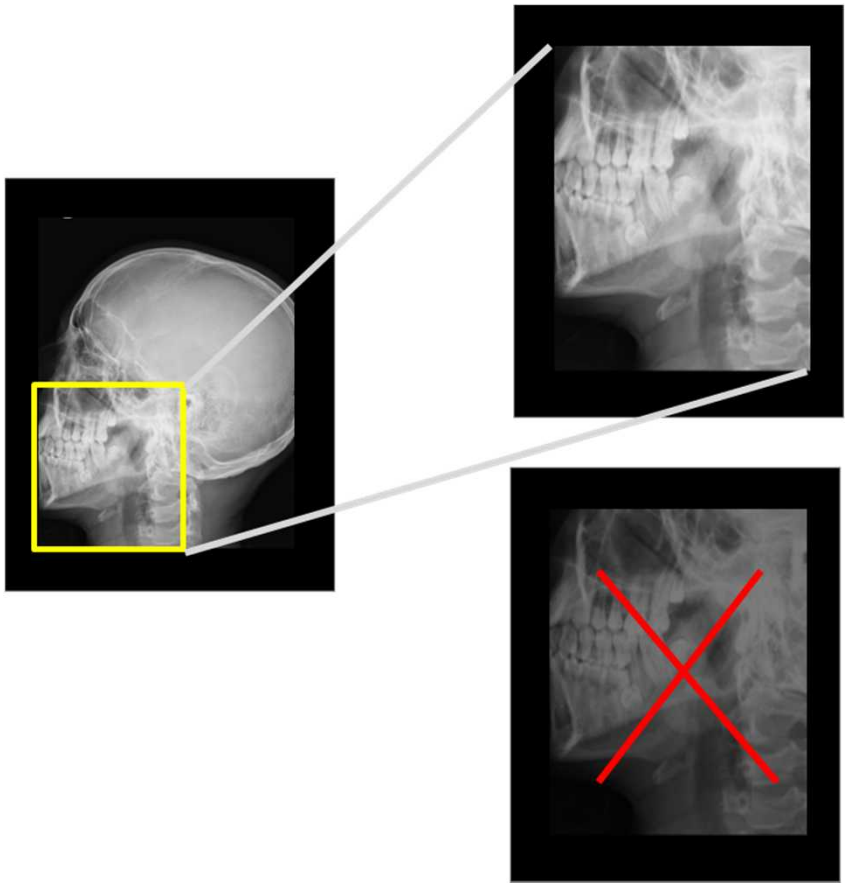


Fig. 1. Example Image for Luminance maintenance

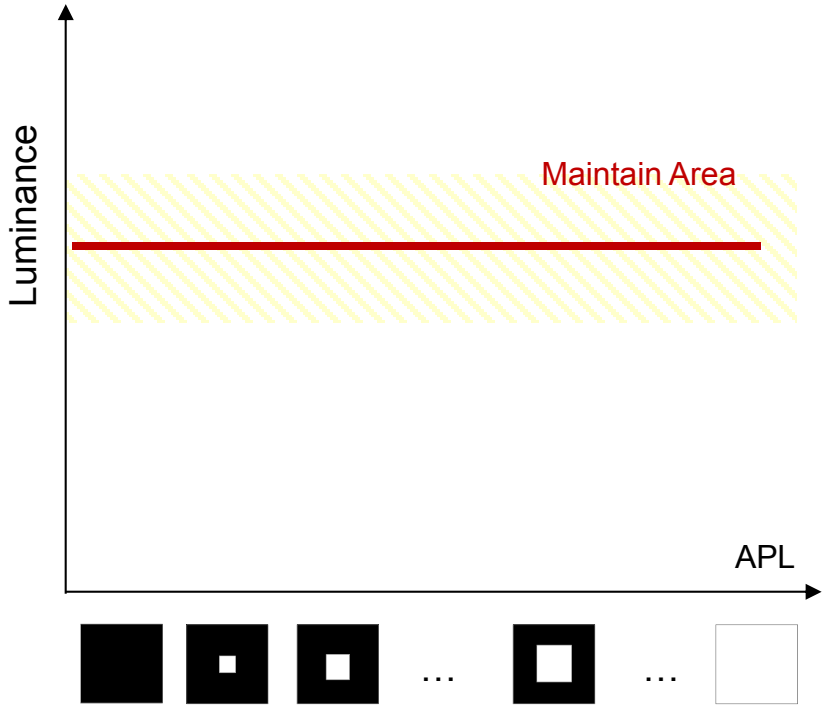


Fig. 2. Expected Results according to APL

Appendix. Luminance Maintenance

- **Measured that the luminance is maintained even when the time is changed.**
- **By maintaining the luminance, accurate medical images with no change over time can be confirmed.**

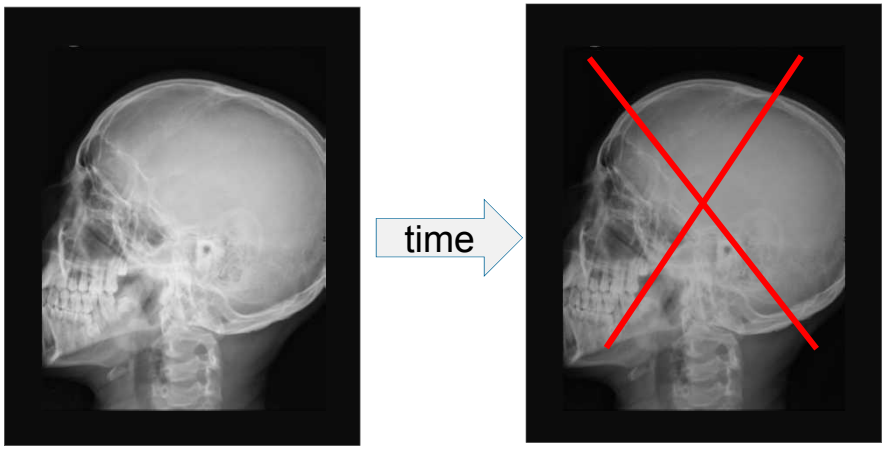


Fig. 1. Example Image for Luminance maintenance

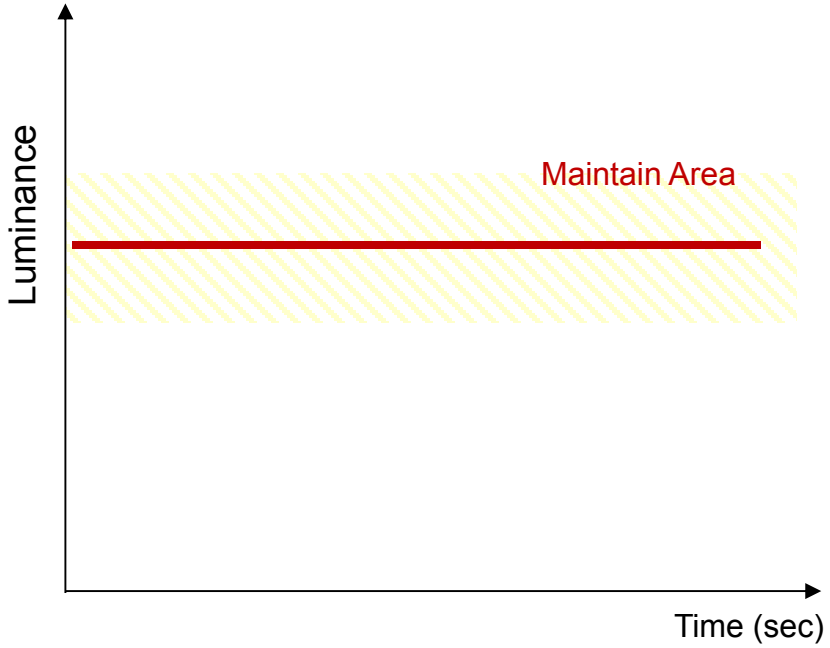


Fig. 2. Expected Results according to time

Appendix. Temporal Properties

□ Response Time

- A measure of how fast the display can transition from one gray shade to another.
- Measure the time for a display to change from black to white and to black again.
- In case of surgery, it is possible to express natural medical images seamlessly over time.

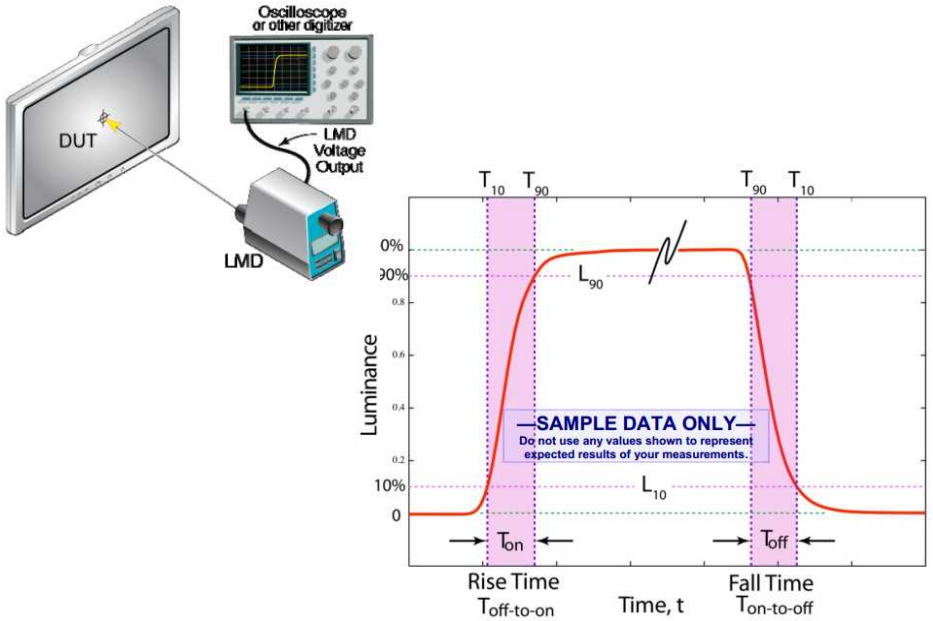
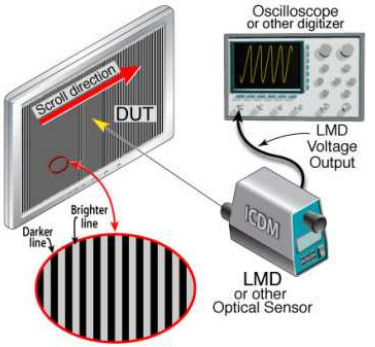


Fig. 1. Measurement Method and Analysis Method of Response Time

□ Flicker

- Measure intensity as a function of time, then use Fourier analysis to compute flicker intensity as a function of frequency, and finally calculate flicker levels and report the frequency and flicker level of the highest flicker peak.

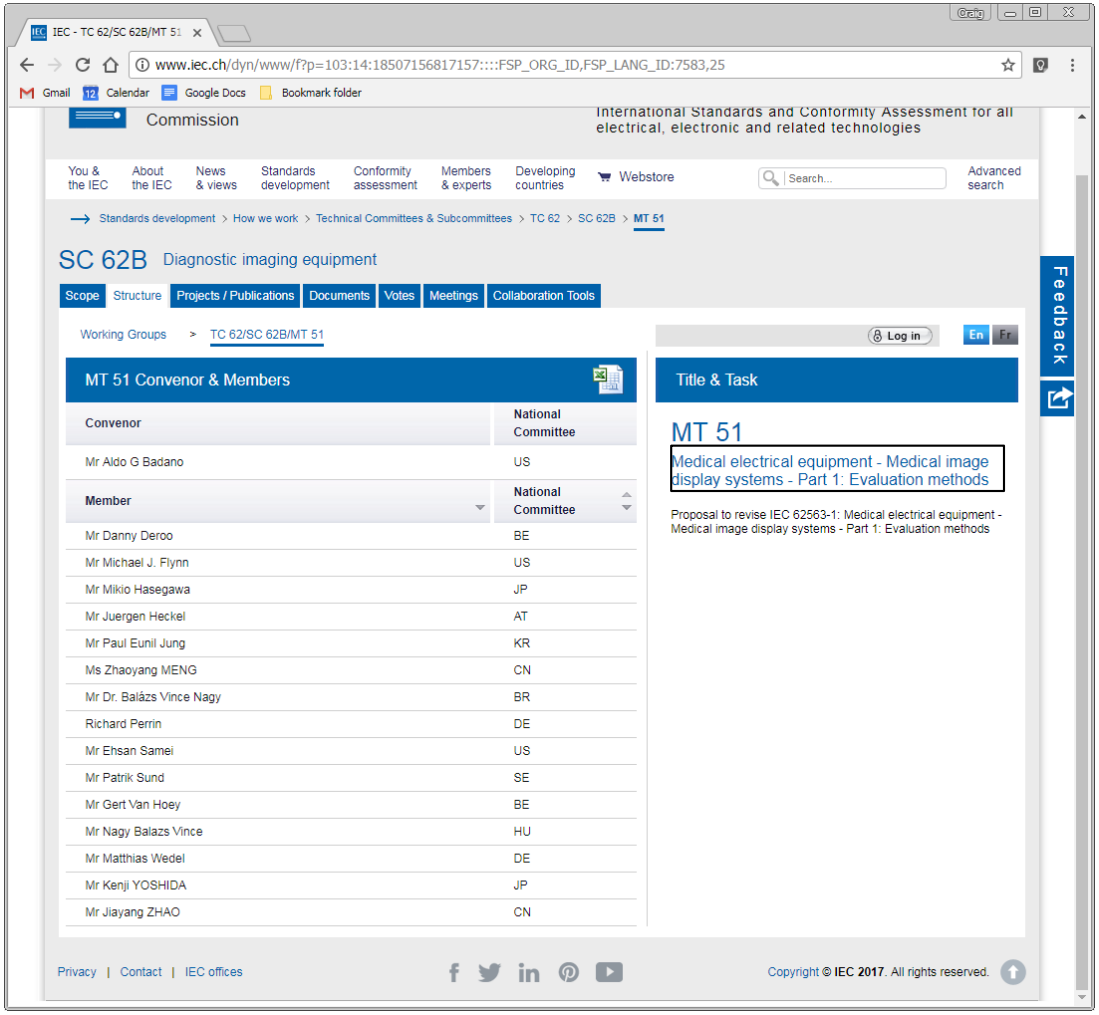


$$\text{flicker level(dB)} = 20\log_{10}\left\{2\times\left[\frac{\text{Weighted}(f_p)\times\text{FFT}(f_p)}{\text{Weighted}(f_0)\times\text{FFT}(f_0)}\right]\right\}$$

$$(\textit{main frequency} = f_p = \frac{f_R}{m})$$

Fig. 2. Schematic Diagram of the Measurement Setup with the vertical stripe pattern

Possible liaison with IEC 62B/MT51



MT 51 Convenor & Members

Convenor

Mr Aldo G Badano

Member

Mr Danny Deroo

Mr Michael J. Flynn

Mr Mikio Hasegawa

New work item proposal (IEC 62B/MT51)

WORKING DOCUMENT FOR NEW TASK IN AAPM TG196

version 0.0

Chair:

Wednesday, June 28, 2017

AAPM TG196 has a very close liaison with IEC 62B/MT51

Possible future projects for MIWG

- Guidelines for digital pathology viewing environment (check telemedicine guidelines)
- Recommendation for colour vision testing and development of tools to aid practitioners with colour deficiency
  - Daltonisation to improve diagnostic ability
- Algorithms for analysis of medical images (we need to determine what the ICC could do to help this)
- LG medical display/application assessment
- Others? Call to MIWG + Honorary Members [CR]

Action items review

MIWG-16-01	Petri plate	Send Petri plate imaging guidelines for review by MIWG	16-02-2016	Pescatore	Open
MIWG-15-30	Displays	Make assessment targets available to group	13-10-2015	Kimpe	Open
MIWG-16-12	Displays	Discuss ICS for GSDF and report back to MIWG	04-05-2016	Bai, Derhak, Nagashima-san, Kimpe	Open
MIWG-16-20	Petri plate calibration	Distribute draft primer on Petri plate system calibration by December 2016	05-11-2016	Pescatore	Open
MIWG-17-03	General	Develop activity proposals on Viewing Environment in Pathology Imaging; Automation of Detecting Anomalous Features; and Electro-Optical Requirements for Medical Displays	20-05-2017	Revie; Lianza; Wonseon	Open