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Evaluation of a novel photon-counting CT system using a 16-channel MPPC array for multicolor 3-D imaging

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X-ray computed tomography (CT) is widely used in diagnostic imaging of the interior of the human body; however, the radiation dose of conventional CT typically amounts to 10 mSv. Under such environments, X-ray photons are severely piled-up; therefore, the CT images are monochromatic and various artifacts are present due to beam hardening effects. In contrast, photon counting CT (PC-CT) offers a low dose and multicolor CT system. At present, PC-CT systems based on CdZnTe devices are widely studied. This system is yet far from being an established clinical technique, owing to the high-cost and complexity of huge number of read out channels; the pixel size of CdZnTe must be as small as ˜0.1-0.2 mm to withstand high counting rate due to the slow mobility of electron-hole pairs. In this paper, we propose a cost-effective, novel PC-CT system consisting of 16-ch multipixel photon counter (MPPC) coupled with a high-speed scintillator array. As a proof of concept, we show 3-D color images of a lighter phantom taken in a sufficiently low-dose environment. Material identification is possible by setting multiple energy windows. Next, we applied our PC-CT system for K-edge imaging, which can improve blood-tissue contrast using a specific contrast agent. By setting appropriate energy windows, our PC-CT system accurately reconstructed absolute concentration of iodine and gadolinium. Finally, we discuss the prospects and possible future clinical applications of the developed PC-CT system.

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