Purpose: To reduce the impact of x-ray scatter in dedicated breast computed tomography (BCT) images.

Methods: The inclusion of x-ray scatter in BCT projections results in cupping artifacts, loss of contrast, and quantitative inaccuracies. To correct for this, an additional set of BCT projections is acquired with a tungsten plate placed between the x-ray source and the patient breast. The tungsten plate includes a two-dimensional grid of perforations to generate an array of pencil beams. Due to the limited area illuminated by the x-ray pencil beams, an array of signals of primary x-rays only is obtained. At the pencil beam locations, the difference between the plate projections and the standard projections is an estimate of the scatter present in the latter. These estimates are interpolated to obtain scatter-only estimates of the whole images, which are subtracted from the standard projections, resulting in BCT projections with primary signal only, which are then reconstructed. To reduce the impact of the quantum noise of the scatter signal, the resulting reconstructions are noise filtered. Monte Carlo simulations were performed to estimate the amount of scatter included in the pencil beams and the dose from these additional projections. The algorithm was tested using breast phantoms on a BCT clinical prototype system.

Results: The maximum scatter signal in the pencil beams is 2.2% (mean of 0.7%) of the total signal, so the pencil beams are an excellent estimate of the primary-only signal. The additional projections result in only 0.4% of the glandular dose of the standard projections. The homogeneity of the resulting phantom images, the signal difference between adipose and glandular tissue, reconstruction accuracy, and contrast-to-noise ratios were improved with this algorithm.

Conclusions: The proposed algorithm has the potential to substantially improve BCT image quality with practically no additional dose to the patient breast.