PhD Thesis title: 'Respiratory-gated PET/CT protocols and reconstructions optimization.'

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ABSTRACT:
Respiratory motion may highly deteriorate PET images. Indeed, uptakes of mobile organs appear fuzzy and their intensity is lowered. That may lead to error in the image interpretations by clinicians. The aim the work related here is to propose practical solutions to overcome these problems.
In a first time, we focused our research on the development of an approach directly applicable in the department of any institution. The proposed method, named CT-based, is derived from motion compensation techniques. CT-based is based on a respiratory-gated PET acquisition followed by an end-expiration breath-hold CT scan. An *a posteriori* process selects PET events that occurred only around the respiratory position recorded during the breath-hold CT acquisition. This method has been successfully implemented in our department and we have demonstrated its efficacy.
The second method is based on the introduction of motion information directly in the reconstruction process in order to obtain a motion-free volume by using the entire counting statistics. In that way, we propose an iterative reconstruction algorithm, called MOSEM. As a prerequisite, a particular tomographic operator, which integrates true detectors' response, was developed. Future work will be focused on the clinical validation of this algorithm.

References to author publications that relate specifically to the dissertation:

[1] J. Daouk, L. Fin, P. Bailly, and ME. Meyer, "Improved attenuation correction via appropriate selection of respiratory-correlated PET data," Computer Methods and Programs in Biomedicine, vol. 92, Oct. 2008, pp. 90-98.

[2] L. Fin, J. Daouk, J. Morvan, P. Bailly, I. El Esper, L. Saidi, and ME. Meyer, "Initial clinical results for breath-hold CT-based processing of respiratory-gated PET acquisitions," European Journal of Nuclear Medicine and Molecular Imaging, vol. 35, Nov. 2008, pp. 1971-80.

[3] L. Fin, P. Bailly, J. Daouk, and ME. Meyer, "A practical way to improve contrast-to-noise ratio and quantitation for statistical-based iterative reconstruction in whole-body PET imaging," Medical Physics, vol. 36, Jul. 2009, pp. 3072-79.

[4] J. Daouk, L. Fin, P. Bailly, and ME. Meyer, “Respiratory-gated positron emission tomography and breath-hold computed tomography coupling to reduce the influence of respiratory motion: methodology and feasibility,” Acta Radiologica, vol. 50, Mar. 2009, pp. 144-55.

[5] L. Fin, P. Bailly, J. Daouk, and ME. Meyer, “Motion correction based on an appropriate system matrix for statistical reconstruction of respiratory-correlated PET acquisitions,” Computer Methods and Programs in Biomedicine, vol. 96 Mai. 2009., pp. e1-e9