AbstractID: 6571 Title: The Solid State X-ray Image Intensifier (SSXII): a next-generation high-resolution fluoroscopic detector system

Purpose:
Present the design for the new SSXII high-resolution fluoroscope capable of overcoming lag, noise, and resolution limitations of current flat-panel devices (FPDs). .

Method and Materials:
The SSXII consists of an array of modules each featuring an electron multiplying (EM) CCD which views a structured phosphor through a fiber-optic taper (FOT). The EMCCD operates like a standard frame-transfer CCD; however, an additional row of multiplication elements enables on-chip signal gains up to 2000X to overcome subsequent instrumentation-noise degradation. The SSXII therefore has quantum-limited performance at both fluoroscopic exposures with moderate gain, and radiographic exposures with low gain. The SSXII array design, through pixel binning and module selection, will enable rapid sequence and fluoroscopic imaging for either the full field-of-view (FOV) or high-resolution regions-of-interest (ROIs).

Results:
A SSXII module was assembled with direct fiber-optic coupling of the 350 micron thick CsI(Tl) phosphor and the EMCCD (Texas Instruments TC285SPD chip with 1004x1002 pixels). Operation at fluoroscopic and angiographic exposure levels was verified experimentally for gains of ~80X and 1X, respectively, demonstrating sequences of a moving stent with no lag and bar-pattern resolution up to 20 lp/mm with a 1:1 FOT. An array of four modules each with 6:1 FOTs will have an effective pixel size of 48 microns covering a FOV of 10x10 cm, sufficient for region-of-interest and neurovascular imaging. Larger arrays may be constructed to satisfy both cardiac imaging and general fluoroscopic applications. Module alignment, digital stitching, and distortion correction issues are being addressed.

Conclusion:
When assembled in an array of sufficient size, the new SSXII can be used in the same applications as current FPD’s with advantages of high frame rates with no lag, high resolution due to the smaller pixels possible, and low-effective-noise, quantum-limited fluoroscopic performance due to the on-chip gain.

(Support: UB Foundation, NIH grants R01-EB002873, R01-NS43924)