Purpose:

To characterize the spatial correlation of quantum noise of a cone beam CT (CBCT) system for breast imaging under scatter and non-scatter corrected conditions as a function of object radius.

Methods:

Experiments were conducted using a conical phantom under scatter and non-scatter corrected conditions. The cone phantom filled with 700ml of water was positioned near the isocenter of the quasi-monochromatic CBCT imaging system. 360 projections were acquired and beam-stop measured scatter correction was performed. Both scatter and non-scatter corrected projections were reconstructed with an iterative ordered subsets convex (OSC) algorithm.

NPS measurements were made at several cone radii (6-12cm) using 4 overlapping 50x50 pixel ROI's with a 50% overlap between adjacent ROIs. An ensemble average of NPS measurements was taken over 5 slices at each radius.

Results:

For both scatter and non-scatter corrected data overall noise is higher with increasing object radius. Each 1-D NPS area under the curve was found to be within the standard deviation of the respective ROI variance. The variance of scatter corrected images is higher at each radius. The 1-D NPS indicates a decrease in peak value for both scatter and non-scatter corrected images as radius increases. Scatter corrected NPS shows a slight shift in the peak towards higher spatial frequencies, and a larger spread of noise over all spatial frequencies as radius increases.

Conclusions:

This work demonstrates that scatter correction increases noise at each spatial frequency at various object radii. However as radius increases, lower frequency noise decreases and concomitantly higher frequency noise increases. As a result of this equalization of noise across spatial frequencies, the noise texture appears more uniform at larger radii under scatter corrected conditions. These results and methodology can be used to determine optimal detection of low contrast signals in phantoms of different radii and with clinical breast data.