Purpose: Photon counting spectral breast CT is feasible in part due to using an adaptive filter. An adaptive filter provides flat x-ray intensity profile and constant x-ray energy spectrum across detector surface, decreases required detector count rate, and eliminates beam hardening artifacts. However, the altered x-ray exposure profiles at the breast and detector surface may influence the distribution of CT noise, CT numbers, and contrast to noise ratio (CNR) across the CT images. The purpose of this work was to investigate these effects.

Methods: Images of a CT phantom with and without adaptive filter were simulated at 60kVp, 90kVp, and 120kVp tube voltages and 660 mR total skin exposure. The CT phantom with water content had 14cm diameter, contrast elements representing adipose tissue and 2.5mg/cc iodine contrast located at 1cm, 3.5cm, and 6cm from center of the phantom. The CT numbers, CT noise, and CNR were measured at multiple locations for several filter/exposure combinations: (1) without adaptive filter for 660mR skin exposure; (2) with adaptive filter for 660mR skin exposure along central axis (mean skin exposure across the breast was <660mR); and (3) with adaptive filter for scaled exposure (mean skin exposure was 660mR).

Results: Beam hardening (cupping) artifacts had 47HU magnitude without adaptive filter but were eliminated with adaptive filter. CNR of contrast elements was comparable for (1) and (2) over central parts but was higher by 20-30% for (1) near the edge of the phantom. CNR was higher by 20-30% in (3) as compared to (2) over central parts and comparable near the edges.

Conclusions: The adaptive filter provided: uniform distribution of CT noise, CNR, and CT numbers across CT images; comparable or better CNR with no dose penalty to the breast; and eliminated beam hardening artifacts.