Purpose: Reconstructed tomosynthesis data is known to exhibit non-stationarity, (i.e., the pixel mean and standard deviation depends on location), which is expected to impact our ability to accurately assess imaging performance. The purpose of this study was to characterize the magnitude and impact of non-stationarity on various imaging tasks.

Method and Materials: A phantom consisting of an array of 15 aluminum oxide beads was constructed to measure the 3D modulation transfer function (MTF) across a range of locations in the breast. Similarly, a uniform breast phantom was used to measure the noise-power spectrum (NPS) across the same range of locations. Simulated tomosynthesis and real tomosynthesis images were acquired to characterize independently the impact of non-stationarity on quantum and anatomical noise measurements and the impact of scatter on non-stationarity. The MTF and NPS were compared across locations in terms of measures of sharpness and noise and furthermore combined with a task function to measure task-based performance indices including the detection, localization, and size estimation of a 4 mm mass. The variability and range of the indices were characterized across the different regions of the breast.

Results: The 3D MTF and NPS varied in shape and orientation across location. The measure of sharpness and noise was found to vary by 3% and 2%, respectively, from the center to the edge (located 4 cm from center). The task-based performance also depended on location, with 4% variation for a detection task and 3% variation for a size estimation task. Overall, variation was mostly along the lateral direction of the breast.

Conclusions: This work provides guidelines for the application of Fourier-based metrics in breast tomosyntehsis. While the shape and orientation of the 3D MTF and NPS are dependent on location, variability of the task-based performance indices was found to be minimal.