PROJECT

Supervisor:	_____Prof. Antonio Esposito_____
Title:	Redefining Clinical CT with Photon-Counting Technology: protocols optimization and cost-effectiveness
Curriculum:	Clinical and Experimental Medicine
Link to the personal page of the University or relevant hospital site website:	https://www.unisr.it/docenti/e/esposito-antonio

Description of the Project (max 3,000 characters including spaces)

Background/gap of knowledge

Photon-Counting Detector CT (PCD-CT) represents a major technological advancement in computed tomography, offering improved spatial resolution, intrinsic spectral capabilities, and reduced electronic noise compared with traditional Energy-Integrating Detector CT (EID-CT). These technical advantages may significantly enhance diagnostic accuracy, especially in cardiovascular and oncological imaging.

PCCT technical potentials are currently only partially transferred to clinical practice because: 1) the full exploitation of its spectral capabilities requires larger datasets and further protocol optimization; 2) the high cost of the scanner demands clear evidence of cost-effectiveness over its expected operational lifespan.

Rationale and hypothesis

1. PCCT scanners are technically characterized by higher quantum efficiency in converting incoming photons into imaging signal, as well as by intrinsic spectral capabilities enabling material decomposition and virtual monoenergetic imaging. These features allow improvements in diagnostic accuracy while potentially reducing radiation dose and contrast media volume. However, optimal protocol refinement still requires systematic analysis of data derived both from vascular and parenchymal structures, including data derived from dedicated phantom scanning and real-world clinical examinations. Hypothesis is that these data may contribute to further optimize protocols to minimize CT impact in terms of radiation and contrast exposure and energetic consumption.

2. PCD-CT provides significantly higher spatial resolution compared with conventional EID-CT. Our hypothesis is that this enhanced resolution may improve the positive predictive value of CCTA, thereby reducing the number of downstream functional tests and unnecessary invasive coronary angiographies (ICA), ultimately supporting more appropriate clinical decision-making and improved prognostic assessment. Consequently, if these effects are confirmed, the cost-effectiveness of PCD-CT may outperform that of EID-CT across the expected operational lifespan of the scanner.

Objectives and specific aims

First aim of the present project is to optimize scanning and reconstruction parameters for PCD-CT imaging across oncological and cardiovascular applications. Second aim is to to assess the cost-effectiveness and prognostic impact of adopting PCD-CT in patients with suspected CAD.

Expected outcomes

The project is expected to generate evidence supporting optimized acquisition protocols, improving diagnostic accuracy through enhanced spatial resolution and spectral characterization.

The project is also expected demonstrating the clinical and operational value of Photon-Counting Detector CT (PCD-CT) in cardiovascular and oncological diagnostics. In particular it is expected to show a reductions in unnecessary downstream testing when used to perform CCTA, with advantages in terms of radiation dose and contrast media usage, thereby enhancing patient safety and streamlining diagnostic pathways. In parallel, cost-effectiveness analyses may demonstrate superior long-term economic performance of PCD-CT compared with EID-CT. Finally, by optimizing protocols and workflow efficiency, the project aims to highlight the environmental advantages associated with optimized PCD-CT protocols, contributing to more sustainable imaging practices.

Skills that the student should acquire (max. 600 characters including spaces):

The student will develop advanced skills in CT protocol design, spectral data interpretation, and quantitative image analysis for cardiovascular and oncological applications. Training will include clinical study management, cost-effectiveness modelling, and handling of large imaging datasets. The student will work within a multidisciplinary team.

References (max. 15)

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