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P2.67: Stationary CT baggage scanner with a dual-layer detector and pi-angle sparsity for enhancing the detection of threats

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Two-dimensional (2D) X-ray inspection systems have been widely used for homeland and aviation security, but they still have limitations in recognizing 3D shape of the hidden threats. Hence, there has been increasing demand for computed tomography (CT) scanner for carry-on baggage screening. In a previous study [1], we designed a new stationary CT baggage scanner with compressed-sensing (CS) algorithm and □-angle spacity, comprising several dozen pairs of X-ray source and linear array-type detector placed within a scan angle of 180 degrees at an equiangular distance. Our previous results showed that the proposed CT configuration significantly reduced the streak artifacts appearing in the standard filtered-backprojection (FBP) reconstruction, thereby considerably improving the image quality. In this study, as a continuation of our X-ray imaging R&D, we replaced the linear array-type detector in a previous design with a dual-layer detector (X-Card 1.5-64DE, Detection Technology Co.) and applied a typical material decomposition algorithm to separate soft and dense materials for enhancing the detection of threats. Dual-energy CT is a theoretically well-established X-ray technique used to differentiate and classify material composition in CT using projection images acquired at two different X-ray energy spectra [2]. In addition to material-specific images, the dual-energy projection data can be used to synthesize virtual monochromatic CT images as the potential to reduce beam-hardening artifacts that are usually observed in traditional polychromatic CT images. Before the practical implementation of the proposed dual-energy CT baggage scanner, we conducted a series of simulations to validate its efficacy. Figure 1 shows (a) the schematic of a stationary dual-energy CT scanner with pi-angle sparsity and a dual-energy detector and (b) X-ray energy spectra used in the simulation for material decomposition. Figure 2 shows the schematic of the proposed dual-energy CT algorithm to separate soft and dense materials. Figure 3 shows the preliminary simulation results of a stationary dual-energy CT scanner with pi-angle sparsity and material decomposition. More systematic and quantitative simulation and experimental results will be presented in the paper.

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