Purpose: Digital breast tomosynthesis (DBT) is a 3D imaging modality in which tomographic sections of the breast are generated from a limited range of x-ray projections. Conventional practice is to perform reconstructions possessing pitches within the angular range of the DBT scan, since the Central Slice theorem states that Fourier space is sampled within double-napped cones (DNCs) whose opening angle matches that angular range. This work investigates the possibility for both resolution and super-resolution (i.e., sub-pixel resolution) outside the angular range of the DNCs.

Methods: Because the image of an object is translated in sub-pixel detector element increments with each projection, our prior work has demonstrated that DBT is capable of super-resolution. The previous study assumed a reconstruction plane parallel to the breast support; our current work analyzes super-resolution in oblique reconstruction planes. Experimentally, a bar pattern phantom was imaged with a commercial DBT system using a goniometry stand, and reconstruction was performed in the oblique plane of the bar patterns. Clinical images of microcalcifications were similarly reconstructed in various oblique planes. Subsequently, an analytical framework for investigating super-resolution in oblique reconstructions was developed by calculating the filtered backprojection (FBP) reconstruction of a high frequency sine input.

Results: Bar pattern reconstructions showed visibility of frequencies both less than and greater than the alias frequency of the detector at pitches well outside the angular range of the DBT scan. Visibility of microcalcifications did not differ considerably using similar oblique reconstruction planes. For analytical proof of super-resolution in oblique reconstruction planes, we demonstrated that FBP could properly resolve a high frequency sine input whose Fourier transform is non-vanishing outside the DNCs of frequency space.

Conclusions: This work provides a platform for investigating super-resolution in oblique reconstruction planes whose pitches are outside the angular range of the DBT scan.