AbstractID: 14221 Title: Dramatic noise reduction and potential radiation dose reduction in breast cone-beam CT imaging using Prior Image Constrained Compressed Sensing (PICCS)

Purpose:
Radiation dose becomes more of an issue for contrast enhanced breast Cone Beam CT than regular breast CBCT, due to the multiple scans required in order to trace the contrast uptake curve. In this paper, we report a novel scheme to reduce noise variance for each individual breast cone beam CT scan by a factor of about 20. As a result, radiation dose reduction can be achieved by lowering the x-ray tube current.

Method and Materials:
The enabling technology is Prior Image Constrained Compressed Sensing (PICCS) method. A prior image with significantly low noise is generated by: (1) first low pass filtering the projection data along the z-direction which is perpendicular to the patient table top, and: (2) then reconstructing the prior image volume with the standard FDK algorithm. Then the entire cone-beam CT image volume is reconstructed by applying the above described PICCS algorithm to the natively measured cone-beam projection data.
The method was validated using CBCT datasets acquired with a dedicated Breast CT scanner. Phantom experiments as well as a contrast enhanced breast cone beam CT exam were performed to demonstrate the dramatic noise reduction using the new scheme.

Results:
For both phantom experiments and the human subject exam, PICCS image considerably reduces the noise and enhances the low contrast visibility. Noise variance measurements shows that a noise reduction factor of about 20 was achieved.

Conclusion:
The proposed method demonstrates a noise reduction ratio of more than 20 and the potential of significant dose reduction for breast CBCT by an order of ten. For an accepted noise variance level, the new scheme can be applied to enable more than 10 cone beam CT scans in contrast enhance breast CT imaging while the total radiation dose level is maintained at the two-view mammography level.