PET image reconstruction incorporating 3D mean-median sinogram filtering

ABSTRACT

Positron Emission Tomography (PET) projection data or sinogram contained poor statistics and randomness that produced noisy PET images. In order to improve the PET image, we proposed an implementation of pre-reconstruction sinogram filtering based on 3D mean-median filter. The proposed filter is designed based on three aims; to minimise angular blurring artifacts, to smooth flat region and to preserve the edges in the reconstructed PET image. The performance of the pre-reconstruction sinogram filter prior to three established reconstruction methods namely filtered-backprojection (FBP), Maximum likelihood expectation maximization-Ordered Subset (OSEM) and OSEM with median root prior (OSEM-MRP) is investigated using simulated NCAT phantom PET sinogram as generated by the PET Analytical Simulator (ASIM). The improvement on the quality of the reconstructed images with and without sinogram filtering is assessed according to visual as well as quantitative evaluation based on global signal to noise ratio (SNR), local SNR, contrast to noise ratio (CNR) and edge preservation capability. Further analysis on the achieved improvement is also carried out specific to iterative OSEM and OSEM-MRP reconstruction methods with and without pre-reconstruction filtering in terms of contrast recovery curve (CRC) versus noise trade off, normalised mean square error versus iteration, local CNR versus iteration and lesion detectability. Overall, satisfactory results are obtained from both visual and quantitative evaluations.

Keyword: Filtered-backprojection; Maximum likelihood expectation maximization OSEM; Mean and median filters; Median root prior; PET sinogram