The Reliability of Generative AI from CT to PET on Lung Cancer: An Extensive Validation

Morteza Salehjahromi[†1], Tatiana V Karpinets[†2], Carol C. Wu[‡3], Jianjun Zhang[‡2,4], Jia Wu[‡1,4,5]

1. Department of Imaging Physics, MD Anderson Cancer Center, Houston, TX USA
2. Department of Genomic Medicine, MD Anderson Cancer Center, Houston, TX, USA
3. Department of Thoracic Imaging, MD Anderson Cancer Center, Houston, TX, USA.
4. Department of Thoracic/Head and Neck Medical Oncology, MD Anderson Cancer Center, Houston, TX, USA
5. Institute for Data Science in Oncology, MD Anderson Cancer Center, Houston, TX, USA

† These authors contribute equally; ‡ co-senior authors

Introduction

18F-Fluorodeoxyglucose positron emission tomography (FDG-PET) is widely recognized for its effectiveness in diagnosing and staging lung cancer by measuring glucose metabolism. Despite its clinical value, FDG-PET is not universally accessible, especially in low-income regions, due to its high costs. Computed tomography (CT), although more widespread, lacks the functional insights provided by PET. Recent advances in deep learning present a potential solution by enabling the synthesis of PET images from existing CT scans, which could broaden access to essential diagnostic information.

Method

We developed a conditional generative adversarial network (cGAN) designed to transform diagnostic CT images into synthetic PET images. This pipeline was trained and validated using a large, multicenter dataset comprising 1,478 lung cancer patients, ensuring a robust model that is generalizable across various demographics and machine types.

Validation

The synthetic PET images underwent extensive validation, including: 1) comparison of imaging quality and tumor contrast with ground-truth FDG-PET scans, assessed by expert radiologists; 2) radiogenomics analysis to confirm that synthesized images reflect accurate biological information; 3) evaluation of the synthetic PET's clinical utility in improving lung cancer diagnosis, and prognosis.