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Foreword

A Note from the Editorial Board

Welcome to this year's annual magazine from the Global Scientific Collaboration team.

uInnovation is a scientific magazine published by United Imaging Healthcare that has been successfully distributed for over past three years. It aims to serve as a platform for sharing ground-breaking advancements, emerging trends, and future possibilities in the vast expanse that is oncology.

uInnovation is currently in its fourth edition. This year's edition will inform, engage, and inspire you about the latest developments and applications of United Imaging Healthcare. This journal includes quick read sections for those in a rush, and appealing images to promote visual understanding.

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Clinical Significance of Coronary Artery Calcium Score in Predicting Single Low-Dose CT for Combined Lung Cancer Screening and Coronary Artery Calcium Scoring with Artificial Intelligence Iterative Reconstruction

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The Challenge

Coronary artery disease (CAD) and lung cancer share several common risk factors. Patients eligible for screening one condition are hence often candidates for screening for the other condition too.

Currently, lung cancer screening is performed using low dose CT scans to detect lung nodules, while ECG-gated normal dose CT scans are used to assess coronary artery calcium (CAC) to evaluate CAD risk. As a result, patients undergo two separate scans targeting the overlapping anatomical regions.

Dual scanning has a number of disadvantages: it exposes patients to duplicate radiation. It also increases healthcare costs and contributes to inefficiencies in clinical workflows due to redundant imaging procedures. It is natural to explore whether the two screenings could be consolidated into a single scan.

The Technology

Artificial Intelligence Iterative Reconstruction (AIIR) may provide the necessary answer here. AIIR was evaluated for its ability to mitigate the image noise and artifacts inherent in low-dose CT lung cancer screening, and to determine if it could provide reliable calcium scoring results under these conditions.

Note on image reconstruction: AIIR is a next-generation reconstruction algorithm that combines the strengths of artificial intelligence with model-based image reconstruction. Its workflow (Figure 1) consists of two core components. Firstly, a data-fidelity term incorporates multiple models, including a system optics model, a detector model, and a quantum statistical model, to ensure an accurate characterization of the system for each specific scan. In each iteration, estimated images are forward-projected, compared with the acquired projection data, and updated via forward and backward projection, allowing raw projection data to enhance image reconstruction while preserving anatomical and pathological details. The second component, a deep-learning denoising engine, is trained on millions of high-quality/low-dose image pairs covering diverse clinical scenarios, including different body regions, scan protocols, dose levels, and pathologies. This extensive training dataset enhances the model's generalizability and robustness.

AIIR enhances the images from the low dose lung cancer screening CT to clearly depict the coronary arteries, allowing for an accurate CAC score measurement. The CAC scores are computed by an application in the uCT workstation (uInnovation-CT, R001, United Imaging Healthcare).

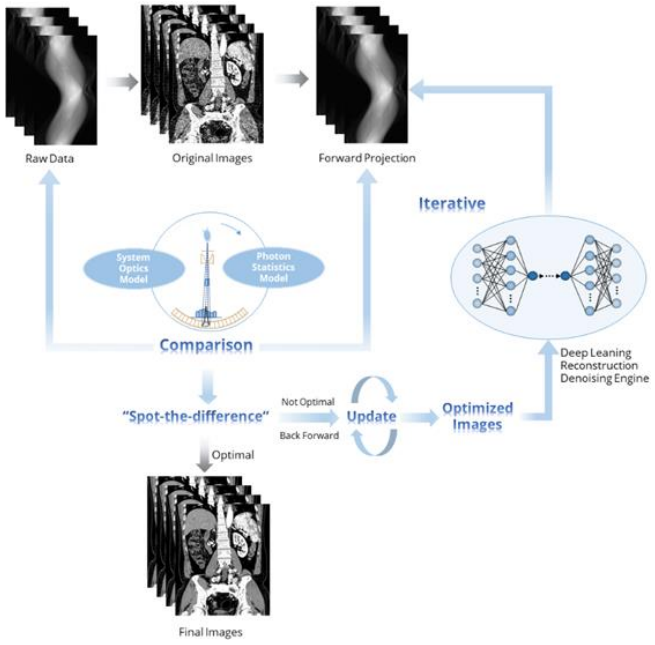


Figure 1. AIIR Reconstruction Workflow

Findings

Patient scans were compared in two categories: those with CAC scores of zero and those with non-zero. CAC score of zero means no calcified plaques or calcifications.

Figure 2 shows one example of a 72-year-old male with calcium detection in the right coronary artery. The calcium burden can be clearly detected in the low dose non-gated lung cancer screening (B) compared to the full-dose calcium scoring scan.

Scans with CAC score =0 on the gated full-dose scan also had a score of 0 on the AIIR non-gated CT, demonstrating 100% agreement in identifying patients without calcification.

For scans with non-zero CAC scores, low to moderate levels of calcification can be expected. Among the 18 patients with non-zero CAC scores on the full dose scan, category-level agreement varied:

I. 11 patients with a CAC score between 1 and 100, 10 remained in the same category on the lung cancer screening scan, while one was reclassified into the 101–400 category.

II. Among the four patients with scores between 101 and 400, three remained in the same category, and one was reclassified into the >400 category.

III. All three patients with CAC scores >400 on the full dose CAC scan were consistently categorized in the same group using the lung cancer screening scan.

These findings show that AIIR-enhanced low dose CT scans show excellent agreement in detecting the absence of CAC, and slight variability exists in score categorization among patients with low to moderate levels of calcification, particularly in borderline cases.

So What?

The application of AIIR to reconstruct images from low dose lung cancer screening CT scans for the purpose of CAC scoring demonstrates clear clinical utility. Comparative analysis indicates no statistically significant differences between the conventional dual-scan method and the proposed single-scan lung cancer screening protocol with AIIR reconstruction.

This integrated approach offers multiple advantages, including reduced radiation exposure, decreased imaging time, and lower overall patient costs. Additionally, it streamlines radiology department workflows by eliminating the need for separate CT acquisitions, improving operational efficiency and increasing daily patient throughput.

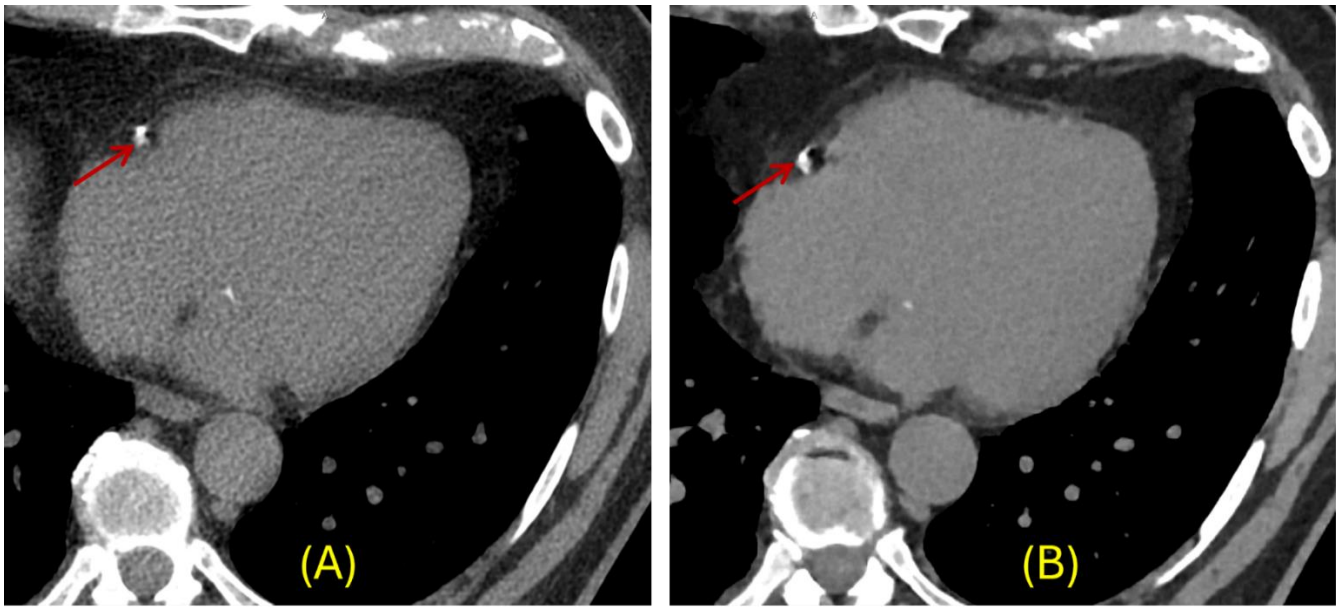


Figure 2. A 72-year-old male with calcium detection in the right coronary artery. (A) Image from a dedicated gated calcium scoring scan with a slice thickness of 2 mm × 2 mm. (B) Image from a non-gated lung cancer screening scan reconstructed using AI-based iterative reconstruction (AIIR) with a slice thickness of 1 mm × 1 mm.

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Dr. Omer Aras is a physician-scientist with formal training in both clinical radiology/nuclear radiology and molecular imaging research. His clinical interests lie in oncologic imaging, with a focus on genitourinary and bone marrow cancer. His primary research interest involves developing novel and innovative molecular imaging approaches for cancer diagnostics and combining and utilizing the biology, nanotechnology, chemistry with advanced non-invasive imaging methods (predominantly PET/optical imaging) to create novel imaging agents that allow much earlier detection and improve therapy monitoring of cancer. As a result of translational work, much of it completed under his own initiative, he has published a number of peer-reviewed papers in biomedical journals and been invited to present his work at national and international venues.

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