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PSF RECONSTRUCTION ALGORITHM IN PET/CT: PERFORMANCE EVALUATION AND OPTIMIZATION OF THE RECONSTRUCTION PARAMETERS

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BACKGROUND-AIM

In the last years many improvements have been made to enhance the performances of iterative reconstruction algorithms for PET. An important one is the incorporation of the point spread function (PSF) of the PET scanner into the estimation step of the reconstruction algorithm that allows to improve the contrast to noise ratio. The aim of our work was to optimize the reconstruction parameters for the PSF algorithm, recently installed in our PET scanner, and compare its performances to the OSEM algorithm performances.

METHODS

NEMA Quality Image Phantom has been filled with different spheres to background ratio (SBR = 2:1, 4:1, 8:1) and then acquired on our PET/CT scanner (Siemens Hirez). Acquired sinograms have been used to reconstruct the images using both the 3D OSEM and the PSF (TRUEX) algorithms with different matrix size, iteration and subset numbers. Image quality, defined as the ability of the system to recover the hot contrast (QH), and statistical noise (SD) have been evaluated according to NEMA 2001 guidelines. A figure of merit (FOM), that take into account both quantities and defined as the ratio of QH and SD, has been used to optimize the reconstruction parameters and compare performances of both algorithms.

RESULTS

For both algorithms and for all the matrix sizes evaluated the SD increases linearly compared to the number of equivalent iterations (the product between number of iterations and number of subsets) while the QH, after a steep increase, approaches a saturation value. Consequently the FOM reaches a maximum value and then decreases. The FOM peak values are observed at different equivalent iterations for the two algorithms: 48 and 72 for 3D OSEM and PSF (TRUEX) respectively. Comparing the images obtained with the two different algorithms and the relative optimized reconstruction parameters the FOM results higher for PSF algorithm for all the SBR set and for all the spheres volumes. The QH increment, due to the new algorithm, ranges from 5% to 20% depending on the sphere volume: the highest improvement is seen with the smallest volume.

CONCLUSION

Our work confirms the importance of the optimization of the reconstruction parameters for every algorithm used. The new PSF iterative algorithms are superior to standard iterative ones especially in terms of small lesions detectability. Nevertheless its better performances it is still necessary to perform phantom measures to evaluate the correction factor for the partial volume effect.