

The GigaCT: Advancing Photon-Counting CT for Next-Generation Spectral Imaging

White Paper – April 2026

Authors: Lisa Marie Petzold¹, Benjamin Berger¹, Daniel Berthe¹, Josh Star-Lack², Thomas Frach², Patrick Bücherl³, York Hämisch², Franz Pfeiffer¹

¹Chair of Biomedical Physics, School of Natural Sciences, Technical University of Munich (TUM)

²Varex Imaging Corp.

³Schleifring GmbH

Introduction

Computed tomography (CT) has revolutionized medical imaging, yet conventional CT systems utilizing energy-integrating detectors (EIDs) face inherent limitations in spectral information and material differentiation. The emergence of photon-counting detectors (PCDs) promises to overcome these challenges, enabling energy-selective and thus material-selective imaging that can enhance diagnostic capabilities across clinical and research applications. In addition, the much higher spatial resolution of PCDs leads to higher accuracy in many areas of medical diagnosis. However, current photon-counting CT systems are constrained by data throughput bottlenecks and spectral resolution, which not only limit their performance but also their utility in many clinical imaging scenarios.

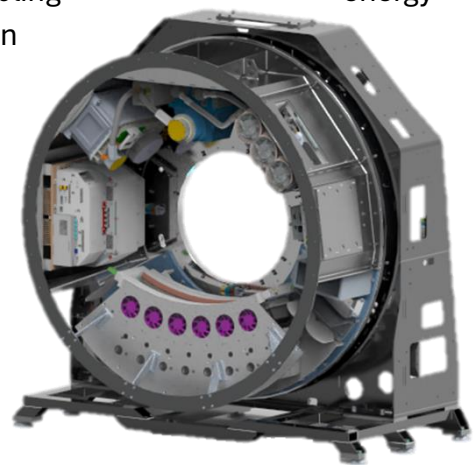


Fig. 1: GigaCT system rendering

The GigaCT: System Overview

The GigaCT represents a novel prototype photon-counting CT system designed to address the data transfer and spectral resolution limitations of existing technologies. Featuring a state-of-the-art architecture, the system achieves a data transfer rate of 320 Gbit/s, supporting high-resolution imaging with a pixel size of 150 μm and six energy bins per pixel. The gantry, installed at the Technical University of Munich (TUM) in Germany, integrates advanced X-ray generation components, including the Varex MCS-

7500 rotating anode tube (100 kW max power, 140 kV peak voltage, and magnetic focusing), and a detector arc composed of 48 Varex Pyxis modules providing a total active area of 936 x 77 mm² and a total of over 3 million pixels.

Technical Innovations

Key innovations in GigaCT include a parallel data acquisition system utilizing a Varex developed high speed acquisition system and a Schleifring proprietary ultra-fast parallel data transfer system using eight GigaCAP HD transmitters and nine receivers, proprietary data routing, and FPGA-based control units as well as an innovative liquid cooling system for the detector. The system's slipring technology supports high-speed, uni-directional image data transfer, and bi-directional configuration & control. The TUM server infrastructure achieves writing speeds of up to 484 Gbit/s. Detector modules employ CdTe material with 1.6 mm thickness, charge sharing correction, and ASG support, allowing to operate at frame rates of up to 10,000 fps (2x2 binned) – while supporting up to six energy bins per pixel.

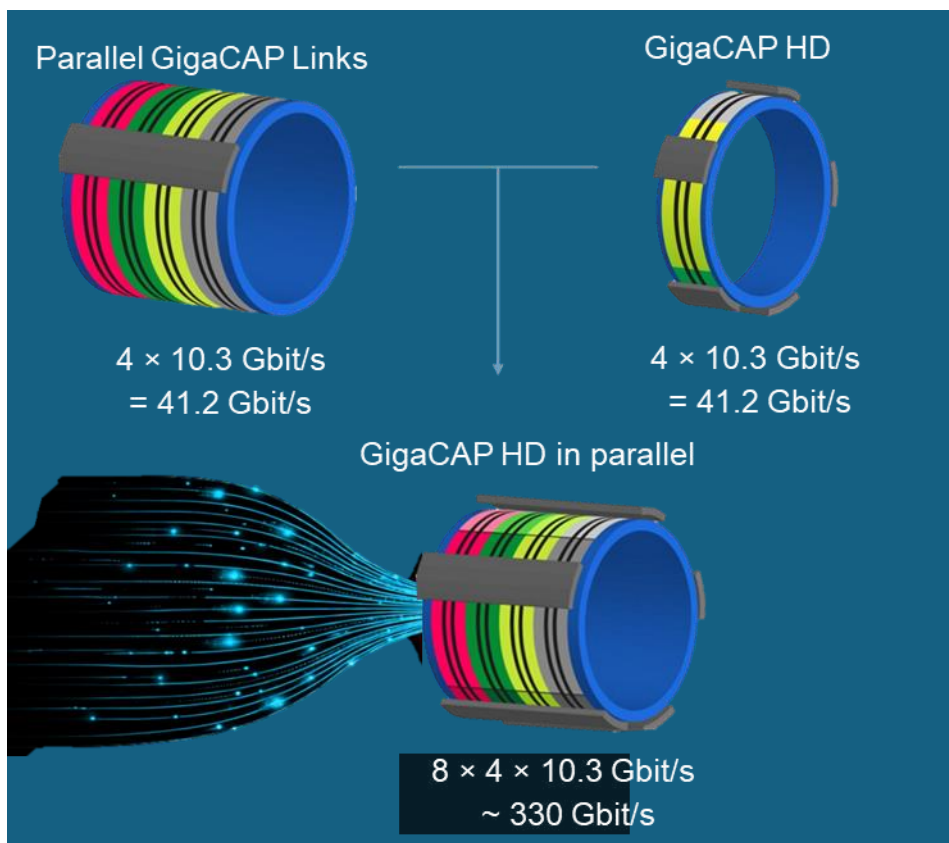


Fig2: Slip ring data transfer architecture of GigaCT provided by Schleifring GmbH

Performance and Early Results

Initial tabletop imaging tests have demonstrated promising results, with corrected projections processed using Varex proprietary CST software to address challenges such as pixel and material inhomogeneities as well as geometric corrections. Comparative

