LABORATOIRE THÉRAPIE
ET APPLICATIONS ULTRASONORES

Master / Engineering student project – 6 months

Experimental validation of a novel biaxial method enabling the targeted delivery of ultrasound for the treatment of brain disorders.

Context of the study

Neurostimulation is an exciting and rapidly expanding field for the treatment of neurodegenerative and psychiatric disorders such as epilepsy, Parkinson's disease or various forms of neuropathic pain. Current neurostimulation strategies, relying on diffuse electrical or magnetic fields to affect the activity of neural structures, are however limited by their invasiveness when it comes to the stimulation of specific deep brain regions. Ever since the reversible effects of ultrasound on neural structures were reported in the first third of the 20th century, ultrasound-based methods potentially offering minimally-invasive and targeted neurostimulation modalities were conceptualized. Already widely exploited in medical imaging and therapeutic applications, the propagation properties inherent to this mechanical wave, allow for the focusing of acoustic energy non-invasively and at depth within biological tissues. With the advent of complex electronic systems, *focus steering* has also been made possible, opening the doors to novel treatment approaches based on the fact that acoustic energy could be deposited to various locations within tissues without requiring any mechanical movement of the ultrasound emitting transducer.

Although focus steering would be highly valuable in the context of neurostimulation, as it would allow the quasi-simultaneous stimulation of various functional regions, standard multi-element-based solutions are discarded when confronted to the space constraints inherent to this setting. In this context, we tested through numerical simulations in collaboration with the University of Calgary (Canada) and the company *NovusTX*, the application of a novel *biaxial driving* method providing focus steering capabilities to piezoelectric transducers while keeping electrical driving complexity sufficiently low.

Project objectives

The aim of this master's or engineering's degree internship will be to characterize the electromechanical and electroacoustic properties of transducer prototypes implementing this method and to design a setup enabling the experimental validation of the results previously obtained through simulations. At a later stage, in vitro experiments validating the neurostimulation capabilities of the prototypes will be performed.

Activities

- Bibliographic studies, training, disseminations and valorizations of the research results
- Realization of electromechanical and electroacoustic measurements
- Design and realization of a software and hardware platform to carry out acoustic measurements
- Preclinical studies: preliminary *in-vitro* validation of the prototype's focusing and steering capabilities

Skills

- General knowledge in physics, acoustics, and signal processing
- Previous experience with electronics and/or metrology
- Proficiency in programming with languages such as Python or Matlab
- Appreciation for experimental work, and analysis of experimental datasets

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Additional information

This project is funded though the Accelerate program by the Canadian agency Mitacs as well as the French national research agency (ANR) grant. The successful candidate will conduct the project's research work at the Laboratory of Therapeutic Applications of Ultrasound (LabTAU, Inserm U1032) located in the Grange-Blanche area, in Lyon, France. The duration of the internship will be 6 months. Remuneration will be assigned according to national standards: 4.05 euros per hour.

Contacts

Send a CV and a motivation letter to:

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