AbstractID: 9515 Title: Quantification of Breast Density with Dual Energy Mammography

Purpose: To investigate a quantitative method for measuring breast density (the percentage of glandular breast tissue) with dual energy mammography using a dual exposure / dual kVp technique.

Method and Materials: An analytical simulation model was developed to determine the mean glandular dose required to quantify breast density to within an accuracy of 1%. The simulation considered stochastic x-ray and detector noise sources in a dual energy breast density image. The breast was modeled as a semicircle 10 cm in radius with homogenous equal thicknesses of adipose and glandular tissues. Monoenergetic beams were simulated with an ideal detector and polyenergetic spectra were simulated with an energy integrating detector modeled after an existing clinical system. A surrogate breast phantom was constructed to simulate a range of breast densities from 0 to 100%. The phantom was imaged using a full field digital mammography system at 25 kVp and 39 kVp with an additional 2 mm Al filter added to the high energy image. Dual energy images were generated with a non linear basis decomposition algorithm to yield image thickness maps of glandular and adipose tissue. Breast density was quantified using the dual energy images.

Results: For a 4.2 cm breast of 50% density, optimal energies determined from simulation, for monoenergetic beams and an ideal detector, were 19 keV and 71 keV. For an energy integrating detector and polyenergetic spectra, optimal energies were 20 and 69 kVp. The estimated required dose for either technique was less than 0.1 mGy. For dual energy images, the known (K) and measured (M) breast densities were related by $M = 1.007K – 0.006$ ($r = 0.999$). RMS error for all densities was calculated to be less than 2% of the mean density.

Conclusions: The results suggest that breast density can be accurately measured with dual energy mammography.