Title: **Deep Learning-Based PET Image Correction Toward Quantitative Imaging**

Other suggestion:

1. Advancements in AI for PET Image Correction: A Multi-Center Deep Learning Approach
2. Advancements in CT-Free PET Imaging: Deep Learning for ASC Correction

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Introduction:

Recent advancements in Deep learning (DL) have significantly impacted PET imaging. exploring CT-free methods. has significant advantages not only for attenuation scatter correction (ASC) but also in artifact correction. However, practical applicability is challenging due to differences in scanners and radiotracer distribution.

Objective: By developing an Integrated multi-center U-Net deep neural network model (IMCM), we addressed ASC, and assessed several case studies on image artifact correction, focusing on mismatch and halo artifacts in 68Ga PET imaging.

Methods: 270 images were selected from a collection of over 1000 patients undergoing 68Ga and 18F-FDG PET/CT scans across seven centers. Three centers are set aside for external tests (Ga-data named Ex-center and FDG-data as Rt-center). A dedicated 3D-DynUnet which employs a deep supervision strategy, was used for training the rest of data.

Results: For internal-centers, the model achieved Mean Error (ME) of -0.56±0.74, Mean Absolute Error (MAE) of 1.28±0.37, Root Mean Squared Error (RMSE) of 2.90±0.58, Peak Signal-to-Noise Ratio (PSNR) of 37.66±2.67, and Structural Similarity Index (SSIM) of 0.93±0.03.

IMCM yielded an ME of -1.92±0.58 and -0.54±0.13, an MAE of 2.38±0.76 and 0.69±0.12, an RMSE of 5.41±3.05 and 1.17±0.52, a PSNR of 32.25±3.04 and 35.39±5.84, and an SSIM of 0.89±0.03 and 0.78±0.10, for the Ex-center and Rt-center, respectively.

Joint histograms revealed, IMCM had a regression of 0.65x+0.2,R=0.920 and 0.83x-0.2,R=0.917 at Ex-center and Rt-center. At internal-centers, IMCM showed prediction of 0.90x-0.07,R=0.974

Discussion: The developed model addressed variations in scanner types and radiotracers, demonstrating its adaptability and effectiveness in different clinical environments for the same study. Untuned IMCM struggled with cross radiotracers but showed strong performance after fine-tuning.

Conclusion: The study highlighted the potential of DL to provide accurate, artifact-free PET images, this method offers a promising alternative to CT-based ASC, reducing radiation exposure and artifacts.

Keywords: Deep learning, attenuation scatter correction, CT-free imaging.

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| A diagram of a number of colored boxes  Description automatically generated with medium confidence | A diagram of a root mean squared error  Description automatically generated |
| A chart with different colored boxes  Description automatically generated | A diagram of a number of different colored boxes  Description automatically generated with medium confidence |