Advances in Digital Breast Tomosynthesis: Image Reconstruction, Artifact Correction, and Dose Reduction

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Breast cancer is the second most prevalent cancer, globally, with millions of new cases identified each year. Since the introduction of widespread screening for breast cancer, there has been a steady decline in breast cancer mortality. In order to reliably detect breast cancers, breast screening methods need to offer high spatial resolution, low dose, high patient throughput, and excellent low contrast detectability. Mammography has been the gold standard in breast cancer screening since it was introduced, however many new technologies have emerged recently that offer many additional benefits when compared with mammography. One such method, digital breast tomosynthesis (DBT) builds on existing equipment and techniques used in mammography by incorporating three dimensional (3D) information. Clinically available in the United States since 2011, the addition of DBT has been shown to improve both sensitivity and specificity for breast screening when compared with two dimensional (2D) mammography alone. However, due to the unique requirements of breast imaging, image reconstruction, processing, and analysis for DBT is quite challenging. In this dissertation, several research areas are explored with the overarching goal of improving DBT imaging in a clinical setting. First, a novel image reconstruction algorithm and implementation strategy are introduced for DBT. Second, a technique to assess and understand the anatomical noise in the breast with respect to these new reconstruction methods is described. Finally, a platform-agnostic post-processing technique to reduce image noise and potentially reduce dose for DBT exams is presented. The tools presented in this work have been found to improve through-plane spatial resolution, reduce anatomical clutter, and potentially enable significant dose reduction for DBT. These are all very important steps in providing effective and safe breast cancer screening in the future.