

Creating a modality-optimized medical display for DBT based on MEVIC simulations

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Rationale: Medical Virtual Imaging Chain (MEVIC [1]) is a simulation platform based on the image quality circle [2] which can be used for optimizing medical systems in terms of image quality and clinical performance. In this paper, we elaborate how MEVIC simulations have been used for selecting the display features of highest importance for a new imaging modality: digital breast tomosynthesis (DBT), and how these features have been improved in a new, dedicated DBT display.

Methods: MEVIC was used to simulate the complete imaging/processing/visualization/diagnosis chain. The simulation included a virtual digital breast tomosynthesis modality encompassing real reconstructed images with inserted lesions (micro-calcifications), a virtual display and virtual specialists [4, 5]. For the virtual specialists, the two observer models are used: the extension of JNDMetrix-IQ [4] and the channelized Hotelling observer (CHO) [5]. We simulated the influence of several display-specific display properties including brightness, contrast, spatial uniformity, sharpness and temporal response. Specifically, we used this simulation to quantify their impact on the diagnostic performance. The simulation is used to model and improve displays without building any prototypes. The features can be then ranked and selected in function of their importance or impact.

Results: DBT images can be visualized either statically or dynamically (stack-browsing). For the dynamic mode, the influence of the temporal response was ranked as the most important display property, while in the static mode, contrast was paramount, followed by sharpness and brightness. The new DBT display takes these findings into account: it contains a real-time medical grade algorithm that solves the problem of slow, non-uniform and asymmetrical response time [6]. The optical characteristics of the new DBT display have been improved such that subtle, moving images exhibit a crisp appearance [7]. To increase the brightness, a new backlight has been created. A dedicated DBT display was developed and the clinical study described in [3] has shown a difference of 10% in comparison to standard mammography (FDA approved) displays in terms of area under the curve during a ROC study.

Conclusions: The MEVIC platform has been used successfully for selecting the most important display features for DBT. This eventually resulted in a modality-optimized display, with proven clinical performance.

References

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