AbstractID: 13153 Title: Modeling the Performance Characteristics of a "Dual-side" Read Computed Radiography System for Mammography

Purpose: To determine objective image quality metrics such as modulation transfer function (MTF) and detective quantum efficiency (DQE) using an image formation model for optimizing the imaging performance of "dual-side" read computed radiography (CR) systems.

Method and Materials: A parallel-cascades based linear systems model that included "granular" noise associated with grain size variations, wherein several model parameters were estimated using Monte Carlo techniques, was used to determine the objective performance of a "dual-side" read CR system employing a granular storage phosphor. In our simulations, an imaging plate (IP) comprising 150μm thick BaFBr(0.85)I(0.15) layer, 10μm protective polyethylene terephthalate (PET) layer, and 320μm support layer (PET) was imaged with mammography x-ray spectrum matched to Fetterly's experimental work [Med Phys 30: 1843, 2003]. A 2mW, 680nm laser with Gaussian intensity ($1/e^2$ diameter: 50μm) was orthogonally incident on the IP with a dwell time of 5μs and the IP was "readout" with 50μm sampling. Signals from top and bottom readouts were combined to maximize the Noise Equivalent Quanta [Arakawa, Proc. SPIE 3659: 572 (1999)].

Results: Our results indicated a 10% MTF of ~7 cy/mm, a maximum DQE(0) of ~0.6 at 1mR, and a DQE(0) of ~0.55 at clinically relevant 9.4mR. DQE(0) decreased with increasing exposure due to granular noise, consistent with theory and experimental data. While the specifications of FCR5000MA (Fuji Medical Systems) were unknown to us, our results are in remarkable agreement with Fetterly.

Conclusion: A model such as that addressed here enables for improved understanding of the effect of storage phosphor physical properties and CR reader parameters on objective image quality metrics for "dual-side" read CR systems, and may allow designing new CR systems. Supported in part by NIH R01EB004105. Contents are solely the responsibility of the authors and do not represent the views of NIH or NIBIB.

Conflict of Interest: None