

Mura Index with the Human factor correction under IEC

Steve Hasegawa ¹, Satoshi Tomioka ² and Kunihiko Nagamine ²

¹Sony Visual Products Inc., NBF Osaki Bldg., 2-10-1 Osaki Shinagawa-ku, Tokyo, 141-8610, Japan
Tel.:81-50-3140-6667, E-mail: Steve.Hasegawa@jp.sony.com

²Sony corporation, 1-7-1 Konan Minato-ku, Tokyo, 108-0075, Japan

Currently, the majority of FPD manufacture and FPD products manufacture are using the limit sample with visual inspection. We have proposed FPD's General Mura Index (Y_{Gen}) to the IEC (The International Electrotechnical Commission) TC110 HHG2 (Horizontal Harmonize Group2) in order to provide the scale of Mura on the screen of the FPD's correlating with human perception, because this organization has been starting to develop Mura measurement method in 2010 and the method we have developed suited to IEC requested measurement. In this paper we report a review of our evaluation method of Mura and a use case of Y_{Gen} using commercial TV sets. Y_{Gen} was defined by the equation

$$Y_{Gen} = 0.705Y_{Lum} + 0.634Y_{Colour} \quad (1)$$

where Y_{Lum} is Luminance Mura Index and Y_{Colour} is Colour Mura Index defined by the following equations

$$Y_{Lum} = 1.90Xa + 0.186Xb + 19.9Xc \quad (2) \quad Y_{Colour} = 3.97Xd + 0.0160Xe + 12.8Xf \quad (3)$$

where
 Xa: High and low luminance area (The ratio of dark and bright area to full screen area)
 Xb: Maximum luminance difference (from average)
 Xc: Luminance edge area (The ratio of area which has large gradient value of L^* to full screen area)
 Xd: Colour Mura area (The ratio of high chroma value area to full screen area)
 Xe: Maximum chroma
 Xf: Chroma edge area (The ratio of area which has large gradient value of C^* to full screen area).

Fig.1 shows the correlation between general Mura Index (Y_{Gen}) and subjective visual inspection based on the five-grade impairment scale: ITU-R BT.500-13. The results shows high correlation score ($R^2=0.90$). Therefore, we have enough confidence for this method proposed to the IEC. Our proposed method was underpinned by two factors; the one is the integration of real space information as viewing distance and real image size using MTF of eye. The second is correction of S-CIELAB's a^* value for reddish colour. These factors are very effective for converting a measured image to recognized image, and enable a more accurate evaluation of Mura.

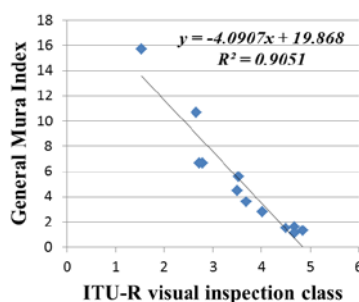


Fig.1 Correlation between general Mura Index and subjective visual evaluation value

Acknowledgment

The authors would like to express their gratitude to the members of Display Deice Standardization Committee in JEITA. The authors received generous support from the committee members to propose this measurement method to the IEC.

References

1. K.Nagamine, S.Tomioka, T.Tamura et al., Proc. 31st IDRC EuroDisplay 2011: session 10.3.
2. K.Nagamine, and S.Tomioka, Proc. 19th International Display Workshops, 2012: p1975- 1976.
3. Y.Miyake, T.Ishihara, K.Ohishi et al., Proc. IS&T and SID 9th Color Imaging Conference, 2001: p153-157.
4. S.Hasegawa, S.Tomioka, and K.Nagamine, Proc. 21th International Display Workshops, 2015: p949- 952.