AbstractID: 9197 Title: An analysis of signal-to-noise ratio differences between the new high-sensitivity, microangiographic fluoroscope (HSMAF) and a standard flat-panel detector (FPD)

Purpose:
To explain the difference in the measured signal-to-noise ratio (SNR) for a new high-resolution detector with that for a standard FPD

Methods and Materials:
We measured a ratio of 4.3 between the SNR^2 of an FPD (194 μm pixels) and HSMAF (35 μm pixels). This ratio cannot be explained by the pixel areas alone since the FPD pixel area is 30.7x larger than that of the HSMAF. To explain this disparity, we investigated the role of instrumentation-noise and the x-ray conversion phosphor (600 and 300 μm thick CsI:Tl for the FPD and HSMAF, respectively) considering differences in absorption efficiency, Swank factor and blur. Point spread functions (PSF's) were derived from measured presampled line spread functions (assuming isotropic blur), and the effect was analyzed by convolving with a simulated Poisson-distributed x-ray image. The calculated SNR^2 ratio was compared to the measured SNR^2 ratio for a practical range of exposures (1-100μR).

Results:
The difference between SNR^2 of the detectors was largely accounted for by considering detector characteristics in addition to pixel size. The increase in SNR^2 from optical blur was about 8 times greater for the HSMAF than for the FPD, since the signal was spread across more of the smaller pixels for the HSMAF. With consideration of the effect of absorption efficiency and Swank factor on SNR, the calculated SNR^2 ratio agreed well with that measured (4.6 versus 4.3, respectively).

Conclusions:
The measured SNR depends not only on pixel area, but also to a large extent on phospher characteristics. Despite having a much lower number of incident x-ray photons per pixel, the SNR^2 of the HSMAF was much closer to that of the FPD because of a greater spread of light quanta over a larger number of pixels.

(Support: NIH Grants R01-NS43924, R01-EB002873, Toshiba Medical Systems Corporation)