Development and Evaluation of a Dedicated Breast CT Scanner

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This dissertation is focused on the development and evaluation of a dedicated breast CT (bCT) scanner. Significant characterization and modeling of a prototype bCT system has been performed. Quantitive evaluation of important performance metrics including MTF, NPS and DQE has been studied by both physical measurement and computer simulation approaches. The results elucidate bCT performance and provide guidance for future improvements in scanner design. Algorithms have been developed to address key issues related to high quality bCT imaging including detector response calibration, geometric calibration, cone-beam CT reconstruction, HU calibration, as well as beam hardening and scatter correction.

The initial clinical experience from ongoing clinical trials demonstrates that high quality tomographic images can be produced with a dedicated bCT system

at radiation levels identical to two-view mammography. The excellent detail and anatomical complexity seen from bCT images provide rich diagnostic information and are very encouraging. The long term goal of the breast CT study is to evaluate the potential of bCT as a screening tool, as a lower cost replacement for breast MRI, or as a guidance method for robotic breast biopsy or tumor ablation procedures. While the clinical efficacy of bCT awaits observer-performance evaluation, it is likely that this technology will have some role to play in the breast imaging clinic.