AbstractID: 7774 Title: Comparison of Backprojection and a penalized Maximum Likelihood Algorithm for Detection of Microcalcifications in Breast tomosynthesis.

Tomosynthesis is proving to be a valuable tool for generating three dimensional images of the breast with only a limited number of projection angles. The image quality of the resulting tomosynthesis slices can potentially be improved by using more optimal acquisition geometries and/or improved reconstruction techniques. In this paper we compare the performance of a standard back-projection (BP) algorithm with an algorithm that maximizes a penalized likelihood (PML) objective function using an optimization transfer principle leading to a simultaneous update algorithm. To compare reconstruction algorithms, a computer simulation is used to model the breast tomosynthesis geometry and human observer performance in detecting micro-calcification clusters is evaluated. The simulation modeled the compressed breast using a structured breast phantom, with randomly inserted clusters of spherical “micro-calcifications”. Clinically realistic x-ray spectra were generated and x-ray transport through the breast phantom was modeled using ray-tracing combined with the focal spot and the detector blur of a 200 micron CsI scintillator. The iterative reconstruction used a simultaneous update algorithm where the non-quadratic penalized likelihood objective function (which is difficult to maximize) is replaced by a surrogate paraboloidal function. A Huber prior was used as the potential function with the ability to control edge preserving factors and smoothness. A standard back-projection technique that is computationally faster (in comparison to the iterative method) was used as a comparison. To evaluate microcalcification detection accuracy of the methods, an N-alternative forced choice (NAFC) based observer study was performed. The results of NAFC studies performed with 3 observers and 63 pairs of images for each method shows that the PML based technique gave a percent correct improvement by 0.32 over the FB technique. The observers read the PML based images about 4 times faster than the FB technique indicating higher visibility of calcifications in the former.