AbstractID: 6681 Title: The new Solid State X-ray Image Intensifier (SSXII): a demonstration of operation over a range of angiographic and fluoroscopic exposure levels

Purpose: To demonstrate the SSXII's capability to image at high angiographic to low fluoroscopic exposure levels using the built-in adjustable gain.

Method and Materials: The prototype SSXII is composed of a 1kx1k, 8µm pixel EMCCD camera system coupled to a 350 µm thick CsI(Tl) structured phosphor via a 1:1 fiber-optic taper (FOT) and is designed for easy interchange of these front-end components for task-based optimization. Variable signal amplification (in solid state) from 1x to 2000x effectively eliminates image degradation due to read-out noise over all input x-ray intensities. Images were acquired of a stent crimped on a 1 mm diameter balloon-tip catheter, for various x-ray spectra, using both radiographic and fluoroscopic exposures ranging from 6 mR to 145 µR and 80 to 2.7 µR, respectively. The EMCCD gain was adjusted in order to maintain a constant output signal of ~90% of maximum over these exposures (~3700 digital units).

Results: A series of images, obtained by halving the exposure while doubling the gain, offers a near textbook demonstration of the effect of incident SNR on the resulting image quality. Fine structures of a crimped stent are visible for the entire range of radiographic exposures tested, demonstrating the very high-resolution capabilities of the SSXII. In pulsed fluoroscopic mode, resolving the crimped stent structures becomes difficult below 40 µR. Using high gain, the object was visible down to 2.7 µR, which corresponds to ~0.1 incident x-ray photons per pixel, demonstrating both tremendous sensitivity and extremely low effective instrumentation noise.

Conclusion: Images obtained with the prototype SSXII, over a vast range of exposure levels, indicate this new dynamic x-ray imager has the potential to provide significant improvements over current state-of-the-art detectors (both FPDs and XIIs) for high-resolution angiographic and low-noise, real-time fluoroscopic imaging.

(Partial support from the UB Foundation and NIH grants R01-EB002873, R01-NS43924.)