

AbstractID: 1992 Title: Effect of area x-ray beam equalization on image quality and dose in digital mammography

In mammography, thicker or denser breast regions persistently suffer from reduced contrast-to-noise ratio (CNR) because of degraded contrast from large scatter intensities and relatively high noise. Area x-ray beam equalization can improve image quality by increasing the x-ray exposure to under-penetrated regions without increasing the exposure to over-penetrated regions. The implementation of equalization into digital mammography, however, requires that optimal parameters with respect to image quality and patient dose be determined. Equalization parameters were optimized through computer simulations and validated with experimental observations on a breast equivalent tissue (BR12) step phantom and breast phantom. Three parameters important in equalization digital mammography were considered: attenuator material ($Z=13$ to 92), kilovoltage (22 to 34 kVp), and equalization level. A Mo/Mo digital mammography system was used for image acquisition. A prototype 16×16 piston driven equalization system and silicon binder material were utilized for the preparation of patient-specific equalization masks. Improvements in contrast, CNR, and figure of merit ($FOM = CNR^2/exposure$) due to equalization were quantified, and the enhancement of image quality and micro-calcification detectability with equalization was subjectively assessed. Simulation studies showed that a molybdenum attenuator, a tube voltage of approximately 26 to 28 kVp, and an equalization level of 20 were optimal for improving contrast, CNR, and FOM. Experimental measurements using these suggested parameters showed significant improvements in contrast, CNR, and FOM. Moreover, equalized images of a BR12 breast phantom showed improved overall image quality and micro-calcification detectability. These results indicate that area beam equalization can improve image quality in digital mammography.