Scatter and random correction of PET list-mode data using machine learning approaches

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Abstract

Positron emission tomography (PET) is a medical imaging technique that can be used to visualize the metabolic and biological function of the human body. This imaging modality is commonly used to diagnose and monitor the treatment of cancer, heart disease, and neurological disorders, among other medical uses. The performance of quantitative measurements with this technique requires a careful understanding of the imaging process and all sources of error that distort the true physiological information under study. A possible source of error in the reconstructed image in PET is due to the presence of scattered and random coincidences, which produce loss of contrast and incorrect quantification of activity.

In this work, we present a method for performing both scatter and random correction of list-mode data in a simulated PET ring system using machine learning techniques before the image reconstruction. Using positional, energetic and time information from both photons stored in the detector we are able to classify and discard non-true coincidences in order to enhance image quality. Two machine learning algorithms have been tested, based on decision trees and neural networks respectively, and lead to high accuracies in the classification task. A significant reduction in the number of scattered and random coincidences is confirmed. Several image quality metrics have been studied in order to confirm quality improvement. RMSE is found to decrease and PSNR is found to increase in both of corrected images, appearing to have higher quality and better image contrast.

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