AbstractID: 13977 Title: The effect of oblique x-ray incidence on the design of x-ray detectors for digital tomosynthesis

Purpose: Digital breast tomosynthesis (DBT) is an emerging imaging modality in which tomographic sections of the breast are generated from x-ray projections taken over a limited range of angles. One drawback of DBT is resolution loss in the oblique projection images. The purpose of this work is to extend Swank's formulation of the transfer functions of x-ray fluorescent screens to oblique x-ray incidence. This analysis generates a platform for optimizing the design of detectors used in DBT. **Method and Materials:** We model a non-structured turbid granular phosphor such as Gd_2O_2S:Tb which is commonly used in breast imaging and which can reasonably approximate other detector materials. From first principles, the optical transfer function (OTF), noise power spectra (NPS), and detective quantum efficiency (DQE) are derived using the diffusion approximation to the Boltzmann transport equation. We use this analysis to investigate the effect of oblique x-ray incidence on DQE. The DQE is calculated using the Nishikawa formulation, where the DQE is written as the product of the x-ray quantum detection efficiency (QDE), the Swank information factor, and the Lubberts factor. **Results:** As expected, the modulation transfer function (MTF) is shown to decrease with increasing projection angle regardless of frequency. By contrast, the dependence of the DQE on projection angle is found to be frequency dependent. At low frequencies DQE increases with projection angle, but at high frequencies DQE decreases with projection angle. Furthermore, the x-ray QDE yielding maximal DQE at high frequencies is found to be projection angle dependent, shifting to lower QDE values (thinner phosphors) at higher projection angles. **Conclusion:** This work develops analytical models of OTF, NPS, and DQE for a turbid granular phosphor irradiated at oblique incidence. The models have applications in the design of optimal DBT detectors.