

Comparison of Readability and Sharpness of Different Professional Displays

Steffen Reichel, Karlheinz Blankenbach, Andreas Reber

Fakultät für Technik, Hochschule Pforzheim

steffen.reichel@hs-pforzheim.de

Displays must provide low reflectance and great readability (i. e. sharpness) for ergonomics in applications with ambient light and long observation time. Therefore, displays have Anti-Reflection (AR) and/or Anti-Glare (AG) surfaces to reduce reflections which can reduce sharpness. We provide measurements for three professional displays to assess sharpness and reflections.

1 Introduction

Professional displays must have high quality, are expensive (~20.000 €), and often used for hours. In addition, they have application-adapted specifications, e. g. grey scale for medical x-ray image reproduction. Professional displays in control rooms have shifted from dark to bright light environments due to ergonomics, see Fig. 1.

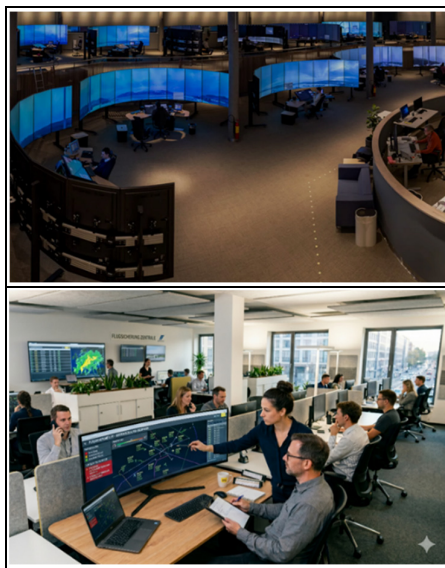


Fig. 1 Displays in control rooms: dark environment (top) [1] shifts to bright light environment (bottom) [2].

Such displays must provide low reflectance and great readability (i. e. sharpness). Glossy AR surfaces show sharp reflections which is typically judged as annoying. Matte AG surfaces have blurred reflections which reduce sharpness. We evaluate three displays “D1-AG”, “D2-AR” and “D3-AR” by measurements to assess different surfaces on reflectance and readability (sharpness).

2 Measurement Methods

Reflectance measurements are performed using a small white LED spot lamp (diameter ~6 mm, Fig. 2 left) for specular reflections and with a white flat LED

lamp (60 cm x 60 cm, Fig. 2 right) that includes also diffuse reflections (according [3], [4]). The measurement device is an imaging luminance measuring device (ILMD) and measurements are done in dark room by measuring luminance of the display reflection L_R and of the light source L_L via a mirror.

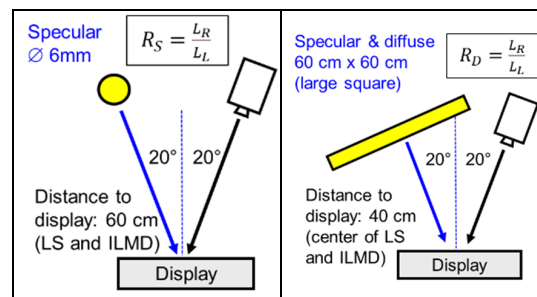


Fig. 2 Specular reflection measurements R_S (left) and with both, specular and diffuse R_D (right).

Sharpness is described by luminance profile measurements via contrast C of neighboring ON and OFF pixels, see Fig. 3.

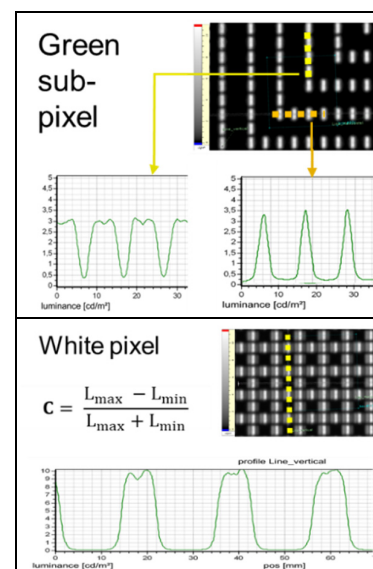


Fig. 3 Luminance profile measurement using 1 green subpixel on (2 subpixel red/blue off, top) and white pixel 1 x 1 (= RGB on, neighboring pixel off, bottom).

3 Measurement Results for Reflection

Firstly, reflection is measured with a white LED spotlight at specular angle (no diffuse light) for all three displays (see Chapter 2). For different evaluations the reflection coefficient R_S is given in Tab. 1.

Spotlight	D1-AG (little AR)	D2-AR	D3-AR
Reflection (average center) R_S	2.0%	8.2%	0.9%
Reflection (peak)	2.5%	11.4%	1.1%

Tab. 1 Specular reflection for all three displays and two measurement methods. Green color shows the best result – red the worst.

“D3-AR” display shows the lowest, the “D2-AR” display the highest specular reflection, which was noticed by observers. The manufacturer claimed “D2-AR” as an improvement!

Secondly, reflection coefficient R_D is measured with a white 60 cm x 60 cm LED at specular angle that includes specular and diffuse light – see Tab. 2 (using a large rectangular evaluation area).

Large lamp	D1-AG (little AR)	D2-AR	D3-AR
Reflection (average) R_D	2.5%	3.9%	6.0%

Tab. 2 Specular and diffuse reflection for all three displays. Green color shows the best result – red the worst.

Display “D3-AR” display shows the highest reflection (lowest for spot light) whereas “D1-AG” has the lowest large area reflection coefficient. Thus, “best” display at ambient light depends on light source: spotlights vs. windows.

4 Measurement Results on Sharpness

Image sharpness (MTF) is a measure for readability and here expressed in terms of contrast C . A value $C = 1.0$ describes a perfect sharp image whereas $C = 0.1$ describes a blurred image. Tab. 3 shows our measurement results for all three displays.

Contrast C			D1-AG (little AR)	D2-AR	D3-AR
Green sub-pixel	h	2 sub-pixel between lines	0.87	0.98	0.81
	v		0.76	0.93	0.84
White pixel 1x1	Mean h&v	line profile center	0.78	0.91	0.97

Tab. 3 Contrast results for green subpixel and white pixel (h = horizontal / v = vertical) and all three displays. Green color shows the best result – red the worst.

Display “D2-AR” has the highest sharpness, the other two also “good” for green subpixel in horizontal direction. In vertical direction and also for the green subpixel “D1-AG” has lowest value as expected due to the matte surface. Note: the green subpixel measurement corresponds to the highest spatial frequency.

For the white pixel both “AR” displays provide more than “good” contrast value. A lower contrast value has display “D1-AG”, as expected, due to the matte surface.

5 Summary and Outlook

Reflections and sharpness of content dominate readability and visual fatigue of display users. We evaluated three displays (see Fig. 4) for long term use regarding ambient light reflections and sharpness. Reflections of ambient spot / large light (at specular angle) simulate e. g. light sources and large area lamp simulates e. g. windows and walls.

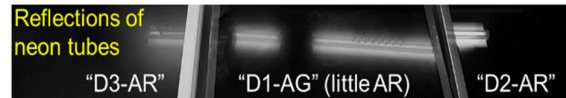


Fig. 4 Visual impression of the three different professional displays showing reflections of neon light tubes.

Display “D1-AG (with little AR)” has best (lowest) reflection, both “AR” displays have different performances (they are from two different manufacturers). The best reflection reduction method depends on the scenario of the workplace.

In terms of sharpness both AR displays have for green subpixel (= highest frequency) the best values (higher sharpness as “AG”) – as measured. The three displays have different sweet spots and thus, additional visual evaluation by users is strongly recommended.

References

- [1] INVIDIS, see <https://invidis.de/2024/07/flugsicherung-wo-digital-signage-extreme-critical-ist/> (18.05.2026)
- [2] Google Gemini AI generated image using „Generate image of air traffic control room with several desks with monitors showing typical air traffic control content. The office is well lit with windows and ceiling lights.“, (19.05.2026)
- [3] Standard ISO 15008: Road vehicles — Ergonomic aspects of transport information and control systems — Specifications and test procedures for in-vehicle visual presentation under Sunlight specular, daylight, (2017)
- [4] Standard SID ICDM IDMS v1.3 (2025): § 11.6, §11.7.4; see <https://www.sid.org/Standards/ICDM> (2026)