COMPUTER ASSISTED MEDICAL INTERVENTIONS

Internship Proposal

High frequency ultrasound and micro computed tomography cochlea image fusion for intra cochlear navigation

Internship subject supported by the LABEX CAMI, http://cami-labex.fr/

Internship location: LIRMM Lab. (University of Montpellier)

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Internship duration: 6 months.

1. Context and background

Medical interventions (surgery, interventional radiology, radiotherapy) can benefit from a significant boost for progress in terms of optimal planning, performance and consistence. The Computer Assisted Medical Interventional (CAMI LABEX) strategic vision is that an integrated approach of medical interventions will result breakthroughs in terms of quality of medical interventions, demonstrated in terms of medical benefits and degree penetration of CAMI technology in routine clinical practice.

Computed Assisted Surgery (CAS) rely on a pre-operative anatomical land marking by medical imaging, followed by a perioperative recalibration by navigation systems. Inner ear surgery, especially cochlear implantation, could benefit this technique in order to preserve cochlear architecture, and thereby residual hearing. Development of such a tool is limited by current inner ear imaging performance. Indeed, Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) have an insufficient spatial resolution for this use.

Recent literature data tend to show that high frequency ultrasound (US) could improve the visualization of inner ear structures, with a 50 µm spatial resolution and a 5 mm depth. It would thus match the requirement of a perioperative monitoring. Nevertheless, conical deformation due to US might complicate the identification of anatomical structures. A solution to this issue would be to fuse these US images with pre-operative X-ray images. X-ray and US image fusion in CAS has already been studied for other organs, but never for the cochlea. Through this project, we aim to study the feasibility of US and micro CT image fusion applied to morphological study of the cochlea in guinea pigs.

2. Proposal

The recruited student will collaborate with an ENT Medical Doctor on the following stages: surgical removal of guinea pigs cochlea, inclusion of the temporal bones in silicone polymer blocks after determination of the right texture, manufacturing of a tridimensional fiducial frame that will be integrated in the polymer block, attaching a marker (tracker) on the polymer block and the echography probe, linked to a LED detection camera, micro CT and US scanning of each specimen.

Considering his/her engineering background, the recruited student will be in charge of the image processing: multiplanar reconstruction of the micro CT images, temporal bone semi-automatic segmentation, recalibration between US and micro CT images, using both processes: fiducial frame and trackers, checking the quality of the model.

3. Required knowledge

Experience and skills in C/C++ programming and image processing.

Good command of English is expected.