AbstractID: 7069 Title: A three-dimensional linear model for investigating the image quality of breast tomosynthesis

Purpose:
To build a three dimensional (3D) linear model for breast tomosynthesis in order to investigate the effects of different imaging system design parameters on the reconstructed tomosynthesis image quality.

Method and Materials:
The 3D model incorporates the detector performance, imaging geometry and reconstruction filters for the filtered backprojection (FBP) method. To validate the model, experiments were performed on a prototype breast tomosynthesis system equipped with an amorphous selenium (a-Se) digital mammography detector. The detector can be operated in full resolution with 85 micron pixel size or binning mode to reduce acquisition time. Twenty–five projection images were acquired with an angular range of $\pm 20^{o}$. The images were reconstructed using a slice thickness of 1 mm with 0.085 mm x 0.085 mm in-plane pixel dimension. The 3D noise power spectrum (NPS) was computed using reconstructed scatter free uniform images and an edge phantom was imaged to measure the in-plane modulation transfer function (MTF). An ACR mammography accreditation phantom was imaged to demonstrate the effects of detector operation modes and image acquisition geometry, i.e., angular range, on reconstructed image quality.

Results:
The measured in-plane MTF and 3D NPS are both in good agreement with the model. Our results showed that both NPS and in-plane MTF depend on the reconstruction filters and angular range. Increasing angular range helps improve the MTF at low frequencies, resulting in better detection of the large-area, low-contrast mass lesions in the phantom. Pixel binning cuts the acquisition time in half at the cost of decreased high frequency response. This results in reduced visibility of small calcification specks.

Conclusion:
A 3D linear system model for breast tomosynthesis was developed and validated with experimental measurements. The model can be used to predict the effects of system design parameters on reconstructed image quality.

*Research sponsored by Siemens AG.