AbstractID: 12779 Title: Effect of focal spot sizes and magnification on the total system performance for a high resolution detector system using generalized linear system metrics (GMTF, GDQE).

Purpose: The generalized linear system metrics(GMTF, GNNPS, and GDQE) provide measures of the total system performance including the effects of the image detector, scatter from the object, focal-spot size, and magnification. In this study, these generalized metrics were used to evaluate the effect of focal-spot size and magnification on system performance when using a high-resolution image detector.
Method and Materials: The micro-angiographic fluoroscope (MAF)(35 micron pixel and 300 micron thick CsI), a newly developed high-resolution detector with very low instrumentation noise and large variable gain was used for the study. The detector MTF was measured using the slanted edge method and the focal spot MTF's were measured using a standard pin-hole assembly. The scatter fraction was measured for a head-equivalent phantom. For the comparison analysis, the GMTF, GNNPS and GDQE were determined for different magnifications corresponding to different planes within the phantom and for three different focal spots(0.3 mm, 0.5 mm and, 0.8 mm).
Results: Results showed the MAF performance is affected significantly by the choice of focal-spot size because of its very small pixel size. We found about 29, 66 and 87% decrements in MTFs at 50% of the Nyquist(i.e.,7.1 cycles/mm in object plane) for the small, medium and large focal spots, respectively, at the mid-object plane with a magnification factor of 1.1. The corresponding decrements in DQEs were 63, 92 and 98%.
Conclusion: This study demonstrates the significance of focal-spot size and magnification on the system performance when using a high-resolution detector and shows a need to choose the optimum focal spot based on the location of the object plane to be imaged. Similar studies based on the generalized linear system metrics can serve as an efficient tool to evaluate total system capabilities under different realistic conditions to enable optimal design for the specific imaging tasks.
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