Title:

Pipeline for Motion Correction in Dual Gated PET with an L1-like data term

Objectives:

Respiratory and cardiac motion induces artifacts in cardiac PET due to elongated acquisition times. In this work, an L1-like data term is combined with a dual gating motion correction pipeline to reduce motion to a maximum extent.

Methods:

The principle of the proposed PET motion correction pipeline is to estimate respiratory and cardiac motion independently and combine the motion estimates to yield individual transformations for each dual gate. Motion estimation is performed by means of non-linear mass-preserving image registration. To better handle noise-induced outliers in the data term, we propose an L1-like distance measure in our registration functional. An evaluation based on noisy software phantom data with accompanied ground-truth motion information is followed by an 18F-FDG PET study of ten patients (three minutes scans). A 5x5 dual gating is performed in each case.

Results:

The average Euclidean distance of the estimated motion vectors to the ground-truth motion vectors of the software phantom is 1.46mm. Given a voxel size of 3.375mm this represents subvoxel accuracy. For comparison, an SSD data term without using the pipeline results in a distance of 1.60mm. For the patient data, motion artifacts could be clearly reduced. NCC increased on average from 0.86 to 0.91 for the respiratory component and from 0.88 to 0.92 for the cardiac component.

Conclusions:

The L1-like data term is successfully used to handle noisy PET images. In combination with the motion correction pipeline the accuracy of the estimated motion could be noticeably increased. The clinical applicability was shown in a patient study. For future work we plan to evaluate the optimal number of dual gates.

Research Support:

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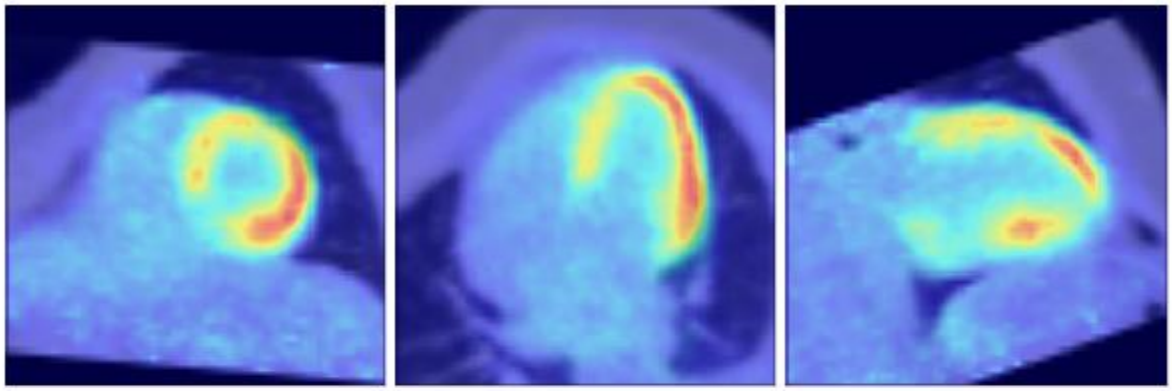
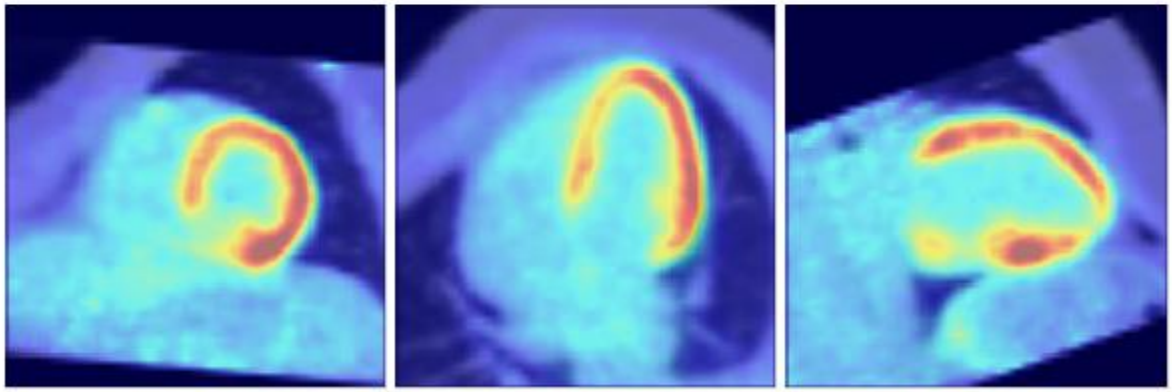


(a) Without motion correction



(b) With motion correction

Figure caption:

Cardiac planes of PET data for one patient are shown (a) without and (b) with motion correction. The PET data is overlaid to CT data, which is used for attenuation correction. From left to right the short axis, horizontal long axis, and vertical long axis is shown. A clear reduction of motion artifacts can be observed in the image with motion correction.