

LabTAU - Unité de recherche U1032

Applications des ultrasons à la thérapie

Cyril LAFON, Directeur de Recherche

Master student project – 6 months

Acoustical holography with a 7-axes robotic arm for characterizing HIFU transducer

Context of the study

Ultrasonic waves propagate in depth in the human body. High Intensity Focused Ultrasound (HIFU) were proposed recently as a surgical tool for ablating biological tissues either thermally or mechanically. Large extracorporeal focused transducers are used in order to concentrate the delivered energy and ablate the target around the geometrical focus without harming intervening tissues. This therapeutic technique is completely noninvasive but requires knowing precisely the generated pressure field.

The pressure distribution can be measured in a water tank by scanning a hydrophone in front of the HIFU transducer to characterize. The velocity at the surface of the ultrasound source (with a known geometry) can be estimated by measuring thoroughly the pressure distribution in a plane at a known position with respect to the source. This technique is called acoustic holography. Propagation of the wave from the surface of the transducer can be modeled in biological tissues with numerical methods. In order to be accurate, acoustic holography requires recording pressure in a plane that covers entirely the ultrasonic beam. Furthermore, the plane of measurements must be sampled very finely. The measurement is very sensitive to the directivity of the hydrophone.

Project objectives

The Master student will investigate the development of a setup using a 7-axes robotic arm to perform acoustic holography. The use of such equipment should allow maintaining the angle of incidence of the ultrasound waves on the hydrophone and recording the pressure on non-plane surfaces. By the end of the internship, one would like to be able to reconstruct the surface vibration of a large multi-element focused array and, from this, improve the modeling of focal pressure.

Project tasks

- Operating a multi-element HIFU transducer (IGT amplifier or Vantage Verasonics)
- Operating and programming a 7-axes robotic arm (Kuka)
- Developing a software for recording holograms and reconstructing surface vibrations
- Compare pressure measurements in the focal plane obtained considering uniform vibration of the elements or non-uniform vibration as measured by holography
- Assess the role of hydrophone directivity on the measurements
- Report on the software that drives the equipment and reconstruct the surface vibration

Skills

- The candidate must be an Engineering Student or a Master Student in one of the following fields: Acoustic instrumentation, System and Image, Robotic
- Programming skills: C++, Matlab
- Acoustics
- Medical Ultrasound

Contacts

Send a CV and a motivation letter to Cyril LAFON (cyril.lafon@inserm.fr)