

AbstractID: 12905 Title: Characterization of Point Spread Functions of Indirect Digital Radiography Detectors

Purpose: To characterize the point spread function (PSF) of indirect digital radiography detectors with varying scintillator thickness.

Method and Materials: The Mantis Monte Carlo program was used to simulate x-ray detection in indirect digital detectors. The simulation was first validated by replicating previously published geometries and comparing the results. Upon validation, the CsI:Tl layer thickness was varied between 0.5 mm to 2.0 mm. Based on previous publications by other groups, the amorphous layer thickness was defined as 20% of the total CsI:Tl layer, and the needles of the structured layer were simulated with a 5° tilt, in varying directions. The incident x-rays were simulated both normal to the detector and at non-normal angles, representing incidence at various locations. Methods were developed to estimate the PSF for any needle tilt direction from the results of only four simulated tilt directions.

Results: Comparison of the validation results yielded acceptable similarity. The CsI:Tl quantum efficiency (QE) in the simulations agreed with theoretical predictions. It was found that the CsI:Tl needle tilt direction introduces important variations and asymmetries in the PSF, especially for non-normal x-ray incidence angles. The interpolation method developed successfully estimates the PSF for any tilt direction from the results of only four simulated tilt directions. As expected, the PSF widens with increasing CsI:Tl, with the presence of the amorphous CsI:Tl layer introducing significant spreading of the PSF.

Conclusion: The PSF at various detector locations will be used to develop and test a shift-variant deconvolution algorithm which will allow for further optimization of the image acquisition process, by allowing for the use of thicker scintillators, to take advantage of potentially increased DQE despite a wider PSF. In addition, the impact of relatively thinner amorphous CsI:Tl layers and smaller needle tilt will be investigated.

Conflict of Interest: Research sponsored by GE Global Research.