

First CT Evaluation of a Novel Photon-Counting Detector Module for Clinical CTs

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Abstract:

Background:

Photon-counting computed tomography (PCCT) is a rapidly emerging imaging modality that offers significant advantages over conventional energy-integrating detectors (EIDs)-based CTs, such as improved image quality, spectral imaging, and dose and noise reduction. Developing a new photon-counting detector with four-side buttable technology and six energy bins enables CT systems that provide high resolution, enhanced tissue differentiation, and multi-energy imaging in a single acquisition and represents a significant step toward advancing the development of PCCT systems with the potential to set new milestones in medical imaging and clinical applications.

Objective:

This study presents the first CT evaluation of a novel prototype photon-counting detector module developed by Varex Imaging, designed to advance PCCT technology for clinical applications. A first detector version was tested on a tabletop CT setup to assess its performance, particularly regarding resolution and tissue characterization. An anthropomorphic hand phantom from QUART GmbH (Zorneding, Germany) and a 3D-printed phantom were used as test objects.

Materials & Methods:

The prototype module consists of 2x3 active tiles, each with 128x128 pixels and 0.15mm² in pixel size. For CT scans of the samples at 120kVp, three energy thresholds (20keV, 50keV, 80keV) were set to enable multi-energy data acquisition, spectral separation, and tissue characterization. CT scans were performed on a 3D-printed phantom and an anthropomorphic hand phantom mimicking bone and soft tissue contrast. The acquired data were compared to reference scans from conventional clinical CT systems (with an energy-integrating detector (EID)) to assess image quality, resolution, and noise.

Results & Outlook:

The results indicate that the Varex photon-counting detector provides a significant advantage over conventional EID-based clinical CT systems in terms of image quality, particularly in high-contrast imaging of bone and soft tissues. Although tested on a table-top setup, these first evaluation results indicate its usefulness in clinical applications requiring high-resolution, multi-energy imaging for high-detail anatomical studies. Further research will focus on CT system integration, assessing clinical feasibility, and validation in real-world medical imaging scenarios.