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P1.13: Improvement of metal artifact and noise characteristics in computed tomography incorporated with CdTe photon-counting detector and Tin filter

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The use of a photon-counting detector (PCD) in computed tomography (CT) can reduce related artifacts such as beam-hardening and metal artifacts, improving the image quality and potential diagnostic value of CT images. However, PCD sets a threshold at a specific energy level to only collect photons with energies higher than the threshold. If the threshold value is high, the number of detected photons will decrease, thus increasing electronic noise. In this study, by changing X-ray energy spectrum using an additional filter, high-energy binned PCD image with reduced noise can be obtained by receiving selectively more high-energy photons. In addition, the proposed method can also reduce beam-hardening artifacts. In order to demonstrate the efficacy of the proposed method, we conducted a systematic simulation on a numerical dental arch phantom having metal inserts using a PCD toolkit (PcTK) available from Johns Hopkins University. In the simulation, several thicknesses of tin (Sn) filter in the range of 0.1-0.6 mm were added to aluminum (Al) filter of a thickness of 2.0 mm to find a thickness of tin filter appropriate for improving of metal artifact and noise characteristics in CT. Two tube conditions of 120 and 140 kVp were tested, simulations assume that the object receives the same number of photons and vary the threshold of PCD at 25, 55, 80, and 100 keV. Our results indicated that CT images of a dental arch phantom obtained at tube voltages of 120 and 140 kVp and several thickness combinations of aluminum and tin filters using the PcTK toolkit. We noted that the metal artifact and noise characteristics were significantly improved for the conditions of 2.0 mmAl + 0.6 mmSn filter at 140 kVp. According to our preliminary results, a higher thickness of the tin filter reduced effectively electronic noise and metal artifacts, thus improving the image quality of CT images. More quantitative simulation results will be presented in the paper.

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