

The effect of fixed adaptation on the calibration of medical displays

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Purpose: Medical displays are normally calibrated according to the DICOM part 14 calibration method, the grayscale standard display function (GSDF). Based on the assumption of variable adaptation, calibration according to the GSDF results in a perceptually linearized display, for which the perceived contrast is equally distributed at all luminance levels. However, the assumption of variable adaptation is questionable and recently a method of calibration of medical displays that instead is based on the assumption of fixed adaptation was presented (Sund et al, Med Phys 2015). The new calibration method results in a fixed-adaptation compensated grayscale standard display function (GSDF_{FAC}), for which the contrast perceived at fixed adaptation is equally distributed. The purpose of the present work was to investigate the effect of the choice of the adaptation level on the GSDF_{FAC}.

Material and methods: Based on the formulation of the GSDF_{FAC}, theoretical calibration curves for fictitious medical displays with different luminance ranges were determined. The calibrations were performed at different assumed adaptation levels. For comparison, the original GSDF was determined for each type of display.

Results: For fixed adaptation at a luminance level close to the logarithmic average of the minimum and maximum luminance levels, a small but significant difference between the GSDF and the GSDF_{FAC} was obtained. The more the adaptation level deviated from this average, the larger the difference between the two calibrations. For example, for adaptation at a luminance level given by the linear average of the luminance levels corresponding to all digital driving levels (DDLs) – corresponding to fixed adaptation at a histogram-equalized image – the contrast enhancement at low luminance levels was substantially higher with the GSDF_{FAC} than with the GSDF.

Conclusions: The present study shows that the GSDF_{FAC} is strongly dependent on the adaptation level. The study indicates that although an improvement in terms of even distribution of contrast compared with the GSDF can be expected with the GSDF_{FAC}, knowledge of the correct adaptation level is crucial.