AbstractID: 7750 Title: Feasibility of low dose x-ray contrast enhanced digital mammography with gold nanoparticles

Purpose: To study the feasibility of low dose x-ray contrast enhanced digital mammography (CEDM) with gold nanoparticles as a contrast agent.

Method and Materials: Contrast enhanced digital mammography (CEDM) with iodine based agents is currently being explored. However, novel materials such as gold nanoparticles seem very promising for CEDM because of their high x-ray absorption in the mammographic energy range. Computer generated volumetric breast compositions of 50% and 75% mean glandular fractions and thickness of 5 and 7.5 cm were analytically ray-traced at various mono-energetic conditions and spectrally combined with simulated power-law noise to create 2D projection images with mammogram-like texture at 100 micron pixel resolution. The projection images were modified in accordance with the system resolution and noise power spectrum of a clinical full-field digital mammography system (Senographe 2000D, GE Healthcare, WI) and used to generate image data sets. A 6 mm diameter spherical lesion with an inherent glandular fraction of 65% and 100% was used for the 50% and 75% glandular breast conditions respectively. Lesions with contrast agent concentrations of 0.5, 1, 2 and 4 mg/cc were generated. A 26 kVp, Mo/Mo and 31 kVp, Rh/Rh x-ray spectra were used to generate full-dose images (~2 mGy mean glandular dose) for the 5 and 7.5 cm-thick breasts respectively. A Laguerre-Gauss Channelized Hotelling observer (LG-CHO) was implemented to compute the signal-to-noise ratio (SNR).

Results: Good contrast visualization was observed at ~0.13 mGy per image frame with CEDM. Contrast agent concentrations between 0.5-2 mg/cc in the lesion resulted in much higher SNRs compared to full dose mammography.

Conclusion: This work suggests favorable properties for gold nanoparticles as an x-ray contrast agent for CEDM. This could potentially benefit high-risk patient groups such as women with dense breasts. Other potential applications include progress monitoring in neo-adjuvant treatment regimens.