Purpose:

To evaluate the performance of the Solid State X-ray Image Intensifier (SSXII) using generalized linear-system metrics and to study the effect of different scatter fractions, object magnifications, and focal spots on its performance.

Methods:

The SSXII is a high-resolution and high-sensitivity region-of-interest x-ray imaging detector that provides real-time imaging with low instrumentation noise. To evaluate the total system performance for a clinical environment, we used generalized metrics that include the effects of scattered radiation, finite focal-spot size, and geometric unsharpness. For comparison, a commercial standard flat-panel detector (FPD) was used. The focal-spot MTF was obtained by taking the Fourier Transform of the point-spread function of x-ray pin-hole images. The detector MTF was measured using the standard edge method. The scatter MTF was simulated with a theoretical model. We have calculated the GMTF and GDQE for the SSXII and FPD. Three focal-spots (small, medium, and large), different object magnifications and scatter fractions were used for the GMTF and GDQE comparison.

Results:

The GMTF and the GDQE were shown to be degraded significantly from that of the detector alone at the higher spatial frequencies because of blur due to the finite size of the focal-spot, and at the lower frequencies because of scatter. Furthermore, the degradation increases even more as the focal-spot size, object magnification and scatter fraction increases. The GMTF and the GDQE for the FPD were similar to those of the SSXII at lower frequencies, but were limited to frequencies below its 2.5 cycles/mm Nyquist frequency due to the 194-micron pixel size compared to the 18.9 cycles/mm Nyquist frequency of the 26.4-micron pixel-size SSXII.

Conclusions:

This work demonstrates that the SSXII and the FPD have similar performance at the lower spatial frequencies, whereas, the SSXII demonstrates superior performance over the FPD at higher frequencies.

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