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Multimodal Direct Neural Network Positron Emission Tomography Reconstruction

Authors : William Whiteley, Jens Gregor

Abstract : In recent developments of direct neural network based positron emission tomography (PET) reconstruction, two prominent architectures have emerged for converting measurement data into images: 1) networks that contain fully-connected layers; and 2) networks that primarily use a convolutional encoder-decoder architecture. In this paper, we present a multi-modal direct PET reconstruction method called MDPET, which is a hybrid approach that combines the advantages of both types of networks. MDPET processes raw data in the form of sinograms and histo-images in concert with attenuation maps to produce high quality multi-slice PET images (e.g., 8x440x440). MDPET is trained on a large whole-body patient data set and evaluated both quantitatively and qualitatively against target images reconstructed with the standard PET reconstruction benchmark of iterative ordered subsets expectation maximization. The results show that MDPET outperforms the best previously published direct neural network methods in measures of bias, signal-to-noise ratio, mean absolute error, and structural similarity.

Keywords : deep learning, image reconstruction, machine learning, neural network, positron emission tomography
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