

RESEARCH INTERNSHIP - BAC + 5 - 2024

Medical Image Analysis - Head CT Implant Detection and Segmentation for micro robot neuronavigation

OBJECTIVE

Robeauté is a French start-up in the field of biotechnology, which is developing a medical microrobot for surgery - in partnership with LIP6. In this context, robotic neuronavigation is a fundamental element of the system. Robeauté developed a real-time 3D tracking system, which consists in an extra-cranial implant, alongside medical neuro-imaging, such as 3D computerised tomography (CT). The elements of the implant have to be detected and segmented on the CT image, in order to enable the tracking and neuronavigation system. Today, detection and segmentation are done in a semi-automatic fashion and with traditional image processing techniques. The first objective of the internship is to develop automatic detection models with a segmentation of the implant as a following step, using or adapting state-of-the-art machine learning methods. The second objective is to assess and improve the accuracy and precision of these detection and segmentation models. The performance will be evaluated in different types of images to prove the robustness of the methods.

TASKS

The development will be done in Python. The first step is to study the best approaches that exist in the literature and which ones have available and usable code. Also, the results will be improved by exploiting prior information like the geometry of the implant. Additionally, the possibility of generating synthetic CTs with the implant for data augmentation will also be studied. Finally, the method will be integrated on Robeauté's custom neuronavigation software in the live tracking workflow.

DEVELOPMENT PHASES

The bibliography will be studied at the same time as the first steps of the code development. These first steps will be: (i) getting introduced with the data manipulation (DICOM, Nifti images) and (ii) understanding the algorithm behind the semi-automatic method already developed. The next step is to propose and test the detection and segmentation methods, separately and in a combined fashion. The methods will be tested in our test bench images and then iterated with improvements and adjustments to increase their accuracy and precision.

In detail, we have the following steps:

- Literature review on medical implant detection algorithms in 3D CT images
- Literature review on medical implant segmentation algorithms in 3D CT images
- Learn how the semi-automatic detection works and understand the implementation

- Decide which are the best methods to do the detection and segmentation considering the performance, availability and code complexity
- Train and test the methods with the images of our data base
- Evaluate the accuracy and precision on our test bench
- Improve the chosen methods or test other alternatives to improve the performance
- Integrate prior information like implant geometry to improve the results
- Create synthetic CTs for data augmentation
- Integrate into the microrobot live tracking workflow on our custom software

Desired profile: M2 student in computer science, engineering, AI or biomedical imaging.

Contact us with CV, motivational letter, latest grades transcript and a list of the subjects studied in M2: leandro@robeaute.com, isabelle.bloch@lip6.fr

Internship start date: mid-February

Internship location: Sorbonne Université - Jussieu Campus, with occasional visits at Robeauté.