AbstractID: 11714 Title: Quantitative Breast tomosynthesis: Development of an Estimation Performance Metric and Optimization Framework

**Purpose:** To develop performance metrics for estimation tasks and employ the framework to optimize breast tomosynthesis systems for quantitative imaging purposes.

**Method and Materials:** A maximum likelihood (ML) estimator was derived in terms of the noise power spectrum (NPS), which yielded a figure of merit for quantitative imaging performance denoted the ML mean error ($\sigma_{ML}$). The $\sigma_{ML}$ was computed for the estimation of lesion diameter, volume, and attenuation. Volumetric tomosynthesis reconstructions of a breast phantom, which incorporated electronic, quantum, and anatomical noise ($1/f^b$) with embedded spherical lesions were simulated at tomosynthesis acquisition angles (tomo-angle) varying from $4^o$ to $200^o$ and at constant total acquisition dose (1.5 mGy). The estimation task results were further compared with a more conventional lesion detection task.

**Results:** Results reveals tradeoffs between electronic, quantum, and anatomical noise. For a 1.25 mm radius spherical lesion, the mean error ($\sigma_{ML}$) as a function of tomo-angle varied from 0.06 to 0.5 mm for the 2D disk radius estimation task and from 0.2 to 0.9 mm for the 3D sphere radius estimation task. Furthermore, for a given $\sigma_{ML}$, the 3D size estimation task required a larger tomo-angle than for the 2D size estimation task, highlighting the need for larger acquisition angles in 3D imaging tasks (i.e., volume estimation). Overall, size estimation performance was maximized at a tomo-angle of ~$90^o$. Results also suggested that size estimation tasks generally required a larger tomo-angle than conventional detection task.

**Conclusions:** Analysis of quantitative imaging performance using Fourier metrics highlights the difference between 2D and 3D estimation tasks in breast tomosynthesis and provides a meaningful framework for optimizing the performance of volumetric imaging systems for quantitative imaging tasks.