Abstract ID: 15910 Title: Radiation Dose Reduction in Monochromatic Phase Contrast X-Ray Mammography Using Equally Sloped Tomography

Purpose:In mammography, while maintaining the image quality, it is necessary to keep the delivered dose as low as possible since breast is a highly radiosensitive organ. Monochromatic phase contrast X-ray mammography has shown its potential at higher sensitivity and lower impact in terms of dose delivery compared to absorption based diagnostic X-ray mammography. An exact Fourier-based iterative technique termed Equally Sloped Tomography(EST) has been newly developed and implemented on it. Using this technique, we conducted a series of comparative experiments to explore the further more radiation dose reduction in phase contrast mammography through reduction of projection numbers.

Methods:Experiment took place at the biomedical beamline at ESRF(ID17). Full Human breasts samples were fixed in 4% formalin solution. Planar imaging and Computed Tomography(CT) modalities were combined to PCI techniques at 60KeV and using a 2kx2k taper optics CCD detector(45 micron pixel). The number of projections scanned was 2000 and digitally removed to 512 for reconstructions. Comparison reconstructions were produced by Filtered-Back Projection(FBP) with a standard uncropped-ramp filter. To optimize the result, Non-local-means regularization was applied for post-processing in both cases.

Results:Compared to the FBP reconstruction using 2000 projections, EST using 512 projections has comparable SNRs and CNRs, no obvious contrast degradation is observed between tumor and normal glandular tissue. In addition, the collagen exhibit similar visibility.

Conclusions:Our results indicate that in the phase contrast mammography, EST technique can reduce the dose up to 50%~75% by reducing number of projections, while images have comparable quality as the full dose FBP reconstruction. Furthermore, it makes the acquisition time 2~4 times faster, which is important in in-vivo imaging. The main reason for this is that EST is an exact Fourier-based iterative algorithm that can incorporate different physical and mathematical constraints. It is always guided towards a lowest-possible noisy state while keeping strictly consistent with measurements.

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