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Towards task-based assessment of PET performance: System and object DQE across different reconstruction algorithms

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Introduction: Detective quantum efficiency (DQE) of an imaging system is an indicator of the image quality metrics of the system taking into consideration detector efficiency.

Purpose: To investigate a measurement method for evaluating the DQE of a PET imaging system across reconstruction algorithms.

Methods and Materials: A novel and highly homogeneous, high - activity flood source was prepared, placed between two semi cylindrical PMMA blocks and imaged in a PET/CT scanner. The modulation transfer function (MTF) was calculated from the line spread function (LSF) of the transverse slice of the thin flat source. The normalized noise power spectrum (NNPS) was also calculated from the coronal slice of the same source. Furthermore, the DQE was calculated from the number of photons emitted from the plane source which is a measure for the incoming SNR^2. The authors adapted the DQE concept to reconstruction, in order to quantify the impact of reconstruction algorithm on image quality.

Results: The effect of 2D (with septa) and 3D (without septa) scanning modes on DQE was investigated and statistical significant differences were found ($p<0.05$). The reconstruction DQE was determined for conventional and fully 3D iterative reconstruction algorithms, with several combinations of iterations and subsets.

Conclusion: The determination of DQE via MTF and NNPS, could be useful in characterizing different PET/CT systems in terms of image quality metrics and detector efficiency. Moreover, DQE could be a useful criterion for the evaluation of different PET reconstruction algorithms.

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