"A trimodality (EEG/MR/PET) scanner for brain imaging"

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Abstract

TRIMAGE is an interdisciplinary FP7-funded European collaboration aimed at developing a PET/MR/EEG brain scanner for early diagnosis of schizophrenia. The brain activity measured with the highly sensitive temporal information from EEG (ms time scale), with fMRI (second to minute time scale), combined with the highly sensitive molecular information provided by PET (minute to ten of minutes time scale)converges into a new imaging tool for diagnosis, monitoring and follow-up of mental disorders.The TRIMAGE scanner has been designed and built from scratch, with the aim of producing a cost-effective, brain dedicated device.

The MR magnet is cryogen-free with a main B0 field of 1.5 T, a weight of 1500 kg and a length of 1250mm. The magnet warm bore is 720 mm with a field uniformity of ±1 ppm and a field stability <0.1 ppm/hour. The 5 gauss line fringe field is about < 2.8 m axially and < 2.2 m radially from the center. The inner diameter of the free space after gradient coil and shimming is 580 mm. The typical MR sequences that will be used are: UTE (for attenuation correction), MPRAGE and FLAIR (for anatomical information) EPIK (for High resolution functional information)

The PET component is designed to provide performance beyond the state of the art for clinical PET systems with a spatial resolution of about 2 mm FWHM and a sensitivity of 6.8%. The PET field-of-view is 160 mm axially by 240 mm transaxially with an open bore of 308 mm diameter. The free space for the head after the quadrature birdcage RF coil has a diameter of 260mm. The PET detector comprises 216 tiles featuring two layers of LYSO crystal matrices (3.3 mm pitch) with half pitch staggering. NUV-SiPM matrices are used as photodetectors. A DAQ based on a specially designed ASIC (TRIROC) and FPGAs takes data in list mode.

A state-of-the-art MR-compatible 64 channels EEG cap will be simultaneously used with the PET/MRI scan.

A pilot clinical study has been performed on a sample of 40 healthy controls and 40schizophrenic patients, who have been examined on the available 3T PET/MR scanners in Munich (20/20) and Julich-Aachen (20/20). In Munich, F-DOPA has been used and static and dynamic analyses have been compared with fMRI data. In Jülich-Aachen, PET measurements have been made with the radiotracer [11C]-ABP688 to study the GLUTAMATE receptors.

The results of the pilot study, of the simulations and of the experimental tests on the TRIMAGE scanner will be presented.

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