

AbstractID: 4838 Title: Characterization of X-Ray Scatter and Glandular Dose in Digital Tomosynthesis for Breast Imaging Using Monte Carlo Simulations

Purpose: To study the characteristics of x-ray scatter and glandular dose in digital tomosynthesis for breast imaging.

Method and Materials: Monte Carlo simulations of x-ray transport in breast tomosynthesis were performed using the Geant4 package [Agostinelli et al, Nucl Instrum Meth A 506: 250-303, 2003]. Scatter-to-primary ratio (SPR) maps, maximum SPR, scatter point spread functions (PSF) and glandular dose to the breast were computed at several projection angles while varying compressed breast size, thickness, glandularity and x-ray spectrum. For validation, the SPR and scatter PSF for the planar mammography view (0 degrees) for various setups were compared with published values [Boone et al, Med Phys 27(10): 2408-16, 2000 and 27(8): 1818-1831, 2000].

Results: SPR maps and PSF show variations with increasing projection angle, with apparent asymmetry appearing at projection angles beyond 10 degrees. When the projection angle is increased from 0 to 21 –degrees, while the breast thickness encountered by the central ray increases by 7.1%, the maximum SPR for a semi-circular 10 cm radius breast increases by 10.1% and 18.8 % for breast thicknesses of 2 cm and 8 cm, respectively. Dose deposition shows a decrease, varying by 3.8-7.6% for the same thicknesses and projection angles.

Conclusion: Since the use of an anti-scatter grid is not easy to implement in tomosynthesis imaging, the development of software-based post-acquisition scatter reduction is important, which requires a good understanding of the scatter effects. This work characterizes the scatter signal present in tomosynthesis images and shows that x-ray scatter affects each projection angle differently and therefore each projection must be corrected separately, using appropriate prior knowledge. Decreased glandular dose with increasing projection angle must be taken into account when planning a tomosynthesis clinical protocol. Research supported in part by: NIH-NIBIB Grant RO1-EB002123 and the Georgia Cancer Coalition.