AbstractID: 8745 Title: Noise power properties of a cone-beam CT system for breast cancer detection

Purpose: To investigate the noise power properties of a cone-beam breast CT (bCT) system.

Method and Materials:
Polyethylene cylinders were scanned under different acquisition conditions. Normalized noise power spectra (NNPS) were calculated from difference images by subtracting two identical scans. Multi-dimensional NNPS were used to evaluate the noise properties of the bCT under different acquisition and reconstruction parameters including kVp, mA, number of projections, cone angle, object size, interpolation method, reconstruction filter, field of view (FOV), matrix size, and slice thickness.

Results:
Findings from the analysis:
The bCT NNPS is rotational symmetric within the coronal plane and its shape is determined by the interpolation method and filter. For a cone angle range from 0° to 14°, the shape of the NPS curve changes slightly. The image variance increases slightly with increasing cone angle.
Noise aliasing can be avoided if the sampling frequency of CT image is beyond a specific threshold. The coronal plane noise power decreases with increasing slice thickness.
If the radiation dose (mA) is below a specific threshold, the electronic noise from the detector plays a dominate role and the system is no longer quantum limited. The threshold value decreases with increasing object size. When the radiation dose is beyond this threshold, the system is quantum limited. The image variance has a power law relationship of approximately -1.1 with the total dose. If the dose is increased by linearly increasing the number of projections but not the tube current, the noise power has an inverse linear relationship with the dose. When the dose level is kept constant, the image noise also depends on the x-ray spectrum and the object size.

Conclusion:
A thorough investigation of the noise power was performed. Quantitative results provide guidance for the bCT system operation, optimization and data reconstruction.

Conflict of Interest: N/A