Dear reader,

Welcome to the third issue of the HYPMED project's newsletter.

Our EU-funded collaborative project aims to develop a new hybrid PET/MRI technology to improve the detection and diagnosis of breast cancer at significantly lower radiation dose. We are designing, building and testing a PET insert with an integrated radiofrequency (RF) coil that can be utilised with any MRI machine to enable high-resolution PET/MRI imaging.

In the third project year we have made a huge step forward in the design of the HYPMED PET/MRI device. You will find detailed information about this activity in the article from our colleagues Volkmar Schulz (Universitätsklinikum Aachen) and Sebastian Aussenhofer (NORAS) below. Communication and dissemination activities of the project are progressing and HYPMED finds increasing attention over social media platforms. In 2018 our project was promoted at major congresses, such as the European Congress of Radiology, the European Association of Nuclear Medicine conference and the IEEE Nuclear Science Symposium and Medical Imaging Conference.

This time we would like to cordially invite you to visit the EIBIR Networking Event at the European Congress of Radiology (ECR) in Vienna on March 2nd 2019, 12.30-13.30. HYPMED will be presented at the EIBIR Lounge making it an ideal opportunity to learn more about the ground-breaking technology and to ask questions about our research and its potential applications.

The EIBIR Lounge will be located on the entrance Level at ECR 2019, adjacent to the main entrance hall.

We hope you enjoy reading this newsletter and look forward to sending you further updates in the months to come.

Sincerely,

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PARTNER SPOTLIGHT

INTRASENSE (ISE)

ISE's role in HYPMED is to develop analysis algorithms and provide software tools to characterise the morphology of lesions. Myrian® is an ISE software platform for the advanced visualisation and analysis of medical images. It will be extended within the project to integrate the imaging capabilities of the new insert. The goal is a ready-to-market work-station platform to generate probability maps from collected data. ISE offers skills in IT, healthcare and tailored designs for advanced visualisation and optimises medical image interpretation in various fields such as biomarker development, artificial intelligence, and deep-leaning. www.intrasense.fr

FUTURA COMPOSITES (FUT)

Futura Composites plays a key role in the development of the breast PET-RF insert by manufacturing RF screens for the PET detectors. FUT ensures support for the clinical application of the device and provides a novel shielding technology based on carbon fibre composite materials. For HYPMED FUT will design the highly sensitive RF-coil and MR-compatible PET detector modules. FUT was one of the first composite manufacturers in the Netherlands and is a specialist in manufacturing fibre reinforced materials. www.futuracomposites.nl

Significant progress made in the development of HYPMED's software and hardware solutions

3-D Fingerprinting of cancerous tissue

By V. Schulz (Universitätsklinikum Aachen)

The development of the HYPMED breast PET-MRI insert gives the participating researchers a unique opportunity to investigate new MRI-based strategies for tissue classification and quantification. Quantitative MRI sequences promise to differentiate between different types of tissues, or even between different types of pathologies, based on the physical tissue parameters that underlie the formation of contrast in MRI. For the reconstruction of PET images, moreover, knowledge about the so-called attenuation map is required. An attenuation map contains three-dimensional information about the distribution of aqueous tissue, fatty tissue, bone tissue and air within the field of view of the PET scanner. These four tissue classes attenuate gamma photons to different extents - an effect that researchers need to take into account for obtaining most accurate PET images.

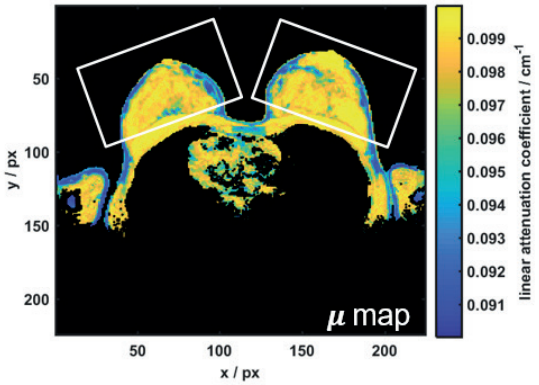

Figure 1: Screenshot of the high-resolution attenuation map derived from MR-Fingerprinting using Myrian software.

Within HYPMED, we explored the possibility to obtain both quantitative MR data of the breast, i.e., maps of the tissue relaxation times, as well as information about the water, fat and air distribution within the PET rings needed for attenuation correction in one single scan. Therefore, we adapted a quantitative MR-Fingerprinting sequence and extended it by a water-fat separation approach. Figure 1 shows an attenuation map that was computed based on the resulting water and fat distribution within the breast. In a first next step, we will investigate the distinction between normal and cancerous tissue based on the quantitative MR Fingerprinting results, whereas in a second step different types of tumours shall be compared. Hybrid PET-MRI breast scans with HYPMED will allow to correlate the findings from MRI with the high specificity of PET images as well as with histologic findings from biopsy – an exciting multimodal approach.

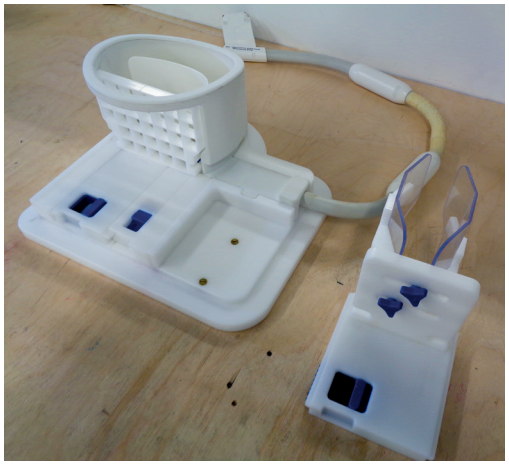

Figure 2: First experimental prototype of RF coil. The setup will be placed in a hermetically sealed bucket and integrated within the PET-ring system.

RF-coil prototype and breast fixation system

By S. Aussenhofer (NORAS)

To fulfil the MRI imaging requirements, and in an attempt to maximise patient comfort, a novel custom slanted outer-to-sternum breast geometry 2-channel crossed receive-only RF-coil was developed. Figure 2 shows the first experimental prototype of this design, which will be contained in a hermetically sealed bucket and placed inside each PET ring to support the same field of view. The RF-coil needs to work when the C-arms are closed (diagnostic imaging mode) as well as when the C-arms are slid backwards (biopsy imaging mode). As the C-arms are made from RF-shielding materials this implies a changing boundary condition for the RF-coil. Initial tests with this novel RF-coil design nested in a dedicated RF-shielding environment benchmarked to a commercially available Siemens 4-channel breast coil showed a comparable level of performance. It was measured that this custom RF-coil design will see an approximate decrease of 10% in Signal to Noise Ratio (SNR) when changing from the diagnostic imaging mode to the biopsy imaging mode within the HYPMED device.

To facilitate the immobilisation of the breast in both the cranio-caudal direction for diagnosis scans, and then in the lateral direction for biopsy two different fixation systems were developed. These two fixation systems are mounted via a flexible docking system within the HYPMED PET-RF insert base. The biopsy unit's orientation grid was developed to be able to accommodate the majority of biopsy tools current implemented in clinical practice. These units are designed to be cost effective and easily replaceable in case of significant contamination. The biopsy allows a histological verification of any findings in the PET and or MRI image.

HYPMED at European Congress Radiology 2019

The HYPMED project will be promoted at the EIBIR Lounge at the European Congress of Radiology in Vienna/AT. Our partners will present the project making it a must for any congress attendee interested in hybrid imaging and the ground-breaking PET/MRI technology being developed by HYPMED.

Find us at the ECR 2019 in the EIBIR Lounge on the entrance level

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