Reconstruction of simultaneous transmission and emission patient data in a sequential TOF-PET/MRI system

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INTRODUCTION Attenuation correction remains a major challenge for combined PET-MRI scanners. Deriving an attenuation map from MR images is difficult because MR signals are not related to electron density. Additionally, MRI coils can attenuate significantly but are invisible on MRI images. In our design the necessary transmission data can be obtained simultaneously with emission data by adding an annulus shaped transmission source and using time-of-flight separation in image space. In this work we have performed the first tests on patient data, acquired on the Gemini TF PET-MRI scanner from Philips. We have evaluated the effect of the presence of the transmission source on the emission data, as well as the feasibility of visualizing MR coils with our method.

MATERIALS AND METHODS PET-MRI acquisitions of the head and neck region of two patients were done. For the first patient a simultaneous emission/transmission scan (5min) was acquired with the MRI coils present. The attenuation map was reconstructed from the transmission data and the appearance of the coils was verified visually. Two PET scans (5min) were acquired of the second patient without MRI coils present. The first scan was acquired with the standard protocol of the scanner (no transmission source, MRI-based attenuation correction). For the second scan the transmission source was present and the PET images were reconstructed using the proposed transmission based attenuation correction method.

RESULTS The reconstructed attenuation map of the first patient shows the reconstruction of the MR-coil and patient table. No metal artefacts can be seen. The TX-based and MR-based attenuation corrected emission maps show less then 9% difference in a spherical VOI in the cortex of the brain and less then 4% in the regions around the mouth and neck.

CONCLUSION The proposed method can be used for attenuation correction in sequential TOF-PET/MRI systems. The attenuation of the coils is also measured by this method. Transmission and emission data are acquired simultaneously so no acquisition time for attenuation correction is lost in PET or MRI.

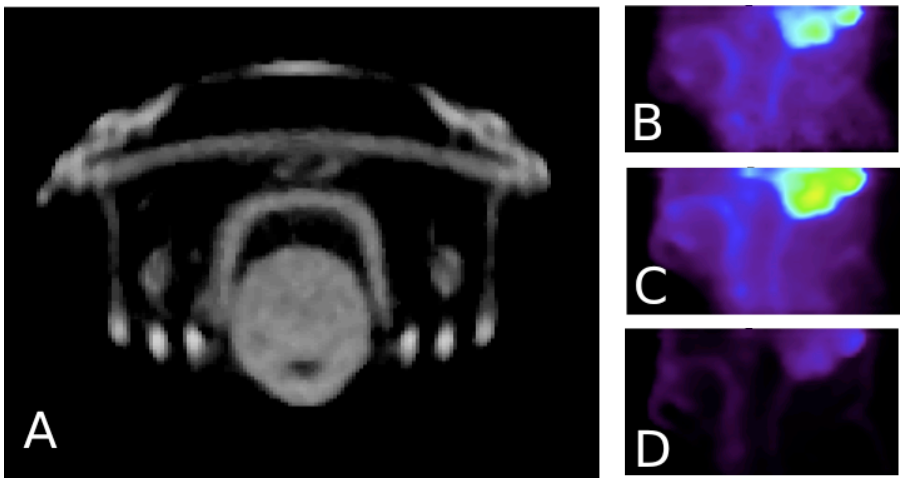

Figure 1 : Reconstructed attenuation map with MRI coils and patient bed (A), reconstruted emission map using TX-based (B) and MR-based (C) attenuation correction and without acttenution correction (D).