AbstractID: 9666 Title: Beyond the Limits of Active Matrix Flat-Panel Imagers: A Comparative Performance Assessment of X-ray Converter Enhancement versus Innovative Active Pixel Sensor Architectures

Purpose: Despite the many advantages of Active Matrix Flat-Panel Imagers (AMFPIs), these devices suffer from modest system gain relative to additive noise, as well as restrictions on maximum frame rates and charge trapping. A quantitative comparison of the performance of two of the strategies being developed to overcome these limitations is presented. One strategy employs significant enhancement of direct detection converter properties while the other employs complex, polycrystalline silicon (poly-Si) pixel circuits to form active pixel sensor (APS) architectures. **Method and Materials:** Theoretical upper limits for DQE and for other metrics that determine maximum frame rate and charge trapping effects were computed under fluoroscopic and radiographic conditions using a combination of cascaded systems analysis and circuit simulation. The cascaded systems calculations employed empirical measurements, published data and analytical calculations, while the simulations used representative a-Si:H and poly-Si transistor models. **Results:** The potential of high sensitivity photoconductors, such as HgI_2, to offer up to a factor of 10 increase in system gain results in significant improvement to DQE performance under conditions of low exposures and/or for very small pixel sizes. Poly-Si APS designs are capable of equivalent, or even greater DQE improvement through a combination of gain provided by in-pixel amplifiers, along with correlated double sampling of the pixel signal. Furthermore, APS circuit designs allow substantially higher frame rates as well as reduction in charge trapping effects such as ghosting. **Conclusion:** While both approaches offer substantial improvements in DQE, and thus imaging performance, under conditions of low exposure and/or for small pixel pitches, converter enhancement offers the potential advantage of compatibility with existing AMFPI array designs. Conversely, poly-Si APS architectures offer flexibility of design, function and operation, providing for the possibility of variable gain as well as addressing frame rate limitations and charge trapping issues.