AbstractID: 7364 Title: Enhancement of Signal Performance through Innovative Pixel Design for Indirect Detection Active Matrix Flat-Panel Arrays

Purpose: Active matrix flat-panel imager technology is being introduced to an ever-increasing variety of imaging applications. This has been greatly facilitated by improvements in optical signal collection achieved through innovations in array pixel design. Such improvements are particularly important for applications involving low exposures and high spatial frequencies, where DQE can be strongly attenuated due to relatively high additive electronic noise. In this presentation, recent innovations to pixel design are described and the effect on various signal properties, as determined through measurements and calculations related to novel prototypes, is reported.

Method and Materials: Optical and radiation signal measurements were performed on prototype imagers incorporating a series of six increasingly sophisticated array designs, with pixel pitches ranging from 75 to 127 µm. The most recent discrete photodiode array employs aggressive design rules that significantly increase optical fill factor while also incorporating a clamp circuit. Two other array designs incorporate a continuous photodiode structure with the goal of providing an optical fill factor of 100%.

Results: The new 127 µm pitch discrete photodiode design achieves a sensitivity consistent with its design goal of an ~85% optical fill factor while the 75 and 90 µm pitch continuous photodiode designs demonstrate sensitivity corresponding to an ~95% fill factor. These designs demonstrated no degradation in MTF due to charge sharing and the pixel clamp reduces memory effects at high signal levels. The effects of these enhanced sensitivities on DQE are illustrated and compared to the performance of arrays based on earlier generations of design.

Conclusion: Aggressive application of design rules can achieve very high levels of optical fill factor and sensitivity resulting in improvements in DQE. Continuous photodiode designs extend optical fill factors almost to the theoretical limit, even for very small pixels, and are well suited to designs containing more complex pixel circuits.