

Purpose: Dual-energy contrast-enhanced digital breast tomosynthesis (DE CE-DBT) is a promising technique to identify lesions on the basis of angiogenesis. Several potential imaging acquisition protocols exist for DE CE-DBT. In this work we experimentally evaluate the sensitivity of the reconstructed image signal to timing of low (L) and high (H) energy images and changes in iodine concentration during image acquisition.

Methods: Fifteen angular views of a breast-equivalent phantom with spherical lesions were acquired over a 43.75 degree angular extent with H and L spectra. Iodine concentrations were varied from 0 to 3.0 mg/ml (0.1 mg/ml increments) between successive dual-energy acquisitions. These datasets were used to simulate contrast uptake for a range of clinically relevant patterns in post-processing. For each pattern and a variety of acquisition protocols, the dual-energy recombined reconstructions are characterized in terms of the signal-difference-to-noise ratio (SDNR) between the lesion and background.

Results: The reconstructed signal is expected to represent an average of the signal from each projection image, so we compared dynamic simulations to reconstructions of the equivalent mean static iodine concentration. For a 9.5 mm diameter lesion, and for all acquisition protocols and enhancement patterns, when the L/H image pairs are acquired simultaneously, the SDNR is within 5% of the SDNR in a static image. With up to a 0.1 mg/ml iodine increase between the L and H images (upper limit of uptake rate) the SDNR is within 10% of the static case. When separate L/H energy tube sweeps are used for image acquisition, the measured SDNR can differ from the static case by as much as 30%.

Conclusions: For quantitative and high quality DE CE-DBT reconstructions, the data suggest that the L and H image acquisitions be made within one x-ray tube sweep. Separate L/H tube sweeps can degrade SDNR for particular enhancement patterns.

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