QUIERO

Newsletter n.3
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EMPIR EURAMET

QUantitative Imaging Enables Reproducible Outcomes

18HLT05 – Quantitative MR-based Imaging of Physical Biomarkers

Welcome to the third newsletter of the European EMPIR project 18HLT05 QUIERO, whose aim is to evaluate the suitability of two MR-based emerging techniques, Electrical Properties Tomography (EPT) and Magnetic Resonance Fingerprinting (MRF), to contribute to the "quantitative revolution" in MRI. Our consortium is composed of six European metrology institutes, two clinical centres and three universities.

The fourth meeting of the project, initially planned to be hosted by the IRCCS Stella Maris (Pisa, Italy), took place on 17-18 November 2021, as an online event. It was a successful meeting, in which the partners discussed the progress of the project and the next actions.
Among the latter, the consortium will organize a virtual workshop on cardiac MRF, at the beginning of July 2022. The workshop will include hands-on sessions on the numerical simulation of cardiac MRF data, the clinical evaluation of MRF maps and the use of machine learning to automate MRF data analysis.

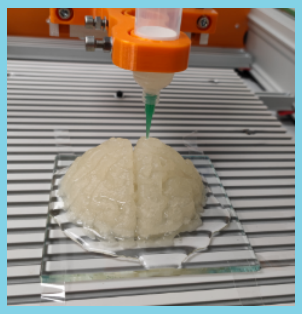
We are on the web!

Visit our website, consult our community on Zenodo, and take a look at our pages on LinkedIn and ResearchGate

Watch the video that explains QUIERO's work plan.

Highlights

The consortium has developed a new low-cost soft-matter 3D-printer, which exploits biopolymer-based ink materials, processed to crosslinked hydrogel constructs, to build large anthropomorphic phantoms (volume > 120 ml).



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Consortium

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WP 1

Development of the reconstruction techniques

EPTlib, the library that collects the implemented EPT methods, has been further consolidated and its official user guide has been released. In addition, an original EPT technique, which deduces the dielectric properties of brain tissues from MRF-based T1 data, exploiting their correlation with the water fraction, has been developed. The environment to simulate MRF signals in the cardiac region has been extended to include non-rigid respiratory and cardiac motion fields. Moreover, the MRF acquisition scheme designed for T1 mapping has been put at the disposal of the 18HLT09 project **NeuroMET2**, to support the diagnosis of neurodegenerative diseases.

WP 2

Metrological characterisation of reconstruction techniques in silico

A large number of virtual experiments has been carried out to identify the parameters that allow to optimize the accuracy and precision of the MRF and EPT results. The outcomes of the analysis have been collected into two dedicated technical reports, one for MRF and the other for EPT.
Starting from a set of digital models of healthy human heads, a wider population has been created. For each original model, a physiological variant, with altered properties of white and grey matter, and eight pathological variants, with anomalous inclusions in the white matter, have been produced. These models will be used to investigate the possibility to perform a computer-based detection of the pathologies in the quantitative maps.

WP 3

Experimental characterisation of EPT and MRF in phantoms

New phantoms have been produced, exploiting both mould-based techniques and 3D-printing. The latter has been realized through a new 3D printer, specifically designed and built to print relatively large phantoms. The relaxation and dielectric properties of the tissue mimicking materials have been characterized (including dielectric characterization as a function of temperature) and their stability has been monitored periodically. The phantoms have been used to perform quantitative MRI experiments, including repeatability and reproducibility MRF and EPT tests.

WP 4

In vivo quantitative differentiation of tissue

The clinical study of brain diseases, including a total number of 100 in vivo scans, has been concluded. Both MRF and EPT measurements have been performed and will be analyzed soon. In parallel, also the clinical study of heart diseases has started.

Strategies for the automatic detection of pathologies, which have performed well in preliminary experiments on noiseless synthetic brain data, will be applied to in vivo data in the next months.

QUIERO supports the first *Joint Workshop on MR Phase, Magnetic Susceptibility and Electrical Properties Mapping*.

...see you in Lucca!

Recent publications

- S. Metzner et al., Bayesian Uncertainty Quantification for Magnetic Resonance Fingerprinting, Physics in Medicine and Biology, 2021.

- A. Arduino, EPTlib: An Open-Source Extensible Collection of Electric Properties Tomography Techniques, Applied Sciences, 2021.

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