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Title	Quality Enhancement of Dynamic Brain PET Images via unsupervised learning
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Abstract

Dynamic Positron Emission Tomography (PET) imaging modality is of great importance in nuclear medicine by measuring quantitative parameters to support clinical decisions. However, limitation in time acquisition due to low count rates causes increased noise levels. Furthermore, conventional denoising methods, including filtration, has the disadvantage of decreasing image resolution. Additionally, methods using supervised deep learning require big dataset for high accuracy. In this paper, we used unsupervised deep learning to enhance the quality of the dynamic brain PET images by noise reduction while pre- serving the spatial resolution.

In this method, ten patients' dynamic 18F-FDG brain PET images were assessed. The Images with 10-sec frame reconstruction were considered noisy images, while 60-sec frame reconstruction was appointed as ground truth. A 3D U-Net architecture with skip connections considering optimized parameters was designed, and training was carried out using static PET and CT images as inputs. The results were compared with Gaussian and NLM filtering methods.

The results show the Mean PSNR of 18.35(dB) in our proposed method of using DIP with CT images and 18.29(dB) with static images as priors compared to 16.21 and 16.02 for NLM and Gaussian filtering denoising method respectively. Mean SSIM in our framework is 0.711 in DIP by static PET images and 0.744 by CT images while NLM and Gaussian filtering display values of 0.44 and 0.45.

Our proposed algorithm and designed 3D-UNet model is capable of enhancing dynamic PET/CT images quality using only its single static PET and CT images. This unsupervised learning method is time-efficient which could be applied clinically