

**Stony Brook University
The Graduate School**

Doctoral Defense Announcement

Abstract

Low-Contrast Lesion Detection in Tomosynthetic Breast Imaging

By

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Conventional 2D mammography is currently the most effective approach to detecting early stage breast cancer. Tomosynthetic breast imaging is a potentially more valuable 3D technique for breast cancer detection. This technique acquires a limited number of noisy 2D projection images over a limited angular range and then mathematically reconstructs a 3D breast. In breast imaging, the contrast between cancerous lesions and background features is fairly small; furthermore, the presence of lesions is masked by normal anatomical structures. The low contrast, anatomical masking and effects of radiation noise all combine to make lesion detection a difficult task.

In this simulation study, we investigate the efficacy of three tomosynthetic reconstruction algorithms – simple backprojection, algebraic, and statistical – in the context of an especially difficult lesion detection task. This is the detection of a very low-contrast mass embedded in a very dense fibro-glandular tissue background – a clinically useful task for which tomosynthesis may be well suited. The project uses anatomically realistic 3D breast phantoms whose normal anatomic variability limits lesion conspicuity. In order to capture anatomical object variability, we generate an ensemble of 3D breast phantoms by using stochastic algorithms, each of which results in random instances of various breast structures. Power-law structural noise is added to simulate small-scale object variability. The irregular mass is simulated by a 3D random walk algorithm. Low-dose data are acquired using an isocentric geometry and simulated Poisson radiation noise is added. The data are then reconstructed via the three types of methods. Reconstructed slices through the center of the lesion are presented to human observers in a two-alternative-forced-choice test to measure lesion detectability by computing the area under the ROC curve. We conclude that backprojection algorithms perform significantly more poorly compared to the other two types of reconstruction methods.

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