PhD14

Quantitative assessment of coronary plaques by motion-compensated PET-MRI

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Application Area: Cardiovascular **Modality:** PET-MRI **Related:** PhD 2, 6, 10, 13

Background

Coronary plaques are the main cause of myocardial infarction. ^{18}F-sodium fluoride (^{18}F-NaF) PET imaging has been shown to allow for detection and assessment of coronary plaques[1] which could enable preventive treatments. Accurate quantification of plaques can be strongly impaired by physiological motion (e.g. breathing, heart beat)[1]. Simultaneous PET-MR allows for accurate motion correction of PET images in a wide range of different applications using high-resolution 3D MR images with excellent soft tissue contrast[2-6].

Hypothesis

High-resolution 3D MR images can be used to compensate for respiratory and cardiac motion in simultaneously acquired PET and MR images improving quantification of coronary plaques.

Methods

A novel high-resolution 3D MRI acquisition technique will be developed to obtain accurate respiratory and cardiac motion information. Motion compensation using different motion models will be assessed in simulations, phantoms and patients.

Work Packages

WP1: MRI Sequence development

WP2: In vivo experiments / image registration

WP3: Numerical simulations

WP4: PET-MR with motion correction

year 1 — *year 2* — *year 3*

WP1: Implementation of a 3D whole-heart coronary MR sequence which allows for the reconstruction of images showing the coronary artery at different cardiac and respiratory motion states.

WP2: Evaluation of different image registration and MR motion compensation algorithms for varying breathing patterns and heart rates.

WP3: Develop a numerical simulation environment which allows for the simulation of different motion types and which can be used to study the effect of physiological motion and motion compensation on the quantification of coronary plaque using ^{18}F-NaF PET.

WP4: Extend the MR-based motion compensation techniques to simultaneous PET-MR to improve the reliability and robustness of ^{18}F-NaF PET for the quantification of coronary plaque.

Clinical Translation

Based on the clinical pilot study carried out during this project a comprehensive patient study will be initiated to thoroughly evaluate the developed methods in a follow-up to this PhD project.

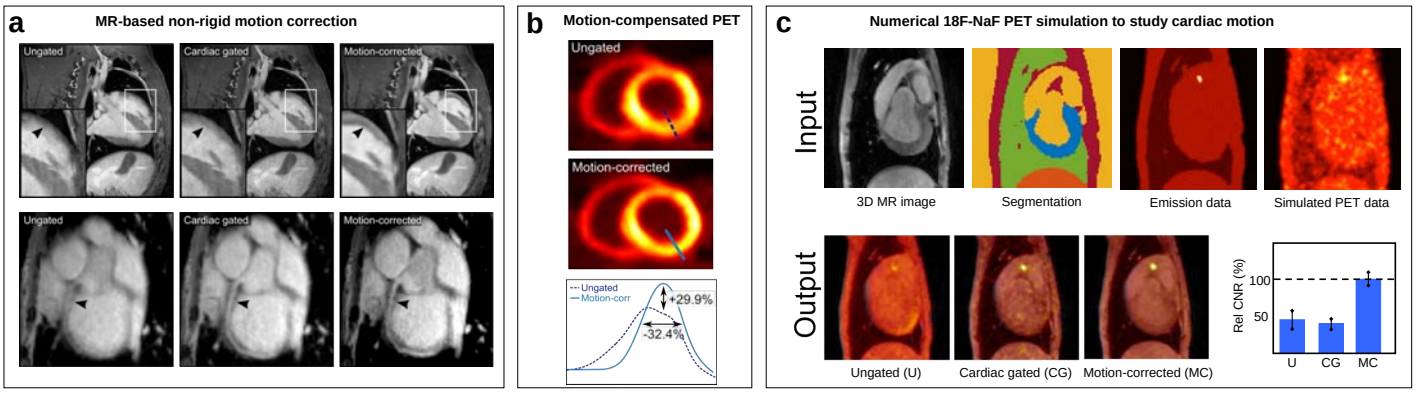

Figure: Motion-compensated simultaneous PET-MR[5]. a) Cardiac motion correction of 3D MR acquisition showing improved visualization of right ventricular wall (black arrow). b) Motion-compensated FDG PET images using MR-based non-rigid cardiac motion information. c) Numerical PET simulation studying the effect of cardiac motion on 18F-NaF PET.

Literature

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