Project title: Adaptation of a protocol of acoustic safety measures

Laboratory: CREATIS
Research team: PILoT (Preclinical Imaging Facility)

Supervisor(s): A. Bernard, ingénieur d'études INSERM, adeline.bernard@creatis.insa-lyon.fr

Duration and gratification: 2 or 3 months and ~ 600€/month

Context and project description:

CONTEXT :

In recent years, new modes of ultrasound imaging (ultrasound) have been developed and implemented on ultrasound scanners dedicated to research. These systems are called "open" and allow access to settings close to the hardware and raw signals usually not available on clinical ultrasound scanners.
These new imaging modes could be useful for a large number of clinical studies (internal and external to the laboratory), whether for cardiac, vascular, cancer or neurological applications.

In order to test the new sequences developed on research ultrasound scanners on healthy volunteers and patients, within the framework of Research Protocols Involving the Human Person (RIPH - Jardé law), it is necessary to provide to the ANSM (National Agency for the Safety of Medicines and Health Products) and the CPP (Committee for the Protection of Persons) with measurements of acoustic safety indices specific to each sequence and each ultrasound probe to certify the absence of risk in their use by comparing them to the thresholds set by the standards.

The current standards propose protocols for measuring and calculating the safety index well adapted for imaging sequences known as "focused" or the new modes developed by the ULTIM (ULTrasound IMaging) research team of the CREATIS laboratory (Research Center for Image Acquisition and Processing for Health) are of the "unfocused" type as in the diagram below: plane wave 1 angle.

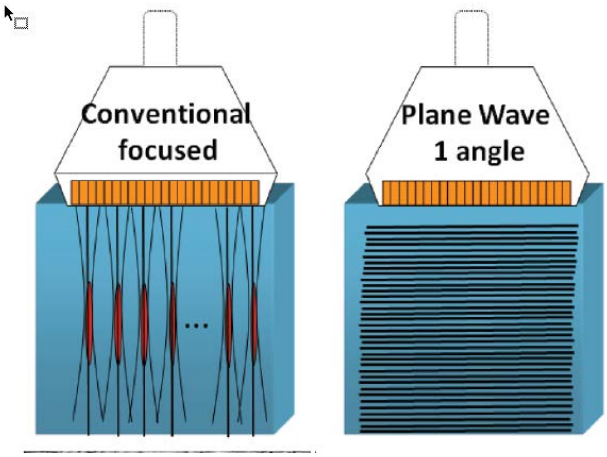


Figure 1: left: schematic diagram of a focused ultrasonic emission - right: schematic diagram of an unfocused ultrasonic emission.

The current strategy is to scan the entire emitted field in 3 dimensions instead of following the standards protocol to make sure to find the maximum value of the field.

PROJECT DESCRIPTION:

The aim of the proposed course is to adapt the current measurement and calculation protocol of acoustic safety indexes for non-focused emissions.
To do so, after taking over and finalising the protocol of the standard under Matlab, the trainee will have to make acoustic measurements following several approaches and compare and even optimize them in order to make them compatible with the new imaging modes developed in the lab.
The optimization of the protocol will also have to be implemented under Matlab and tested.
A part of the topic will be dedicated to the estimation of measurement uncertainties.
One week of the internship, will be dedicated to the servo-control of the non-magnetic translation plate for a more transverse mission for he imaging platform.

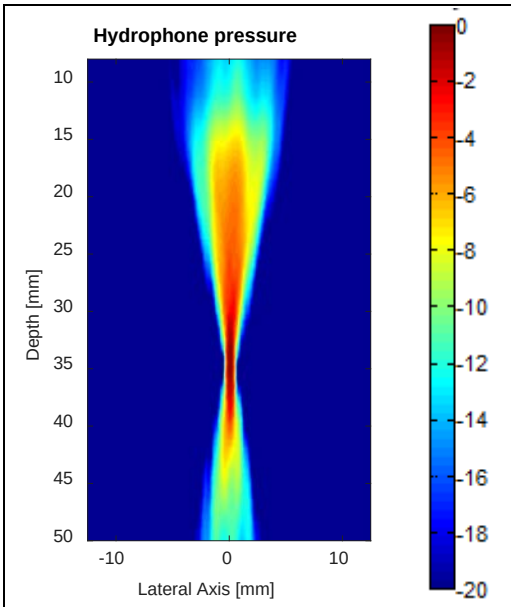
Trainees should have skills in the following areas:
Matlab programming, instrumentation.

Skills developped:
In strong interaction with senior engineers and research staffs, this internship will give the trainee the opportunity to improve its skills in ultrasound physics and signal processing.

Methods: *(Experiments, analytical modeling, numerical simulation…)*
EXPERIMENTS :

The ultrasound technical platform, of the multimodal imaging platform (PILoT), has a three-axis linear motion bench controlled by a software manufacturer (OWIS) and by Labview which allows to perform acoustic measurements by hydrophone and recovered on an oscilloscope. A first version of a software software is available on Matlab.

Figure 2: photo of the complete assembly with an ultrasound scanner on the left, and on the right an ultrasound probe above a water tank and a hydrophone attached to the 3-axis displacement bench.



Scale in dB

Figure 3: example of pressure Field in 2D of a focalised transmission