Dear reader,

Welcome to the second issue of the HYPMED project's newsletter. Our four year 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 positron emission tomography (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 second year we have successfully concluded the first official reporting to the European Commission and made a huge step forward in the design of the HYPMED PET/MRI device. You will find detailed information about this activity in the below article from our colleagues Dennis Schaart (TUD) and Volkmar Schulz (UKA).

We would also like to cordially invite you to attend the special session "European imaging researchers united in diversity" at the European Congress of Radiology in Vienna on March 1, 2018. HYPMED´s Work Package 3 leader, Thomas Helbich, will present the multicentre clinical trial of the HYPMED MR/PET insert, making it an ideal opportunity to learn more about our research and its potential applications.

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

Sincerely,

Prof. Christiane Kuhl

Scientific Coordinator

University Hospital Aachen
Aachen, Germany

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Project Manager

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Introduction of two project partners

The **University Hospital Aachen** (UKA) is the academic hospital of the Aachen university medical faculty that identifies "Technology in Medicine" as one of its major research goals. The UKA is a tertiary care hospital that comprises both teaching and research as well as patient care under one roof. Thus a tight collaboration between preclinical research and clinical practice fosters the translation of new diagnostic modalities into clinical practice.

Technical University Delft (TUD) is the largest University of Technology in the Netherlands and a multifaceted institution offering education and research in the technical sciences with health technology being one of its most important research areas. The Faculty of Applied Sciences is the largest faculty of TUD that conducts fundamental, application-oriented research and offers scientific education. The faculty is active in the fields of Life and Health Science & Technology, Chemical Engineering, Radiation Science & Technology, and Applied Physics.

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The PET-RF insert & software solutions: recent progress

Dennis R. Schaart & Volkmar Schulz

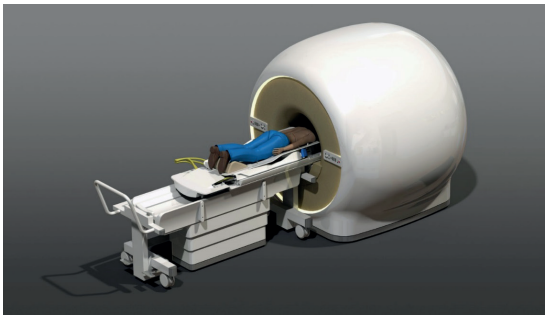


Figure 1: The entire HYPMED device will be mounted on a MRI table top allowing to use it with a standard clinical 1.5-Tesla MRI system without any need for modification. The patient can be moved into the MRI system for a combined PET/MR scan.

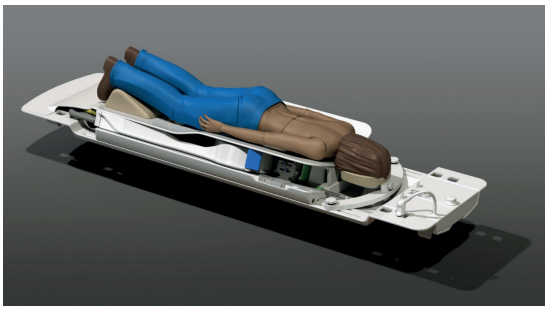
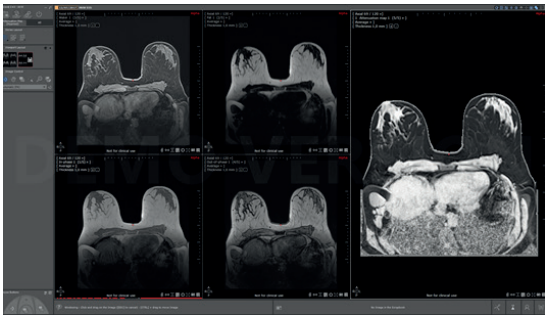


Figure 2: Close-up of the HYPMED device. Both breasts can be independently accessed by moving the outer halves of the PET rings towards the feet of the patient. The patient bed is an ergonomic thin table on which the patient is located in prone position. The head holder with cushioning provides a clean open view. For optimal diagnostic imaging, the breasts are mechanically immobilized in cranial-caudal direction. Multimodality biopsies can be performed by replacing the diagnostic clamps with a dedicated biopsy fixture.



We aim to develop a dedicated PET-RF device for breast imaging to be inserted into a standard MRI system, see Fig. 1. This novel approach allows improving the spatial resolution and sensitivity by a factor of four. At the start of the third project year, the full design of the HYPMED PET/MRI device is about to be completed. Workflow aspects and the challenge of PET and RF integration have been the major design tasks of the second year. In addition to further refinements of the mechanical design, considerable progress has been made in the development of the highly sensitive RF coil and the high-resolution, MRI-compatible PET detector modules.

Extensive tests with a mechanical mock-up of the device were performed in Aachen, involving the consortium's physicians and volunteers. Based on the results of these evaluations, ergonomic improvements have been included in the mechanical design, so as to optimise patient comfort as well as aspects of importance for an efficient clinical workflow.

A variety of tests have been performed on prototypes of the different subcomponents of the device, such as the RF coil, the PET detectors, the data acquisition circuits, and the cooling system. Intense and fruitful collaboration between the different groups and disciplines involved in the project has made it possible to optimise the performance of each of the subcomponents.

The full design is nearing completion and a first integration test to demonstrate and fine-tune the combined operation of the PET modules and RF coil will be carried out within the next few months. Upon the successful completion of those tests, the design of the device will be frozen and the manufacturing and assembly of the first-ever PET/MRI insert for multimodality breast cancer imaging will commence.

Good progress has also been made in implementing the Myrian software required to visualise the images produced by the HYPMED device, with the project's radiologists giving their feedback to ensure that it meets routine clinical needs. Preparatory patient studies for the development of the multimodality image processing software were conducted successfully.

Figure 3: Screenshot of the software package Myrian. The software is capable to segment a DIXON MRI image fully automatically to compute the attenuation correction (AC) map with the required high resolution. Compared to the whole body AC map of commercially available PET-MRI devices, the computation of the AC map within HYPMED is substantially simplified, which is expected to substantially improve the robustness of the overall PET-MRI procedure.

HYPMED Project at European Congress Radiology 2018

The clinical aspect of the HYPMED project will be presented in the special EIBIR session "European imaging researchers united in diversity" at the European Congress of Radiology in Vienna/AT.

Work Package 3 leader, Thomas Helbich, will speak about the multicentre clinical trial of the HYPMED MR/PET insert, making it a must for any congress attendee interested in hybrid imaging and European clinical trials.

Thursday, March 1, 16:00-17:30, Room L8