Lesion Detectability in Contrast-Enhanced Breast CT using Model Observers

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Introduction: Imaging protocols in contrast-enhanced breast CT (bCT) should be optimized for lesion detection and is dependent on a host of factors. In this study, we quantitatively evaluate the improvement in lesion detectability due to contrast enhancement across lesion diameter, section thickness, and breast density using a pre-whitened matched filter (PWMF) model observer.

Methods: The relationship between iodine concentration and HU was measured using a rod phantom containing known iodine concentrations placed in a polyethylene breast phantom and scanned on a prototype bCT system. Mathematically generated spherical mass lesions of varying diameters and contrast enhancement levels were inserted at random locations in 139 actual patient bCT datasets. Images with varying section thicknesses were generated by slice averaging. The volumetric glandular fraction (VGF) of the patient datasets was quantified using a previously reported algorithm. A PWMF was generated for combinations of lesion diameter, contrast enhancement, section thickness, and breast density. The PWMF detection performance was assessed using the area under the ROC curve for 200 lesions and non-lesions per breast and parameter combination.

Results and Discussion: In unenhanced bCT, optimal display section thickness is at 75% of the lesion diameter. When section thickness is less than 4mm, contrast enhancement enables detection of lesions greater than 1mm in diameter 100% of the time. In unenhanced bCT, a monotonic decrease in detection performance is observed as breast density increases across all lesion sizes. In contrast-enhanced bCT, detection performance is minimally dependent on breast density across all lesion sizes.

Conclusion: This study demonstrates quantitatively how lesion detectability improves with contrast enhancement in bCT across relevant parameters. Contrast imaging protocols can be optimized depending on patient breast density and estimated size of lesion being detected.

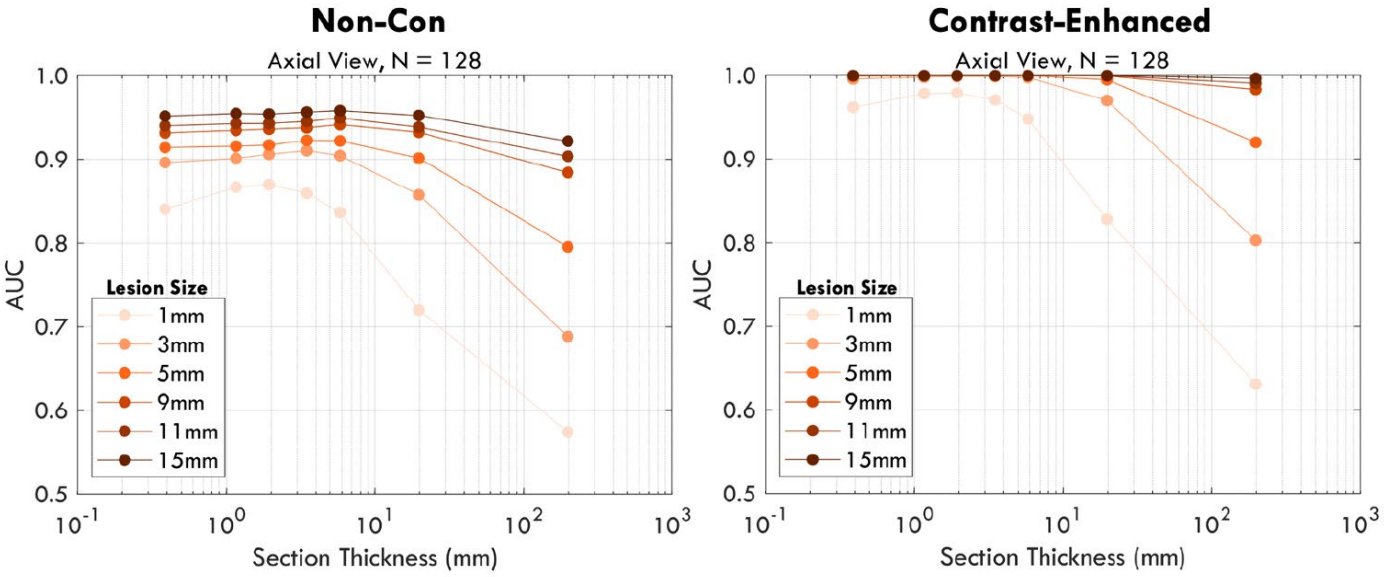

Figure caption: Left) Effect of section thickness in unenhanced bCT for lesion sizes 1, 3, 5, 9, 11, 15 mm. Right) Effect of section thickness in contrast-enhanced bCT for lesion sizes 1, 3, 5, 9, 11, 15 mm.