Master Internship 2021-2022

Translating free-breathing MRE from a preclinical to a clinical examination.

Laboratories : CREATIS /LabTau
Research teams : MAGICS Team/Wave and Instrumentation

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Scientific background and rationale: Hepatic fibrosis is a common syndrome with multiple causes. Untreated it can progress to more severe stages such as cirrhosis and ultimately hepatocellular carcinoma. Diagnosing fibrosis is therefore important and relies on biopsies which are invasive, give a very localized picture of the liver and are not very well accepted by patients. By measuring the liver elasticity, Magnetic Resonance Elastography (MRE) [1] is able to give a broader picture of the state of the liver enabling a reliable staging of fibrosis. Moreover, its non-minimally invasive nature makes it well suited for a longitudinal study of the evolution of the pathology.

To be able to carry out MRE of the liver, patients are required to uphold their breath so as to limit organ motion during the examination. Unfortunately patients who are prescribed MRE for hepatic fibrosis staging are often unable to do so properly leading to a failure of MRE. Recently, free-breathing MRE strategies [2] have been proposed and evaluated on a Siemens MR scanner yielding interesting results. Liver MRE has also been carried out on small animal models such as mice [3] where free breathing is mandatory. However, up till now no reliable setups enabling non-invasive MRE on a preclinical MRI has been reported.

Aim: To develop and evaluate free-breathing MRE sequences on a preclinical MRI scanner (Bruker 7T) using a mouse model, including the realization of a dedicated MRE bench enabling non-invasive examinations. At the same time, MRE sequences and setup available at Edouard Herriot Hospital (HEH) will be investigated in view of implementing free-breathing MRE sequences. Free-breathing strategies will be tested on healthy subjects and compared to classical breath-hold MRE.

Description of the internship work:

1. Development of an MRE bench to carry out non-invasive, in-vivo liver MRE on a mouse model on a preclinical MRI
2. Acquisition of liver MRE images on a mouse model with various free-breathing strategies.
3. Investigation of clinical MRE sequences so as to determine the possibilities offered by the clinical MRI.
4. Application of free-breathing MRE strategies on healthy subjects on a clinical MRI and comparison with available breath-hold sequences.

References

[1] : Venkatesh, S.K. et al. J. Magn. Reson. Imaging, 37: 544-555 (2013)
[2] : Shahryari, M et al. Magn Reson Med. 85: 1962– 1973 (2021)
[3] : M. Yin et. al. Magn. Reson. Med. 58-2 : 346-353 (2007)

Skills required: Instrumentation, Programming, Physics,